

FEB
1978

practical WIRELESS

45p

ECONOMY TIMING STROBE

THE IGNITION SYSTEM



Fig. B.3
When the groove in the crankshaft is
with the small projection on the
and 4 pistons

ALSO:
ACTIVE TONE CONTROL
PLUS ALL THE USUAL FEATURES

the engine is now started...
rear flange of the crankshaft pulley...
the small projection on the timing...
piston is exactly at T.D.C. (see Fig. B.3...
Set the contact breaker points to 014...
(5) Screw the distributor into its housing, and engage...
dog lugs with the drive shaft teeth (both...
which are offset) by slowly rotating the rotor...
clamp plate to the distributor housing, and do not...
tighten them. Failure to leave these bolts slack will...
cause misalignment of the distributor resulting in...
excessive wear of the drive gears.
(6) Position the distributor so that the vacuum...
diaphragm to the rear.
the points are fully closed. Then the vacuum...
in a clockwise direction. Until the...
commence to open. Secure the...
pinch-bolt and nut, give the...
allow fully tighten the...
that the rotor arm is...
for the cylinder wh...
tion stroke
IMPORTANT:
an electrical...
actual pos...
following...
W...
trib...

tion B.7
The igni...
ments of...
INFORM...
After...
distrib...
ins...
order...
contact...
its pivot...
polish the...
subolt. After...
and apply a...
of the pivot. The...
should be between...
(ms) measured at the...
07 and...
of...
fact...
ap...
Se...
D...
the dr...
the un...
Extra...
plate

...VING AND REPLACING THE...
DISTRIBUTOR...
...tor can be removed and re...
with the ignition timing, pro...
bolt is not disturbed. ...
the replacement of ...
cover and turn it ...
... position po...
... lead from the terminal on...
the suction advance pipe at...
... the distributor clamp...
... and withdraw the

...os. 1
... Issue 2 27

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

7400 14p	7413 30p	7432 25p	7454 15p	7490 35p	74121 30p	74139 100p	74156 70p	74174 100p	74189 350p
7401 14p	7414 60p	7437 25p	7460 15p	7491 75p	74122 60p	74141 60p	74157 70p	74175 75p	74190 140p
7402 14p	7416 30p	7438 25p	7470 30p	7492 25p	74123 60p	74142 270p	74160 90p	74176 100p	74191 140p
7403 14p	7417 30p	7440 15p	7472 25p	7493 40p	74125 50p	74143 270p	74161 90p	74177 100p	74192 120p
7404 14p	7420 15p	7441 65p	7473 30p	7495 60p	74126 50p	74144 270p	74162 90p	74178 140p	74193 120p
7405 14p	7422 20p	7442 65p	7474 30p	7496 70p	74130 130p	74145 75p	74163 90p	74179 140p	74194 100p
7406 40p	7423 25p	7445 80p	7475 30p	74100 95p	74131 100p	74147 230p	74164 125p	74180 100p	74195 100p
7407 40p	7425 25p	7446 85p	7476 30p	74104 40p	74132 65p	74148 160p	74165 125p	74181 200p	74196 100p
7408 20p	7427 25p	7447 75p	7477 30p	74105 30p	74135 100p	74150 120p	74166 125p	74182 75p	74197 100p
7409 20p	7428 40p	7448 70p	7483 85p	74107 30p	74136 80p	74151 65p	74167 125p	74183 150p	74198 185p
7410 15p	7429 15p	7449 15p	7485 100p	74109 50p	74137 100p	74152 70p	74168 125p	74184 150p	74199 185p
7411 20p	7430 15p	7451 15p	7486 30p	74118 90p	74138 125p	74153 70p	74169 125p	74185 150p	
7412 20p		7453 15p	7489 250p	74120 90p					

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AC121 30p	BA154 12p	BC169C 15p	BC549C 14p	BF127 50p	BF363 60p	C1120 30p	OC200 80p	TIP36A 350p	2N1308 50p
AC126 19p	BA157 15p	BC171 12p	BC557 13p	BF186 30p	BF594 30p	C1164 20p	ORP12 70p	TIP41A 70p	2N1711 22p
AC127 19p	BA173 15p	BC178C 12p	BCY34 80p	BF187 25p	BFV58 20p	E100 42p	R1039 150p	TIP41C 80p	2N2219A 25p
AC127/01 25p	BA216 16p	BC178A 16p	BCY70 15p	BF173 25p	BFV59 30p	E300 47p	TIP29 45p	TIP41C 80p	2N2483 30p
AC128 18p	BA316 16p	BC182 16p	BCY71 15p	BF179 35p	BFX81 130p	E430 125p	TIP29A 47p	TIP42B 85p	2N2906 18p
AC151 25p	BAX13 5p	BC182L 12p	BCY72 15p	BF179C 40p	BFX84 25p	MJE340 45p	TIP30 55p	TIP295 70p	2N307 20p
AC153K 40p	BAX16 5p	BC183 10p	BD121 85p	BF180 30p	BFX85 30p	MPSA06 25p	TIP30A 58p	TIP305 55p	2N3053 20p
AC176 20p	BB105A 35p	BC183L 12p	BD123 100p	BF181 35p	BFX87 25p	OA10 40p	TIP30B 58p	TIS90 25p	2N3054 50p
AC177 35p	BC110 45p	BC184 12p	BD124 85p	BF182 30p	BFX88 25p	OA47 15p	TIP30B 58p	TIS91 25p	2N3055 60p
AC179 30p	BC107 10p	BC184L 12p	BD131 36p	BF183 30p	BFY50 20p	OA90 6p	TIP30B 58p	TIS91 25p	2N3055 60p
AD149 80p	BC108 10p	BC186 24p	BD132 39p	BF186 25p	BFY52 20p	OA91 6p	TIP30B 58p	TIS91 25p	2N3055 60p
AD161 40p	BC108C 15p	BC205 14p	BD133 45p	BF194 10p	BFY90 125p	OA202 6p	TIP30B 58p	TIS91 25p	2N3055 60p
AD162 40p	BC109 10p	BC212 11p	BD135 40p	BF195 10p	BR101 35p	OC23 200p	TIP30B 58p	TIS91 25p	2N3055 60p
AD161/2MP 90p	BC109C 14p	BC212L 12p	BD136 40p	BF196 10p	BRV39 35p	OC25 100p	TIP30B 58p	TIS91 25p	2N3055 60p
AF114 22p	BC113 12p	BC213L 12p	BD137 38p	BF197 10p	BRV39 35p	OC28 75p	TIP30B 58p	TIS91 25p	2N3055 60p
AF115 22p	BC117 18p	BC214 13p	BD139 40p	BF198 25p	BRV39 35p	OC35 75p	TIP30B 58p	TIS91 25p	2N3055 60p
AF116 22p	BC125 20p	BC214L 14p	BD139 40p	BF199 25p	BRV39 35p	OC42 35p	TIP30B 58p	TIS91 25p	2N3055 60p
AF117 22p	BC126 15p	BC258 13p	BD140 40p	BF200 30p	BRV39 35p	OC43 35p	TIP30B 58p	TIS91 25p	2N3055 60p
AF118 50p	BC146 12p	BC294 35p	BD181 80p	BF224 20p	BRV39 35p	OC45 35p	TIP30B 58p	TIS91 25p	2N3055 60p
AF125 25p	BC147 10p	BC303 55p	BD182 80p	BF225 20p	BRV39 35p	OC71 25p	TIP30B 58p	TIS91 25p	2N3055 60p
AF139 35p	BC148 10p	BC317 15p	BD207 70p	BF241 16p	BU105 150p	OC72 30p	TIP30B 58p	TIS91 25p	2N3055 60p
AF239 45p	BC157 10p	BC323 60p	BD233 60p	BF244B 35p	BU153 75p	OC75 30p	TIP30B 58p	TIS91 25p	2N3055 60p
AS126 40p	BC159 10p	BC328 13p	BD263 85p	BF257 28p	BU100 20p	OC81 30p	TIP30B 58p	TIS91 25p	2N3055 60p
BA114 9p	BC158 10p	BC338 12p	BDY10 100p	BF258 26p	BY100 20p	OC81D 25p	TIP30B 58p	TIS91 25p	2N3055 60p
BA121 9p	BC159 10p	BC547 12p	BDY62/01 90p	BF259 30p	BY126 15p	OC83 50p	TIP30B 58p	TIS91 25p	2N3055 60p
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5V1	10p
5V6	10p
6V2	10p
6V8	10p
7V5	10p
8V2	10p
9V1	10p
10V	10p
11V	10p
12V	10p
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10/16	5p	2200/100 120p
10/25	5p	3300/16 40p
10/35	5p	3300/25 42p
10/50	5p	3300/63 80p
22/6V3	5p	3300/63 80p
22/10	5p	4700/25 45p
22/16	5p	4700/40 50p
22/25	5p	4700/63 20p
22/35	5p	
22/50	6p	
33/6V3	5p	
33/16	6p	
33/25	6p	
33/40	6p	
33/50	7p	
47/10	6p	
47/16	6p	
47/25	6p	
47/35	6p	
47/50	7p	
100/10	6p	
100/16	6p	
100/25	6p	
100/50	8p	
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0.03	5p
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4009	70p	4028	155p	4071	30p
4011	20p	4029	130p		
4012	20p	4030	60p	4072	30p
4013	55p	4032	150p	4081	20p
4015	90p	4043	220p	4082	30p
4016	55p	4046	150p	4083	145p
4017	110p	4047	115p	4511	200p
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 A look at a problem posed by readers of our RAE Series
 Medium Wave Tuner/Amplifier, trailed last month, has been delayed. We hope to feature it in a forthcoming issue

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Sparkrite Mk2

Capacitive discharge electronic ignition kit

VOTED BEST OF 8 SYSTEMS TESTED BY 'POPULAR MOTORING' MAGAZINE OCT 74



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T15/100 15" 100w	£41.00 (£29.95)
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CABINETS FOR ABOVE Heavy duty, finished in black Vynide with Vynair fronts, protective corner pieces Vynair sizes and cut-outs. TE1 1 x 12" £11.95 (£10.95) Carr. £1. TE2 2 x 12" (£15.95). Low Deposit Terms on orders over £20.

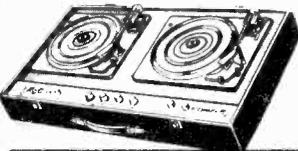


TITAN TA/100C COMBO

100w R.M.S. Amp. incorporating a fabulous Fane Crescendo 12" 100 watt spkr for really superlative results with Lead Guitar (£99.95) Val. £149 Carr. £6 Or Dep £17.95 & 18 f'tnly payts £6.69 (Total £138.37)

DISCO MAJOR/100 TWIN TURNTABLE POWER CONSOLE (£119.95)

Twin Full size BSR turntables. Sonotone or Acos Cartridges with Diamond Styli. Facilities as TD1 Console but with built-in 100 watt Power Amplifier complete with lid. Terms: Deposit £19.95 and 18 fortnightly payments £7.70 (Total £158.55) Carr. £3.50



DISCOMAJOR/200 (£139.95) Carr. £4.00

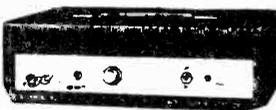
200 watt version of above. Terms: Dep. £29.95 and 18 fortnightly payments £8.60 (Total £184.75)



RSC PHANTOM 50 COMBO AMP. (£55.50)

Rating 50 watts. 3 inputs, 2 vol controls—Bass, Treble Presence. Suitable for Lead or Rhythm Guitar, mic., Radio, Tape, etc. Inc. High Flux 12" 50w Speaker. Dep. £10.95 & 8 monthly payments £8.71 (Total £80.63) Carr. £2.

100W POWER (SLAVE) AMPLIFIER

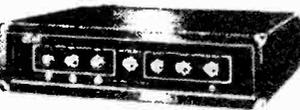


Suitable for use with DISCO-Consoles. Also for increasing output of lower-powered Amplifier. Dep. £9.00 and 8 mthly pyts of £6.05 (Total £57.40) Carr. £1.50 (£44.50)

100+100W MODEL (£57.75) Carr. £1.50

TITAN TA/50A 50W AMPLIFIER

Solid state. 3 sep. controlled inputs plus Master control. Bass, Treble & Presence Controls. Vynide covered cab. with corner protectives. Value £60. Terms: Dep. £9 & 8 monthly payments £6.05. (Total £57.40) Carr. £1. (£36.95)



TITAN TA/100A 100W AMPLIFIER

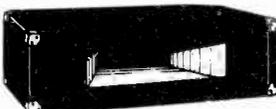
TWIN CHANNEL—4 INPUTS (NORMAL OR BRIGHT) A De-luxe professional unit with many facilities. R.M.S. Rating. Matching 2 x 12" 120w Cabinet speaker £49.95 with above only. Carr. £1.50 (£59.95)



TITAN 'ADD-ON' HIGH FREQUENCY HORN UNITS



MODEL TS2H
Inc. Pair of highly sensitive Horns. Range 3-15 kHz Imp 16Ω. Use with 8 or 15Ω 2 x 12" or 1 x 15" or 18" Drive Unit for increased sound clarity and projection. Rating 100 watts. Either model (£17.95) Carr. 95p
Terms: Dep £6.95 & 8 mthly pyts £3.12 (Total £31.91)



MODEL TIH
With single super efficient Horn. Range 3-15 kHz. Imp 8Ω. Use with max 8Ω 2 x 12" or single 15" or 18" 8Ω Drive Units. Maximum amplifier power output to be 100 watts. Comparable with units at twice the cost.

FANE HIGH FREQUENCY HORNS 'J' SERIES

MODEL J44 Imp 8Ω
Size approx. 3 1/4" x 3 1/4" x 3"
Rating 30-50 watts Range 3-15 kHz
Carr. 60p. (£3.99)

MODEL J73 Imp 8Ω
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Rating 50 watts Range 2-20 kHz
Carr. 75p (£5.95)

FAL DISCO LIGHTING SYSTEMS from (£55.95)

Incl 2 Spotbanks and bulbs



MODEL J104 Imp 8Ω
Size approx 10 1/4" x 3 1/4" x 7 1/4"
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approx. 3/4 full size digits shown here

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In the latest Ambit catalogue: more TOKO coils, chokes, filters etc., data on the short wave coil sets, a revised price list, micro-microphone inserts, special offer lines etc.

DETECKNOWLEDGEY

Metal locator principles and practise, including some of the facts and information manufacturers of £100+ detectors would rather you didn't know. £1.00 each.

The Bionic Ferret 4000 - a VCO metal locator based on the PW seekit, including all parts, plasticwork, ready wound coil etc. Inc. free copy of detecknowledgey. £34.26 in pp and VAT at 8%.

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HA1137FM	FM IF 2.20	BF224	6ghz RF 0.22	with matching transfs. 9.95
TBA120	FM IF 0.75	BF274	7ghz RF 0.18	MFH series 4/5/7kHz band-
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ua720	AM rad 1.40	ZT X214	30v/.3w 0.17	Modules/tunerheads etc.
CA3123E	AM rad 1.40	ZT X451	60v/1w 0.18	EC3302 3cct v/cap fm 7.50
HA1197	AM rad 1.40	ZT X551	60v/1w 0.18	EF5600 5cct v/cap fm 12.95
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LM1496	Bal mix 1.25	BD536	60v/50w 0.53	7252 complete fm mono
MC1310P	mpx dec2.20	BD609	80v/90w 0.70	tunerset. afc, agc, mute 26.50
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AA53 0-25	AS215 1-25	BC170 0-18*	BD115 0-60	BF196 0-13*	BZ788 0-13	OA81 0-30	OC84 0-60	ZTX107 0-11*	2N705 0-80	2N3441 0-80
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AC128 0-25	BA145 0-15*	BC183 0-11*	BD138 0-40*	BF336 0-50*	GEX46 1-50	OC210 0-75	OC171 0-25	ZTX304 0-19*	2N1303 0-37	2N3705 0-15*
AC141 0-20	BA148 0-15*	BC184 0-11*	BD139 0-43*	BF337 0-53*	GEX541 1-75	OC211 1-50	OC200 1-50	ZTX311 0-12*	2N1304 0-45	2N3706 0-14*
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AC142 0-20	BA155 0-10*	BC213 0-14*	BD144 2-00	BF521 2-27	GJM5078A 1-50	OC202 1-25	OC202 1-25	ZTX500 0-13*	2N1306 0-50	2N3708 0-14*
AC142K 0-25	BA156 0-13	BC214 0-17*	BD181 1-38	BF528 1-38	KS100A 0-50	OC203 1-25	OC203 1-25	ZTX501 0-16*	2N1307 0-50	2N3710 0-14*
AC176 0-25	BA162 0-05	BC237 0-17*	BD182 1-48	BF591 0-25*	MJE370 0-85	OC204 1-75	OC204 1-75	ZTX502 0-16*	2N1308 0-60	2N3711 0-15*
AC187 0-25	BAX13 0-07	BC238 0-12*	BD237 0-80	BF598 0-28*	MJE371 0-81	OC205 1-75	OC206 1-75	ZTX503 0-17*	2N1309 0-60	2N3712 0-15*
AC188 0-25	BAX16 0-07	BC301 0-45	BD238 0-85	BF599 0-28*	MJE520 0-65	OC206 1-75	OC207 1-25	ZTX504 0-20*	2N1693 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC207 1-25	OC207 1-25	ZTX505 0-20*	2N1693 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC208 2-00	OC208 2-00	ZTX506 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC209 2-00	OC209 2-00	ZTX507 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC210 2-00	OC210 2-00	ZTX508 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC211 2-00	OC211 2-00	ZTX509 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC212 2-00	OC212 2-00	ZTX510 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC213 2-00	OC213 2-00	ZTX511 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC214 2-00	OC214 2-00	ZTX512 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC215 2-00	OC215 2-00	ZTX513 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC216 2-00	OC216 2-00	ZTX514 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC217 2-00	OC217 2-00	ZTX515 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC218 2-00	OC218 2-00	ZTX516 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC219 2-00	OC219 2-00	ZTX517 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC220 2-00	OC220 2-00	ZTX518 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC221 2-00	OC221 2-00	ZTX519 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC222 2-00	OC222 2-00	ZTX520 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC223 2-00	OC223 2-00	ZTX521 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC224 2-00	OC224 2-00	ZTX522 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC225 2-00	OC225 2-00	ZTX523 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC226 2-00	OC226 2-00	ZTX524 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC227 2-00	OC227 2-00	ZTX525 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC228 2-00	OC228 2-00	ZTX526 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC229 2-00	OC229 2-00	ZTX527 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC230 2-00	OC230 2-00	ZTX528 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC231 2-00	OC231 2-00	ZTX529 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC232 2-00	OC232 2-00	ZTX530 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC233 2-00	OC233 2-00	ZTX531 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC234 2-00	OC234 2-00	ZTX532 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC235 2-00	OC235 2-00	ZTX533 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC236 2-00	OC236 2-00	ZTX534 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC237 2-00	OC237 2-00	ZTX535 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC238 2-00	OC238 2-00	ZTX536 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC239 2-00	OC239 2-00	ZTX537 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC240 2-00	OC240 2-00	ZTX538 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC241 2-00	OC241 2-00	ZTX539 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC242 2-00	OC242 2-00	ZTX540 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC243 2-00	OC243 2-00	ZTX541 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC244 2-00	OC244 2-00	ZTX542 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC245 2-00	OC245 2-00	ZTX543 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC246 2-00	OC246 2-00	ZTX544 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC247 2-00	OC247 2-00	ZTX545 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC248 2-00	OC248 2-00	ZTX546 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC249 2-00	OC249 2-00	ZTX547 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC250 2-00	OC250 2-00	ZTX548 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC251 2-00	OC251 2-00	ZTX549 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC252 2-00	OC252 2-00	ZTX550 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC253 2-00	OC253 2-00	ZTX551 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC254 2-00	OC254 2-00	ZTX552 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC255 2-00	OC255 2-00	ZTX553 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC256 2-00	OC256 2-00	ZTX554 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC257 2-00	OC257 2-00	ZTX555 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC258 2-00	OC258 2-00	ZTX556 0-16*	2N1893 0-33	2N3717 0-15*
AC189 0-25	BAX16 0-07	BC301 0-45	BD239 0-85	BF599 0-28*	MJE521 0-75	OC259 2-00	OC259 2-00	ZTX557 0-16*	2N1893 0-33	

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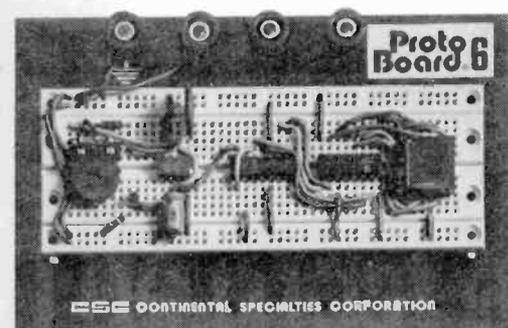
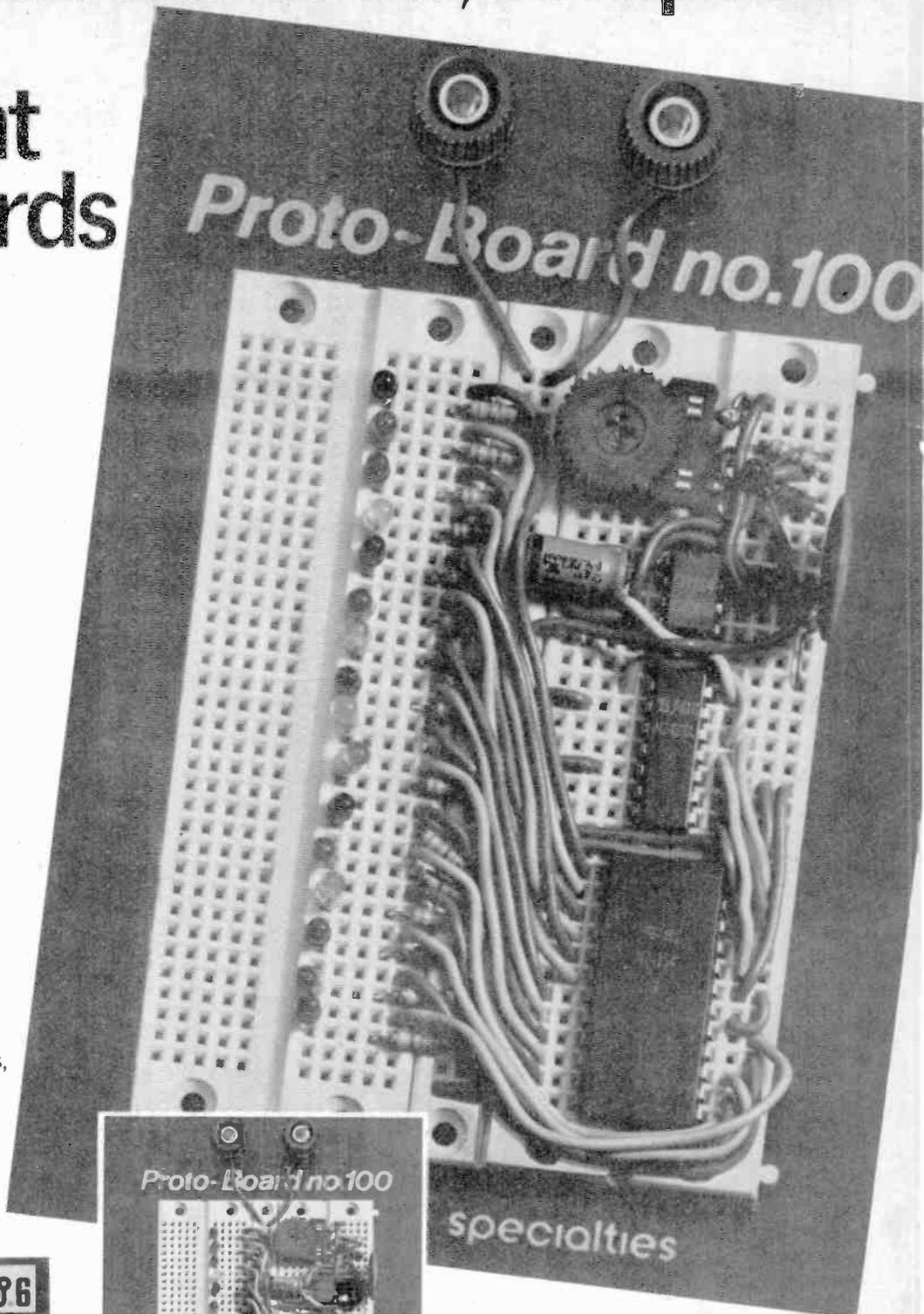
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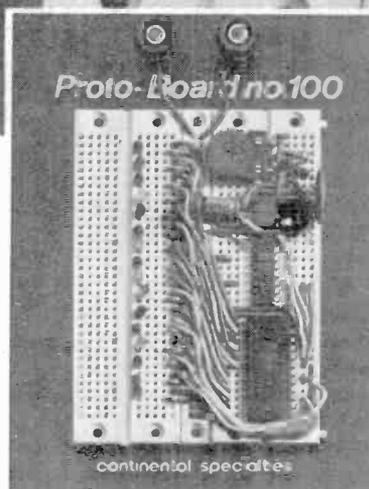
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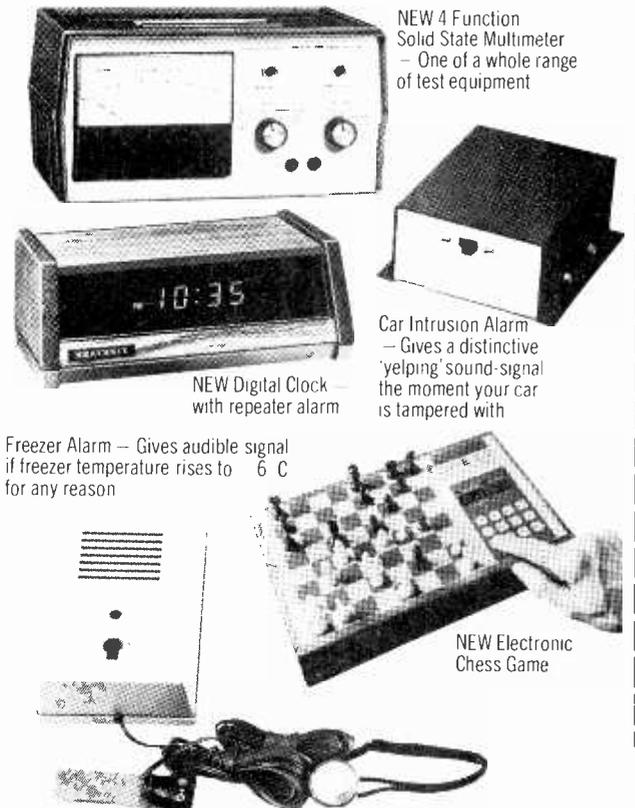
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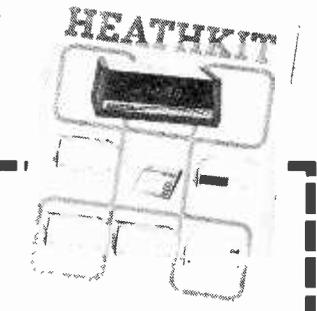
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7411	26p	74120	130p	74LS73	60p	4018	110p	AY-1-1313	775p	NE555	35p	TIP32A	62p	2N3708/9	14p	1A 50V	25p	4A 400V	96p
7412	25p	74121	32p	74LS75	60p	4019	52p	AY-1-5050	255p	NE556	97p	TIP33A	62p	2N3713	320p	1A 100V	27p	4A 50V	96p
7413	40p	74122	50p	74LS77	60p	4020	120p	AY-3-8500	775p	NE561B	450p	TIP34A	62p	2N3717	320p	1A 400V	31p	6A 100V	108p
7414	85p	74123	75p	74LS75	75p	4021	120p	AY-5-1315	75p	NE562B	450p	TIP31A	56p	2N3819	27p	2A 50V	40p	6A 400V	120p
7416	40p	74125	70p	74LS85	144p	4022	100p	AY-5-1317A	75p	NE565	140p	TIP31C	66p	2N3820	50p	2A 100V	45p	10A 400V	270p
7417	40p	74126	65p	74LS86	65p	4023	22p	CA3028A	112p	NE566	200p	TIP32A	63p	2N3823	70p	3A 200V	70p	25A 400V	432p
7420	18p	74128	82p	74LS90	80p	4024	80p	CA3048	85p	NE567	180p	TIP33A	97p	2N3866	97p	4A 100V	80p	VM18	
7421	45p	74132	81p	74LS93	80p	4025	22p	CA3048	250p	RC4151N	432p	TIP33C	120p	2N3905/6	22p	4A 100V	90p	1A100V	48p
7428	28p	74136	81p	74LS107	55p	4026	178p	CA3053	75p	SG3402N	275p	TIP33C	120p	2N3905/6	22p				
7423	36p	74141	85p	74LS107	55p	4026	178p	CA3053	75p	SN7210N	54p	TIP33A	120p	2N3905/6	22p				
7425	33p	74142	300p	74LS115	120p	4027	65p	CA3065	200p	SN76033N	275p	TIP33A	120p	2N3905/6	22p	TRIACS Plastic			
7426	43p	74145	95p	74LS138	140p	4029	120p	CA3068E	250p	SN26008	280p	TIP33A	120p	2N3905/6	22p	3A 400V	85p	15A 400V	200p
7427	40p	74147	205p	74LS139	150p	4030	55p	CA3090A	425p	SN76013N	175p	TIP33A	120p	2N3905/6	22p	2A 400V	107p	15A 500V	225p
7428	40p	74148	160p	74LS151	110p	4033	250p	ICL8038CC	400p	SN76013ND	160p	TIP33A	120p	2N3905/6	22p	6A 500V	120p	40430	T066
7430	18p	74150	130p	74LS153	110p	4034	250p	LM339N	175p	SN76013ND	160p	TIP33A	120p	2N3905/6	22p	10A 100V	140p		
7432	37p	74151	81p	74LS153	110p	4034	250p	LM339N	175p	SN76013ND	160p	TIP33A	120p	2N3905/6	22p	10A 500V	160p	40669	T0220
7433	43p	74153	81p	74LS157	130p	4035	100p	LM337N	112p	SN76023ND	160p	TIP33A	120p	2N3905/6	22p				
7437	37p	74154	160p	74LS160	180p	4042	100p	LM3800	220p	SP8515	710p	TIP33A	120p	2N3905/6	22p				
7438	37p	74155	97p	74LS161	180p	4043	100p	LM389N	160p	TCA940	200p	TIP33A	120p	2N3905/6	22p				
7440	18p	74156	97p	74LS162	180p	4044	100p	LM3911N	120p	TAA961A	310p	TIP33A	120p	2N3905/6	22p				
7441	85p	74157	97p	74LS163	180p	4046	140p	M252AA	850p	TBA120	97p	TIP33A	120p	2N3905/6	22p				
7442	75p	74159	250p	74LS164	120p	4047	100p	MC1310P	190p	TBA541B	300p	TIP33A	120p	2N3905/6	22p				
7443	120p	74160	100p	74LS164	120p	4047	100p	MC1310P	190p	TBA541B	300p	TIP33A	120p	2N3905/6	22p				
7444	120p	74161	100p	74LS164	120p	4047	100p	MC1310P	190p	TBA541B	300p	TIP33A	120p	2N3905/6	22p				
7445	108p	74162	100p	74LS175	160p	4050	57p	MC1496L	120p	TBA810	125p	TIP33A	120p	2N3905/6	22p				
7446	108p	74163	100p	74LS175	160p	4050	57p	MC1496L	120p	TBA810	125p	TIP33A	120p	2N3905/6	22p				
7447	75p	74164	120p	74LS181	375p	4055	140p	MC3340P	160p	TAA820	100p	TIP33A	120p	2N3905/6	22p				
7448	85p	74165	150p	74LS181	375p	4055	140p	MC3360P	180p	TAA820A	310p	TIP33A	120p	2N3905/6	22p				
7450	18p	74166	160p	74LS190	250p	4056	135p	MC3401	70p	TAA2020	360p	TIP33A	120p	2N3905/6	22p				
7451	18p	74167	320p	74LS191	200p	4060	130p	MFC4000B	120p	ZN414	40p	TIP33A	120p	2N3905/6	22p				
7453	18p	74170	260p	74C00	25p	4067	425p	NE540L	225p	ZN425E	420p	TIP33A	120p	2N3905/6	22p				
7454	18p	74172	750p	74C02	25p	4068	24p					TIP33A	120p	2N3905/6	22p				
7460	18p	74173	190p	74C04	27p	4069	27p					TIP33A	120p	2N3905/6	22p				
7470	38p	74174	120p	74C08	27p	4070	65p					TIP33A	120p	2N3905/6	22p				
7472	32p	74175	87p	74C10	27p	4071	27p					TIP33A	120p	2N3905/6	22p				
7473	36p	74176	130p	74C14	90p	4072	27p					TIP33A	120p	2N3905/6	22p				
7474	37p	74177	120p	74C42	110p	4073	30p					TIP33A	120p	2N3905/6	22p				
7475	43p	74180	120p	74C48	230p	4076	170p					TIP33A	120p	2N3905/6	22p				
7476	37p	74181	324p	74C73	75p	4081	21p					TIP33A	120p	2N3905/6	22p				
7480	54p	74182	60p	74C74	70p	4082	24p					TIP33A	120p	2N3905/6	22p				
7481	108p	74183	250p	74C85	200p	4093	94p					TIP33A	120p	2N3905/6	22p				
7482	90p	74185	90p	74C86	65p	4098	115p					TIP33A	120p	2N3905/6	22p				
7483	99p	74186	990p	74C90	90p	14502	180p					TIP33A	120p	2N3905/6	22p				
7484	108p	74190	120p	74C93	90p	14503	90p					TIP33A	120p	2N3905/6	22p				
7485	120p	74191	120p	74C107	125p	14507	55p					TIP33A	120p	2N3905/6	22p				
7486	95p	74192	50p	74C160	125p	14508	300p					TIP33A	120p	2N3905/6	22p				
7489	340p	74193	100p	74C151	260p	14508	300p					TIP33A	120p	2N3905/6	22p				
7490	36p	74194	160p	74C157	250p	14510	130p					TIP33A	120p	2N3905/6	22p				
7491	90p	74195	110p	74C160	125p	14511	160p					TIP33A	120p	2N3905/6	22p				
7492	58p	74196	100p	74C161	155p	14512	110p					TIP33A	120p	2N3905/6	22p				
7493	36p	74197	130p	74C162	155p	14515	160p					TIP33A	120p	2N3905/6	22p				
7494	90p	74198	250p	74C163	155p	14518	110p					TIP33A	120p	2N3905/6	22p				
7495	75p	74199	250p	74C164	140p	14520	110p					TIP33A	120p	2N3905/6	22p				
7496	80p	74221	175p	CMOS	4000	20p	14560					TIP33A	120p	2N3905/6	22p				

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HIGH POWER "CROSS-OVERS"

HPX1R (3-5KHz) **£3.25**
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Impedance or total impedance of Bass Drivers not to exceed 8Ω. Otherwise use series Horns or attenuation provided with HPX1R and HPX2R.

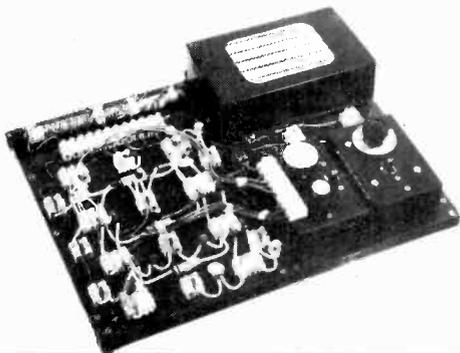
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NEW ELECTRONIC MASTER KIT

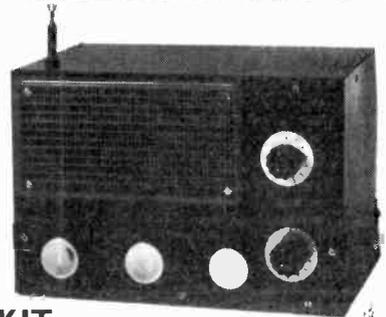
WITH SPECIAL MULTI-BAND V.H.F. TUNER MODULE TO CONSTRUCT. A completely Solderless Electronic Construction Kit, with ready drilled Bakelite Panels, Nuts, Bolts, Wood Screws etc. Also in the kit: Transistors, Capacitors, Resistors, Pots, Switches, Wire, Sleeving, Knobs, Dials, 5" x 3" Loudspeaker and Speaker Case, Crystal Earpiece, etc. Also ready wound Coils and Ferrite Rod Aerial. These are the Projects you can build with the components supplied with the kit, together with comprehensive Instruction Manual Pictorial and Circuit Diagrams.

PROJECTS: V.H.F. Tuner Module ★ A.M. Tuner Module ★ M.W. L.W. Diode Radio ★ Six Transistor MultiBand V.H.F. Earpiece Radio ★ One Transistor M.W. L.W. Radio ★ Two Transistor Metronome with variable beat control ★ Three Transistor and Diode Radio M.W. L.W. ★ Four Transistor Push Pull Amplifier ★ Eight Transistor MultiBand V.H.F. Loudspeaker Receiver ★ Variable A.F. Oscillator ★ Jiffy MultiTester ★ Four Transistor and Diode M.W. L.W. Radio. ★ A.F. R.F. Signal Injector ★ Five Transistor Push Pull Amplifier ★ Sensitive Hearing Aid Amplifier ★ Three Transistor and Diode Short Wave Radio ★ Signal Tracer ★ Three Transistor Push Pull Amplifier ★ One Transistor Class A Output Stage to drive Loudspeaker ★ Sensitive Transistor Pre-Amp ★ Transistor Tester ★ Sensitive Three Transistor Regenerative Radio ★ Four Transistor M.W. L.W. and Diode Tuner ★ Five Transistor M.W. L.W. Trawler Band Regenerative Radio ★ Five Transistor V.H.F. MultiBand Tuner ★ Three Transistor Code Practice Oscillator ★ Five Transistor Regenerative Short Wave Radio ★ Four Transistor and two Diodes M.W. L.W. Loudspeaker Radio ★ Seven Transistor M.W. L.W. Radio with Loudspeaker Push Pull output ★ One Transistor Home Broadcaster. **£14.99 + P & P £1.10**



NEW ROAMER TEN MODEL R.K.3

MULTIBAND V.H.F. AND A.M. RECEIVER. 13 TRANSISTORS AND FIVE DIODES. QUALITY 5" x 3" LOUDSPEAKER.
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 Complete kit of parts including carrying strap. **£13.99** Including Post and Packing Case Enclosure Kit (if required) £1.90 inc. P. & P.



NEW MODEL R.K.1

MultiBand A.M. Receiver. M. W. L. W. Trawler Band and Three Short Wave Bands. Seven Transistors and Four Diodes. Push Pull Output stage. 5" x 3" Loudspeaker. Internal Ferrite Rod Aerial. Kit includes all parts to build it up including Carrying Strap, Rubber Feet and ready-drilled Panels. Comprehensive Instruction Manual for stage by stage construction. Uses P.P.9 Nine Volt Battery.

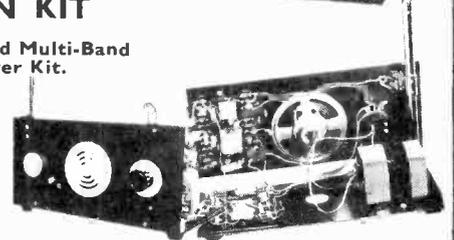


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ELECTRONIC CONSTRUCTION KIT

E.C.K. 2 Self Contained Multi-Band V.H.F. Receiver Kit.

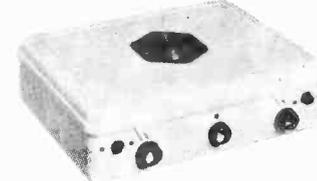
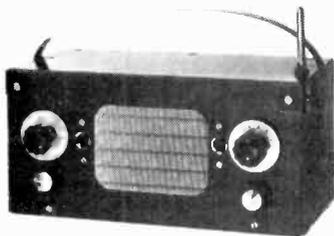
8 transistors and 3 diodes. Push pull output. 3in. loudspeaker, gain control, 7 section chrome plated telescopic aerial V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F. local stations, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit)



Complete kit of parts **£7.95 + P & P and Ins. 90p**

NEW MODEL R.K.2

MW, LW and Air Band Receiver. Eight Transistors and Four Diodes. 3" Loudspeaker, Telescopic Aerial, Internal Ferrite Rod Aerial. Complete with Carrying Strap, and ready-drilled Panels and all components necessary for construction. A sensitive Receiver with the additional luxury of an Air Band section to pick up Aircraft from many miles away. Full Instruction Manual enables stage by stage construction. Uses P.P.9 Nine Volt Battery. **£9.99 + P & P £1.10**



EDU-KIT MAJOR COMPLETELY SOLDERLESS ELECTRONIC CONSTRUCTION KIT

BUILD THESE PROJECTS WITHOUT SOLDERING IRON OR SOLDER

Complete kit of parts including construction plans Total building costs

£9.99 + P & P and Ins. £1.10

- 4 Transistor Earpiece Radio
- Signal Tracer
- Signal Injector
- Transistor Tester
- NPN—PNP Amplifier
- 4 Transistor Push Pull Amplifier

- 24 Resistors
- Earpiece
- 2 Slider Switches
- 21 Capacitors
- Mica Baseboard
- Ferrite Rod
- 10 Transistors
- 3 12-way Connectors
- 1 Tuning Condenser
- 5" x 3" Loudspeaker
- 2 Volume Controls
- 3 Knobs
- Ready Wound Coils
- 6½ yards of wire
- 1 yard of sleeving, etc.

E.V.6.

Build this exciting new design. 6 Transistors and 2 diodes. MW/LW. Powered by 9V battery. Ferrite rod aerial, tuning condenser, volume control, and now with 3in. loudspeaker. Attractive case with red speaker grille. Size 9in. x 5½in. x 2½in. approx. All parts including Case and Plans.



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Build this converter kit and receive the aircraft band by placing it by the side of a radio tuned to medium wave or the VHF band and operating as shown in the instructions supplied free with all parts.

Uses a retractable chrome plated telescopic aerial, gain control, V.H.F. tuning capacitor, transistor, etc. All parts including case and plans

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1G8GT	1.00	6AX4	-75	6J5GT	-85	10C14	-52	20D4	2.50	108CJ	-40
1H8GT	1.00	6B8G	-75	6J6	-35	10D1	-80	20F2	-85	150C2	-65
1L4	-85	6BA6	-52	6J7G	-60	10DE7	-1.00	20L1	1.80	2158G	-80
1LD6	-70	6BC8	-90	6J7M	-65	10F1	-67	20P1	1.00	956	-50
1LN8	-70	6BE8	-70	6J8A	-90	10F9	-85	20P3	1.00	807	1.10
1N8GT	-75	6B6G	-60	6K7G	-85	10F14	-65	20P5	-84	1825	2.60
1R5	-80	6BH6	1.10	6K8G	-50	10L11	-45	20F5	1.50	1821	1.00
1R6	-40	6BJ6	-75	6K8GT	-55	10L14	-75	25A6G	-70	6702	1.20
1R8	-35	6BK7A	-65	6L1	2.50	10LD12	-75	25L6G	-70	6763	2.75
1T4	-30	6BN8	1.00	6L7	1.50	10PE1	-70	25Y5	-80	6087	2.00
1U4	-70	6BQ5	-48	6L12	-50	10P13	-80	25Y5G	-60	6060	2.00
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2GK5	-70	6BR8	1.25	6LD12	-48	12AC6	-80	25Z6G	-80	6483	2.00
2X2	-75	6BW6	3.50	6LD20	-80	12AD6	-80	25D7	2.00	7025	2.00
3A4	-55	6BW7	-65	6N7G	-70	12AP6	-80	30A5	-75	7193	-60
3B7	-55	6BX6	-40	6PL12	-80	12AT5	-45	30C1	-80	7475	1.20
3D6	-40	6BY7	-45	6P15	-48	12AT7	-52	30C15	1.00	9002	-55
3Q4	-80	6BZ8	1.50	6Q76	-75	12AU6	-50	30C17	-90	9006	-45
3Q5GT	-70	6C4	-50	6Q7GT	-70	12AU7	-52	30C18	2.25	A3042	6.00
3V4	-65	6C6	-45	6Q7M	-75	12AV6	-60	30F5	-70	AC2PEN	1.20
3B4	1.00	6C9	2.00	6R7G	-70	12AX7	-52	30L1	-39	AC2PEN	1.00
4CB6	-75	6C10	1.00	6R7A	-70	12B48	-80	30L15	-75	AC2PEN/	
4GK5	-75	6CB6A	-65	6RC7GT	-1.00	12B48	-80	30L17	-70	DD	1.00
5CG8	-75	6C12	-55	6RGT	-70	12B66	-85	30P4M	-98	AC6PEN	
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5U4G	1.00	6CL6	-75	6SK7	1.00	12J5GT	-40	30P4	-90	AC/P4	1.50
5V4G	1.00	6CL8A	-95	6K7GT	-70	12J7GT	-70	30P16	-50	ACTH1	1.00
5Y3GT	-65	6CM7	1.00			12K5	1.50	30P18	-50	AL60	1.50
5Z3	1.40	6C86	-65	6SQ7	-70	12K7GT	-80	30P11	1.25	ARP3	-60
5Z4G	-75	6C95	-90	6T4GT	1.00	12K8	-75	30P12	-62	ATP4	-60
5Z4GT	1.00	6D3	75	6U7G	-55	12Q1GT	-50	30P13	1.30	AZ1	-60
6J30L3	-80	6E7	-70			12S47	-75	30P14	1.50	AZ31	1.00
6A8G	1.40	6DT6A	-85	6V6G	-50	12RC7	-50	30P15	1.30	AZ41	-50
6AC7	-70	6E6W6	-85	6V6GT	1.00	12RG7	-55	35A3	1.00	B36	-75
6A05	-35	6E5	1.00	6X4	-85	12RH7	-50	35C5	-80	B719	-50
6AG7	-70	6F1	-80	6X5GT	-80	12R7	-80	35D5	-90	B729	-90
6A16	-70	6F6G	-70	6Y6G	-95	12SK7	-80	35L6GT	-80	B183	2.00
6AJ5	-70	6F12	-70	6Y7G	1.25	12SN7GT				CL33	-80
6AJ8	-55	6F14	-90	7A7	-80					CV6	-80
6AK5	-66	6F15	-85	7B6	1.00	12QGT	-80	35Z4GT	-70	CV63	-80
6AK6	1.50	6F16	-1.00	7B7	1.00	12QGTGT		35Z5GT	-80	CV988	-25
6AK8	-48	6F18	-80	7D5	2.00					CY1C	1.00
6AL5	-85	6F23	1.00	7E8	2.00	12SR7	-78	60B5	-95	CY31	1.00
6AM6	-70	6F24	-80	7E7	1.00	13D8	2.00	60C5	-70	D1	-60

D83	-50	EC53	1.00	EL32	1.00	KT86	3.00	PFL200	1.12	UL41	-90	AA199	-18	BF178	-44
DA632	-80	EC64	1.00	EL37	3.00	KT71	1.00	PL31	1.00	UL84	-85	AA213	-61	BF181	-47
DAF91	-85	EC68	-84	EL41	1.00	KT81	3.00	PL36	-80	UM80	1.00	AC107	-18	BF184	-47
DAF96	1.00	EC68	-84	EL81	1.00	KT88	6.75	PL81	-49	U9	1.00	AC113	-30	BF186	-47
DC90	-70	EC90	-55	EL83	1.00	KTW61	1.50	PL81A	-75	UL12	-45	AC126	-14	BFY60	-26
DD4	-80	EC92	1.00	EL84	-48	L63	-65	PL82	-50	UV41	-70	AC127	-80	BFY61	-23
DF33	-75	EC97	-75	EL86	-80	LN119	-70	PL83	-50	UY42	-70	AC128	-26	BFY62	-23
DF91	-80	EC99	1.00	EL90	-75	LN162	-55	PL84	-50	UY86	-70	AC132	-28	BY100	-81
DF92	-25	ECC33	2.00	EL95	-80	LN309	-75	PL85	1.00	UI0	1.00	AC134	-30	BT114	-21
DF96	1.00	ECC35	2.00	EL96	2.00	LN319	-75	PL85A	1.00	UI2/14	1.15	AC156	-23	BY126	-19
DH63	-75	ECC40	1.00	EL608	2.50	M8182	2.00	PL504/500		U18	1.05	U18	2.50	BY127	-21
DH76	-50	ECC81	-52	EL509	2.50	MHL4	1.00	PL508	1.80	U19	4.00	AC165	-30	BZ210	-80
DH77	-80	ECC82	-52	EM80	1.00	MHLD6	99	PL509	2.55	U25	1.00	AC166	-30	BZ211	-80
DH81	1.00	ECC83	-52	EM81	1.00	MKT4	1.20	PL519	2.80	U26	-90	AC168	-44	BZ212	-80
DE32	-60	ECC84	-50	EM83	1.00	MU14	1.15	PL802	8.20	U28	1.75	AC176	-64	BZ213	-80
DK40	1.00	ECC85	-50	EM84	1.00	MX40	1.00	PT4D	1.00	U35	1.75	AC177	-32	FBY11A	-96
DK91	-50	ECC86	2.00	EM85	1.20	N150	1.00	PY382	-50	U47	2.80	ACY18	-23	FBY41A	-26
DK92	1.00	ECC88	-72	EM87	1.45	N305	-98	PY80	-80	U81	-80	ACY19	-33	OA9	-14
DK96	1.00	ECC91	-35	EMM803		N709	-48	PY81	-60	U191	-50	ACY20	-30	OA7	-18
DL83	-70	ECC189	1.00	EM88	2.80	P61	-60	PY82	-40	U251	1.00	ACY21	-80	OA70	-18
DL82	1.00	ECC304	-80	EY81	-65	PABC90	-45	PY83	-60	U301	1.00	ACY22	-18	OA78	-18
DL92	-65	ECC807	2.80	EY81	1.50	PC86	-80	PY88	1.12	U408	-90	ACY28	-21	OA79	-11
DL94	1.00	ECCF80	-45	EY83	1.40	PC88	-80	PY800A1	56	U404	-75	AD140	-50	OA81	-11
DL96	1.00	ECCF82	-50	EY86/7	-45	PC88	-80	PY801	-60	U801	1.00	AD161	-53	OA85	-11
DM70	1.25	ECCF86	-80	EY88	1.00	PC85	1.00	PY801	-60	U4020	1.00	AD162	-53	OA89	-14
DM71	1.75	ECC85	2.00	EY91	-50	PC97	-75	PZ30	-50	VP4 (5)	2.00	AP114	-30	OA91	-11
DM74	1.15	ECC42	1.00	EY900	1.45	PC900	-65	QV03/10		VP23	-65	AP115	-80	OA95	-11
DW4	-70	ECC81	-55	EZ35	-50	PC84	-39	Q895/10	2.00	VF41	-90	AF17	-32	OC35	1.00
DY11	2.00	ECC88	1.00	EZ40	1.00	PC88	-47	Q8150/15		VF150	-75	AF124	-88	OC45	-18
EY87/8	-62	ECC84	-75	EZ41	1.00	PC88	-61	Q8150/15		VU111	1.00	AF180	-56	OC70	-14
EY802	-50	ECL80	-55	EZ80	-42	PC89	-49	Q8150/15		VU120	1.00	AF186	-94	OC71	-18
EY80C	4.75	ECL82	-60	EZ81	-45	PC89	-49	QV04/7	8.00	VU183	1.00	BA115	-16	OC72	-13
EY80F	6.00	ECL84	-90	EZ90	-95	PC89	-49	QV08/20		W107	1.00	BA116	-81	OC74	-86
EY83	5.50	ECL85	-80	EY801	1.25	PC89	-49	QV08/20		W229	1.20	BA129	-14	OC75	-13
EY83C	1.20	ECL86	-94	GZ30	75	PCF84	-70	R10	4.70	X41	1.00	BA130	-12	OC76	-18
EY8CC	4.50	ECL88	-94	GZ32	1.00	PCF86	-57	R19	5.00	X66	2.00	BA148	-20	OC77	-82
EY80C	5.00	ECL89	-94	GZ33	4.00	PCF200	1.35	UABC90	-45	Z759	6.50	BA163	-18	OC77	-82
EY82	1.00	ECL90	-94	GZ34	2.25	PCF201	1.00	UAF42	-70	Transistors		BC107	-14	OC78D	-13
EY83	1.00	ECL91	-94	GZ37	4.00	PCF801	-49	UBC41	-70	Diodes		BC108	-14	OC81	-13
EY84	1.00	ECL92	-94	HABC80	-80	PCF802	-80	UBC81	-55	1N4744	-16	BC109	-14	OC81D	-13
EY85	1.00	ECL93	-94	HL13C	-60	PCF805	2.25	UBF80	-50	2N404	-21	BC113	-30	OC82	-13
EY86	1.00	ECL94	-94	HL23DD	-68	PCF806	-70	UBF89	-39	2N966	-61	BC115	-13	OC82D	-13
EY87	1.00	ECL95	-94	HL41DD	1.00	PCH200		ULB21	-20	2N1766	-58	BC116	-30	OC83	-23
EY88	1.00	ECL96	-94	HL42DD	1.00	PCL82	-62	UC92	-90	2N2147	-99	BC118	-26	OC83	-23
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Ref	12V	24V	£	P & P
111	0.5	0.25	2.20	0.45
213	1.0	0.5	2.64	0.78
71	2.0	1.0	3.41	0.78
18	4	2	4.03	0.96
70	6	3	5.35	0.96
108	8	4	6.98	1.14
72	10	5	7.67	1.14
116	12	6	8.99	1.32
17	16	8	10.39	1.32
115	20	10	13.18	2.08
187	30	15	17.05	2.08
226	60	30	26.82	0A

30 VOLT RANGE

Prim 220/240V Sec 0-12-15-20-24-30V
Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V 15-0-15V, 12-0-12

Ref	12V	15V	20V	24V	£	P & P
112	0.5	0.5	2.64	0.78	0.78	0.78
79	1.0	1.0	3.57	0.96	0.96	0.96
3	2.0	2.0	5.27	0.96	0.96	0.96
20	3.0	3.0	6.20	1.14	1.14	1.14
21	4.0	4.0	7.44	1.14	1.14	1.14
51	5.0	5.0	8.37	1.32	1.32	1.32
117	6.0	6.0	9.92	1.45	1.45	1.45
88	8.0	8.0	11.73	1.64	1.64	1.64
89	10.0	10.0	13.33	1.84	1.84	1.84

60 VOLT RANGE

Prim 220/240V Sec 0-24-30-40-46-60V
Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60V or 24-0-24V or 30-0-30V

Ref	24V	30V	40V	£	P & P
124	0.5	0.5	0.96	0.96	0.96
126	1.0	1.0	5.58	0.96	0.96
127	2.0	2.0	7.60	1.14	1.14
125	3.0	3.0	10.54	1.32	1.32
123	4.0	4.0	12.23	1.84	1.84
40	5.0	5.0	13.95	1.64	1.64
120	6.0	6.0	15.66	1.84	1.84
121	8.0	8.0	20.15	0A	0A
122	10.0	10.0	24.03	0A	0A
189	12.0	12.0	27.13	0A	0A

50 VOLT RANGE

Prim 220/240V Sec 0-20-25-33-40-50V
Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40, 50, 25-0-25 or 20-0-20

Ref	25V	30V	£	P & P
102	0.5	0.5	4.41	0.78
103	1.0	1.0	5.37	0.96
104	2.0	2.0	6.98	1.14
105	3.0	3.0	8.45	1.32
106	4.0	4.0	10.70	1.50
107	6.0	6.0	14.62	1.64
118	8.0	8.0	17.05	2.08
119	10.0	10.0	21.70	0A

MAINS ISOLATING (SCREENED) PRIM 120/240 SEC 120/240 CT

Ref	VA (Watts)	£	P & P
*07	20	4.40	0.79
149	60	6.20	0.96
150	100	7.13	1.14
151	200	11.16	1.50
152	250	12.79	1.84
153	350	16.28	1.84
154	500	19.15	2.15
155	750	29.06	0A
156	1000	37.20	0A
157	1500	45.60	0A
158	2000	54.80	0A
159	3000	79.05	0A

*This model 115 or 240v only

HIGH VOLTAGE MAINS ISOLATING PRIM 200/220V or 400/440V Sec 100/120V or 200/240V

Ref	100V	120V	£	P & P
60	243	5.89	1.32	1.32
350	247	14.11	1.84	1.84
1000	250	35.65	0A	0A
2000	252	54.25	0A	0A

AUTO TRANSFORMERS

Ref	VA (Watts)	£	P & P
113	15 0-115-210-240	2.48	0.71
64	75 0-115-210-240	3.95	0.96
4	150 0-115-200-220-240	5.35	0.96
67	500 0-115-200-220-240	10.99	1.64
84	1000 0-115-200-220-240	18.76	2.08
93	1500 0-115-200-220-240	23.36	0A
95	2000 0-115-200-220-240	34.82	0A
73	3000 0-115-200-220-240	48.00	0A

CASED AUTO TRANSFORMERS 240V cable in 115V USA flat pin outlet

VA	£	P & P	Ref
15	4.96	0.96	113W
150	8.48	1.14	4W
200	9.92	1.45	65W
250	10.49	1.45	69W
350	12.53	1.64	53W
500	15.73	1.64	67W
750	18.55	1.76	83W
1000	22.68	0A	94W
1500	26.02	0A	93W
2000	37.65	0A	95W

SCREENED MINIATURES

Ref	Volts	£	P&P
238	200 3-0-3	1.99	0.55
212	1A, 1A 0-6-0-6	2.85	0.78
13	100 9-0-9	2.14	0.38
235	330, 330 0-9-0-9	1.99	0.38
207	500, 500 0-8-9-, 0-8-9	2.59	0.71
208	1A, 1A 0-8-9, 0-8-9	3.53	0.96
236	200 0-15-0-15	1.99	0.38
214	300, 300 0-20-0-20	2.56	0.78
221	700 (DC) 20-12-0-12-20	3.41	0.78
206	1A, 1A 0-15-20-0-15-20	4.63	0.96
203	500, 500 0-15-27-0-15-27	3.99	0.96
204	1A, 1A 0-15-27-0-15-27	5.39	0.96
239	50 12-0-12	1.99	0.38
S112500	12-15-20-24-30	2.64	0.78

PLUS

HIGH QUALITY MODULES

10 Watts RMS AMPLIFIER	£3.66
25 Watts RMS AMPLIFIER	£4.57
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200 Mixed value resistors (count by weight)	150
150 Mixed value capacitors (count by weight)	30
30 Mixed value precision resistors ½W 2%	15
15 Assorted pots	10
10 Reed switches	15
15 Wire wound resistors—mixed wattage	1
1 Pack wire 50 metres assorted colours	25
25 pre-set assorted types and values	Please state pack required. 60p per pack
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Prices correct 27-11-77. Please add VAT after P & P.

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AVO 71	£29.00
AVO 73	£39.00
AVO MM5	£24.00
AVO TT169 in circuit	£30.00
Transistor Tester	£30.00
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Carriage £4.00 8% VAT.	
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VAT 12½% *VAT 8% P & P 15p.	

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BE4 Prim 120 or 240V 9-0-9 1A	£1.88 P & P 0.38
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EP20KN 20,000 opv multimeter with 'off' damping and anti-parallax mirror. Ranges: DC volts: 25, 5, 25, 125, 500, 1,000 (20,000 opv). AC volts: 10, 50, 250, 1,000 (10,000 opv). DC amps: 50µA, 2.5mA, 250mA. Resistance: 60K ohms, 600K ohms, 6 megohms. Decibels: -20 to +22dB. £16.95 inc. VAT.

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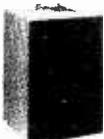
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+ p & p £5.50

SPEAKERS AVAILABLE WITHOUT CABINETS.
It's the units which we supply with the enclosures illustrated. Size 13" x 8" (approx.) woofer, (EMI), 2 1/2" app. £1700 per tweeter, and matching crossover components. stereo pair Power handling 15 watts rms, 30 watts peak. + p & p £3.40

COMPACT FOR TOP VALUE These infinite baffle enclosures come to you ready mitted and professionally finished. Each cabinet measures approx. per stereo pair 12" x 9" x 5" deep, and is in wood simulate. Complete with two 8" (approx.) speakers for £850 maximum power handling of 7 watts. 8Ω. + p & p £2.20

SPEAKERS Two models - Duo IIb, teak veneer, 12 watts rms, 24 watts peak, 18 1/2" x 13 1/2" x 7 1/2" (approx.). Duo III, 20 watts rms, 40 watts peak, 27" x 13" x 11" app. Duo IIb **£17 PER PAIR** Duo III **£52 PER PAIR** + p & p £6.50

DECCA 20 WATTS STEREO SPEAKER stereo pair This matching loudspeaker system is hand made, kit comprises of two 8" diameter approx. base drive unit, with heavy die cast chassis laminated cones with rolled P.V.C. surrounds, two 3 1/2" diameter approx. domed tweeters complete with crossover networks. 8Ω. £4.00 p & p **£2000**

PERSONAL SHOPPERS

STEREO CASSETTE record/replay fully built P.C. board **£275**

AM. FM. TUNER P.C.B. with Mullard L.P. 1186, 1185, 1181 modules. **£950**

100K Multiturn Varicap tuning pots, 6 for **£100**

PAIR STEREO 8 WATT SPEAKERS 8" bass units with 3 1/2" approx. tweeters **£1295**

Size 16 1/2" x 11" x 8 1/2".

Plinth & cover BSR or Garrard teak finish **£600**

DECCA OC1000 Stereo Cassette P.C.B. complete with switch oscillator coils and tape-heads **£295**

AM. FM. Stereo Multiplex Car Radio/cassette player in dash fixing Negative earth 5 watts output **£3600**

I.C. Stereo 8 Track to Cassette adaptor converts, any 8 track player to cassette player. **£1895**



20 x 20 WATT STEREO AMPLIFIER £2990

Superb Viscount IV unit in teak-finished cabinet. Silver fascia with aluminium rotary controls and pushbuttons, red mains indicator and stereo jack socket. Function switch for mic, magnetic and crystal pick-ups, tape, tuner, and auxiliary Rear panel features two mains outlets. DIN speaker and input sockets, plus fuse. 20 + 20 watts rms, 40 + 40 watts peak. £2.50

30 x 30 WATT AMPLIFIER KIT £2900

Viscount IV amplifier. 60 + 60 peak. p & p £2.50
NOW AVAILABLE fully built and tested. **£3500**
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A 4 channel Stereo Adaptor to all buyers of the Viscount 20 x 20 **£290** Available separately **£395**
Amplifier at + £1.00 p & p.

ADD-ON STEREO CASSETTE TAPE DECK KIT

Designed for the experienced D.I.Y. man. This kit comprises of a tape transport mechanism, ready built and tested record/replay electronics with twin V.U. meters and level control for mating with mechanism. Specifications: Sensitivity - Mic. 0.85 mV a 20K OHMS; Din. 40mV a 400K OHMS; Output - 300mV RMS per channel a 1KHz from 2K OHMS source; Cross Talk - -30db; Tape Counter - 3 Digit. Resettable; Frequency Response - 40Hz - 8KHz ± 6db; Deck Motor - 9 Volt DC with electronic speed regulations; Key Functions - Record, Rewind, Mains Transformer **£1995**
Fast Forward, Play, Stop & Eject. £2.50 + £1 p & p £2.50
Opt. extras: Pair of Dynamic microphones £3.95 + £1.00 p & p.

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45 WATT MONO DISCO AMP

£3500 p & p £2.50
Size approx. 13 1/2" x 5 1/2" x 6 1/2"



45 watts rms, 90 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

70 & 100 WATT MONO DISCO AMP

Size approx. 14" x 4" x 10 1/2"



Brushed aluminium fascia and rotary controls. Five vertical slide controls - master volume, tape level, mic level, deck level. PLUS INTER-DECK FAOER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre-fade level control (PFL) lets YOU hear next disc before fading 100 watt peak p & p £4.00
in. VU meter monitors output level. Output 100 watts RMS 200 watts peak. 100 watt **£65**

CHASSIS RECORD PLAYER DECKS



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cuing device and stereo ceramic head, p & p £2.50
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Home 8 Track cartridge player. This unit will match with the Viscount IV 9" x 8" x 3 1/2". p & p £2.50 **£1650**

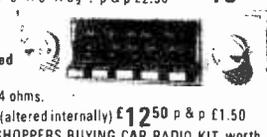
BSR BDS 95 TYPE illus. £2495

Belt drive turntable unit. 2 speed, semi automatic p & p £2.55
BSR MP60 TYPE Single **£195**
play record deck p & p £2.55
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15-240 Watts!

HY5 Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

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

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

SPECIFICATIONS:

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

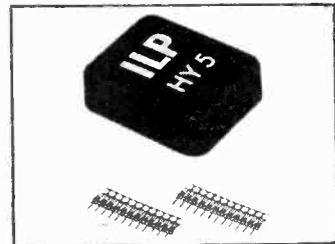
OUTPUTS: Tape 100mV; Main output 500mV R.M.S.

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

DISTORTION: 0-1% at 1kHz. Signal/Noise Ratio 68dB.

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

Price \pounds 5.22 + 65p VAT P&P free.



HY30 15 Watts into 8 Ω

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

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

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

SPECIFICATIONS:

OUTPUT POWER 15W R.M.S. into 8 Ω . DISTORTION 0-1% at 1.5W.

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

SUPPLY VOLTAGE \pm 18V.

Price \pounds 5.22 + 65p VAT P&P free.



HY50 25 Watts into 8 Ω

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

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

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

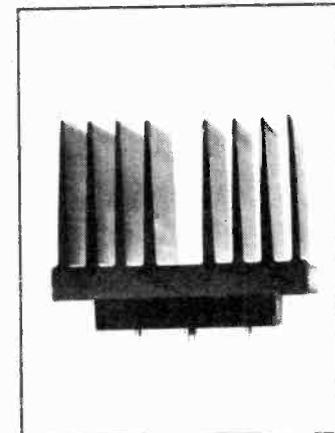
SPECIFICATIONS: INPUT SENSITIVITY 500mV

OUTPUT POWER 25W RMS into 8 Ω LOAD IMPEDANCE 4-16 Ω DISTORTION 0-04% at 25W at 1kHz

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

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

Price \pounds 6.82 + 85p VAT P&P free.



HY120 60 Watts into 8 Ω

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

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

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

SPECIFICATIONS

INPUT SENSITIVITY 500mV.

OUTPUT POWER 60W RMS into 8 Ω LOAD IMPEDANCE 4-16 Ω DISTORTION 0-04% at 60W at 1kHz

SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz—3dB SUPPLY VOLTAGE \pm 25V

SIZE 114 50 85mm

Price \pounds 15.84 + \pounds 1.27 VAT P&P free.

HY200 120 Watts into 8 Ω

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

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

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

SPECIFICATIONS

INPUT SENSITIVITY 500mV

OUTPUT POWER 120W RMS into 8 Ω LOAD IMPEDANCE 4-16 Ω DISTORTION 0-05% at 100W at 1kHz.

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

SIZE 114 50 85mm

Price \pounds 23.32 + \pounds 1.87 VAT P&P free.

HY400 240 Watts into 4 Ω

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

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

APPLICATIONS: Public address—Disco—Power slave—Industrial

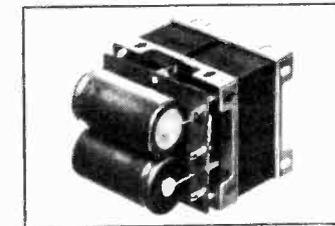
SPECIFICATIONS

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

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

INPUT SENSITIVITY 500mV SIZE 114 100 85mm

Price \pounds 32.17 + \pounds 2.57 VAT P&P free.



POWER SUPPLIES

PSU36 suitable for two HY30's \pounds 5.22 plus 65p VAT. P/P free.

PSU50 suitable for two HY50's \pounds 6.82 plus 85p VAT. P/P free.

PSU70 suitable for two HY120's \pounds 13.75 plus \pounds 1.10 VAT. P/P free.

PSU90 suitable for one HY200 \pounds 12.65 plus \pounds 1.01 VAT. P/P free.

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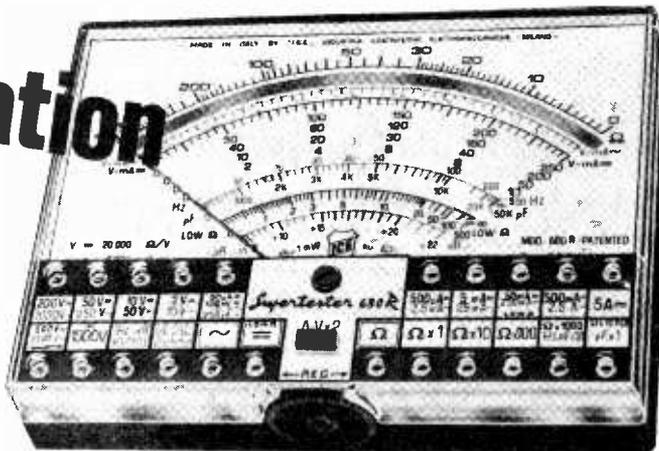
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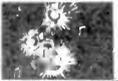
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MULTISPEED MOTORS

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



RECTANGULAR HOT PLATE

Aluminium panel with ridged top and angled underneath to strengthen it. This is approx. 10" x 4 1/2" of flat plate. Beneath plate is 100w element and sensor switch which will maintain the surface of the plate just too hot to touch. With leads and tages. This is ideal if you are making up a food warmer or for an airing cupboard, etc. Price £1.03.



HUMIDITY SWITCH

American made by Ranco, their type No. J11. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive microswitch adjustable by a screw, quite sensitive—breathing on it for instance will switch it on. Micro 3 amp at 250v AC. Overall size of the device approx. 3 1/2" long, 1" wide and 1 1/2" deep. 75p.



MAINS RELAY

With triple 10 amp changeover contacts—operating coil wound for 230 volts AC, chassis mounting, one screw fixing, ex unused equipment 80p each, post and VAT paid.



PP3/PP9 REPLACEMENT MAINS UNIT

Japanese made in plastic container with leads size 2" x 1 1/2" x 1 1/2", this is ideal to power a calculator or radio, it has a full wave rectified and smoothed output of 9 volts suitable for a loading of up to 100mA. £2.53.



MAINS TRANSISTOR 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 many of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer, rectifier, smoothing and load resistor, condensers and instructions. Real snip at only £1.50. Postage 50p.

DRILL CONTROLLER

CONTROL DRILL SPEEDS

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. £3.45 including post & VAT. Made up model £1.00 extra.

MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied. Model 1153 500mW power output £1.50 including Post & VAT. Model 1172 1W, power output £1.85 including Post & VAT. Model EP9000 4 watt power output £2.90 including Post & VAT. EP 9001 twin channel or stereo pre-amp. £2.90 including Post & VAT.



SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts £1.90—crystal earphone 55p including VAT and postage.



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Four unused, made for computer units containing most useful components, and these components unlike those from most computer panels, have free ends of usable length. The transistors for instance have leads over 1" long—the diodes have approx. 1/2" leads.

List of the major components is as follows:—17 assorted transistors—38 assorted diodes—60 assorted resistors and condensers—4 gold plated plugs in units which can serve as multipin plugs or as hook up boards for experimental or quickly changed circuits (note we can supply the socket boards which were made to receive these units). The price of this four units parcel is £1 including VAT and post (considerably less than value of the transistors or diodes alone) DON'T MISS THIS SPLENDID OFFER.

FLUORESCENT TUBE INVERTOR

For camping—car repairing—emergency lighting from a 12v battery you can't beat fluorescent lighting, it will offer plenty of well distributed light and is economical. We offer inverter for 21" 13 watt miniature tube for only £3.75 with tube and tube holders as well.



THIS MONTH'S SNIP



is a miniature sealed relay 12v dc operated with two sets of changeover contacts. The unique feature of this relay is its heavy lead out wires, these provide adequate support and therefore the relay needs no fixing; on the other hand there is a fixing bolt protruding through one side so if you wish you can fix the relay and use its very strong lead outs to secure circuit components—an expensive relay; but we are offering it for only 87p each. Don't miss this exceptional bargain!

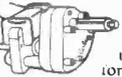
EXTRACTOR FAN

Ex computers—made by Woods of Colchester, ideal for fixing through panel—reasonably quiet running—very powerful 2500 rpm. Choice of two sizes 5" or 6 1/2" dia. £4.41 and £6.



SPIT MOTOR WITH CARTER G/BOX

Probably one of the best spit motors made. Originally intended to be used in very high priced cookers, however this can be put to plenty of other uses, for instance your garden barbecue or to drive a tumbler for stone polishing; in fact there are no ends to its uses. Normal mains operation. £4.32 including POST & VAT.



LATCHING RELAY



by Guardian Electric, mains operated it is in fact two relays mounted on a metal base plate. The relays being mounted in such a way to ensure that when one closes the other opens and vice versa thus when closed relay A would remain locked until manually released or electrically released by energising relay B. Each relay has 2 sets of 10 amp changeover contacts. Should be ideal for burglar alarms and similar applications £2.11.

TERMS:

Cash with order—prices includes VAT and carriage unless stated but orders under £6 must add 50p to offset packing etc. BULK ENQUIRIES WELCOMED. Phone 01-688 1833

J. BULL (ELECTRICAL) LTD
(Dept. PW), 103 TAMWORTH RD.
CROYDON CR9 1SG

IT'S FREE

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—it's an interesting list and it's free—just send S.A.E. Below are a few of the Bargains still available from previous lines.

FM Tuner and decoder, two very well made (Japan) units, nice clear dial, excellent reproduction £9.95 the pair £1.25 VAT.

12 Volt Heavy Duty Relay, plug in type has three pairs of 10 amp changeover contacts. A transparent dust cover, price £1 + 8p, suitable 11 pin base 27p + 2p. 4 Changeover Mains Relay, upright mounting with perspex type dust cover, the really interesting feature is 4 sets of 10 amps changeover contacts price £1.62 + 12p.

12 Volt Pump. Designed we believe as a bilge pump, this is 12 volt AC/DC motor coupled by a long enclosed shaft to a submersible pump. Suitable for water or most any fluids. Price £1.70. Post 80p.

Just arrived. Fruit machines, working order very impressive choice of several but very heavy so you must collect. £50.

High Load 24 Hour Clock Switch, made by the famous AEG Company for normal mains but with clockwork reserve has load capacity of 80 amps at 240v 50hz. Therefore suitable for dealing with large loads of say shop lighting, water heating, storage heaters etc. Has triggers for on and off once per 24 hours but extra triggers will be available. Price £1.50 per pair Size of clock approximately 8" x 5" x 5", totally encased but has lift up flap for ease of altering switching times. Price, new and unused £10.65 or used but guaranteed o.k. £6.50.

Enclosed 24 Hour Clock, with contacts for breaking 10-12 amps at 240 volts. This one has two sets of on/off per 24 hours, price £7.00.

Smiths 24 hr. Timers—Heart only, with over-ride similar to those used in the auto set etc. £4.75 + 38p.

Light Dimmer, our timer module with small mods makes an excellent light dimmer. Contains a 4 amp 400v SCR so it should be suitable for loads approaching 1kW. Price of module with variable resistor and instructions £2.25.

Push Pull Solenoids, mains operated solenoids which will push as well as or instead of pull. Very heavy duty estimate this at 20lbs push or pull 1 1/2" x 3 1/2" x 4" made Magnetic Devices Co. £7.50.

Flashing Lights, chasing lights, random flashes, strobe effects etc. etc. can easily be achieved using our disco switches and with Christmas just around the corner you can do something special for your home or business. These switches are offered at approximately one-fifth of their proper price are ex-equipment but guaranteed perfect and supplied with an adaptor suitable for mains working. To get some idea of the loading number, each switch is 10 amp which is approx 2kW so the 6 switch model could handle over 12kW's.

For the light pipe or Catherine Wheel effect we suggest 12 switch model, interconnecting the switches to give fastest speed. 6 switch model £5. 9 switch model £9.75. 12 switch model £6.20. Also add 50p post per switch. If you want the light pipe diagram please request this.

Always in Stock. Turntables with pick-up lift, ideal for disco's at £11.95, post £2.25. We are also expecting some professional belt drive type at £25. Call or ring us for more information.

Reed Switches, standard 60 watt glass type. Normal open contacts glass lengths 2" diameter 3/16" 10 for £1 + 8p, 100 for £8 + 64p, 1000 for £65 + £5.20.

Flat Reed Switches, for stacking, greater quantity in confined space. Price 50p each. 4p.

Single Ended Types for jobs where it is not easy to bring a lead to each end 75p each. All these switches are normally open but can be biased to a normally closed position by fitting a magnet adjacent. The reed switch would then be opened by a magnet of opposite polarity being brought up to it.

Ceramic Magnets suitable for operating reed switches, central fixing hole. 10 for £1.

Music Centre Transformer 12-0-12 at 1 amp and 9 volt at 1/2 amp. Normal primary, upright mounting, impregnated and varnished for quiet operation. Price £2.95. Post 54p.

"W" Shaped Fluorescent Tubes for porch light, box signs or where you want light evenly spaced over a confined area of approx. 10" x 10", 30 watts, made by Philips price £1.60. Post 54p.

Plinth for BSR Record Player still available at the record price of 95p + 12p. This is excellent value but unfortunately being a bulky and delicate item the postage has to be £1.50 + 12p so this is obviously only a bargain for callers.

Our Smokey Cover can be used with the above plinths, four small locating pins are fitted to the motor board. Size approx 12 1/2" x 14 1/2". Price £2.50 + 32p Post £2.00 + 16p.

Extension Speakers 8 ohm 4-5 watts handling power. We have 5 or 6 different models in stock, cheapest being the Partytime at £3.95 each, again only really a bargain for callers as postage is £1.50 per speaker.

T.V. Monitor, an item for callers, believed to be in good working order, switchable thro' 405-525 & 625. 21" tube line systems, normal controls, volume, brightness, contrast, width etc. Price £16-20, 12" model £18, suitable for conversion into special purpose scope, etc.

Auto transformers for working American tools and equipment, completely enclosed in sheet metal case with American type flat output socket made for computer so obviously first class, 500 watts With carrying handle, offered at about half price only £15 + 80p, carriage £2 + 16p. These may be a bit soiled but are fully guaranteed. Similar but 1000 watt £29.50 or £6.48. Post £1.62.

AUDIO MODULES - ALL REDUCED! TRANSISTOR PRICES SLASHED! MANY PAKS 33% OFF

BI-PAK GREAT SPACE

WE NEED THE SPACE

SPECIAL OFFER!

THYRISTORS

No. THY1A/50	1 Amp.	50 volt	T05	18p
No. THY1A/400	1 Amp.	400 volt	T05	32p
No. THY3A/50	3 Amp.	50 volt	T064	25p
No. THY3A/200	3 Amp.	200 volt	T064	32p
No. THY3A/400	3 Amp.	400 volt	T064	40p
No. THY5A/50	5 Amp.	50 volt	T066	25p
No. THY5A/400	5 Amp.	400 volt	T066	40p
No. THY5A/600	5 Amp.	600 volt	T066	50p
No. C106/4	6 Amp.	400 volt	T0220	42p

TRIAC

S84	8 Amp.	400 Volt	T0220 Plastic (Non Isolated Tab)	80p
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DIACS

BR100				15p
D32				15p

SWITCHES

No. 16178	5 x Mains Slide Switches	40p*
No. S17	5 x Miniature Slide Switches	40p*
No. S18	4 x Standard Slide Switches	40p*
No. S19	4 x Miniature Push to Make single hole mounting	40p*
No. S20	3 x Miniature Push to Break single hole mounting	40p*
No. S21	Push button Switch Pak 4 x Assorted types multi bank and singles Latching and non-Latching	£1.00*

CAPACITOR PAKS

16201	18 Electrolytics	4.7µF - 10µF	
16202	18 Electrolytics	10µF - 100µF	
16203	18 Electrolytics	100µF - 680µF	
All 3 at SPECIAL PRICE of £1.20*			
16160	24 Ceramic Caps	22pF - 82pF	
16161	24 Ceramic Caps	100pF - 390pF	
16162	24 Ceramic Caps	470pF - 3300	
16163	21 Ceramic Caps	4700pF - 0.047µF	
All 4 at SPECIAL PRICE of £1.60			

RESISTOR PAKS

Order No.				
16213	60½W.	100 ohm - 820 ohm		
16214	60½W.	1K - 8.2K		
16215	60½W.	10K - 82K		
16216	60½W.	100K - 820K		
All 4 at SPECIAL PRICE of £1.60*				
16217	40½W.	100 ohm - 820 ohm		
16218	40½W.	1W - 8.2K		
16219	40½W.	1K - 8.2K		
16220	40½W.	100K - 820K		
All 4 at SPECIAL PRICE of £1.60*				

TRANSISTOR FALL-OUT PACK, GERM, SILICON, POWER, NPN, PNP. ALL MIXED. YOURS TO SORT AND TEST. Approx. 500 Pieces. Order No. S23 £1.25 per pack.

VOLTAGE REGULATORS

Positive			
No. MVR7805	µA7805	T0220	85p
No. MVR7812	µA7812	T0220	85p
No. MVR7815	µA7815	T0220	85p
No. MVR7818	µA7818	T0220	85p
No. MVR7824	µA7824	T0220	85p
Negative			
No. MVR7905	µA7905	T0220	£1.10
No. MVR7912	µA7912	T0220	£1.10
No. MVR7915	µA7915	T0220	£1.10
No. MVR7918	µA7918	T0220	£1.10
No. MVR7924	µA7924	T0220	£1.10
µA723C T099	38p	72723 14 pin Dil	38p
LM309K T03			£1.20

MICROPHONES

DYNAMIC DUAL IMPEDANCE UNI DIRECTIONAL CARDIOID MICROPHONE
Impedance 600 ohms and 50K. Response 50-14,000 Hz. Sensitivity 54db at 50K.
Size 1½" Dia x 6½" Long
Order No. 1328 £7.50*

DYNAMIC CASSETTE MIC

Fitted with On/Off switch, 1 metre of tough lead with floating 2.5 and 3.5 mm plugs.
Impedance 200 ohms Sensitivity 90db
Frequency 90-10,000 Hz.
Size 20mm Dia. x 120mm Long
Order No. 1326 £1.15*

LOGIC PROBE

A pocket size instrument capable of detecting T.T.L., D.T.L. Flip Flop and other pulse circuits. It is easy to use and operates from the 5V. D.C. supply of the circuit under test. The logic levels are indicated by 2 red LED's one for High and the other for Low. There is also a green LED for the Pulse Mode of the unit.
No. S59 Our Special Price £18.95.

TRANSISTORS

BRAND NEW - FULLY GUARANTEED

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC107	25p	BC177	12p	BF194	*9p	TIP32A	34p	2N1613	15p
AC126	14p	BC178	12p	BF195	*9p	TIP32B	35p	2N1711	15p
AC127	16p	BC179	12p	BF196	*12p	TIP32C	36p	2N1893	28p
AC128	16p	BC182	*9p	BF197	*12p	TIP41A	34p	2N2218	15p
AC128K	24p	BC182L	*9p	BF200	25p	TIP41B	35p	2N2218A	18p
AC176	16p	BC183	*9p	BFX29	22p	TIP41C	36p	2N2219	15p
AC176K	24p	BC183L	*9p	BFX84	18p	TIP42A	36p	2N2219A	18p
AC187	16p	BC184	*9p	BFY50	12p	TIP42B	37p	2N2221	15p
AC187K	26p	8C184L	*9p	BFY51	12p	TIP42C	38p	2N2221A	16p
AC188	16p	BC212	*10p	BFY52	12p	TIP2955	65p	2N2222	15p
AC188K	26p	8C212L	*10p	MPSA05	*22p	TIP3055	42p	2N2222A	16p
AD161/1		BC213	*10p	MPSA06	*22p	ZTX107	*6p	2N2369	10p
162 MP	80p	BC213L	*10p	MPSA06	*22p	ZTX108	*6p	2N2904	14p
AF139	30p	BC214	*10p	MPSA55	*22p	ZTX109	*7p	2N2904A	15p
AF239	30p	BC214L	*10p	MPSA56	*22p	ZTX300	*7p	2N2905	14p
BC107	6p	BC251	*10p	OC44	12p	ZTX301	*7p	2N2905A	15p
BC108	6p	BCY70	12p	OC45	12p	ZTX302	*9p	2N2906	12p
BC109	6p	BCY71	12p	OC71	9p	ZTX500	*8p	2N2906A	14p
BC118	*10p	BCY72	12p	OC72	12p	ZTX501	*10p	2N2907	12p
BC147	*8p	BD115	40p	OC75	10p	ZTX502	*12p	2N2907A	13p
BC148	*8p	BD131	*35p	OC81	14p	2N696	10p	2N2926G	*8p
BC149	*8p	BD132	*37p	TIP29A	35p	2N697	10p	2N2926Y	*7p
BC154	*16p	BF115	17p	TIP29B	35p	2N706	7p	2N3053	12p
BC157	*9p	BF167	19p	TIP29C	36p	2N706A	8p	2N3055	35p
BC158	*9p	BF173	20p	TIP29C	36p	2N708	8p	2N3702	*7p
BC159	*9p	BF180	25p	TIP30A	38p	2N1302	12p	2N3703	*7p
BC169C	*10p	BF181	25p	TIP30B	37p	2N1303	15p	2N3704	*6p
BC170	6p	BF182	25p	TIP30C	38p	2N1304	15p	2N3903	*11p
BC171	*6p	BF183	25p	TIP31A	32p	2N1307	18p	2N3904	*11p
BC172	*6p	BF184	25p	TIP31B	33p	2N1308	22p	2N3905	*11p
BC173	7p	BF185	25p	TIP31C	34p	2N1309	22p	2N3906	*11p

DIODES

Type	Price	Type	Price	Type	Price	Type	Price
AA119	5p	8AX16/		BYZ16	30p	OA85	7p
AAZ13	4p	OA202	5p	BYZ17	28p	OA90	6p
BA100	6p			BYZ18	28p	OA91	7p
BA115	5p	BY100	15p	BYZ19	28p	OA95	7p
BA144	5p	BY127	*10p	OA47	5p	IN34	5p
BA148	10p	BY210	32p	OA70	5p	IN60	6p
BA173	10p	BY211	32p	OA79	7p	IN914	4p
BAX13/		BYZ12	32p	OA81	7p	IN4148	4p
OA200	5p	8YZ13	30p				

LINEAR I.C.'s

TBA800	12 pin QIL	*75p	UA711C T099	25p	UA748 T099	28p
TBA810	12 pin QIL	*£1.00	UA703 T099 (Plastic)	20p	72558 (Dual 748) T099	45p
TBA820	14 pin QIL	*80p	741P 8 pin DIL	18p	MC1310P 14 pin DIL	*£1.25
LM380	14 pin DIL	*80p	72741 14 pin DIL	20p	76115 14 pin DIL	*£1.25
LM381	14 pin DIL	*£1.35	UA741C T099	20p	NE555 8 pin DIL	32p
72709	14 pin DIL	28p	72747 14 pin DIL	55p	NE556 14 pin DIL	60p
UA709 T099		28p	748P 8 pin DIL	28p	SL414A 10 pin	*£1.80

NEW CONSIGNMENT ZN 414 RADIO CHIP 75p*

OPTOELECTRONICS

Displays		2nd QUALITY LED PAKS			
No 1510	707 LED Display	70p each	No. 1507	10 x LED's Assorted	75p
No 1511	747 LED Display	£1.50 each	LED CLIPS		
No. 553	DL33 Triple 7 Segment LED Display Character height 11 Common Cathode 12 pin DIL	30p each	No 1508/125	.125	5 for 12p
LED's			No 1508/2	.2	5 for 15p
No. S51	Red TIL209 (5 x .125")	50p	SPECIAL REDUCTIONS		
No. S52	Red FLV117 (5 x .2")	50p	No 1514	NORP 12	45p each
No. 1502	Green .125"	18p each	No S76	OC7P1	5 for £1.00
No. 1505	Green .2"	18p each	No S83 5,	NIXIE Tubes ITT 5870 ST	£2.00
No 1503	Yellow .125"	18p each	(including Data)		
No. 1506	Yellow .2"	18p each	No S77	Neon Indicator Lamps 230V A.C State Colour (Red, Amber and Green)	25p each
No. S82	Clear .2" (illuminating red)	12p			

D.I.Y. PRINTED CIRCUIT KIT

Contains 6 pieces of copper laminate board, box of etchant powder, measure, tweezers, marker pen, high quality pump drill, Stanley knife and blades and 6 in metal rule.
Full easy to follow instructions.
Order No. S64 Sale Price £5.50

P.C.B. BOARDS

S61	8 pieces 8" x 3½" (approx.) single sided paper	50p
S62	4 pieces 8" x 3½" (approx.) single sided fibreglass	50p
S63	3 pieces 7" x 3½" (approx.) double sided fibreglass	50p

ETCH RESIST PENS

Order No. 1609 50p each

SOLDER

5m of 18 sw Multi-core Solder.
Order No. S60 50p

I.C. INSERTION EXTRACTION TOOL

Order No. 2015 30p

MAMMOTH I.C. PAK

Approx 200 Pieces Assorted fall-out integrated circuits, including Logic, 74 series Linear, Audio and D.T.L. Many coded devices, but some unmarked - you to identify
Order No 16223 £1.00

POWER SUPPLY STABILIZER BOARD

Unused ex-equipment stabilizer board. Input 30V D.C. Output 20V Complete with circuit diagram.
Order No. S81 £1.25

P.O. RELAYS

S85 - 2 Off Post Office relays 40p

BATTERY HOLDERS

to take 6 x HP7's
Order No. 202 10p each

EX. G.P.O. MICROSWITCHES

Order No. S51 4 for 50p

CABLE CLIPS

S84 - 50 2.5mm round single pin fixing 30p

SEMICONDUCTOR PAKS

Code No's shown below are given as a guide to the type of device. The devices themselves are normally unmarked.

No. 16130	100 Germ. Gold bonded diodes like OA47	40p
No. 16131	150 Germ. Point contact diodes like OA70/81	40p
No. 16132	100 200mA Sil. diodes like OA200	40p
No. 16133	150 75mA Sil. Fast switching diode like IN4148	40p
No. 16134	50 750mA Sil. top hat Rects. like OA70	40p
No. 16135	20 3 amp Sil. stud Rect.	40p
No. 16136	50 400mW Zeners D.O.7 case	40p
No. 16137	30 PNP Plastic trans. like BC107/8	40p*
No. 16138	30 PNP Plastic trans. like BC177/8	40p*
No. 16139	25 NPN trans. like 2N697/2N1711 T039	40p
No. 16140	25 PNP trans. like 2N2905 T039	40p
No. 16141	30 PNP trans. like 2N706 T01B	40p*
No. 16143	30 PNP Plastic trans. like 2N3906	40p*
No. 16144	30 PNP Plastic trans like 2N3905	40p*
No. 16145	30 PNP Germ. trans. like OC71	40p
No. 16147	10 NPN to 3 Power trans. like 2N3055	80p

I.C. SOCKET PAKS

No. S66	11 x 8 pin DIL Sockets	£1.00
No. S67	10 x 14 pin DIL Sockets	£1.00
No. S68	9 x 16 pin DIL Sockets	£1.00
No. S69	4 x 24 pin DIL Sockets	£1.00
No. S70	3 x 28 pin DIL Sockets	£1.00

TRANSISTOR SOCKETS

No. S71	15 x T018 Sockets	£1.00
No. S72	10 x T05 Sockets	£1.00

MOUNTING PADS

No. S73 50 Mixed Transistor Pads T018 and T05 40p

TRANSISTOR HEATSINK PAK

20 Assorted types, T01, T05, T018, T092
Our Mix
Order No. S75 60p

TRANSISTOR INSULATING KITS

Mica washers and bushes assorted types i.e. T0220, T066, T03 etc. Approx. 100 pieces. (Approx. 40 sets)
Order No. S74 50p

DARLINGTON POWER TRANSISTORS

70 watt 8 amp NPN and PNP in plastic case 199 High Voltage (Typ 80V). High gain. 10 pieces 5 NPN and 5 PNP Data Sheet supplied.
Order No. S78 £1.00 per Pak

MATCHED PAIRS OF PNP GERMANIUM MED. POWER TRANS

2 amp		750mW	
VCE	VCB	HFE	
NKT301	40	60	30-100 35p per pair
NKT302	40	60	50-150 35p per pair
NKT303	20	30	30-100 25p per pair
NKT304</			

SAVING SALE BI-PAK

YOU MAKE THE SAVING!

OPT FOR OPTOELECTRONICS! PRINTED CIRCUIT KITS, BOARDS & PENS.

SILICON RECTIFIERS - 1/2 AMP. G.E.

No. S48	40 x 50V	60p
No. S49	30 x 200V	60p
No. S50	20 x 700V	60p

G.E. HIGH VOLTAGE SILICON RECTIFIERS

GR559	10mA 14KV (14,000)	20p each
GA432	1 AMP. 2 KV (2,000)	20p each
FD2.5	2.5 KV Voltage Doubler	20p each

POTENTIOMETERS

Slider 40mm TRAVEL			
Order No.			
16191	6 x 470 Ohm LIN Single	40p*	
S24	6 x 1 K LIN Single	40p*	
S25	6 x 5 K LIN Single	40p*	
16192	6 x 10 K LIN Single	40p*	
S26	6 x 10 K LOG Single	40p*	
16193	6 x 22 K LIN Single	40p*	
16195	6 x 47 K LOG Single	40p*	
16194	6 x 47 K LIN Single	40p*	
S27	6 x 100 K LIN Single	40p*	
S28	6 x 100 K LOG Single	40p*	
S29	6 x 500 K LOG Single	40p*	

Slider 60mm TRAVEL			
Order No.			
S30	6 x 2.5 K LOG Single	40p*	
S31	6 x 10 K LIN Single	40p*	
S32	6 x 50 K LIN Single	40p*	
S33	6 x 250 K LOG Single	40p*	
S34	4 x 5 K LOG Dual	40p*	
S35	4 x 10 K LIN Dual	40p*	
S36	4 x 100 K LOG Dual	40p*	
S37	4 x 1.3 MEG LOG Dual	40p*	

S38 MIXED SLIDER POTS - VARIOUS VALUES AND SIZES - OUR MIX ONLY £1.00*
S39 6 x CHROME SLIDER KNOBS 40p*

WIREWOUND

A range of wirewound single gang pots. with linear tracks of 1 watt rating.

Order No.	Value	Order No.	Value
1891	10 ohms	1894	100 ohms
1893	47 ohms	1895	220 ohms
1896	470 ohms	1898	2K2
1897	1K	1899	4K7

NOW 35p* each

16173	15 Rotary Potentiometers. Assorted values and types.	40p*
16186	25 Pre-sets Assorted Values and types	40p*

SALE PRICE 40p

MULTI-TURN PRE-SETS

S40 3 x 100 K LIN ONLY 50p*

AUDIO PLUG AND SOCKET PAKS

Order No.		
S1	5 x 3.5 mm Plastic Jack Plugs	40p*
S2	5 x 2.5 mm Plastic Jack Plugs	40p*
S3	4 x Std. Plastic Jack Plugs	30p*
S4	2 x Stereo Jack Plugs	30p*
S5	5 x 5 Pin 180° DIN Plugs	50p*
S6	8 x 2 Pin Loudspeaker Plugs	50p*
S7	6 x Phono Plugs Plastic	50p*
S8	5 x 3.5 mm Chassis Sockets (Switched)	25p*
S9	5 x 2.5 mm Chassis Sockets (Switched)	25p*
S10	4 x Metal Std. Chassis Switched Jack Sockets	50p*
S11	2 x Stereo Jack Sockets with instruction leaflet for H/Phone connection.	50p*
S12	5 x 5 Pin 180° DIN Chassis Sockets	40p*
S13	8 x 2 Pin DIN Chassis Sockets	50p*
S14	6 x Single Phono Sockets	40p*

AUDIO LEADS

Order No.		
117	A.C. Mains connecting lead for cassette recorders and radios Telefunken type	45p*
118	5 pin DIN headphone plug to stereo socket	78p*
119	2 x 2 pin plug to inline stereo socket for headphones	60p*
123	20 ft. of coiled guitar lead	£1.15*
124	3 pin to 3 pin DIN plug	50p*
125	Audio lead 5 pin plug to 5 pin DIN plug	50p*
126	Audio lead 5 pin DIN plug to tinned open ends	50p*
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7401	0.11	0.10	7450	0.12	0.10	74123	0.65	0.62
7402	0.11	0.10	7451	0.12	0.10	74141	0.68	0.65
7403	0.11	0.10	7453	0.12	0.10	74145	0.75	0.72
7404	0.11	0.10	7454	0.12	0.10	74150	1.10	1.05
7405	0.11	0.10	7460	0.12	0.10	74151	0.85	0.80
7406	0.28	0.25	7470	0.24	0.23	74153	0.70	0.68
7407	0.28	0.25	7472	0.20	0.19	74154	1.20	1.10
7408	0.12	0.11	7473	0.26	0.22	74155	0.70	0.68
7409	0.12	0.11	7474	0.24	0.23	74156	0.70	0.68
7410	0.09	0.03	7475	0.44	0.40	74157	0.70	0.68
7411	0.22	0.20	7476	0.26	0.25	74160	0.95	0.85
7412	0.22	0.20	7480	0.45	0.42	74161	0.95	0.85
7413	0.26	0.25	7481	0.90	0.88	74162	0.95	0.85
7416	0.28	0.25	7482	0.75	0.73	74163	0.95	0.85
7417	0.26	0.25	7483	0.88	0.82	74164	1.20	1.10
7420	0.11	0.10	7484	0.85	0.80	74165	1.20	1.10
7422	0.19	0.18	7485	1.10	1.00	74166	1.20	1.10
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7425	0.25	0.23	7489	2.70	2.50	74175	0.85	0.82
7426	0.25	0.23	7490	0.38	0.32	74176	1.10	1.00
7427	0.25	0.23	7491	0.65	0.62	74177	1.10	1.00
7428	0.36	0.34	7492	0.43	0.35	74180	1.10	1.00
7430	0.12	0.10	7493	0.38	0.35	74181	1.90	1.80
7432	0.20	0.19	7494	0.70	0.68	74182	0.80	0.74
7433	0.38	0.36	7495	0.60	0.58	74184	1.50	1.40
7437	0.26	0.25	7496	0.70	0.68	74190	1.40	1.30
7438	0.26	0.25	74100	0.95	0.90	74191	1.40	1.30
7440	0.12	0.10	74104	0.40	0.35	74192	1.10	1.00
7441	0.60	0.57	74105	0.30	0.25	74193	1.05	1.00
7442	0.80	0.70	74107	0.30	0.25	74194	1.05	1.00
7443	0.95	0.90	74110	0.48	0.45	74195	0.80	0.75
7444	0.95	0.90	74111	0.75	0.72	74196	0.90	0.85
7445	0.80	0.75	74118	0.85	0.82	74197	0.90	0.85
7446	0.80	0.75	74119	1.30	1.20	74198	1.90	1.80
7447	0.70	0.68	74121	0.28	0.26	74199	1.80	1.70

Devices may be mixed to qualify for quantity price. Data is available for the above series of ICs in booklet form price 35p.

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BACK NUMBERS

We are very glad to announce the re-establishment of a PW Back Numbers Service for our readers. In future back numbers dated from June 1977 only will be available from our Post Sales Department for 65p, which includes postage and packing. Cheques and Postal Orders should be made payable to IPC Magazines Ltd.

Send your orders to:- Post Sales Department, IPC Magazines Ltd., Lavington House, Lavington Street, London SE1 0PF.

A Time of Change

THOSE among our readers who notice such things will have realised that there are quite a number of new names among the staff of *PRACTICAL WIRELESS*, as listed on this page. When it was announced earlier this year that some of the Practical group of magazines were to move to Poole, there were several staff members who, for various personal reasons, felt unable to make the move away from London.

To those we have left behind, we say a farewell, and thank them for all that they have done for the magazine in the past. Some were comparative newcomers, others had been familiar names for many years. Some will, we hope, continue to make a contribution to *PW*, and so for them the break will not be complete.

We bid a welcome to our new staff, who bring with them in-depth knowledge of several fields which are, we know, of great interest to you, our readers. We plan to make use of this knowledge for your future interest and enlightenment.

With all these changes, including a new occupant for the editor's chair, you will probably be wondering what the future pattern of the magazine will be. Well, there will undoubtedly be some changes, but we hope not to frighten away our established readers! As our title would imply, we shall continue to give regular attention to wireless or radio—call it what you will—in its various applications, but will not neglect the ever-popular fields of hi-fi, disco equipment, musical instruments, nor the requirements of the electronics hobbyist. We hope you'll like the mix!

Geoffrey C. Arnold

PLEASE NOTE

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

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

Mini Monitor

Shown for the first time at Video-Tradex, the Sinclair picture monitors MON 1A and MON 1A/S are derived from the well-proven Microvision.

Special interfacing provides for standard level international signals. The model at the exhibition operates on the CCIR format but, as with the Microvision receiver, Sinclair will be able to adapt the device to 525-lines 60 fields.

Model MON 1A is cased, uses integral, rechargeable NiCad batteries and is supplied with a power unit. In addition to its normal function, it could well find application as a view-finder.

The MON 1A/S is supplied less case and cells, but is otherwise likened to the MON 1A. It is principally aimed at OEMs and systems engineers.

Both monitors in their CCIR form accept a standard, composite input of 0.7 volts video/0.3 volts sync, which is terminated by 75 ohms.

Connection is via a BNC socket.

Each unit is unconditionally guaranteed by the manufacturer for 1 year from date of purchase; should any unit fail within this time, the Company will repair or replace it free of charge. For details of price apply to:

Sinclair Radionics Ltd., London Road, St. Ives, Huntingdon, Cambridgeshire.



More Chips!

Texas Instruments have recently announced details of several new devices. The TL505 is an analog-to-digital converter IC, and is designed for use with microprocessors similar to the Texas TMS1000 series. Both the TL505 and the TMS1000 are designed to operate from a single 7 to 15 volt supply, making them ideal for battery operation. Other features are three-digit (0.1%) accuracy, on-chip reference voltage, auto-zero, and high impedance MOS inputs. Unfortunately, prices are only quoted for 100 piece batches—in this case £2.29 each chip.

Also announced, and in roughly the same operating area, is a 5 volt regulator, with, it is claimed, greatly improved accuracy. Designated TL7805AC it is credited with an output current capability of 1.5 amps, with internal current limiting and thermal shutdown, thus providing reasonable immunity to overload. This device is priced at £1.12 each item, per batch of 100.

Finally, two new series of BIFET op. amps have emerged. These are the TL061 series, comprising three low-power op. amps, and the TL071 series with four low-noise audio op. amps. These are monolithic IC op. amps using high impedance junction field-effect transistors and bipolar transistors in a single chip. The TL061 device features a 3.5V per second

slew rate, and the TL071 is quoted with a harmonic distortion of 0.01% typically, and a low noise level of 18 nanovolt per root Hertz. Both series feature a very high input impedance, and wide unity gain bandwidths, allowing significantly higher gain at higher frequencies than the 741 series. Both the TL061 and the TL071 are available in 8 pin plastic and ceramic dual-in-line packages. No prices are to hand for these, but details may be obtained, as with the rest of the devices reviewed, from:

Texas Instruments, Linear Circuits Department, Manton Lane, Bedford.

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A short course of nine special lectures on monochrome and colour video recording techniques, systems and applications of magnetic tape and cassette recorders for closed circuit television and broadcasting will be held in the Lecture Hall on consecutive Tuesday evenings from 6.30 to 8.30pm, commencing 17 January 1978. Slides will be shown and demonstrations will be given.

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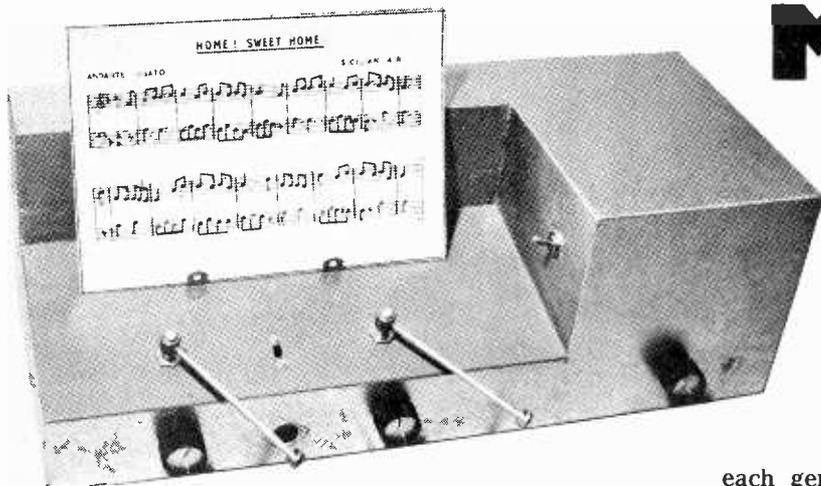
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The special offer list is normally valid until 21 January 1978, however, if you mention *Practical Wireless* with your order, Technomatic have kindly agreed to extend the closing date until 10 February 1978.

The catalogue and special offer lists are available, free of charge, if you send a SAE (6in x 9in) from *Technomatic Ltd., 54, Sandhurst Road, London NW9 9LR. Tel: 01-204 4333.*



MULTIVIB 'MUSICO'

R.H. LONGDEN

The Theremin was a novel electronic instrument in which radio frequencies were combined to produce an audible beat. It had infinitely-variable pitch, obtained by hand capacitance, but would not meet present-day radiation suppression requirements. A similar result however is even more readily obtained by using a variable frequency multivibrator.

Most musical instruments can be divided into two classes. In one, the pitch is found by the skill of the performer: in the other, the note is pre-tuned and is selected by the performer from the available range. The Multivib "Musico" can be used in either way: as an instrument in which the frequency is selected by the movement of projecting arms or tillers, or with a plug-in keyboard, tuned for two octaves.

Two note generators are used, so that separate left and right-hand tones are available. The whole instrument, especially with the two tiller controls, is extremely straightforward and has an IC audio amplifier which further simplifies building. It is operated from a dry battery. Separate bass (left hand) and treble (right hand) output controls are fitted, in addition to a volume control. There is also a jack outlet, either to permit the use of a bigger speaker, or to allow personal practice with a headset.

Note Generator

As each generator is variable, only two are required, and the circuit, Fig. 1 is duplicated for the second unit. The frequency is controlled by the resistance connected to point 3, which is in series with R2. The output from C3 goes to the level control so that

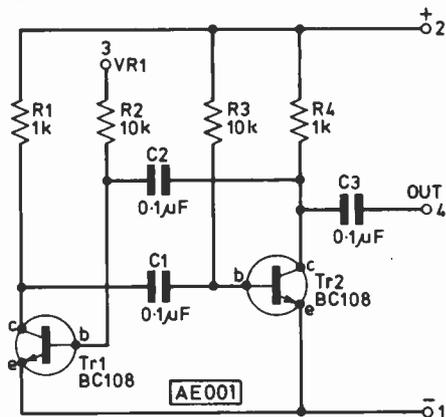


Fig. 1: The Tone Generator circuit diagram.

each generator is able to cover the same range of frequencies; with the two tillers in use, both may be operated at any point within the range available. Therefore both could be on bass or treble frequencies, if desired. This is particularly useful for sound effects.

When the keyboard is added, one generator is tuned for the octave below Middle C, the other running upwards from here, in order to obtain consecutive notation. The left hand is then confined to notes below Middle C, the right hand playing Middle C and higher notes.

Tag-Boards

Each board is made as in Fig. 2. Other forms of wiring could be employed, but this is a method needing no preparation, and taking very little time. Low voltage disc ceramic capacitors are used, and the components are not critical.

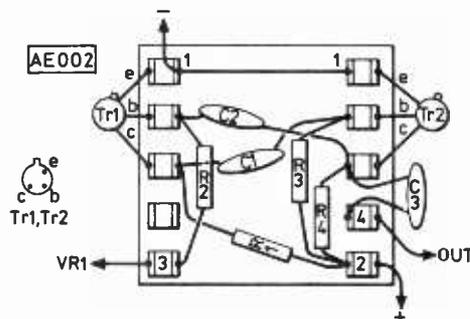


Fig. 2: Wiring the Tone Generator board.

The complete circuit

The full circuit (excluding the change-over switch and keyboard socket) is shown in Fig. 3. Each board has its own output control VR2, and VR2B, coupled to the common volume control VR3 by resistors R5 and R5B. VR2 and VR2B allow adjustment of the relative power of bass or treble.

The AF amplifier is available as a circuit board for the TBA800, having input, output, and battery connecting foils. Details of the amplifier are given later. It requires relatively few components and can provide a good audio output without heavy drain on the battery. A 16 ohm speaker can be used with some reduction in audio power. A jack breaks the speaker circuit, the audio signal then being available through tip and sleeve of the plug. Capacitor C4 is necessary to maintain stable operation. None of the component values in Fig. 3 was found to be critical.

It was not found necessary to screen the amplifier input or any other circuits. As all the potentiometers are mounted on wood, it is essential to connect the mounting bush and metal case of VR3 by wire to its negative tag. If a metal enclosure were used, this would not, of course, be necessary.

fillets to strengthen the whole. Allow for overlap where necessary, though the actual finished dimensions are not important.

The lower part of the case allows a simple music stand to be provided. This consists of two strips pivoted on brackets, so that they can be folded down

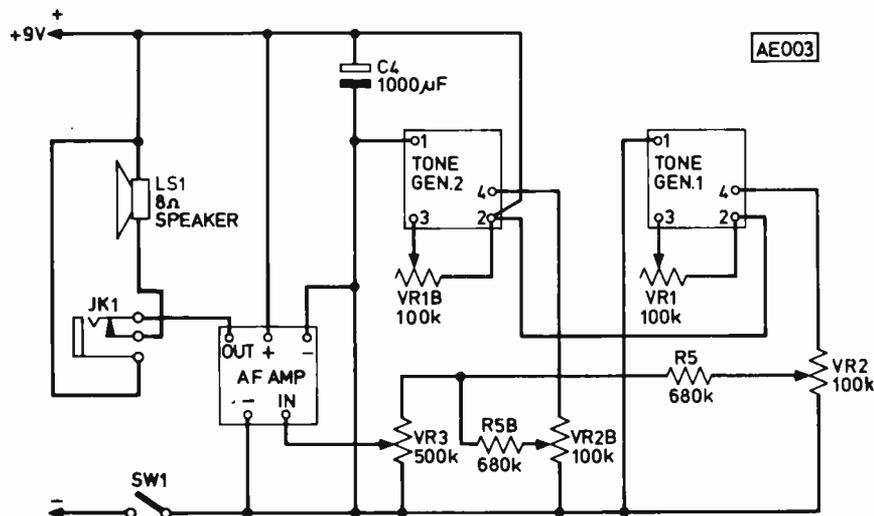


Fig. 3: Complete circuit diagram of the "Musico."

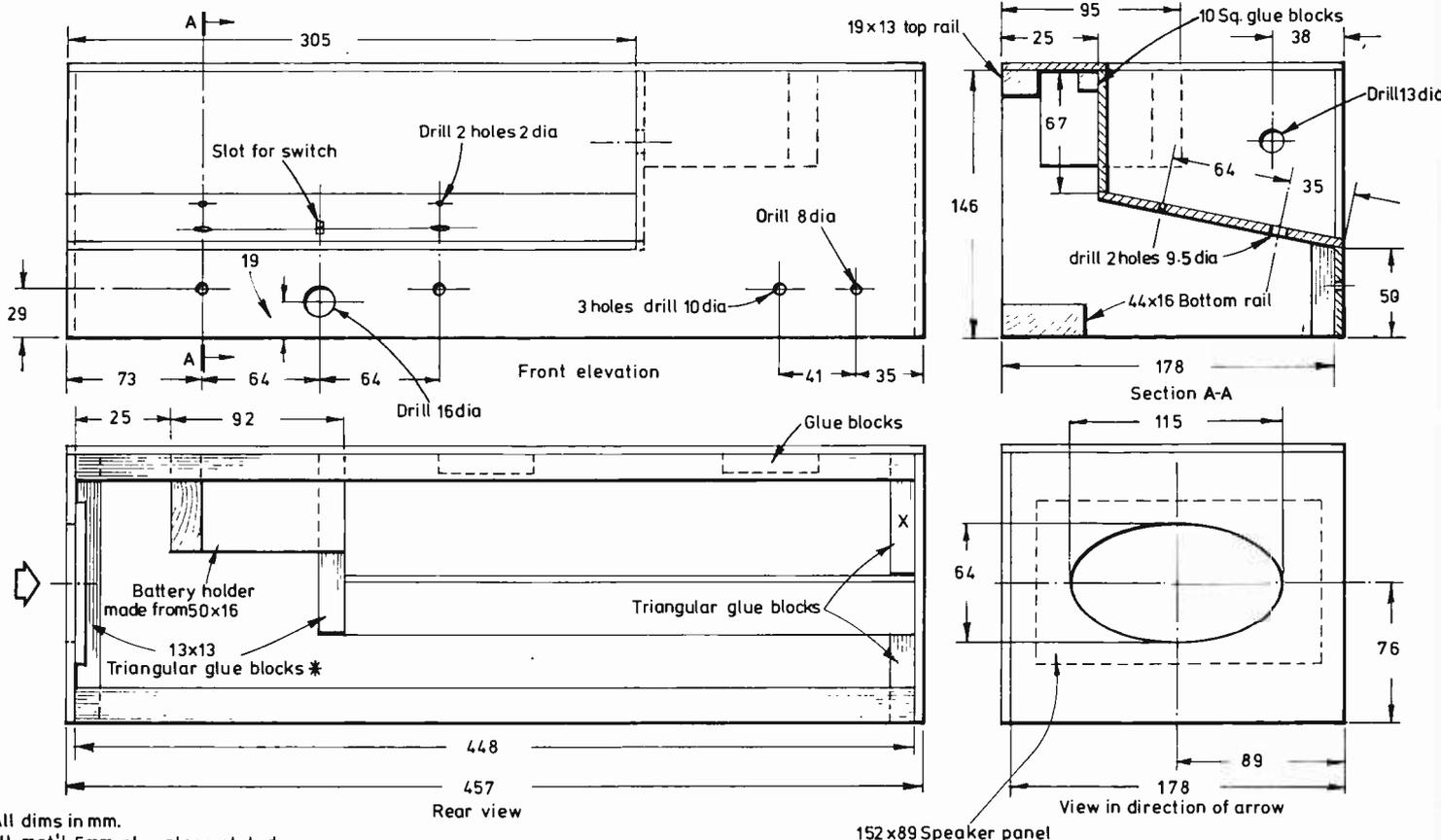
Case

The case (Fig. 4) has a low section for the pitch controls, and a higher part to accommodate the speaker and battery. It would be feasible to construct the equipment in a shallow, inverted box, if the speaker were separate or mounted flat. Assembly of the case is with panel pins and adhesive, with wooden

out of the way, or raised to support the music.

The battery fits in the higher part of the case, in a box glued in position, with a metal strip which can be moved aside to remove the battery.

Fig. 4: Constructional details of the "Musico" case.



All dims in mm.

All mat'l 5mm ply unless stated.

* Triangular glue blocks attached to front panel, except X.

RW002

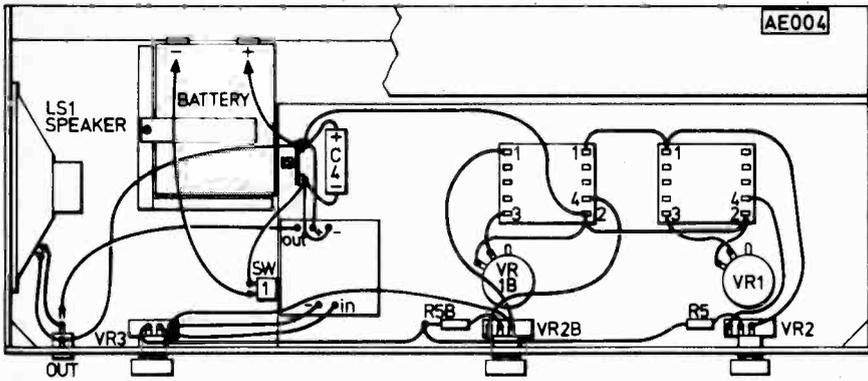


Fig. 5: Wiring diagram of the complete unit.

Underside wiring

The wiring is shown in Fig. 5. It is convenient to use red wire for positive and black for negative circuits. The boards are held clear of the wood by spare nuts or washers on the screws which hold them in place. A tag strip supports C4 and provides connecting points for positive and negative circuits. If these are wired as shown, loops which could cause instability will be avoided. VR3 could quite well have an on-off switch, if preferred.

Amplifier

For ease of building, it has been assumed that a ready-made printed circuit board, with IC, would be used, and a circuit for this item is shown in Fig. 6. It was found necessary to use quite a large decoupling capacitor (positive to negative) to avoid motor-boating and other troubles at some frequencies. If alternative audio amplifiers are used, they should have a fairly high input resistance and sufficient gain to avoid the need for a pre-amplifier.

The TBA800 can give a little over 1 watt with a 9V supply, and does not require a heat sink for this power. Higher outputs are possible with increased voltage, but a heat sink will then be needed.

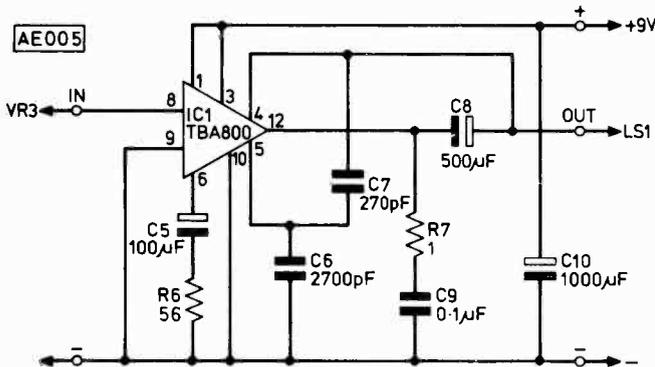


Fig. 6: Circuit diagram of the amplifier.

Tillers

The tillers were made by sawing a 6.3mm ($\frac{1}{4}$ in) brass coupler in two, thus obtaining collars which can be fitted to the potentiometer spindles. Each projecting arm was about 100mm (4in) long, with a small knob fitted at the end. They were made from Meccano rods, threaded 4BA at one end, with a collar the other end. Threading would not be needed with 4BA rods. This method of making the tillers is easy, but alternatives of wood, metal or plastic could be used.

Playing

Check that both oscillators work by adjusting VR2 and VR2B. Fit the tillers so that both notes are the same, with the knobs directly forward; a rise in pitch is obtained by moving the knobs to the right, and a fall in pitch to the left. It should be easy to find the positions which result in the notes being in unison

★ components

Tone Generator

Resistors

R1	1k Ω	R4	10k Ω
R2	10k Ω	R5	680k Ω
R3	10k Ω	All 5% $\frac{1}{4}$ W	
VR1	100k Ω lin	VR2	100k Ω log

Capacitors

C1, C2, C3 0.1 μ F 18V ceramic

Transistors

Tr1, Tr2 BC108

Miscellaneous

Tagboard 4-way

Note—All the above are duplicated for the second generator.

Amplifier, etc.

Resistors

R6	56 Ω	R7	1 Ω
VR3	500k Ω log		

Capacitors

C4	1000 μ F 10V elect.	C8	500 μ F 10V elect
C5	100 μ F 10V elect	C9	0.1 μ F
C6	2700pF	C10	1000 μ F 10V elect
C7	270pF		

Integrated Circuit

IC1 TBA800

Miscellaneous

LS1 5 x 3in elliptical, 8 Ω

SW1 SPST

JK1 Switched jack

Printed circuit board for TBA800 (obtainable from J. R. Hartley, 78b High Street, Bridgnorth, Salop.)

Knobs. Battery Clips. Materials for case and tillers (see text)

Keyboard

Resistors

VR4-VR29 100k Ω min. horizontal pre-sets (26 off)

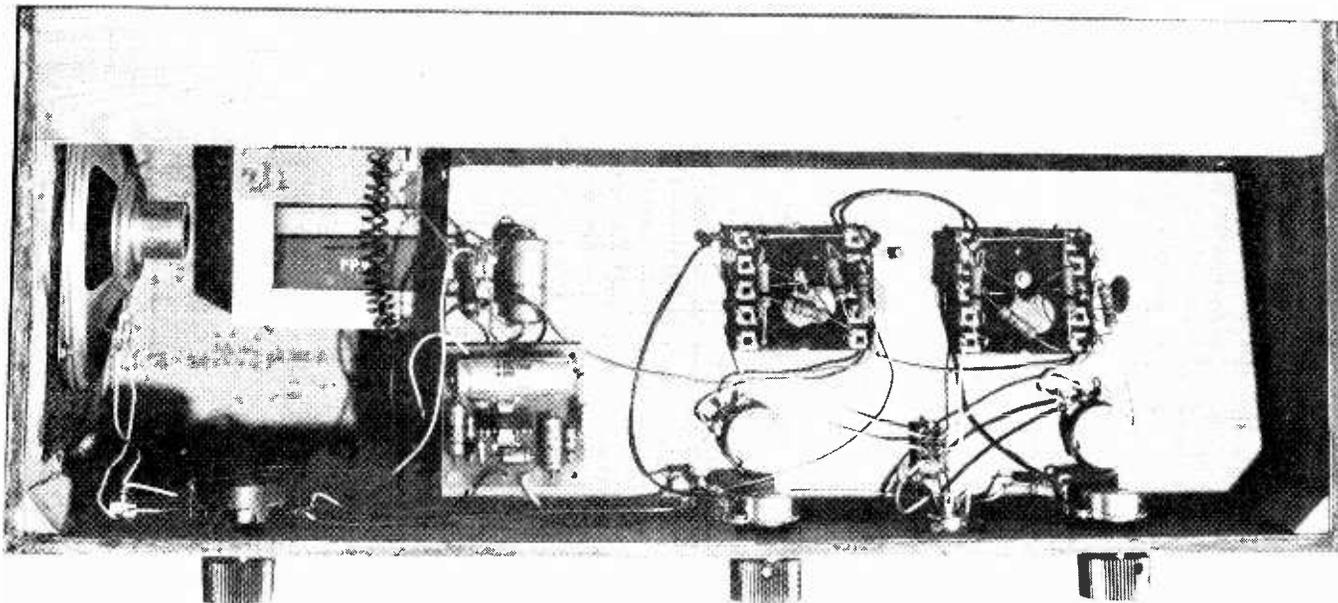
Miscellaneous

Materials for case and keyboard

and octaves. The manipulation to best advantage needs some practice.

Warbling and similar odd background effects are readily produced, the general effect being similar to that heard from a musical saw. Vibrato effects are achieved by fluttering one or both tillers slightly with the fingers. There is separate volume control of rising or falling tones.

between VR1 and VR1B. In one position, this connects VR1 and VR1B as before; in the other position the keyboard resistors are connected instead. All the keys are connected together and return to point 2 on the oscillator boards. When any key is depressed, it touches a screw underneath it. Pre-set potentiometers VR4 to VR29 are divided into two sections, wired for left and right hands. A 3-way plug allows



Plug-in Keyboard

It will be seen that if a pre-set resistor for each required frequency is substituted for VR1 and VR1B, the notes would be obtained by switching the appropriate resistance values into circuit. A simple means of doing this is to use the well-known type of stylus keyboard, where the circuit is completed by touching a metal point on a conductive area representing the note. The keyboard shown in Fig. 7 is not of this type, but has metal keys or switches which are pressed to complete the contact, as this is easier to manipulate rapidly.

A 2-pole 2-way slide switch is fitted on the board

the keyboard to be disconnected for carrying or when it is not needed.

It was decided to use Meccano strips for the keys, as these are of a convenient width and strength, and do not need drilling. Metal strips could of course be cut for this purpose. They are 114mm (4½in) long for the sharps and flats, and 140mm (5½in) long for the naturals. They could each have a wooden finger piece screwed on, but this was not done with the keyboard shown, and would have to be completed before fitting the keys. Finger contact with the metal has no effect on the pitch because all keys are joined electrically. The construction of the keyboard should be clear from Fig. 8.

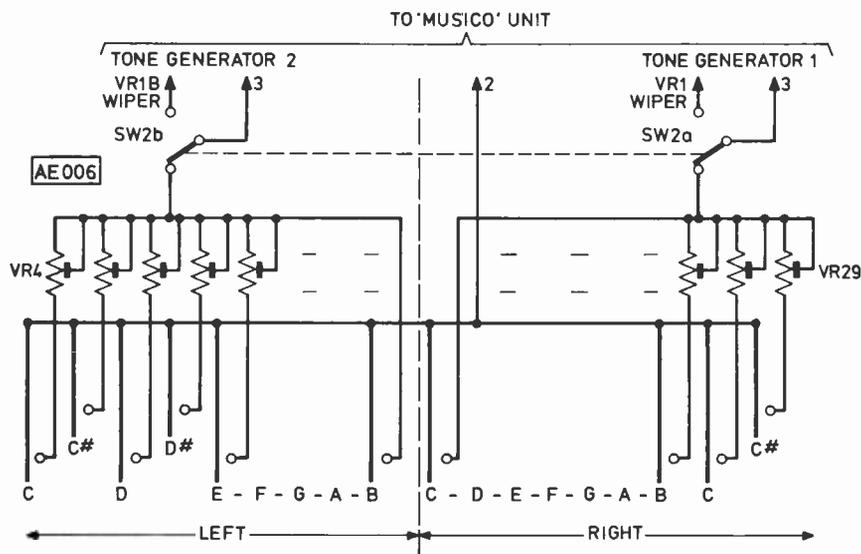


Fig. 7: Circuit diagram of the add-on keyboard.

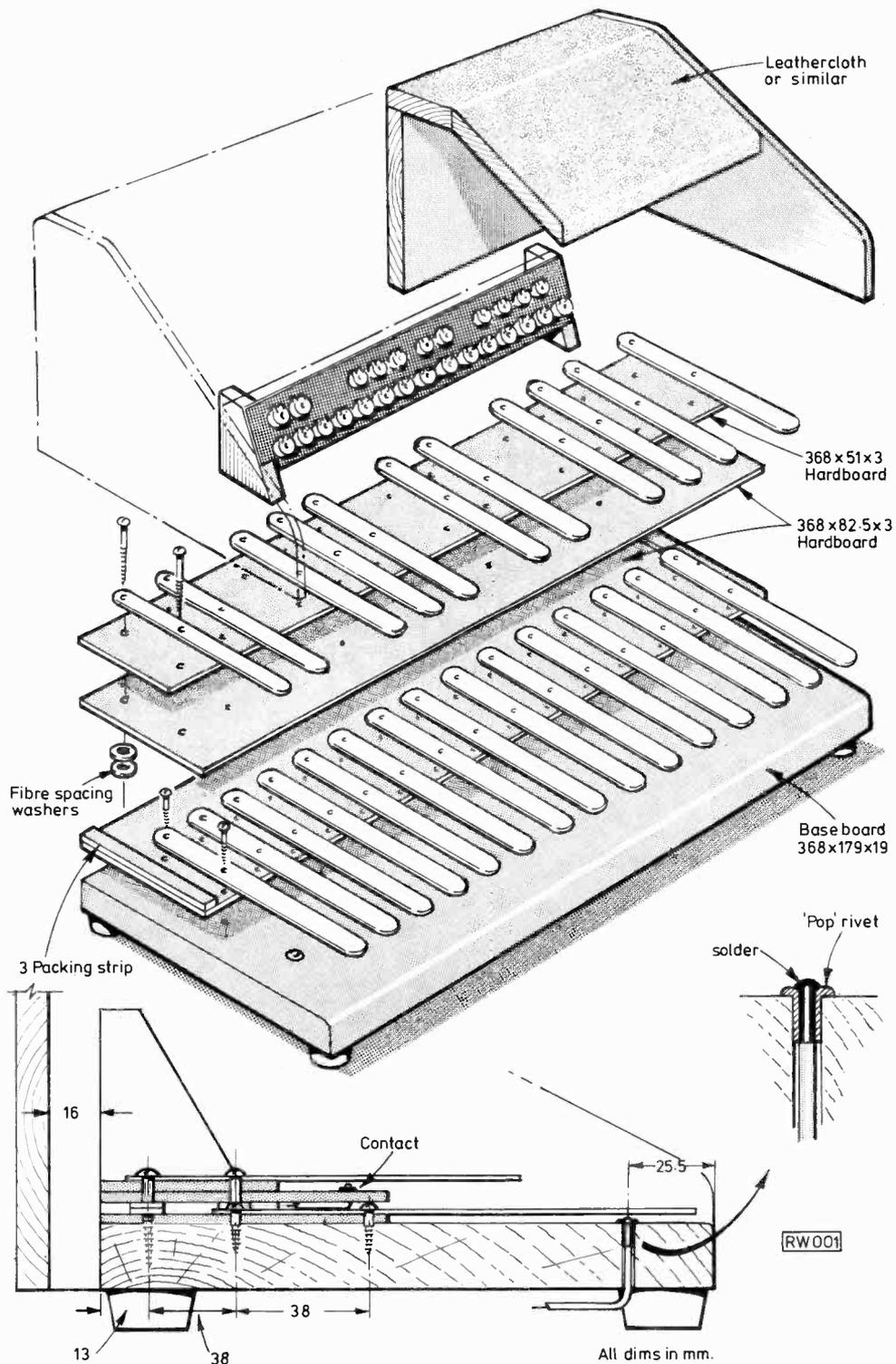


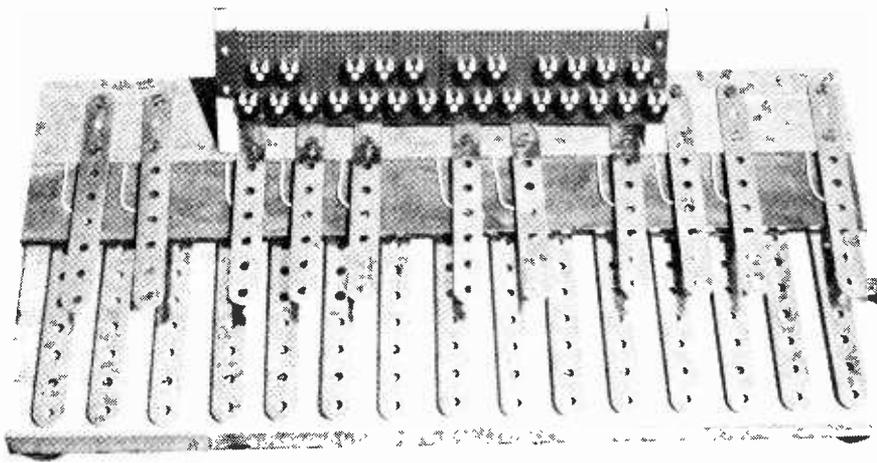
Fig. 8: An exploded view of the keyboard unit, showing constructional details and dimensions.

Pre-set Assembly

The pre-set potentiometers were fitted to a piece of 0.1in matrix perforated board 197 x 45mm (7³/₄ x 1³/₄in). The board is supported on two triangular pieces of wood, so that the pots are easily reached when soldering the leads. They are in two rows, the higher of these being set in pairs and threes to match

the sharp and flat keys, for ease of identification.

All the potentiometers are wired into two groups (Fig. 7) for left and right hands. The wires from the keys are then brought up the back one by one, cut to length, and soldered to the correct potentiometer. A 3-core lead is prepared and used for left-hand, right-hand, and common key return circuits.



An internal view of the keyboard, showing the keys and the mounting board for the pre-set potentiometers.

The assembled keyboard unit.

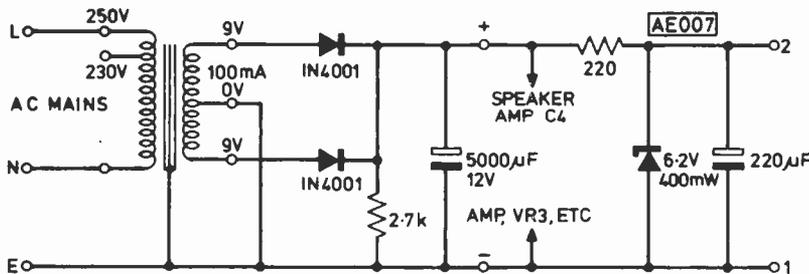
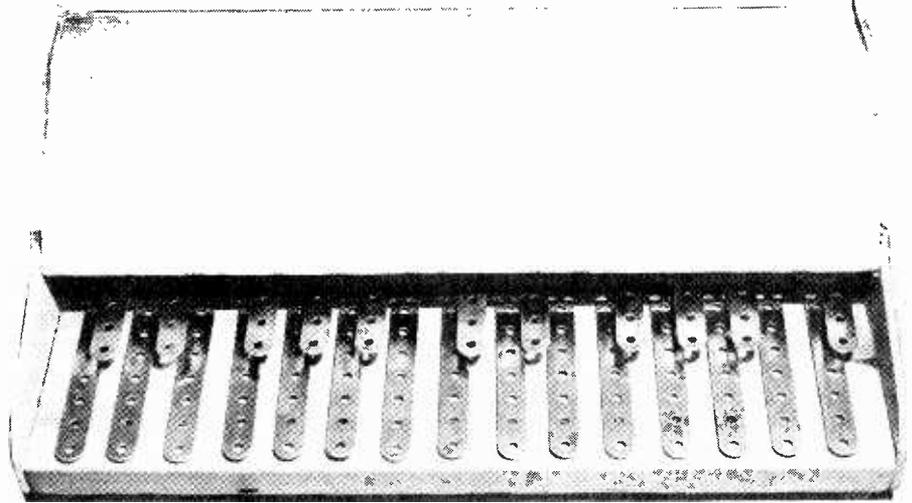


Fig. 9: Circuit diagram of a suitable mains power supply.

Tuning

The potentiometers should be connected so that the resistance in circuit increases, key by key, from right to left. Some rough adjustment can be given to the pots by clipping a meter to the board to measure resistance and depressing each key in turn. The resistance should increase note by note, and could be about 10k ohms for upper C, 25k for middle C, and 60k for lower C (exact values depend on other components). Such an adjustment will give some sort of progressive scale, with which to begin tuning.

A piano or other musical instrument should be available, so that each potentiometer can be adjusted to bring the note into tune. A good musician's ear is by no means necessary for this, as the adjustment is only to bring the pitch to that of a known note.

A tool with a fairly large handle, or fixed crossbar, permits quite critical adjustment. It would also be possible to use combinations of fixed and variable resistors for the notes, or pre-sets of lower values for the higher notes.

With the tillers only in use, no tuning is of course

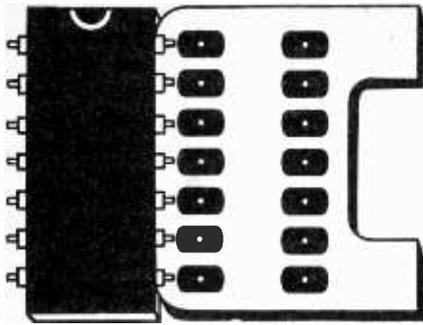
required, frequency depending on the operator's ear. "Microtonal" music or similar sound effects are also then possible.

Mains Power Pack

Frequency does not depend too critically on battery voltage, but changes in tone from this source can be largely avoided by adding a Zener diode to stabilise the supply to the oscillators. A simple mains pack can be added, either assembled in a box to replace the battery, or fixed in the space available in the instrument.

The mains power pack circuit and connections for the diode are shown in Fig. 9. A 3-core mains lead should be used to provide earthing, and the plug fitted with a 2A fuse. In the interests of safety, mains connections should be made on insulated blocks, or should be enclosed so that they cannot be touched.

The series resistor, diode and capacitor are supported by the adjacent tag board. A battery may still be used with the diode added.



OF THE MONTH 66

Brian DANCE M.Sc

THOMSON-CSF PROXIMITY DETECTOR

Proximity detectors are circuits which detect the presence of a piece of metal when it is brought close to a certain part of the circuit—often a coil. When the metal is brought into close proximity with the coil, the output voltage from the circuit changes. Proximity detectors may be used to measure the rate of rotation of a shaft, the rate of pulsing of the output being proportional to the speed of rotation of the shaft. They may, for example, be employed in a car rev counter, in which case a piece of metal connected to the cam shaft produces a pulse each time it passes the coil of the proximity detector. Alternatively, a proximity detector fitted to the propeller shaft or to one of the wheels of a vehicle can be used as an electronic speedometer. Another application in motor vehicles is the generation of the timing pulses for an electronic ignition system.

However, the use of proximity detectors is by no means confined to motor vehicle applications. They are very useful on industrial production lines for counting objects which may vary in size from a small piece of metal to a road vehicle. Indeed, they can be used in almost any application in which a piece of metal moves or in which the movement of any object can be converted into the movement of a small piece of metal.

The ESM 1601

The ESM 1601 is a new monolithic device manufactured by Thomson-CSF which can be connected to a small tuned circuit. The coil of this circuit is wound on a special ferrite cup core and when a piece of metal is brought up to the open face of this cup core, a large change in the output voltage occurs. The metal need not actually touch the cup core; the circuit operates when the metal is a few mm from the face of the core.

The ESM 1601 is encapsulated in a small TO72 metal transistor type package, the leadout of which is shown. The device requires only a very simple circuit as in Fig. 1. Although the IC will not be damaged if the power supply is accidentally connected with the wrong polarity, it is important to note that the use of the load resistor R1 is essential and that the device will normally be destroyed if the power supply is directly applied to the package.

Operation

The natural resonant frequency of the tuned circuit L1/C1 should be within the range 500kHz to 6MHz; it is, of course, equal to $\frac{1}{2\pi\sqrt{L_1C_1}}$. The values shown have been chosen to provide a natural resonant frequency of about 3.9MHz. The ferrite cup core used for L1 is shown in Fig. 2, but more details about it will be given shortly.

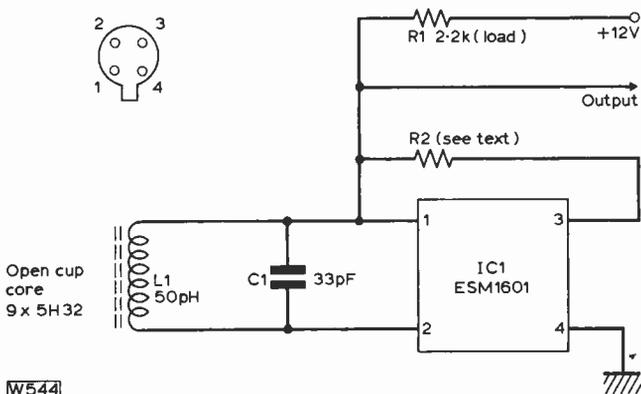
When no metal is near the coil, the circuit oscillates at the frequency of the tuned circuit. The output voltage is "low" when oscillation is taking place, the output being typically +1.55V at 25°C. The minimum output voltage during oscillation is 1.2V at 125°C and the maximum 2V at -40°C.

If a piece of metal is moved close to the face of the ferrite cup core (as shown in Fig. 2), Foucault or eddy currents flow in the metal. Power is absorbed from the tuned circuit since the currents generate a small amount of heat in the metal through which they flow. When the amount of power absorbed causes the amplitude of the oscillation to fall below a certain critical level, the output voltage rises suddenly to a value of between +5.7V and +6.9V. The rise and fall times of the output voltage are typically 8μs and 5μs with maximum values of 25μs and 15μs respectively. The circuit returns to its former state with the output voltage "low" when the metal is removed from the coil face.

Cup core and coil

The miniature ferrite cup core recommended for use with the ESM 1601 is only 9mm in diameter and 3mm in depth; it is manufactured by Thomson-CSF under the type number 9 x 5H32 and has a small hole at its centre for mounting purposes. The manufacturers recommend that the coil should consist of 50 turns of stranded (*Litzendraht*) wire comprising 5 strands which each have a diameter of 0.06mm. Unfortunately the writer did not have any of this wire available and it is unlikely that many readers will be able to obtain it easily.

However, it was found easy to make a coil using 50 turns of single silk covered enamelled copper wire of diameter 0.15mm (38 SWG). A small resistor was



W544

Fig. 1: Circuit of the ESM 1601 Proximity Detector.

selected which had a body diameter approximately the same as the internal diameter of the coil to be wound. About 20 turns of the wire were wound on the resistor, the width of the coil being suitable for fitting into the cup core. The 20 turns were fixed in position by applying a solution of polystyrene in amyl acetate before another 10 turns were added. These were fixed with the same cement before another 10 turns were added followed by further cement and the final 10 turns to make the total of 50 turns. Before the polystyrene cement had completely set, the coil was gently pushed off the resistor into the recommended ferrite cup core. A reasonably neat coil can be made in this way.

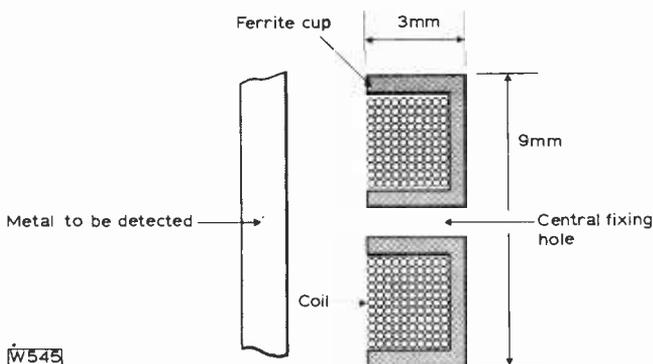


Fig. 2: Rough sketch of the ferrite cup core.

Value of R2

The value of the resistor R2 controls the amount of feedback; if R2 is small the circuit is more likely to oscillate than if it is large. The data sheet suggests that R2 can have a value of 47 kilohms when the recommended stranded wire is used for the coil L1. However, it was found that no oscillation occurred with the single wire coil when R2 had this value, but the circuit worked well when the value of R2 was reduced to about 8.2 kilohms. The additional losses in the coil using single wire necessitate the use of more feedback to maintain oscillation and this extra feedback is obtained by reducing the value of R2.

Load resistor

The value of the load resistor must limit the current to the device to the maximum permissible value of 20mA, but must not be so high that the current is less than 0.6mA. In addition, the maximum power dissipation (325mW at 25°C) must not be exceeded. The value shown is suitable for almost all applications, but is not at all critical. The minimum supply voltage is 8V.

In many applications, the output voltage may be used to deflect a small meter, but it can also be used to feed complex logic circuits. The maximum switching speed is 10kHz.

The ESM 1601 is available at 98p (including VAT) plus 20p for packing and postage from Phoenix Electronics Ltd., 46 Osborne Rd., Southsea, Hants PO5 3LT. Phoenix also supply the recommended cup core 9 x 5H32 price 75p including VAT.

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THE 5 METRE STORY part 1

Ron HAM BRS 15744

The object of this article is to pay tribute to the many radio enthusiasts, both licensed amateurs and SWLs, who pioneered the five metre band from 1930 until September 1 1939 when the amateur radio licences in the UK were withdrawn. Many of those 5m operators are still active today, and will, no doubt, add their personal "tit bits" to this story through the letters page of this journal.

To prepare this article, the author has gathered information from the *T & R Bulletin* (then, monthly journal of the RSGB), and other contemporary documents, and by personal contact with people who were "there at the time".

"Ultra High Frequency"

When the words "Ultra High Frequency" (UHF) are used today we automatically think of radio wavelengths shorter than one metre, but, in those pre-1940 days, UHF meant the 56 and 112Mc/s bands. In fact, Chapter 12 of the first edition of the *Amateur Radio Handbook*, published by the RSGB in 1939, is entitled *Ultra High Frequencies* and is devoted to the 5 and 2 $\frac{1}{2}$ m bands. In the circumstances we'll continue to use 'Mc/s'!

To really appreciate this story the reader must clear his mind of today's technology and accept the fact that the 5m band, 46 years ago, was an unexplored part of the radio frequency spectrum. Try to think as those early pioneers did. Is it really possible to work DX on such a band? Could a circuit oscillate around 56 million times per second? What about propagation, and what effect would the earth's atmosphere have on such a high frequency radio signal?

Try Anything

The past seventy years have shown us that as radio advanced from using wavelengths of 3000 metres to micro-wavelengths of three centimetres and less, radio amateurs have been prominent among the leading experimenters. Anything that was thought to be impossible, you can be sure that somewhere an individual radio enthusiast had tried it out, had a little success, and reported his progress to others.

Soon, a group of them would be trying to master the problem, with the technical press just itching to report their activities through the columns of their magazines.

Apart from the experimental aspect, 56Mc/s operation had certain advantages over the HF bands, mainly because it was very suitable for short distance working (across town), thus avoiding the congestion of the lower frequencies, and also because the aerials were smaller and required much less space. Converts to 'five' were delighted to find a band almost free of atmospherics, except for local thunder storms, although they soon found out that interference came from the ignition systems of the ever growing number of motor vehicles, and it was unfortunate for a 5m enthusiast who lived near a busy cross-road! We often forget that in the early thirties, the aeroplane, motor car, photography etc were growing side by side with radio communication, and each had its own band of enthusiasts.

When the author asked one 5m experimenter if he had any pictures of his early activity, he replied, "We could not afford photography as well as radio in those days". This remark was not surprising when one refers to the adverts in those early radio magazines e.g. in 1930:—a 0-100 mA meter £2.2.6, a quartz crystal £1, an output transformer £1.2.6, a tuning capacitor 15s, valves around 30s, a 10k Ω wire-wound pot 7s 6d and 'grid leaks' at more than 2s each!

Transmitting Licences

During his researches, the author was puzzled by a paragraph in the *T & R Bulletin* (p 411) March 1937 headed 'Special 56Mc/s Permits', and it read as follows:— "Members holding 56Mc/s permits are reminded that they may apply for permission to operate portable 56Mc/s stations from Good Friday until the end of September without additional fee. An assurance however must be given that frequency stabilised apparatus will be used. Applications must reach Headquarters not later than March 20."

Did this really mean that one could only operate portable in the summer months? Surely the authorities were aware of the fact that radio enthusiasts wanted to operate at any time and almost

anywhere if need be! The author telephoned Miss Constance Hall G8LY who, as well as being a 5m pioneer herself, is a mine of information on amateur radio matters. Fortunately, Constance had preserved her pre-war licence documents and instantly made them available for this article. On October 5 1937 Constance received a letter from the GPO authorising her to use a transmitter in the 5m band.

Like many of the other 5m enthusiasts Constance wanted to operate from a portable location, so, via the RSGB, she duly applied for permission to do so, but oh!, what restrictions! In a letter dated 15 April 1939, Constance was authorised to install and use an experimental wireless station, in the open air, on Saturdays and Sundays until the end of September 1939, but limited to a 10 mile radius of her home.

Only a Few

According to L. A. Moxon G6XN, writing in November 1930, there were less than a dozen active amateurs working on 5Mc/s in this country and very few in other parts of the world. One of these amateurs was G2DT who, in 1929, was the first 5m station in the UK to receive signals from a distance of over 100 miles.

Many SWLs played an important role in the development of the 5m band and one of these was Ted Williams (later G2XC) who, in 1932 joined the RSGB as a listening member. He was invited by the Society's Town Representative, Leonard Newnham G6NZ, to visit him. Len was firing everyone with enthusiasm for the 5m band and he transmitted every

Sunday morning using a self-excited rig, while the listening stations all had super-regenerative portable receivers.

Ted built himself such a receiver and took it along to Len's station in Southsea to make sure that it was working "in the band". He returned to his own location, perched in the back seat of a friend's car, with earphones on, and using an odd length of wire as an aerial. He heard G6NZ's transmissions for a few hundred yards and then nothing until the car reached the top of Portsdown Hill (near Portsmouth) about 4½ miles from G6NZ, and then nothing again when the car went down the other side of the hill.

Line of Sight

A few Sundays later Ted drove along the length of the ridge of the hill so that he could plot G6NZ's signal strength at various points. No one believed then that reception over anything other than "line-of-sight" was possible. Ted's outing was typical of the contribution made by the listeners, many of whom held transmitting licences. The important thing at this point was that the amateur concerned had built a working "UHF" receiver and was prepared to go almost anywhere to use it.

At the Crystal Palace

In May 1933 G6HP, G6NF and G6QB humped a variety of radio equipment to the top of the North Tower of Crystal Palace for the famous 56Mc/s tests. Their transmitter used two B12's in the usual push-pull oscillator circuit while the modulator used two 211-E's in parallel. The microphone was fed directly into the grid through a high-ratio modulation transformer with no further amplification. Their transmitter power was about 10 watts, and the aerial a 2½m length of copper petrol piping hanging from a stand-off insulator on the end of a pole which poked out, fishing-rod fashion, from the gallery of the tower.

The two receivers, both super-regens, were fed from independent LT and HT supplies so that they could be used together from opposite sides of the tower. This proved to be very useful and some interesting results were obtained. All the gear was tested out on the Saturday night and then, early next morning, the three operators re-climbed the 400 stairs and began working soon after 0900. Their first QSO was with G5VY of Tottenham, and then they called various receiving stations, some mobile and some fixed. G5IS heard them well on Inkpen Beacon but he was caught in a local thunderstorm and was unable to effect a two-way QSO.

Their signals were also received 130 miles away by Douglas Walters G5CV who was flying in an aircraft at 10 000ft "somewhere north of the Wash". Doug's report of R9+ was on top of the racket from a totally unsilenced and unscreened aero-engine. G5CV was a reporter for the *Daily Herald* newspaper and the aeroplane was chartered by the Editor for the occasion, another example of the enthusiasm toward wireless experiments in those days!

Kite Aerial

Their most amazing report came from G6PL at Hollin Bank, Yorks. G2NH heard them while he was using a kite aerial at South Harting, Sussex, during

n. 4.10.37.



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Your Reference
P.O. Reference WZ/A.3455

By GEORGE LEE,
L. B. S. C. W. O. B. E. M. C. M. I. E. E.
Inspector-Chief.

ENGINEER-IN-CHIEF'S OFFICE (Radio Branch)
GENERAL POST OFFICE,
ARMOUR HOUSE,
LONDON, E.C.1.

5 October, 1937.

Miss C. R. Hall,
North Waltham Rectory,
Winchester,
Hants.

Dear Madam,

Experiments in Wireless Telephony.

With reference to your letter of the 19th September, you are hereby authorised to send messages on waves within the frequencies and by the systems specified hereunder:-

Frequencies (in Kilocycles per second)	Approximate equivalent wavelengths (in metres)	Systems
28010 to 29990	10.71 to 10.00	(Continuous wave, modulated continuous wave and telephony)
56020 to 59980	5.36 to 5.00	(Continuous wave, modulated continuous wave and telephony)

at the experimental wireless station G8LY and Condition 2 of the licence dated 4th June 1937, is hereby extended accordingly.

Yours faithfully,



for Engineer-in-Chief.



A facsimile of the GPO letter authorising Miss Constance Hall to operate a transmitter in the 5 metre band.

the afternoon, but in the morning, on Hindhead in Surrey, he said that their signal was audible "160ft away from a pair of Browns 'A' phones"! The reports rolled in from G2KB Dunstable, G6GZ Farnborough, G6LK Cranleigh, G5JZ Nutley, Kent, G2GG Newbury, G6OA Westcliff, BRS1011 Leigh-on-Sea, G6NA Guildford and BRS1117 at Reigate, Surrey.



Douglas Walters G5CV operating the 5metre receiver in the chartered Daily Herald aircraft.

This historic photograph is the property of the RSGB, and is reproduced by their kind permission.

NFD

During the 1938 National Field Day, 2CIL with his brother and 2DCT, installed their receiving equipment in a beacon tower near Horsham, Sussex. Their aerial was a Yagi made up on broomsticks, fed by open wire feeder. It could be used horizontally or vertically so that transmitter polarisation could be observed from the incoming signal. On the Saturday they were listening, by arrangement, to the signals from G8LY who had a sked with GW6AA/P on Snowdon. An hour or so later there was a thunderstorm overhead and the tower lightning conductor took a charge! The receiver and the listeners were installed in a room below the lead roof; the set crackled but stood the shock. When the hail had finished the crew had to venture on to the roof to loosen the guy lines which were bending the broomsticks like a bow! However they received an award from the RSGB for a remarkable log which contained more than 30 entries and an extensive report of the event.

DX!

During the summer of 1939 G5CM was visiting 2CIL and tuned George's receiver to about 56Mc/s, acting on information supplied by Barbara Dunn G6YL, and heard MCW signals from CS3VA situated on an airfield in Spain. It seems that this signal was acting like one of our present day beacons because it was as a regular automatic signal sending "VVV de CS3VA". Of course by 1939 a large number of amateurs in many countries were both interested and active on the 5m band.

5 METRES	
SCHOOL HOUSE, ALFOLD, SURREY	
WORKED 57 COUNTRIES.	TO RADIO <input type="checkbox"/> 5band
R.S.G.B.	W.B.E. (C4)
W.A.C.	2CIL
This confirms our QSO of	ENGLAND
29-6-1938	G5CM
at 1735 BST	XMITTER
on 56 Mc bd	59 3-valve - 4V6
Ux sigs were	Antenna: 50 Poles
RST 3.1.1	Input 10 Watts
or	Aerial 60 V.F. Ant.
W.A.A. R.M.M.	QRG 5.611.2 KCS
Remarks	Receiver 2 tube
<i>many thanks for report George checks perfectly.</i>	
TNX	Op. T. H. STREETER.
<small>QSL Direct via RSGB</small>	

A QSL Card from G5CM acknowledging the 5m report from 2CIL.

They took to the Air

On Sunday May 21 1933, Douglas Walters G5CV took off in a Puss Moth aircraft with two completely shielded 3-valve super-regen 56Mc/s receivers on board. One was his own and the other belonged to George Jessop G6JP (Present General Manager and past President of RSGB). Immediately the plane left the ground, Doug was getting a tremendous signal from G6JP and very soon, altitude now 3000ft, a colossal carrier was heard from G6QB operating from the North Tower at Crystal Palace, mentioned earlier. As the plane flew over London about a dozen 56Mc/s signals were heard including G5MG, G6CJ, G6UH, G2JU and G6VA. When flying 60 miles north-east of London, Doug and his colleagues in the plane heard G6QB at terrific strength and later, at 8000ft, they heard both sides of a QSO between G6CJ and G6QB. Owing to the shortage of fuel the plane turned back toward London when at 10 000ft and at 130 miles out they were still getting a strong signal from G6QB at Crystal Palace. Douglas was convinced that had they been able to carry on in a more northerly direction G6QB's signals would have been heard at 250 miles or more.

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Phil Pittman, Wireless World, Nov. 1977

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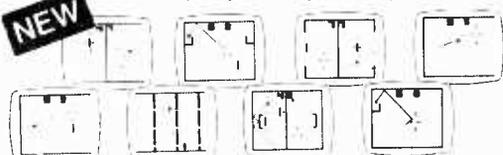
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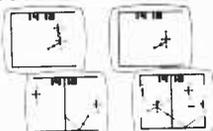
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audio dummy load

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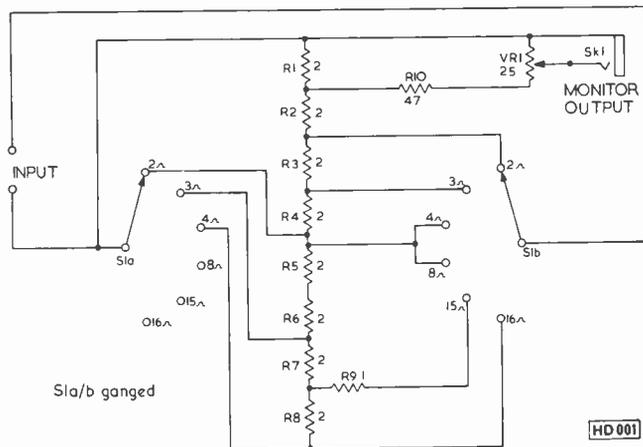


Fig. 1: Circuit diagram. Note that the power sinking capacity is different for various simulated loads—see table. The circuit doesn't include any reactive components; these may be more conducive to amplifier failure than a low value of load resistance.

When an amplifier is left working for a period to check temperature rise, or tested to find its output capability, the audio obtained from the speaker may be a great nuisance or even unendurable! This can be avoided by feeding the audio output into a dummy load. For other than moderately low power, it is convenient to make up the total load with a number of resistors which are individually of relatively low wattage. It is then easy to add a switch which will allow various output loads to be chosen. It is also convenient to add an attenuator and output socket so that a low-level output can be fed to a monitor speaker.

Resistor load

Fig. 1 is arranged to give best utilisation of eight 2Ω 6W resistors and one 1Ω resistor, with a 2-pole 6-way switch. For a 2Ω load, R1/R2 and R3/R4 are in parallel. For 3Ω, R1/R2/R3 and R4/R5/R6 are in parallel. For 4Ω, R1 to R4 are in parallel with R5 to R8. The 8Ω load is secured by R1 to R4 in series, while 15Ω is obtained with R1 to R7 plus R9, and 16Ω with R1 to R8.

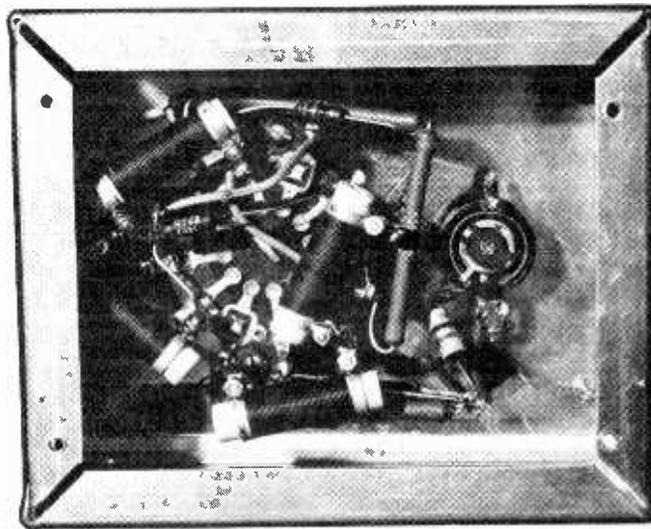
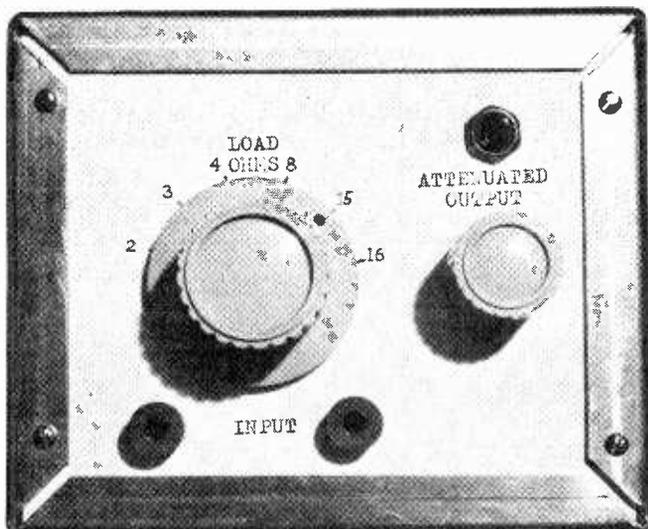
Some of the resistors used were Bulgin 2Ω 6W, while others were the cheaper 2.2Ω 7W type, each with a 22Ω ½W resistor in parallel to obtain 2Ω. Suitable resistors are readily available. It would also be practical to make them from resistance wire, if low values of resistance can be measured accurately.

The wattage ratings quoted are for **continuous** operation. For relatively short periods of intermittent use they can be increased by about 20%. For **short** checks, just to find maximum power output, they can be increased by 50% or more.

Due to the way in which it is necessary to switch the resistors, the maximum **continuous** ratings with 6W resistors are as follows:-

2Ω	24W
3Ω	36W
4Ω	48W
8Ω	24W
15Ω	38W
16Ω	48W

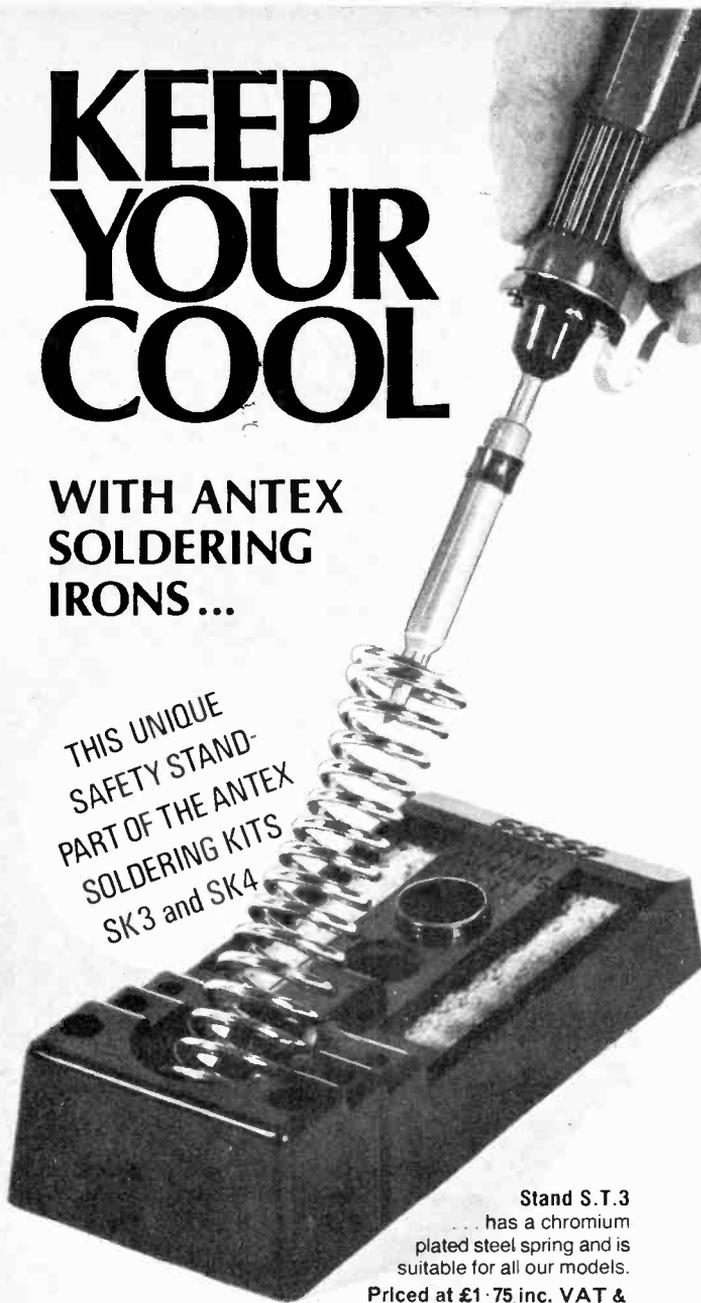
The 1Ω 2W resistor limits the power at 15Ω but it was not felt worthwhile to use larger resistors in some positions to secure a 48W rating throughout. R10 and VR1 allow sufficient audio to be fed, with negligible effect on the dummy load value, to a small monitor speaker or headphones.



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1R5	0.50	6AL5	0.40	6CY7	1.00	12BH7A	0.75	ECL82	0.75	GZ30	0.65	PL36	0.75
1S4	0.40	6AM6	0.65	6DQ6B	1.45	12BY7A	0.80	ECL83	1.15	GZ32	0.65	PL81	0.65
1S5	0.40	6AM8	0.70	6DT6	0.80	35V4	0.70	ECL84	0.70	KT66	4.50	PL82	0.55
1T4	0.40	6AN5	2.50	6GH8A	0.80	50C5	1.00	ECL85	0.65	KT88	5.80	PL83	0.50
1U4	0.70	6AN6	0.85	6GK5	0.70	*75C1	0.80	ECL86	0.75	OA2	0.55	PL84	0.75
1U5	0.80	6AQ5	0.85	6J4	1.00	*85A2	0.85	EF80	0.40	OA3	0.75	PL95	0.70
1X2B	1.20	6AR5	0.70	6JS7	0.80	*90C1	1.20	EF85	0.48	OB2	0.60	PLS04	1.05
2CV4	4.50	6AS6	1.00	6J6	0.55	*807	1.00	EF86	0.55	OB3	0.75	PLS08	1.30
*2D21	0.80	6AS7G	1.10	6J7	0.80	*811A	3.20	EF92	0.75	OC2	1.40	PL802	2.80
*3.500Z	40.00	6AT6	0.75	6K6GT	0.85	*829B	6.30	EF97	0.70	OC3	0.75	PY81	0.70
*3E29	6.50	6AU6	0.50	6L6GT	0.80	*832A	6.00	EF98	0.90	OD3	0.75	PY82	0.55
3Q4	0.75	6AV6	0.60	6N7GT	0.85	*866A	3.00	EF183	0.70	PABC80	0.45	PY83	0.70
3S4	0.50	6AV8A	0.75	6Q7	0.90	*872A	6.00	EF184	0.70	PC86	0.70	PY88	0.70
5AQ5	0.75	6AX4GTB	1.00	6SA7	0.80	*5763	2.85	EFL200	1.00	PC88	0.70	PY500A	1.30
5ATB	0.80	6AX5GT	1.30	6SG7	0.80	DAF96	0.60	EH90	0.60	PC92	0.60	TT21	7.80
5T4	0.75	6BA6	0.45	6SK7	0.80	DF96	0.60	EL34	0.95	PC95	0.70	TT22	7.80
5U4G	0.60	6BE6	0.48	6SL7GT	0.70	DK92	1.00	EL36	0.95	PC96	0.50	U25	1.00
5U4GB	0.95	6BF5	0.85	6SN7GT	0.70	DL96	0.60	EL81	0.65	PC97	0.95	U26	1.00
5UB	0.75	6BF6	0.75	6SQ7	0.80	ECC84	0.60	EL82	0.60	PC900	1.00	UABC80	0.58
5V4G	0.60	6BH6	0.85	6VG7	0.65	ECC85	0.48	EL83	0.60	PCC84	0.50	UBF89	0.60
5X4G	0.80	6BJ6	1.20	6X4	0.60	ECC86	1.25	EL84	0.45	PC85	0.60	UBL21	0.85
5X8	0.90	6BN6	0.80	6XS7	0.60	ECC88	0.75	EL86	0.70	PCC88	0.65	UCC84	0.75
5Y3GT	0.65	6BQ7A	0.65	12AC6	0.80	ECC89	0.80	EL95	0.70	PC89	0.75	UCC85	0.55
5Z4GT	0.65	6BR8A	1.20	12AD6	0.80	ECC189	0.80	ELS04	0.80	PCF189	1.00	UCF80	0.75
6AB4	0.55	6B8B	0.85	12AE6	0.85	EF80	0.60	EM80	0.65	PCF80	0.65	UCH81	0.65
6AB7	0.60	6BV7	1.00	12AT6	0.60	ECF86	0.80	EM81	0.60	PCF82	0.45	UCL81	0.70
6AC7	0.80	6BZ6	0.65	12AT7	0.50	ECF200	0.90	EM84	0.60	PCF84	0.65	UCL82	0.75
6AF4A	0.70	6BZ7	0.70	12AU6	0.65	ECF201	0.90	EM87	1.00	PCF201	1.10	UCL83	0.80
6AG5	0.65	6C4	0.55	12AU7	0.47	ECH80	0.95	EY51	1.00	PCF806	1.00	UF85	0.50
6AG7	0.85	6CB6	0.55	12AV6	0.60	ECH82	0.95	EY81	0.60	PCL81	0.65	UL84	0.75
6AH6	0.85	6CS7	0.85	12AV7	1.00	ECH81	0.50	EY87	0.60	PCL82	0.75	UM80	0.60
6AJ5	0.65	6CUs	1.00	12AX7	0.47	ECH83	0.60	EY88	0.55	PCL84	0.75	UM81	0.75
6AK5	0.55	6CU6	1.00	12AY7	0.85	ECH200	0.80	EY500A	1.50	PCL86	0.75	UM84	0.45

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HOTLINES

A REVIEW OF RECENT DEVELOPMENTS

In general, the author does not have any more information on products than appears in the article.

The ultimate deterrent?

Calling all motorists. Your salvation from radar speed traps is at hand—literally. An American company has produced a little 8lb receiver which tunes wideband from 8 to 18GHz and will give an alarm if it sniffs any radar radiation. It's intended for front line troops so that they will know when the enemy is watching them on radar. If it's for the military, then it should be good.

Unfortunately, the US Police Departments are also well up in electronics. They have just brought out a small radar which employs a microprocessor to help prevent its detection by "with-it" motorists.

This device will hold the microwave radar signal until the target vehicle is in sight. Then it fires. If the motorist has some form of radar detector, it will be too late to take any slowing down action because by the time he (the motorist) receives a warning, the police radar will already have measured the speed of the vehicle.

And it gets more complex, too. The new police radar also has to measure accurately the speed of the police vehicle—and to do this it has to emit a radar signal—which some motorist might detect! So; the police unit fires its radar emission in little blasts so quickly that it exceeds the integration time of most radar detectors. Pulse, frequency and period are all pseudo-random and it would be extremely difficult to find this complex "radio signature". Even if this were possible the police claim that they can alter all the elements by simply reprogramming the unit.

Seems to me it would be simpler just not to exceed the speed limit—or to stay at home with one of those German TVs and watch both pictures!

A weighty problem

Not having had my weight checked electronically before I was interested in the latest in bathroom scales which give ones weight digitally. The price is around £27 but then I found that the scales are really quite conventional in the weighing part, they just show the weight digitally.

The Americans have come up with something a little better. Certain electronic scales over there use strain gauges to sense the weight and the accuracy is to within one tenth of a pound. Another good idea is that the digital bit which shows you the weight, is a separate unit that can be wall-mounted where you can see it easily. Anyone who, like Ginsberg, has crouched in a precarious position, balanced on the edge of the bathroom scales, knees either side of ears, struggling to read a talcum-encrusted needle, will appreciate the usefulness of the newer approach. Trouble is, these new beasties will weigh heavily on your wallet; between £165 and £225 each! Ah well, back to the fifth lotus weighing position!

Split personality

Have you ever watched television and wondered what's on the other channel? Or perhaps, as an ardent button pusher you've "twitched" from one programme to another and back again? Relax—your worries are over. A German manufacturer has come up with the ultimate—two pictures at the same time—together—simultaneous—like! Just think, "Noddy meets Lady Chatterley", or "Ena Sharples versus the Six Million Dollar Man".

In practice it's not quite so easy to do! Basically, the manufacturer has managed to put a small picture (of the other channel) at the bottom of the screen which is filled with the channel picture that you are watching.

The difficulties become apparent when one considers that the tiny picture must somehow be 'shrunk' and that the single beam from the CRT's electron gun must produce both pictures simultaneously even though they are out of phase with each other. Again, both sweeps, horizontal and vertical, must be quite different to those required for the other picture because of the size difference.

The solution has been to use two memories. Video information is fed into the first memory and then fed out in the required timing sequences. While the first memory is being read out, the second memory is taking in fresh video data. The "memory" used

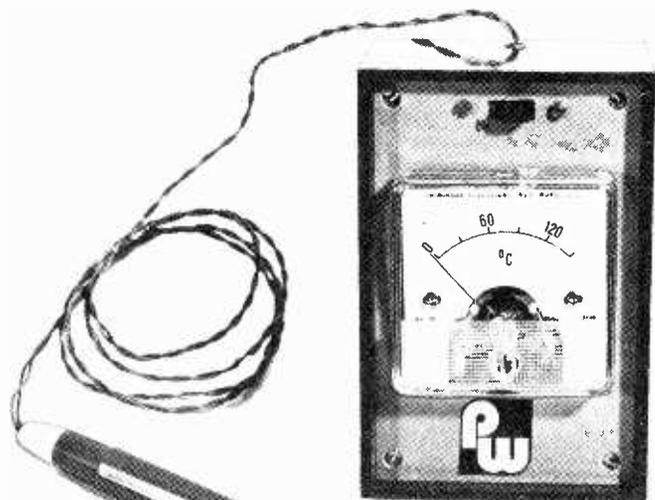
is a form of bucket-brigade device. Here, the signals are delayed by the time taken to pass them from one element in the chain to the next—rather like a chain of people would pass buckets of water to each other along a human chain. Here, the device is passing charges.

Unfortunately, the available BBDs which were conventional types proved useless; basically a MOS arrangement of transistors interspersed with capacitors. In practice, they didn't delay the signal long enough, even though several hundred transistors were employed. The solution was to manufacture a BBD device where the elements were arranged in a matrix with short line elements and low signal losses. In one of these chips, there are some 8,000 elements comprising 4,000 transistors and 4,000 capacitors—all in 12mm².

And all to let you look at two pictures at the same time! Perhaps the smaller picture could come from a CCTV camera pointing down your front path for security surveillance? Come to think of it, the current standard of TV programmes might make Ginsberg's front path more interesting viewing!

Puzzle corner

Computers and chess are often mentioned in the same breath. If you just happen to have an interest in both, then you'll be pleased to hear that the Computer Chess Newsletter has been started. This is aimed at providing information on chess programming for computers, records of games played with computers (and even between computers themselves) plus all sorts of news. If you are interested, why not drop the Editor a line? Write to Douglas Penrod at 1445 La Cima Road, Santa Barbara, California 93101, USA. You must send an IRC (international reply coupon—get one from the Post Office) and the equivalent of a dollar if you want a sample copy of the journal.



A HEATSINK THERMOMETER

I. HICKMAN

This simple thermometer was made up to check that power transistors on heatsinks were running at a safe temperature. Diode D1 is the temperature sensing element, Fig. 1, and is enclosed in a tiny copper heatsink which is held against the surface where temperature is to be measured. A constant current is passed through the diode by R1 from the stabilised voltage across D2. The voltage across D1 varies by approximately 2.1mV per degree Centigrade, resulting in a change of more than 300mV over the range, 0°C to 150°C.

This is measured by M1 the positive terminal of which is returned to the junction of R2 and R3. The potential at this point is set by VR2 such that it equals the voltage across the diode when the latter is at freezing point. Thus the meter reads zero at 0°C. VR1 is set so that the meter reads $\frac{2}{3}$ full scale at the temperature of boiling water, thus FSD corresponds to 150°C. A 5.6V zener was chosen for D2 as this offers nearly zero temperature coefficient and a low slope resistance. By supplying the zener from the high collector slope resistance of a transistor, excellent voltage stability is obtained even using the 9V battery down to a little over 6V. With intermittent use, the battery will last many months.

Construction

Fig. 2 shows how a small piece of 20SWG copper sheet is cut and shaped so that it can be bent up to virtually enclose D1. D1 should be of the "double slug" type of construction where the silicon wafer is sandwiched directly between metal slugs without any intermediate whisker. A fine copper wire, 42SWG

or thinner, is soldered to one end of the diode and the other end is soldered into the hole in the heatsink and the lead cut off flush. The diode should be hard up against the heatsink; the soldering process will not damage it. Another fine wire is soldered to the heatsink and the inside filled with Araldite, after arranging the wires in a small loop to minimise heat conduction. The wires are then passed up the inside of a length of 0.2in paxolin tube, to the end of which the diode/heatsink is Araldited.

Finally, the end of the heatsink is carefully filed flat to enable a good thermal contact to be achieved. The probe should be finished by mounting the paxolin tube in a suitable handle, which also contains the transition from the fine copper wires to a lightweight flex. The barrel of a felt tip pen makes a convenient handle.

The rest of the circuit, including the meter and battery, is mounted in a "Bargain Project Box" obtainable from Messrs. Crescent Radio Ltd. All the components except S1, D1 and the battery mount on a small PC board, Fig. 3, which fits over the meter terminal posts and is soldered to the meter's soldering tags.

★ components

Resistors

R1	3.3k Ω	VR1	4.7k Ω
R2	2.7k Ω	VR2	4.7k Ω
R3	470 Ω		min. skeleton
R4	47 Ω		vertical
R5	6.8k Ω		
All $\frac{1}{4}$ or $\frac{1}{2}$ W 5% carbon film			

Semiconductors

D1	1N916 (see text)
D2	BZY88 C5V6 (5.6V zener)
D3	1N916
Tr1	OC71 or similar

Miscellaneous

M1, meter 100 μ A FSD Type MR38P, S1, DP slide switch.
Copper for heatsink. Material for probe. Metal or plastic box approx 85 x 55 x 37mm (3 $\frac{1}{2}$ x 2 $\frac{1}{4}$ x 1 $\frac{1}{2}$ in.) PP3 battery.

GT121

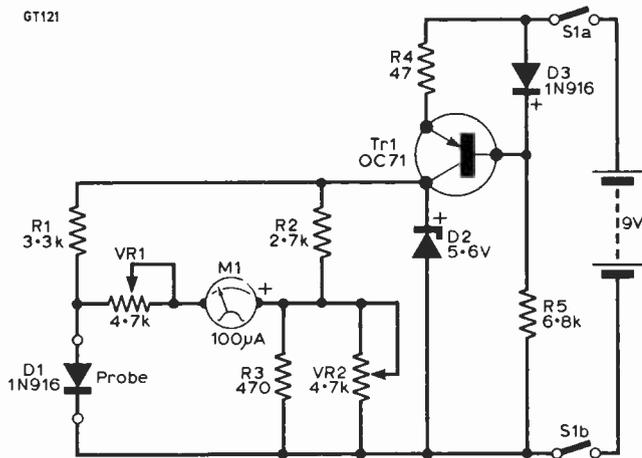
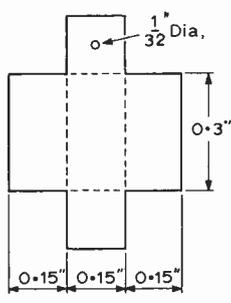
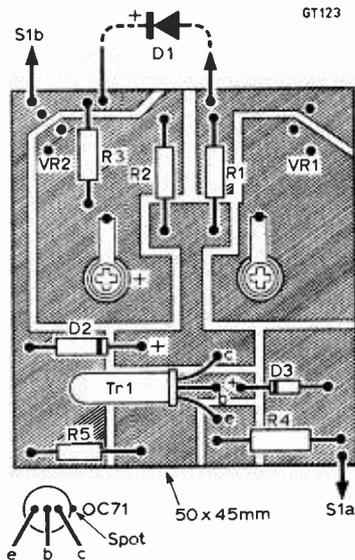


Fig. 1: Complete circuit diagram of the heatsink thermometer.

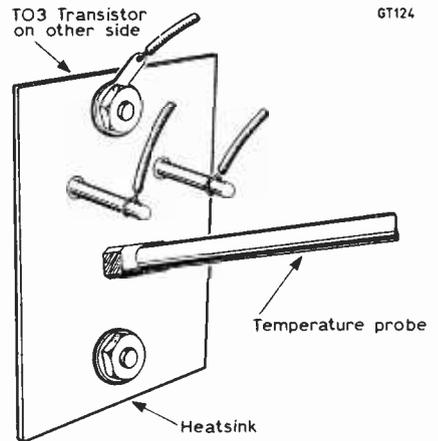


Material:- 20 SWG Copper
GT122

Fig. 2 (above): Temperature probe housing cutting details. Fig. 3 (right): A suggested PCB layout. All components are mounted on the copper side of the board.

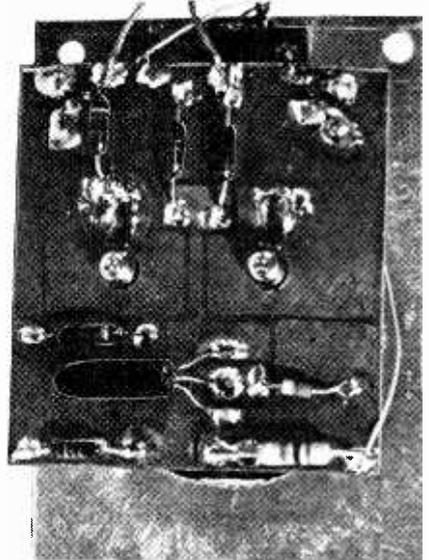


GT123



GT124

Fig. 4: The temperature probe should be applied to the heatsink, not the transistor case.



Calibration

Having finished construction and checked that 5.6V approx. appears across D2, set VR1 to mid-range and adjust VR2 for zero meter reading when the probe tip is immersed in a mixture of water and melting ice, well stirred. Next, dry the probe and place the tip on the outside surface of a kettle of boiling water, using plenty of heatsink compound. Adjust VR1 for a scale reading of 100°C. The probe will not quite have reached this temperature, but the difference should only be two or three degrees, as can readily be checked by immersing the probe tip. If you do, carefully remove all the heatsink compound first! The thermometer is now calibrated.

Use

The recommended method is to measure the temperature of the heatsink on the opposite side from

the power transistor, as in Fig. 4. To ensure that the power transistor is running at a safe temperature, it is necessary to deduce the junction temperature of the actual silicon chip inside. From the voltage across and the current through the transistor, calculate its dissipation P in watts. Next, to the thermal resistance from junction to case $R_{\theta_{j-c}}$ add that from case to heatsink $R_{\theta_{c-h}}$. These are quoted by the transistor manufacturer on the data sheet. There will usually be three values for $R_{\theta_{c-h}}$: (a) transistor mounted on heatsink direct (b) ditto, but with silicone grease and (c) insulated by a mica washer. Multiply the dissipation P by the total thermal resistance

$$R_{\theta_{j-h}} \text{ where } R_{\theta_{j-h}} = R_{\theta_{j-c}} + R_{\theta_{c-h}}$$

to find the temperature of the junction relative to the heatsink. Add this to the measured heatsink temperature and check that the resultant junction temperature is within the manufacturer's rating, e.g. 200°C for a 2N3055.

With today's very high cost of motoring, an increasing number of people are servicing their own cars. This can save a lot of money, but also lead to some difficulties. The efficiency of an engine depends on a large number of factors, one of which is the condition of the ignition system and how accurately it is set up.

Here lies one of the difficulties. The motorist can set the contact-breaker points gap fairly easily, whereas a garage will use an expensive dwell meter which measures the interval over which the points are closed. The ignition timing is a critical adjustment which has a great influence on fuel consumption, but is not so easily checked by the d-i-y motorist. True he can set the timing statically, using a bulb, but it is much better and more accurate to set the timing with the engine running. Here the professional uses a strobe timing light, but few motorists possess such an expensive piece of equipment:

A short while ago, the author wanted to fit an electronic ignition system to his car to improve its performance and fuel economy. The particular type being fitted used a magnetic sensing system to provide the timing, rather than the more usual mechanical contact-breaker. This meant that the timing method using a bulb could not be adopted. Instead a strobe timing light was necessary, and it was this which led to the development of the low-cost unit described here.

Circuit description

As can be seen from the circuit diagram, Fig. 1, a mains-driven power unit provides an output of some 200 to 300 volts d.c. This is connected across the xenon strobe tube, FT1, whose trigger electrode is connected to one of the sparking plugs. Each time a high voltage pulse from the distributor is applied to the plug, the strobe tube will fire, producing a flash of light. The power supply capacitor C1 will be discharged through the tube, and will recharge in the interval before the next trigger pulse.

The requirement for a mains power supply is the one disadvantage of this simple system. However, it does mean that the light output from the tube is greater than that obtained from some other low-cost designs. As the unit will not normally be used very often, it was not considered too great a drawback.

ECONOMY TIMING



Construction

The timing light is built in two parts: the strobe head itself, with the sparking-plug adaptor attached, and the power unit. The strobe head should be housed in a plastics box, for good insulation, and safety in handling. Constructional details are shown in Fig. 2. The strobe tube is mounted in a piece of

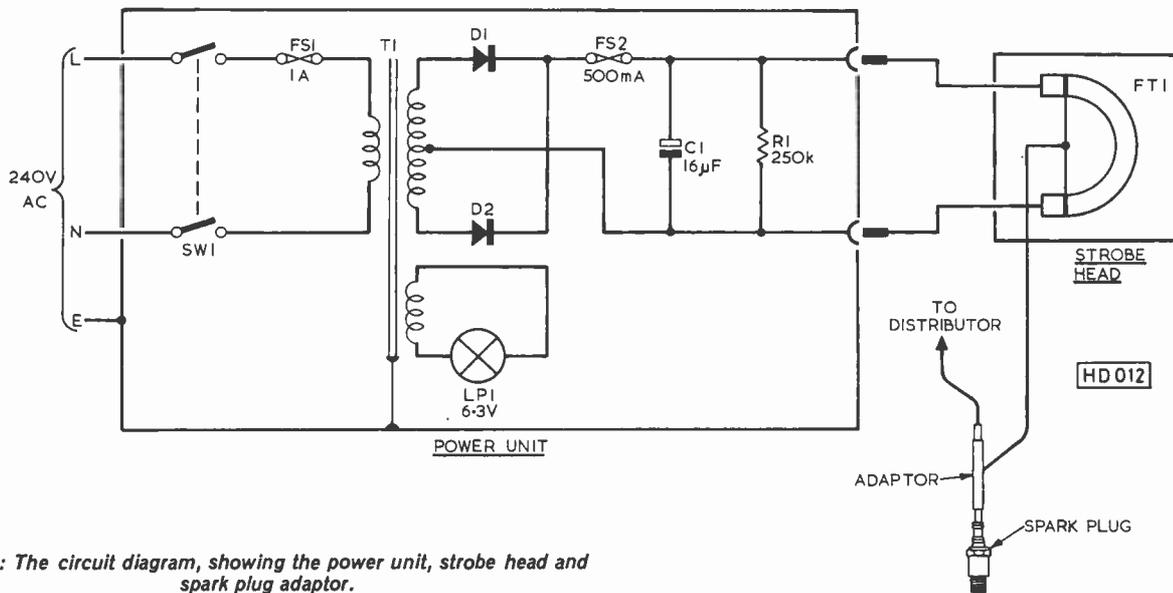


Fig. 1: The circuit diagram, showing the power unit, strobe head and spark plug adaptor.

STROBE

B. HARVEY



5mm (3/16in) thick Paxolin, and held in place by means of some flexible adhesive such as Evostik. The tube, being glass, is fairly fragile, and some care in handling is advisable. The aluminium reflector should be polished using Brasso, etc. to provide the maximum light output from the unit.

The connecting lead to the power unit should be in good quality heavy duty twin mains flexible, while that to the sparking-plug adaptor should be in car HT cable, obtainable from motor accessory shops. A length of one metre is normally adequate.

Sparking-Plug Adaptor

The sparking-plug adaptor is made from a piece of brass rod about 10mm ($\frac{3}{8}$ in) in diameter. One end is turned down in a lathe or electric drill until it will fit firmly into the plug lead cap. The size will depend on the type of plug lead used on your car. Usually, British cars use the plug with the adaptor screwed on the end, but many European cars use only the threaded portion, without the adaptor.

★ components

Resistor

R1 250k Ω 1W

Capacitor

C1 16 μ F 450V Electrolytic

Diodes

D1, D2 BY100 etc. (400V 1A)

Miscellaneous

T1 Pri: 240V

Sec 1: 200-0-200 to 300-0-300V

15mA (see text)

Sec 2: 6.3V 0.5A

FT1 Strobe tube (Tandy Cat. 272-1145 or similar)

FS1 1A

FS2 500mA

S1 D.P.S.T. mains switch

LP1 6.3V 0.3A lamp

Holders for lamp and fuses. Plastic box 101 × 54 × 41mm (Tandy Cat. 270-231 or similar). Metal box for power unit. Car HT cable (1m). Terminals or plug and socket for DC output connection. Paxolin, Perspex, aluminium sheet. Cable clamps, grommets, brass rod and plastic tubing for insulation.

The other end of the adaptor is drilled out to fit the top connector of the sparking plug. A slot is then sawn down the length of the hole and the sides sprung slightly inwards to give a firm fit.

Good insulation is essential on the sparking plug adaptor and on all connections inside the strobe head. Remember that the power supply is capable of giving a very dangerous shock, while the trigger lead will have anything up to 20,000 volts on it every time the plug fires.

Power supply

No constructional details are given for the power supply unit, because this can take more or less any form, and it may be that the constructor already has a suitable power pack available. The HT output should be capable of supplying 200-300 volts at not less than 15 milliamps.

For safety and robustness, the power unit should be housed in a metal case. The prototype used a die-cast box. It is advisable not to omit the pilot lamp, which provides a warning of the presence of the HT output.

Engine timing

What is usually referred to as the timing on a car engine, is the point at which the sparking plug fires in relation to the position of the piston in the cylinder. If the spark occurs too early then severe stress and even damage can occur in the valve gear, connecting rod, piston, crankshaft and bearings. If the spark occurs too late, some or all of the power developed by burning the fuel is allowed to dissipate itself to atmosphere via the exhaust pipe. This is not usually so dangerous to the engine as having the spark too far advanced, but is very wasteful.

The exact point at which the fuel air mixture in the cylinder is ignited is critical within close limits. A few degrees out either way causes the efficiency of the engine to drop.

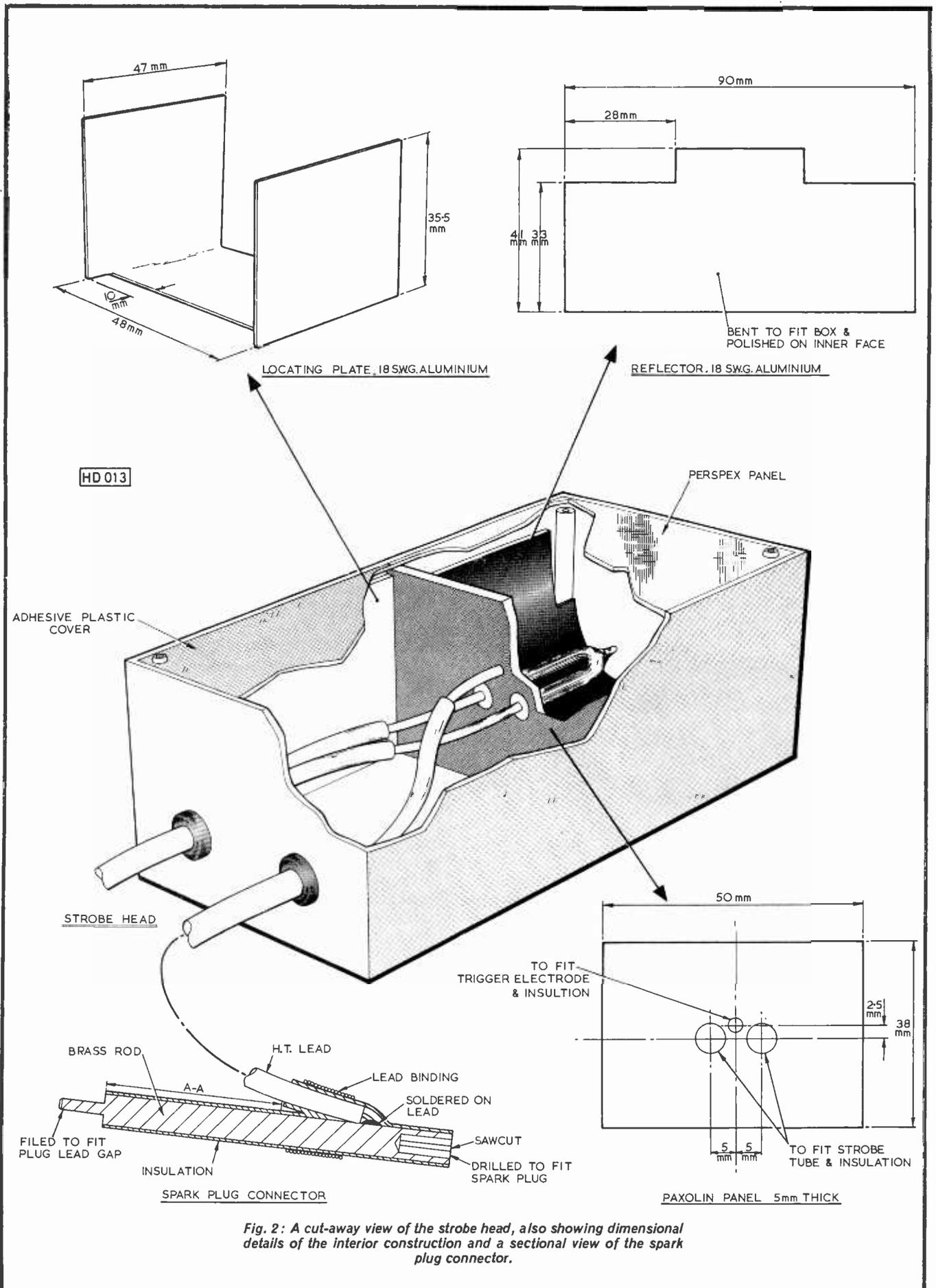


Fig. 2: A cut-away view of the strobe head, also showing dimensional details of the interior construction and a sectional view of the spark plug connector.

KINDLY NOTE!

In order to check the exact relationship between the timing of the spark and the position of the piston, some form of reference marks have to be used. On most car engines the end of the crankshaft protrudes through the front of the engine casing. On this shaft is mounted a pulley wheel which drives the cooling fan, the dynamo or alternator and sometimes the water pump via the fan belt. On the front face of the crankshaft pulley wheel, or sometimes on the edge, is a mark, indentation or raised portion that coincides with another mark on the body of the engine when one cylinder (usually No. 1, the front one) has its piston at the highest point it can reach, normally referred to as "top dead centre" (t.d.c.).

Therefore we have a simple indicator that shows when one of the pistons has reached top dead centre. If further marks are added corresponding to 5 degrees and 10 degrees before t.d.c. on our reference cylinder then the timing of the engine can be found. This will hold good for the other cylinders of the engine, as the firing of all cylinders is controlled by the distributor cam and cannot change.

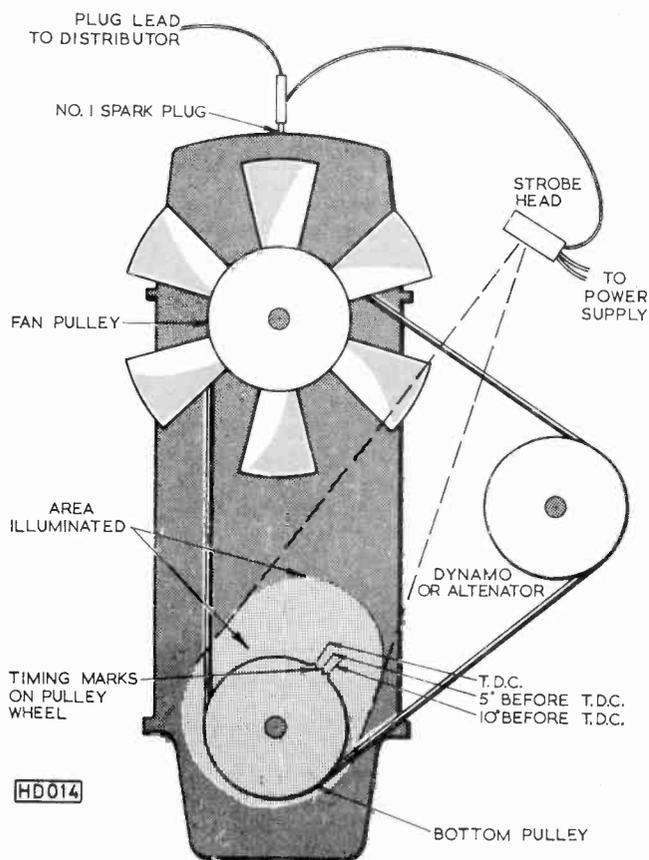


Fig. 3: A general view showing the strobe head illuminating the timing marks on the pulley wheel.

Using the Strobe

The strobe timing light should be connected to its power unit and the sparking plug adaptor connected in the lead to No. 1 cylinder plug. The engine should then be started up and allowed to stabilise its speed. If the power unit is now switched on, the strobe light will flash each time the spark occurs in No. 1 cylinder.

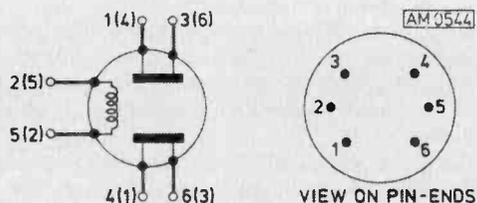
continued on page 757

Jubilee Organ Project

- i September 1977, p 353. Transistor ident. BFY71 should read BCY71.
- ii November 1977, Part 3. The circuit diagram of the accompaniment section, p 509, shows the base of Tr5 connected to the 12V positive rail. This connection should be broken, leaving the base connected to the free end of R44 (1 megohm) only.
The PCB as purchased from Readers' PCB Services is correct in this detail.
- iii The end of R45, shown connected to the 12V positive rail, should go to the junction between R40 and C17.
The PCB as purchased from Readers' PCB Services is correct in this detail.
- iv Collated components list, p 353 September 1977 contains the information "3-off 33nF"; this should read "3-off 3.3nF Polystyrene."

Gas/Smoke Sensor Alarms, April 1977

We have received a number of queries from readers regarding the pin connections for the TGS812 Gas Sensor used in this design. These are as shown in the diagram below:



The TGS812 is a symmetrical device, and can be plugged into a standard 7-pin miniature (B7G) valve holder.

We regret that the pin numbers quoted in Fig. 1 of the article are incorrect. They should be amended as follows:

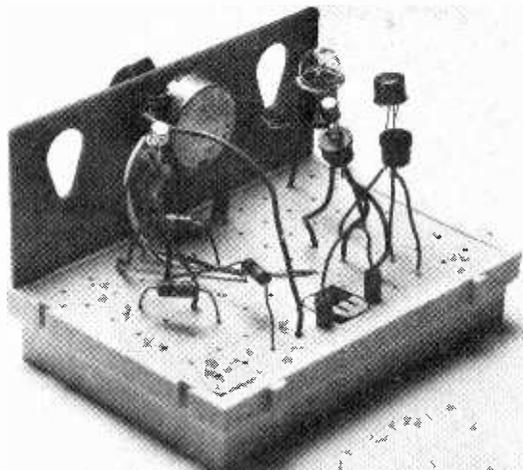
Pins 1, 2 and 3 to +5V (C1 positive)

Pins 4 and 6 to VR1

Pin 5 to negative supply rail (C1 negative)

S-DeCnology

DAVID GIBSON



12



THIS MONTH



'The Might Light'

This month's S-DeC circuit, the last in the present series, should provide a gripping finish to any party. Two contestants are asked to hold a "probe" in each of their hands. An adjustment is made until a bulb just extinguishes. On the command "Go", each contestant must grip/squeeze his/her two probes as hard as possible. One contestant has the power (depending on the strength of grip) to make the bulb light—the greater the grip the brighter the bulb lights. Conversely, the other contestant can dim the bulb (greater squeeze equals dimmer light) and can keep the bulb turned off.

The circuit uses only eight components (plus a battery) and functions as follows. By gripping the upper pair of probes the "light" contestant puts the resistance of the body in parallel with the resistor R1. The less this body resistance is, the more Tr1 is biased "on" and the more it will drive transistors Tr2 and Tr3. As Tr1 draws more and more current, the voltage developed across VR1 becomes greater and so drives the Darlington pair (Tr2/Tr3) harder "on". As these Darlington-connected transistors draw more current, the bulb in their collector circuit will obviously glow brighter.

The "dark" contestant puts his body resistance across R3. The less resistance there is here, the more Tr1 will turn "off" i.e., the less current it will draw and so less driving voltage will appear across the potentiometer VR1. The resistor R2 was included as a safety measure since, if the "light" contestant probes were accidentally shorted together, then the base of Tr1 would be directly connected to the positive battery rail causing the circuit to draw heavy current.

The potentiometer offers a simple means of balancing the circuit prior to a contest. If both contestants hold the probes lightly, then VR1 is easily adjusted until the bulb just extinguishes. It is more exciting if the bulb is adjusted for a slight glow, as any variation in brightness can then be seen immediately by the onlookers and, of course, the judges!

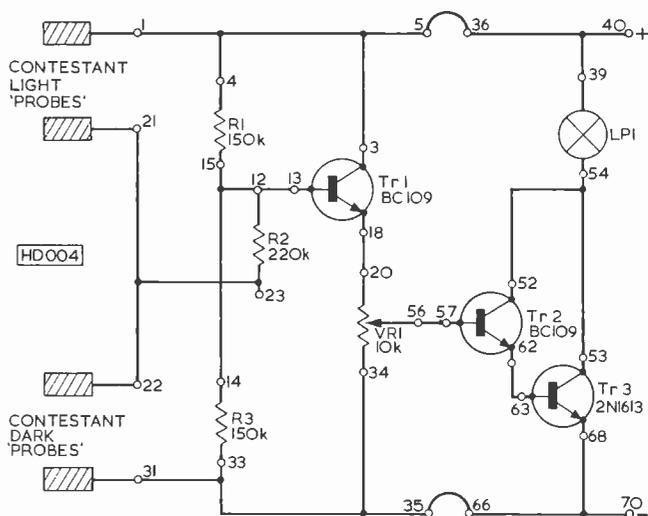


Fig. 1: The circuit diagram

Once you have assembled the circuit on your S-DeC (don't forget the shorting links between holes 5/36 and 35/66) you should apply the battery voltage, but leave the probes unconnected. It should be possible to swing the potentiometer to light the bulb from full brilliance to completely extinguished. The value of VR1 offers a wide range and can easily adjust for any values of human skin resistance.

The probes are best made from short lengths of metal pipe, about 125mm (5in) long and anything from 12mm (1/2in) to 25mm (1in) diameter. You can simply paint a band around the top part of each probe, using white and black paint for "light" and "dark" respectively. Don't paint the whole pipe or you will insulate the skin contact from the metal and the circuit will not function.

Games using the circuit are endless and limited only by the imagination. For example, teams could join hands and the leaders then hold the probes. The potentiometer is adjusted and on the command every-

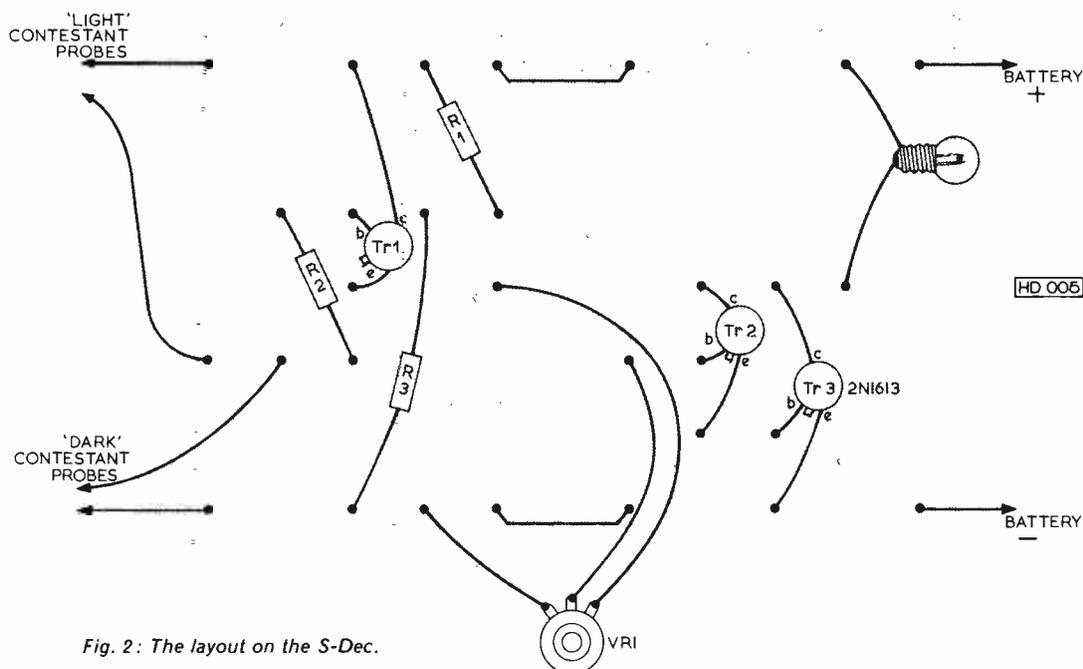


Fig. 2: The layout on the S-Dec.

you will need . . .

R1 150k Ω	Tr1 BC109
R2 220k Ω	Tr2 BC109
R3 150k Ω	Tr3 2N1613
VR1 10k Ω potentiometer	
LP1 6V 100mA bulb	
One S-Dec	
6V battery	
Four pieces metal pipe (see text)	

one must squeeze the wrist of their partners; a sort of "Squeeze-o-War".

Power demands

Battery voltage is not critical and the circuit will function with any voltage from 12V (maximum) down to 4.5V. It ceases to work below 4.5V. The lower voltages mean greater battery life although the bulb does not light quite so brightly at maximum brilliance. Since maximum brightness is not used anyway, it is sensible to use lower voltages. At 6V, the total circuit current measured was slightly under 90mA, and with VR1 adjusted to just extinguish LP1 the current was 24mA. These figures should be taken as a guide only, since the gains of individual transistors could alter this, although in the circuit shown the variations will not be enormous and VR1 can be adjusted for correct circuit operation no matter what.

This is the last S-DeCnology circuit in the series. However, a new series of one-IC circuits will start shortly. The principles of simple circuitry and ease of construction will be carried on, and the new series will use a DeC which can accept ICs plus discrete components.

ECONOMY TIMING STROBE—contd. from page 755

If the light flashes only very weakly, it is probably due to the power supply capacitor not recharging sufficiently between trigger pulses. This may be overcome by reducing the value of C1.

The strobe head can now be held in a position that allows it to illuminate the crankshaft pulley (Fig. 3), making sure that everything is safely out of the way of the blades of the fan, which are often difficult to see. Due to the stroboscopic effect of the light, the bottom pulley wheel will appear to be stationary. If the engine timing is correct, the two sets of marks on the pulley wheel and the engine body will line up. If they do not, the engine is either too far advanced or retarded. If the engine speed is then increased, a device called a centrifugal governor, housed in the distributor, will automatically advance the engine timing and show if the engine is advanced or retarded.

The precise method of making these checks will vary according to the particular engine. Most cars have the timing set for around 5 degrees before t.d.c. at 1,000 r.p.m. with the vacuum advance disconnected. If the exact procedure is not known then the information can be obtained from the car workshop manual. If it is found that the timing is incorrect then the usual method of adjustment is to rotate the body of the distributor, after first slackening the clamping bolt. Some distributors are provided with an adjusting mechanism which allows the timing to be adjusted over a few degrees by turning an external knurled nut. The letters "A" and "R" on the distributor body indicate which direction of movement advances or retards the timing.

The time required to carry out a timing check is very little, but it can save a considerable amount of money, and is well worth while.

PRODUCTION LINES

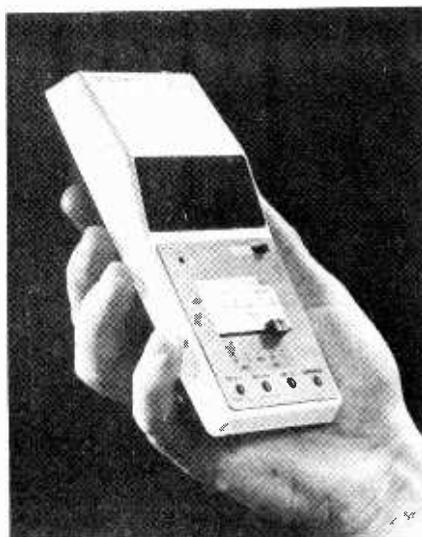
bill tull

NEW FROM SINCLAIR

A new concept—a "personal" digital multimeter, at a price competitive with low-cost analogue multimeters, has been launched by Sinclair Radionics.

Designated the PDM35, this 3½ digit meter measures just 155 × 75 × 30mm. The facilities incorporated were chosen as a result of an international market survey, and allow measurements in the range 1mV to 1000V DC, 1V to 500V AC, 1nA to 200mA DC and 1Ω to 20MΩ. The resistance ranges can also be used for semiconductor junction testing—matching V_{be} etc.

Accuracy on resistance measurements is 1.5%, improving to 1% on



the other ranges. A red LED display is used, and auto-polarity is incorporated. Power is derived from an internal 9V PP3-size alkaline or zinc-carbon battery.

The PDM35 costs £29.95 plus VAT, including test leads, protective carrying pouch and operating manual.

Optional extras available are an AC mains adaptor, padded pouch for protection in the field, and a 30kV EHT probe.

Consumer research also influenced the design of Sinclair's new calculator, the "Enterprise". It led them to abandon liquid crystal displays,

increasingly popular with other manufacturers, as "Smudgy, slow and



unreliable'. Instead a new, bright 5.5mm red LED display was developed. Featuring the four standard functions, plus square root, percent and memory, the Enterprise measures 127 × 51 × 19mm (max.) and is powered by a PP3-type battery.

The price is £9.95 plus VAT, including instruction book and carrying case. An AC mains adaptor is available as an optional extra.

Further details on both these products from Sinclair Radionics Ltd., London Road, St. Ives, Huntingdon, Cambs PE17 4HJ.

Cassette deck

Watford Electronics are now supplying, ready built and tested, a stereo cassette deck, which, although not of the supreme highest quality, can boast a very respectable frequency response on Cr02 tape of 80 to 12000 Hz. Compris-



ing a high quality tape transport mechanism, and twin record/playback amplifiers, the TCD 68 is designed to be used in conjunction with an existing Hi-Fi set-up. Correct recording level is achieved by referring to two moving coil meters, while along with the usual cassette tape controls, switches are provided for Cr02/Normal tape, stereo/mono, and oscillator shift. Distortion is said to be around 2% maximum, while W/F is better than 0.25%. Price is £45.50 plus VAT, and if you can't get to the shop, then there's an extra £1.50 p & p.

Watford Electronics, 35 Cardiff Road, Watford, Herts. Tel: Watford 37774

A saw point!

Files and saws don't sound all that electronic do they? but like it or not they're still needed by the electronic enthusiast when filing out holes for potentiometers, and cutting bigger holes for displays etc. Just on the market is a brand new type of tool that combines the features of an awl for making and preparing holes in soft and hard woods and certain plastics, with the features of a rasp for working on metals, ceramic tiles, plastics and wood. Called the RASPAWL, price including VAT is 67p.

Looking very similar to the normal junior hacksaw, the DEEP sawfile



kit differs in that the frame has an extended depth of throat of 6in. This enables the saw to be successfully used on far more jobs than would normally be possible with a regular model. The kit, which is sold in a 'bubble pack' contains the saw frame, two Abrafile blades and a standard junior hacksaw blade. Price including VAT is 70p.

Abrasive Tools Ltd., Abrium Works, Colne Road, Twickenham, TW2 6QE. Tel: 01-894 1273

Transformers galore

Transformers off-the-shelf is the intention of Lascar Electronics and they have formed a new company to provide the service.

The initial range covers 3VA, 6VA, 12VA, 25VA and 50VA types and is available in chassis mounting or printed circuit board mounting formats. The secondary voltages have been carefully chosen to cover most popular applications, but are particularly suited to the construction of regulated power supplies. As an added safety measure, particularly where mains voltages are involved, all the transformers, bar one, are supplied with clip-on terminal insulators at no extra cost.

Providing a transformer can be wound on one of their standard bobbins, with the standard 120V/240V primary, they will wind the secondary, if possible, to your desired specification. Lascar call this their "Blue Riband" service and claim this system results in a drastic reduction in the time required to design, manufacture and deliver special purpose transformers (**Note minimum order 5 transformers**).

A range of transformer development kits is available and is claimed to be

the most convenient method of producing prototype or special transformers. The kits are available in 3VA, 6VA, 12VA, 25VA and 50VA sizes and both clamp-mounting and 0.1in printed circuit board mounting transformers can be constructed. A double-section bobbin with a 120V/240V primary already wound is provided. Bobbin shrouds, a mounting clamp, "E" and "I" lamination sections and terminal insulators make up the kit. The constructor can wind the secondary to his own specification on the empty half of the bobbin. Tapped or independent secondaries can be wound using a suitable insulated copper wire (not supplied). The transformer may then be assembled using the instructions provided, and can be finished off with a varnish dip if required.

A fully-priced brochure listing all their standard transformers and kit details is obtainable from:

Lascar Electronics, P.O. Box 12, Module House, Billericay, Essex CM12 9QA. Tel: 02774 3394.

£42 Per Watt.

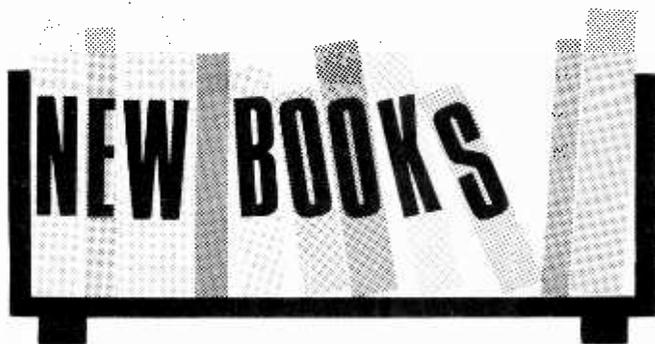
If you feel like spoiling yourself for the new year, you might be interested in the "Globetrotter 800" from

Nordemende. According to Nordemende's marketing agents in Aldershot, Hants, this fully portable mains/battery receiver is the "latest thing" in quality portables. It covers 17 wavebands, dealing with FM, MW, LW, three SW ranges from 1.58 to 19 MHz, and 11 spread short-wave bands. The band-spreading is effected via a double superhet stage, a switchable BFO is included, and a product demodulator is active for SSB reception. Unusual features include a key for switching from LW ferrite rod to an external connection for DF "sonde" for radio navigation.

The power unit incorporates a charging unit for accumulator, automatic cut-off for batteries or accumulator when on mains operation, and a large meter is provided to indicate signal strength for fine tuning and a check on battery condition. The receiver, it is claimed, is fitted with a "large, good speaker", through which is provided 7W (music) power.

At £295, this receiver clearly provides wide coverage—at a price! This does include VAT.

Available from:
Vessco Vision and Radio Ltd., Vessco House, Unit 4, Blackwater Way, Ash Road, Aldershot, Hants.



HOW TO BUILD ADVANCED SHORT WAVE RECEIVERS

by R.A. Penfold

Published by Bernard's Ltd., The Grampians, Shepherds Bush Road, London W6 7NF
118 pages £1.20

This very useful little book first describes a basic superhet using two transistors and an IC audio stage plus optional BFO. How the circuits work and how the set should be constructed and aligned is fully covered. The 'How to Build' bit of the title then just dies! The rest of the book contains circuits of alternative front-ends, audio and IF filters, Q-multiplier etc with a description of how they work and ways of connecting to the main receiver. The whole idea is to try all possible combinations and presumably end up with an 'advanced' receiver. However, by no stretch of the imagination could the result be termed 'advanced'. It would still be a basic, albeit effective, receiver.

Other than specifying a dial for the basic receiver no mention is made of tuning dials in general yet the overall performance of any SW set depends entirely upon the quality of the dial mechanism. Excessive backlash, wrong reduction ratio or bad parallax error can ruin an otherwise good receiver. Incidentally, the one facility to be found on any SW receiver worthy of the name is bandspread tuning yet our little book does not even mention the word, as far as I can recall!

The author has based the standard circuits on Denco coils since they are about the only ones available to the home constructor but this does mean that the LC ratio of the tuned circuits is pretty grim on the SW ranges. It must be remembered that the 365pF tuning capacitors are intended to cover the medium and long wave bands as well as the SW bands, accomplished by plugging in the appropriate set of coils. Hardly an advanced design!

On the production of the book itself, symbols such as 'mfd' and 'KHZ' should really not appear today. I would have liked the values of the components to be shown on the circuit diagram of the basic receiver especially as the circuit is necessarily divided up owing to the small page size. The component list is on yet another page. Strangely enough the remainder of the circuits do have the values of components on them! The first circuits show the symbols for the tuning coils and IFTs as if they were mains transformers! Nowhere are they shown as being adjustable by means of their cores.

In spite of these various drawbacks I would still recommend this book to the newcomer to receiver construction as it would give him the very important grounding in practical work that leads to a thorough understanding of receiver operation.

Eric Dowdeswell

OSCILLOSCOPE

Maurice ALLENDEN

VIEWING HOODS

The need for a cathode ray tube viewing hood became apparent when the author developed an interest in slow-scan television and the problem of daylight observation was encountered. Tubes made from thin card met with only limited success but eventually the local Garden Centre provided a solution.

The hoods shown in the photographs were all constructed from black plastic plant pots, which are available in a variety of sizes, both circular and rectangular. Those used in the prototype were of "STEWART" manufacture, 102mm (4in) square.

To provide a mount, the base (i.e. "closed" end) of a pot should be removed, leaving a 32mm (1.25in) rim which is then fixed around the C.R.T. face (Fig. 1). Once in position, it will accommodate a wide range of hoods, two of which are shown in the photographs. The short one would be for general use, whilst the long "radar" type is for viewing in high ambient light.

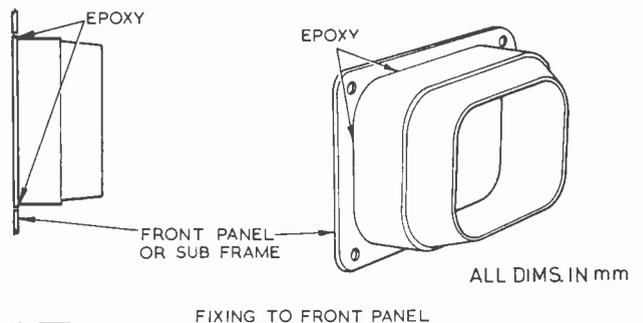
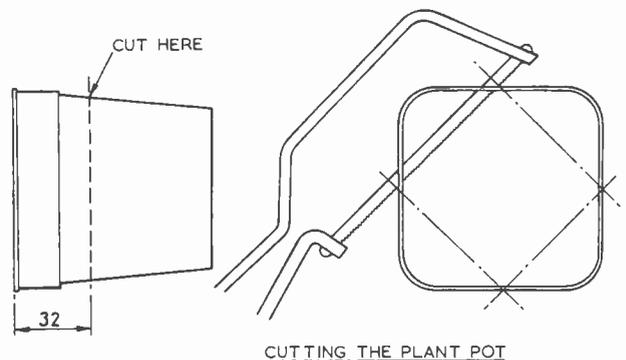
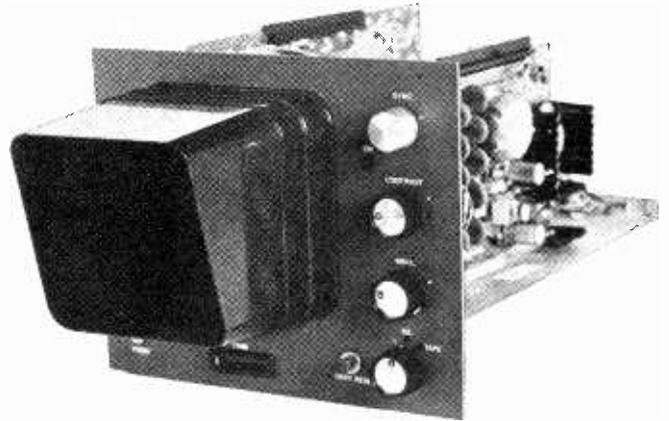
Construction

A number of pots will need to be purchased, the types and sizes being determined by the C.R.T. In the author's case, a 5FP7 tube of 127mm (5in) diameter was used, so the pot size selected was 102mm (4in) square. Black masking tape was then fixed to the oscilloscope graticule, leaving a square display area of 83mm (3.25in).

Referring to Fig. 1, carefully mark a line 32mm (1.25in) parallel to the open end of the pot—a yellow Chinagraph pencil is well suited for this purpose. Next, take a fine-toothed coping saw (or small hacksaw) and cut across each of the four corners in turn, until the blade goes through the thin plastic. Care is needed with this operation if damage to the pot is to be avoided. Gently saw from each corner until the cuts meet and the pot is divided. The rough edge may now be carefully smoothed and made parallel by means of a fine sanding block. The 32mm section is now fixed to the oscilloscope by making an accurate aperture in the front panel and then bonding with two spots of epoxy resin at each corner.

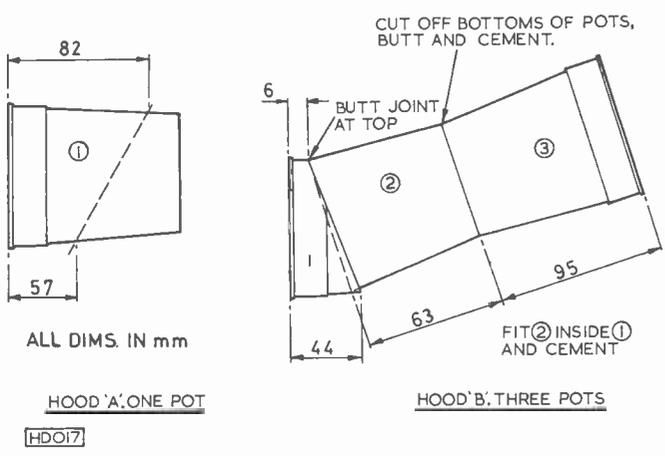
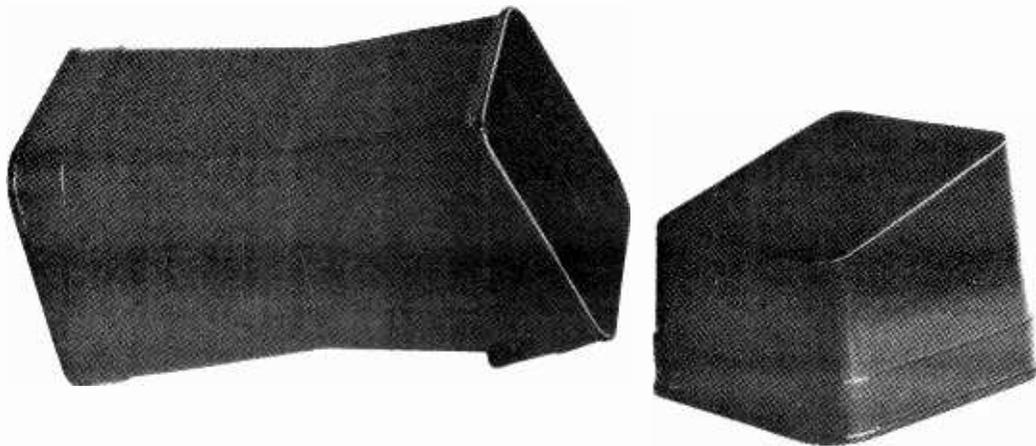
For existing panels, a small sub-frame of aluminium can be made and the hood mount secured to this. The sub-assembly is then fixed to the instrument with screws (Fig. 1).

Having produced the mount, make up some hoods from other plant pots, cutting and sanding the edges as before. Fig. 2 shows how the various pots are cut. For the larger hood "B," three pots are used. Cut carefully, then use polystyrene cement to butt-joint the sections together; a good, light-resisting design will result.



HDO16

Fig. 1: The mount for the various hoods is made from the rim of one plastic plant pot.



Finish

Further improvement can be achieved by spraying the inside with a matt black paint. If a cellulose-based paint is used it will tend to dissolve the surface of the plastic, giving an attractive matt-etched finish. The outside should be masked during this process for protection.

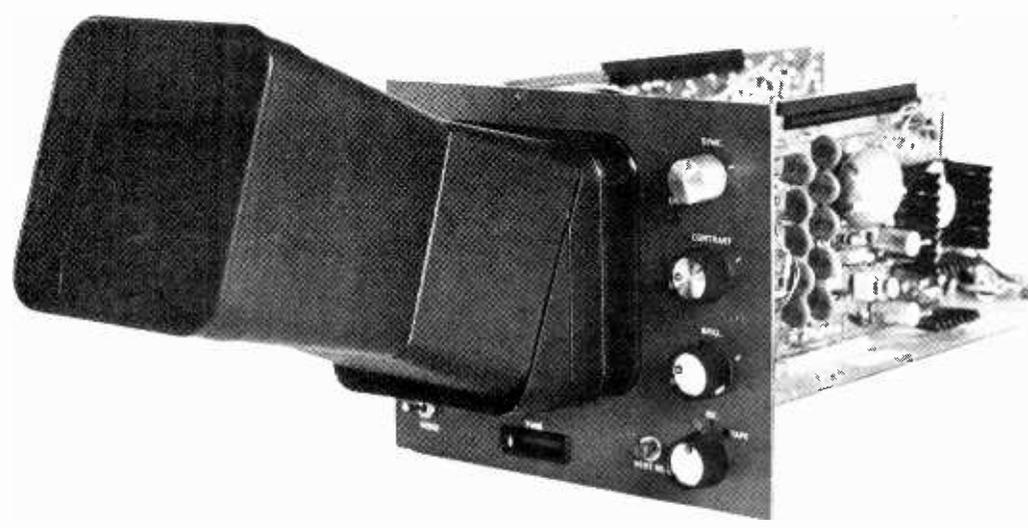
When fixed to the mounting, the hoods should be a nice, snug fit but if trouble is experienced, small pieces of PVC tape can be applied to the inside corners.

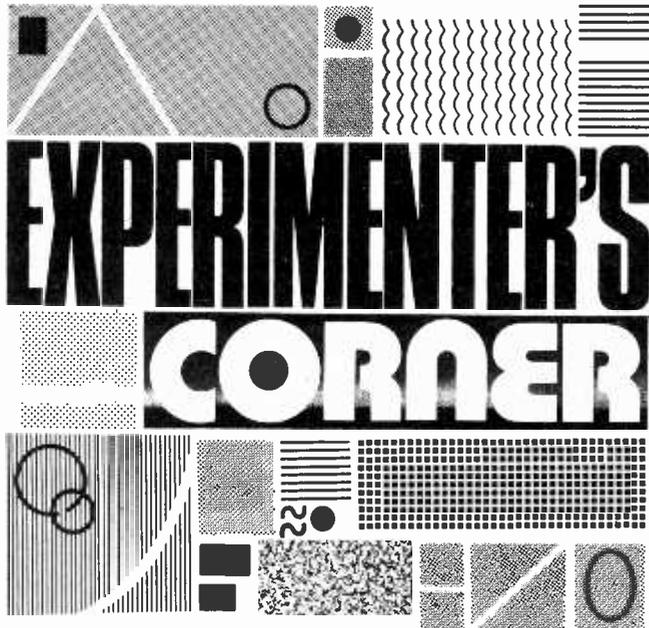
The hoods as described have given trouble-free service with the author's SSTV monitor for some time. With imagination, many purpose-built types of low cost and professional appearance can easily be made.

Acknowledgements

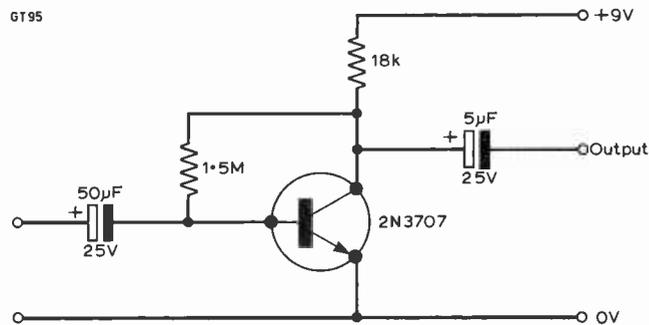
The author would like to thank Bob Weston for his assistance in preparing this article.

Fig. 2: Cutting details of the short hood, using one pot, and the long hood using three.





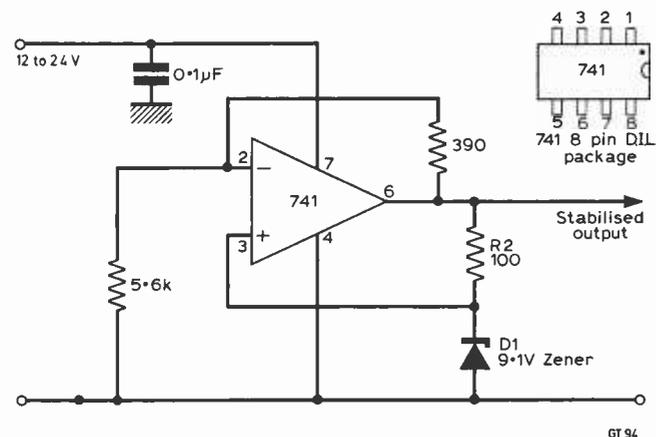
Simple Low-Z Preamp



This general-purpose preamplifier is suitable for a wide range of applications where small signals are involved. Its advantages over more complex designs include ease of construction, cheapness of components, and compact dimensions. Employing a low-noise NPN transistor of the 2N3707 type, which is readily available, the amplifier presents a low to medium input impedance, and is therefore suited to moving-coil microphones, magnetic pick-ups, etc. In the circuit illustrated, the gain is fairly low, but a high-gain transistor may be used, such as the BC109, when very small signals are concerned. Supply is 9V in the circuit shown, but this may be varied from about 5V to 25V according to availability, with consequent shift in input impedance.

*D. L. Jones
Denbigh, N. Wales*

Basic 9V Stabiliser



Matching supply voltage requirements of ancillary equipment to those of an established installation can sometimes be a problem. This stabiliser circuit is intended for situations where high power is not a fundamental factor, such as supplying a stereo decoder for use with a tuner unit operating on an 18V rail. It uses the versatile 741 operational amplifier, and may be used with any input voltage between about 12 and 24 to give approximately 9V stabilised (positive) output. Control is effected by means of a 9.1V Zener in the circuit shown, but any type operating within the range 4.7V to 12V will do, according to the output voltage required.

Devices for which the unit is suitable include decoders such as the MC1310, and the Mullard LP1186, or other VHF "front ends".

*R. N. Soar
Mexborough, S. Yorks*

NEXT MONTH IN...

practical WIRELESS

ON SALE FEB. 3RD.

* EXTRA INSIDE!

8~PAGE SUPPLEMENT

PW GUIDE TO AERIALS

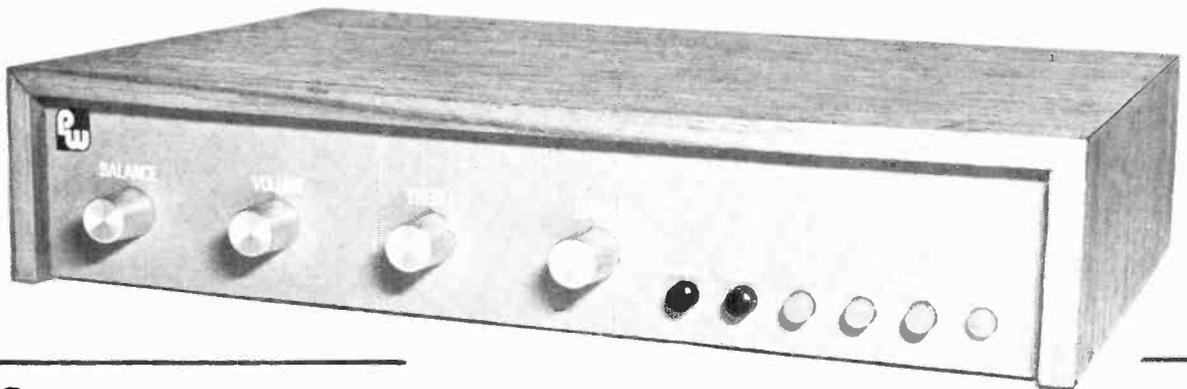
~FROM LONG WAVES TO UHF~

Whether you are listening to an amateur in Australia or to your local radio station, the weakest link in the chain is your receiving aerial! Use our Free Guide to ensure that your radio equipment is getting what it deserves, the best in aerials.

ALSO:—

PW EUROPA

The "Europa" stereo amplifier gives an output of 30 watts per channel into 4 ohms. Designed with ease of construction in mind, the Europa has almost all components mounted on a single p.c.b., and uses the case as heat-sink for the output transistors. Inputs are provided for magnetic, ceramic or crystal pick-ups, tape-head and timer.



PLUS:—

Starting next month!

U~DeCnology

Following on from the popular S-DeCnology series, David Gibson describes a number of circuits using a single i.c., each one built on another variety of plug-in solderless breadboard, the U-DeC.

Practical Wireless, February 1978

**DON'T
MISS THIS
ISSUE!**

So you want to pass the R.A.E. (Radio Amateurs' Examination)?

No. 6

John Thornton Lawrence GW3JGA & Ken Mc Coy GW8CMY

This month we are taking a break from calculations and theory to look at block and circuit diagrams and how to tackle these in the R.A.E. We will also be discussing valves and semiconductors and various applications for these in amateur radio equipment.

Block Diagrams

The purpose of a **block diagram** is to show, in the clearest possible way, the arrangement of a basic system or piece of equipment, and to show the signal flow through it. A block diagram can sometimes be so effective that no other explanation is necessary, Fig. 34.

In the block diagram of a piece of equipment, it is important that the path of the main signal is clearly shown and this will usually be from left to right. Any other less important signal entering or leaving the main signal flow should do so at right angles, e.g.

local oscillator and "S" meter, as shown in the super-het receiver block diagram in Fig. 35. Also see Fig. 6.3 in The Radio Amateurs Examination Manual.

However, if two equally important signal paths exist independently and these join to a common stage later on, then these can be drawn one above the other as shown in Fig. 36.

Block diagrams are concerned primarily with signal flow, signal processing, amplification, etc., no account is taken of how the processing is actually carried out, a valved radio receiver and a transistorised radio receiver may look identical in block diagram form although the detailed circuitry can be very different indeed.

When the block diagram is for a complete piece of equipment such as a receiver, then the power supply may also be included, but this is usually shown on its own away from the main operational part of the diagram as shown in Fig. 35.

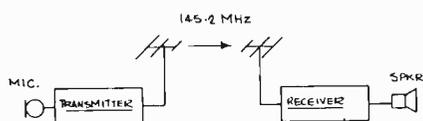


Fig. 34

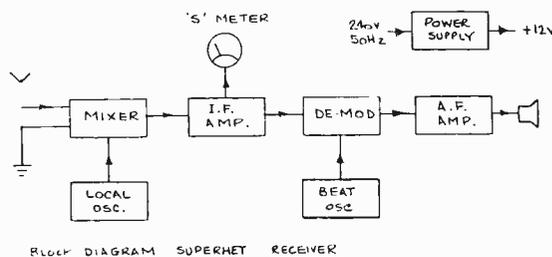


Fig. 35

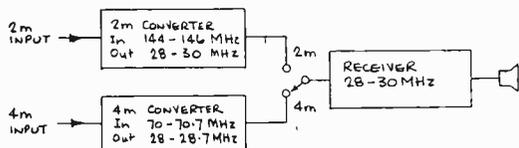


Fig. 36

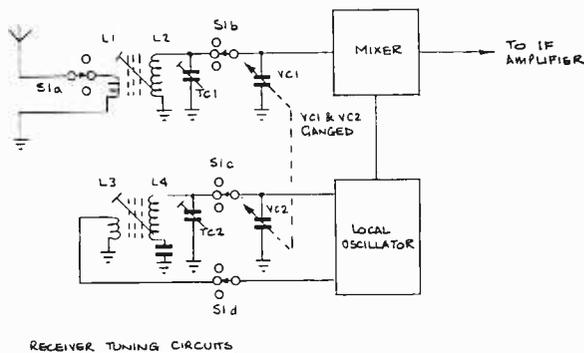


Fig. 37

Block diagrams are easy to draw using just a pencil and ruler, as these have been, but be sure to allow enough space for labelling the blocks. It is better and quicker to label the blocks directly on the diagram, but if this is not possible it will be necessary to give each item a letter, a, b, c, etc., and include a coded list adjacent to the diagram.

All diagrams should be drawn in pencil (H or HB) and if you have a good eraser (Staedler Noris—Plastic) then you can easily make any corrections or reposition something if you need to. Remember, in the exam, time is of the essence, speed and accuracy in drawing block and circuit diagrams only comes with practice, so plenty of practice in drawing a range of standard types of circuits is required, but more about these later.

Moving in a little closer now, you may be required to show a particular stage of the equipment in slightly more detail, but without going to the complete circuit diagram. The best way of doing this is to retain the basic block diagram approach but to show the important signal handling parts as actual components. The circuit in Fig. 37 shows the tuned circuits of a receiver, without being cluttered by biasing resistors, coupling and decoupling capacitors and so on.

Circuit Diagrams

Circuit diagrams are more difficult and more time-consuming to draw and so more care and attention to detail is required here.

The same rules that applied to the block diagram still apply, signal flow from left to right and other signals join and leave at right angles. In addition, we are now concerned with supply voltages and currents. Remember, we are thinking of conventional current (which flows from the positive supply through the circuit to the negative or zero) and this flow will be down the page from the top to the bottom as shown in Fig. 38.

If the diagram contains blocks of circuitry above or below the main central section then these may be considered as separate blocks each with their own supply lines. For example, in Fig. 35 the beat frequency oscillator may have its own positive supply line immediately above its circuit and the zero line below but with the direct current still flowing conventionally down the page.

For the purposes of the R.A.E. it would be convenient to stick to *nnp* transistors throughout as *nnp* transistor circuits have the positive line at the top and relate more readily to valve circuits and applications.

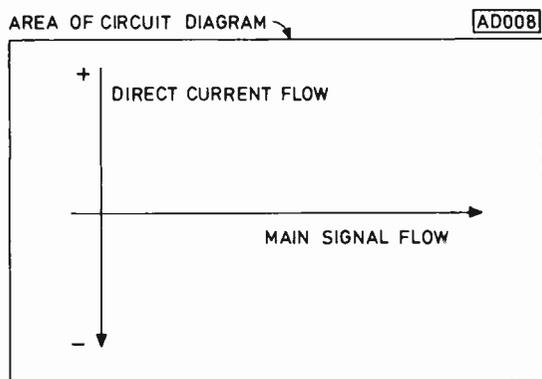


Fig. 38: In a circuit diagram, power supply paths run down the page, signal path across the page from left to right.

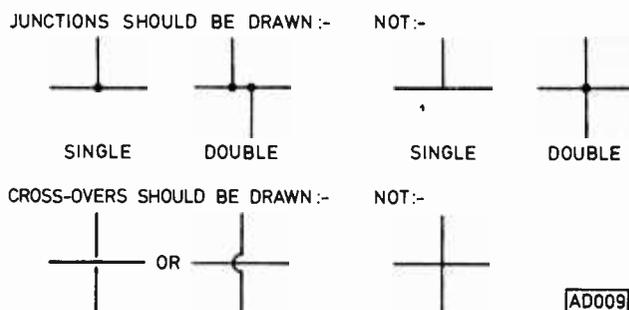


Fig. 39: The best method of drawing junctions is to some extent a matter of opinion.

There is nothing wrong with *pnp* transistors or negative supply lines but it does mean some upside-down thinking when describing these circuits and this is best avoided in the exam. Remember, "*nnp* Rules OK!"

The drawing of a circuit diagram is made easier by a moment or two of mental planning. Think of the parts of the circuit that are to be included, allow about 5 to 6cm spacing between valves or transistors, more where there are switches and coils, less where coupling is direct or very simple. Set an imaginary horizon line across the centre of the page and where convenient, keep the valves or transistors approximately on the line. Some circuits require the valves or transistors to be one above the other, space these so that they fit in conveniently. Provisionally, draw in a zero line and a positive supply line and see if you have enough room for everything vertically and horizontally. If you cannot manage to fit the diagram in horizontally then you can, if absolutely necessary, break the drawing and continue it on another sheet. However, this takes up valuable time, so avoid it if you possibly can.

In both the valve and transistor circuits, the direct current path through the resistors can easily be visualised as flowing down the page with the signal path crossing horizontally from left to right. See also Fig. 1. in the November 1977 issue of *PW*.

If the question requires you to insert typical component values then, to save time, this can be done alongside each component on the diagram. If there is not enough room, then the components must be numbered, R1, C1, etc. and a table of values given adjacent to the diagram. It is a good plan to number the components anyway, because, if you are required to describe the operation of the circuit, then the component can be referred to more readily, as for example, "C1" instead of "the input coupling capacitor"

There are various schools of thought on how junctions and crossovers should be drawn and although we are at variance with some of the excellent professional draughtspersons (including those at *PW*) we think that the methods of drawing junctions and crossovers given in Fig. 39. are less likely to be misdrawn or misunderstood when drawn by the examinee under examination conditions. For your own interest, have a look at circuit diagrams in various books and magazines and see how they do their junctions and crossovers.

The actual drawing of the circuit diagram should be done in pencil using a ruler and ideally a stencil. Radio component stencils are available at most big stationers or shops selling drawing instruments. A typical one made by UNO, is type BB4 at £3.85, but

this may reasonably be considered too expensive to buy just for use in the R.A.E. As an alternative, use a general purpose stencil which has circles, squares and triangles on it. Faber-Castell make a suitable one (Type 943) which is very useful and considerably less expensive.

All the diagrams in this section have been drawn using a ruler and the above-mentioned stencil.

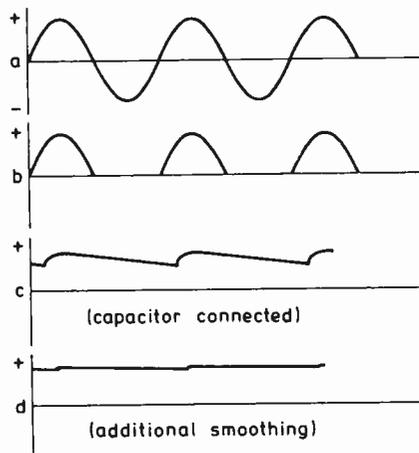
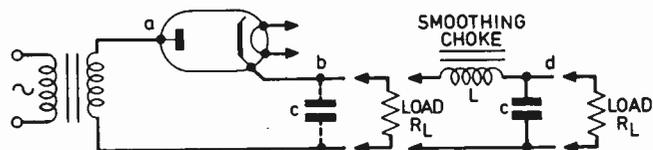
Remember, drawing circuit diagrams takes time, so read the question very carefully before starting. The diagram should be as detailed as required by the question, but no more.

As a guide, the drawing times for the previous diagrams were as follows:—

- Fig. 34. 4 minutes
- Fig. 35. 10 minutes
- Fig. 36. 8 minutes
- Fig. 37. 20 minutes

When you have completed the drawing, check down the page to see that each vertical current path is complete all the way through component, valve or transistor and that the horizontal signal path is also complete whether it be direct or by coupling capacitor or transformer.

Someone said that one picture is worth a thousand words and this could be equally true for a correct and clearly drawn circuit diagram.



AD011

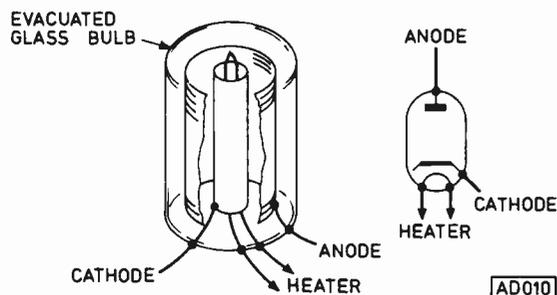
Fig. 41(a): A half-wave rectifier circuit, with voltage waveforms produced at various points.

VALVES AND SEMICONDUCTOR DEVICES

All the devices that we have discussed up to this point have been what might be called "passive" devices—that is they require no external power source to make them work. The devices which we will be considering next will be of the "active" type.

The Thermionic Diode

Although the thermionic diode has been almost totally superseded by the semiconductor diode in modern radio equipment, a description of its operation will help to show how valves work. Fig. 40 shows the construction of an indirectly-heated diode.

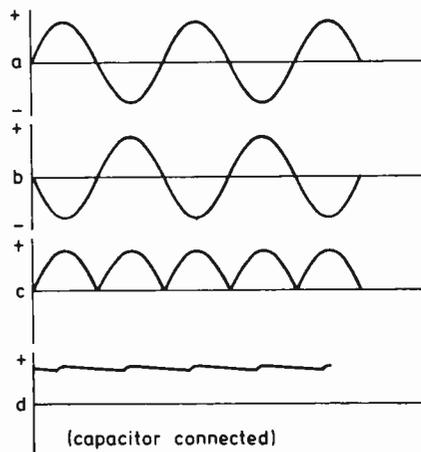
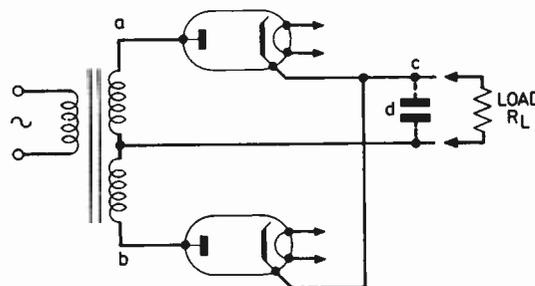


AD010

Fig. 40: Basic construction of an indirectly-heated thermionic diode.

The **cathode** structure consists of a narrow cylinder of nickel, coated with a layer of material which readily emits electrons when heated, in the centre of which is a heater.

The cathode is located in the centre of a hollow cylinder of nickel which forms the **anode**. The whole arrangement is contained inside a glass envelope from which all air is evacuated. Connections for the anode, cathode and heater are brought out through glass-to-metal seals.



AD012

Fig. 41(b): A full-wave rectifier circuit, with waveforms. The ripple frequency is doubled compared with the half-wave case, easing smoothing problems.

When a current is passed through the heater and the cathode becomes heated, electrons, from atoms of the electron-emissive material, break free from the surface and form a "cloud" around the cathode. If a positive potential is applied to the anode then the electrons which are negatively charged, will tend to move in that direction causing a "current" to flow.

Alternatively, if a negative potential is applied to the anode, the electrons will be confined to the cathode region, since like charges repel. If, however,

an alternating potential is applied to the anode, then the diode will only pass current or "conduct" during the positive excursion of the anode.

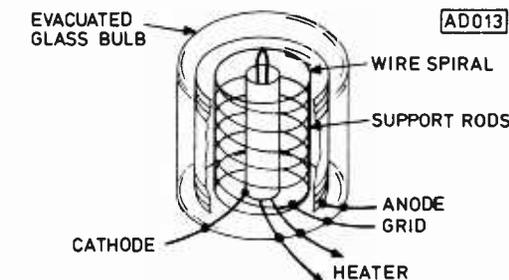
The main application of a thermionic diode is in a **half-wave rectifier** circuit as shown in Fig. 41(a). Alternating voltage is fed to the anode and as the diode conducts only when the anode is more positive than the cathode, then current flows only during the positive half-cycles. This results in only the positive half-cycles of voltage appearing across the load.

By connecting a capacitor across the load, to act as a reservoir, the "chunks" of positive voltage can be smoothed to give an almost constant output. The capacitor is charged or recharged on each positive half-cycle and is discharged by a small amount in between each half-cycle by the current drawn by the load. The output voltage waveform is shown in Fig. 41(a).

By adding an extra diode and a further winding to the transformer, in which the voltage is of the opposite phase to the existing one, we can produce a **full-wave rectifier** circuit in which the two diodes conduct alternately on each half-cycle, as shown in Fig. 41(b). This has the effect of doubling the ripple frequency and reducing significantly the amplitude of the ripple across the smoothing capacitor. Further reduction of ripple can be obtained by adding a choke-capacitor filter.

The Thermionic Triode Valve

The **thermionic triode** (three-electrode) valve is basically similar to the diode except that a "grid" is interposed between the cathode and the anode.



CONSTRUCTION OF TRIODE (BASE & PINS OMITTED)

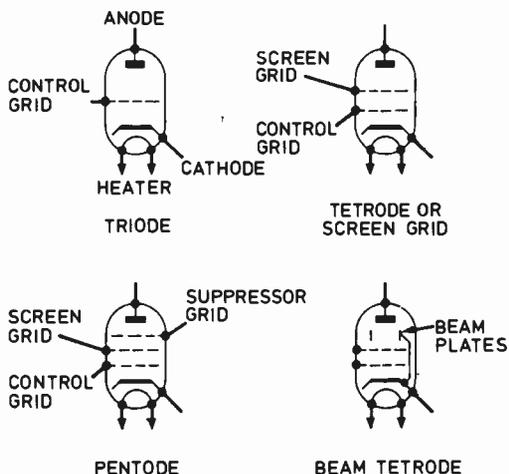


Fig. 42: Basic construction of a thermionic triode, plus circuit symbols for this and some more complex valves.

The **grid** consists of a spiral of wire (usually nickel) arranged around the cathode. The turns are welded to support rods for rigidity, as shown diagrammatically in Fig. 42.

If a positive potential is applied to the anode and the grid is connected to the cathode, electrons will leave the cathode, pass through the grid and accelerate towards the anode, causing the valve to "conduct".

If a negative potential is now applied to the grid, the grid structure will repel electrons and if the potential is great enough it will repel all the electrons emitted by the cathode, thus "cutting off" the flow altogether and making the valve non-conductive.

If however, the grid potential is held or biased a few volts negative, it is possible to control the conduction of the valve by small variations of the grid potential about this value.

There are a few simple relationships that we need to remember about the voltages and currents in the triode valve.

Mutual Conductance

The ratio of the change of anode current (for a fixed anode voltage) to a change of grid voltage is known as the **mutual conductance** or "slope" of the valve (symbol g_m). It is usually quoted in mA/V, sometimes millimhos or millisiemens.

$$g_m = \frac{\text{Change in anode current (mA)}}{\text{Change in grid voltage (V)}} = \frac{\Delta I_a}{\Delta V_g}$$

Amplification Factor

The ratio of the change of anode voltage to the change of grid voltage (for a constant anode current) is known as the **amplification factor** of the valve, (symbol μ or mu).

$$\mu = \frac{\text{Change in anode volts}}{\text{Change in grid volts}} = \frac{\Delta V_a}{\Delta V_g}$$

Impedance

The ratio of the change in anode voltage to a change in anode current (for a fixed grid voltage) is known as the **impedance** or a.c. **resistance** of the valve (symbol r_a).

$$r_a = \frac{\text{Change in anode volts}}{\text{Change in anode current}} = \frac{\Delta V_a}{\Delta I_a}$$

The relationship between mutual conductance, amplification factor and impedance is given by

$r_a = \frac{\mu}{g_m}$ and putting this in the form of a memory aid we have the triangle of Fig. 43. Note that if g_m is in milliamps/volt then μ must be multiplied by 1000.

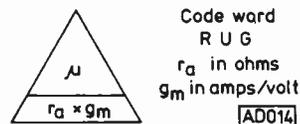


Fig. 43: The Impedance Triangle.

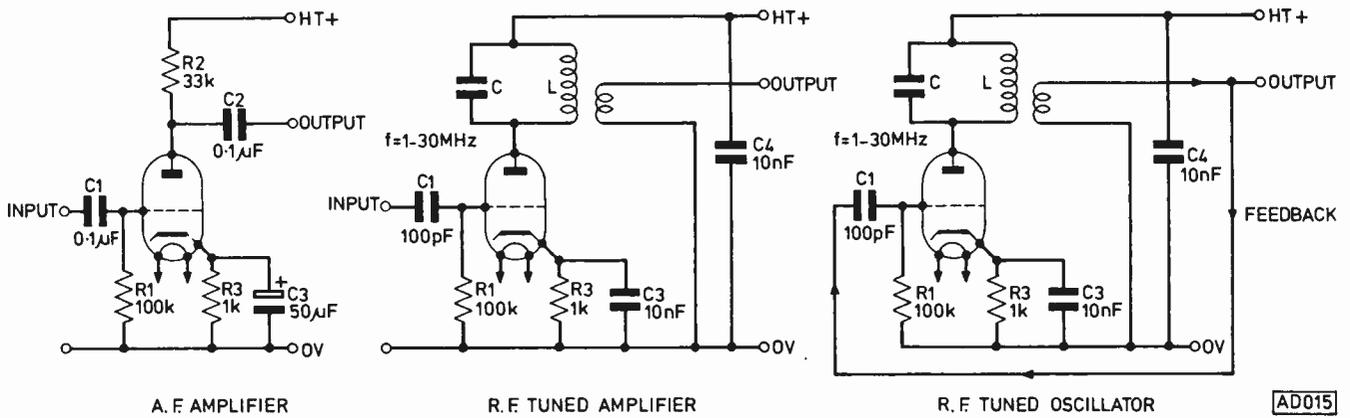


Fig. 44: Basic single-valve circuits for an A.F. Amplifier, a tuned R.F. Amplifier and an R.F. Oscillator.

Tetrodes and Pentodes

The **tetrode** (four-electrode) valve, has an additional grid, known as the **screen grid**, which is placed between the control grid and the anode. This grid, when maintained at a fixed positive potential, has the effect of increasing the amplification of the valve.

The **pentode** (five electrodes) has yet another grid interposed between the screen grid and the anode. This is known as the **suppressor grid**. It is normally connected to the cathode and its purpose is to suppress any secondary electrons which may be emitted from the anode and would otherwise be attracted to the screen grid causing excessive screen current and a reduction in efficiency.

A further improvement in the performance of tetrodes can be achieved by the use of **beam-forming plates**. These plates are arranged in conjunction with the grid structure to focus the electrons emanating from the cathode into a beam, thus reducing the screen-grid current and improving the overall efficiency of the valve. These valves are known as "beam tetrodes".

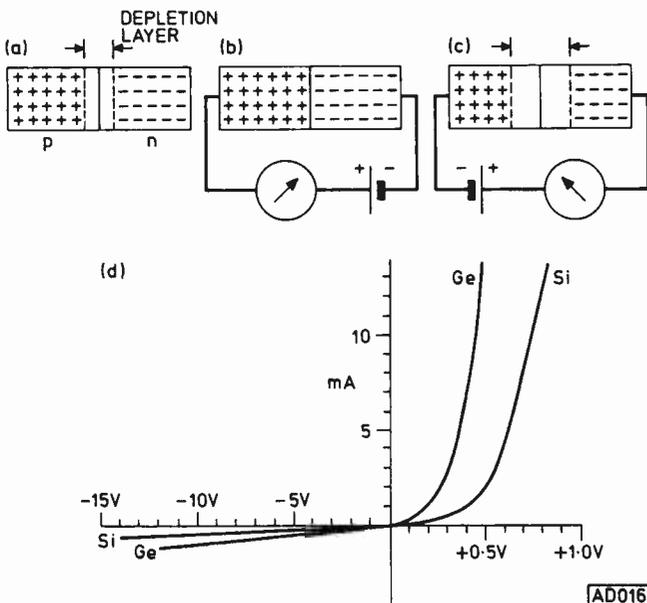


Fig. 45: The semiconductor junction diode (a) without external bias (b) forward biased and (c) reverse biased. In (d) is shown the current/voltage characteristic.

APPLICATIONS OF VALVES

Audio Amplifier

The triode valve in Fig. 44 is used as an **audio-frequency amplifier**. The negative bias voltage for the control grid is provided by including a resistor in the anode circuit. The current flowing in the anode circuit also flows through the cathode resistor resulting in the cathode being raised to a positive potential of a few volts. Since the grid is held at zero volts by R1 then, with respect to the cathode, the grid appears negative.

An audio frequency voltage applied to the grid will vary the electron flow to the anode (the anode current) and the variation of this current through R2 produces an audio frequency voltage across R2 and also at the output terminal. Capacitor C2 is included to pass this amplified audio frequency voltage but not the standing direct voltage on the anode.

The coupling capacitors C1 and C2 and the decoupling capacitor C3 are chosen to have a low reactance at audio frequencies and the values given are typical, as are the resistor values.

Tuned Amplifier

The DC conditions are similar to the AF amplifier but in this circuit the anode resistor is replaced by a parallel tuned circuit. The impedance of this tuned circuit is maximum at resonance and so the amplifier will have maximum amplification at the resonant frequency. The output could be taken from the anode or from a coupling winding as shown.

As in the previous circuits coupling and decoupling capacitors are chosen to have a low reactance at the operating frequency and the values shown are typical.

Valve Tuned Oscillator

By taking the output from the tuned amplifier and returning this to its input (and assuming that the polarity of the signal is correct) then the circuit becomes an oscillator.

Assume a small signal or disturbance occurs at the grid which produces an amplified signal at the output and this is in the same direction as the original signal.

When this is fed back to the grid the signal is amplified yet again and again until eventually the amplitude is limited by the valve being cut off or made fully conductive. The output signal is then an approximation of a sine wave at a frequency determined by the resonant frequency of L and C.

There are many types of oscillator circuits, all basically consisting of an amplifier with a frequency-selective or tuned circuit to define the frequency of oscillation. Look at some receiver circuit diagrams and find the oscillator tuned circuit and the transistor or valve providing the amplification to maintain the oscillation.

SEMICONDUCTOR DEVICES

Several of the reference books listed at the beginning of this series contain sections on the nature and behaviour of semiconductor materials and so we will omit these and pass on to describe briefly the semiconductor diode and transistor.

Semiconductor Diode

A semiconductor junction diode consists of a piece of *p*-type semiconductor and a piece of *n*-type semiconductor joined together as shown in Fig. 45(a).

The *p*-type material has an excess of holes and the *n*-type, an excess of electrons. At the junction, electrons and holes cross the junction and recombine leaving a region virtually depleted of all charge carriers, known as the **depletion layer**. Since the *p*-type has lost a few holes it acquires a slight negative charge and the converse is true for the *n*-type which acquires a slight positive charge. Thus there exists a small reverse bias across the junction.

In Fig. 45 we show the "forward biased" condition. The applied voltage has first to exceed this "built-in" reverse bias before current will flow. For silicon materials this is 0.6-0.7 volts and for germanium, 0.2-0.3 volts. Once this potential has been exceeded current flows readily in the "forward" direction.

The "reversed bias" condition is shown in Fig. 45c. Here the depletion layer has been increased in width, i.e. there is a large region where there are no free charge carriers and only a very small leakage current flows.

Increasing the voltage to a very high level will eventually cause the diode to break down. If the current is not limited in any way this will permanently damage or destroy the diode. The characteristic of a semiconductor diode is shown in Fig. 45(d).

Semiconductor diodes have many applications as rectifiers in power supplies, detectors, demodulators, switches etc.

SEMICONDUCTOR DIODE APPLICATIONS

Power Supplies

Because, unlike valves, semiconductor diodes do not require a heater and associated heater supply they are ideal for use in a bridge rectifier circuit which provides full-wave rectification from a single winding. The current flow through the bridge for each half-cycle is shown in Fig. 46.

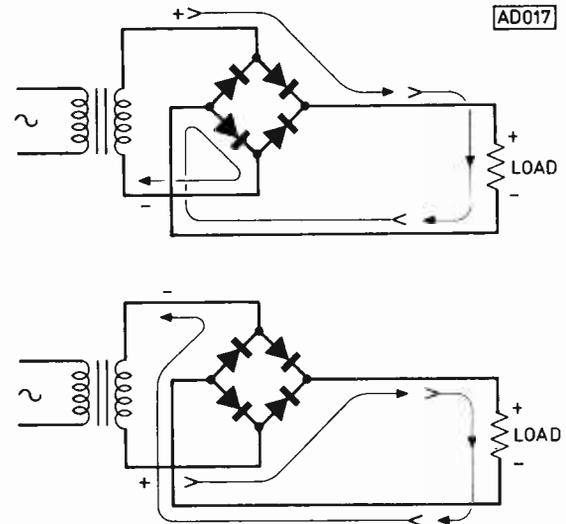


Fig. 46: Current flow around a bridge rectifier circuit.

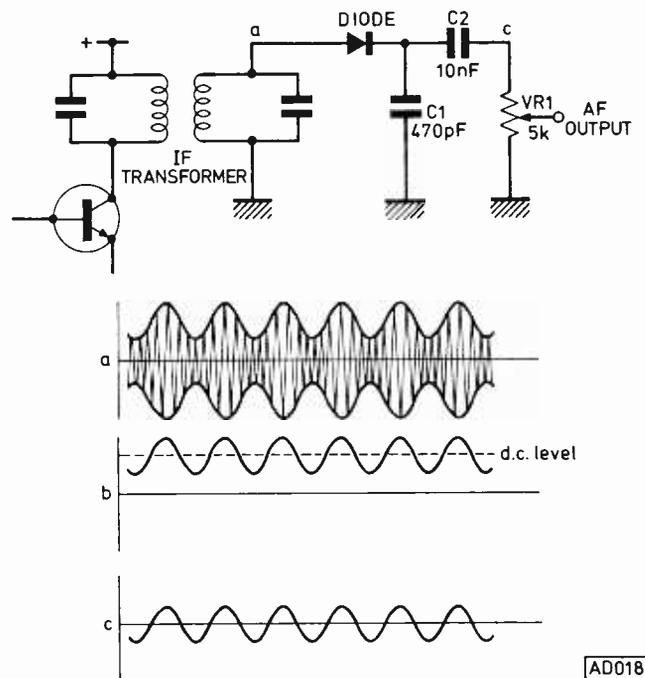


Fig. 47: A diode detector circuit with waveforms produced at various points.

Diode Detector

The circuit in Fig. 47 shows a simple amplitude modulation detector stage. An r.f. signal at the intermediate frequency, amplitude modulated with audio frequencies, is present at "a". At "b" the negative-going section of the r.f. and a.f. waveforms are removed and the a.f. appears varying about a DC level which is obtained by the "smoothing" action of C1 (similarly to DC power supplies). Capacitor C2 removes this DC level and passes the audio frequencies (now varying about zero level) to the load resistor VR1. From this point the a.f. goes through one or possibly several stages of amplification, to the loudspeaker.

Next month we cover transistors, transmitters and modulation.

THE FORCEFUL MR. FLEMING

"If the thumb and first two fingers of the left hand are held at right angles to each other, the first finger represents the direction of the field, the second shows the current, and the thumb points along the direction of the force". So runs Fleming's Left-Hand Rule. Don't feel dejected if you aren't a Russian gymnast and suffer with very stiff wrists (or happen to have a hand in plaster), the whole thing hinges on a bit of confusion regarding Part 4 of our series "Design Your Own", in which Fleming's Left-Hand Rule is quoted.

Several readers have noted that the Left-Hand Rule is traditionally associated with the electric motor principle, while the Right-Hand Rule covers the dynamo or generator principle. Most text books written before about 1970 will be found to follow this convention, indeed, even as late as 1968, Noakes ("Text-Book of Electricity and Magnetism", Macmillan, London) referred without question to "the Left-Hand motor rule and the Right-Hand dynamo rule". Similarly, Morley and Hughes in their perennial "Principles of Electricity" point out the difference, but without mention of alternative implications.

The definitive version is related to electron flow rather than to conventional current flow, and M. Nelkon in "Electricity" (Arnold, London, 1971), outlines on p.245 the background to the apparent divergence of views:

"Fleming's Right-Hand Rule . . . note that the current direction is that of conventional current, or the movement of positive charges, which is opposite to the movement of electrons or negative charges. Applying the rule to Fig. 1 the middle finger points from P to Q. Hence, this is the direction of the induced emf in the conductor. If a galvanometer is joined to P and Q, completing the circuit, conventional current flow is from Q round to P through the galvanometer. Electrons move through the galvanometer in the opposite direction, from P round to Q".

Diagrammatically, the two opposing concepts involved in this one principle may be summarised by Fig. 2. There is of course no reason why, if you are so inclined, you should not reject modern ideas about electron flow, stick to conventional current, and

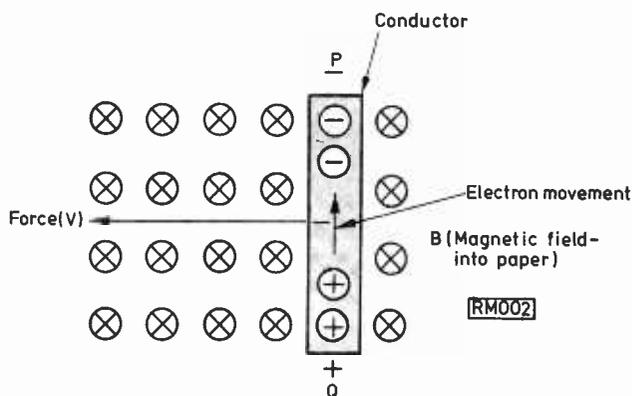


Fig. 1: The application of Fleming's Right-Hand Rule.

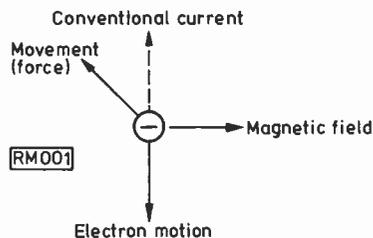


Fig. 2: If electron flow is used instead of conventional current, the opposite "Hand Rule" applies.

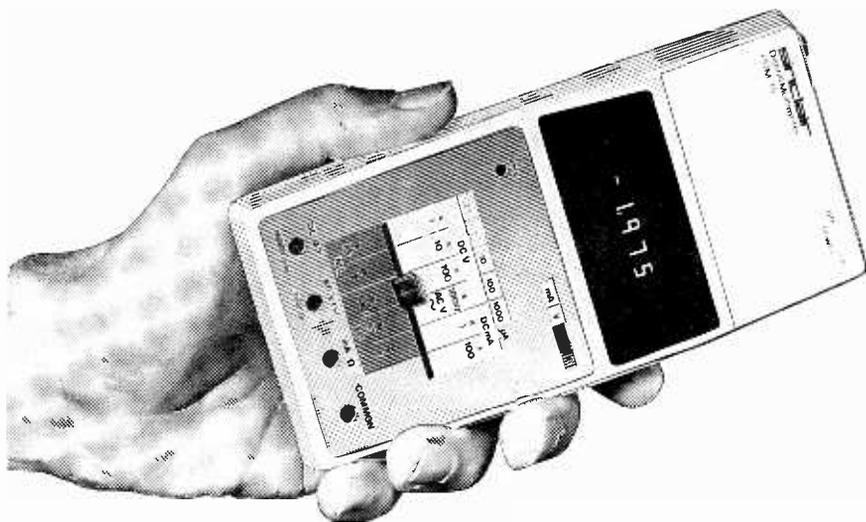
ignore the assumption that a motor is a generator "inside out" as it were. In other words, it's up to you how you respond on this one. At least one thing is certain—if the lights go out again all over Europe, it will only be the result of industrial action, and not the sudden unaccountable reversal of a universal principle of physics.

Ted Parratt, with acknowledgements to M. Nelkon, "Electricity".

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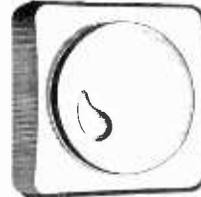
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ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

It would seem that not all readers of this column appreciate the purpose of the "Log Extracts" item at the end of this blurb each month. I get some lengthy logs, obviously copied with a lot of care, which might contain just one entry that qualifies for Log Extracts. So, valuable listening time is being wasted! The idea is that as most listeners to the amateur bands keep a record of the number of different countries or zones heard, either from a sense of personal achievement or to get various certificates, they need to know of any activity from stations in countries or zones not normally or seldom heard. QSL information is most important and a rare station will usually have a "QSL Manager", frequently in the USA, and his callsign is all that is needed initially.

But, what is a "rare" station? Today, most such stations are "DX-peditions" organised by a group of amateurs to a seldom-heard country, and for a limited period. Unfortunately, like so many other ideas, the DX-pedition is frequently taken to extremes by "activating" remote reefs and islets, often under water for a lot of the time, that could not be considered "countries" by any stretch of the normal imagination. However, there are permanent stations in countries where amateur radio is viewed with a jaundiced eye by the authorities. Operation is intermittent and when a station does come on he could be considered as "rare".

The newcomer to amateur radio cannot, logically, expect to know what is rare and what is not until he has had some experience of the various bands and learned their characteristics. So choose your monthly selection of rare ones very carefully, half a dozen would be a lot!

First, an SOS! **David Birch** of Trowbridge, Wilts., are you there? I have mislaid your last letter and so your full address. If you will write to "G2DYM Aerials" you will hear something to your advantage! See their ad. in any issue of PW. **Les Weeks** of Manchester has been busy with his FRG-7 receiver, particularly on 10 and 15m bands. He comments that he has plenty of spare time "owing to muscular dystrophy, bronchitis and emphysema, but otherwise I'm OK"! Our hobby is probably about the best possible for such unfortunate folk. I do hope, Les, that you will soon be able to take your RAE and talk back to the stations that, so far, you have only logged.

A GM4 call in the New Year is the aim of **John Overton** in Glasgow and he has already decided that a Yaesu FR50B and FL50B set-up will do to start with! John is one of the few readers submitting some loggings on CW. Talking of CW, the award of the month for persistence must surely

go to **Jess Luxton G8GMI**, a member of the RAIBC, who has copied code for at least a couple of hours a day for the last four years and has now passed his test. I look forward to knowing your new call OM!

Bill Stewart of Dundee had had his FRG-7 for just a week when he wrote to me asking a string of questions on amateur matters! As with all newcomers I referred him to the RSGB's *Guide to Amateur Radio*, £1.38 by post, which contains all the answers, just about. Welcome to our world Bill. Another newcomer is **David Greenhalgh** who hails from Poynton in Cheshire. He has been SW DX-ing but now wants to move up to the amateur bands. Good lad, you are on the right track! However, being only 14 he doesn't have that much bread to spare for a suitable RX so if anyone has a spare set going cheap write to David at 24 Park Avenue, Poynton, Cheshire. Must get you active somehow, Dave!

Simon Robinson was also sans RX until he got hold of a version of the famous B40 at a rally. This plus a 100ft "invisible" aerial down the garden has got him going properly, at last. Simon, of Stocksfield, Northumberland, recently appeared on BBC TV's "Swop Shop" and later enjoyed a tour of the studios. He, too, is a hopeful for the RAE next year. **Dave Peck** BRS37621 remains the sole reader reporting on RTTY activity although I am sure that there must be others. He now has a brand-new Creed 7 printer which he celebrated by copying his first ZL in this mode.

From Worcester, **Bernard Hughes** submits a brief letter and log but since he is BRS25901 he is obviously an old hand at the game! Stations logged included 5W1AZ, HH5RB, HP1PS all of which I consider as "rare". He uses an FRG-7 plus dipoles and a 66ft wire. Regular **Brian Harrison** (Hastings) doesn't like turning his AR88 off in case he misses anything on the 10m band! Don't then, if you can afford to pay for the electricity! Or run the oscillator valve heater from a separate transformer that is permanently on, thus eliminating the annoying warm-up drift on this set. Catch of the Month for **Paul Pasquet** of Farnham, Surrey, was KC4USV/MM at the McMurdo Ice Station in the Antarctic, on 20m, on his new HQ170.

Log extracts

P. Pasquet:— 80m VP8OW 20m KC4USV/MM ZK1DR 3D6BP 15m VS6BB UV0EX (Sakahlin Is.) KG4SC 10m A6XB CX8BE FM0FC H18LAP HD1DX ZD8EW

B. Hughes:— 20m P29JS VU2LQA 5W1AZ 15m FM0FC HH5RB H18FEG HD1DX KZ5PM VP2MF VP2MUU 10m PY2CSS ZE6JC ZS6AYW

B. Harrison:— 20m CE0AE (Easter Is.) 15m DU2GL 10m A4XGB CW0A (Uruguay) EP2RL FG7AX FM7AV HD1DX (Ecuador) H18XDJ HP1PK HK0QA (San Andres) OA4M OY1A PZ1DP TA1ZB VP2MSA VP8LP VK6HK ZD7HH 3D6BE 5T5ZR

J. Overton:— 40m CW VK3AE ZL3GQ 20m PJ2FR TR8GB VP8PJ YN1KL FG7AR/FS7 FM7WV FP8DX

D. Peck:— 20m RTTY EA8IY JA4ONZ UA9PP VE1AA VK2SG VK4YS VK6IF YU3EM ZL2AQZ 4X4MR 7X4MD 9H1ET 20m KG6RT KL7BUY ZL3GS 6W8LZ

All loggings are SSB unless indicated otherwise.

BROADCAST BANDS

SHORT WAVE BROADCASTS

by Charles Molloy G8BUS

It was with regret that the writer listened to the final edition of DXers Calling from Radio Australia. On the air weekly without a break for the past 31 years, this programme finally came to an end on 20 October, though there will be a segment for DXers in Club Forum, which is broadcast at the same times one day earlier, Fridays at 2040 and Saturdays at 0240, 0840 and 1440. On a brighter note, Radio Nacional Espana now has a weekly programme for DXers in its European broadcasts. It can be heard on 7155, 9505 and 11840 kHz on Sundays towards the end of the English transmission. Listen around 2215 GMT.

Harold Emblem (Mirfield) sends news of the Voice of Turkey which is now on 7175 as well as 9515 with its nightly programme in English which starts at 2200. There is a DX programme in English on Monday to Friday at 2230. Harold logged the new channel at 2300 using his Eddystone 730/4. **G. A. Powell** (Lichfield) has been trying the short waves with an old Beethoven domestic set connected to a 40ft length of wire dangling from a 12th floor window (is this safe? A whip aerial on the window would probably give as good results). DX heard with this set-up between 2000 and 2330 included All India Radio and HCJB Ecuador both on the 25m band. The Voice of the Andes, HCJB, Quito Ecuador is operated by World Radio Missionary Fellowship and reports should go to Casilla 691, Quito, Ecuador. DX Party Line, from HCJB is now on the air on Mondays, Thursdays and Saturdays at 2000 on 11955 in the 25m band and 15300 in the 19m band.

"I have tried unsuccessfully to receive Latin American stations and I wonder if you can help me" writes **John Larkin** from Clonmel, Co. Tipperary. John uses a Philips 5-valve receiver with either an 80ft loft aerial or a TV aerial, and his log contains The Voice of Turkey on 9515 at 2225, Radio Havana Cuba on 17885 at 2025 and Radio Australia on 9520 at 0745. Listen for Latin America from 2100 in the evening on the 31m, 25m and 19m bands. On 31m look for Radio Aparacida Brasil on 9635, La Voz de Chile on 9680, Radio Rio Mar Brasil on 9695. On 25m listen for Radio Clarin, Dominican Republic on 11700, Radio Globo Brasil on 11805, Radio Brasil Centro on 11815, Cap Haitien in Haiti on 11835, Radio el Espectador Uruguay on 11835. When conditions are favourable many Latin Americans can be heard between 2100 and midnight on these bands.

It is on the Tropical Bands though, especially 60 metres (4750 to 5060kHz) that Latin America dominates the scene, for it is here that large numbers of low to medium power locals operate, and when there is a path of darkness to the UK they can easily be picked up here. Listen from 2300 onwards through the night for Radio Popular Ecuador on 4800, Radio Clarin, Dominican Republic on 4850 (in English Monday—Friday at 2330), Radio Universo Venezuela 4880, Radio Progreso Honduras 4920, Ecos del Torbes Venezuela 4980, Radio Sutatenza Colombia 5075.

Fred Ainslie's main interest is in the Tropical Bands since "there are no jammers or megawatters and West Africans and South Americans are regulars". Using a homebrew triple conversion receiver he reports hearing VLM4 Brisbane Australia on 4920kHz on several occasions just after dawn (must have been on the long route across the Pacific!), Radio Singapore on 5010 and 5050 (both channels carry the same programme which makes identification easy) and Burma on 4725 closing down in English at 1500. DX from Africa includes Lagos on 4990, Accra on

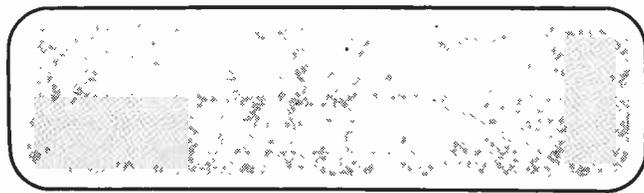
4915, Mauritania on 4845, Congo on 4765, ELWA Liberia on 4770, Dakar 4890, Benin 4870, Ivory Coast 4940, Togo 5047, all between 2100 and 2300.

"Any gen on Indonesian stations, are they still on the short waves?" asks Fred. Indeed they are. On the International Bands RRI is listed as broadcasting daily in English at 2330 on 9710 and 11970, though the writer has not managed to log it on either channel. On the Tropical Bands, though, there are plenty of Indonesian locals which can be heard in the UK during two time slots daily; from 1400 until sign-off at 1600 and again from sign-on at 2200 until fade-out after midnight. Search on 60m for Ujung Padang on 4719, Medan 4763 and Jakarta on 4774 during the afternoon at this time of year, and for Semarang on 3935 (75m band), Jakarta on 4805, Banda Aceh 4954 and Padang on 4985 in the late evening.

Tropical Band DXers will be interested in the Tropical Bands Survey, which is a 27-page booklet published annually in June, by the Danish Short Wave Club International. It contains a listing of all broadcasting stations in the range 2000 to 5900kHz, including transmission times where known. Stations are classified as Regularly Reported, Seldom Reported, Not Reported but known active, Possible Inactive, and there is information about Indonesian Provinces and Special Districts. Write to the DSWCI, Greve Strandvej 144, DK 2670 Greve Strand, Denmark enclosing 5 International Reply Coupons which are obtainable for 25p each at main post offices, for a copy of the Survey and details of club membership.

Ian McLean, Port Glasgow, has a Worldwide 9-band receiver purchased in Canada, which when connected to a 100ft long wire via a Codar PR40 Preselector pulled in Radio Jerusalem on 9090 at 2000, Cairo on 9495 at 2200, All India Radio on 9590 at 2202, Pakistan on 15110 at 1000, Radio Havana 17885 at 2110 and Radio Australia on 21570 at 0928. (The Address of Radio Australia is PO Box 428G, GPO Melbourne 3001, Australia). Ian has been trying to log Radio Afghanistan and NHK Japan. Try 15365 or 15195 at 1130 for Afghanistan in English in the International Service, or for the Home Service from 1530 until 1740 on 4775kHz in the 60m band.

Radio Japan can be heard in English between 0800 and 0830 on 15325kHz in the 19m band. On Sundays there is Tokyo Calling at 0810, followed by DX Corner at 0820. This transmission is also on the 16m band, though the frequency was not mentioned over the air and it could not be heard by the writer. Much louder reception was obtained, in Japanese at 0755 on 17795 and 17825 followed by the interval signal at 0800 and then talk in Chinese. According to a recent report in Sweden Calling DXers, Radio Japan intends to build relay bases in the Mediterranean and Caribbean area in order to improve reception in Europe and the Eastern United States.



MEDIUM WAVE DX

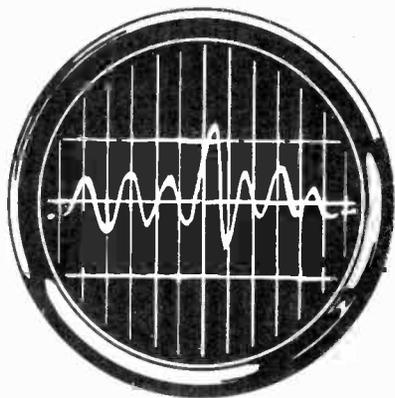
by Charles Molloy G8BUS

A good log of Asiatic and American DX comes from Booterstown, Co. Dublin where **Mike McGovern** uses a Philips BX48A receiver along with a home-made pre-selector. Stations heard were Taipei in Taiwan, on 600kHz at 2100, Bangkok on 830 at 2300, Fukuoka Japan on 1410 at 2100, Iba in the Philippines 1470kHz at 1600 and Radio Nacional in Paraguay on 920 at 0130. Also KOMO in Seattle on 1000 at 0630, CHQM Vancouver on 1320 at 0530 and KFBK Sacramento on 1530 at 0430.

Although Mike has heard and verified 25 of the 50

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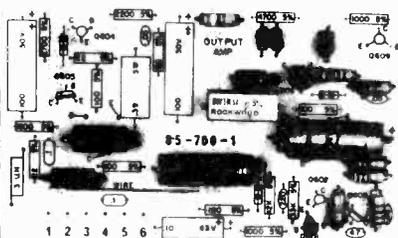
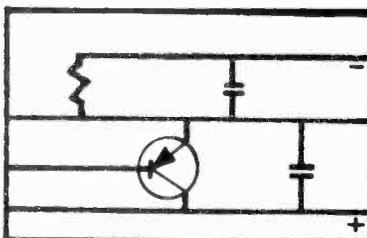
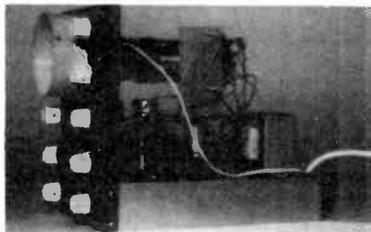
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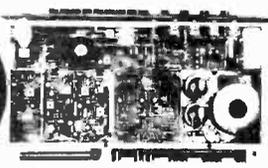
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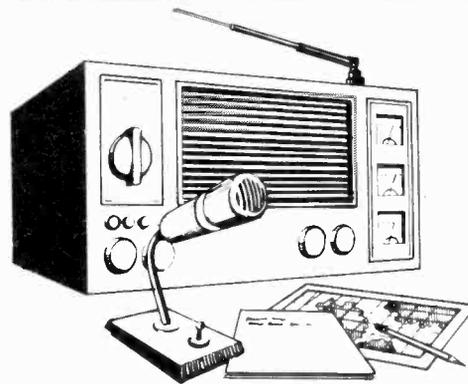
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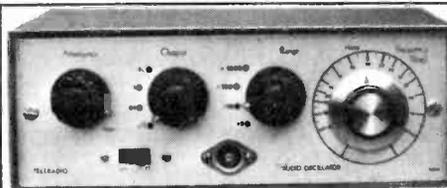
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states of the USA he has not been successful with Alaska and he suggests the reason might be that the Great Circle path from his QTH to Alaska passes over the north magnetic pole which is in Bathurst Island. This of course is the reason why Alaska and parts of the Pacific are not logged in the UK. In the vicinity of the north magnetic pole absorption of medium wave signals is high and it is this factor rather than distance that prevents world wide reception on the medium waves. DXers in New Zealand and Australia are able to pick up medium wave stations in Europe and it is only the high level of QRM that inhibits reception in the reverse direction.

Another good log, this time from **Fred Ainslie** of Hartlepool, who uses a homebrew receiver and a 100ft long wire. He had modified the receiver so that the second IF is now 100kHz. This gives very good selectivity but has degraded the sound quality. Detuning slightly to either side of the carrier should improve the audio. Fred mentions the 1000kW transmitter in Calcutta on 1130kHz which he has heard regularly signing on at 2145 with the All India Radio theme tune followed by a programme in Chinese.

Highlights from a very comprehensive log include two Asiatics, Quetta Pakistan on 750kHz and Hyderabad India on 1010; four from the Caribbean, St. Vincent on 705, St. Lucia on 840, ZDK Antigua on 1100 and Martinique on 1310 and four Africans, Gambia on 648kHz, Dakar 764, Sierre Leone 1205 and Libreville, Gabon on 1554. All heard between 2300 and 0100 GMT.

David Brooks of Redruth in Cornwall asks for information about receiving far-off stations on the medium waves. First, there must be a path of darkness between transmitter and receiver. There is no DX to be heard during the day on the medium waves! The main obstacle to MW DXing in the UK is interference (QRM) as the band is overloaded with Europeans, many of whom stay on the air all night.

A communications receiver used with a loop aerial will go a long way to reducing QRM but a careful study of station schedules can also help. A number of Europeans do sign off at night, usually around 2300, but on Saturdays many are on extended schedule, so Saturday is actually the worst evening for DXing. On Sundays signing-on times are usually later than during the week and this applies to the BBC whose domestic services are up to one hour later in starting than on other days. Sunday therefore offers quite an advantage to the DXer who listens around sunrise.

A careful study of the European band plan, which incidentally will change next November, will pay big dividends. In Europe, stations are on channels separated by 9kHz (apart from near the band edges) while in other parts of the world the separation is 10kHz and the channels are also on multiples of 10kHz, i.e. the last digit is a zero. It follows from this that at intervals of 90kHz the channels of the two systems coincide and at these points DXing will be difficult. These are 620kHz, 800, 890, 980, 1070, 1160, 1250, 1340, 1430 and 1520kHz. There are other parts of the band where the separation between the closest European and possible DX channels is 4kHz. These frequencies occur in pairs such as 660kHz and 670kHz, 750 and 760, 840 and 850 and so on through the band. Baghdad is on 760kHz which lies between the European channels 755 and 764 and consequently it is logged frequently by DXers in the UK.

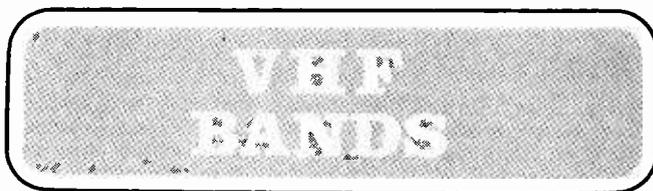
A few DX stations operate on what US DXers call a split channel—the last digit is a 5. St. Vincent on 705 logged by Fred Ainslie is an example of a “split” which lies between 701kHz and 710kHz, both heavily occupied by QRM. Studying the European band structure and searching for holes where DX may be found, plus a study of European schedules, will pay off in a big way for the MW DXer who lives in the UK. It may also help to explain to the newcomer to the hobby how quite exotic DX such as Japan, India and Latin America can be heard on occasion on the medium waves.

Derek Taylor (Preston) has been “doing a little experimenting” with loops recently. He fixed up two turns of wire the complete circumference of the room, which in practice is an 8 by 12ft loop. The turns should be vertical, not horizontal. The position of the fixed loop is roughly NE/SW and its effect on the signal strength of Latin American and Caribbean stations was remarkable. When listening to ZDK (1100kHz) on a 40in loop the station could just about be copied, but when the large loop was used a gain of some 10 to 15dB was obtained, while with Radio Margarita, Venezuela on 1020 an attenuator had to be switched in.

The rig in use is a Yaesu Musen FRG7 communications receiver. Derek says that although not very versatile and a little prone to QRM, his large fixed loop could make the difference between a station being unreadable and loud enough at least to get enough for a reception report. This type of aerial cannot be used with a transistor portable or other receiver that has its own internal aerial.

Two YENED (Greek Armed Forces) stations are mentioned in Derek Taylor's log. The 200kW transmitter in Athens on 980kHz can be picked up with a loop as the strong Arabic station (Algiers) that shares the channel, can easily be nulled-out. The other is Thessaloniki on 1178 which is usually swamped by Horby in Sweden and in this case a loop is of little help as the two stations are roughly on a reciprocal bearing from the UK. Horby though, signs off for half an hour from 2130 to 2200, between the end of its domestic and the start of its international service, providing a time slot when the Greek station can be heard loud and in the clear.

Fourteen-year-old **Stephen Cook** has a Realistic DX160 communications receiver coming his way at Christmas and he would like to hear from fellow users. Write to Squirrels Leap, Bonville Chase, Altrincham, Cheshire, WA14 4QA. Postage will be returned.



by **Ron Ham BRS15744**

Congratulations to a frequent contributor, **Alan Baker**, formerly G8LGQ, who, having passed his morse test now sports the callsign, G4GNX. Alan plans to install HF gear both at his home in Newhaven and in his car, and will no doubt chalk up more super DX to add to his already spectacular VHF record. His first HF QSO was with an IT9 on 20m using the Mid-Sussex Amateur Radio Society's club station at Burgess Hill, and, a few days later, he made his first CW contact, from home, on 2m, with G6OX in Surrey and feeling happy with a key, his next QSO was, of course DX; a 559 on 2m with ON4VN.

It was Alan's regular reports that convinced me of the value of the repeater network for propagation studies, which prompted me to buy an FDK TM-56B, 12 channel plus 4 scan, FM monitor receiver, and its arrival coincided with the tropospheric opening which began on October 25th. The origin of this disturbance can be traced back to midnight on the 22nd when the atmospheric pressure gradually increased from 30.0in to 30.25in by midnight on the 24th, and then rose sharply to 30.4in at noon on the 25th where it remained for 24 hours and began to fall at midday on the 26th.

At 1016 on the 25th, a signal from the Bristol Channel repeater, R6, opened the squelch on my new toy, fed with a dipole 30ft AGL, and around the same time there were

539 signals on 70cm from GB3EM and GB3SUT. During the afternoon, G4GNX heard a Lancashire station operating through the Kent repeater, and, throughout the following day, I received strong signals from the repeaters in Birmingham, Bristol, Suffolk and Kent. Often the traffic through GB3BM was overpowering signals from our local repeater, GB3SN, in Hampshire; both on R5.

In the afternoon, Roy Bannister, G8LXR, Lancing, heard EI9Q working a 2m station in Crowborough and Andy Mepham, G4CBZ/P, worked a GW on 70cm using a vertical-colinear aerial on Ditchling Beacon, he also worked northern G stations on 2m using a 5/8 whip aerial mounted on his car.

For most of the day I received a watchable picture from Lichfield on Channel 8, strong signals from both the Emley Moor and Sutton Coldfield beacons on 70cm, and, around midday, a variety of continental broadcast stations were audible in Band II. At 1412 on the 29th, Alan Baker worked G8HPQ, Nr. Chesterfield, on 2m ssb, during another period of falling pressure, and in less favourable conditions, at 2155 on November 6th, he put out a chance CQ on 2m and contacted G8KHR in Newark.

The AP rose again to 30.2in from noon on the 8th to midnight on the 9th and by 0400 on the 10th it was falling, and, true to form, there was a brief tropospheric disturbance. For most of the morning I received strong signals from 10 continental broadcast stations between 88-100MHz, GW mobiles were opening my squelch via GB3BC and I heard a 59 signal from GU4EON via GB3SN. Around this time, Roy Bannister could hear both the Cambridge and Suffolk repeaters and French stations on S20, while G4GNX heard signals through the Bristol Channel and Kent repeaters and later had a 55 contact with G4DAZ in Bedfordshire.

Stan Heys, Peacehaven, a member of the St. Dunstan's Amateur Radio Society was, since 1972, an active SWL specialising in 80m, however, last August he obtained his licence and now operates on 2m under the call sign G8NOE. Stan has a Uniden 2030 giving him 10 watts of FM to a $\frac{1}{4}$ wave, loft-mounted ground plane, and so far he has worked about 100 stations and his best DX is St. Austell.

Cmdr. Henry Hatfield, Sevenoaks, and myself recorded several bursts of solar radio noise at 136MHz on October 22nd, 23rd, 25th and 28th, the result of which was no doubt responsible for the ionospheric disturbance reported by the BBC World Service on 27th and 28th. We both recorded further bursts on the 31st and November 2nd, 16th and 18th, noise storm conditions on the 6th and 17th, and high solar noise level on the 12th and 13th, which ties up nicely with the visual aurora reported at 2200 on the 14th and the ionospheric disturbance reported by the BBC World Service on the 16th.

On November 9, Henry gave a most interesting step-by-step survey, illustrated with slides, of the construction and workings of his spectrohelioscope, to a packed meeting of the Brighton and District Radio Society. Henry made many comparisons between the reception and bandwidth or radio signals and light waves but emphasised that his optical equipment works at 457 million megahertz. Members and guests present were fascinated by the pictures of the typical solar events which create the radio noise and cause radio blackouts and aurora which are frequently reported through this column and in other journals. On November 11th Henry saw two bright patches on the eastern solar limb and on the 13th he identified two new sunspots, and a fairly active area.

From October 23rd to 27th, Nigel Golds, BRS 36910, West Chilmington, Sx, heard 22 countries on 10m, from Israel to Argentina and from Italy to Ukraine. I have paid particular attention to the behaviour of signals from the International Beacon Project stations on 10m and at 1400 on October 31st I received a 539 signal from 3B8MS, Mauritius, and, a 559 from 5B4CY in Cyprus. Almost daily from November 3rd to 19th I heard 5B4CY around

0930 at strengths varying from 539 to 589, in fact, I could leave the receiver tuned to 28.220MHz and wait for its signal to appear. Most lunch times throughout this period, North American stations were as predominant on 10m as the Russian stations were in the early mornings.

Gordon Goodyer, BRS 37345, Petworth, Sx, using his Eddystone 750, a loft-mounted wire dipole and a homebrew, EF183 valve pre-selector did very well on 10m between 1030 and 1500 on the 13th. Gordon heard strong ssb signals from Ukraine to Rhodesia, Norway to North America, Spain to Argentina and much of South America. Between 0930 and 1030 on both the 13th and 15th I received 539 signals from the Bahrain beacon A9XC, 28.245MHz, and during the mornings of November 4, 5, 7, 8, 13, 14, 15 and 17, I heard signals, averaging 549, from ZE2JV a temporary propagation beacon for project TESSA (Transequatorial Scatter to Southern Africa).

Between 0830 and 2330, on November 14th and 18th I monitored the frequency (70.31MHz) of the Polish broadcast station at Gdansk and counted the number of times that its signal bounced off meteor trails (pings) during the Leonids meteor shower. The following rounded off daily figures show that the peak activity occurred on the 16th; total number of "pings" recorded daily were: 14th 7000, 15th 11000, 16th 14000, 17th 9000 and 18th 8000. I would be very interested to have more reports about this form of propagation.

Thanks again for your reports and for the interest you are taking in my column.

NEW BOOKS

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George H. Olsen

Published by W. H. Allen

306 pages £1.75.

On the face of it, this book appears to offer more value, in terms of cash for paper, than book No. 1, but it is debatable whether this is a prerequisite for any technical summary, so alternative judgements must follow.

It is to be hoped, starting at the cover, that readers will not immediately conclude that every technical process is so easily capable of ultimate simplification: "Build Your Own Orbiting Laboratory" is hardly likely to follow hard on the heels of this publication, in spite of the assertion of its title.

To be fair though, its treatment of an immensely wide subject area is at once engaging and concise. There is plenty that is traditional, such as "slabs" on power supplies, Hartley and Colpitts oscillators, use of ICs and so on, and it does move into the more involved processes of synchronisation and principles of television.

The sections dealing with the integration process are lucid and interesting, but I was not so impressed with the somewhat behind-hand diagrams showing typical shadow mask construction. Precision-In-Line, slot aperture colour tubes have been around for long enough to warrant inclusion, especially since moving-coil pick-ups are mentioned, if only at the diagram stage. Overall then, only one or two reservations—at some points information is sketchy—but there is a clear attempt to attack the subject from a wide base, and this can itself introduce the perennial problem of dynamic selection.

A slightly disturbing sensation results from the perusal of page 299, however. Kits for some of the projects are apparently available from NESLO Electronics—palindromes are clearly grist to Mr. Olsen's mill!

Ted Parratt

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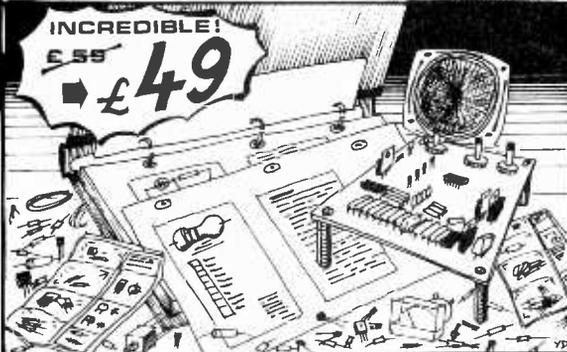
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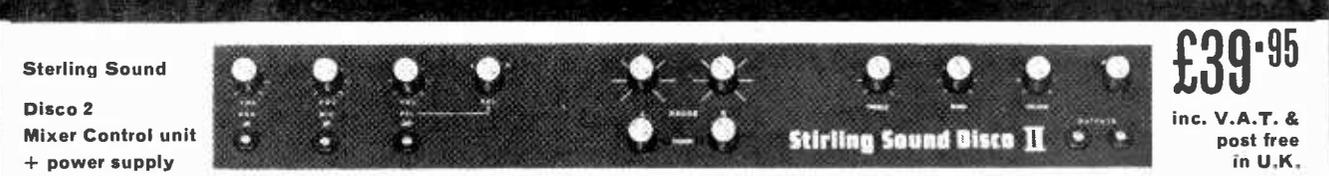
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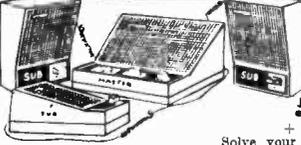
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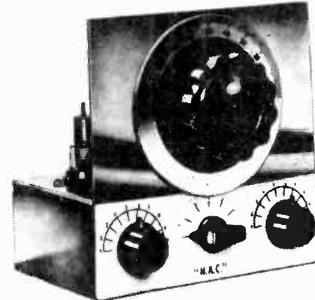
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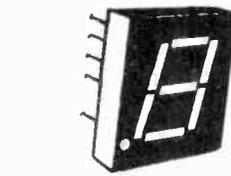
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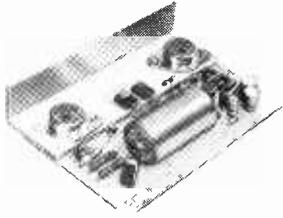
OUR UNIQUE BARGAIN PLAN CLOSES JAN. 31ST

STIRLING POLICY means specs. and prices you can rely on—no hidden extras—nothing to misunderstand. Until Jan 31st, when ordering a power amp. and power supply unit together

DEDUCT	<i>If ordered</i>	DEDUCT	<i>If ordered</i>	DEDUCT
5%	<i>with</i>	A	<i>with</i>	A
	UNIT ONE	FURTHER	UNIT TWO	FURTHER
		£1-00		£1-18

AMPLIFIERS 3 to 100 WATTS R.M.S.

Ready assembled on P.C.B.s., tested and guaranteed. Easy to connect. With instructions. Output ratings ± 1dB.

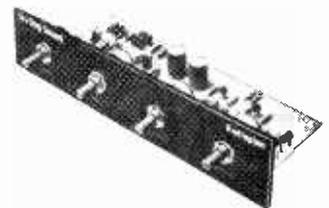
SS.103	I.C. amp. 3 watts R.M.S. using 20V/8Ω or 14V/4Ω. Input 100mV.	£2-85	
SS.103-3	Stereo version of above, 2 I.C.s	£5-00	
SS.105	5 watts R.M.S. into 3Ω using 13.5V. Sensitivity — 30mV. THD — 0-3%. 3½" x 2" x 1".	£3-95	
SS.110	10 watts R.M.S. into 4Ω using 24V. Sensitivity — 60mV. THD — 0-3%. 3½" x 2" x 1".	£4-85	
SS.120	20 watts R.M.S. into 4Ω using 34V. Sensitivity — 80mV. THD — 0-3%. 3½" x 2" x 1".	£5-15	
SS.125	25 watts R.M.S. into 8Ω using 50V. Sensitivity — 140mV. Distortion — Less than 0-05% into 8Ω S/N better than 70dB.	£7-25	
SS.140	40 watts R.M.S. into 4Ω using 45V. Sensitivity — 300mV. Distortion typically 0-1%. 5" x 3½" x 1½".	£6-50	
SS.160	64 watts R.M.S. into 4Ω using 50V. Sensitivity — 350mV. Distortion typically 0-1%. 5" x 3½" x 1½".	£8-50	
SS.1100	100 watts R.M.S. into 4Ω using 70V/2A. Input sensitivity — 500mV. Distortion at half-power, typically 0-1%. 5" x 3½" x 1½".	£10-50	
HS.160	Multi-finned heatsink for SS.140 or SS.160.	75p	
HS.1100	Ditto for SS.1100	£1-50	

THE CONTROL AND PRE-AMP MODULES

UNIT ONE
Combined stereo pre-amp & active tone control unit. Input sensitivity 50mV for 200mV out, 10/10V operation. Bass ± 15dB at 30Hz; Treble ± 15dB at 10KHz; Balance control; Volume control. For ceramic P.U. radio or tape inputs. WITH FREE CONTROL PANEL FASCIA **£9-00**

UNIT TWO
With control facilities similar to UNIT ONE but for magnetic cartridge input. R.I.A.A. corrected. Input sensitivity — 5mV for 200mV out (can be varied). WITH FREE CONTROL PANEL FASCIA **£12-43**

CONTROL PANEL FASCIA available separately **50p**
SS.100 basic active stereo tone control module to provide ± 15dB on base at 30Hz and on treble at 10KHz. **£3-00**
SS.101 Stereo pre-amp suitable for ceramics, tape, radio, etc. **£2-75**



SS.102 Stereo pre-amp for mag. pick-ups. R.I.A.A. corrected **£4-45**
F.M. STEREO DECODER, phase lock loop type, with LED indicator showing when a stereo transmission is being received **£5-25**

POWER SUPPLY UNITS

Every Stirling Sound Power Unit is tested and guaranteed under working conditions before despatch. All units except SS.312 include a stabilised low voltage take-off point (13-15V) for pre-amp, tone control, radio tuner, etc. Outputs quoted minimal unloaded ratings.

SS.312	12V/1A	£6-60
SS.318	18V/1A	£6-95
SS.324	24V/1A	£7-65
SS.334	34V/2A	£8-75
SS.345	45V/2A	£10-75
SS.350	50V/2A	£11-75
SS.360	60V/2A	£12-75
SS.370	70V/2A	£14-75

SS.310/50 Stabilised power supply unit with variable output from 10V to 50V/2A. Short circuit protected **£17-75**

SS.300 Power stabilising unit variable from 10 to 50V/8A for adding to un-stabilised supply units **£5-50**



ALL GOODS POST FREE IN U.K. ALL PRICES INCLUDE V.A.T. Prices subject to alteration without notice. Order to Dept. PW28A.

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ALL DEVICES BRAND NEW, FULL SPEC. AND FULLY GUARANTEED. ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.O. OR BANKERS' ORDER. WITH ORDER: GOVERNMENT AND EDUCATIONAL INSTITUTIONS OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT INQUIRY WELCOME. P & P ADD 25p* TO ALL ORDERS UNDER £10.00. OVERSEAS ORDERS POSTAGE AT COST.

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POLYESTER CAPACITORS: Axial lead type. (Values are in μ F)
40V: 0-001, 0-0015, 0-0022, 0-0033 8p, 0-0047, 0-0068, 0-01, 0-015, 0-018 9p, 0-022, 0-033, 10p, 0-047, 0-068, 14p, 0-1, 1.5p, 0-15, 0-22, 0-25, 0-33, 0-47 35p, 0-68 45p.
50V: 0-001, 0-0015, 0-0022, 0-0033, 0-047 18p, 0-068, 1-0 22p, 2-2 32p, 4-7 38p.
DUBILIER: 1000V: 0-01, 0-015 16p; 0-022 18p; 0-047 18p; 0-1 34p; 0-47 43p; 1-0 85p.

POLYESTER RADIAL LEAD (Values in μ F): 250V: 0-01, 0-015 6p; 0-022, 0-027 7p; 0-033, 0-047, 0-068, 0-1 8p; 0-15 12p; 0-22, 0-33 14p; 0-47 16p; 0-68 20p; 1-0 24p; 1-5 27p 2-2 31p

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in μ F).
250V: 100 65p; 63V: 0-47, 1-0, 1-5, 2-2, 2-5, 3-3, 4-7, 6-8, 8-10, 10, 15, 22, 9p; 47, 32, 50, 12p; 63, 100, 27p; 50V: 1-0, 7p; 50, 100, 22p; 47, 50p; 1000, 62p; 2200, 68p; 40V: 22, 33, 5p; 10, 22, 9p; 100, 12p; 3300, 62p; 4700, 64p; 35V: 10, 33p; 70, 33p; 330, 47p; 1000, 48p; 10, 22, 9p; 6p; 8p; 100, 16p; 100, 8p; 220, 25p; 13p; 470, 64p; 25p; 1000, 27p; 1500, 30p; 2200, 34p; 3300, 47, 47p; 4700, 54p; 18V: 10, 40, 47, 68, 7p; 100, 125, 8p; 470, 16p; 1000, 150p; 2200, 34p; 3300, 47, 47p; 4700, 54p; 10V: 4, 10, 6p; 640, 10p; 1000, 14p.

TAG-ENT TYPE: 70V: 2000, 98p; 4700, 121p; 50V: 3000 75p; 40V: 2500, 65p; 25V: 4700, 48p; 2000, 37p; 40V: 2000-2000, 95p; 350V: 32+32, 185p.

TANTALUM BEAD CAPACITORS: 35V: 0-1 μ F, 0-22, 0-33, 0-47, 0-68, 1-0, 2-2Hf, 3-3, 4-7, 6-8, 25V: 1-5, 10, 20V: 1-5 μ F, 18p each; 10V: 22uF, 33, 60, 22uF, 47, 68, 3V: 100uF 20p each; 10V: 100uF 35p, 16V: 47, 100uF 45p

MYLAR FILM CAPACITORS: 100V: 0-001, 0-002, 0-005, 0-01 μ F 5p; 0-015, 0-02, 0-03, 0-04, 0-05, 0-056uF 8p; 0-1 μ F, 0-15, 0-2, 2-7p. 50V: 0-47uF 10p

CERAMIC CAPACITORS 50V: Range: 0-5pF to 10nF
15nF, 22nF, 33nF, 47nF, 4p, 100nF 3p

POLYSTYRENE CAPACITORS: 10pF to 1nF, 6p; 1-5nF to 47nF, 10p.

JACKSONS VARIABLE CAPS.
Dielectric 105p 0-2 385pF 275p
100/300pF 105p 0-2 365pF with 305p
500F 125p motor Drive 305p
DILEMIN 00 208/176 285p
3000F/500pF 185p " " with slow motor drive 305p
6:1 Ball Drive 4511/DAF 107p* C804-5pF; 10; 15; 25; 50p

SILVER MICA (25P)
3-3, 4-7, 6-8, 10, 12, 18, 22, 27, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 200, 250, 300, 330, 360, 390, 600, 820pF 16p each
0-1-385pF (6p) 00-3x25pF 386p

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

MINIATURE TYPE: 2-5-6pF, 3-10pF; 3-30pF, 10-40pF 22p; 5-25pF, 65pF, 88pF 30p

COMPRESSION: 3-40pF, 10-80pF 22p; 15-200pF 33p; 100-500pF 12500pF 38p

AUDIBLE Warning Devices 12V 178p*

TRANSFORMERS* (Mainly Pri.M. 220-240V)
6-0-6V 100mA 90p 20-0-20 2A 320p+
9-0-9V 75mA 95p 6-0-6V 1.5A 345p+
12-0-12V 100mA 98p 0-18-0-18V 1.5A
0-12-0-12V 150mA 140p 0-15-0-15V 2A 240p+
0-4-5-0-4 5V 240p+
12-0-12V 0.5A 240p+
0-10-0-10 0.5A 240p+
15-0-15V 0.5A 240p+
24-0-24V 0.5A 280p+
2x 4-5V 0.5A 280p+
0-0-9V 1A 245p+
0-12-0-12V 1A 245p+
30-24-20-15-12-0 1A 240p
Multi tappings 36p+
30-24-20-15-12-0 2A, multi tap 445p+
15-0-15V 1A 245p+
18-0-18V 1A 275p+
30-0-30V 1A 295p+
(Please add 48p p&charge to all prices marked +, above our normal postal base.)

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0-4-5-0-4 5V 240p+
12-0-12V 0.5A 240p+
0-10-0-10 0.5A 240p+
15-0-15V 0.5A 240p+
24-0-24V 0.5A 280p+
2x 4-5V 0.5A 280p+
0-0-9V 1A 245p+
0-12-0-12V 1A 245p+
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Multi tappings 36p+
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0-4-5-0-4 5V 240p+
12-0-12V 0.5A 240p+
0-10-0-10 0.5A 240p+
15-0-15V 0.5A 240p+
24-0-24V 0.5A 280p+
2x 4-5V 0.5A 280p+
0-0-9V 1A 245p+
0-12-0-12V 1A 245p+
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15-0-15V 0.5A 240p+
24-0-24V 0.5A 280p+
2x 4-5V 0.5A 280p+
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0-10-0-10 0.5A 240p+
15-0-15V 0.5A 240p+
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2x 4-5V 0.5A 280p+
0-0-9V 1A 245p+
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TRANSFORMERS* (Mainly Pri.M. 220-240V)
6-0-6V 100mA 90p 20-0-20 2A 320p+
9-0-9V 75mA 95p 6-0-6V 1.5A 345p+
12-0-12V 100mA 98p 0-18-0-18V 1.5A
0-12-0-12V 150mA 140p 0-15-0-15V 2A 240p+
0-4-5-0-4 5V 240p+
12-0-12V 0.5A 240p+
0-10-0-10 0.5A 240p+
15-0-15V 0.5A 240p+
24-0-24V 0.5A 280p+
2x 4-5V 0.5A 280p+
0-0-9V 1A 245p+
0-12-0-12V 1A 245p+
30-24-20-15-12-0 1A 240p
Multi tappings 36p+
30-24-20-15-12-0 2A, multi tap 445p+
15-0-15V 1A 245p+
18-0-18V 1A 275p+
30-0-30V 1A 295p+
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TRANSFORMERS* (Mainly Pri.M. 220-240V)
6-0-6V 100mA 90p 20-0-20 2A 320p+
9-0-9V 75mA 95p 6-0-6V 1.5A 345p+
12-0-12V 100mA 98p 0-18-0-18V 1.5A
0-12-0-12V 150mA 140p 0-15-0-15V 2A 240p+
0-4-5-0-4 5V 240p+
12-0-12V 0.5A 240p+
0-10-0-10 0.5A 240p+
15-0-15V 0.5A 240p+
24-0-24V 0.5A 280p+
2x 4-5V 0.5A 280p+
0-0-9V 1A 245p+
0-12-0-12V 1A 245p+
30-24-20-15-12-0 1A 240p
Multi tappings 36p+
30-24-20-15-12-0 2A, multi tap 445p+
15-0-15V 1A 245p+
18-0-18V 1A 275p+
30-0-30V 1A 295p+
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TRANSFORMERS* (Mainly Pri.M. 220-240V)
6-0-6V 100mA 90p 20-0-20 2A 320p+
9-0-9V 75mA 95p 6-0-6V 1.5A 345p+
12-0-12V 100mA 98p 0-18-0-18V 1.5A
0-12-0-12V 150mA 140p 0-15-0-15V 2A 240p+
0-4-5-0-4 5V 240p+
12-0-12V 0.5A 240p+
0-10-0-10 0.5A 240p+
15-0-15V 0.5A 240p+
24-0-24V 0.5A 280p+
2x 4-5V 0.5A 280p+
0-0-9V 1A 245p+
0-12-0-12V 1A 245p+
30-24-20-15-12-0 1A 240p
Multi tappings 36p+
30-24-20-15-12-0 2A, multi tap 445p+
15-0-15V 1A 245p+
18-0-18V 1A 275p+
30-0-30V 1A 295p+
(Please add 48p p&charge to all prices marked +, above our normal postal base.)

TRANSISTORS

AC107	P	BC170	P	BF179*	P	OC23*	P	TIS49	P	2N2218A
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WATFORD ELECTRONICS

(Continued from opposite side)

DIODES	*BRIDGE RECTIFIERS	SPEAKERS
AA119 15	(plastic case)	8Ω 0.3W
AAZ15 15	2" 2.5" 85	2" 2.5" 3" 58
AEY11 80	1A/50V 20	40Ω 2.5" 85
BA100 10	1A/200V 25	8Ω 5W 190
BY100 24	1A/400V 29	7" x 4" 160
BY126 14	1A/800V 34	
OA9 12	2A/50V 35	
OA27 12	2A/100V 44	
OA70 12	2A/200V 46	
OA81 12	2A/400V 53	
OA85 12	2A/600V 65	
OA90 15	4A/100V 72	
OA91 6	4A/200V 75	
OA95 6	4A/400V 79	
OA98 6	4A/800V 105	
OA200 9	4A/100V 120	
OA202 8	6A/100V 73	
IN814 4	6A/200V 78	
IN916 5	6A/400V 85	
IN4001/2 5	BY164 58	
IN4003 5	VM18 40	
IN4004/5 6		
IN4006/7 7		
IN4148 4		
IS44 20		
3A/100V 18		
3A/400V 20		
3A/800V 27		
3A/1000V 30		
6A/600V 50		
SCR's	ZENERS	LAMP HOLDERS AND LAMPS*
Thyristors	Rng: 3-3V-33V	LES HOLDER Dome shaped, Red, Blue, Green, Yellow, White
1A50V 38	400mW 9	1-3W 17
1A100V 42		
1A200V 47		
1A400V 52		
1A800V 70		
3A50V 38		
3A100V 43		
3A200V 80		
3A400V 110		
3A800V 120		
5A400V 129		
7A400V 125		
8A400V 150		
BT106 150		
CT106D 55		
TIC44 25		
TIC45 45		
2N4444 191		
	VARICAPS	LES BULBS 6v and 12v
	MVAM2 135	MES HOLDERS Chrome cover, Red or Amber, Jewelled top
	MVAM115 95	LES OR MES Batten Holders
	BB104 40	MES BULBS 3-5V 6V 12V
	BB105B 40	NEONS Mains, Sealed with Resistor, Sq. Top, Red or Grm. Round Top Red
	BB106 40	Neon Open with leads, 95V AC
	Noise Diode	FERRIC CHLORIDE*
	Z5J 105	1lb bag Anhydrous 65p + 30p p. & p.
	ALUM. BOXES with lid*	DALO ETCH RESIST
	2 1/2 x 3 1/2 88	PEN* + spare tip 75p
	4 x 4 x 1 1/2 88	COPPER CLAD BOARDS*
	4 x 2 1/2 x 1 1/2 60	Fibre Single-Double-SRBP
	4 x 5 1/2 x 1 1/2 78	Glass sided 8" x 10-5"
	4 x 2 1/2 x 2 64	6" x 6" 75p 90p 75p
	5 x 4 x 2 82	6" x 12" 130p 175p
	6 x 4 x 2 88	DIL SOCKETS*Low Profile (TEXAS)
	7 x 5 x 2 114	8 pin 10; 14 pin 12; 16 pin 13; 18 pin 20;
	8 x 6 x 3 148	22 pin 27; 24 pin 30; 28 pin 42; 40 pin 58
	10 x 7 x 3 172	SOLDERCON PINS*
	10 x 4 x 3 142	100 - 50; 1000 - 350;
	12 x 5 x 3 165	TERMINALS* - Screw type Insulated
	12 x 8 x 3 210	Red, Black, Yellow, Green, White 21

OPTO ELECTRONICS*

LEDS + Clip	7 Segment Displays
TIL209 Red 13	5-LT-01 Futaba 460
TIL211 Grn 23	TIL312 3" C.An 125
TIL212 Yellow 27	TIL313 3" C.Cth 125
0-2" Red 17	TIL321 5" C.An 140
0-2" Yellow, Grn, Amber 21	TIL322 5" C.Cth 140
OCF70 40	DL704 3" C.Cth 99
ORP12 63	DL707 3" C.Anod 99
2N5777 54	FND357 180
OPTO ISOLATORS	XAN351 3" Green 180
TIL111/2 105	XAN625 6" Green 250
TIL114 110	MINITRON 3015F 240
TIL117 164	DRIVERS
	75491 75; 75492 80

VOLTAGE REGULATORS*

723 DIL 45	Plastic Case
TBA625B 95	78L82AVC 1A 8V 51
TO3 Can Type	LM320-12 150
1A 5V 170	MC7805 1A 5V 130
1A 12V 180	MC7812 1A 12V 130
1A 15V 190	MC7815 1A 15V 135
1A 18V 210	MC7818 1A 18V 135
1A 20V 210	FT8N24 1A 24V 140
Variable Type	LM325N ± 15V 240
LM325N ± 15V 240	LM326N ± 12V 240
LM327N ± 5-12 260	LM317K 20W 1.5A 220
MVR5 180	LM317K 20W 1.5A 220
MVR12 180	1 + 1.2V to 37V 250

ROTARY: Make your own multiway Switch. Adjustable Stop Shifting Assembly, Accommodates up to 6 Wafers

Mains Switch DPST to fit Break Before Make Wafers, 1 pole/12 way, 2p/6 way, 3p/4 way, 4p/3 way, 6p/2 way	68
Spacer and Screen	34
ROTARY: (Adjustable Stop)	47
1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way	41
ROTARY: Mains 250V AC, 4 Amp	45

KNOBS* fit 3" shaft with grub screw except K2, K8, K12, K15, K16 (push fit).

K1 Black or White pointer type	9
K2 Slim Silvered Plastic	12
K4 Black serrated. Metal top with line indicator 33mm diam.	22
K4A As above but 25mm diam.	20
K5 Black fluted metal top and skirt calibrated 0-10, 37mm diam.	26
K6 PK2 as K5, pointer on skirt	26
K7 Black, knurled, tapered. Metal top & skirt. Callb. 0-10, 30mm	25
K8 Black or silvered for slider pot	10
K12 Aluminium plastic with line indicator 22mm	16
K15 Black plastic ribbed body, white indicator line, 15mm diam. tapered coloured Insert tops, Red, Blue, Yellow 19mm height.	16
K16 As above but 23mm diam	20

SWITCHES*

TOGGLE 2A 250V	58
SPST	28
DPST	34
DPDT	38
4 pole on off	54
SUB-MIN TOGGLE	
SP changeover	58
SPST on off	54
SPST biased	85
DPDT 6 tags	70
DPDT C/OFF	79
DPDT Biased	115
SLIDE 250V	
1A DP	14
1A DP CO	16
1A DP	13
4 pole 2-way	24
PUSH BUTTON Spring loaded	
SPST on off	60
SPDT C cover	65
DPDT 6 Tag	85
MINIATURE Non Locking	
Push to make	15
Push Break	25
ROCKER: (Black)	
on/off 10A 250V	23

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Screened chrome body	Plastic	Open metal	Moulded with break
2.5mm 12p	8p	8p	8p
3.5mm 15p	10p	8p	8p
MONO 23p	15p	13p	20p
STEREO 31p	18p	15p	24p

SOCKETS

Din	Plugs	Socket	In line
2PIN Loudspeaker 3, 4 & 5 pin Audio	13p	8p	20p
CO-AXIAL (TV)	14p	14p	14p
PHONO assorted colours metal screened	10p	8p 1-way	12p 3-way
BANANA 4mm 2mm 1mm 3mm	10p	10p	8p
WANDER 3mm	8p	8p	8p

VEROBOARD* Pitch

0-1	0-15	0-15
2 1/2 x 3 1/2 (copper clad)	3p	29p
2 1/2 x 5" (plain)	43p	38p
3 1/2 x 3 1/2	43p	40p
3 1/2 x 5"	48p	53p
2 1/2 x 17"	134p	107p
3 1/2 x 17"	173p	143p
4 1/2 x 17"	222p	145p
Spot of 36 pins	—	29p
Spot face cutter	—	69p
Pin insertion tool	—	89p

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2N3053	28	2N8126	45	BC237	14	BF204J	20	TIP32A	55	LM710N	60
2N3054	60	AC126	45	BC238	12	BF244A	35	TIP32C	75	LM723C	85
2N3055	70	AC127	45	BC239	15	BF245A	40	TIP41A	70	LM723N	75
2N3441	85	AC128	45	BC257	17	BF257	37	TIP41C	90	LM741C	65
2N3442	135	AC151	40	BC258	18	BF258	45	TIP42A	80	LM741N	40
2N3702	13	AC152	50	BC259	19	BF259	48	TIP2955	50	LM747N	90
2N3704	15	AC153	55	BC307	15	BF336	38	TIP3055	55	LM748-8	55
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2N4059	15	AF279	90	BFY71	28	BF386	30	LM308N	85	NE555	40
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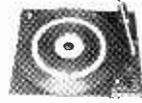
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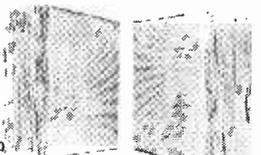
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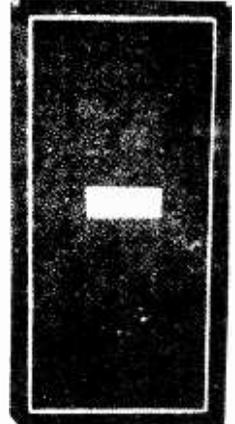
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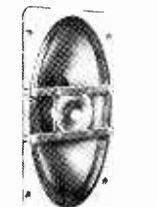
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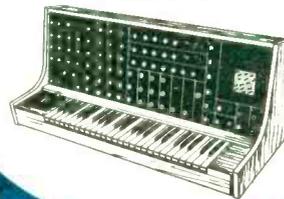
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