

NOV  
1977

# practical WIRELESS

45p

**EXTRA  
INSIDE**



**WIDE-RANGE  
VOLTMETER**

**RF  
RESONANCE  
INDICATOR**



**&  
IC OF  
THE MONTH  
(ZN1304E TIMER)**

**ALL-BAND  
SW CONVERTER**



**'COMPONENT SOURCE DIRECTORY'  
24 PAGES: COMPLETE IN THIS ISSUE**

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

7400 14p	7413 30p	7432 85p	7454 15p	7490 35p	74121 25p	74139 100p	74156 70p	74174 100p	74198 350p
7401 14p	7414 60p	7437 25p	7460 15p	7491 75p	74122 40p	74141 60p	74157 70p	74175 75p	74199 140p
7402 14p	7416 30p	7438 25p	7470 30p	7492 45p	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	7443 80p	7475 30p	7497 70p	74131 100p	74146 230p	74164 125p	74180 200p	74195 100p
7407 40p	7425 25p	7446 85p	7476 30p	7498 70p	74132 65p	74147 230p	74165 125p	74181 200p	74196 100p
7408 20p	7426 25p	7447 75p	7477 30p	7499 85p	74135 100p	74148 160p	74166 125p	74182 75p	74197 100p
7409 20p	7427 25p	7448 70p	7478 30p	7500 100p	74136 80p	74149 160p	74167 325p	74183 150p	74198 180p
7410 15p	7428 40p	7449 15p	7479 30p	7501 100p	74137 100p	74150 120p	74168 125p	74184 150p	74199 180p
7411 20p	7429 40p	7450 15p	7480 30p	7502 100p	74138 125p	74151 65p	74169 125p	74185 150p	74200 180p
7412 20p	7430 15p	7451 15p	7481 30p	7503 100p		74152 65p	74170 200p	74186 150p	74201 180p
		7452 15p	7482 30p	7504 100p		74153 65p	74171 200p	74187 150p	74202 180p
		7453 15p	7483 30p	7505 100p		74154 65p	74172 200p	74188 150p	74203 180p
			7484 30p	7506 100p		74155 70p	74173 150p	74189 150p	74204 180p

## SEMICONDUCTORS

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

AA113 10p	BA138 16p	BC188B 14p	BC548C 14p	BF123 45p	BF336 35p	BY164 50p	OC140 150p	TIP35A 230p	2N1305 30p
AA144 10p	BA148 16p	BC188C 15p	BC549B 13p	BF125 45p	BF337 35p	BY194 8p	OC171 40p	TIP35B 280p	2N1306 30p
AA177 30p	BA154 16p	BC189C 15p	BC549C 14p	BF127 50p	BF363 60p	C1120 30p	OC172 40p	TIP36A 350p	2N1308 50p
AC121 30p	BA157 15p	BC171 12p	BC557 13p	BF166 30p	BF94 30p	C1164 20p	ORP12 70p	TIP41A 70p	2N1711 25p
AC126 19p	BA173 15p	BC172C 12p	BCY34 80p	BF167 25p	BFW58 20p	E100 42p	R1039 150p	TIP41B 75p	2N219A 22p
AC127 19p	BA216 16p	BC178A 16p	BCY70 15p	BF173 25p	BFX29 30p	E300 47p	TIP29 45p	TIP41C 80p	2N2483 30p
AC127/01 25p	BA316 16p	BC182 10p	BCY71 20p	BF175 35p	BFX81 130p	E430 125p	TIP29A 47p	TIP42A 80p	2N2806 18p
AC128 18p	BA319 5p	BC183 10p	BCY72 15p	BF179 40p	BFX84 25p	MJE340 45p	TIP29C 75p	TIP42B 85p	2N2807 20p
AC151 25p	BA318 5p	BC183 10p	BD121 85p	BF180 30p	BFX85 30p	MPSA06 25p	TIP30A 50p	TIP295 70p	2N3053 20p
AC153K 40p	BB105A 35p	BC183L 12p	BD123 100p	BF181 35p	BFX87 25p	OA10 40p	TIP30B 50p	TIP3055 55p	2N3054 50p
AC176 20p	BB110 45p	BC184 10p	BD124 85p	BF182 30p	BFX88 25p	OA47 15p	TIP30C 85p	TIS90 25p	2N3055 60p
AC177 35p	BC107 10p	BC184L 12p	BD131 40p	BF183 30p	BFY50 20p	OA90 6p	TIP30D 80p	TIS91 25p	2N3439 50p
AC178 30p	BC108 10p	BC186 24p	BD132 30p	BF186 25p	BFY51 20p	OA91 6p	TIP31 55p	IN914 5p	2N3702 11p
AD149 60p	BC108C 15p	BC205 14p	BD133 45p	BF190 10p	BFY52 20p	OA202 8p	TIP31A 58p	IN3754 10p	2N3703 12p
AD149 40p	BC109 10p	BC212 11p	BD135 40p	BF195 10p	BFY90 125p	OC23 20p	TIP31B 65p	IN4001 5p	2N3704 11p
AD182 40p	BC109C 14p	BC212L 12p	BD136 40p	BF196 10p	BR101 35p	OC28 180p	TIP31C 70p	IN4002 5p	2N3705 12p
AD161/2MP 90p	BC113 12p	BC213L 12p	BD137 40p	BF197 10p	BRY39 35p	OC28 75p	TIP32 60p	IN4003 5p	2N3706 11p
	BC117 19p	BC214 13p	BD139 38p	BF198 25p	BRY56 35p	OC35 75p	TIP32A 65p	IN4004 5p	2N3711 12p
AF114 22p	BC125 20p	BC214L 14p	BD140 40p	BF199 25p	BSX20 20p	OC42 35p	TIP32B 85p	IN4005 5p	2N3715 30p
AF115 22p	BC126 15p	BC258 13p	BD141 40p	BF199 30p	BSY40 25p	OC43 30p	TIP32C 85p	IN4006 5p	2N3722 17p
AF116 22p	BC146 12p	BC294 35p	BD181 80p	BF224 20p	BSY95 20p	OC43 35p	TIP32C 90p	IN4006 7p	2N3819 25p
AF117 22p	BC147 10p	BC303 55p	BD182 80p	BF225 20p	BT100A 80p	OC45 35p	TIP33 100p	IN4007 6p	2N3866 95p
AF118 50p	BC148 10p	BC317 15p	BD207 70p	BF241 18p	BU105 150p	OC71 25p	TIP33A 105p	IN4148 4p	2N3904 15p
AF125 25p	BC148C 14p	BC323 60p	BD233 50p	BF244B 35p	BU133 75p	OC75 30p	TIP33B 115p	IS44 4p	2N4062 14p
AF139 35p	BC149 10p	BC328 13p	BD263 85p	BF257 25p	BU208 220p	OC81 30p	TIP33C 130p	2N456A 90p	2N4126 20p
AF239 45p	BC157 10p	BC338 12p	BDY10 100p	BF258 25p	BY126 15p	OC81D 25p	TIP34 115p	2N697 15p	2N5061 35p
AS526 40p	BC158 10p	BC347 12p	BDY62/01 90p	BF259 30p	BY126 15p	OC81D 25p	TIP34A 118p	2N929 20p	2N5163 35p
BA114 9p	BC159 10p	BC347B 13p	BF120 50p	BF274 15p	BY127 15p	OC83 50p	TIP34B 145p	2N930 20p	2N6227 50p
BA121 9p	BC167A 12p	BC548 12p	BF121 45p	BF324 30p	BY133 22p	OC84 50p	TIP35 225p	2N1302 25p	2SD234 50p

<b>BZ788</b>	400M.W.
0V7	10p
2V4	10p
2V7	10p
3V0	10p
3V3	10p
3V6	10p
3V9	10p
4V7	10p
5V1	10p
5V6	10p
6V2	10p
6V8	10p
7V5	10p
8V2	10p
9V1	10p
10V	10p
11V	10p

<b>BZ788</b>	12V 10p
	13V 10p
	15V 10p
	18V 10p
	20V 10p
	22V 10p
	27V 10p
	30V 10p
	33V 10p
	100 Mixed
	Zeners 850p
	BZ788
	Zeners 850p

SN76013ND	125p
SN76013N	180p
SN76023ND	125p
SN76023N	180p
SN76227N	160p
SN76228N	180p
SN76668N	100p
ZN414	120p

<b>CA3090AQ</b>	400p
TAA300	150p
TAA350	100p
TAA550	50p
TAA570	220p
TAA581B	140p
TAA700	380p
TAD100	250p
TAD110	200p
TBA120S	125p
TBA120T	125p
TBA540	300p
TBA540Q	400p
TBA550Q	400p
TBA560	400p
TBA641A12	250p
TBA720	230p
TBA800	100p
TBA820	100p
TBA900	250p
TCA270Q	250p
TCA270S	250p

LM301A	65p
LM307N	65p
LM308T OIS	130p
LM309K	130p
LM317K	325p
LM348N	200p
LM380N	110p
LM555	35p
LM710 TO5	60p
LM710 P	65p
LM723 TO5	60p
LM723 14 DIL	75p
LM741	25p
LM748	45p
LM1303N	95p
LM3900	180p
NE555	35p
NE556	100p
NE562B	400p

<b>ELECTROLYTIC CAPACITORS</b>	
µF/V	330/35 16p
	47/25 18p
	1/16 5p
	1/25 5p
	1/50 5p
	2/2/25 5p
	3/3/25 5p
	4/7/10 5p
	4/7/16 5p
	4/7/25 5p
	4/7/50 5p
	6/9/25 5p
	10/10 5p
	10/16 5p
	10/25 5p
	10/35 5p
	10/50 5p
	22/6V3 5p
	22/10 5p
	22/16 5p
	22/25 5p
	22/35 5p
	22/50 5p
	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
	100/35 6p
	100/50 6p
	100/63 10p
	125/15 6p
	220/16 10p
	220/25 12p
	220/50 20p
	330/25 15p

<b>POLYMER CAPACITORS</b>	
µF	0.01 5p
	0.022 5p
	0.033 5p
	0.047 5p
	0.068 5p
	0.1 5p
	0.22 5p
	0.33 5p
	0.47 5p
	1 6p
	2.2 7p
	3.3 8p
	4.7 12p
	10/63 10p
	100/25 12p
	100/50 20p
	220/16 10p
	220/25 12p
	220/50 20p
	330/25 15p

<b>SPECIAL OFFERS</b>	
BC147	100
BC148	100
BC149	100
BC158	100
BC159	100
BF194	100
BF195	100
BF196	100
BF197	100
IN4148	100 for £15p
741 Op AMPS	100 for £20
555 TIMERS	100 for £30
RELAYS	24V 3 C.O. H.D. 11 Pin Plug IN £1-00 Each
ASSORTED POLYESTER CAPACITORS	100 for £3-00
BYX94 DIODES	1250 PIV 1 Amp. 100 for £6-00
MULLARD	600V/64V C.432 Screw Terminal 75p

<b>RESISTORS CARBON FILM 5%</b>	
-25 W	2p
2-2 Ω-4-7M	2p
-5 W	2p
2-2 Ω-4-7M	2.5p
1 W	2p
2-2 Ω 10 MEG 3-5p	2p

<b>POTENTIOMETERS</b>	
1K Lin	30p
5K Lin	30p
10K Lin	30p
25K Lin	30p
50K Lin	30p
100K Lin	30p
250K Lin	30p
500K Lin	30p
1 Meg Lin	30p
2 Meg Lin	30p
5K Log	30p
10K Log	30p
25K Log	30p
50K Log	30p
100K Log	30p
250K Log	30p
500K Log	30p
1 Meg Log	30p
2 Meg Log	30p

<b>ROTARY SWITCHES BY LORLIN</b>	
1P 12W	40p
2P 6W	40p
3P 4W	40p
4P 3W	40p

<b>MULLARD POT CORES</b>	
LA3 100-500 KHz	

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**For our Constructors**

- 486 **A WIDE RANGE VOLTMETER for AC, DC and RF**  
 An input impedance of 11MΩ enables this voltmeter to be used on just about any circuit without upsetting the circuit conditions. Six ranges to 1000V plus probes permits measurement of AC or DC voltages  
*M. Tooley BA, G8CKT*
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 This converter can be aligned for the amateur bands or the SW broadcast bands and provides an IF output at 5.5MHz for feeding into your main receiver ..... *F. Rayer G3OGR*
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 With the aid of an external signal source this very useful indicator can be used to find the resonant frequency of a tuned circuit or to select values of inductance and capacitance for a given frequency *D. H. E. King G3TQN*
- 505 **THE PW 'JUBILEE' ELECTRONIC ORGAN—3**  
 Details this month on the operation and adjustment of the melody, drum and rhythm, and accompaniment sections ..... *M. J. Hughes MA, C.Eng, MIERE*
- 512 **DESIGN YOUR OWN PROJECTS—3**  
 This **Car Courtesy Light** project will give you another 15 seconds of light inside your car when the door clicks to, instead of plunging you into darkness in the usual way! ..... *Toby Bailey and Bob Whitaker*

**General Interest**

- 501 **SO YOU WANT TO PASS THE R.A.E?—3**  
 Ohm's Law is translated into some practical transistor circuits and the very important principles of magnetism are discussed in this part ..... *John Thornton Lawrence GW3JGA and Ken McCoy GW8CMY*
- 516 **IC OF THE MONTH**  
 The ZN1304E is used in timing circuits to provide accurate delays of up to one year! Several circuits are shown for different applications of the IC.

★ **Free This Month!**  
 24 PAGE 'COMPONENT SOURCE DIRECTORY'

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# TIME FOR WIRELESS?



The MA1012 LED digital clock module is a full 12/24 hour format clock unit, operating from 50/60Hz mains and offering a host of features: Hours, minutes display in bright 0.5" LEDs, with optional seconds, sleep and snooze alarms, fast and slow setting, PM indicator, switched output for radio, but the most important feature is the non-multiplexed directly driven display. This means no RFI, so the MA1012 is ideal for use in any type of radio/tuner etc. The neat fitting means it can be slotted into many existing cabinets/chassis - only 1.75 x 3.75 x 0.7" total!! £9.45 per module - isolating mains transformer £1.50 (8% vat) Two modules and two transformers for £20.00 + 8% VAT.

AMBIT announce a new addition to the catalogue - information on TOKO's new ceramic ladder filters, 2.4kHz SSB filters etc. HF coils, new flat faced low cost panel meters. Catalogue 45p.

## DETECKNOWLEDGEY

Metal locator principles and practise, including some of the facts that the manufacturers of £100+ metal locators wouldn't like you to know!! £1.00 The Bionic Ferret 4000 - A little detector technology of our own. The VCO based metal locator for the electronics constructor, including plastic moldings for housings of electronics and search coil, tubing etc. Can be set up using just a test meter. 'All in' price £34.26 inc PP and 8% VAT.

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## COMPONENTS ETC :

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### SEMICONDUCTORS

CA3089E	FM IF	1.94	BC413	lo noise	0.18
KB4402	FM IF	1.94	40238	shld.RF	0.25*
HA1137W	FM IF	2.20	BF224	.6GHz RF0.22	
TBA120	FM IF	0.75	BF274	.7GHz	0.18
TBA120S	FM IF	1.00	ZTX212	50v/.3W	0.17
SN76660N	FM IF	1.75	ZTX213	30v/.3W	0.16
uA720	AM radio	1.40	ZTX214	30v/.3W	0.17
CA3123E	AM radio	1.40	ZTX451	60v/1W	0.18
HA1197	AM radio	1.40	ZTX551	60v/1W	0.18
TBA651	AM radio	1.40	BD515	45v/10W	0.27
MC1350	apc gain	1.00	BD516	45v/10W	0.30
uA753	FM gain	1.80	BD535	60v/50W	0.52
LM1496	Bal mix	1.25	BD536	60v/50W	0.53
MC1310P	mpx dec.	2.20	BD609	80v/90W	0.70
CA3090AQ	mpx dec.	4.35	BD610	80v/90W	1.20
HA1196	mpx dec.	4.20	BF256	1GHz jfet	0.34
LM380N	2w AF	1.00	E176	p ch. swt.	0.38
LM381	st. pream.	1.81	MEM614	(40822)	0.38*
tds2020	15w AF	2.90	MEM616	(40873)	0.57*
tca940e	10w AF	1.80	MEM860	lo noise	0.75*
tba810as	7w AF	1.08	BA102	vhf varic.	0.30
LM301an	op amp	0.39*	BA121	dual varic.	0.40
CA3130T	mos oa	0.85*	BB104	dual varic	0.35
uA741	op amp	0.34*	BB105	uhf varic	0.40
LM3900	op amps	0.68*	mvam2	dual am	1.48
7805uc	5v/1A	1.55*	mvam115	15v/1A	1.05
tda1412	12v/6A	0.95*	mvam125	25v am	0.90
78M20uc	20v/5A	1.20*	<b>TOKO COILS &amp; filters</b>		
78M24uc	24v/5A	1.20*	AM IFts with cap.	0.30	
uA723cn	variable	0.80*	FM IFts with cap.	0.33	
NE5500a	variable	0.80*	eg	4.50*	
TAA550b	32v ref.	0.50*	YHCS11098AC2	0.30	
tel8038cc	sig gen	4.50*	YHCS12374AC2	0.30	
NE555v	timer	0.70*	YHCS11100AC2	0.30	
NE567v	vco	2.50*	KACSK586HM	0.33	
NE560b	tone dec.	3.50*	7mm 1Fs for RC	0.33	
NE561b	hf pll	2.50*	ML3107N ceramic	0.50	
NE565k	hf pll	3.50*	MBR3132 6pole fm	2.25	
NE565k	if pll	2.50*	MFL 2.4kHz 0.95	0.95	
MC1312	quad	1.50	MFH1 4.577kHz	1.65	
11C90	650MHz	14.00	MFK 7/9kHz	1.65	
ZTX107	50v/.3W	0.14	Chokes 1uH to 124mH OA.		
ZTX108	30v/.3W	0.14			
ZTX109	30v/.3W	0.14			

### Modules/tunerheads

EC3302U 3 varicap	FM	£7.50
EF5600U 5 varicap	FM	£12.95
NT3302UG 3 gang	FM	£7.50
EF5800 6 varicap	FM	£14.00
EF5801 (5800-osc op)		£17.50
8319 4varicap mos mix		£11.45
7252 fm tuner		£26.50
7253 stereo tuner		£26.50
7020 cer. fill. fm if		£6.95
7030 linear phase if		£10.95
NB FM kit for 455-470kHz		
hbfm if filter/amp/detector		
for +12v		£5.95
92310 mpx decoder		£6.95
91196 mpx decoder & birdy		
filter		£12.99
93090 mpx decoder		£8.36
91197 mw/1w tuner		£11.35
7122 3 varicap am tuner for		
MW (or LW) kit		£9.00
810k complete TBA810AS		
module kit		£3.00
940k as above with tca 940E		
(both kits inc heatsink)		£3.95
NB All our audio ICs are		
"short circuit" protected as		
defined by the manufacturer		
All our mpx decoders are		
provided with TOKO mpx		
notch filters. All our FM IF		
modules use the improved		
mute version HA1137W.		

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 FR1 mw/1w ferrite rod £0.90  
 Min. foil trimmers by Dau:  
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 33/42pF swing 7.5 0.26  
 60pF swing 10mm dia 0.24  
 22turn 100k diode law  
 trim pots for varicaps 0.45  
 1000pF feedthrus 0.05  
 10000uF/63v 1.15

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		8 ohm, 10 watt	£3.70
		8" 8 ohm Dualcone	£3.45
		10" Dualcone	£4.10
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	£2.60 £1.20	Memorex	£0.81 £1.38 £1.90
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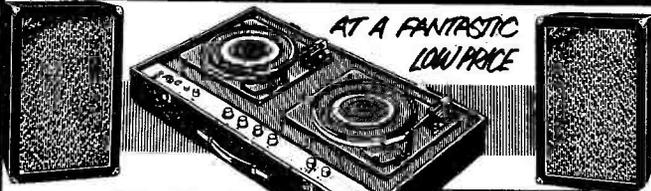
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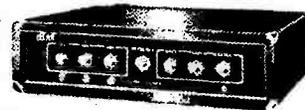


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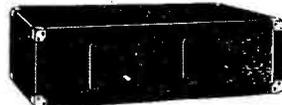
## TITAN TA/100A 100W AMPLIFIER



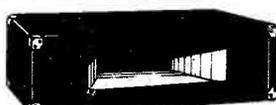
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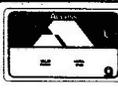
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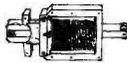
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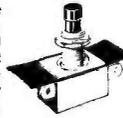
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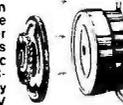
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		12V 40 MA		12V 100 MA		14V 75 MA	
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		14V 75 MA		28V 40 MA		12V 160 MA	
		28V 40 MA		14V 80 MA			

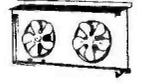
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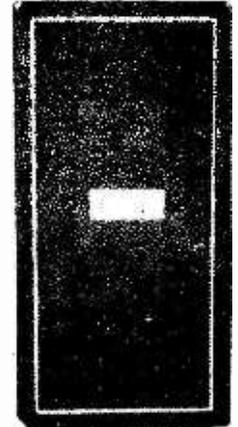
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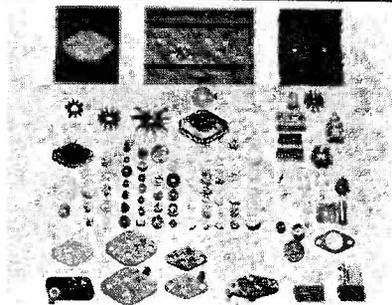
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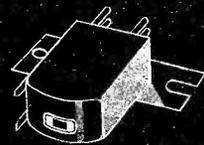
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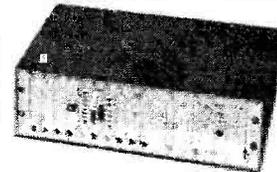
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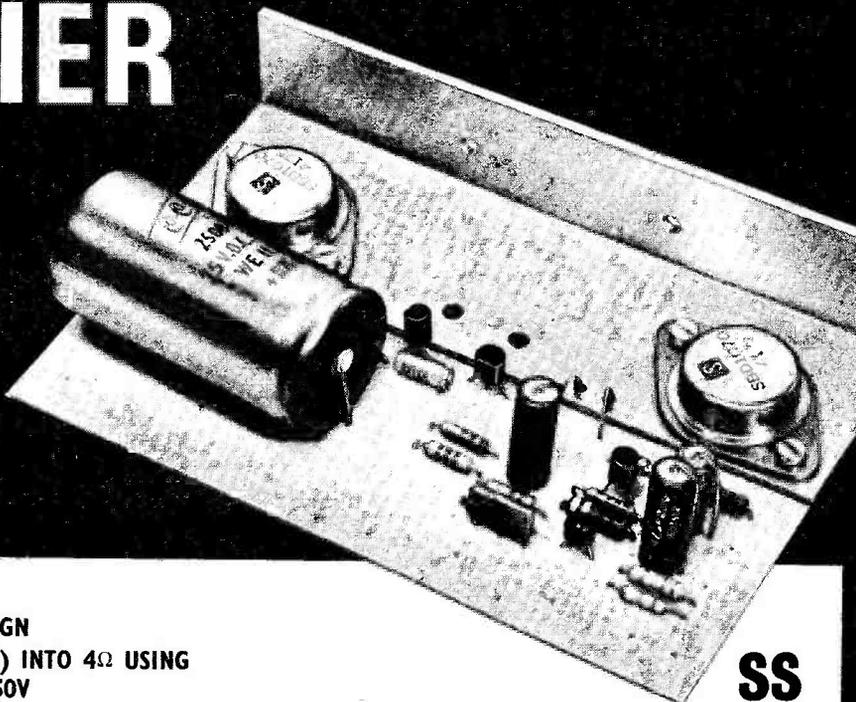


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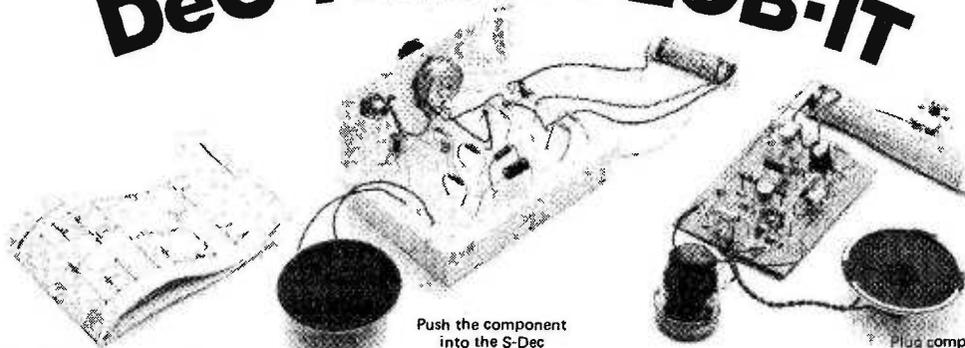
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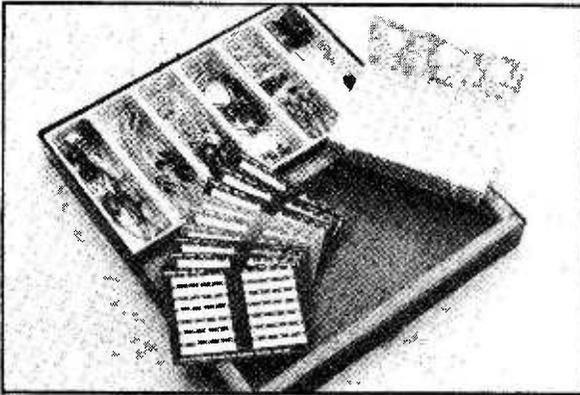
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- Twin D.C. & output fuses.
- Top-grade components throughout.

30 Watts rms	60 Watts rms		120 Watts rms		240W rms
SA308 30W rms/ 8 ohms £9.50	SA604 60W rms/ 4 ohms £12.50	SA608 60W rms/ 8 ohms £13.50	SA1204 120W rms/ 4 ohms £14.50	SA1208 120W rms/ 8 ohms £21.00	SA2404 240W rms/ 4 ohms £25.50

POWER SUPPLIES FOR THE ABOVE MODULES—READY WIRED & FUSED ON GLASS FIBRE PCB

PM301 For 1/2 £9.90	PM601/4 For 1/2 £12.50	PM601/8 For 1/2 £12.50	PM1201/4 For 1 £12.50	PM1201/8 For 1 £12.50	PM1202/4 For 2 £19.50	PM1202/8 For 2 £19.50	PM2404/1 For 1 £19.50
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### SYSTEM 7000 COMPLETE DISCO MIXERS (with Autofade)

Mono or Stereo



The choice of the professional D.J.

Controls: Mic volume, Bass, Treble, A/Fade Depth, Tape, L/Deck, R/Deck volumes, Bass, Treble, Master, Headphone volume, Selector & On/Off.

Mono 18v **£37.50** Mains **£43.50** Stereo 18v **£53.50** Mains **£59.50**

**IN MODULAR FORM**—All you require is front panel (see below) knobs & sockets etc. All electronics are assembled & tested.

- Specification as for complete mixer
- All Potentiometers supplied & fitted
- Low cost do it yourself with step by step easy to follow instructions.

Mono **£19.50** Stereo **£29.50** Panel **£3.50** Supply unit **£8.50**

### SYSTEM 7000 LIGHTING CONTROL UNIT MK II (Four channel)

#### HAS YOUR LIGHT UNIT GOT?



- 4,000 W handling
- Sequence facility
- Smart 2 tone panel
- Advanced IC circuitry
- Top grade components
- Integral dimmers
- Automatic audio level

All your needs in one superbly designed unit

**ONLY £42.50**

### IN MODULAR FORM—THE QUADRAFECT

(Panel £2.50)

As with the mixers the MK II L.C. unit may be purchased in module form with all controls, requiring only a panel, case & knobs etc. There are 13 simple connections

- 1-240w Audio
- 8A RCA triacs
- 0.5-20Hz Sequence
- Fully suppressed

### CUSTOM MIXER MODULES (Complete or in printed circuit form only)

Make your own mixer, mono or stereo, up to 2 channels, with full monitoring facilities, and provision for echos end/return etc.

- Inputs for low and high 2 mic, ceramic & magnetic cartridge etc.
- Up to 20 input modules per single mixing module
- Feed most types of amplifier—accepts all inputs
- Professional low noise circuitry 20Hz-30kHz
- Infinitely adaptable—Extremely economical



### COMPLETE MODULES With facia panel, Knobs & sockets, Monitor buttons, Ready wired & tested

Mono input **£8.50** Mono mixing stage **£8.50**  
Stereo input **£12.00** Stereo mixing stage **£12.00**

- 0.5W headphone circuit
- Full range bass/ treble controls
- Noise—80dB

### PRINTED CIRCUIT MODULES With controls fitted, requires only sockets, facia & knobs

Mono Input **£5.50** Mono mixing stage **£5.50**  
Stereo Input **£9.00** Stereo mixing stage **£9.00**

Power supply for up to 20 channels—PPM18—£8.50.

### SYSTEM 7000 SOUND—LITE (3-CHANNEL)

#### IN COMPLETE OR MODULAR FORM (Modular form illustrated)

- Complete unit similar to Mk II unit above
- Long established & proven design
- 3 Channels—100W per channel
- RCA 8A Triacs—individual channel fuses
- 1-240 W Input—master audio level plus Bass/Middle/Treble



**COMPLETE UNIT**—Fully cased with rear terminations—just plug in and go! **£24.75**  
**MODULAR FORM**—Facia & knobs etc. Needs only 11 simple connections **£16.50** (Panel £2.50)

### COMPLETE DISCO SYSTEMS

WITH TWO YEAR GUARANTEE—LOW INTEREST CREDIT

FROM ONLY **£16.06** DEPOSIT

#### CENTAUR 100W

**STEREO**

with TWIN LOUDSPEAKERS, SOUND to LIGHT SEQUENCER PLUS DISPLAY. **£225 + £10 carr.** (Dep. £28.80, 12 months at £21.33 or 24 months at £12.01)

#### SUPER CENTAUR 200W

**STEREO**

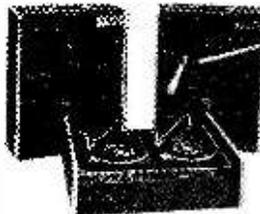
As above but with 200 WATTS OUTPUT and larger TWIN CABINETS. **£275 + £10 carr.** (Deposit £32.80, 12 months at £29.39 or 24 months at £15.21).

#### GXL CENTAUR 200W

**STEREO**

As the SUPER CENTAUR but with extra large twin 200 WATT CABINETS, DECK LIGHTS, DECK STARTS & SUPERIOR DECKS. **£349 + £10 carr.** (Deposit £42.72, 12 months at £36.58 or 24 months at £20.54)

- Cue Light + Head Phone monitoring
- Mic & Tape Inputs
- Crossfade & Override
- Logic Circuitry Lights show
- Complete and ready to use
- Extremely Rugged construction
- Twin BSR Decks



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**50W MINI DISCO** **£139.50 + £5 carr.** (Dep. £16.05, 12 months at £13.30 or 24 months at £7.46)

**100W MINI DISCO** **£159.50 + £5 carr.** (Dep. £22.66, 12 months at £14.73 or 24 months at £8.27)

Two extremely compact mono systems complete with loudspeakers and leads.

- TWIN BSR DECKS
- HEADPHONE MONITORING
- MIC INPUT
- 100W PACKAGE P.A.** **£145 + £7.50 carr.** with twin loudspeakers and PIEZO HORNS Dep. **£19.70**, 12 months at **£13.70** or 24 months at **£7.73**

SEND YOUR SPECIAL REQUIREMENTS FOR A CUSTOM DISCO QUOTATION

### SYSTEM 7000

#### MINOTAUR 100—All Purpose Wide Range Amplifier



- 100W rms  $\pm$  1dB
- Standard 8 ohm output
- Twin mixed inputs accept a wide range of signals
- 30HZ-30KHZ  $\pm$  2dB
- 23dB base/treble
- A four Input, high power amplifier which will deliver up to 150 watts output. An absolute must where multiple mixing & power are required
- Four individually mixed inputs
- Wide range bass/treble + master

An extremely compact and versatile amplifier with full protection and a clean, attractive appearance. Ideal for all groups, disco's & clubs

**£49.50**

- Vynide covered case
- Fully short proof
- Superb value for money



### SAXON 150 HEAVY DUTY AMPLIFIER **£59.00**

### STROBES & PROJECTORS (We stock the full Pluto range)

Send for details

#### SUPERSTROBE **£19.75**

- 2-3 Joules
- 80W Tube for long life
- Compact 4" x 4" x 4"

#### PRO-STROBE **£32.50**

- 6-8 Joules
- External trigger
- Long Life tube timer circuit



#### 150 WATT LIQUID WHEEL PROJECTOR

- Accepts all accessories
- C/w with wheel & motor plate
- Sturdy steel construction
- Remarkable value—Sold elsewhere at £39.50. Our price is only: **£33.00**

### ACCESSORIES

Condenser mics EM501 600 ohms **£13.50**  
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Heavy duty boomstand **£14.50**

All prices subject to VAT @ 8% except SA308/PM301, mics. and headphones (12½% Add 50p post & packing on all orders except where already shown. Ordering: By Telephone —Access, Barclay Card or COD Ring (01) 684 6385/0098 By post —Send cheque or crossed P.O.'s or 60p for COD or send in your Access/Barclay card NUMBER ONLY

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### PIEZO HORNS!! UP TO 150 WATTS HANDLING. NO X-OVER REQUIRED **£8.50 ea.**

Exporters to 17 countries—enquiries welcomed  
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7410	10p	74126	82p
7411	20p	74127	81p
7412	25p	74128	81p
7413	40p	74129	85p
7414	85p	74130	300p
7415	40p	74131	95p
7416	40p	74132	205p
7417	40p	74133	160p
7418	10p	74134	130p
7419	43p	74135	130p
7420	28p	74136	160p
7421	36p	74137	81p
7422	33p	74138	160p
7423	36p	74139	160p
7424	43p	74140	97p
7425	43p	74141	97p
7426	43p	74142	97p
7427	40p	74143	97p
7428	18p	74144	250p
7429	18p	74145	250p
7430	18p	74146	250p
7431	43p	74147	130p
7432	43p	74148	130p
7433	43p	74149	130p
7434	37p	74150	140p
7435	37p	74151	140p
7436	37p	74152	140p
7437	37p	74153	140p
7438	37p	74154	140p
7439	37p	74155	140p
7440	37p	74156	140p
7441	85p	74157	320p
7442	85p	74158	320p
7443	120p	74159	750p
7444	120p	74160	750p
7445	100p	74161	130p
7446	100p	74162	130p
7447	85p	74163	130p
7448	85p	74164	130p
7449	85p	74165	130p
7450	85p	74166	130p
7451	85p	74167	130p
7452	85p	74168	130p
7453	18p	74169	324p
7454	18p	74170	324p
7455	18p	74171	324p
7456	18p	74172	324p
7457	32p	74173	990p
7458	32p	74174	990p
7459	32p	74175	990p
7460	32p	74176	990p
7461	32p	74177	990p
7462	32p	74178	990p
7463	32p	74179	990p
7464	32p	74180	990p
7465	32p	74181	990p
7466	32p	74182	990p
7467	32p	74183	990p
7468	32p	74184	990p
7469	32p	74185	990p
7470	32p	74186	990p
7471	32p	74187	990p
7472	32p	74188	990p
7473	32p	74189	990p
7474	32p	74190	990p
7475	32p	74191	990p
7476	32p	74192	990p
7477	32p	74193	990p
7478	32p	74194	990p
7479	32p	74195	990p
7480	32p	74196	990p
7481	32p	74197	990p
7482	32p	74198	990p
7483	32p	74199	990p
7484	32p	74200	990p
7485	32p	74201	990p
7486	32p	74202	990p
7487	32p	74203	990p
7488	32p	74204	990p
7489	32p	74205	990p
7490	32p	74206	990p
7491	32p	74207	990p
7492	32p	74208	990p
7493	32p	74209	990p
7494	32p	74210	990p
7495	32p	74211	990p
7496	32p	74212	990p
7497	32p	74213	990p
7498	32p	74214	990p
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**CMOS ICs**

4000	21p	4040	150p
4001	21p	4042	97p
4002	21p	4043	100p
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4007	21p	4047	120p
4008	67p	4049	64p
4011	21p	4050	58p
4012	23p	4050	58p
4013	55p	4054	120p
4014	90p	4055	140p
4015	90p	4056	140p
4016	90p	4060	130p
4017	120p	4069	30p
4018	110p	4071	30p
4019	57p	4072	30p
4020	140p	4081	30p
4021	140p	4082	30p
4022	140p	4093	104p
4023	23p	4510	140p
4024	90p	4511	140p
4025	23p	4516	130p
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4028	110p	14433	£14
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4030	67p	14583	£1

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8 pin 12p	22 pin 36p
14 pin 13p	24 pin 40p
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**MEMORY ICs**

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2102-2 RAM	210p
2107 RAM	864p
2112-2 RAM	470p
AY-5-1013P UART	650p
C8080A CPU	1400p
RC3-2513 ROM	850p

**OP. AMPS**

LM301A	40p	741	25p
LM318A	225p	747	70p
LM324N	120p	778	210p
LM339N	175p	MC1468	75p
NE531V	140p	CA3130	100p
709	38p	CA3140	100p
733	150p	CA3160	120p
		LM3900	70p

**LINEAR I.C.s**

AY-1-212	650p	NE556	100p
CA3028A	112p	NE561B	450p
CA3046	85p	NE562B	450p
CA3048	250p	NE565	200p
CA3053	75p	NE565V	200p
CA3065	200p	SN72710N	54p
CA3080E	97p	SN76003N	275p
CA3088E	250p	SN76008	280p
CA3090AQ	425p	SN76013N	175p
ICL8039CC	400p	SN76013ND	160p
LM371N	200p	SN76018	230p
LM380N	112p	SN76023N	175p
LM387N	190p	SN76023ND	160p
LM389N	160p	SN76033N	275p
M252AA	850p	SP8515	710p
MC1310P	180p	TAA821A	310p
MC1351P	110p	TAA861B	150p
MC1495L	490p	TBA120	97p
MC1496G/P	112p	TBA841B	300p
MC3340P	180p	TBA851	225p
MC3360P	160p	TBA800	112p
MFC4000B	120p	TBA810S	125p
MFC6040	200p	TBA820	112p
NE559E	112p	TDA2020	400p
NE540L	225p	TDA2020	400p
NE555V	40p	ZN414	140p

**VOLTAGE REGULATORS—Fixed**

Plastic—TO220—3 Terminals				
1 Amp -I-ve				
5V	7805	115p	-ve 7805	160p
8V	7808	115p	7805	160p
12V	7812	115p	7912	160p
15V	7815	115p	7915	160p
18V	7818	115p	7918	160p
24V	7824	115p	7924	160p
100mA—TO92				
5V	78L05	70p	78L05	80p
6V	78L06	70p	78L05	80p
12V	78L12	70p	78L12	80p
15V	78L15	70p	78L15	80p
LM309K (TO3) 1A 5V 150p				
LM323K (TO3) 3A 5V 700p				
LM327N (16 DIL) 100mA +5 -12V 275p				
MC1468 (16 DIL) 100mA ±15V 300p				
(Adj.) by Rs from ±8V to ±20V				
TBA825E (TO5) 0.5A 12V 120p				
7805 (TO3) 1A 5V 150p				

**VARIABLE**

723 14 pin DIL 2V-37V 150mA	45p
LM317T TO220 1A-2V-37V	325p
TL430 TO92 100mA 2V-30V	75p
78MGT2C 4 pin DIL 5V-30V 500mA	145p

**OPTO-ELECTRONICS**

OCF 71	130p	LEDS: TIL209	Red	14p
ORP 12	100p	TIL211	Green	27p
ORP 60	90p	TIL32	Infrared	81p
ORP 61	90p	0-2"	Green	20p
N25777	40p		Yellow	36p
3015F Mintron	200p	FND500	Red	130p
DL704 Red/Green	160p	FND507	Red	130p
DL707 Red/Green	160p	TIL321	Red	130p
DL747 Red/Green	250p	TIL322	Red	130p

**DRIVERS:**

75491	84p	9368PC	216p
75492	104p	9374PC	216p

**SCR-THYRISTORS**

1A 50V TO5	65p	C108D	70p
1A 400V TO5	85p	2N3925	130p
3A 400V stud	120p	2N4444	200p
7A 400V TO5	120p		
12A 400V TO220	180p		
16A 400V TO220	220p		
16A 600V TO220	270p		
BT 106 stud	150p		

**TRIACS**

3A 400V 85p			
6A 400V 197p			
6A 500V 120p			
10A 400V 140p			
10A 500V 160p			
15A 400V 200p			
15A 500V 225p			
40A30	130p		
40669	130p		
T2 302D	130p		
BR100	32p		

**HEAT SINK**

TO92 Plastic			
TO18			
TRC or VR			
17S	22p		
FM TUNER			
LP1186	£9.50		

**PW "JUBILEE" ELECTRONIC ORGAN**

AY-1-0212	650p	VM18	
AY-1-5050	250p	IA DIL Bridge	45p
AY-1-1313	775p	7812	115p
AY-5-1315	750p	LM320-12	
AY-5-1317A	650p	-12V Regulator	160p
DIL SKTS to suit available. All prices VAT Inc.			

**TRANSISTORS**

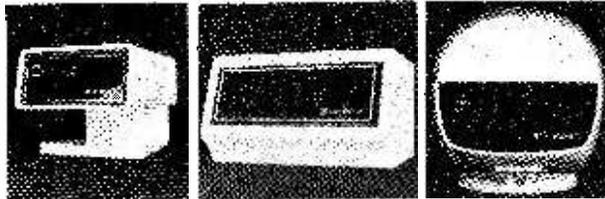
AC125	30p	TIP29C	62p
AC126	25p	TIP30A	60p
AC127	25p	TIP30A	72p
AC128	25p	TIP31A	35p
AC129	25p	TIP31C	65p
AC171	25p	TIP32A	63p
AC187	25p	TIP32C	85p
AC188	25p	TIP33A	87p
AD149	60p	TIP33C	120p
AD161	45p	TIP34A	124p
AD162	48p	TIP34C	160p
AF114	30p	TIP35A	243p
AF115	30p	TIP35C	290p
AF116	30p	TIP36A	297p
AF117	30p	TIP36C	360p
AF127	40p	TIP41A	76p
AF139	40p	TIP41C	84p
AF239	48p	TIP42A	76p
BC107B	10p	TIP42C	80p
BC108B	10p	TIP2855	76p
BC109	11p	TIP3055	60p
BC109C	11p	TIS43	40p
BC147	9p	TIS93	28p
BC148	9p	2N897	25p
BC149	9p	2N898	25p
BC157	11p	2N706	22p
BC158	13p	2N708	22p
BC159	13p	2N918	43p
BC169C	15p	2N930	19p
BC171	12p	2N1131	25p
BC172	12p	2N1932	22p
BC177	20p	2N2484	32p
BC178	17p	2N2484	32p
BC179	20p	2N2646	52p
BC182	12p	2N2804/A	22p
BC183	12p	2N2805/A	22p
BC184	12p	2N2806/A	22p
BC187	32p	2N2807	25p
BC187	32p	2N2808/B	25p
BC212	14p	2N2820G	1

## NEW FROM CASIOTRON

A new range of these superb watches, available from October. Full details and photographs are not available yet but they should knock spots off all the competition. All with at least 9 functions including backlight plus **Stopwatch** to 13 hours. Some will have a **Dual Time Zone** feature and some a full **Chronograph** measuring lap times to **One Hundredth** of a second. Slimmer than ever, around  $\frac{1}{2}$  inch thick in some cases. We will also be having a **Casiotron Alarm Watch** with five way programming of the alarm. These watches will be all **Stainless Steel** with **Mineral Glass** face and **Water Resistant** to 3 atmospheres, 100 feet. We anticipate they will have battery hatches with one battery lasting 15 months or more.

### FAIRCHILD TIMEBAND MAINS DIGITAL ALARM CLOCKS

C500 (left) black or white £14-35. CB110 (centre) £15-90 C590 (right) £24-95



**NEW FROM IBICO.** Slim 6-digit 6-function watch plus backlight and **CHRONOGRAPH**. 1/100 second to 1 hour. Lap and Net times. In the all **Stainless Steel** 402ES **Water Resistant** case. 451 ES £49-95. On leather strap 451 ELB £48-50.

**I.C.** New low cost 6-digit watch with 1/100 second stopwatch. £32-50. **Solar powered** version with Tritium "Beta Light" night light £44-50.

**ACCURIST.** New slim-line quartz analogue (stepping motor). Round face, **Stainless Steel** or **Gold Plated** on strap or matching bracelet. Luminous. R.R. Prices around £55.

**CITIZEN.** Once the same Company as Seiko. Wide range of these superb quartz analogue and digital including **Solar Powered** analogue. **PRICES ON APPLICATION.**

**SPECIAL OFFERS.** Spend over £20 on CASIO products and we give you a **Brushed Chrome PAPERMATE** pen worth £3-90. Casio ST-1 £24-95. CO-1 £29-95. MO-1 £24-95. Full range of Casio Scientific Calculators. Last month's prices. **Gold Plated Pen & Pencil Set**, or two pens, worth £11-90 with any of these watches: Timeband TC410 £27-95, TC412 £31-95. TC413 £28-95. National Semiconductor DAC5 YS £25-90, DAC5 YB £28-50, DAB5 WB £32-50, DAB5 YB £36-90, IBICO 405 ILB £26-50, 405 IS £27-50, 450 HS Chronograph £47-50, INSTAL 2 $\frac{1}{2}$  function LCD Gold Plated on matching bracelet £15-50.

Send 15p for our illustrated catalogue. Car Clock, T.V. games, etc.

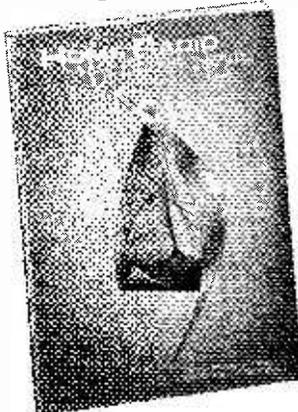
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# Sparkrite mk2

## Capacitive discharge electronic ignition kit

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



- \* Smoother running
- \* Instant all-weather starting
- \* Continual peak performance
- \* Longer coil/battery/plug life
- \* Improved acceleration/top speeds
- \* Optimum fuel consumption

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

Because of the superb design of the Sparkrite circuit it completely eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R.P.M. Contact breaker burn is eliminated by reducing the current to about 1/50th of the norm. It will perform equally well with new, old, or even badly pitted points and is not dependent upon the dwell time of the contact breakers for recharging the system. Sparkrite incorporates a short circuit protected inverter which eliminates the problems of SCR lock on and, therefore, eliminates the possibility of blowing the transistors or the SCR. (Most capacitive discharge ignitions are not completely foolproof in this respect). All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

### THE KIT COMPRISES EVERYTHING NEEDED

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

### OPTIONAL EXTRAS

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**QUICK BLOW 20mm**

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150mA	611	1A	615	3A	619
250mA	612	1.5A	616	4A	620
550mA	613	2A	617	5A	621
800mA	614	2.5A	618	All 5p each	

**ANTI-SURGE 20mm**

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2.5A	628
250mA	623	2A	626	3-15A	629
500mA	624	1-6A	627	5A	630

**QUICK BLOW 1 1/2in**

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 7p each

Type	No.	Type	No.	Type	No.
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1.6A	636	3A	639	5A	642
2A	637	All 6p each			

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

# Perseverance

AWAY from any technicalities this month. Just the story of a PW reader's perseverance. Charlie M. is nearly 78. He was a Marconi marine operator in World War 1 and in his latter years has long cherished the idea of joining the radio amateur fraternity and talking to other folk around the world. He'd done all the swotting but a couple of problems confronted him. His wife is a chronic invalid requiring constant attention, and they live in a remote part of Wales, with but one equally lonely neighbour. How could he leave his wife and go anywhere to take the RAE and the code test?

Following up a couple of suggestions Charlie was able to get the nearest technical college, some 20 miles away, to make the necessary arrangements for him to sit the exam last May. His sole neighbour came round for a few hours and off went Charlie to college, the only candidate! The result? A "distinction" in Part 1 of the paper and a "credit" in Part 2. So far, so good, but taking the code test wasn't quite so simple!

A trip to the nearest testing centre would have meant too long away from home and his wife. He contacted the centre, at Cardiff, and eventually the Marine Radio Surveyor there telephoned Charlie to say that he would call round the next time he was in the area on duty. Eventually he turned up and "they did the necessary test on the kitchen table" A few days later a "pass" certificate arrived. Charlie writes "prompt and willing service like this, in these days of 'couldn't care less' is really most heart-warming".

A lovely story, isn't it? A GW4 call ought to be on its way very soon. Another not-so-young amateur has loaned Charlie an AR88 receiver plus a 50 watt transmitter so at long last a dream is about to be fulfilled. Charlie has been reading PW since 1952, "a valuable wireless encyclopaedia that I wouldn't part with for all the tea in China". With the present price of tea, that values PW very highly indeed!

Due to increased production costs, the cover price of your copy of *Practical Wireless* has been increased to 45p. The price for new binders has also been increased, as from the 1st October to £2.85. These price increases have been approved by the Price Commission.

## 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.

## A Century of Recorded Sound

As previewed in the September issue of PW, the City of London Phonograph and Gramophone Society recently held an exhibition of early reproducers and associated items at the British Institute of Recorded Sound, Exhibition Rd., Kensington, which celebrated one hundred years of recorded sound.

1877 was in fact a year of universal significance for the sound recording industry, seeing the parallel but independent emergence of two versions of a world-shattering device—the sound reproducer, or “talking machine”. Charles Cros in France and Thomas Edison in the United States had almost simultaneously arrived at the same answer to an interesting problem, and while Edison’s was a practical working model, the Cros version although restricted to a set of detailed plans, was every bit as brilliantly conceived. It was largely lack of funds and his failure to convince a prospective backer which prevented Cros from seeing his machine emerge as a reality.

### Edison v Cros

The exhibition itself naturally displayed an emphasis upon Edison’s machines, although Cros was in a sense acknowledged by the inclusion of an Emile Berliner hand-cranked gramophone; it was Berliner who had eventually developed the reality from the plans Cros had deposited at the Academie Francaise in April 1877.

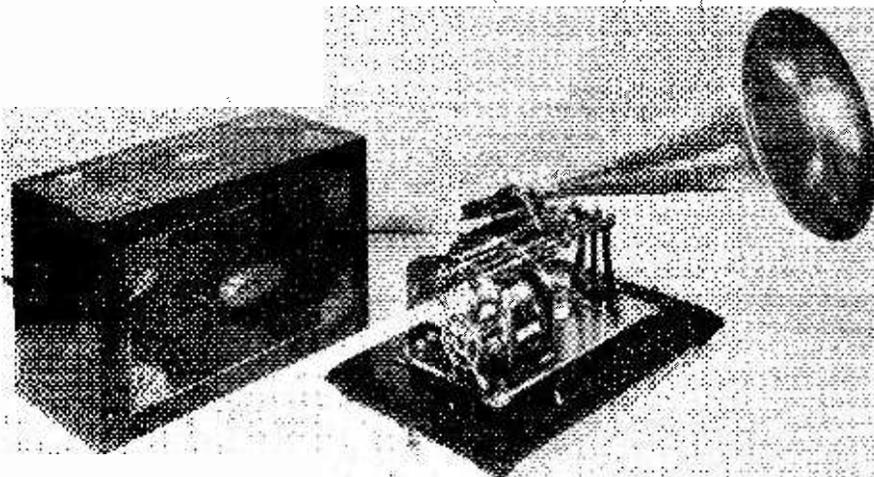
Whatever the arguments about origins, however, a stroll around this display evoked an atmosphere of warm, pre-electric nostalgia. Delicate cylinder phonographs rubbed shoulders with bluff, aristocratic console gramophones in select veneers. Splendid wooden horns balanced at the end of strange foil contraptions with worm gear drives and irresistible cranking handles peered out at an utterly changed world.

Surprisingly, in spite of their great age, most of the machines on view were still playable, in fact, at the height of its popularity, the gramophone was capable of very good reproduction, even though little scientific investigation of basic principles had accom-

panied its development. The HMV “Re-entrant” model (console gramophone of about 1930) proved very pleasant to listen to in spite of a relatively narrow audio range.

Perhaps a good deal of the interest evident at the exhibition may be dismissed as pure sentimentality, for the machines are somewhat crude by modern standards, but they do represent the beginnings of an immense extension of the range of human experience, and as such they will remain vital informational pieces of equipment. They are additionally interesting as a group of acoustic dinosaurs—they represent the visible and audible

exhibition was not restricted to the purely acoustic devices, and a selection of early “radio-gramophones” and electrically operated record players was in evidence, including the well-known Decca “Deccalian” with interchangeable heads for 78 or LP. Long-playing records were the “coming thing” in the fifties, and also included in the display was a range of earlier attempts to produce longer playing times, among which was a variable-speed type, designed to exploit the higher speeds at the perimeter of the disc, although this had the disadvantage that a complex device was needed for replay—one which pro-



One of the reproducers in the display—a Thorens phonograph circa 1905.

end of an era, their electrical counterparts proving unequally effective and competitive in the ensuing conflict.

On the other hand, they had, and still retain, real beauty; a combination of satisfying mechanical symmetry and the atavistic flesh-and-blood appeal of real wood, the voices of Melba and Caruso, and above all, an aura of magic and mystery which characterised an age of real discovery.

### Past successes

In terms of the eventual establishment of enterprise in the reproducer field, there was plenty of evidence of the developing “names” in audio devices. Thorens, for example, now heavily committed to quality hi-fi, were represented by an early piece of acoustic precision engineering in the shape of a particularly attractive motor design for a phonograph.

The chronological span of the

duced a differential slowing towards the centre. Edison’s attempts were more practical and saleable—a long player at 78rpm, which clearly necessitated a remarkably close-cut groove, a good deal closer than a modern LP cut on vinyl.

Another century on may well see an exhibition of 1977’s music centres and cassette recorders, languishing in chrome and plastic bowers filled with surround sound, but it is questionable whether they will stimulate the imagination or convey as much of the character of the age as these quaint works of wood, metal and mica. They are important because they stirred up the ripples which led to a gigantic tidal wave in human affairs—the crude boxes which paved the way for the world-wide recording industry, and in so doing, opened up one of the most creative extensions of human commercial and artistic endeavour.

Ted Parratt

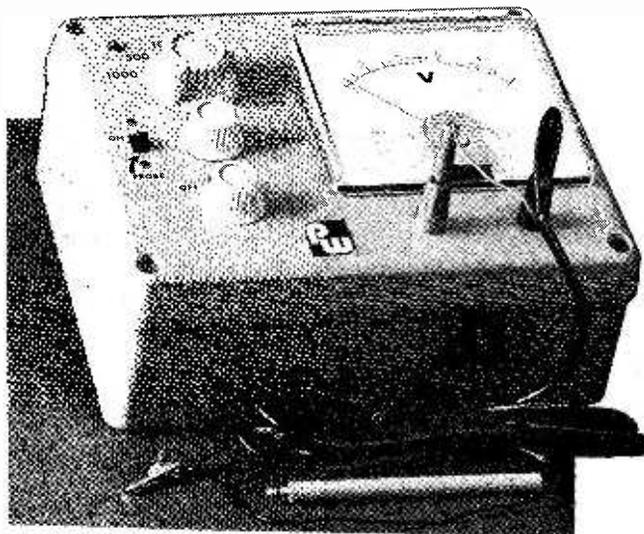
# A WIDE RANGE

# VOLTMETER

M. TOOLEY BA G8CKT

FOR AC • DC • RF

A reliable high-impedance DC and AC voltmeter is an invaluable asset in any enthusiast's workshop. The circuit described is simple to use, exhibits excellent linearity and has a constant input impedance of  $11M\Omega$  on all ranges. The basic voltmeter is provided with six DC ranges from 1V to 1000V full-scale. A variety of probe designs is included in order to facilitate further DC, AC and RF measurements. The unit is portable and operates from the mains or alternatively it may be powered from an external DC supply. An automatic diode switch is included for changing over from internal to external power.



## Circuit Description

A simplified circuit of the DC voltmeter is depicted in Fig. 1. This shows the basic bridge configuration formed by Tr2, Tr3, R9 and R10. A constant voltage is developed across R10, the emitter resistor of Tr3. The input voltage, less approximately 0.6V which is the base-emitter voltage drop for Tr2, is effectively developed across R9, the emitter resistor of Tr2. The difference between these two voltages produces a

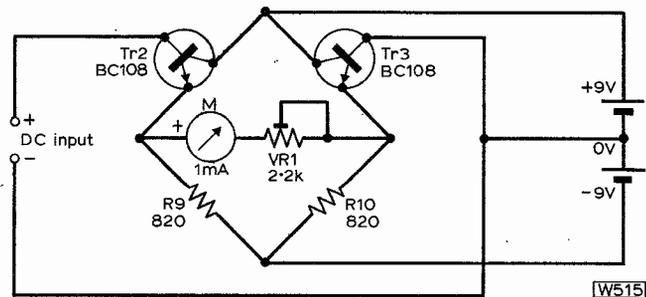


Fig. 1: Simplified circuit of the voltmeter.

## ★ specifications

<b>Functions:</b> D.C. positive, DC negative. AC (by means of suitable probe).	
<b>Ranges:</b>	1V (full-scale DC)      100V 10V                              500V 50V                                1000V
<b>Input Resistance:</b> $11M\Omega$ without probe or $10M\Omega$ with $1M\Omega$ in probe. (DC)	
<b>Supply Voltage:</b> 220/240V 50Hz. external DC 18 to 24V at 40mA.	
<b>Typical Accuracy:</b> DC $\pm 2\%$ AC $\pm 5\%$	

current in the milliammeter, M. The calibration of the instrument is set by the variable resistor, VR1.

The voltage to be measured is applied to the potential divider formed by resistors R2 to R7, see Fig. 2. The voltage division ratio is selected by means of the Range Switch, S2. A fixed resistor, R1, is provided in the input lead. To ensure correct calibration this resistor is bypassed by means of S3 when a probe is fitted. The output from the potential divider is fed to the FET transistor, Tr1. This transistor is connected as a source follower and provides a very high input resistance and a voltage gain of very slightly less than one.

Transistors Tr2 and Tr3 operate as a balanced emitter follower pair. This symmetrical arrangement ensures good linearity and a high degree of temperature stability. The base voltage for Tr3 is fixed at approximately half the DC supply by means of the potential divider formed by R11 and R12. The circuit may be balanced by means of VR3 which sets the DC potential at the gate of Tr1 and in turn the potential at the base of Tr2.

The meter connections are reversed to facilitate positive and negative voltage measurements without the necessity of altering the input lead connections. For AC measurements the instrument is effectively used on the DC negative range and a suitable probe must be employed. The probe is designed to produce a negative DC output using a simple half-wave diode rectifier arrangement. The value of probe resistor, R, is chosen so that the instrument is calibrated for RMS AC voltages, see table.

## Construction

The transistors, Tr1, Tr2, Tr3 and associated components are mounted on a 150 x 115mm 0.1in matrix board, Fig. 3. Components and connecting leads are located and soldered on this board by means of press-fit terminal pins. Wire links between pins are made using insulated solid wire. The completed board assembly is mounted below the lid of the plastic box and secured by means of the two meter terminals.

Resistors R2 to R6 are wired directly to the contacts of the Range Switch, S2. Resistor R1 is wired across the contacts of the Probe Switch, S3. Care should be taken to keep wiring as short and neat as possible. The mains transformer is secured to the base of the box, Fig. 4, preferably in such a way as to distribute the weight evenly over the base area of the instrument whilst ensuring adequate clearance when the lid and associated components are fitted in place. The external supply sockets are also located in the base of the box, adjacent to the fuseholder. The bridge rectifier and capacitor are fitted to the main circuit board.

## Probes

Various probe designs are given in Fig. 5 together with suitable component values as given in the table. The DC probe of Fig. 5a is intended for use when DC voltage measurements are to be made in the presence of AC and RF signals. The 1MΩ probe resistor provides an extra degree of isolation for the circuit under investigation and minimises reactive loading effects. The construction of this probe is shown in Fig. 6. The

Table of components for probe designs

Probe	Figure	Component values	Useful voltage range	Useful frequency range
DC	5a	R—1MΩ 0.5 2% high stability metal oxide	0 to 1000V	DC only
AC low voltage	5b	R—3.3 MΩ 2% high stability. C—1μF polyester tubular 250VDC. D—OA91	0.5 to 30V	15Hz to 100kHz
AC medium voltage	5c	R—3.3 MΩ 2% high stability. C—1μF polyester tubular 250VDC D1, D2, D3 OA91	1.5 to 100V	15Hz to 100kHz
RF	5d	R—3.3 MΩ 2% high stability. C—1nF poly- styrene 160VDC. D—OA91	0.5 to 30V	100kHz to 100MHz

probe circuit is housed in the barrel of a discarded felt-tip pen. The tip contact of the probe makes use of the body of a 3.5mm jack plug which is inserted in the barrel of the felt-tip pen and held in place by means of epoxy adhesive. Only the tip electrical

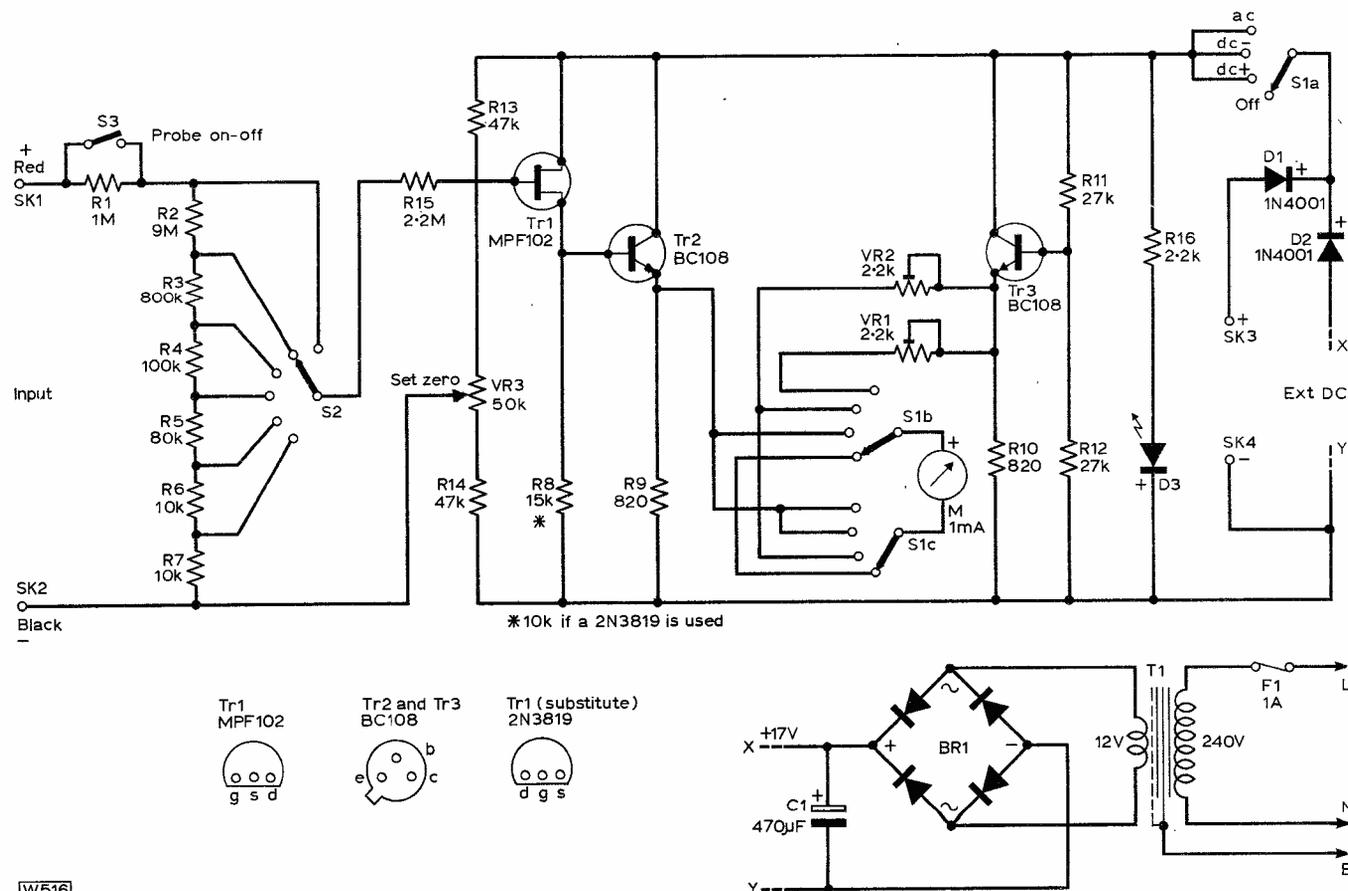


Fig. 2: The detailed circuit diagram, including transistor base connections and optional power supply circuit.

W516

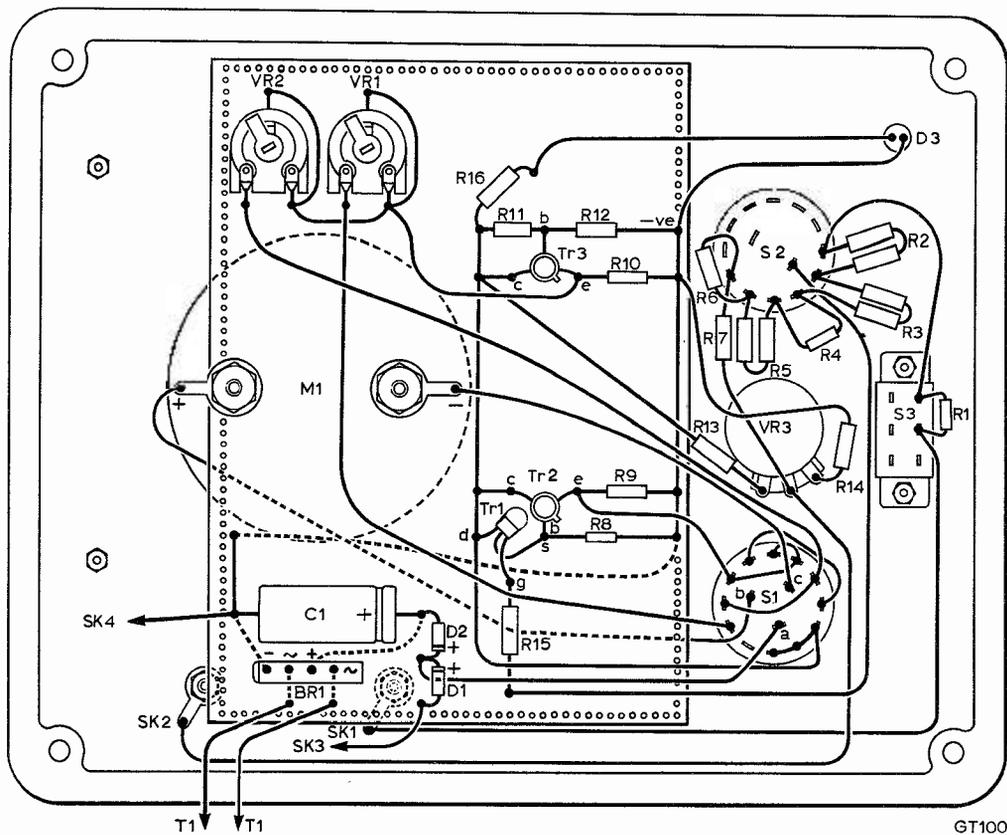


Fig. 3: (above) showing internal layout, and Fig. 4 (below) indicating mains input and transformer details.

### ★ components

#### Resistors

R1	1MΩ	R9	820Ω
R2	9MΩ (2·2MΩ + 6·8MΩ)	R10	820Ω
R3	800kΩ (470kΩ + 330kΩ)	R11	27kΩ
R4	100kΩ	R12	27kΩ
R5	80kΩ (47kΩ + 33kΩ)	R13	47kΩ
R6	10kΩ	R14	47kΩ
R7	10kΩ	R15	2·2MΩ
R8	15kΩ	R16	2·2kΩ

R1 to R7 ½W metal oxide high stability 2%  
R8 to R16 ¼W carbon film high stability 5%  
VR1/2 2·2kΩ horizontal pre-set  
VR3 50kΩ linear carbon.

#### Semiconductors

Tr1	MPF102	D1/2	1N4001
Tr2/3	BC108	D3	LED (pushfit)
BR1	Bridge rectifier 100PIV 1A		

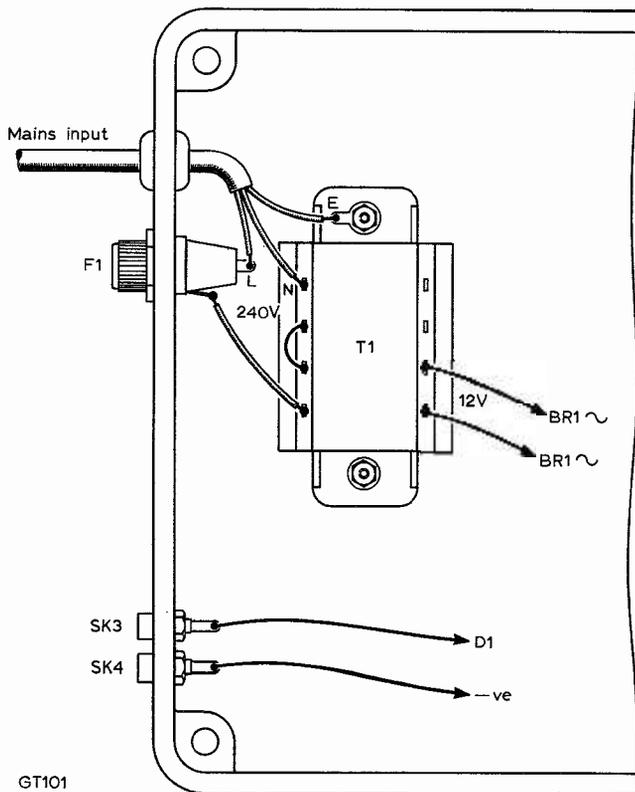
Note: Tr1 may be replaced by a 2N3819 if R8 is changed to 10kΩ. See lead-out connections on Fig. 2.

#### Switches

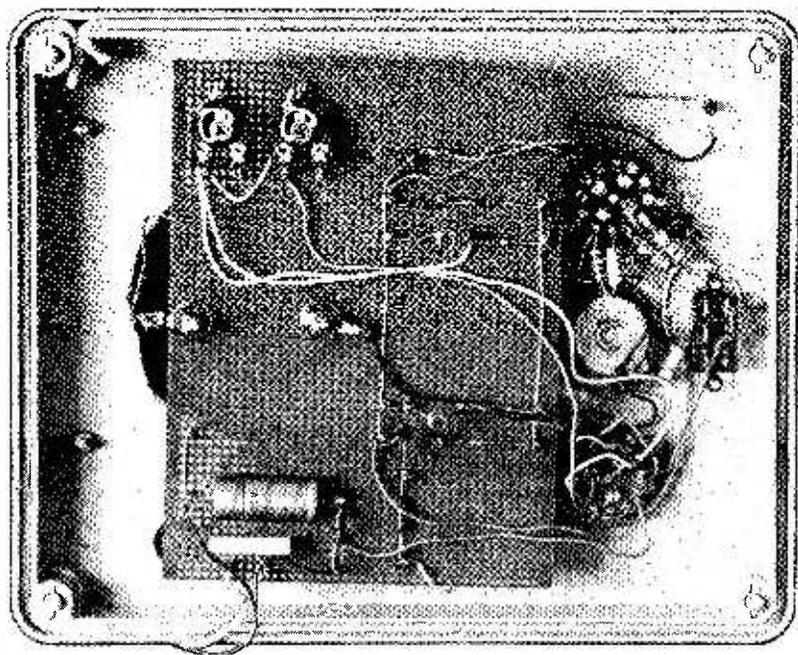
S1	3P 4W midget wafer
S2	1P 6W " "
S3	SPST (or DPDT) slide switch

#### Miscellaneous

C1, 470μF 25V. Sockets (2), 2mm, red and black. Terminals (2), 4mm, red and black. Mains transformer, 240V to 12V 500mA. Fuse 1A and holder. Meter, 1mA FSD, size depending on readout accuracy required. The author's meter was 117 × 105mm (4½ × 4in. approx.). Plastic case approx. 225 × 175 × 85mm (9 × 7 × 3½in.).



GT101



A view of the inside of the voltmeter, to be used in conjunction with Fig. 3, in which the method of connecting resistors in series to form R2, R3, and R5 is clearly shown.

connection of the jack plug is used, the outer connection is ignored.

A short length (approximately 1m) of coaxial cable is used to couple the probes to the voltmeter. This should preferably be a substantial RF type cable with a copper braided screen. The braid terminates in a short length of stranded wire fitted with a crocodile clip. This ensures a low-resistance contact with the chassis or common rail of the circuit under investigation. The voltmeter end of the connecting cable is fitted with two 4mm plugs. The AC and RF probes use a similar construction technique, Fig. 7.

## Calibration

Calibration on the DC and AC ranges is carried out by means of VR1 and VR2 respectively. Calibration on the DC ranges may be checked either by the application of an accurately known DC voltage or by reference to another DC voltmeter. If neither is avail-

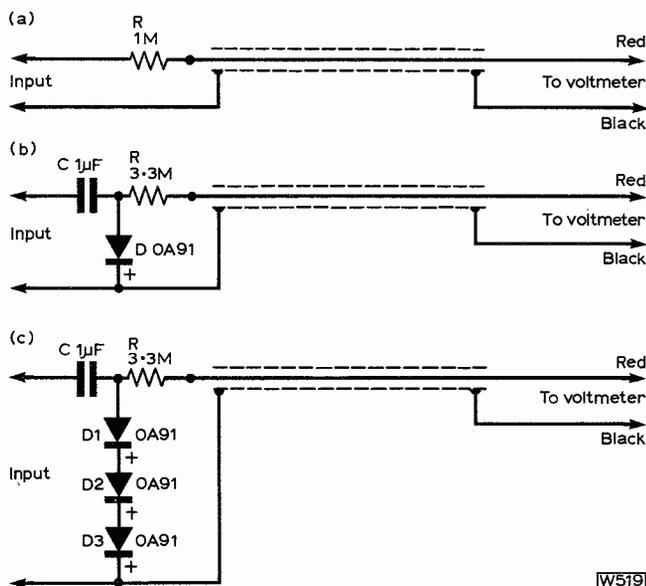


Fig. 5: Suitable probe designs for the unit.

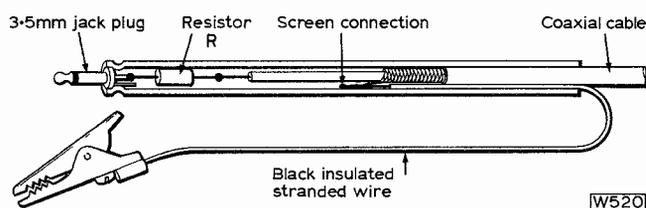
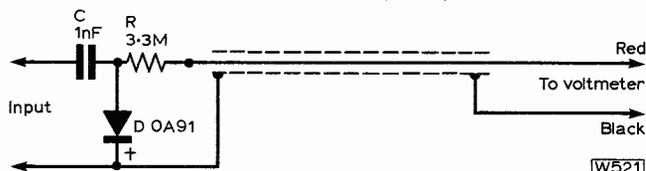


Fig. 6: The construction of the DC probe, (above) and the circuit of the AC and RF probes (below).



able a new 1.5V cell may be connected to the instrument and VR1 accurately set for a reading of 1.5V, after first remembering to set the Probe Switch "off" and zero the meter! Repeat the calibration procedure for the DC negative and AC ranges (but without a probe connected). Calibration can be checked on the AC range if a known source of AC is available. This may conveniently be a low-voltage transformer of known output supplied from the mains. Do not attempt to calibrate the instrument using AC mains voltage directly since this may cause damage to the probe and to the instrument. The AC probes are suitable only for relatively low AC voltages.

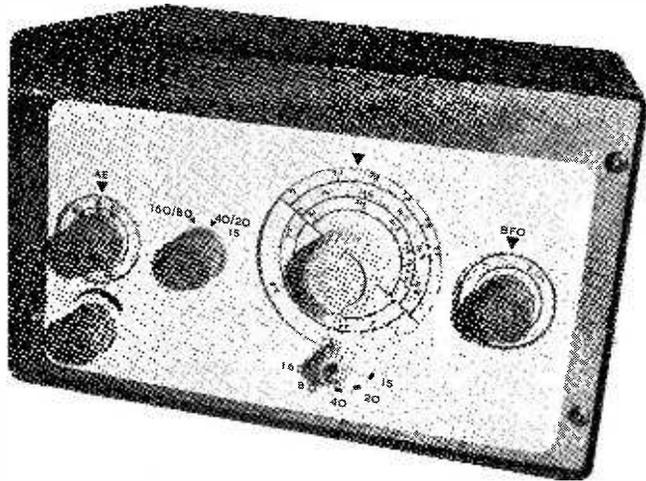
## Operation

The voltmeter is switched to the desired Function and the Set Zero control is then adjusted in order to accurately zero the meter. The Range Switch is set to the 1000V range. The input leads are then connected to the circuit under test and the Range Switch is then progressively advanced to the range which produces an easily measurable indication. Note that, for the sake of simplicity, a separate mains switch is not fitted to the instrument. Thus, when the unit is not required for use, it is advisable to disconnect the instrument from the AC supply by removing the mains plug.

# all band short wave converter

Part 1

F. RAYER G3OGR



The controls are, left to right, RF Tune, Bandswitch, main tuning and BFO Tune. The RF Attenuator/on-off switch is below the RF Tune control at the left.

With a receiver intended particularly for multi-band reception individual coils with parallel and series capacitors are often provided for each range, values being arranged to secure suitable coverage. A band-spreading capacitor suitable for the LF bands is too large in value for the HF bands, so that some ranges need series padders. The number of coils, trimmers and padders for a multi-band receiver of this type becomes large and careful adjustment is needed to track aerial and oscillator tuning.

The converter described here avoids these difficulties, and is in line with the trend to use a high intermediate frequency, to eliminate second channel interference. It is suitable for operation with a receiver tuned to about 5.5MHz, which will be available with many general coverage receivers, and allows 1.8 to 21MHz to be covered with a single converter oscillator coil.

Although this article describes a converter intended for use on the amateur bands there is no reason why it should not be aligned for the SW broadcast bands, since most of these bands are adjacent, in terms of frequency, to the amateur bands.

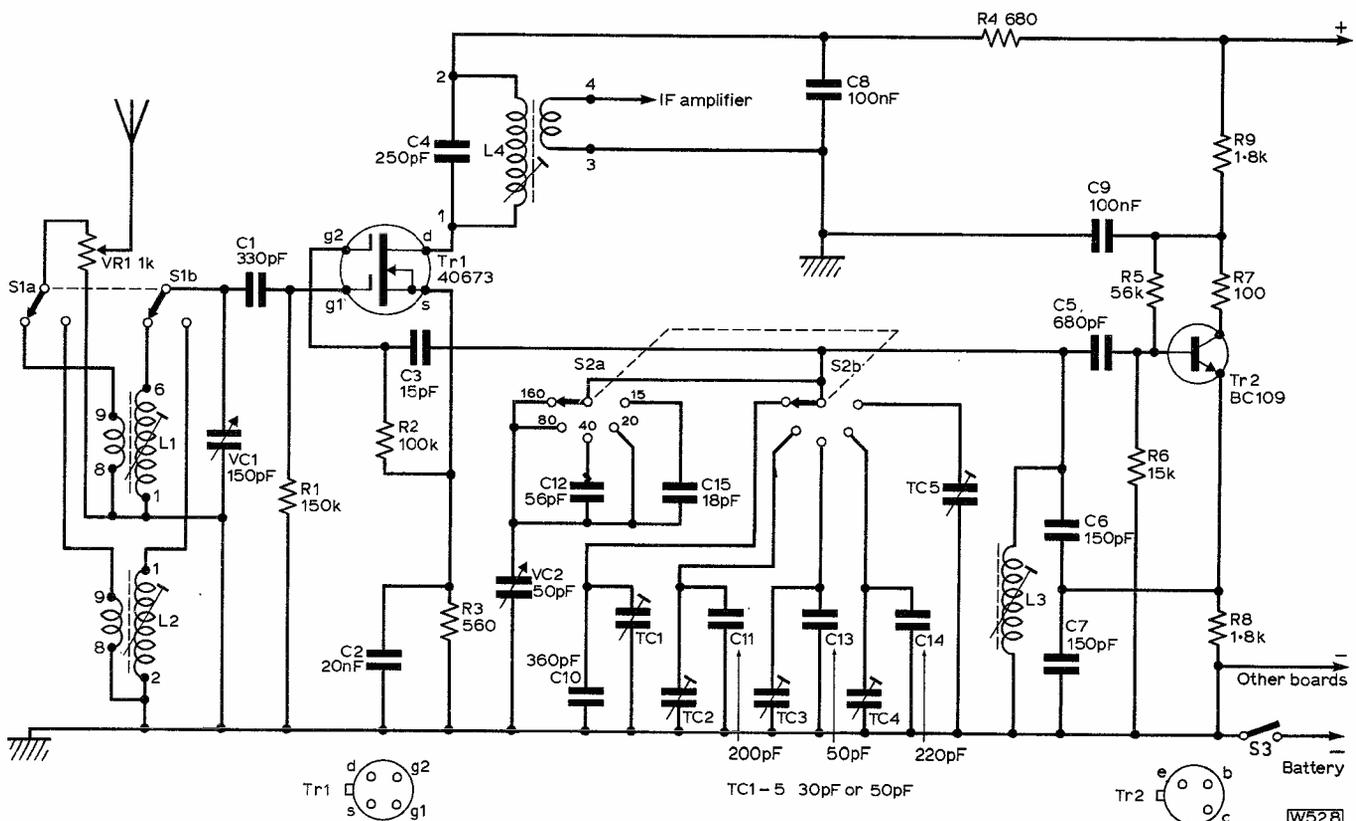


Fig. 1: Circuit diagram showing the mixer and oscillator sections of the converter, together with the lead-outs for the transistors.

## Circuit Description

Fig. 1 shows the mixer and oscillator stages. The ganged switch S1a/S1b brings into circuit either L1 or L2 for aerial tuning, L1 covering the 15, 20 and 40m bands, and L2 the 80 and 160m bands. Each band is peaked by the panel control VC1. This provides five bands with two coils, with no trimming or similar alignment difficulties.

L3 is the oscillator coil, tuned by VC2, with the switch S2a/S2b. This switch has five positions, operating as follows:—

**160m** VC2 has C10 and TC1 in parallel, so that the oscillator coverage is 7.25 to 7.5MHz. With the 5.5MHz IF, this gives reception over the 1.75 to 2.0MHz range.

**80m** C11 and TC2 are in parallel with VC2, giving an oscillator coverage of 9 to 9.5MHz, or 3.5 to 4.0MHz on reception.

**40m** C13 and TC3 are across L3, and C12 is in series with VC2. Oscillator coverage is 12.5 to 13MHz, giving reception of signals in the 7 to 7.5MHz band.

**20m** C14, TC4 and VC2 are in parallel, so that L3 tunes 8.5 to 9MHz and reception is from 14 to 14.5MHz.

**15m** TC5 is across L3 and C15 is in series with VC2, giving an oscillator range of 15.5 to 16MHz, for reception over 21 to 21.5MHz.

VC2 is operated by a ball drive and is the main tuning, with VC1 peaking signals as mentioned. VC1 is calibrated to avoid tuning to second channel frequencies, which arise at about 11, 13, 15 and 18MHz in the usual way with a 5.5MHz IF. VR1 is an

## ★ components

### Resistors

R1 150kΩ	R6 15kΩ	R11 2.2kΩ
R2 100kΩ	R7 100Ω	R12 680Ω
R3 560Ω	R8 1.8kΩ	R13 390kΩ
R4 680Ω	R9 1.8kΩ	R14 6.8kΩ
R5 56kΩ	R10 1.2MΩ	R15 2.7kΩ

VR1 1kΩ linear carbon with switch S3

All resistors are  $\frac{1}{4}$  or  $\frac{1}{2}$ W 5%

### Capacitors

C1 330pF	C9 100nF	C17 10nF
C2 20nF	C10 300pF*	C18 100pF*
C3 15pF	C11 200pF*	C19 100nF
C4 250pF*	C12 50pF*	C20 10nF
C5 680pF	C13 50pF*	C21 220pF*
C6 150pF*	C14 220pF*	C22 220pF*
C7 150pF*	C15 18pF*	C23 470μF 12V
C8 100nF	C16 220pF	

\*2% silver mica preferred

TC1/5 50pF trimmer

VC1 150pF (Jackson C804)

VC2 50pF (C804)

VC3 20pF (C804)

### Semiconductors

Tr1 40673	Tr3 2N5459
Tr2 BC109	Tr4 2N2926

### Miscellaneous

S1, 2-pole 2-way wafer switch; S2, 2-pole 5-way wafer switch; L1, 140μH, Range 4, valve type (Denco); L2, White, Range 2, valve type (Denco); L3, 4, 5 and 6, see text; 11mm coil former with core, 1 off; 7mm coil former on square base, with core, 3 off (Home Radio); Square screening can for L5; Coaxial sockets, 2 off; Ball drive, 6.25 ratio (Jackson); Knobs; Panel brackets; Chassis, 8" x 8" x 1"; Cabinet, 10" x 6" x 6"; Plain veroboard 0.15" track, see text.

W529

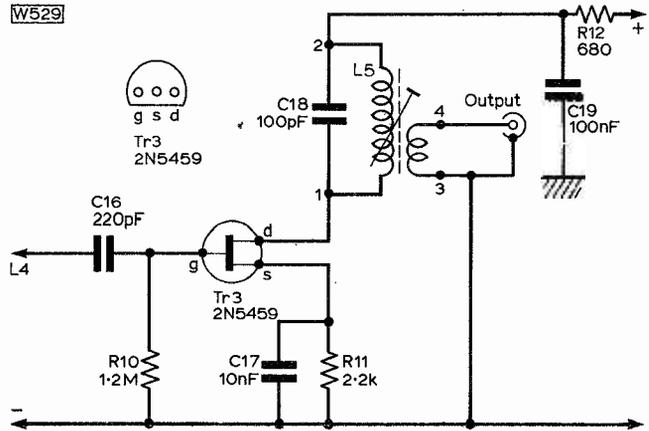


Fig. 2: The optional IF amplifier stage which works at 5.5MHz. This is a separate unit, and may be fitted if the main receiver is relatively insensitive.

attenuator or aerial input control, enabling the strength of signals to be kept down so that satisfactory CW and SSB reception can be obtained, also preventing the overloading of the receiver with strong AM transmissions. Tr1 is the mixer, with the signal input to gate 1, and the oscillator input to gate 2. Tr2 is the oscillator stage, operating as described. L4 is tuned to approximately 5.5MHz and is followed by an optional FET 5.5MHz stage. This can be omitted with a reasonably sensitive main receiver, or can be added later. A BFO is included to allow CW and SSB reception with the popular type of receivers which may have no beat frequency oscillator incorporated.

Fig. 2 is the circuit of the 5.5MHz optional stage. Signal input is taken from Tr1 coupling coil L4 pin 4, to C16. L5-C18 is a further 5.5MHz coil connected in the drain circuit of Tr3, and coupled to the output socket. This stage is assembled as a separate unit, fitted to the chassis later.

## BFO

The beat frequency oscillator is designed for a centre frequency of 5.5MHz and uses the circuit in Fig. 3. It is also assembled as a separate unit. Without the BFO, only AM signals can be received, unless a suitable BFO is present in the receiver itself. As AM reception may be required, provision is made to switch off the BFO for this purpose. To do this, the corner of the back moving plate of VC3 is bent so that it contacts the fixed plate when VC3 is fully closed. The stage is then not operative and current is limited to about 1mA by R14 and R15. An on-off switch in series with R15 could be used if preferred.

W530

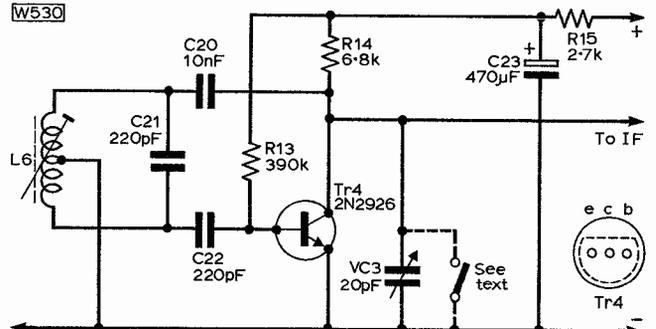
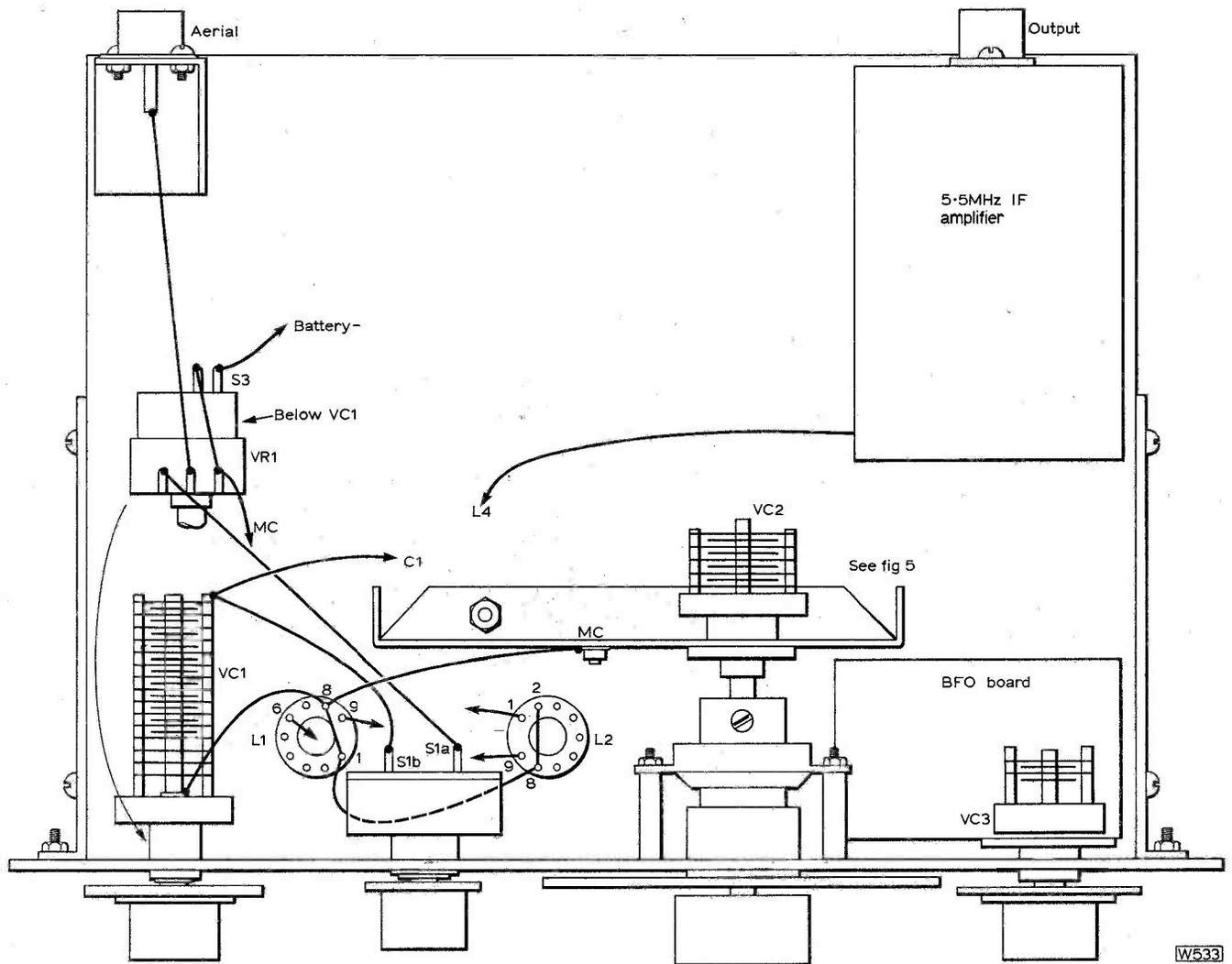


Fig. 3: Another optional unit is the beat frequency oscillator which also operates at about 5.5MHz. If the main receiver has a BFO then this unit is not required.





W533

Metal bracket 100 x 90mm (4 x 3 1/2") approx

W532

Fig. 6: Layout of the units and main components on the chassis. After the main tuning dial has been fitted to the panel the remaining panel components can be mounted in the same line.

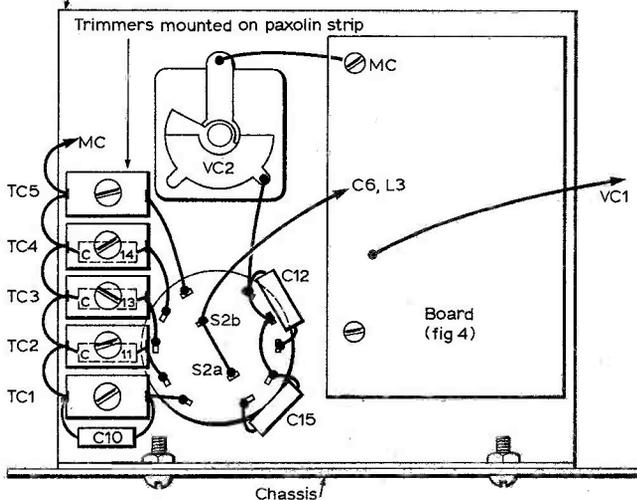


Fig. 5: Details of the assembly mentioned in the photograph. It can be finished completely as shown before mounting on the main chassis.

The positions of components and wiring can be seen from Fig. 4. The chassis returns MC are 1/2in 6BA bolts, with extra nuts and tags, so that the board can be mounted later with clearance for connections and leads. Insulated leads are provided to go to S2a/b, VC1, positive, and output socket or IF stage. Leads of Tr1 and Tr2 are shown in Fig. 1.

## Osc/Mixer assembly

VC2 and S2a/b are fitted to a bracket approximately 100 x 90mm (4in x 3 1/2in) as in Fig. 5. The five trimmers are mounted on a strip of paxolin, which is spaced from the bracket by a long bolt, or similar, to clear the switch. Connect C10 to TC1, C11 to TC2, C13 to TC3, and C14 to TC4 before mounting the trimmer strip, including leads to take to the switch tags on that side.

The board is mounted by the bolts described earlier. The switch requires a spindle 2in long, so that it can project through a 1/4in hole in the panel, when the assembly is bolted in place approximately 1 1/2in behind the panel. Alternatively, a shaft coupler can be added, with a length of rod. The exact distance from bracket to panel is arranged so that the spindle of VC2 engages correctly with the ball drive bush.

Fig. 6 shows the positions of components on the chassis, and connections for L1 and L2. VR1 fits directly below VC1. The aerial lead runs direct to VR1, away from the 5.5MHz circuits to avoid unnecessary 5.5MHz breakthrough. The BFO board fits to the right, as shown.

Part 2 next month will deal with the construction of the BFO and final alignment of the converter plus a few hints on using the converter.

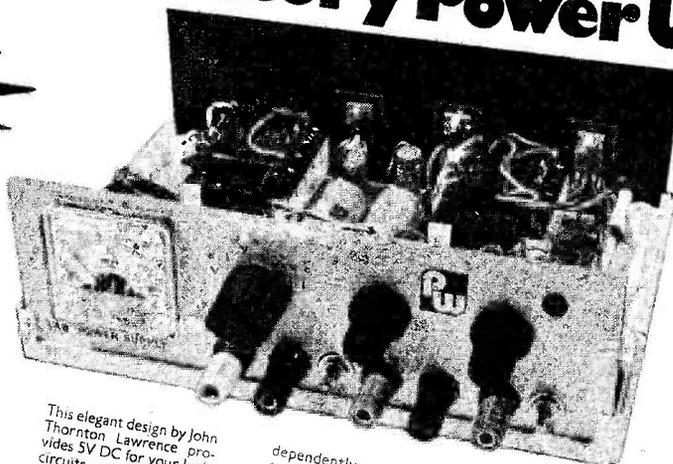
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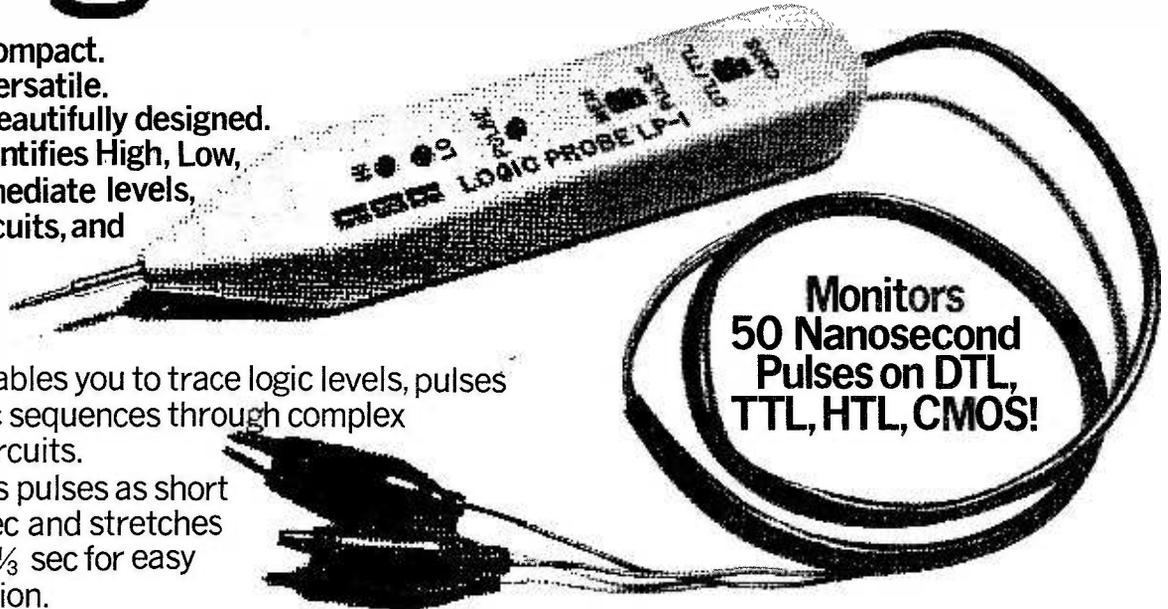
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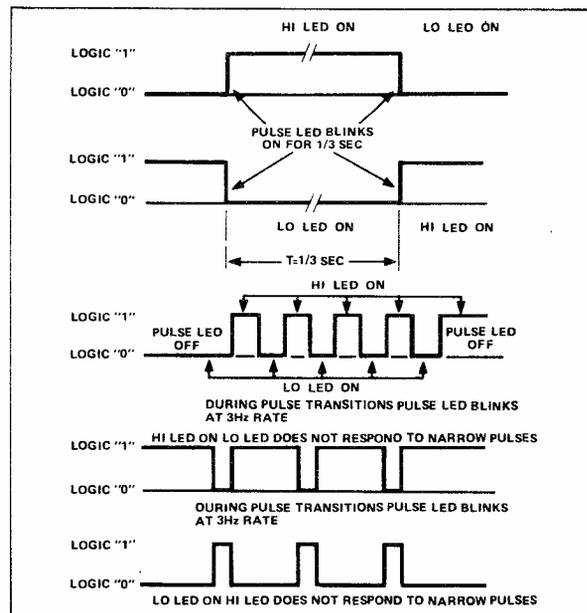
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logic 0, 0.80V $\pm$ 0.10	Size: 6.1 x 1.0 x 0.7 inches (155 x 25 x 18mm)
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Min. detectable pulse: 50 nanoseconds	



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This resonance indicator is not intended to replace more accurate (and more expensive!) apparatus, but rather to provide a rapid method of checking unknown tuned circuits in the range 100kHz to 28MHz. With a given inductor in circuit, the values of unknown capacitors may be found within the range of VC1a and b by resonating the inductor at the same frequency, first with and then without the unknown capacitor between terminals N and M. The change in the value of VC1a or VC1b needed to re-establish resonance is therefore the value of the unknown capacitor.

## Circuit operation

In a series tuned circuit maximum current flows at resonance and in Fig. 1 this current through R1 feeds the emitter of Tr1 with an increased RF voltage compared with the voltage at other frequencies. The emitter and base of Tr1, just biased on by R2, VR1, form a detector circuit and the boosted RF thus acts to increase the emitter-base current. The resulting increase in collector current is indicated by the meter so that the resonance of a particular coil with a selected capacitance and frequency is now known.

## Construction

Because a variable capacitor usually has the frame earthed, this has to be fitted at the 'bottom' of the circuit and the operational electronics are therefore at the 'live RF' end, as is the push-button on-off switch. All components apart from R1, S1, S2, VC1 and M1 may be fitted to a piece of Veroboard; VR1 is adjusted to give a small (about 20 per cent) pointer deflection when S1 is closed. R1, a carbon type, is fitted directly from the coaxial RF input socket to terminal O to limit excess inductance; the circuit board could be attached across R1 by short stiff wires if one wishes to avoid making additional fixings to the chassis or panel. See Figs. 2 and 3.

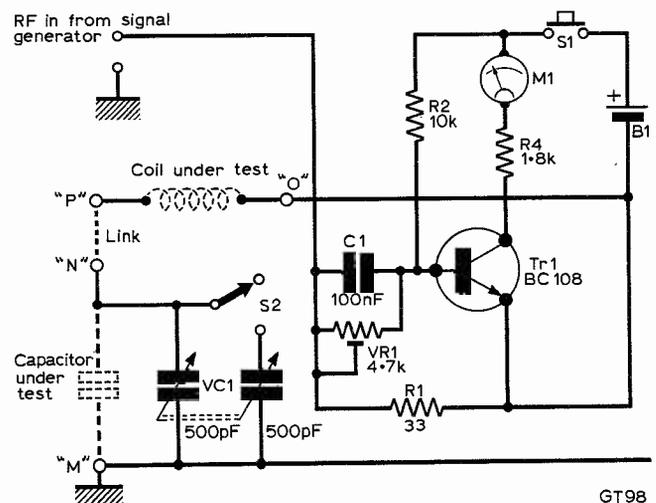
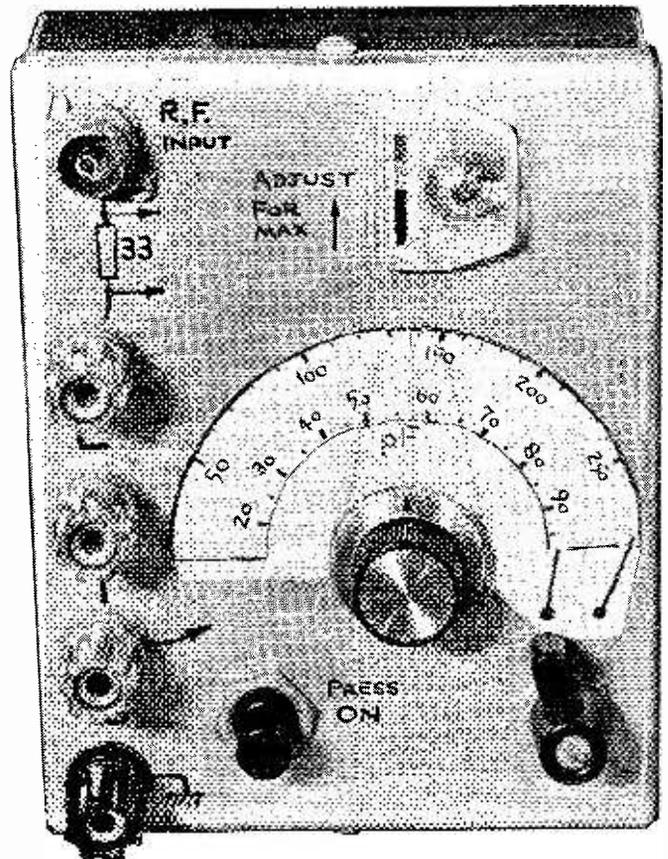


Fig. 1: The circuit diagram of the RF Resonance Indicator.

VCI is bolted direct to the case. A metal case is recommended rather than a plastic one. A short pointer on the shaft traverses over a card scale glued to the outside of the box. During construction ensure that the link between terminal N and P is easily removed for ease of calibration.

The single Mallory cell (in its holder) may be glued into place, and should last for several years.

Piece of veroboard mounted on stiff wires between meter and R1

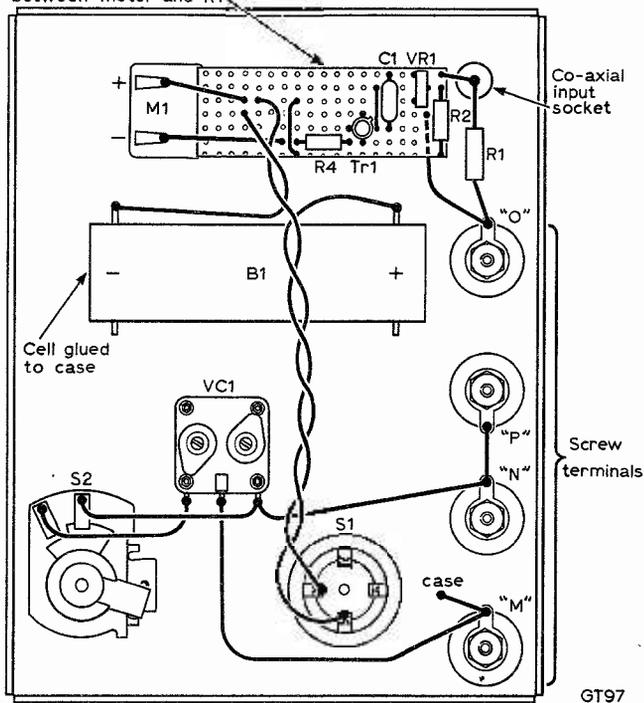


Fig. 2: General wiring inside the aluminium case.

## Calibration

Connect a coil (fifteen turns of plastic or enamel covered wire close-wound and taped securely to a ferrite aerial rod will do) between terminals P and O. Temporarily unsolder the link N-P. Connect a close-tolerance 50 or 100pF silver mica or polystyrene capacitor between terminals N and M, keeping S1 closed. Then vary the tuning of the RF signal generator connected to the RF input socket while looking for a peak in meter deflection. Without changing the RF generator frequency, remove the external capacitor, connect N-P and vary VC1 until the meter reading again peaks.

The scale-card may then be marked with its first 50 or 100pF calibration point. Close S2, retune VC1 for peak reading and calibrate the other scale. Depending upon the particular type of variable capacitor available it is possible that the minimum capacitance of both gangs in parallel is more than 50pF and that 100pF will be the first calibration.

Now with VC1 set to the 50pF calibration point, add the external capacitor and vary the input frequency to obtain a peak meter reading. Remove the external capacitor and increase the value of VC1 to regain the peak meter reading, marking this new calibration point on the scale. In this way calibration points may be located at 50 or 100pF intervals around the scales.

It will also be possible to confirm the basic frequency formula that if the 15-turn coil resonates at about 5 to 6 MHz with 50pF, then at 450pF, nine

## ★ components

**Resistors:** R1 33Ω, R2 10kΩ, R4 1.8kΩ, VR1, 4.7kΩ preset.

**Capacitors:** C1 100nF polycarbonate, VC1, 500/500pF gang capacitor

**Transistor:** BC108

**Switches:** S1, push-to-make switch, S2, SPDT wafer

**Miscellaneous:** Screw-type terminals, Co-axial socket. Metal case, 5½" × 4½" × 1½" (140mm × 105mm × 45mm), (AB10) B1: 1.2V to 1.5V cell (mercury), Piece of Veroboard, 2" × 1" (50mm × 25mm).

Note breaks in print at rows 3 and 6

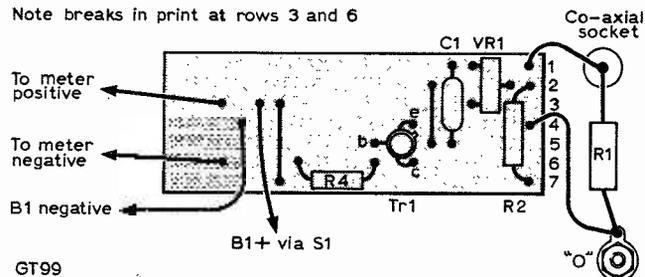
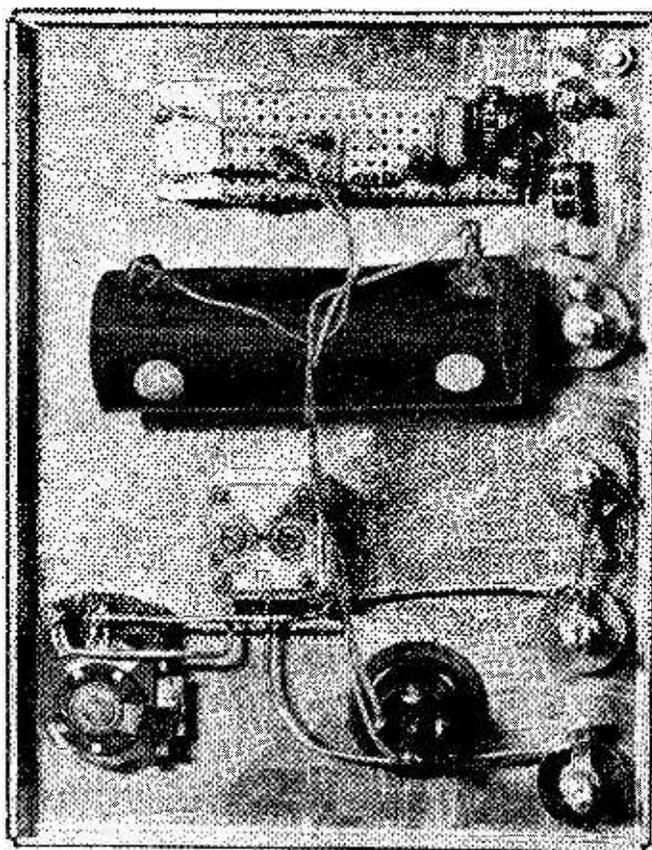


Fig. 3: Showing the component positions on the Veroboard, and meter and battery interconnections.



times the original capacitance, the resonant frequency becomes one-third of its value at about 1.8MHz. This is because resonance is proportional to the square-root of the ratio of capacitance change. ●

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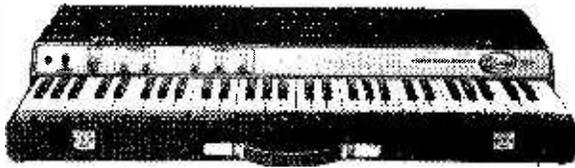
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## Practical Ohm's Law

Before we move off Ohm's law and resistance, let us see how it can be applied to calculating the resistor values in a practical circuit. We are going to use an audio frequency amplifier as an example and this is shown in Fig. 1a. As we are only concerned with the DC conditions and how they are set up, we can forget about all the AC components, the coupling and de-coupling capacitors, leaving only the DC components as shown in Fig. 1b. Most modern small signal transistors have a beta (DC gain) of 100 or more, this implies a very small base current, sufficiently small

that it may be ignored altogether if certain "rule-of-thumb" conditions are observed.

In a small signal audio frequency transistor amplifier stage, the collector current for optimum gain, noise performance, etc., would be about 1 to 2mA, so for simplicity we will choose 1mA ( $10^{-3}$ A). Now for the current flowing down the base potential divider, R1 and R2. As a rule-of-thumb guide this should be a tenth of the collector current, so in our circuit it would be 0.1mA ( $10^{-4}$ A). This ensures that this current is large compared with the small bias current of the transistor. The two currents are shown in Fig. 1b.

Now for the voltages in the circuit. First we must know the supply voltage, so for our example we will make this 9V. The emitter resistor R4 provides stabilisation of the operating conditions for Tr1. A typical voltage drop across this would be 0.5 to 1V. So again for simplicity we will choose 1V. The collector voltage should sit midway between the emitter voltage +1V and the supply voltage +9V, that is at +5V. This will allow a signal voltage swing on the collector to go positive by 4V to the supply voltage and negative by 4V to the emitter voltage. Remember, up the page is more positive and down the page is more negative (away from positive)! Finally, the voltage drop across the emitter-base of a silicon transistor is 0.6V so if the emitter is at +1V the base will be at +1.6V.

Now for the sums to work out the value of the resistors, these are taken in reverse order.

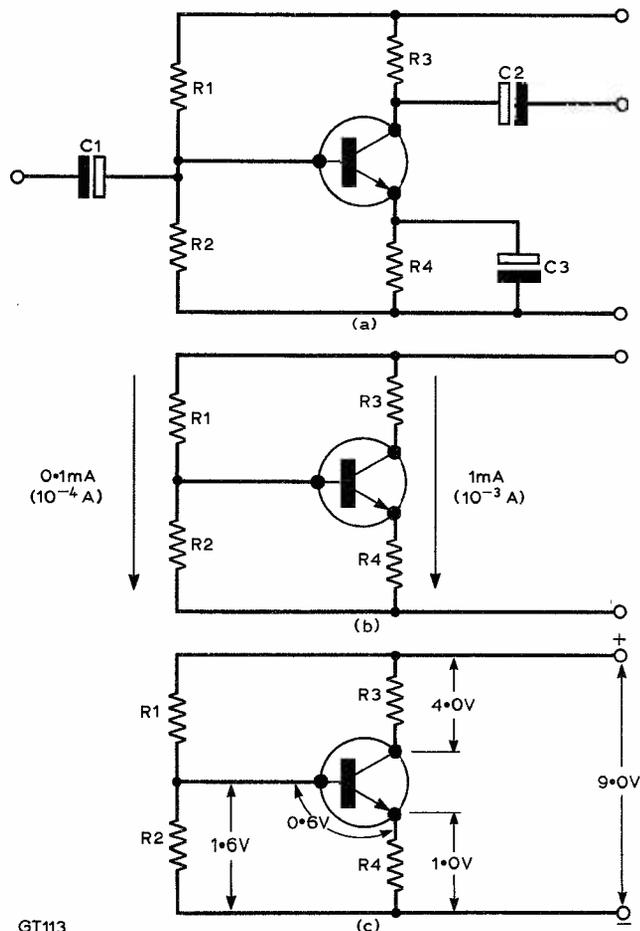
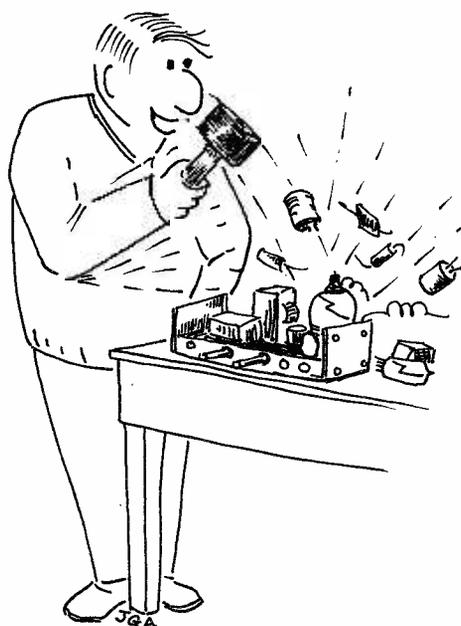


Fig. 1: The application of Ohm's Law to a simple transistor circuit.



... some practical experience is desirable!

$$R4 = \frac{V}{I} = \frac{1V}{10^{-3}A} = 10^3 \Omega = 1k\Omega$$

$$R3 = \frac{V}{I} = \frac{4V}{10^{-3}A} = 4 \times 10^3 \Omega = 4k\Omega$$

$$R2 = \frac{V}{I} = \frac{1.6V}{10^{-4}A} = 1.6 \times 10^4 \Omega = 16k\Omega$$

$$R1 = \frac{V}{I} = \frac{9.1.6V}{10^{-4}A} = \frac{7.4V}{10^{-4}A} = 7.4 \times 10^4 \Omega = 74k\Omega$$

In a practical circuit the value of each resistor would have to be chosen from the list of "preferred" values. There are 12 "preferred" values in each decade of the 10% tolerance range of resistors and 24 "preferred" values in the 5% range.

10% (E12) range:—  
1.0, 1.2, 1.5, 1.8, 2.2, 2.7, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2.

5% (E24) range. All the above values plus:—  
1.1, 1.3, 1.6, 2.0, 2.4, 3.0, 3.6, 4.3, 5.1, 6.2, 7.5, 9.1.

To complete our exercise let us now specify the preferred values for our circuit.

	R1	R2	R3	R4
Calculated value	74kΩ	16kΩ	4kΩ	1kΩ
5% range (E24)	75kΩ	16kΩ	3.9kΩ	1kΩ
10% range (E12)	68kΩ	15kΩ	3.9kΩ	1kΩ

## Magnetism

We are not proposing to spend any time on permanent magnets except to say that a permanent magnet has a "north seeking" pole and a "south seeking" pole and that imaginary lines of magnetic field or force run from the north to the south pole of the magnet. If two magnets are brought close together then the poles attract one another if they are dissimilar, N-S or S-N, and repel one another if they are similar, N-N, S-S. (See Radio Amateurs' Examination Manual, page 9).

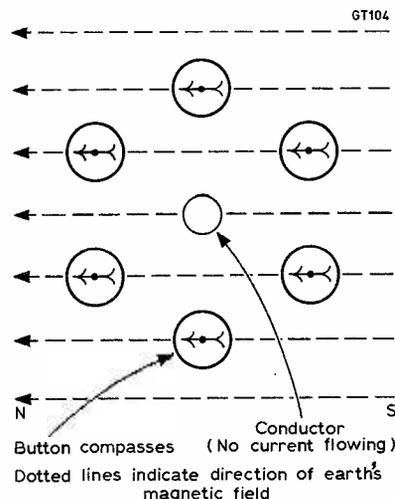
If you are a family man, perhaps you could borrow your son's copy of the Ladybird Book, "Magnets, Bulbs and Batteries"! Seriously though, it's an excellent little book and illustrates pictorially the effects we are going to discuss.

## Magnetic Effect of an Electric Current

In the following section we shall look at the magnetic effects produced by currents flowing in conductors. When illustrating these effects in diagrams it is essential to know the direction in which

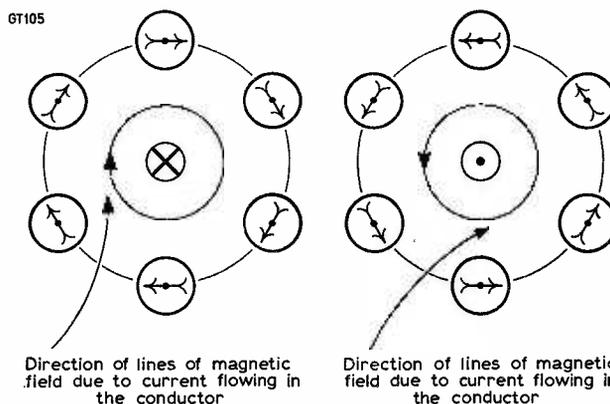
the current is flowing and the way this is done is shown in Fig. 2. A cross on the conductor relates to the flight of the arrow and indicates that the current is flowing away from the observer and a dot on the conductor represents the point of the arrow and indicates that the current is flowing towards the observer.

Now, let's get down to business and look at a conductor in cross section as shown in Fig. 3. The conductor is surrounded by button compasses, no current is flowing and the compasses are taking up a position in line with the earth's magnetic field. When current flows through the conductor away from you, as shown in Fig. 4a, a magnetic field is produced and the compasses align themselves with the lines of this field, in a clockwise direction. When the current flows in the reverse direction, towards you, as shown in Fig. 4b, you can see that the direction of the magnetic field is also reversed. Remember, reversal of the current produces a reversal of the field.



▲ Fig. 3

▼ Fig. 4

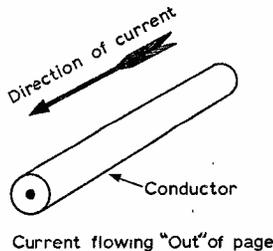
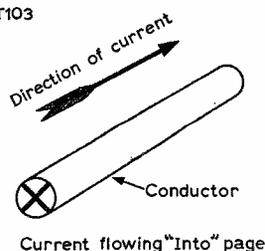


### The Solenoid

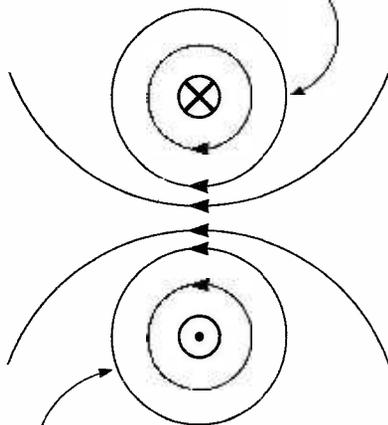
If a conductor is formed into a single turn coil, a cross-section view would appear as shown in Fig. 5. You will now notice that the magnetic fields produced in the centre of the coil are in the same direction and are, therefore, more concentrated. The solenoid is a coil comprising a number of turns, as shown in section in Fig. 6. Here you can see the overall effect of the lines of magnetic field around each conductor, combining to produce a concentrated field in the centre of the solenoid, with an overall magnetic field similar to that produced by a permanent bar magnet

Fig. 2

GT103



Magnetic field direction due to current flowing away from you

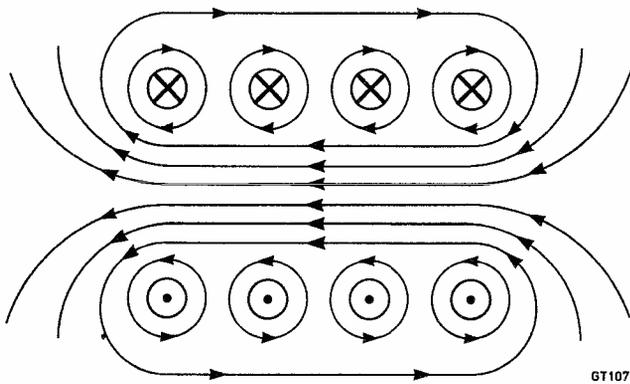


Magnetic field direction due to current flowing towards you

GT106

▲ Fig. 5

▼ Fig. 6



GT107

with its "north seeking" pole and "south seeking" pole. The magnetic polarity of the solenoid can be deduced by observing the direction of the current flow when viewing the coil at one end, as shown in Fig. 7. The arrows on the letters indicate the direction of the current and make a useful memory aid.

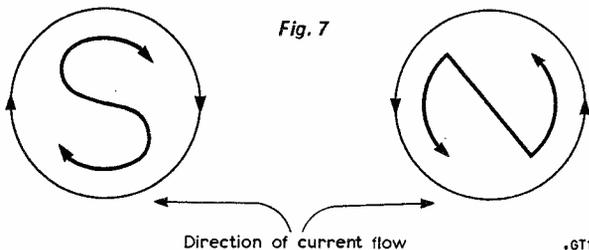


Fig. 7

Direction of current flow

GT108

Now, suppose we place a conductor in a magnetic field, with no current flowing, as shown in Fig. 8a, there is no disturbance to the field. When a current flows through the conductor, its resultant magnetic field reacts with the existing field, as shown in Fig. 8b. You will see that on one side of the conductor the lines of magnetic field are in the same direction as those produced by the current and tend to reinforce the field on that side whilst on the other the fields tend to cancel out. This causes a force to be exerted on the conductor resulting in its moving in the direction indicated. A reversal of current produces a reversal in the direction of movement, as shown in Fig. 8c.

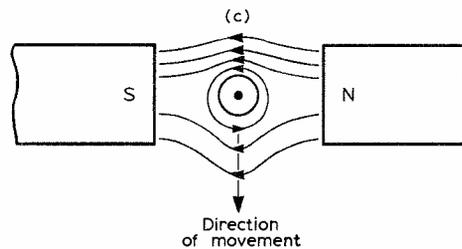
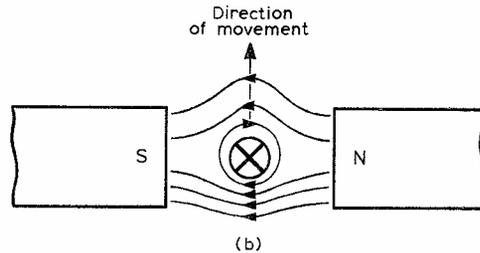
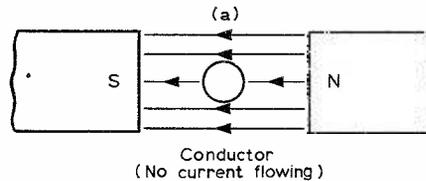
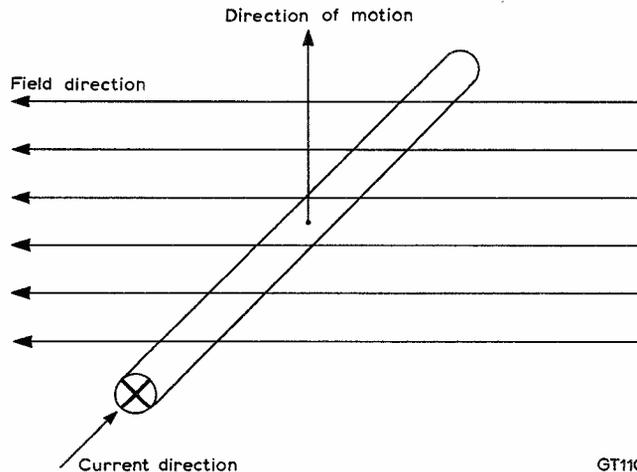


Fig. 8: Physical effect of current flowing in a conductor situated in a magnetic field.



GT110

Fig. 9: Effect on a conductor when it is moving in a magnetic field.

Finally, let us look at the converse of this effect where the conductor is moving at right angles to a magnetic field, as shown in Fig. 9. Here a flow of current is INDUCED in the conductor and its direction depends on the direction of the motion. The memory aid for this, which is Fleming's Left Hand Rule, is illustrated in Fig. 10.

### The Left Hand Rule

If the thumb, forefinger and second finger of the Left hand are placed at right angles to one another,

- (i) The Forefinger indicates Field direction.
- (ii) The ThuMb indicates Motion direction.
- (iii) The SeCond finger indicates Current direction.

So that, if we know any two of the three directions, the third can be found.

To summarize what we have seen in this section,

- (i) If we pass current through a conductor a magnetic field is set up around it.
- (ii) The direction of the field depends on the direction of the current flow.
- (iii) If the conductor is in a magnetic field and a current is made to flow in it, the conductor will move, the direction of motion being dependent on the direction of current flow.
- (iv) If a conductor is moved in a magnetic field, then a current will be *induced* in the conductor, the direction of which is dependent on the direction of motion.

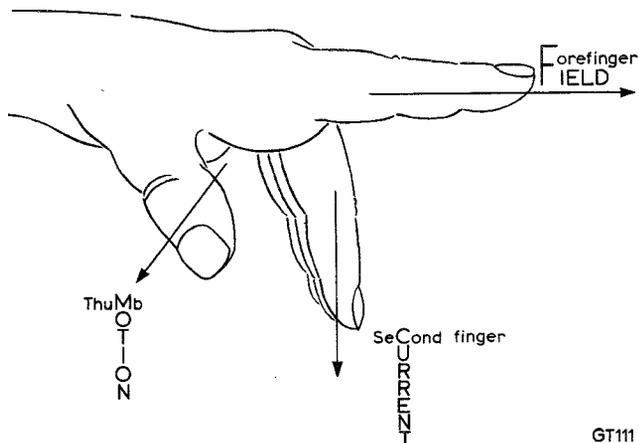


Fig. 10: Illustration of Fleming's Left Hand Rule. The importance of memorising this rule cannot be stressed too strongly.

You may begin to wonder what on earth all this has to do with amateur radio, so we will explain that the relationship between the direction of the current flowing in the conductors and the resulting magnetic field, together with the rate at which a conductor is moved in a magnetic field, are all basic ideas related to the generation of Alternating Current (AC).

### Electromagnetic Induction

In the previous section you will have noticed the term INDUCED current, or a current produced by electromagnetic induction. This effect can best be demonstrated by means of the interaction of a bar magnet and a solenoid, Fig. 11. If the bar magnet is moved into the solenoid a deflection will be noticed in the meter connected between the ends of the windings. When the bar magnet is removed a deflection will be noticed again, but this time in the opposite

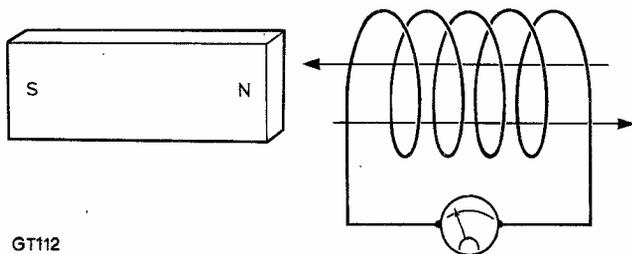
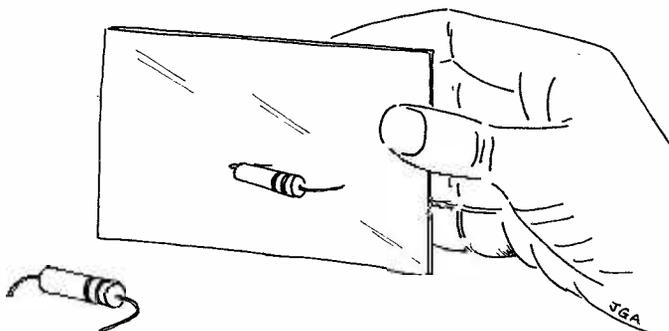


Fig. 11: A practical experiment which will show that a current is generated when a bar magnet is inserted into or removed from a solenoid. Remember:—No movement, no current!

direction. *Whilst the magnet is stationary, no deflection will be observed.* As an aside, you will also notice the fact (and by no means an insignificant one) that the faster you move the magnet, the greater the meter deflection.

As we have said before, some practical experience is very desirable, so why not wind yourself a solenoid, 50 to 100 turns of insulated wire on a toilet roll tube, connect it to a milliammeter, push in a magnet and see what happens!

The meter deflections indicate the presence of a potential difference between the ends of the solenoid conductors, giving rise to INDUCED current. If we think about this for a minute we will remember that, while current is flowing in the solenoid, that current will produce a magnetic field. Now, the direction of that field will be such as to oppose the motion of the magnet which induces it. Thus, if the north pole of the magnet is pushed inside the solenoid the current flow induced will produce an apparent north pole at that end of the solenoid, thus tending to oppose the magnet's motion. As the magnet is withdrawn the induced current will produce an apparent south pole at that end of the solenoid, again opposing the extraction of the magnet, since a north pole will attract a south pole.



... what is meant by "reflected impedance"?

The German physicist Lenz formalised this in his Law in 1834. Basically it means that the direction of the induced potential difference tends to set up a current opposing the motion or change of magnetic field **producing that potential difference.** Now the magnetic field which is used to induce currents in a solenoid need not come from a permanent magnet. It could come from another solenoid placed in close proximity to the first. In this we have the bones of the TRANSFORMER, but, before we look at that subject, the question of the nature of ALTERNATING CURRENT (AC) arises. Again, the previous sections will be of assistance since AC is best understood when reference is made to the facts relating to conductors moving in a magnetic field.

To be continued next month

Readers are asked to note that the publications mentioned already in this series as recommended reading have recently been increased in price. They are "A Guide to Amateur Radio" and "The Radio Amateurs' Examination Manual" which now cost £1.38 and 86p respectively. They are obtainable from the Radio Society of Great Britain, 35 Doughty Street, London WCI. The prices are inclusive of postage.

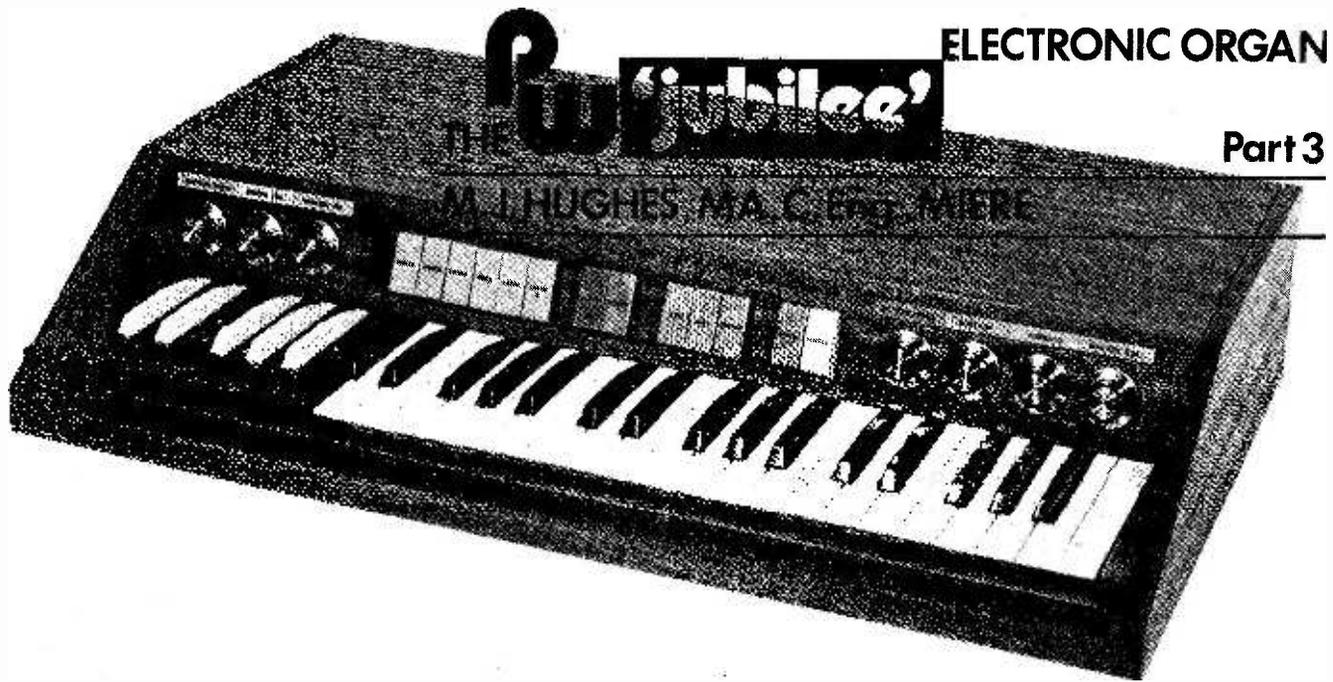


Fig. 1 shows the melody keying, percussion, sustain and tone forming circuits in their entirety. ICs 7, 8 and 9 are the priority encoders described in Part 1. They receive the 37 tones from the generators on pins 16 to 27 in the case of ICs 7 and 8, and 15 to 27 for IC9. There are 13 inputs to the latter to allow for bottom C. Single lines to each keyboard contact can be seen clearly. When one of these lines is pulled to ground through the respective switch, the note associated with that key is latched and fed out at pin 9. The links between the ICs give priority to the highest note played.

### Melody Circuits

The high level signals generated at the outputs of the priority encoders are fed to potential divider (R11 and R12) which reduces them to a level less than  $V_{be}$  for Tr3 which is connected as an emitter follower. If there is no bias at the base of this transistor the audio signal will not appear at the emitter; the rate of application and removal of bias at this point controls the envelope of the output signal—thence the duration of sustain. If S1 and S2 are closed the priority output from IC9 (pin 31) is routed through the three cascaded gates of IC11b, c and d, and eventually appears, at reduced level, across VR5. A proportion of this is fed through D2 to the base of Tr3 providing the bias necessary to allow the audio signal to appear at its emitter. C6 creates a slight time constant, in conjunction with the setting of VR5, to introduce attack in the envelope.

When the selected key is released the priority signal falls immediately to zero but D2 becomes reverse biased allowing a charge to remain on C6. This charge keeps Tr3 (which can be considered to be an analogue gate) open and the audio continues to appear at its emitter. Over a short period the DC charge on C6 leaks away through Tr3 as base current and the bias is slowly lost. As this happens the audio signal at the emitter dies away. Because the signal is a square wave to start with there is no distortion in this operation. The period of charge leakage sets the sustain duration and this can be controlled by adjustment of VR6 which sets the base current for

the transistor. This latter control is brought out to the front panel.

S2 introduces a low-leakage tantalum capacitor into the path of the keying strobe. This differentiates the control signal for Tr3; this opens the analogue gate momentarily allowing a short burst of audio through. The sustain setting controls the rate at which this percussive burst dies away. The burst of audio occurs on the depression of the key and will not sound again until the key is released and pressed again.

IC10 is the repeat percussion oscillator, frequency controlled by VR4 (again a front panel control). When S1 is open the low-frequency pulses of this oscillator are fed through IC11a and pass through the following gate when a key is depressed. Instead of getting a steady DC level at pin 10 of IC11d, the keying signal is now chopped by the repeat signal. This creates note repetition. Using this in conjunction with the sustain control produces effects such as banjo or xylophone sounds. Note that C7 should be a tantalum capacitor.

The RC circuitry following Tr3 creates the voicing. Normally S3, 4 and 5 are closed which shorts the signals to ground. Opening one or more of these switches introduces a particular tone colour. The signals of these three options are mixed by R21, 23 and 26 before being fed to the front panel "Melody Volume" control and thence to the melody buffer amplifier with gain set by VR8. This signal is then fed to the power amplifier or phono output stage.

Use Soldercon sockets for ICs 7 to 9 but do not insert the integrated circuits. Complete the assembly of the rest of this section by reference to Fig. 2. To facilitate testing, solder temporary links across the pairs of pins which will eventually go to S1 and S2. At the same time, temporarily wire in VR4, VR6 and VR7. Set the potentiometers and presets as follows to start with: VR4 Midway, VR5 To bottom (ground) end, VR6 To bottom end, VR7 Midway, VR8 Midway.

Insert the tone generator ICs. With a couple of lengths of wire fitted with clips, select one of the tone lines (see last month's circuit) and hook it tem-

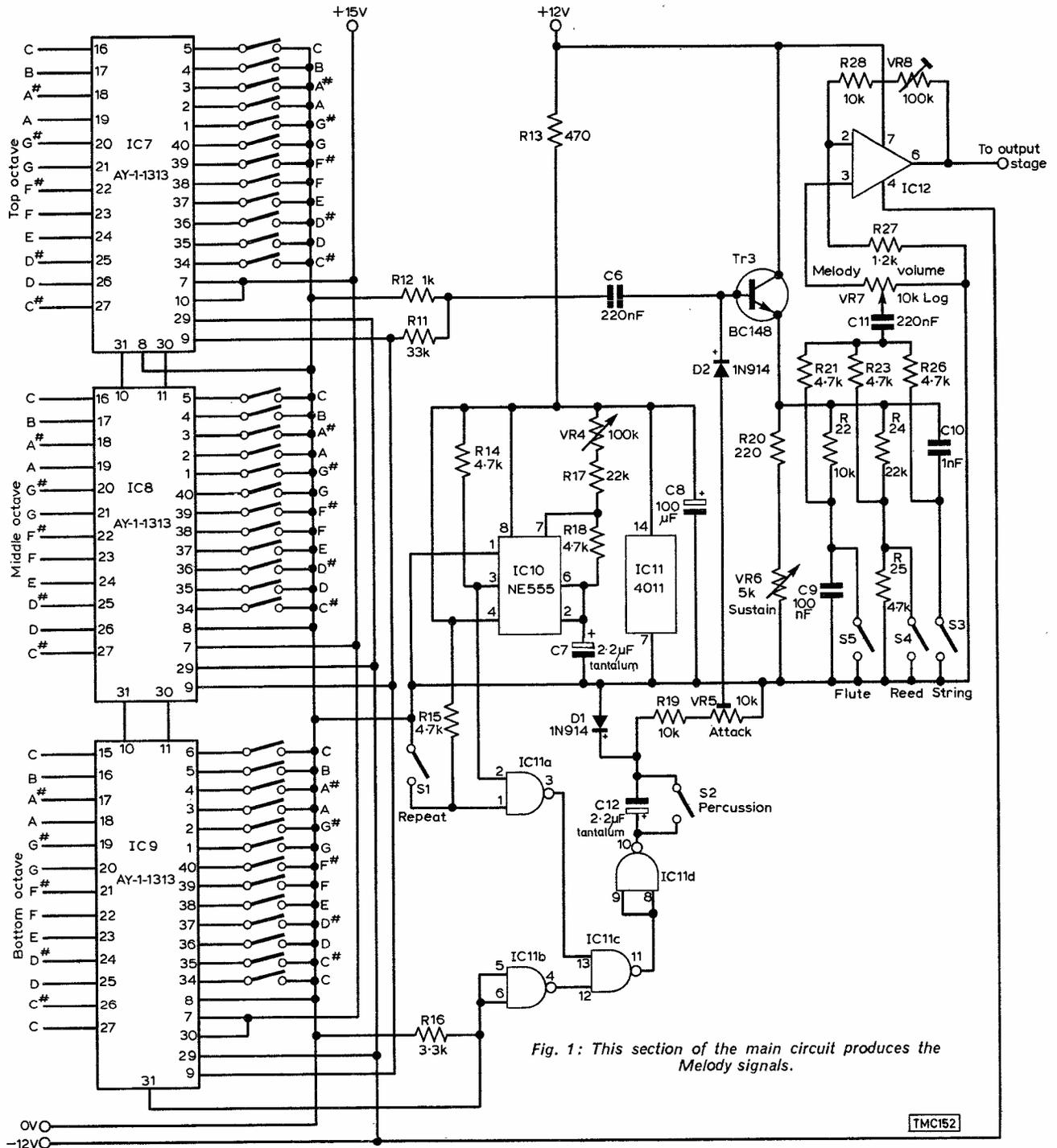


Fig. 1: This section of the main circuit produces the Melody signals.

TMC152

porarily to the end of R11 which goes to the priority encoders. This will provide a test signal. The other wire should have one end clipped to pins 5 and 6 of IC11 (the end of R16 going to this point will do). The other end of this wire simulates keying by touching it to the +12V rail (at the positive end of C8).

Connect the power supply as described last month plus a loudspeaker. When you apply power you should hear nothing. Next hook the keying wire to +12V and you should still hear nothing. Gently adjust the wiper of VR5 away from the bottom end of its track to produce a tone in the loudspeaker. Adjust VR5 until the tone just reaches a stable level (ie does not get louder with increase of the setting). If, at this stage the volume is uncomfortably loud or is distorting, reduce the value of VR8. Remove the keying wire

from the 12V source and the tone should stop immediately. Slowly advance VR6 and tap the keying wire on and off the 12V point. The sustain effect should get greater as VR6 is increased in value. If you get an unpleasant click at each contact with the keying point, you have probably advanced VR5 too much—this setting is fairly critical.

Remove the link across the pins for S2 and try the keying test. You should get the single burst of sound when the keying contact is made. Finally remove the link across the pins for S1. This time, when you key, you should hear repeated percussive bursts of sound—rate adjustable by VR4.

Turn off the power and remove all temporarily connected potentiometers and also remove IC12 or it will be impossible to test following stages.

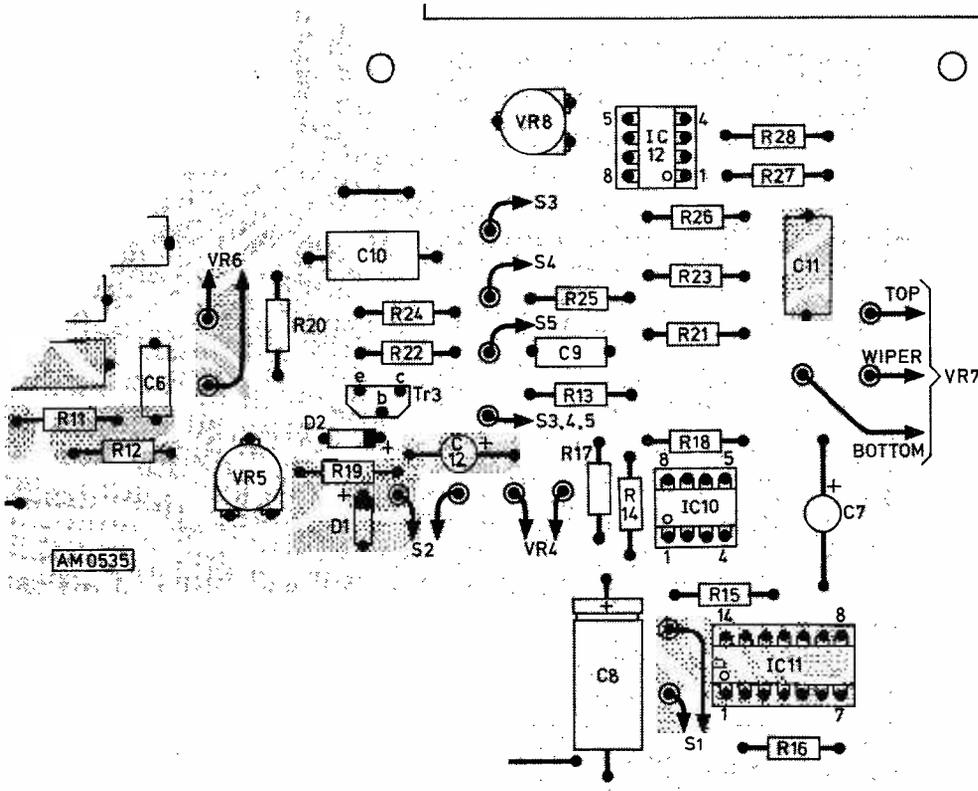
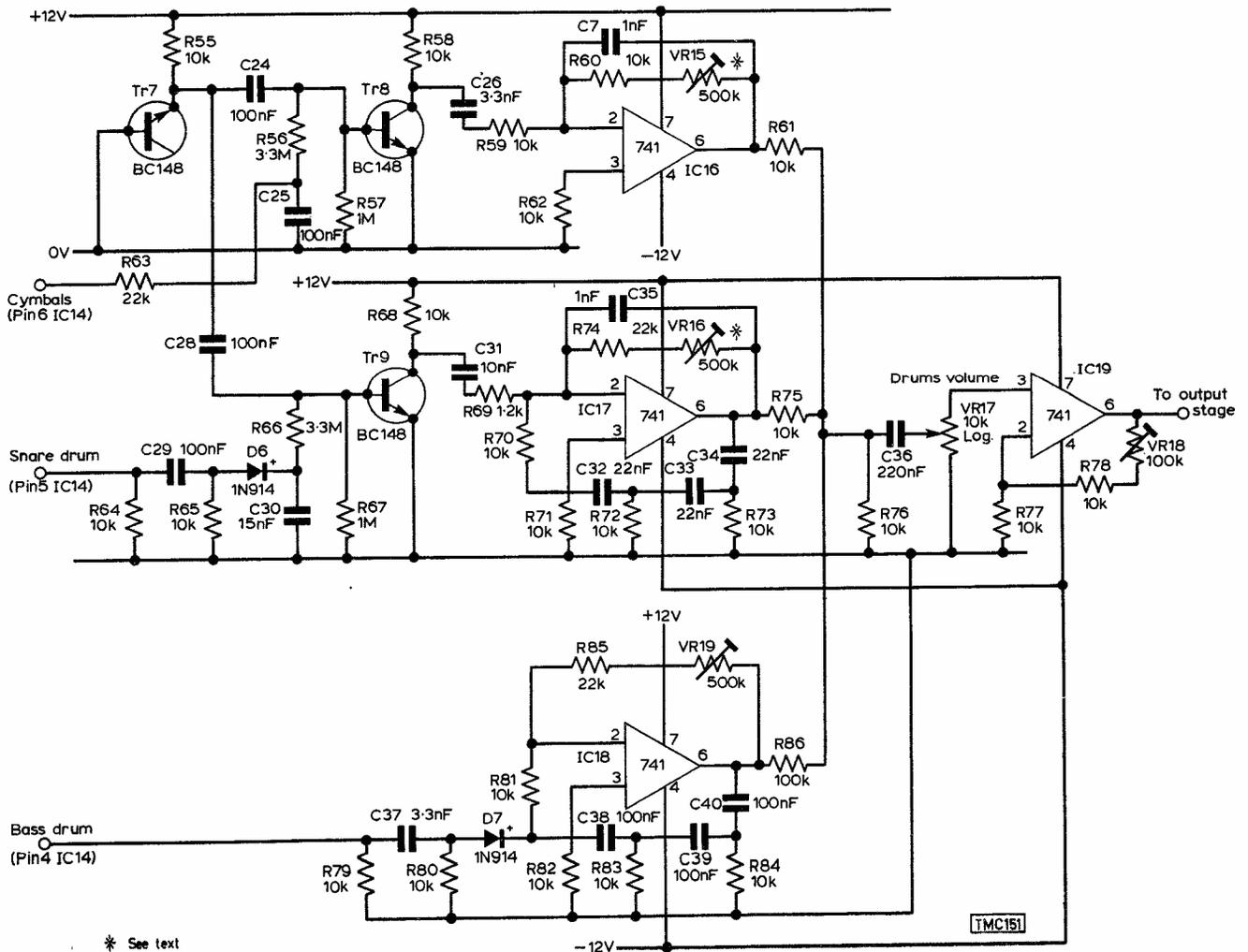


Fig. 2: left, assembly and interwiring diagram for the part of the main circuit shown in Fig. 1.

Fig. 3: below, is the circuit for the Drum and Rhythm part of the organ.



## Drum and Rhythm Section

Fig. 3 shows the drum and cymbal voicing circuits. Tr7 is used as a white noise generator and feeds the cymbals and snare drum stages. Cymbal pulses from the rhythm generator IC are used to gate white noise through Tr8. The envelope of the gate is set by C25 with R63 and R56. The noise is filtered at top and bottom by C26 and C27 respectively. VR15 is used to balance the cymbal level with that for the other instruments.

The snare drum circuit is a little more complex. A sharp burst of white noise is generated at the collector of Tr9 when the trigger is received from the rhythm generator. This is fed to IC17 which is connected as a low-frequency phase-shift oscillator. VR16 is set so that the circuit is just NOT oscillating. When the white noise burst arrives it triggers a decaying oscillation in this stage and mixes with the frequency so produced. Some care is needed in setting VR16 for optimum results but the sound is quite realistic. The bass drum sound is produced by using

the rhythm pulse to trigger a similar phase shift oscillator which is tuned to a lower frequency. VR19 controls the oscillation point.

Assembly details are shown in Fig. 4. Do not insert the rhythm generator chip (IC14) at this stage. Note that this is an 18-pin package. When everything apart from IC14 has been correctly inserted, temporarily connect VR17 to its pins and set the controls as follows: VR15 Minimum resistance, VR16 Minimum resistance, VR17 Midway, VR18 Midway, VR19 Minimum resistance.

Connect the power supply. Slowly increase the value of VR19 until oscillation just starts then turn it back slightly so that it just stops again. With a flying lead, momentarily touch +12V to the top end of R79. You should hear a "thump" similar to that from a bass drum. Adjust VR19 for the correct amount of decay. Use VR18 to preset the level.

Now test the snare-drum circuit. Apply +12V pulses to the top end of R64 and adjust VR16 for best results. Try to achieve a reasonable balance with the bass drum. A 100kΩ component for VR16 would make for easier adjustment. After building several models it was found that the best setting is very close to the bottom end if the original 500kΩ potentiometer is used.

Finally, test the cymbals by applying +12V to the end of R63 going towards the rhythm generator and adjust VR15 until the sound is realistic. As with the snare drum circuit, adjustment may be easier with VR15 as a 100kΩ component.

The quality of the cymbals is to some extent controlled by Tr8. There is a large variation in gain for this device and a very high gain might saturate the device with the trigger pulse. This can be detected by a kind of "hesitation" at the beginning of the cymbal sound. It is remedied by reducing the value of R58 from 10kΩ to 4.7kΩ.

## Accompaniment Circuits

The Accompaniment circuits are shown in Fig. 5 and the assembly details of this stage in Fig. 6. IC14 is the rhythm generator the speed of which is controlled by VR11. Rhythms are selected by the switches S8 to S13 singly or in any combination. The switches couple the rhythm select inputs with the "Any Key Down" signal produced by the chord generator. This ensures a synchronised start of rhythm at the instant an accompaniment key is depressed.

The chord waveform is different from the simple square

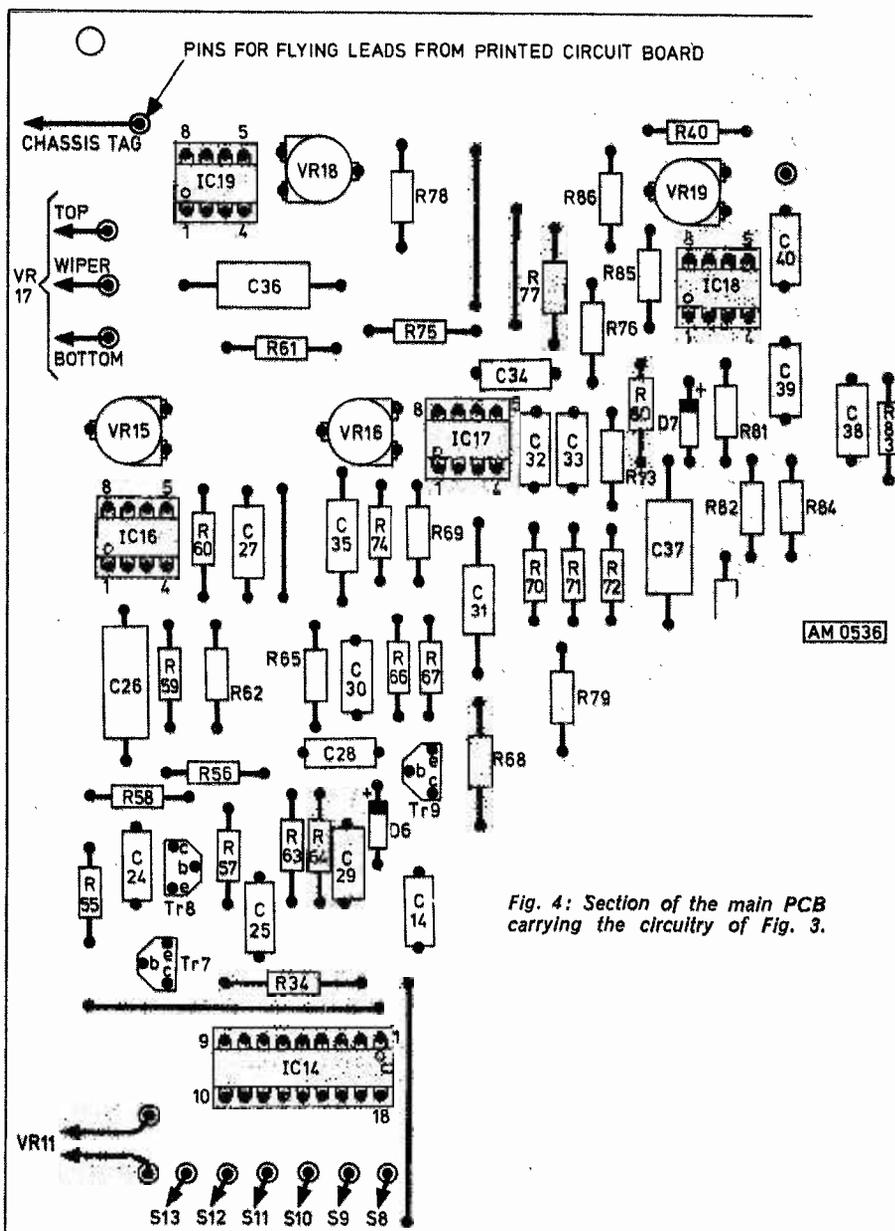


Fig. 4: Section of the main PCB carrying the circuitry of Fig. 3.

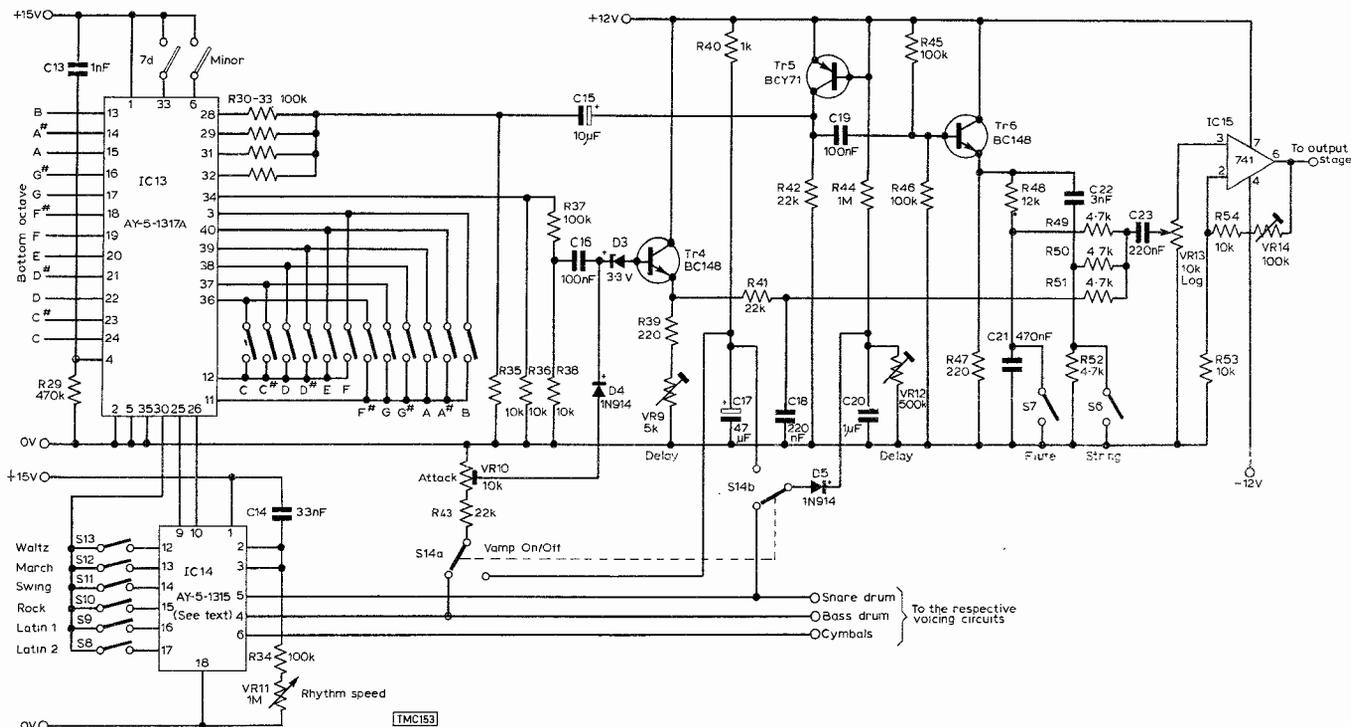


Fig. 5: The last part of the circuit to be described is for the Accompaniment.

## ★ components

Melody Section		
R11	33kΩ	
R12	1kΩ	
R13	470kΩ	
R14/15	4.7kΩ	
R16	3.3kΩ	
R17	22kΩ	
R18	4.7kΩ	
R19	10kΩ	
R20	220Ω	
R21	4.7kΩ	
R22	10kΩ	
R23	4.7kΩ	
R24	22kΩ	
R25/26	4.7kΩ	
R27	1.2kΩ	
R28	10kΩ	
VR4	100kΩ linear	
VR5	10kΩ sub-miniature preset	
VR6	5kΩ linear	
VR7	10kΩ log. (ganged with mains switch if conventional keyboard version is constructed)	
Drums and cymbals section		
R55	10kΩ	
R56	3.3MΩ	
R57	1MΩ	
R58	10kΩ* See text; this resistor might need reducing to 4.7kΩ	
R59/62	10kΩ	
R63	22kΩ	
R64/65	10kΩ	
R66	3.3MΩ	
R67	1MΩ	
VR8	100kΩ sub miniature preset	
C6	220nF	
C7	2.2μF 15V tantalum	
C8	100μF 25V	
C9	100nF	
C10	1nF	
C11	220nF	
C12	2.2μF 15V tantalum	
D1/2	1N914	
Tr3	BC148	
IC7/9	AY-1-1313	
IC10	555	
IC11	4011	
IC12	741	
S1/5	single pole one way toggles (5 off). Rocker Tabs for conventional keyboard version. Keyboard switches (depending on version being built).	
R68	10kΩ	
R69	1.2kΩ	
R70/73	10kΩ	
R74	22kΩ	
R75/84	10kΩ	
R85	22kΩ	
R86	100kΩ	
VR15	500kΩ sub miniature preset but see text	
Bass and Accompaniment Section		
R29	470kΩ	
R30/34	100kΩ	
R35/36	10kΩ	
R37	100kΩ	
R38	10kΩ	
R39	220Ω	
R40	1kΩ	
R41/43	22kΩ	
R44	1MΩ	
R45/46	100kΩ	
R47	220Ω	
R48	12kΩ	
R49/52	4.7kΩ	
R53/54	10kΩ	
VR9	5kΩ sub miniature preset	
VR10	10kΩ sub miniature preset	
VR11	1MΩ linear	
VR12	500kΩ sub miniature preset	
VR13	10kΩ log	
VR14	100kΩ sub miniature preset	
C13	1nF	
C14	33nF	
C15	10μF 25V	
C16	100nF	
C17	47μF 25V	
C18	220nF	
C19	100nF	
C20	1μF	
C21	470nF	
C22	3nF	
C23	220nF	
D3	3.3V 400mW zener	
D4/5	1N914	
Tr4	BC148	
Tr5	BCY71	
Tr6	BC148	
IC13	AY-5-1317A	
IC14	AY-5-1315 (pattern 004—Jubilee)	
IC15	741	
S6/13	single pole one way toggles (8 off)—rocker tabs for conventional keyboard version	
S14	double pole change-over toggle or rocker tab with similar pole configuration	
C30	15nF	
C31	10nF	
C32/34	22nF	
C35	1nF	
C36	220nF	
C37	3.3nF	
C38/40	100nF	
D6/7	1N914	
Tr7/9	BC148	
IC16/19	741	

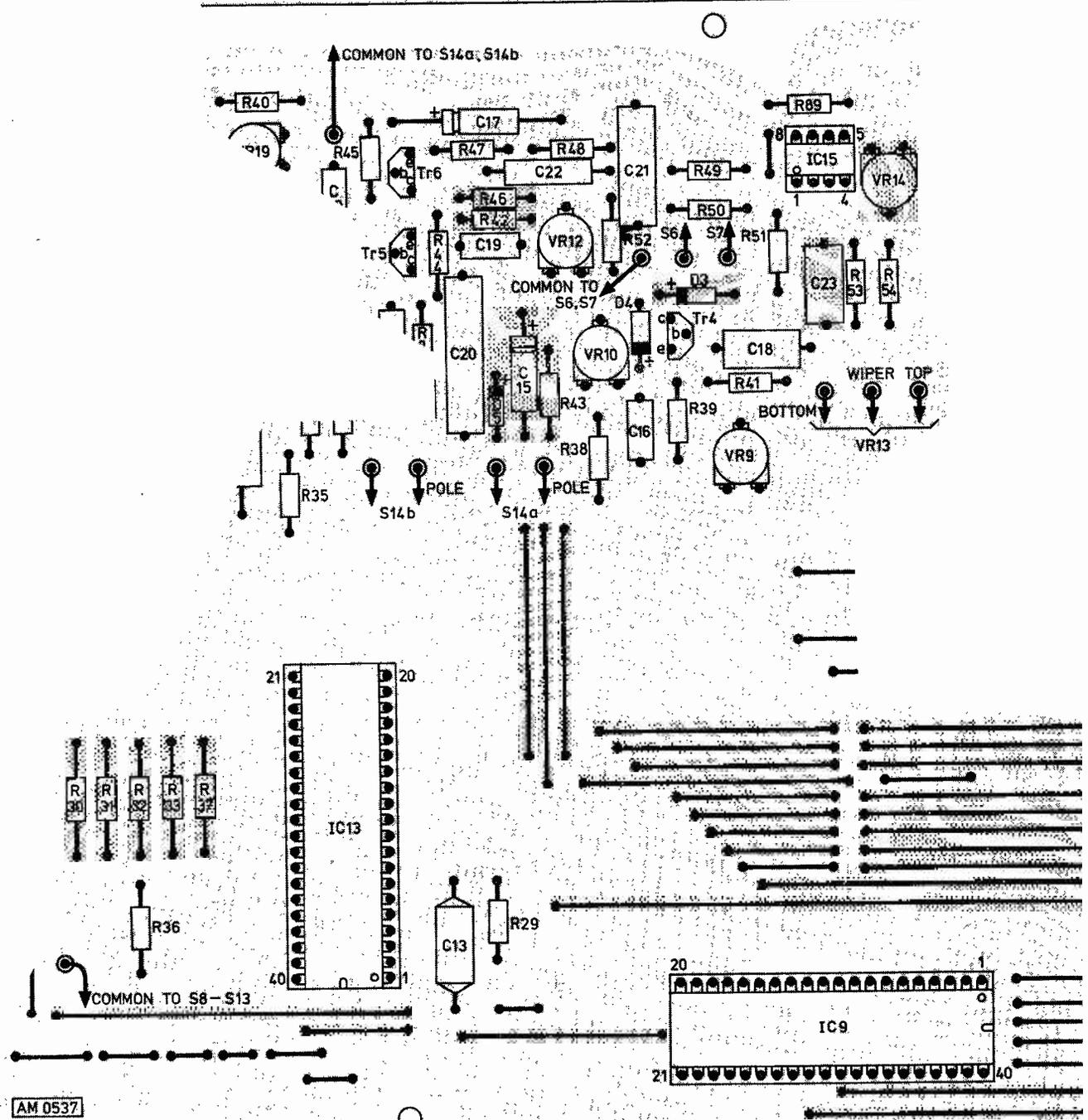


Fig. 6: Assembly details for the circuit shown in Fig. 5.

wave produced in the melody circuits in that it is more akin to a staircase which constantly changes its shape (depending on the harmonic relationships between the three or four elements it comprises). The simple emitter follower type of envelope shaper would introduce asymmetric distortion. Tr5 in conjunction with R42 acts as a voltage controlled attenuator. The mixed chord signal is applied to its collector via C15 and taken from this same point via C19 for further processing. If Tr5 is "turned on" the signal is shunted to the positive rail and its amplitude falls to nearly zero. The transistor is biased so that this is the usual condition. When it is turned off—by means of the snare-drum pulse—the signal momentarily rises at the collector and then dies away as

the charge on C20 is shunted to ground through VR12. This gives a percussive attack and a reasonable sustain; the latter being preset by VR12. If S14b is in the "Vamp OFF" position a steady DC level is maintained on C20 and this holds Tr5 permanently off. In this condition any signals from the chord generator are unaffected by the envelope shaper.

The envelope shaper for the alternating bass is similar to the emitter follower circuit used for the melody rail except that it produces a slightly larger signal (to allow for losses in the heavier filtering which is applied to it). A zener diode (D3) is used to back off the transistor's Veb so that larger signals can be applied without them appearing at the emitter prematurely.

## Last Assembly

Complete the assembly of this stage by reference to Fig. 6. Insert Soldercon sockets for IC13 and IC9 but do not insert these ICs yet. Wire in temporary links between the pole pins of S14a and b to the DC level (at the pin adjacent to R45)—this disables the Vamp and will make initial testing easier. Temporarily short out R35 to inhibit chords. Refer to Fig. 4 which shows the position of IC14 and connect a temporary link between the pin labelled "S13" and "Common". This selects the waltz rhythm. Wire VR11 and VR13 to their respective pins. Set all controls as follows: VR9 to minimum resistance, VR10 to "ground" end of track, VR11 midway, VR12 to maximum resistance, VR13 midway, VR14 midway.

Connect the power supply and loudspeaker but before turning on insert ICs 13 and 14. *Take great care not to damage the pins.* Double check the orientation of these two ICs (they are expensive!).

You can now apply power and should, initially, hear nothing from the loudspeaker. Depress the key marked for the chord of C or, alternatively, use a piece of wire with clips to bridge the contacts in the position of this switch. Slowly move the wiper of VR10 away from ground to produce the bass note. It will be alternating and its speed should be adjustable with VR11. There should be no percussion or sustain at this stage. Set VR10 so that there is no further increase in volume as it is adjusted. If necessary adjust VR14 for correct level.

## Final Steps

Switch off the power and remove the link between the pole of S14a and the DC level pin. Now insert a link between the pole and its adjacent pin (which carries the bass drum pulses).

Re-apply power to hear the alternating bass with percussion and sustain. Adjust VR10 to remove undesirable clicks and then set VR9 for sustain period. Try different chord selections by pressing other keys and you should find that the pairs of bass notes change accordingly.

Removing the shorting link across R35 should produce static chords—depending on the key you are depressing. Try the 7th and Minor select keys in conjunction with the selected chord.

Switch off the power and re-connect the pole pin for S14b to its immediately adjacent neighbour (carrying the snare-drum pulses). Re-apply power and you should now hear rhythmic chords interspersed with the alternating bass. Adjust VR12 for the best duration of chord sustain.

Insert IC9 and then refer to Fig. 2 in Part 2 and insert ICs 7 and 8—at the same time checking all the top side wiring links.

Board assembly is now complete and all the stages have been tested and initially adjusted. Remove all temporary leads. Remember to replace IC12 and IC19.

Next month—the final stages—assembly into the cabinet.

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# DESIGN YOUR OWN PROJECTS

No. 3

## CAR COURTESY LIGHT

TOBY BAILEY & BOB WHITAKER

Courtesy lights in cars can be very annoying. You get into your car at night, sit down, shut the door and the light goes out; leaving you fumbling in the dark trying to insert the ignition key! Most, if not all, of these problems can be solved by an appropriate circuit which keeps the light on for a few seconds after the door is closed—besides, this provides us with an interesting design exercise!

### Specification

Assuming that the car has a negative earth power supply, the circuit in the car before modification will consist of a 12V supply driving the light bulb, with a switch, operated by the door, in the positive line. We want our circuit to supply current to the light for about fifteen seconds after the switch is opened. This arrangement is shown in Fig. 1.

### Design

Well then, how are we going to set about doing this? The only way that springs readily to mind (ours at any rate) is to charge up a capacitor when the switch is on and to let it discharge when the switch is turned off. After all, most timing circuits are based on this principle! Unless we are going to become involved with relays and the like we will need a series pass transistor in parallel with the switch to turn on the light after the switch is turned off. The arrangement will be something like that in Fig. 2.

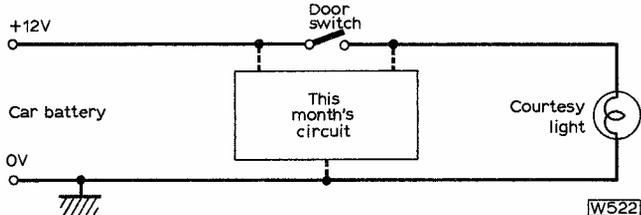
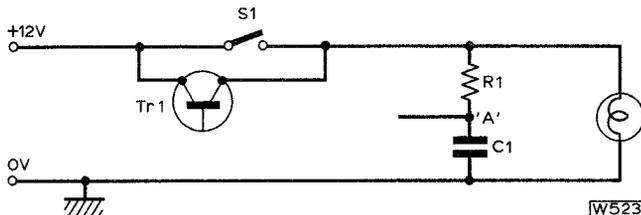


Fig. 1: Above, the normal car courtesy light plus our circuit gives a worthwhile advantage. Fig. 2: below, is the germ of the idea. Don't worry about the incomplete transistor! All will be revealed later.



R1 is the resistor through which we charge up capacitor C1. We haven't drawn an emitter on the pass transistor yet, this is because we've not decided whether it's going to be PNP or NPN! Anyway, there's a slight problem with the circuit as it stands. We want

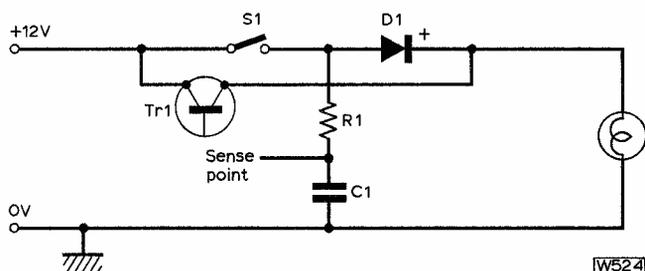


Fig. 3: The diode D1 turns out to be the critical component in this month's circuit.

Tr1 to turn on when the voltage at point 'A' reaches a sufficiently high value: we then want C1 to discharge slowly when S1 is turned off. However, C1 will charge up just as effectively through Tr1 as through the switch, so there's no way that we can discharge C1 when S1 is turned off again. Hence, with the present arrangement, the light will never turn off. Somehow we have to isolate the effects of the switch and the transistor for the purpose of charging up C1.

A small amount of thought produced the following simple modification: we insert a diode between the switch and the light, so that the transistor is in parallel with both. We then take the charging resistor from the switch side, Fig. 3. Now when the switch is closed C1 will still charge up and we can use the voltage at the sense point to hold Tr1 on. The difference now is that when S1 is off and Tr1 is on, D1 will be reverse biased and hence no current can pass through R1. This allows us to discharge C1, in some manner yet to be specified!

Having solved that problem, how are we going to fit those two 'dangling wires' in Fig. 2 together? It's fairly obvious that we're going to need another transistor and that we want it to turn off when the voltage at the sense point becomes low enough. We can then

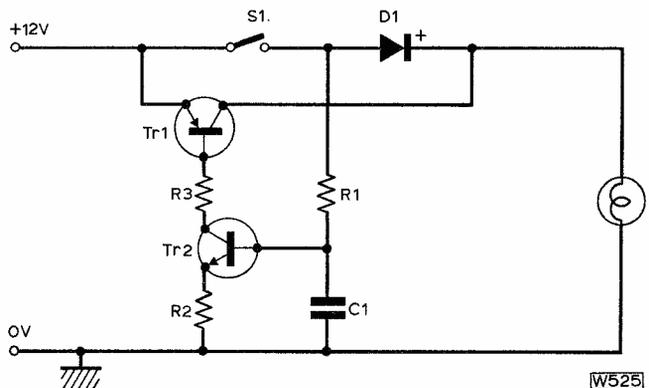


Fig. 4: A second transistor and a working circuit at last.

## ★ components

R1 100kΩ R2 6.8kΩ both  $\frac{1}{4}$  or  $\frac{1}{2}$ W carbon  
 C1 2.5μF 25V electrolytic C2 0.68μF  
 Tr1 OC35 Tr2 2N3702 Tr3 2N3704 D1 1N4001  
 The lamp and the switch S1 are part of the car wiring

use this transistor to control Tr1. If we use an NPN transistor here then Tr1 will have to be PNP to make them fit together sensibly, as in Fig. 4.

You can see that two additional resistors have appeared as well as Tr2. We've included R3 to limit the base current in Tr1—it should stop anything nasty happening! If we don't include R2 then C1 will be discharged very rapidly. This is because Tr2 will saturate and then pass a large current through the forward biased diode of its base-emitter junction. With R2 in the circuit the emitter of Tr2 will just float up to about 0.5V below the capacitor voltage: the current drawn from the capacitor is just the current through the emitter resistor divided by the gain of the transistor. On further consideration, what on earth do we need R3 for? The current that flows in the base of Tr1 is just Tr2's collector current; since R2 will limit this anyway we don't need R3 as well. Also, R3 would be a bit of an embarrassment if it caused Tr2 to saturate so, on second thoughts, let's dispense with it.

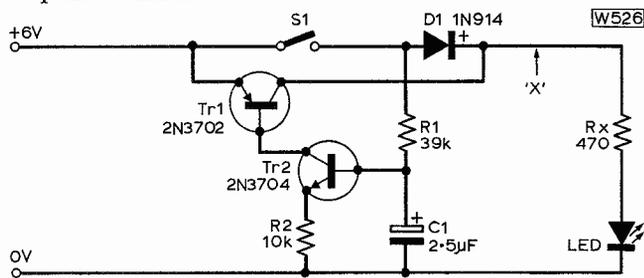


Fig. 5: The test circuit for the idea, using an LED instead of the car's lamp bulb. Note the use of a 6V supply here.

At this stage it's probably a good idea to play with the circuit on S-Dec to make sure that it works. Fig. 5 shows the circuit we assembled; the 6V supply and the LED were used merely because they were nearest to hand. This arrangement gives a good idea of the feasibility of the circuit so far developed.

10kΩ seems a reasonable sort of value for R2, although we could have used any of a wide range of values equally well. It should keep the current drawn from C1 small and prevent excess base current in Tr1. The choice of 39kΩ for R1 is also fairly arbitrary—it charges C1 quite quickly. Rx limits the current in the LED to around 10mA. With these values the circuit works with a delay of about five seconds: so far so good. However, the light turns off rather slowly, taking a couple of seconds after the light starts dimming before it is completely extinguished. The problem is that at the turn-off point the current being drawn from C1 is very small and so everything happens very slowly. We could try sticking a resistor across C1 to increase the current drawn at turn-off but then we'd need a much larger capacitor, since it would discharge very quickly to start with. We must be able to do better than this!

Surely the way to get fast switching is to use positive feedback, i.e. regenerative switching. The only way to produce positive feedback here is somehow to connect the point marked 'X' in Fig. 5 to the base of Tr2. We don't want to use a resistor since this will mess up our biasing and the whole business then becomes very confused. What happens if we use a capacitor to provide the feedback? It certainly should speed up the switching in the critical region: as soon as the light starts to turn off the voltage at point 'X' will start to drop and since the voltage drop across a capacitor can't change instantaneously, the voltage at the base of Tr2 will also be forced down. For our first try the use of a 0.68μF capacitor produced rather a strange result—the LED flashed a few times as it turned off. Perhaps something like that was to be expected; after all we have very nearly constructed an oscillator! With further trials we found that a 0.1μF capacitor had little effect, that 0.47μF produced a vast improvement in switching speed without any untoward effects and that larger values (about 2μF electrolytic) also speed up switching with no hint of oscillation. Having reached this stage it's now time to design the complete circuit for a proper light bulb; we can find the optimum value of 'speed-up' capacitor by trial and error.

A quick attack on the car produced the information that the interior light is rated at 12V 6W. From this it doesn't require much mental strain to work out that we will need to supply about 0.5A to keep the bulb alight. Of the selection of power transistors that we possess an OC35 seems to be the most suitable—

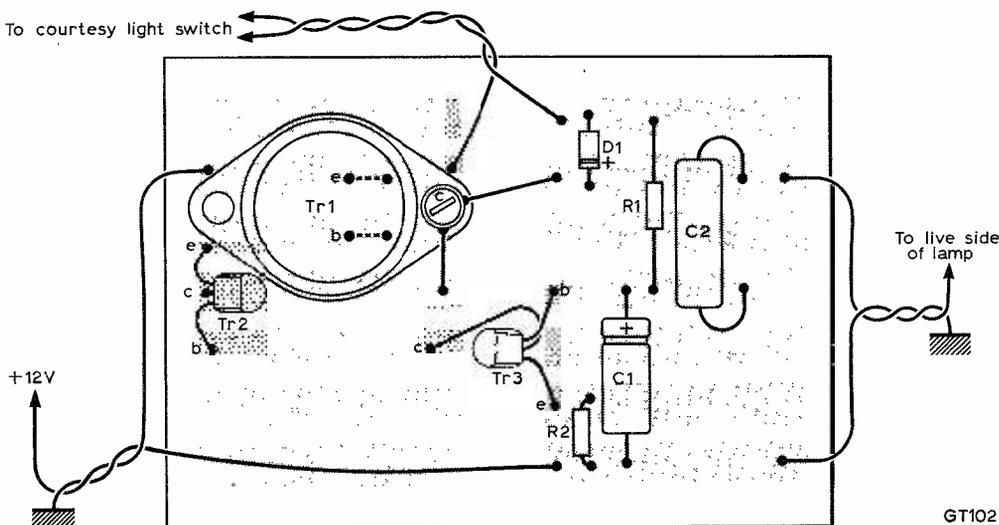


Fig. 7: The final circuit can be built up on a piece of stripboard as shown here. In the author's unit the board was stuck in the bottom of an aluminum die-cast box with flexible leads coming out for the switch, supply and lamp.

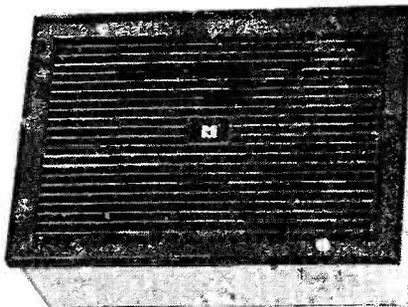
GT102

# PRODUCTION LINES

bill tull

## Protection racket

Not a lot to look at is it? but then a burglar alarm should be fairly unobtrusive in order that it can perform its task to the best of its ability. This latest one from ADE (Security) Co. is called the Maxi-guard Mk 4, and is designed around ultrasonics with an operational range of between 6ft and 30ft. When the device is properly set up it transmits a frequency of 40kHz, and provided there is no movement within the room the same frequency is returned to the units built-in re-



ceiver. However, if there is something in the room that moves, the frequency of the returned signal is altered (Doppler effect), activating the alarm.

The Maxi-guard operates from a 12V DC source and draws approximately 100mA. Measuring 181 x 126 x 64mm, it can be obtained from the manufacturers for £35.00 plus 12½% VAT.

ADE (Security) Co., 217 Warbreck Moor, Aintree, Liverpool. Tel: 051-525 3440.

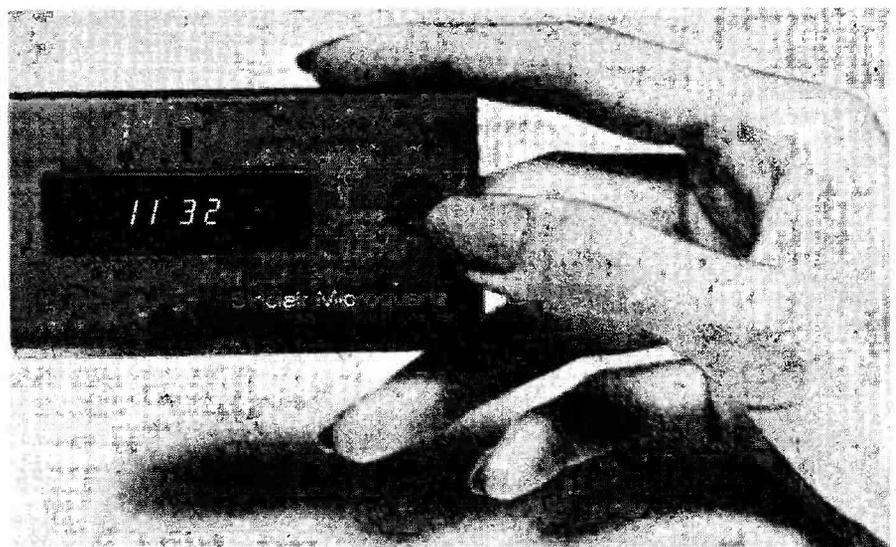
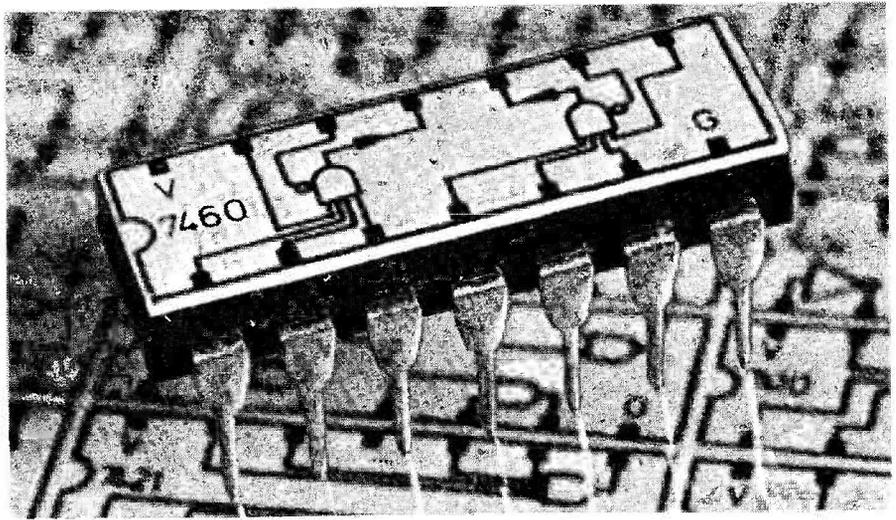
## Quartz controlled

A rather smart looking digital clock has recently been announced by those wizards of miniaturisation—Sinclair Radionics. Finished in matt black, the Microquartz GT is primarily designed for use in the car, although it's equally effective fixed on a desk, bedside table or workbench. Fixing is by means of adhesive pads.

All time settings are adjusted by the

## So simple

Unless you happen to possess a photographic memory, the constructor using TTL IC's almost always has to refer to data books for correct pin configuration. A simple, yet highly effec-



touch of a button, and as the unit is quartz controlled, it is claimed to operate for up to two years on two pen light batteries. The black anodised alloy case measures 90 x 45 x 16mm and weighs in at 3oz.

ive idea from Concept Electronics, is IC-size self-adhesive printed labels showing pin-outs for the 61 most popular 14 and 16 pin ICs. Aply named Stickies, they are attached to the top of ICs and can be used for constructing and fault finding in prototypes, designing PCB layouts, fault finding on production circuits, and are invaluable as a teaching aid.

Available in sets of 450, they are packed in a re-usable plastic folder complete with comprehensive instructions. Also included in the pack is a list of equivalents which extends the range of Stickies to cover 86 ICs. Priced at £2.80 for the pack, further details can be obtained from:—

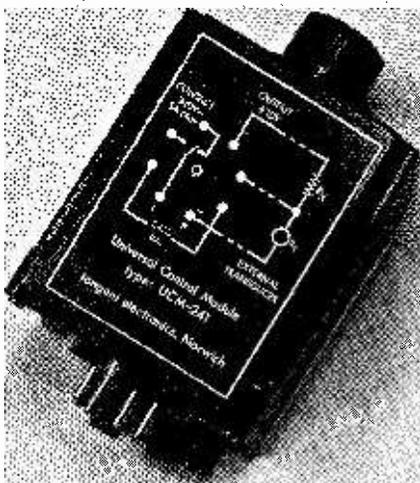
Concept Electronics, 8 Bayham Road, Sevenoaks, Kent. Tel: 0293 514110.

Available from the normal retail shops, the price is £12.95. If trouble is encountered in getting one, then apply direct to Sinclair Radionics, London Road, St. Ives, Huntingdon, Cambs. Tel: 0480 64646.

Practical Wireless, November 1977

## 5-way controller

Plug it in, connect an external transducer and 240V AC and what've you got? Well you've got a temperature controller; a light controller; a variable time delay; a liquid level sensor or a touch switch. To perform any of these control functions it is only necessary to connect a transducer between terminals 5 and 6 (thermistor for temperature control, capacitor for timing control, light dependent resistor for lighting control etc.) and a resistor of similar resistance to the transducer between terminals 6 and 8. Also as this



5 in 1 module operates from the mains it generates its own internal isolated supply of +10V DC at terminal 5. Called the Universal Control Module, it contains its own internal comparator and the level required is obtained by adjusting the knob at the top of the module. The internal single pole/change over contact is rated at 240V 5A AC or 30V 5A DC.

For one-off the price is £14.95 plus VAT, and for an extra £4.80 a kit containing resistors, capacitors, a light sensitive resistor, thermistor etc. can be obtained.

*Tangent Electronics, 136 Whitehall Road, Norwich, Norfolk. Tel: 0603 28015.*

## Master meter

A new arrival from Alcon Instruments is a 20kΩ/V multimeter with claimed accuracy figures of 1.5% on DC and 2% for AC. Called the Master 20 it is available in two versions—standard

*Practical Wireless, November 1977*

## Legal "Scrupping"?

Mention the words Microprocessor system to the average enthusiast and he'll draw in his breath and mention things like the cost of petrol going up, and food isn't getting any cheaper and that he'd like to indulge but just can't afford it. If that person is you—then read on because Bywood Electronics have launched a system, which at £55 is claimed to be more price competitive than any other system available. With the rather unusual and mnemonic name "Scruppi" it has nothing to do with apples, but is designed for the engineer or student who wishes to obtain

experience of using and designing with microprocessors.

All parts are supplied in the Scruppi kit, which incidentally is based on the National Semiconductor SC/MP eight-bit microprocessor. The switches are soldered to the PCB by their terminals while the circuit needs a power supply of +5V and -7V and these can be derived from a single 12V supply with a five volt Zener diode. Comprehensive instructions and operating data are provided with Scruppi along with details for the SC/MP microprocessor. *Bywood Electronics, 68 Ebbens Road, Hemel Hempstead, Herts. Tel: 0442 62757*

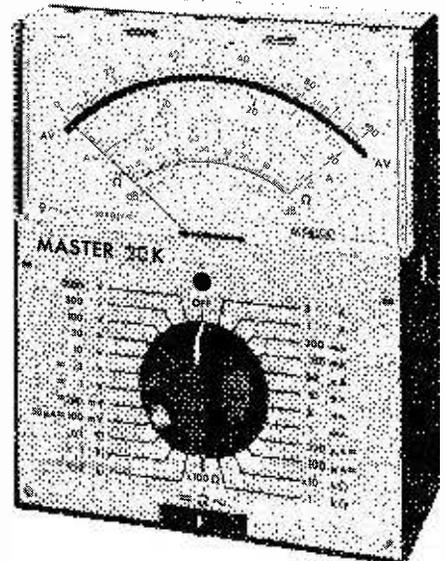
and USI. The latter model derives its name because it incorporates a Universal Signal Injector capable of supplying a 1kHz-modulated 500kHz 20V output, rich in harmonics and detectable up to 500MHz.

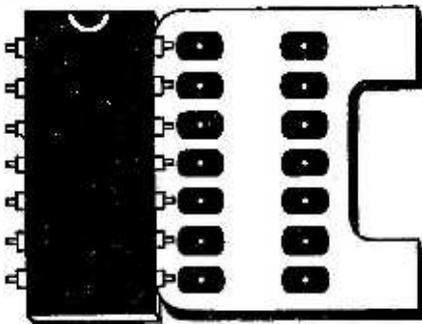
Both models feature a DC range capable of measuring from 100mV to 1kV and currents from 50μA to 3A; an AC range which measures from 10V to 1kV and currents from 1mA to 3A and resistance ranges from 200 ohms to 20M ohms.

Optional extras include a 30kV probe which extends the DC voltage range for servicing TV's, 'scopes etc.

The Master 20 measures 170 x 140 x 62mm and is supplied with leads, prods and instructions. For the standard model the price is £37.15 and for the USI model £41.90. The 30kV probe is £16.95.

*Alcon Instruments Ltd., 19 Mulberry Walk, London SW3. Tel: 01-352 1897.*





## FERRANTI ZN1034E TIMER

Quite a number of monolithic timer devices are now on the market, the "555" being one of the best-known types. Although the economical 555 can provide a very wide range of delay times from about 5μs up to some minutes, it is not suitable for a long delay time of the order of an hour or a week. The problem of using an analogue timer to obtain very long delays is that the product of the timing resistor value and of the timing capacitor value must be very large. However, one cannot employ a large value electrolytic capacitor if one requires an accurate delay time, since this type of capacitor has a large tolerance in its value and the value can change with time. In addition, the leakage current of such capacitors makes it impossible to employ a large value of timing resistor.

### The ZN1034E

A recent device from Ferranti employs an analogue timer, but the same chip also incorporates a 12-stage frequency divider. Thus the basic oscillator must pass through 4095 cycles before the timing period is terminated. One can therefore employ moderate values of the timing components and multiply the oscillator period by a large factor.

It is not usually necessary to employ an electrolytic capacitor to control the timing of the ZN1034E oscillator. Successive timing periods can therefore be repeated very accurately, to within about 0.01 per cent. Similarly the change of the timed period with temperature can be as low as 0.01 per cent per °C if the temperature coefficients of the timing resistor and capacitor are very low.

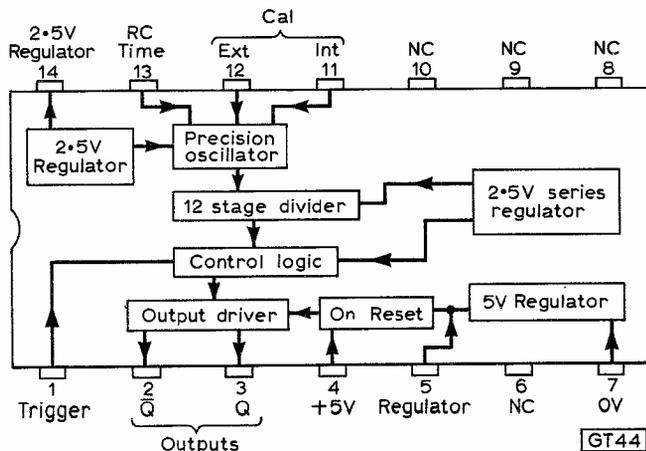


Fig. 1: Connections for the ZN1034E timer IC together with the internal circuit shown in block form.

The ZN1034E device is supplied in a 14-pin dual-in-line package with the connections shown in Fig. 1, but electrically similar devices are available in an 8-pin dual-in-line and in a 10-lead circular metal can under the type numbers ZN1034P and ZN1034T respectively.

### Power supply

If a 5V regulated supply (as used with TTL circuits) is available, pin 4 should be connected to the +5V line and pin 7 to the 0V line. A 0.1μF capacitor should be connected directly between these pins to provide high frequency decoupling. Alternatively a supply of 6V up to 450V can be used in the type of circuit shown in Fig. 2. The positive line is connected through a dropping resistor R<sub>D</sub> to pins 4 and 5. The internal regulator connected to pin 5 ensures that the correct voltage of +5V is applied to pin 4.

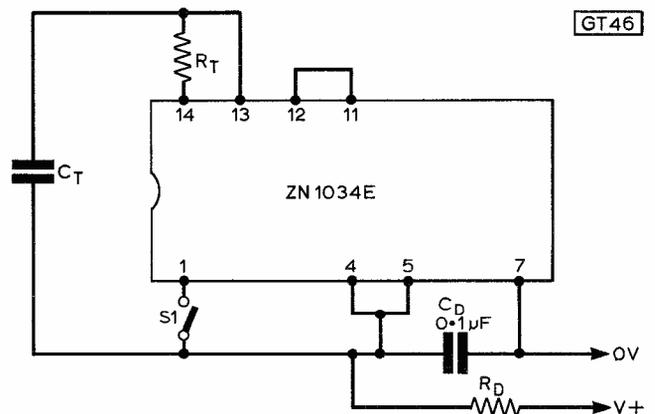


Fig. 2: The ZN1034E with its input and timing circuits and power supply connections.

The value of R<sub>D</sub> in kΩ is given by the equation:—

$$R_D = \frac{(V+ - 5)}{(I+7)}$$

where I is the load current in mA. Additional decoupling may be required if the supply voltage should exceed 50V. The current consumption of the ZN1034E is about 5mA plus any current taken from either of the outputs.

### Timing

The timing resistor (R<sub>T</sub> in Fig. 2) should have a value of between 5kΩ and 5MΩ, but for optimum linearity and performance, the value should be between 50kΩ and 1MΩ. The product of the values of

$R_T$  and  $C_T$  sets the period of the internal oscillator. If the value of  $C_T$  exceeds 68nF, the delay period is 2700 multiplied by  $R_T C_T$  if pins 11 and 12 are joined so as to bring the internal calibrating resistor of 100k $\Omega$  into circuit. Typical values of  $R_T$  and  $C_T$  and the time delays which can be obtained by multiplying  $R_T C_T$  by a large factor are shown in Table 1.

The value of  $C_T$  should exceed 0.01 $\mu$ F for optimum performance; although smaller values may be employed when the timed period must be short, the period is then not linearly related to  $R_T C_T$ . The minimum recommended value of  $C_T$  is 3.3nF. For very long delays, electrolytic capacitors are convenient, but they do not provide such accurate timing.

TIMING COMPONENTS		$R_T C_T$	TIMED PERIOD	
$C_T$ ( $\mu$ F)	$R_T$ ( $\Omega$ )		2736 $R_T C_T$ (Pins 11 and 12 joined)	7500 $R_T C_T$ (300 $\Omega$ from pin 12 to earth)
0.01	39k	0.39ms	1 sec	2.91 sec
0.1	220k	22ms	1 min	2.74 min
1	100k	100ms	5 min	12.5 min
1	1.2M	1.2 sec	54 min	2.5 hours
10	1.2M	12 sec	10 hours	27 hours
10	3.3M	33 sec	1 day	2.7 days
100	2.2M	220 sec	1 week	2.7 weeks

Table 1: Giving various values of R and C that can be used with the timing circuit of the ZN1034E.

An internal calibration resistor of 100k $\Omega$  in value is connected in circuit when pins 11 and 12 are joined; the delay time is then equal to about 2736 $R_T C_T$ . If, however, an external calibrating resistor of 300k $\Omega$  is connected between pin 12 and earth (pin 7), the timed period is 7500 $R_T C_T$ . The multiplying factor can also be fixed at 2500 by the use of a 50k $\Omega$  resistor between pin 12 and ground or at 4100 with a 150k $\Omega$  resistor.

## Measuring the period

The basic oscillator period can be measured by connecting a probe to pin 13, but the probe impedance should not be less than 10 $R_T$  or it will cause a considerable change in the period of oscillation. For short

times the output from this pin should be viewed on an oscilloscope, but for long times a stop watch is convenient. The total delay time is 4095 times the period of the oscillator. The measurement of the period of the basic oscillator is much quicker than the measurement of the whole of a long timed period at the output of the frequency divider circuit, but the measurement of the total timed period at the output will normally provide a more accurate value of this period.

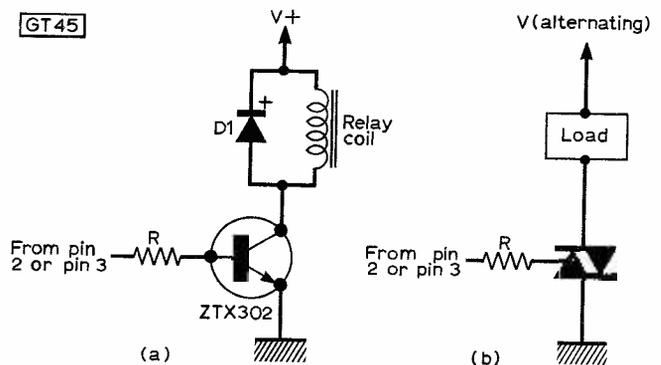


Fig. 3: Two types of output circuit suitable for the timer.

## Starting up

The timing in a ZN1034E circuit may be started by joining pin 1 to earth by closing the switch S1 in Fig. 2 for a moment. The timing process is then unaffected by any further operation of S1. Alternatively, if pin 1 is earthed, timing will begin immediately the power is first applied to the circuit.

## Output circuit

Two complementary outputs are provided from the ZN1034E. The output at pin 2 is normally at a low voltage, but rises to +3.6V at the end of the complete timed period. On the other hand, pin 3 is normally at a 'high' voltage, but this voltage falls from about +3.0V to a 'low' value at the end of the

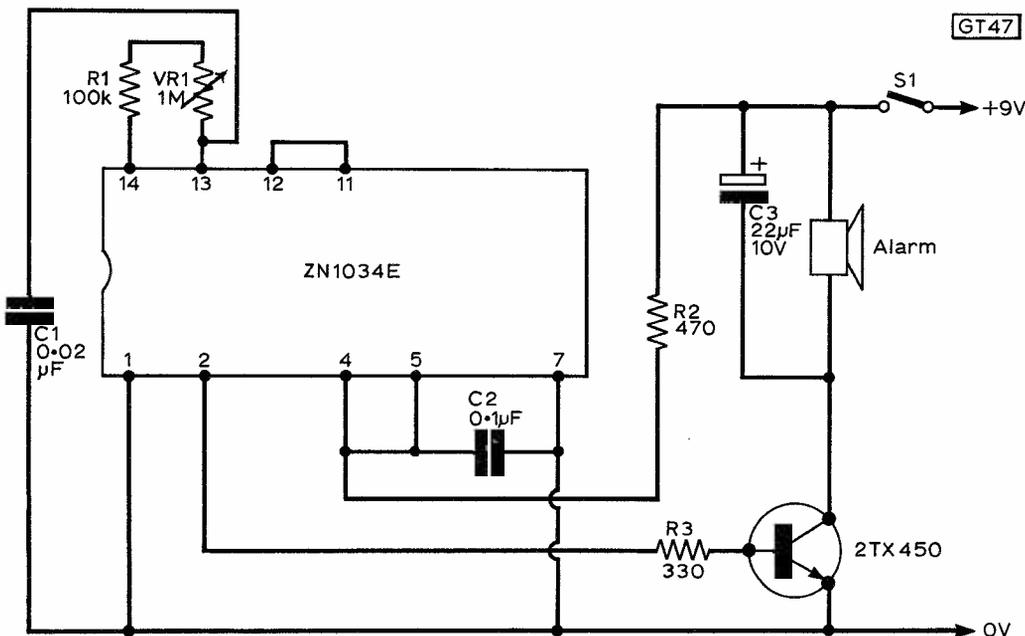
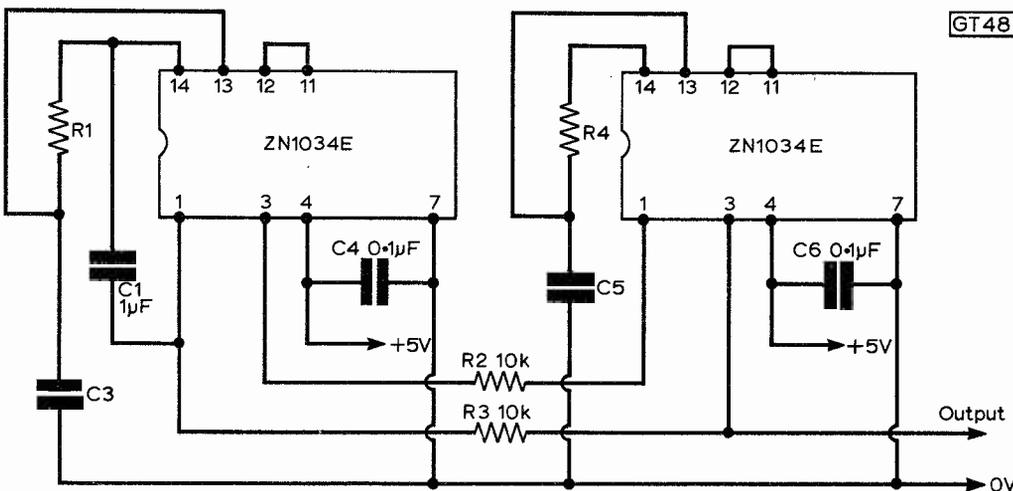


Fig. 4: Here the timer is used in an alarm circuit which can provide delays from 1 to 11 minutes. The transistor type should be shown as ZTX450.



GT48

Fig. 5: Two ZN1034E chips are used here to extend the timed period to a week or more.

timed period. Either output can deliver or accept up to 25mA.

A typical output circuit for the operation of a relay is shown in Fig. 3(a). At the end of the timed period, the output from pin 2 rises in voltage and this causes the ZTX302 NPN transistor to conduct. A current therefore flows from V<sup>+</sup> through the relay coil and the relay closes. The V<sup>+</sup> supply in Fig. 3(a) is chosen to suit the relay used. The diode D1 suppresses transient voltages developed in the relay coil and hence protects the ZTX302 transistor.

If the resistor R of Fig. 3(a) is connected to pin 3 of the ZN1034E instead of pin 2, the relay will be closed during the timed interval and will open at the end of the interval. The resistor R of Fig. 3(a) must limit the current flowing from the ZN1034E output to a value no greater than 25mA. A value of a few hundred ohms is suitable with a minimum value of about 150Ω. Fig. 3(b) shows how the output from a ZN1034E can be used to control a triac device which itself switches the power to a load on or off. As before, R must limit the ZN1034E output current to 25mA.

### Minute timer

In Fig. 4 the product R<sub>T</sub>C<sub>T</sub> can be varied from 0.02 to 0.22 second by increasing VR1 from 0 to 1MΩ. When multiplied by the 2700 factor, times of 1 to 11 minutes can be obtained. Timing starts when S1 is closed and power is applied to the circuit. The alarm sounds at the end of the timed period and continues to sound until S1 is opened. A suitable alarm is obtainable from Doram Electronics Ltd.

### Repetitive timer

The circuit of Fig. 5 shows how a second ZN1034E can be started at the end of the timed period of the first device. At the end of the period timed by the second device, the timing process is started again in the first device. Thus this timer circuit continues to operate with each device working in turn. The output from pin 3 of either device provides the signal through R2 or R3 which begins the timing in the other device. Thus one has an oscillator with a period which can exceed a week!

A wide selection of other circuits is included in the ZN1034E data sheet including (i) a battery charger

which can accurately charge nickel-cadmium cells for a known period at a known current (ii) a metronome (iii) a timer for periods of 1 minute to 1 hour (iv) a 0 to 1 hour industrial timer with suppression against noise pulses (v) a delayed windscreen wiper motor control for vehicles (vi) the use of two ZN1034E devices in cascade to obtain a very large pulse division factor and hence delays of up to a year with an accuracy of 6 minutes after calibration. Other applications include the use of the device on farms for watering, etc, at the required times. ●

## KINDLY NOTE!

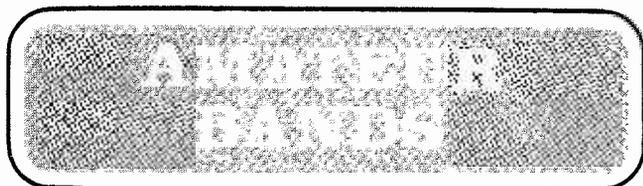
### ATOMIC TIME RECEIVER

August 1977

The author has kindly supplied further information on the coil assembly T1. An alternative to the one specified can be obtained from Hawnt Electronics Ltd., 112 Pritchett Street, Birmingham B6 4EN. This is the 10mm Vinkor LA2936 comprising parts: LA1421 pair of cores, LA1383 adjuster, DT2169 coil former, DT2341 ring, DT2342 clip (4 off) and DT2344 tag board.

The windings required are. Primary: 110 turns of 40 SWG enamelled copper wire. Secondaries: two of 20 turns each centre tapped. There are suitable holes in the PCB for this alternative assembly.

PLEASE MENTION  
PRACTICAL WIRELESS  
WHEN REPLYING  
TO ADVERTISEMENTS



by Eric Dowdeswell G4AR

Not too many reports this month, with just about everyone away on holiday I suppose. With the appalling weather we are having in the south I thought that a lot of you would have been tied to your sets instead of looking after the leaks! Weather or not, it seems that quite a few of you have been doing the rounds of the rallies and other "do's".

**Tom Learmonth** of Cwmbran, Gwent, tells me in his first letter to the column that he has now passed his RAE. Congratulations Tom, but I have to remark that it is usually the other way round! Letters first, pass the RAE, and not another word! Tom is not too keen to get the code test over and done with although I have advised him otherwise. He is anxious to get hold of a secondhand transceiver for the 2m band, possibly for mobile work, so any offers to Tom at 10 Glade Close, Coed Eva, Cwmbran, Gwent. Incidentally, Tom studied entirely on his own for the RAE and now his Dad is thinking of having a go!

From Hastings, **Brian Harrison** has stuck to the job in hand and covered 10, 15 and 20m on SSB while **Robin Bayley** A9203, up in Kemberton, Shropshire, patiently awaits his RAE course to begin so that he can take the exam next May. In the meantime he is using his EC10 and Marconi R1475 to good advantage from 15 to 80m.

**John Tye** G4BYV writes from Dereham, Norfolk, concerning the lads who work continental stations via repeaters and then ask for a QSL! Frequently they have only worked over a couple of miles! John spreads his time over a wide range of bands from 2m down to 23cm where he has worked 107 different stations in 9 countries! A very creditable achievement that really means something, and all with home-made equipment.

From Trowbridge, Wiltshire, comes a complaint from **David Birch**, aged 13, who is fed up with QRM from TV sets, pointing out that according to the TV licence the "apparatus" is not supposed to interfere with other "wireless telegraphy" equipment. You are quite right Dave, but just try to get someone to do something about it! I read recently that there is a possibility of legislation in the US on this matter but I hate to think how long it will take to get it into law and then to implement it. Pity it wasn't done at the beginning, but there, it costs money! Only hope is to try screened twin feeders properly matched and to keep the set and the aerial as far from the source of QRM as possible.

**J. Hodgson** of Morpeth, Northumberland, comments on some strange calls heard in the "10m" band but I fear that these are rubbish from the adjacent 11m band! Unfortunately, with the improving conditions on the

higher frequencies, we shall be able to hear more and more of the overseas Citizens Band stuff.

The organisers of the Worked All Britain Award have now introduced the WAB Counties Award which is also available to listeners. It is issued in two classes, depending upon the number of counties worked/heard. QSLs are not required. A record book to facilitate the "book-keeping" is really a must for this sort of award. Full details from **Alec Brennend** G4AVA, 76 Deneley Avenue, Todmorden, Lancs. Incidentally, as an added incentive to have a go, all profits from WAB activities go to the Radio Amateur Invalid and Bedfast Club.

**Club News.** The newly formed Brighton and District Radio Society is well under way and forthcoming events include a talk on Computers by G3XJG on October 12 and on the 26th G3OEM will discourse on Aeronautical Radio matters. Info from the Hon. Sec. **Nigel Hewitt** G8JFT, 74 Carlyle Street, Brighton.

The Cheltenham ARS and the local RSGB group have investigated the possibility of forming a single club and the likely date for the first combined meeting is November 3. Let's hope the move will be beneficial to all concerned. Further info from **Derek Lively** G3KII, 26 Priors Road, Cheltenham.

The very active Wessex AR Group has its AGM on October 7 and on the 21st they will be reviewing the results of their efforts in the VHF NFD. Several members were successful in the last RAE. It is expected that at least a dozen will start the new course at the Bournemouth College. Further info on the Club from **Geoff Cole** G4EMN, 6 St. Anthony's Road, Bournemouth. Meetings in the Club Room at the Dolphin Hotel, Holdenhurst Road, Bournemouth. 7.30 p.m.

Several readers have queried the new prefix P28 now being heard on the bands. This is the Republic of Djibouti previously using FL8 as a French colony. The series starts with J28AA so it's a bit difficult to tie up old calls in use with the new ones.

From Adlington, Lancs, comes a letter from **Paul Farnworth** who is listening and working for the RAE, "then I will leave school and try to get a job". Paul is 15 so let us hope that his plans work out. **John Overton** writes from Glasgow with some nice log entries on CW. He is very frustrated at not being able to answer back but perhaps it will not be for much longer as he is taking the RAE in December. His BC348 only goes to 18MHz so he's thinking of making another set for the 10 and 15m bands. Once again I must point out that a converter is the proper answer. Why not use all the other facilities you have in the 348, John? No point in duplicating them, and you are not likely to get hold of a better dial movement!

*Radial*, the journal of the RAIBC, reports a healthy growth in the Club membership and activities and a few volunteers are needed for jobs such as Equipment Secretary, Shows and Rallies Manager, Tapes Manager and a Transport Manager. It is not generally appreciated just how much work is involved in the transporting of gear to and from the invalid and bedfast members of the Club, apart from the odd servicing and maintenance chore.

Anyone interested in helping a most deserving cause can contact Harry Boutle G2CLP at 14 Queen's Drive, Bedford MK41 9BQ.

A report from Alan Doherty BR534968 in Portrush, Co. Antrim, just made the dateline. A rare call these days logged by Alan was Libya in the form of K5CO/5A. Not much activity there since the Forces moved out. Alan says not to be fooled by those CY calls, just read VE instead! Two other nice ones that one can go for many years without hearing were VR4DX and VR6TC, Tom Christian on Pitcairn.

## Log extracts

**J. Hodgson:**— 20m FG7XL JW7BK J29AI OJ0MA YB2SV 5W1AU 15m HK3AMV HR6SWA

**J. Tye:**— (G4BYV) worked on 23cm (1296MHz) DF8QK DK3UC PA0FWS PA0VTW PA0EZ ON6AT SM6ESG

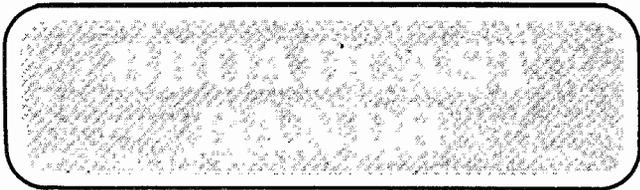
**R. Bayley:**— 80m A2GCO CT2AP KP4EJA VE4BC 40m HK0COP JA4AKU 15m VE7DIY 7P8BC

**B. Harrison:**— 20m F0CH/FC 15m HM2JV JA1PPC 10m 7X2DG

**A. Doherty:**— 80m FG7AN ZS5LB 20m K5CO/5A TU2GA-VR4DX VR6TC W6OKJ/KS6 ZD7SD 3D2AN, 5W1AU 15m WA4RQK/VQ9 ZD8RR 5N2AAX

**J. Overton:**— 20m A9XBC C31A SV1GR TG9DF VP2AA VP1WS

All calls are SSB except those in italic which are CW.



## SHORT WAVE BROADCASTS

by Charles Molloy G8BUS

Solar activity is on the increase according to the Swiss Shortwave "Merry-go-round" which regularly broadcasts the latest sunspot number and gives predictions, which are obtained from the Zurich Observatory. Forecasts of the number of sunspots for the coming months show a gradual rise from 27 in October to 33 in January 1978 and this upward trend is reflected in reports of DX on the higher frequencies. The writer has been listening recently on Sunday mornings at 0840 to the DX programme from Radio Australia on the new frequency of 21570kHz in the 13m band. Although beamed to Asia this transmission comes in better in the UK at this time than the frequencies in the 25m and 31m bands that are beamed to the UK.

Harold Emblem who DXes in Mirfield, in Yorkshire, reports hearing the afternoon transmission of "Sweden Calling DXers" on a new frequency of 21690kHz. HCJB in Quito Ecuador is also on a new 16m channel of 17755kHz, Radio Australia is on 15140 and 15410 in the 19m band and Radio South Africa is on 17780. Harold asks what sort of information should go into reports to this column. The exact frequency (if known) plus the date and time of reception will help readers to search for the station and some information of the gear used and the aerial will help those who intend purchasing or building a receiver or are thinking of putting up an aerial.

An interesting report comes from Derek Taylor of Preston in Lancashire who uses a Realistic DX160 receiver, a calibrator and a 30ft. loft aerial when operating on the shortwaves. He reports hearing the International Service of Radio Nacional de Venezuela in English at 2200 on 15400 and he received a confirmation letter from them after one month. Radio Korea (Seoul) was heard in English at 1330 on 11860kHz and the Voice of Nigeria outlet at Benin on 4932 in the 60m band was logged at 2100.

A newsletter has been received from the Bristol Path-

finder DX-Group. This club has about 20 members, mostly in the Bristol area, but DXers from anywhere in the UK are welcome. Enquiries should go to Lawrence Bennett, 7 Maple Avenue, Fishponds, Bristol BS16 4HJ. D. M. Tinker is a keen DXer who would like to know if there is a DX club in the Rotherham or Sheffield areas. Reply please to 20 Croft Road, Brinsworth, Rotherham, S Yorks S60 5AP.

Roger Fitzpatrick of Roscrea, Co. Tipperary and his friend Sean Keevey recovered a couple of old Pye 5-valve receivers from their respective lofts and were surprised, after blowing away the dust, to pull-in between them the following DX:—The Voice of Vietnam on 10040kHz at 1807, Nigeria on 15220 at 1615, Radio Australia on 9570 at 0800. "Have you any information on Radio Rodina?" asks Roger. Radiostantsia Rodina (Radio Station Homeland according to the World Radio Handbook translation) is not a radio station but a radio programme. It is in Russian and is carried by the external service of Radio Moscow and is intended for Russians living abroad.

Michael Walker (BRS 38836) has been listening to Radio Baghdad and he would like to know the address of this station. Write to:—Iraqi Broadcasting and TV Establishment, Salihiya, Baghdad, Iraq. Frank Hannam sent in a log from Colne in Lancashire. Using a Fidelity Rad 21 and a 35ft inverted-L aerial he heard the Voice of Turkey on 9515kHz at 2210 (there is a DX programme nightly at 2230), Radio Australia on 21570 at 0815 and Radio South Africa on 21535 at 1400. Frank has just been given a big box of valves and he is looking for details of a valve receiver to build.

Can you suggest a good aerial for indoor use, asks Ian Radford (Derby) who reports hearing Radio Australia on 9570 at 0800 and RSA on 21535 at 1700 with his Eddy-stone EC10 and whip aerial. You seem to be doing very well at the moment, Ian! Why not try the TV aerial? Unplug it from the TV and connect the co-ax lead to the EC10. If results are good then you can get hold of a 2-way outlet with switch from a TV dealer and switch the aerial to either the TV or the EC10 as required. Do not join all three, the TV the EC10 and the aerial together, they may not get on with one another!

"Just received a QSL card from Radio South Africa (on 21535) so it looks like the high bands are coming back" writes W. G. Holmes-Jones from Abergavenny, in Gwent. He uses a R209 and a home-brew 16-transistor receiver for the broadcast bands together with the choice of a Joystick, 84ft loft aerial or 45ft longwire plus an ATU and a tunable notch filter. The highlights of a very comprehensive log are Radio 4VEH Haiti on 9779 at 1130, Radio Finland 15260 at 1300 in English, Radio Australia 9570 each day at 0700 but it gets lost before scheduled sign-off at 0900 (try 21570), Radio Iran 17730 at 1930 in English, The Voice of Greece 9760 at 2200, Radio Mozambique on 6115 at 1800. Radio South Africa was heard on 15220 at 1345 with its weekly Wednesday DX programme.

"I have acquired an ex-RAF R1155 receiver which I know you are familiar with" says Alan Spencer who lives at Ryhall, in Lincolnshire. When connected to a 45ft long wire it produced ELWA Monrovia, Liberia, on 4770 at 2230 and Radio Nacional Espejo, Ecuador, on 4680 at 0355. Two resistors have now burnt out and Alan is unable to get hold of a circuit or manual. A. J. Brooks, 5 Farrant House, Winstanley Road, London SW11 2EJ can supply diagrams and manuals for most ex-WD and some other communications receivers. An SAE will bring a list. The paper decoupling capacitors in the R1155 are liable to leakage and it is worth doing what the writer did with his and replace the lot with modern 0.1µF 350VWV capacitors. If a decoupler does short circuit then a burnt out resistor may follow. An old dodge for testing decouplers is to connect the positive lead of a voltmeter to the HT line, disconnect the wire from the live side of the decoupler and tap-on the negative probe from the voltmeter in place of the wire just removed. A good capacitor will give a kick on the meter as it charges and the needle will then go back to zero. A leaky capacitor may give a kick and the needle will return slowly to some intermediate reading

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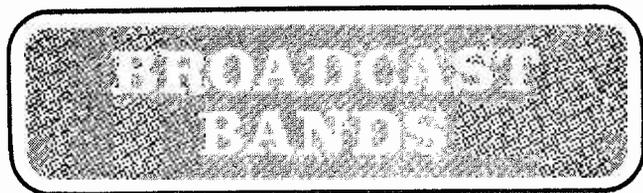
\*Complete as appropriate

PW/11

(please print)

caused by the current leaking through it. A steady reading on the meter equal to the HT volts indicates that the capacitor is short-circuit and will have to be replaced. Be careful to have the meter switched to the appropriate voltage range (to measure the HT volts) or it will have to be replaced as well!

A large mailbag this month has meant that some letters are being held over to next month. My apologies to those concerned.



## MEDIUM WAVE DX

by Charles Molloy G8BUS

"Readers will think I am mad, from your remarks about me in the July issue" writes **Harold Brodribb** from St Leonards-on-Sea, who has taken up the challenge of DXing with vintage radio receivers. "I am getting good results with pre-war sets provided they are maintained well and used on this high site with an outdoor aerial and ATU." Harold mentions that his CR100 has many advantages over vintage equipment. He has changed the RF valves for quieter types (the writer used 6BA6) and fitted an S-meter and a stabilised voltage supply for the oscillator. He has adapted the BFO valve to perform a dual function as BFO and product detector. The writer used the CR100, also known as the B28, for MW DXing for a number of years. Even unmodified it is a very good receiver though it too, could now almost be classified as vintage. A large number of CR100s came on the surplus market after the last war and they can still be obtained privately for quite a modest sum. They have an internal power pack and can be run direct from 240V mains. They are not too bulky, rather heavy, like most ex-WD equipment. An external speaker is required though there is space to fit one inside the metal cabinet.

A useful report of Spanish DX comes from **Declan O'Dea** who lives in Ballinasloe, Co. Galway. With a 10-transistor domestic portable he logged La Voz de Madrid on 1097kHz, R. Espana Madrid on 917, Radio Madrid on 800, R. Zaragoza 872, R. Valencia 1259, R. Sevilla 809, R. San Sebastian 1025, R. Centro Madrid 1385, R. Popular de Jerez 1385, R. Reloj Barcelona 1124 and La Voz de Gerona on 1385. From North America WINS on 1010 was logged at 0300 and there was an unidentified VOA transmission on 1295 which would be from the 600kW BBC transmitter at Crowborough in the UK. Declan would like to contact other PW readers in his area. The address is c/o Bank of Ireland, Society Street, Ballinasloe, Co. Galway.

**John Little** writes from Sunninghill, Berks, to say he was interested in the reference in the July issue to DXing the Middle East. He has just spent two years in Iran where DXing Europe prior to going to work at 0430 was great fun! With local stations not yet on the air, being 3½ hours ahead of London, the BBC frequently came through on 200kHz, 647kHz and 908kHz both on the built-in rod aerial and on an outside inverted L. A further illustration that it is interference (QRM) rather than distance that limits the range of DX on the medium waves.

A Realistic DX160 receiver, a MW loop and a 250ft long wire from the house to a 25ft pole at the bottom of the garden is used by **Martin Liezers** who lives in Newport, in Gwent. DX heard with this set-up between midnight and 0300 included La Voix de la Revolution, Conakry, Guinea, very strong on 1403kHz; CJON St John's, Newfoundland on 930; WNEW New York City on 1130 and an unidentified with the call KB Radio on 1520. The latter is WKBW in Buffalo NY and the complete call will be used in the formal identifications on the hour and the half-hour. Many

stations try to form slogans out of their call signs and some of these will mislead the newcomer. KLOK is "Clock Radio," WIOD is the "Wonderful Island of Dreams" (Miami), KYAK is in Alaska, and there used to be a KOLD in the same territory at one time! Some call signs may help the DXer. WNEW is in New York, WBAL is in Baltimore, WBOS in Boston, WCBS is owned by the Columbia Broadcasting System, WNBC by the National Broadcasting Company and WINS was the International News Service. There are no prizes for guessing what can be heard from WPOP and WFUN!

Martin raises a couple of interesting points in his letter. He mentions "a lot of crackles which disappear at dawn" and he asks what precautions can be taken to protect the house if his long wire is struck by lightning! Static, QRN, atmospheric, are the names given to the noise heard by Martin and each crackle is caused by a lightning discharge. Since the static disappears at sunrise it must, like DX, have been propagated for quite some distance. During the summer, thunderstorms in the tropics create a considerable amount of static which travels as far as the UK after dark and, although not loud enough to interfere with local reception, it can be troublesome to the DXer. A loop will reduce static provided that the DX and the static are not coming from the same direction. Summer static is usually from the south of the UK but it can come from other directions as well.

The advice about lightning protection usually offered in radio books is that the aerial should terminate at the point of entry to the building, on the moving contact of a knife switch. The upper contact goes to the receiver and the lower to a good, short, outside earth.

Summertime ends on October 23 this year in the UK and the return to GMT will mark the start of the winter season for North American DX. It will then be possible to listen to Canada and the USA before midnight and on nights when conditions are good some DX should be heard as early as 2300. The nearest, most consistent and earliest station to appear is CJON, located in St John's Newfoundland, which transmits with a power of 25kW on 930kHz. It can be found just on the low frequency side of AFN Berlin on 935. DXers who have never heard North America on the medium waves should try for CJON. Another regular is WINS in New York City on 1010kHz which is reasonably clear of QRM once the Dutch station on 1007 leaves the air, usually around 2300.

All North American medium wave stations use call signs which are mentioned over the air frequently. The prefix C is used on Canada and either a W or a K in the United States. All stations are on channels which are multiples of 10kHz. The best DX is often heard after midnight but quite a number of stations appear earlier whenever conditions are good. Tune slowly, as all these broadcasters suffer from slow fading and are easily missed. If unsuccessful, try again a few days later. If conditions are poor one night they will probably pick up again before long.



by Ron Ham BRS15744

Several contributors have expressed their pleasure at our journal's new format and the start of a series about taking the RAE. **Nigel Golds** BRS36910 West Chilmington, Sussex, leads his report with "I am pleased that there is a series which will help me with my studies for the RAE". Like many others, Nigel is a keen listener on 10m and has heard the DLs, OKs, Fs, and Gs as well as the German beacon, DL0IGI, during the periodic short skip openings in August.

While on a "junk" crawl, in aid of my early wireless

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## COMPACT FOR TOP VALUE

How about this for incredible bookshelf value from RT-VC! A pair of high efficiency units for only £7.50 - just what you need for low-power amplifiers. These infinite baffle enclosures come to you ready mitred and professionally finished. Each cabinet measures 12" x 9" x 5" (approx.) deep, and is in wood simulate. Complete with two 8" (approx.) speakers for max. power handling of 7 watts.  
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+ 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.).  
**£34 PER PAIR**  
+ P & P £6.50

Duo III, 20 watts rms, 40 watts peak, 27" x 13" x 11 1/2" (approx.).  
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+ P & P £7.50

## EASY TO BUILD RECORD PLAYER KIT

Ideally suited for the constructor who requires a complete stereo unit at a budget price, comprising ready assembled stereo amp. module, Garrard auto/manual deck with cueing device, pre-cut and finished cabinet work. Output 4 watts per channel, phones socket and record/replay socket.  
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+ P & P £4.05

## CAR RADIO KIT

Complete with speaker, baffle and fixing strip. The Tourist IV for the experienced constructor only. The Tourist IV has five push buttons, four medium band and one for long wave band. The tuning scale is illuminated and attractive small aluminium control knobs are used for manual tuning and volume control. The modern style fascia has been designed to blend with most car interiors and the finished radio will slot into a standard car radio aperture. Size approx. 7" x 2" x 4 1/2". 12 volts pos or neg earth (altered internally) p & p £1.50  
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Output 4 watts into 4 ohms.

**FREE TO PERSONAL SHOPPERS BUYING CAR RADIO KIT** ELECTROMATE Rear window heater, modern line element all wiring and switch worth **£3.00**



**SPECIAL OFFER**

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## 20 x 20 WATT STEREO AMPLIFIER

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.  
**£29.90**  
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A 4 channel Stereo Adaptor to all buyers of the Viscount 20 x 20 Amplifier at **£29.90** limited offer. Available separately at **£3.95**  
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## SPECIAL OFFER

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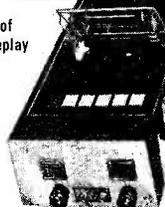
On complete stereo systems using starred Products

## 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 ready for mating together with the mechanism.

Specifications: Sensitivity - Mic. 0.85mV @ 20K OHMS; Din. 40mV @ 400K OHMS; Output - 300mV RMS per channel @ 1KHz from 2K OHMS source; Cross Talk - -30db; Tape Counter - 3 Digit - Resettable; Frequency Response - 40Hz - 8KHz ± 6db; Deck Motor - 3 Volt DC with electronic speed regulations; Key Functions - Record, Rewind, Fast Forward, Play, Stop & Eject. p & p £2.50

Optional extras: Pair of Dynamic microphones **£3.95** + £1.80 p & p. Mains transformer **£2.50** + £1.00 p & p.



**STEREO CASSETTE** record/replay fully built P.C. board incorporating 4 I.C.s.  
**GRUNDIG 5 1/2"** tape 1800 ft. **£1.20** each, 5 for **£5.00**

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**TURNTABLE** illus. diamond stylus, and de luxe plinth and cover. **£29**

Popular **BSR MP 60** type, complete with magnetic cartridge, Ready wired **£4.50**



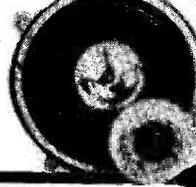
## 30 x 30 WATT AMPLIFIER KIT

Specially designed by RT-VC for the experienced constructor, this kit comes complete in every detail. Same facilities as Viscount IV amplifier. Chassis is ready punched, drilled and formed. Cabinet is finished in teak veneer. Silver fascia and easy-to-handle aluminium knobs. Output 30 + 30 watts rms, 60 + 60 peak.  
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**£29.00**  
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with built-in pre-amplifiers  
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## 45 WATT MONO DISCO AMP

**£35.00**

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Size approx

13 1/2" x 5 1/2" x 8 1/2"

Here's the mono unit you need to start off with. Gives you a good solid 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

**£35.00**

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Size approx

14" x 4" x 10 1/2"

Sloping fascia, you can use the controls without fuss or bother. Brushed aluminium fascia and rotary controls. Five smooth acting, vertically mounted slide controls - master volume, tape level, mic level, deck level, PLUS INTER-DECK FADER 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 70 watt it in. VU meter monitors output level. 100 watt Output 100 watts RMS 200 watts peak. p & p **£4.00**



## BSR BD595 SERIES

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## PRACTICE GUITAR AMPLIFIER WITH BUILT-IN SPEAKER

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+ P & P £3.00



## HOME 8 TRACK CARTRIDGE PLAYER

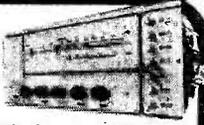
Automatically switches programmes monitored by indicators, with manual override track selection. This unit will match with the Unisound modules and is compatible with the Viscount IV amplifier with Sim teak cabinet. approx. 9" x 8" x 3 1/2". p & p **£2.50** **£16.50**



## PYE STEREO GRAM CHASSIS

(Complete with circuit diagrams)

Complete ready to install - Wave bands LM, VHF STEREO, VHF MONO. Controls for tuning volume, balance, bass and treble. Power output 7 watts R.M.S per channel 14 watts peak 8 ohms. 2" x 8" approx chassis speakers and BSR auto record player deck. **£35.00**



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		EZ39	1.50	EZ38	1.50
		EZ40	1.50	EZ39	1.50
		EZ41	1.50	EZ40	1.50
		EZ42	1.50	EZ41	1.50
		EZ43	1.50	EZ42	1.50
		EZ44	1.50	EZ43	1.50
		EZ45	1.50	EZ44	1.50
		EZ46	1.50	EZ45	1.50
		EZ47	1.50	EZ46	1.50
		EZ48	1.50	EZ47	1.50
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EBF80	0.45	EL32	0.60	TT21	0.50
EBF83	0.45	EL34	0.80	PCL82	0.45
EBF89	0.40	EL35	0.60	PCL83	0.70
EC52	0.40	EL37	3.00	PCL84	0.50
EC81	0.45	EL41	0.30	PCL86	0.60
EC82	0.40	EL51	0.60	PCL805	
EC83	0.40	EL82	0.60	UAB80	
EC84	0.35	EL84	0.35	UAF42	0.75
EC85	0.45	EL86	0.50	UBC41	0.60
EC86	1.25	EL90	0.50	UBF80	0.50
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SP61	0.85	IR5	0.55	6AS6	0.80	6L9GT	0.60	14S7	1.00	6064	0.85
TT21	0.50	IS4	0.30	6AT8	0.65	6L7	0.65	19AQ5	0.75	6065	1.20
U25	1.00	IS5	0.40	6AU6	0.40	6S47	0.55	19G3	10.00	6067	1.00
U26	0.85	IT4	0.40	6AV6	0.50	6S67	0.50	19G6	6.00	6080	3.50
U27	1.00	IX2B	0.80	6AX4GT		6S7J	0.60	19H5	17.00	6146	3.80
U191	0.75	2X2	0.80		0.80	6S7JGT		20P3	0.60	6146B	4.20
U801	0.60	2D21	0.55	6AX5GT		6SK7	0.50	20P4	1.10	6380	1.60
UABC80		2K25	9.00	6B7	0.75	6L7GT		25L6GT0	0.50	9001	0.40
		3A4	0.60	6BA6	0.40		0.55	30C15	1.00	9002	0.55
UAF42	0.75	3E29	5.50	6BE6	0.45	6SN7GT		30C17	1.10	9003	0.70
UBC41	0.60	3D6	2.00	6BG6	1.00		0.55	30C18	1.10	9004	0.40
UBF80	0.50	3S4	0.50	6BJ6	0.75		0.55	30F5	1.00	9006	0.40
UBF89	0.50	3V4	0.85	6BQ7A	0.60		0.55	30FL12	1.20		

PL84	0.50	UBL1	1.00	5B/		6BR7	2.30	6V6G	0.95	30PL1	1.00
PL80	0.95	UBL21	0.75	254M	5.50	6BV6	1.30	6Z4	0.65	30PL13	1.10
PL82	1.35	UCC85	0.50	5B/		6BV7	1.00	6-30L2	0.90	30PL14	1.10
PL83	0.50	UCC86	0.50	255M	5.50	6C4	0.40	6-30L2	0.90	35L6GT0	80
PL85	0.50	UCH42	0.30	5B/		6C8	0.55	7B7	0.80	35L6GT0	80
PL86	0.50	UCH81	0.50	258M	5.50	6C8	0.55	7V4	0.80	35W4	0.80
PL87	0.50	UCH82	0.45	5R4G	1.10	6CB6	0.50	9D2	0.60	35Z4GT0	70
PL88	0.50	UCL83	0.70	5U4G	0.60	6CH6	3.00	9D6	0.75	50C5	0.70
PL89	0.50	UF41	0.75	5V4G	0.65	6CL6	0.75	11E3	11.00	50C6G1	20
PL90	0.50	UF80	0.40	5Y3GT	0.65	6D8	0.50	12A6	0.60	75	1.00
PL91	0.50	UF89	0.50	5Z3	1.00	6E8	0.80	12A6	0.60	75C1	0.80
PL92	0.65	UF89	0.50	5Z4G	0.70	6F8G	0.75	12A7	0.45	78	0.75
PL93	0.60	UL41	0.75	5Z4GT	0.75	6F12	0.65	12A7	0.45	80	0.75
PL94	0.60	UL84	0.50	6AB7	0.60	6F17	1.00	12A7	0.45	85A2	0.75
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collection, I met **Vic Elliott** BRS37850 Midhurst, Sussex, who emphasised his delight about the RAE series and explained, that as an ex-RN morse instructor, he is now brushing up his basics for the next exam and plans to become active on the HF bands. Later, I called on **Gordon Goodyer** BRS37345 Petworth, Sussex, a PW reader for many years, who said that he likes the new format but the increase in size upsets his very tidy bookshelves! Gordon spends a lot of time listening on 10m with his CR100 and dipole and on 2m with his home-brew front-ends, indulging in his special interest of making and testing VHF ground plane aerials.

A period of solar activity began on July 23rd and ended on August 5th during which time our extra-terrestrial observers monitored the event. **John Smith**, Cranleigh, Surrey, recorded two definite peaks in the solar noise output at 142MHz, the first started on the 23rd, reached it's peak on the 28th, and returned to normal on August 2 when it rose again to a climax on the 5th and down again by the 10th. In both cases the maximum was about four times the normal level. While the noise was fluctuating, both John and I recorded a host of individual solar bursts, each lasting between one and five minutes, throughout the event. **Cliff Ranft**, Chilworth, Surrey, found evidence of ionospheric disturbance on July 29th and 30th and he recorded a moderate SCNA (Sudden Cosmic Noise, Absorption) between 1410 and 1510 on August 5th.

Although cloudy skies prevented systematic use of the optical instruments, John Smith did manage to see a sunspot group on July 26th, and **Cmdr. Henry Hatfield**, Sevenoaks, using his spectroheliometer, observed a variety of sunspots between August 1st and 4th, in addition to several small filaments and plages. On August 1st and 2nd Henry saw a bright prominence on the sun's east limb and his records show that each time he sees one of these events we all record some form of radio noise at metre waves. Henry counted five sunspots, plus two plages on the 9th. I received bursts of radio noise at 136MHz on the 10th and on the 13th John Smith noted that the solar noise level was up, and Cliff Ranft again found evidence of an ionospheric disturbance.

According to my observations the cause of the disturbed conditions on the 4th was due to a mixture of tropo, due to the falling pressure noted by both Ciaran and myself, and sporadic-E which manifested itself for most of the morning. At 0913 I received a 599 signal from the 70cm beacon at Sutton Coldfield GB3SUT, a strong picture from Lichfield on Ch. 8 and good signals from ten continental broadcast stations in Band II. At the same time, the influence of sporadic-E ranged from 40 to 73MHz, bringing a host of continental signals into the UK in Band I plus 14 east-European broadcast stations between 66 and 73MHz.

Although the tropo-lift was waning I received 59 signals from F1ENH and G8FAS in Somerset, via the London repeater, GB3LO. Sporadic-E occurred again on the 5th and was most intense at 0910 when I received very strong signals from 46 east-European stations between 66 and 73MHz in addition to sync. pulses on R1, 49.75MHz and a crop of continental stations in Band I.

The falling barometer indicated another tropo opening on August 10 and 11th. At 2300 on the 10th Alan heard a GM station just above the noise on 2m and at 2355 he worked G8JJR near Doncaster on SSB and while he, at the east end of Sussex, listened to a mobile north of Darlington, via the Cambridge repeater, GB3PI. Your scribe, located at the west end of the county, listened to the Bristol Channel repeater GB3BC and it's "Bing-Bong" code, which must be familiar to our GW readers under normal conditions. I am told that the original aerial at the Brighton 70cm repeater GB3BR 433.15MHz has been changed for an improved colinear. G8LGQ who lives to the east of the repeater, with 400ft of chalk in the way, is getting a much better signal than before. Further reports to me or to G8HVV, QTHR.

I received a reasonable signal from GB3SUT from 0050 on the 10th to midday on the 11th, and at 0740 on the 11th I heard the Emley Moor beacon GB3EM 432.910MHz

at 559. Slight tropo-lifts produced signals from GB3SUT on 70cm during the early mornings of the 13th and 16th; more reports about 70cm activity would be welcome.

Interest in our microwave reports is growing and a most welcome letter from **Sam Jewell** G4DDK, Stone, Staffs, who says there is some dozen stations active on 10GHz from Birmingham in the south to Manchester in the north and that there is some activity most weeks between various stations in that area. A typical path recently covered was Mow Cop on the Staffordshire-Cheshire border to Winter Hill in Greater Manchester, a line-of-sight distance of 59km. On this occasion G4DDK, G8ANZ and G8BHH were at Mow Cop and G8AXE with G8AFC on Winter Hill.

The type of equipment being used in the Midlands is typical of modern wideband FM gear for 3cm; a 12mW Gunn diode transmitter to a 16in dish and a separate tunable Gunn diode/Sim-2 mixer as receiver with a 106MHz IF, resolved on an FM broadcast receiver. I know just how good this equipment has to be because I spent part of Sunday, August 21st on the Trundle, a hilltop some 675' ASL, just north of Chichester, Sussex, with Colin Boys G8BCO, Peter Kerry G8ARO and David Bookham G8JNI to see their respective 10GHz stations as they prepared to take part in the RSGB's 10GHz Cumulative contest.

The extreme neatness of each station was impressive. The aerials and the electronics are compact, mounted on sturdy tripods with provision for precise adjustments in both altitude and azimuth. At one time, Colin removed his 18in dish and demonstrated that he could just receive the 10.1GHz beacon GB3IOW St. Catherines, Isle of Wight, on open waveguide proving that he had the full 30dB gain of the dish in hand on that signal. It did not surprise me when I learnt that Colin's microwave gear won him the award at the construction contest organised by the Farnborough and District Radio Society. Peter was using a 12in dish, giving him 24dB gain on his receiver and a 14dB horn on his transmitter. At 1300 a 599 signal from GB3IOW was booming from his receiver and he demonstrated just how critical the direction is; in fact he lost the signal by moving his aerial just 1 1/2in! David's receiver consists of a balanced mixer (pair of 1N23s) into a 40673 mosfet preamp at 100MHz (IF) and then to Mullard modules. His transmitter is a 160mW Gunn diode and his aerial an 18in dish. David also received the beacon signal and a strong signal from G3KSU/P at St Catherines. Each station had two-way contacts with G8BDJ/P Chantonbury Ring, Sussex and G3IZD/P Lynch Down, Sussex. The climax of their day came at 1800 when G8BCO/P had a 55 contact with GU3JHM/P on Alderney and G8ARO/P had a 59 contact with the Alderney station. Peter told me later that several other UK stations had made it to the Channel Islands on 3cm that afternoon.

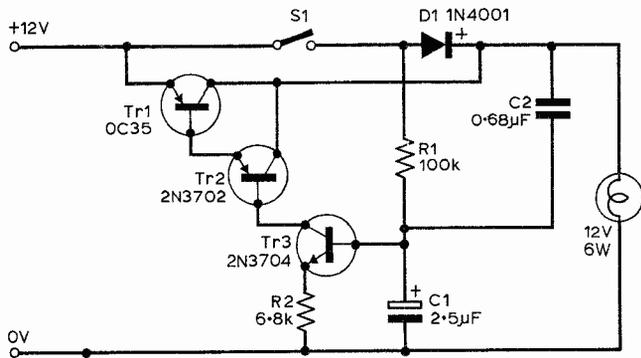
The Microwave round table meeting held on August 7th in Winchester was very successful and well-attended in view of the short notice, which goes to show that once again the amateurs are prepared to experiment and pioneer those difficult signal paths. To help them, the 3cm beacon at Alderney GB3ALD is now active and its signals have already been received on the Trundle, a distance of 167km. I understand that several of the microwave boys are planning to get going on 24GHz and I will certainly look forward to receiving their reports for this column.

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:-

**AMATEUR BANDS** Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashted, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

**MEDIUM and SW BANDS** Charles Molloy G8BUS, 132 Segars Lane, Southport, PR8 3JG. Reports for both bands must be kept separate.

**VHF BANDS** Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.



**W527**  
**Fig. 6:** The final circuit with all the snags ironed out, giving a sharp turn-off to the light, which now remains on for about 15 seconds after the car door is closed.

this is a 30W type so we shouldn't blow it if we use it as the series element. Its gain is given as 25 to 75 at 1A, so let's take a minimum of 20, which means that the base current will need to be  $500/20=25\text{mA}$ . If we try to supply all this current from one transistor then the current drawn from C1 will be too high; the easiest way out seems to be to reduce the base current that needs to be supplied, by making the pass element a Darlington pair. The circuit will then look like Fig. 6.

The 2N3702 and 2N3704 transistors have been kept since we were using them in our experiments before. Previously the timing period was a bit short but this should go up with increased supply voltage—we can always make C1 bigger if the delay is still too small. R1 has been doubled in value since the supply voltage has been doubled, although this isn't really necessary. D1 can be any diode capable of taking 0.5A with a maximum reverse voltage of about 20V—a 1N4001

should be fine. Silicon types must be preferable here, since we don't want any problems with leakage currents through D1, keeping C1 charged. What value do we need for R2? Well we want 25mA of base current for the OC35 and a catalogue tells us that we can rely on a gain of at least 50 from the 2N3702: this means that the 2N3704 has to supply  $500\mu\text{A}$ , at least until the voltage across C1 is down to 3V or so. A  $6.8\text{k}\Omega$  resistor should be OK here; it gives a safe limit to the maximum current that Tr3 can supply.

It would be good practice normally to put a resistor from the emitter of Tr2 up to the +12V line. This stops the Darlington pair doing funny things at low currents. However, we're not involved with low currents here so we'll not bother with this resistor.

It is not entirely obvious what effect changing the load will have on the optimum value for C2, so we'll try  $0.47\mu\text{F}$  again and see what happens. We can do this final experimenting when we've built the rest of the circuit on a piece of Blob Board. With the circuit wired up we find that the courtesy light, temporarily excised from the car, stays alight for about fifteen seconds and then turns off. As for C2, the turn-off seems fast and very stable: yet again  $0.1\mu\text{F}$  appears to be not quite enough but  $0.47\mu\text{F}$ ,  $0.68\mu\text{F}$  and several larger values that we tried all speed up the switching, with none of that embarrassing flickering that we had before, so let's settle for  $0.68\mu\text{F}$  as the final value for C2. A practical layout is shown in Fig. 7.

The output levels and the output impedances of things like cassette recorders don't always match the associated amplifiers so next month's design is for a simple matching circuit.

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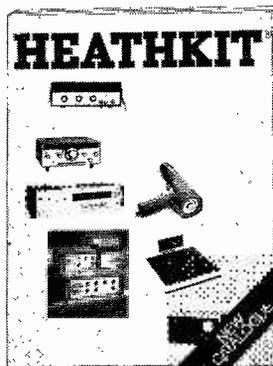
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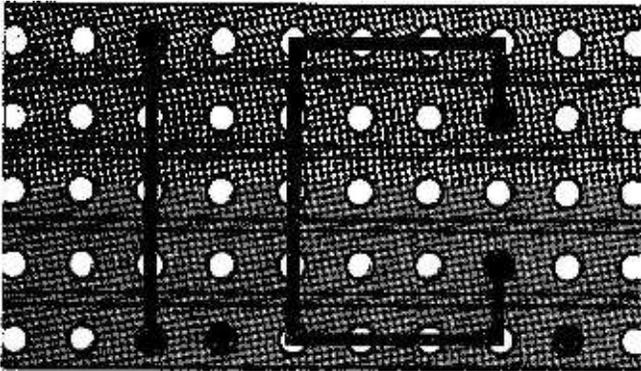
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*Practical Wireless, November 1977*

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1A5GT	55	6AT6	60	6K65	75	9D7	70	19H1	4.00	72	70	EC92	55	EL83	70	KTW61	1.50	PFL200	70	UY41	60	AC127	20	BFY61	23
1A7GT	60	6AV6	40	6G6T	80	9U8	45	19Y3	40	77	45	EC92	55	EL83	70	KTW61	1.50	PL38	1.00	UY42	60	AC128	28	BFY62	23
1B3GT	55	6AV6	50	6H6GT	80	10C2	70	20D1	70	85A2	75	EC92	55	EL83	70	KTW61	1.50	PL38	1.00	UY42	60	AC128	28	BFY62	23
1C2	1.00	6AW8A	84	6J6GT	85	10C14	50	20D4	2.50	85A3	75	EC92	55	EL83	70	KTW61	1.50	PL38	1.00	UY42	60	AC128	28	BFY62	23
1D5	75	6AX4	74	6J7	35	10D1	85	20F2	85	108C1	40	EC92	55	EL83	70	KTW61	1.50	PL38	1.00	UY42	60	AC128	28	BFY62	23
1G6GT	1.00	6B8G	35	6J7G	80	10D7	80	20L1	1.20	10B2C	1.00	EC92	55	EL83	70	KTW61	1.50	PL38	1.00	UY42	60	AC128	28	BFY62	23
1H8GT	80	6BA6	40	6J7M	85	10E1	87	20P1	1.00	10B2C	1.00	EC92	55	EL83	70	KTW61	1.50	PL38	1.00	UY42	60	AC128	28	BFY62	23
1L4	85	6BC8	90	6J8A	90	10F9	85	20P1	1.00	2158G	80	EC92	55	EL83	70	KTW61	1.50	PL38	1.00	UY42	60	AC128	28	BFY62	23
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1LN5	70	6BG6G	1.00	6K8G	50	10L14	45	20P4	84	807	1.10	DM70	80	EC92	55	EL83	70	KTW61	1.50	PL38	1.00	UY42	60	AC128	28
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1S4	40	6B7A	85	6L6GC	85	10L12	45	20P6	1.50	1626	2.50	DM71	1.75	EC92	55	EL83	70	KTW61	1.50	PL38	1.00	UY42	60	AC128	28
1R5	35	6BN8	1.00	6L7	1.50	10L13	80	25T5	80	5763	1.55	DY87E	45	EC81	55	EL25	45	EC92	55	EL25	45	EC92	55	EL25	45
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1U6	85	6BR7	1.00	6L13	2.00	12A06	80	25Z5	75	6067	1.00	EB0CC	2.50	EC88	1.00	EL52	52	EC92	55	EL25	45	EC92	55	EL25	45
2D21	55	6BR8	1.85	6LD12	40	12AD6	80	26Z6G	80	6146	4.70	EB0F	2.20	EC88	1.00	EL52	52	EC92	55	EL25	45	EC92	55	EL25	45
2GK5	75	6BW6	1.70	6LD20	80	12A16	80	28D7	2.00	6463	2.00	EB0F	2.20	EC88	1.00	EL52	52	EC92	55	EL25	45	EC92	55	EL25	45
2K2	70	6B7	85	6L7GT	70	12A76	45	7025	2.00	EB0CC	1.20	EC84	65	EL31	1.00	EC88	1.00	EL52	52	EC92	55	EL25	45	EC92	55
3A4	55	6RX6	28	6PL12	40	12A77	45	7025	2.00	EB0CC	1.20	EC84	65	EL31	1.00	EC88	1.00	EL52	52	EC92	55	EL25	45	EC92	55
3B7	55	6BY7	36	6P15	35	12A78	45	7025	2.00	EB0CC	1.20	EC84	65	EL31	1.00	EC88	1.00	EL52	52	EC92	55	EL25	45	EC92	55
8D6	40	6BZ6	60	6Q7G	50	12A77	45	7025	2.00	EB0CC	1.20	EC84	65	EL31	1.00	EC88	1.00	EL52	52	EC92	55	EL25	45	EC92	55
3Q4	80	6C4	50	6Q7GT	50	12A78	45	7025	2.00	EB0CC	1.20	EC84	65	EL31	1.00	EC88	1.00	EL52	52	EC92	55	EL25	45	EC92	55
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3R4	45	6C9	2.00	6R7G	70	12B56	65	30L1	39	AC2PEN	1.00	EA50	70	EC92	55	EL25	45	EC92	55	EL25	45	EC92	55	EL25	45
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4CB6	75	6CBA5	50	6SC7GT	75	12B77	55	30L15	75	AC2PEN	1.00	EA50	70	EC92	55	EL25	45	EC92	55	EL25	45	EC92	55	EL25	45
4GK5	75	6C12	55	6S7	65	12B77	55	30F4MR	98	AC2PEN	1.00	EA50	70	EC92	55	EL25	45	EC92	55	EL25	45	EC92	55	EL25	45
5C8	75	6CD6G	4.00	6S7	65	12E1	3.50	30P12	74	AC2PEN	1.00	EA50	70	EC92	55	EL25	45	EC92	55	EL25	45	EC92	55	EL25	45
5R4GY	1.00	6CG8A	80	6S7	65	12F6GT	40	30P16	87	AC2P1	1.50	EA50	70	EC92	55	EL25	45	EC92	55	EL25	45	EC92	55	EL25	45
5T4	2.00	6CL6	75	6SK7	1.00	12G17	70	30P16	87	AC2P1	1.50	EA50	70	EC92	55	EL25	45	EC92	55	EL25	45	EC92	55	EL25	45
5U4G	1.00	6CL8A	85	6SK7GT	55	12K15	1.50	30P16	87	AC2P1	1.50	EA50	70	EC92	55	EL25	45	EC92	55	EL25	45	EC92	55	EL25	45
5V4G	60	6CM7	1.00	6S7	65	12K7GT	50	30P18	50	ALF6	1.50	EB91	20	EP94	40	HN309	1.70	PCF82	50	UBF89	2.00	ULB1	2.00	ULB1	2.00
5Y3GT	65	6CS6	45	6U7G	80	12K8	75	30P18	50	ALF6	1.50	EB91	20	EP94	40	HN309	1.70	PCF82	50	UBF89	2.00	ULB1	2.00	ULB1	2.00
5Z3	1.00	6CU5	80	6U7G	80	12Q7GT	50	30P18	50	ALF6	1.50	EB91	20	EP94	40	HN309	1.70	PCF82	50	UBF89	2.00	ULB1	2.00	ULB1	2.00
5Z4G	48	6D3	75	6U8	50	12R47	75	30P12	64	ATP4	50	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
5Z4GT	55	6D7	80	6V8G	60	12R57	60	30P13	1.00	AZ31	60	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6R0L2	75	6D7A	85	6V9GT	1.00	12R57	60	30P13	1.00	AZ31	60	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6A8G	1.40	6E7E	85	6X4	85	12R87	75	30P14	1.90	AZ31	60	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6AC7	55	6E5	1.00	6X5GT	45	12R87	75	30P14	1.90	AZ31	60	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6AG5	35	6F1	80	6Y6G	85	12R87	75	30P14	1.90	AZ31	60	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6AG7	80	6F6G	80	6Y7G	1.25	12S8N7GT	80	35D5	80	B759	50	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6A16	70	6F12	70	7A7	1.00	35D5	80	35L6GT	80	12S8N7GT	80	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6A36	70	6F14	80	7B6	80	12S9Q7	80	35V4	80	35Z3	80	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6A18	55	6F15	85	7B7	80	12S9Q7GT	80	35V4	80	35Z3	80	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6A15	45	6F16	75	7D6	2.00	12S9Q7GT	80	35V4	80	35Z3	80	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6A18	40	6F18	60	7F8	2.00	12S9Q7GT	80	35V4	80	35Z3	80	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6AL5	20	6P23	85	7H7	80	12S9Q7GT	80	35V4	80	35Z3	80	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6AM6	70	6P24	80	7H7	2.00	12S9Q7GT	80	35V4	80	35Z3	80	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00
6AM8A	70	6P25	1.00	7Y7	2.00	12S9Q7GT	80	35V4	80	35Z3	80	EB08	45	EP97	80	HVR2AL	1.00	PCF84	70	UBF89	2.00	ULB1	2.00	ULB1	2.00

# 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 $\Omega$  at 1kHz.

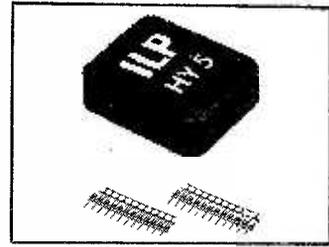
OUTPUTS. Tape 100mV; Main output 500mV R.M.S.

ACTIVE TONE CONTROL'S. 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 $\Omega$

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.

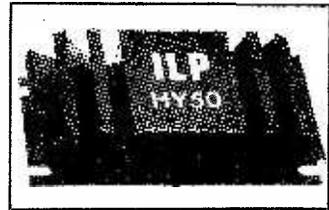
**SPECIFICATIONS:**

OUTPUT POWER 15W R.M.S. into 8 $\Omega$ ; 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 $\Omega$

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

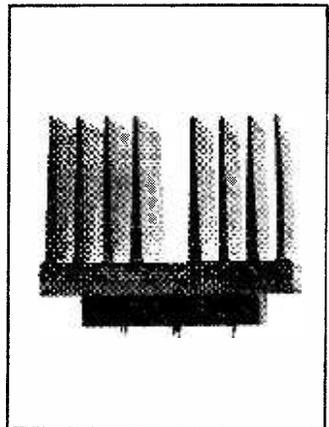
**SPECIFICATIONS:** INPUT SENSITIVITY 500mV

OUTPUT POWER 25W RMS into 8 $\Omega$  LOAD IMPEDANCE 4-16 $\Omega$  DISTORTION 0-04% at 25W

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 $\Omega$

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 $\Omega$  LOAD IMPEDANCE 4-16 $\Omega$  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 $\Omega$

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 $\Omega$  LOAD IMPEDANCE 4-16 $\Omega$  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 $\Omega$

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4 $\Omega$ ! 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 $\Omega$  LOAD IMPEDANCE 4-16 $\Omega$  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 85p VAT. P/P free.

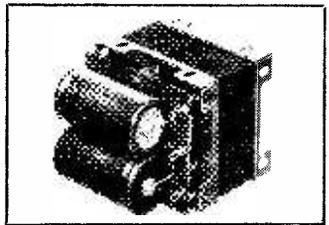
PSU40 suitable for two HY50's  $\pounds$ 6.82 plus 85p VAT. P/P free.

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.

PSU180  $\pounds$ 23.10 +  $\pounds$ 1.85 VAT.

B1  $\pounds$ 0.48 +  $\pounds$ 0.06 VAT.



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## 12 AND 24 VOLT OR 12-0-12V

Ref	12V	24V	£	P & P
111	0.5	0.2	2.20	0.45
213	1.0	0.5	2.64	0.78
71	2	1	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	OA

## 30 VOLT RANGE

Ref	30V	£	P & P
112	0.5	2.64	0.76
79	1.0	3.57	0.96
3	2.0	5.27	0.96
20	3.0	6.20	1.14
21	4.0	7.44	1.14
51	5.0	8.37	1.32
117	6.0	9.92	1.45
88	8.0	11.73	1.64
89	10.0	13.33	1.84

## 50 VOLT RANGE

Ref	50V	£	P & P
102	0.5	3.41	0.78
103	1.0	4.57	0.96
104	2.0	6.98	1.14
105	3.0	8.45	1.32
106	4.0	10.70	1.50
107	6.0	14.62	1.64
118	8.0	17.05	2.08
119	10.0	21.70	OA

## 60 VOLT RANGE

Ref	60V	£	P & P
124	0.5	3.88	0.96
126	1.0	5.58	0.96
127	2.0	7.60	1.14
125	3.0	10.54	1.32
123	4.0	12.23	1.84
40	5.0	13.95	1.64
120	6.0	15.66	1.84
121	8.0	20.15	OA
122	10.0	24.05	OA
189	12.0	27.13	OA

## MAINS ISOLATING (SCREENED)

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	2.15
154	500	19.15	2.15
155	750	29.06	OA
156	1000	37.00	OA
157	1500	45.60	OA
158	2000	54.80	OA
159	3000	79.05	OA

## HIGH VOLTAGE MAINS ISOLATING

Ref	VA (Watts)	£	P & P
60	243	5.89	1.32
350	247	14.11	1.84
1000	250	35.65	OA
2000	252	54.25	OA

## AUTO TRANSFORMERS

Ref	VA (Watts)	£	P & P
113	20	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	5.20 0.96
66	300	0.115-200-220-240	7.75 1.14
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 OA
95	2000	0.115-200-220-240	34.82 OA
73	3000	0.115-200-220-240	48.00 OA

## CASED AUTO TRANSFORMERS

Ref	VA (Watts)	£	P & P
20	4	96	0.96 113W
150	8	48	1.14 4V
200	9	92	1.45 65W
250	10	49	1.45 69W
350	12	53	1.64 83W
500	15	73	1.64 67W
750	18	55	1.76 83W
1000	22	68	OA 84W
1500	26	02	OA 93W
2000	37	65	OA 95W

## SCREENED MINIATURES

Ref	mA	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	0-9, 0-9, 0-9	2.59	0.71
208	1A, 1A	0-8-9, 0-8-9	3.53	0.73
236	200, 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
209	1A, 1A	0-15-27-0-15-27	5.39	0.96
239	50	12-12-12	1.99	0.38
S112500		12-15-20-24-30	2.64	0.78

## PLUS

Item	Price
HIGH QUALITY MODULES	£3.66
25 Watts RMS AMPLIFIER	£4.57
35 Watts RMS AMPLIFIER	£6.95
125W RMS AMPLIFIER	£15.95
PRE-AMP for 5-10W	£6.70
PRE-AMP for 25W	£13.88
POWER SUPPLIES 5-10W	£1.30
POWER SUPPLIES 25W	£3.75
TRANSFORMER 5-10W	£3.09
TRANSFORMER 25W	£4.79
P & P Modules 35p. Trans 90p.	
VAT 12% *VAT 8%	

Item	Price
MUSIC CENTRE KIT	£24.12 inc.
FM Stereo Tuner + MW/LW. Output	
2 x 8.5W rms.	

Item	Price
BLOB BOARD (Pack of 3)	£0.75
2.5" x 5.1" or 2.5" x 5.1" .15"	£1.14
3.75" x 5.1" or 3.75" x 5.1" .15"	£3.78
10" x 6" .1" or 10" x 6" .15"	
IC Range	£0.96
4.8" x 3.2" 4.75" x 7.5" £2.13	
P & P 35p VAT 8%	

Item	Price
ELECTRONIC CONSTRUCTION KIT	£1.70
10 projects (including electronic organ). No	
soldering needed £1.70. VAT 8% P & 70p	

Item	Price
COMPONENT PACKS	
200 Mixed value resistors (count by weight)	
150 Mixed value capacitors (count by weight)	
30 Mixed value precision resistors 1/4W 2%	
15 Assorted pots	
10 Reed switches	
15 Wire wound resistors—mixed wattage	
1 Pack wire 50 metres assorted colours	
25 pre-sets assorted types and values	
Please state pack required. 60p per pack	
VAT 12% P & P 40p	

Item	Price
240V cable in & 115V USA 2 pin outlet	
VA £ P & P Ref	
20 4.96 0.96 113W	
150 8.48 1.14 4V	
200 9.92 1.45 65W	
250 10.49 1.45 69W	
350 12.53 1.64 83W	
500 15.73 1.64 67W	
750 18.55 1.76 83W	
1000 22.68 OA 84W	
1500 26.02 OA 93W	
2000 37.65 OA 95W	

Prices correct 23-6-77. Please add VAT after P & P.

## TEST METERS

Item	Price
AVO 8 MK5	£68.95
AVO 71	£28.00
AVO 73	£37.80
AVO MINOR M5	£21.94
AVO TT169 in circuit	
Transistor Tester	£29.00
U4315 Inc. case	£14.95

## U4315 BUDGET METER

Item	Price
20K Ω/VDC 2K/VAC	
1000V AC/DC 2.5A AC/DC	
500K res. in robust steel case + lead etc.	
VAT 8% P & P £1.15	
AVO cases and accessories	

## BRIDGE RECTIFIERS

Item	Price
200V 2A	£0.45 0.29
400V 2A	£0.55 0.29
200V 4A	£0.65 0.29
400V 4A	£0.80 0.29
400V 6A	£1.05 0.29
500V 10A*	£2.35 0.29
VAT 12% *VAT 8%	

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Item	Price
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multiplug outlet	£5.95
3300 fits into 13A socket 6-7.5-9V	
300mA multiplug outlet	£3.30
RBE 3, 4-5, 6, 7-5, 9, 12V 500mA	
DC plug outlet	£5.32
VAT 12% P & P 55p	

## DECS SOLDERLESS BREAD-BOARDING

Item	Price
S Dec 70 contacts	£1.90
T Dec 208 contacts	£3.65
U Dec "A" for I.C.s etc	£3.99
U Dec "B" for I.C.s etc	£6.99
VAT 8% P & P 40p	

## ANTEX SOLDERING IRONS

Item	Price
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25W	£3.40 Stand £1.40
VAT 8% P & P 43p	

## TI MINI-MULTIMETER

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SX6M	£2.25
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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.



## SWITCH TRIGGER MATS

Wiring dig supplied for complete house protection—'Keep Those Robbers Away'.

13 x 10 £1-85, 24 x 18 £2-33



## CONTROL DRILL SPEEDS



## DRILL CONTROLLER

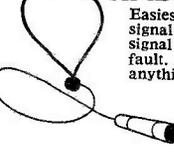
Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £3-45 including post & VAT. Made up model £1-00 extra.

## SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. £7-95 plus 95p VAT & Postage.



## RADIO STETHOSCOPE



Easiest way to fault find, traces, signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything. Complete kit comprises two special transistors and all parts including probe tube, twin stetho-set and instructions £3-95. VAT and postage incl.

## 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.



## MAINS RELAYS



With triple 10 amp changeover contacts—operating coil wound for 230 volts A.C. chassis mounting, one screw fixing, ex unused equipment 60p each, 10 for £5 post and VAT paid.

## BLACK LIGHT

As used in disco's and stage effects etc.—virtually no white light appear until rays impinge on white collars and cuffs etc—we offer mains B.L. lamps, 175 watts plus into any lamp holder requires no choke or control gear price £7-00 + 95p post and VAT or for glamorising rock specimens, looking for watermarks etc. a 9" 6 watt tube with starter, choke lamp holds, etc. all for £4-50 post and VAT paid.

## 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.



## 8 POWERFUL BATTERY MOTORS

For models, Meccano's, drills, remote control planes, boats, etc., etc. £2-00.



## ROTARY PUMP

Self priming, portable, fits drill or electric motor, pumps up to 200 gallons per hour depending upon revs. Virtually uncorrodable, use to suck water, oil, petrol, fertiliser, chemicals, anything liquid. Hose connectors each end. £2-00 Post Paid.

## THERMOSTATS



Room stat. Refrigeration as illustrated with 36" capillary £1-62. Limpet Stat must be mounted in close contact calibrated 90°-190°F 15 amp contacts £1-62. Appliance Stat fix like a volume control—15 amp contact 30°-80°F 85p. ditto but for high temps £1-25. Over Stat—with Serson and capillary 85p. Wall mounting £2-75.

## MAINS TRANSISTOR POWER PACK



Designed to operate transistor sets, and amplifiers full wave and half wave working—output adjustable from 45v to 15v up to 300mA—Kit with full constructional data £2-06

## MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Plessey speakers this should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £14-00 including VAT and postage.



## AMPLIFIER PANEL



6 photo sockets and d.p. changeover slide switch all mounted on insulating board. Glossy black finish size 2" x 8 1/2" approx.—silly price 35p, or £1 for six.

## THIS MONTH'S SNIP-BREAKDOWN PARCEL

four unused made for computer units containing most useful components, and these components unlike those from most computer panels, have wire ends of easily usable length. The transistors for instance have leads over 1" long, the diodes have approx. 3/4" 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 transistor or diodes alone). Don't miss this splendid offer.

## MAINS TRANSFORMER BARGAINS

20v 1/2 amp	£1-25
18v 1 amp	£1-55
6-3v 2 amp	£1-39
25v 1 1/2 amp	£1-75
24v 2 amp	£2-00
50v 2 amp	£4-50
9v 1 amp	£1-25
8-5v-0-8-5v 1/2 amp	£1-25
10v, 20v, 30v, 40v	
250 watt loading	£5-50
20 watt Auto 115v	£1-25
100 watt Auto 115v	£1-75



## REVOLUTION COUNTER

Famous Muirhead generator requires only a voltmeter connected to its terminals. Voltage is exactly 3v at 1000 + rpm. Higher or lower speeds give proportional volts, therefore the motor forms the basis of a useful general purpose revolution counter. £1-25.



## DELAY SWITCH

Mains operated—delay can be accurately set with pointers knob for periods of up to 2 1/2 hrs. 2 contacts suitable to switch 10 amps—second contact opens a few minutes after 1st contact. 95p.

## 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 Philips inverter for 12" 6 watt miniature tube for only £2-75 with tube and tube holders as well.

## TERMS:

Cash with order—but orders under £6 must add 50p to offset packing etc.

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(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.

Rigonda "Party Time" Stereo Record Players. A further batch has just arrived, but we have a lot of outstanding orders and so we urge you, if you want one, to call in or post your order right away. As with the first batch all are "returns under guarantee" or "service room rejects", but we guarantee them to be repairable, and will exchange any not so. Price is only £5-95 + 75p. Carriage £2-00 + 25p, this is of course less than the price of a turntable, so they are a very popular item, hence the urgency for ordering quickly.

Spares for Party Times. Circuit diagrams 50p, Cartridges £2-25, Record mats 85p, Mains transformers £3-00, Amplifiers £2-50, Gram motors £3-00.

Ask about any other spares you require and when you have it working o.k. we can supply the proper Party Time speakers, £9-50 a pair. All prices include post and V.A.T.

This Months Special Offer. All our stocks of 7-029 cable with earth wire have now been sold, but we still have some of the twin left—we are offering this at about half its trade price, namely £8-50 + 72p for 100 metres, also as an extra inducement to buy, during August and September, with every coil we will give free; 100 metres of single 1.5mm which you can use as the earth wire. If not collecting, please add £3-00 carriage.

250 watt Mains Transformer—40v secondary, made up of four 10v sections, all the ends of which are brought out to the tag panel, so they can be separated if required—also the 10v coils are all a very heavy gauge wire, thick enough to take 25 amps, so any one of these coils can be loaded up to the full 250 watts, or this wattage can be spread over two or more coils. We can recommend this transformer for heavy duty battery charging—high power amplifier—plastic sealing—soil heating—light welding and dozens of other jobs. Price, still only £4-50 + 36p. Post £1-50 + 12p.

Flex Bargain. 3 core of 14/0-006, modern coloured cores. White circular p.v.c. outer. A standard flex for appliances using up to 6 amps, or for extensions, leads etc. Special purchase enables us to offer this at £8-50 for 100mm coils (+ 68p). Post £1-50 + 12p.

Save Yourself A Fortune. Build your own rechargeable batteries; using our ex-Home Office nickel cadmium cells—these cells are German made, ref. NCB 22M, which we understand are 1/2 amp hour rating. Normally these cells retail at about £1-00 each, but a special purchase enables us to offer them at only 30p each, or four for £1-08. Post 30p + 3p.

Free Gift: all who purchase 12 cells, will receive, free of charge, a mains operated ni-cad charger unit. DON'T miss this offer. . . .

Self Repairing Fuses—not exactly; but our magnetic circuit breakers do the same job and are a boon for the test bench, saving valuable time. In the event of a short, they trip almost instantly, before the fuse can blow. They are rated at 1-5 amps (enough for the average repair bench). Simply wire it in parallel with your bench switch—you would then use the circuit breaker to switch bench supply on, but keep your normal switch for loads over 1-5 amps—a real bargain @ £1-00 + 8p.

9v-0-9v Mains Transformer. "C" core construction, 1/2 amp continuous rating. Very compact, but there is still room to add a few extra turns for an extra winding, or to change the voltage to, say, 20v. In fact, the transformer uses a separate bobbin for the secondary—its not varnished so if you want a special voltage transformer quickly, then this could be the answer. Price £1-50 + 12p. Post 20p + 2p.

6-5v-0-6-5v Mains Transformer. Continental make, but has standard 230/40v 50Hz primary and is upright mounting, and is rated at 0-75A. Price £1-75 + 14p. Post 20p + 2p.

15 Core Flex Cables: Coloured coded cores, rated at 3 amp, with circular p.v.c. outer—suitable for module inter-connections etc. 10 meter coil £1-00 + 8p.

Rotary Switch. Heavy duty—made for switching d.c., these will make and break really high a.c. currents. We guess these at 30 or more amp—we have type (A) cover engraved on-off. Price £1-00.—(B) cover engraved "on", "high", "off", "low". Six wires can be brought to the switch and would be joined as follows: 1 to 5 and 6 to 2 and in the other position, 1 to 3 and 2 to 4. Prices: (A) £1-00 + 8p. (B) £1-50 + 12p.

Motor with Fan Blades, mains operated, nicely made motor with long bearing for quiet operation and good quality set of fan blades, made by Smiths (air moving division). It is a simple matter to make a stand out of 14 gauge (clothes line) wire, you then have a simple but efficient desk fan. Or if you fit this behind a heating element, in a box, you have a fan heater. Price of motor and fan, £2-50 + 32p. Post 50p + 6p.

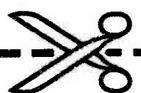
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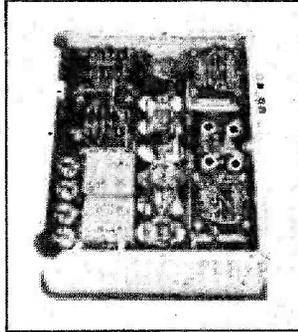
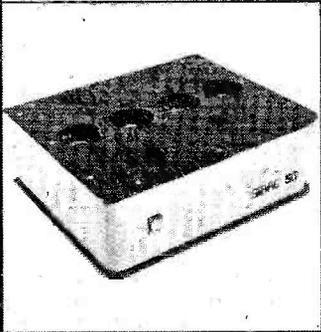
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# Sirac Mk1 Valve Amplifier

Circuit Diagrams  
Outline Drawings  
Exploded Views...



all you need to know for constructing Chris Rogers' outstanding new valve amplifier. Then compare the musicality for yourself with a transistor-type unit!

## Controversial Comparison

An evaluation of the new crop of moving-coil phono cartridges and their complementary voltage step-up devices. Among those tested are the Fidelity Research FR 3, Entré 1, Sony XL55, Ultimo 10A, and Nakamichi 1000, and 7 others.

## Win some Aiwa Super-fi

Another big competition, with the new Autumn range of Aiwa equipment to be won.

## Listening with Beyer

A special review of the Beyer infra-red headphone system.

## Amplifiers Examined

This series for the more technically-minded looks this month at the 'Pulse Width Modulation' philosophy. We also test Cambridge's P80 amplifier - and the new Meridien loudspeaker/power amplifier and pre-amplifier.

PRACTICAL  
**HI-FI & AUDIO**

November issue  
On sale Friday, October 14





### MINI CONSOLES

Ideal for small desk control panels and consoles. Moulded in orange, blue, black and grey ABS. Incorporates slots for holding 1.5mm thick pcb's. Aluminium panel sits recessed into front of console and held by screws running into integral brass bushes.

MC 161 x 96 x 58mm £1.53 (1-9) £1.50 (10+)  
MC 215 x 130 x 75mm £2.20 (1-9) £2.17 (10+)  
Add 25p per £1 order value for Post & Packing

### ECONOMY QUALITY LED's

50 for only £5 - 100 for only £9  
Mixed bags, all sizes, various colours

### FULL SPECIFICATION LED's

1.25" lens    1.6" lens    2" lens  
Red (specify size) 75p per pack  
Green, Yellow, Orange (specify size) £1.20 per pack  
(Each pack contains 5 LED's, Mounting Clips and Data)

### TYPE A NEON INDICATORS

Supplied with resistor for 240 Volts operation  
Held in 8mm hole by plastic bezel  
150mm wire leads

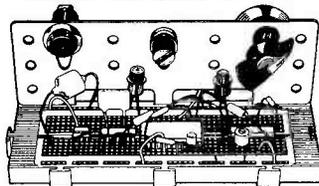
AA    AG    AH  
Red, Amber, Clear, Opal 19p each  
Green 28p each

### 12 VOLTS MINI HAND DRILL

Ideal for drilling pcb, chassis etc as well as model making. Supplied with 2 collets that accept tools and drills with 3/32" and .050" dia. shanks. £7.56 (Includes VAT & P.P.)



Stop wasting time soldering  
**The NEW MW BREADBOARD** accepts Transistors, LED's, Diodes, Resistors, Capacitors and all DIL packages with 6 to 40 pins



Includes slot-in Component Support Bracket and has over 400 individual sockets, plus Vcc and Ground Bus Strips  
Price £9.72 (includes VAT & P.P.)

### TYPE MP NEON INDICATOR

Supplied with resistor for 240 Volts operation  
150mm leads, held in 6.4mm hole by nut



Red, Amber, Clear, Opal 20p each

### SEVEN SEGMENT DISPLAYS

Economy Quality  
Common Anode - 0.3" - Left Decimal  
Red, Yellow and Green @ 45p each

Full Specification  
Common Anode - 0.3" - Left Decimal  
Red @ 98p each  
Green and Yellow @ £1.35 each  
(Data supplied with Full Spec. displays only)



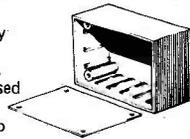
### Quantity quotations on request

P.P. Note Unless included in price add 25p Post & Packing for orders totalling under £10. All prices include VAT and are valid in UK only for 2 months from journal issue date

**Michael Williams Electronics**  
47 Vicarage Av. Cheadle Hulme, Cheshire SK8 7JP

### SC BOXES (square corners)

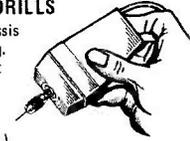
Easily drilled or punched, orange, blue, black and grey ABS. Incorporate slots for holding 1.5mm thick pcb's. Aluminium panel sits recessed into front of the box and held by screws running into integral brass bushes.



SC 85 x 56 x 35mm 80p (1-9) 77p (10+)  
SC 111 x 71 x 48mm £1.07 (1-9) £1.04 (10+)  
SC 161 x 96 x 59mm £1.49 (1-9) £1.46 (10+)  
Add 25p per £1 order value for Post & Packing

### 240 VOLTS MINI HAND DRILLS

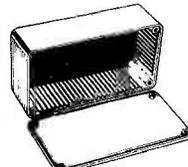
Ideal for drilling pcb's, chassis etc as well as model making. Supplied with 3 collets that accept tools and drills with 1mm, 2mm and 1/8" dia shanks.



£9.72 (includes VAT & P.P.)  
Accessory tools... 5 Burs, 1mm, 2mm, 1/8th Drills, 3/32" Collet Price £1.75 (Includes VAT & P.P.)

### RC BOXES (round corners)

Easily drilled or punched, orange, blue, black and grey ABS. Incorporate slots for holding 1.5mm thick pcb's. Close fitting flanged lids held by screws running into integral brass bushes.



RC 100 x 50 x 25mm 51p (1-9) 49p (10+)  
RC 112 x 62 x 31mm 59p (1-9) 52p (10+)  
RC 120 x 65 x 40mm 68p (1-9) 62p (10+)  
RC 150 x 80 x 50mm 77p (1-9) 74p (10+)  
RC 190 x 110 x 60mm £1.33 (1-9) £1.30 (10+)

### Polystyrene version

in grey only with no slots, no integral brass bushes  
RC(P) 112 x 61 x 31mm 35p (1-9) 32p (10+)  
Add 25p per £1 order value for Post & Packing

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**Slider Switches**, 2 pole make and break (or can be used as 1 pole change-over by linking the two centre pins), 4 for 50p.

**Smart Min. Rectangular Push to Make Switches**, black rectangular surround with white rectangular button, overall size 12 x 17mm, 3 for 50p.

### A NEW RANGE OF QUALITY BOXES & INSTRUMENT CASES.

Aluminium Boxes with Lids.

AB10	5 1/2 x 4 x 1 1/2	60p
AB13	6 x 4 x 2	80p
AB14	7 x 5 x 2 1/2	£1.00
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AB16	10 x 7 x 3	£1.50
AB17	10 x 4 1/2 x 3	£1.30
AB25	6 x 4 x 3	£1.00

### Vinyl Coated Instrument Cases

Light Blue tops and White lower sections. Very smart finish.

WB1	5 x 2 1/2 x 2 1/2	60p
WB2	6 x 4 1/2 x 2 1/2	£1.10
WB3	8 x 5 x 2	£1.60
WB4	9 x 5 1/2 x 2 1/2	£1.80
WB5	11 x 6 1/2 x 3	£2.00
WB6	11 x 7 1/2 x 3 1/2	£2.25
WB7	12 x 6 1/2 x 3 1/2	£2.60
WB853	8 x 5 1/2 x 3 1/2	£2.00

**MAGNETIC DEVICES PROGRAMMERS**. Contain 9 fully adjustable cams and 9 change over micro-switches (rated approx. 1A at 240VAC). Needs slow-motion motor to drive (not supplied). Ideal for disco lights, sequence switching, etc. ex equipment £11.50 each.

**CALIBRATOR XTALS** 100kHz + 1MHz in one 10-X can. £1.00 each.

**MAINS TRANSFORMERS**. Type 60/2. Mains input 200-210-220-230-240-250V a.c., output 0-20-40-60V at 2A. In Metal and Plastic case, approx. 71 x 41 x 4, fully fused (ideal for PSU) £3.00 each.

**MAINS TRANSFORMERS**. Type 15/300 240V input, 17V at 300mA output, £1.50 each.

**MAINS TRANSFORMERS**. Type 45/100, 240, 220, 110, 0-250V output, 45V at 100mA output, £1.50 each.

### RED LED's (Min. type) 5 for 40p.

**VIDICON SCAN COILS** (Transistor type, but no data) complete with vidicon base £6.50 each. Brand New.

### FULL RANGE OF BERNARDS/BABANI ELECTRONICS BOOKS IN STOCK. S.A.E. FOR LIST.

**NEW FOR THE VHF CONSTRUCTOR**. A range of tuned circuits on formers with slugs and screening cans. Frequencies quoted are approximate, and range can be greatly extended by using varying capacitors in parallel.

Type S (pin square, dummy type).  
Type SA 20 to 30MHz (when 33pF fitted in parallel).  
Type SB 35 to 50MHz (with link winding).  
Type SC 70 to 100MHz (with link winding).  
Type SD 135 to 175MHz (with link winding).  
Type M (Min. pin square types).  
Type MA 19 to 28MHz (when 33pF fitted in parallel).  
Type MB 22 to 32MHz (when 33pF fitted in parallel).  
Type MC 25 to 35MHz (when 33pF fitted in parallel).  
Type MD 38 to 50MHz (when 33pF fitted in parallel).  
Type ME 45 to 60MHz (when 33pF fitted in parallel).  
Type MF 100 to 200MHz (without slug) when 0 to 30pF variable fitted in parallel.  
All the above coils available in packs of five only (same type) at 50p per pack of 5.

**PLASTIC PROJECT BOXES** with screw on lids (in black ABS) with brass inserts.  
Type NB1 approx 3in. x 2 1/2in. x 1 1/2in. 40p each.  
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Type NB3 approx 4 1/2in. x 3 1/2in. x 1 1/2in. 60p each.

### MULLARD 85A2 85V STABILISER VALVES (Brand New) 70p each of 2 for £1.20.

T03 transistor insulator sets, 10 for 50p

BSX20 (VHF Osc/Mult), 3 for 50p.  
BC108 (metal can), 4 for 50p.  
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BFY51 Transistors, 4 for 60p.  
BCY72 Transistors, 4 for 50p  
PNP audio type T05 Transistors, 12 for 25p.  
BF152 (UHF amp/mixer), 3 for 50p.  
2N3819 Fet., 3 for 60p.  
BC148 NPN SILICON, 4 for 50p.  
BC158 PNP SILICON, 4 for 50p.  
BAV31 Signal Diodes, 10 for 35p.  
BA121 Varicap Diodes, 4 for 50p.

741CG op amps by RCA, 4 for £1.

**PERSPEX TUNER PANELS** (for FM Band 2 tuners) marked 88-108MHz and Channels 0-70, clear numbers, rest blacked out, smart modern appearance, size approx. 8 1/2in x 1 1/2in., 2 for 35p.

**PLUGS AND SOCKETS**  
N-Type Plugs 50 ohm, 60p each, 3 for £1.50.  
PL259 Plugs (PTFE), brand new, packed with reducers, 50p each.  
SO239 Sockets (PTFE), brand new (4-hole fixing type), 50p each.

**SOLDER SUCKERS** (Plunger type). Standard Model, £5. Skirted Model £5.50. Spare Nozzles 60p each.

**WELLER SOLDERING IRONS**  
**EXPERT**. Built-in spotlight illuminates work. Pistol grip with fingertip trigger. High efficiency copper soldering tip.  
**EXPERT SOLDER GUN 8100D £9.90**.  
**EXPERT SOLDER GUN KIT** (spare bits, case, etc.) £12.90.  
Spare bits 35p pair.

### NEW MARKSMAN RANGE OF SOLDERING IRONS.

S115D 15W 240V £3.80.  
S125D 25W 240V £3.80.  
S140D 40W 240V £4.20.  
S125D 25W 240V + bits etc., KIT £4.90.  
SPECIAL 12V version S125-12 25W 12V £3.80.  
**BENCH STAND** with spring and sponge for Marksman Irons £2.38.  
Spare bits MT5 (for 15W) 50p, MT5 (for 25W) 45p, MT10 (for 40W) 50p.  
**ALL PRICES + 8% VAT.**

### TCPC TEMPERATURE CONTROLLED IRON.

Temperature controlled iron and PSU. £30 + VAT (£2.40).  
**SPARE TIPS**  
Type CC single flat tip, Type K double flat fine tip, Type P, very fine tip, £1 each + VAT (8p).  
**MOST SPARES AVAILABLE.**

### MULTICORE SOLDER

Size 5 Savbit 18 s.w.g. in alloy dispenser, 32p + VAT (3p).  
Size CISA18 Savbit 18 s.w.g., 58p + VAT (4p).  
BAV31 Signal Diodes, 10 for 35p.  
BA121 Varicap Diodes, 4 for 50p.

**14 DIL REED RELAYS**, 5 to 12V DC, 450 ohm coil. Designed to work directly from TTL Logic. Single Pole Change over. Contact ratings 28V @ 3W. £1.75 each.

### A LARGE RANGE OF CAPACITORS AVAILABLE AT BARGAIN PRICES. S.A.E. FOR LIST.

**MIXED COMPONENT PACKS**, containing resistors, capacitors, etc. All new. Hundreds of items £2 per pack, while stocks last.

**ALU-SOL ALUMINIUM SOLDER** (made by Multicore). Solders aluminium to itself or copper, brass, steel, nickel or tinplate. 16 s.w.g. with multicore flux, with instructions. Approx. 1 metre coil 40p pack. Large reel £2.75.

**VARICAP TUNERS** Mullard type ELC1043/05. Brand New, £4.40 + 12 1/2% VAT.

**BARGAIN PACK OF LOW VOLTAGE ELECTROLYTIC CAPACITORS**. Up to 50V working. Seatronic Manufacture. Approx. 100. £1.50 per pack + 12 1/2% VAT.

**OSMOR REED RELAY COILS** (for reed relays up to pin dia., not supplied) 12V, 500 ohm coil, 2 for 50p.

We now stock Spiralax Tools for the electronic enthusiast. Screwdrivers, Nut spanners, BA and Metric sizes, pop rivet guns, etc. S.A.E. for list.

**TWIN I.F. CANS**, approx. 1in. x 1in. x 1in. high, around 3-5MHz, 2 separate transformers in 1 can, internally screened, 5 for 50p + 12 1/2% VAT.

DuBilier Electrolytics, 50uF, 450V, 2 for 50p.  
DuBilier Electrolytics, 100uF, 275V, 2 for 50p.  
Plessey Electrolytics, 470uF, 63V, 3 for 50p.  
TCC Electrolytics, 1000uF, 30V, 3 for 60p.

DuBilier Electrolytics, 5000uF, 35V, 50p each.  
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## NEWS FLASH

Lynx will be holding a seminar this autumn on microprocessors, microcomputers and their applications. There will be a free competition for system based on Z80. More details next month.

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20p



Diodes contd	
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BZY88 Series	0.51
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PIV	1A	3A	3A	4A	6A	8A	10A	16A
(TO5)	(ST-UD)	(C106)	(TO)	(TO)	(TO)	(TO)	(TO)	(TO)
200	0.35	0.50	0.45	0.40	0.58	0.60	0.68	1.14
400	0.40	0.60	0.50	0.45	0.87	0.88	0.98	1.40
600	0.65	0.85	0.70	—	1.09	1.19	1.26	1.80

BT106 £1.00, BT107 £1.60, BT108 £1.60, BT109 £1.00, BT116 £1.00, 2N3525 £0.50.

### TRIACS—Plastic TO-220 Package Isolated Tab

	4A	6.5A	8.5A	10A	15A	
	(a)	(b)	(a)	(b)	(a)	(b)
100V	0.60	0.60	0.70	0.70	0.78	0.83
200V	0.64	0.64	0.75	0.75	0.87	0.97
400V	0.77	0.78	0.80	0.83	0.97	1.13
600V	0.96	0.99	1.01	1.10	1.26	1.42

N.B.—(a) without internal diac. (b) with internal diac.

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7450	0.18	7451	0.18	7452	0.18	7453	0.18	7454	0.18	7455	0.18	7456	0.18	7457	0.18	7458	0.18	7459	0.18	7460	0.18	7461	0.18	7462	0.18	7463	0.18	7464	0.18	7465	0.18	7466	0.18	7467	0.18	7468	0.18	7469	0.18	7470	0.18	7471	0.18	7472	0.18	7473	0.18	7474	0.18	7475	0.18	7476	0.18	7477	0.18	7478	0.18	7479	0.18	7480	0.18
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BA157	0.22
BA158	0.12
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BYX36-600	0.12
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AC128	0.16	BC157	0.09*	BD137	0.40*	BFX85	0.25	OC70	0.30	2N3137	1.10	4009CE	0.20
AC128K	0.25	BC158	0.09*	BD138	0.48*	BFX87	0.20	OC72	0.22	2N3442	1.20	4009DE	0.20
AC141	0.22	BC159	0.09*	BD144	2.20	BFX88	0.20	OC84	0.40	2N3570	3.60	4009EE	0.20
AC141K	0.37	BC160	0.32	BD157	0.60	BFX89	0.20	OC139	1.30	2N3702	0.10*	4009FE	0.20
AC142	0.18	BC161	0.38	BD181	0.82	BFY11	1.10	OC140	1.30	2N3703	0.10*	4009GE	0.20
AC142K	0.32	BC168	0.09*	BD182	0.82	BFY18	0.50	OC170	0.23	2N3704	0.10*	4009HE	0.20
AC176	0.16	BC169	0.12*	BD182	0.82	BFY41	0.60	TIP29A	0.44*	2N3706	0.10*	4010BE	0.52
AC176K	0.32	BC169C	0.14*	BD183	0.87	BFY41	0.60	TIP30A	0.82*	2N3707	0.10*	4010CE	0.20
AC187	0.18	BC182	0.11*	BD184	1.20	BFY50	0.20	TIP41A	0.54	2N3708	0.09*	4010DE	0.20
AC187K	0.36	BC182L	0.12*	BD232	0.60	BFY51	0.18	TIP32A	0.64	2N3709	0.09*	4010EE	0.20
AC188	0.18	BC183	0.10*	BD233	0.48	BFY52	0.19	TIP41A	0.68	2N3710	0.10*	4010FE	0.20
AC188K	0.32	BC183L	0.10*	BD237	0.55	BFY53	0.25	TIP42A	0.72	2N3711	0.10*	4010GE	0.20
AD149	0.80	BC184	0.11*	BD238	0.60	BFY64	0.35	2N404	0.40	2N3715	1.70	4010HE	0.54
AD161	0.35	BC184L	0.12*	BD410	0.60	BFY90	0.90	2N696	0.20	2N3716	1.60	4010IE	1.10
AD182	0.35	BC185	0.20*	BDX32	2.30	BSX19	0.18	2N697	0.20	2N3717	1.60	4010JE	0.50
AF114	0.20	BC187	0.24*	BDY10	1.50	BSX20	0.18	2N706	0.15	2N3722	1.90	4020BE	1.12
AF115	0.20	BC207B	0.11*	BDY20	2.00	BSX21	0.20	2N1131	0.15	2N3723	1.20	4020CE	1.03
AF116	0.20	BC212	0.12*	BDY30	0.80	BSY52	0.28	2N1132	0.10	2N3819	0.28	4020DE	0.95
AF117	0.20	BC212L	0.12*	BDY80	0.60	BSY53	0.39	2N1302	0.40	2N4347	1.10	4020EE	0.95
AF124	0.25	BC213	0.12*	BDY90	0.60	BSY54	0.33	2N1303	0.40	2N4348	1.20	4020FE	0.95
AF125	0.25	BC213L	0.14*	BDY91	1.65	BSY55	0.74	2N1304	0.45	2N4370	0.35*	4020GE	0.95
AF126	0.25	BC214	0.14*	BDY92	1.15	BSY56	0.30	2N1305	0.45	2N4671	0.35*	4020HE	0.95
AF126	0.25	BC214L	0.15*	BDY95	2.14	BSY78	0.20	2N1306	0.45	2N4918	0.60*	4020IE	0.62
AF139	0.35	BC237	0.16*	BDY96	4.96	BSY78	0.20	2N1307	0.50	2N4919	0.70*	4020JE	0.91
AL239	0.37	BC238	0.16*	BF179	0.30	BSY95A	0.16	2N1308	0.60	2N4920	0.50*	4020KE	1.10
AL102	1.45	BC300	0.34	BF180	0.30	BU105	1.80*	2N1309	0.60	2N4922	0.58*	4030BE	0.55
AL103	1.30	BC301	0.32	BF181	0.30	BU105/02	1.90*	2N1711	0.24	2N4923	0.49*	4041BE	0.80
AL107	3.30*	BC302	0.40	BF182	0.30	BU108	3.00*	2N2102	0.44			4042BE	0.83
AL110	1.75*	BC303	0.46	BF183	0.30	BU109	2.25*	2N2217	0.10			4043BE	1.00
AL113	1.60*	BC304	0.46	BF184	0.20	BU128	1.60*	2N2369	0.34			4043CE	0.94
BC107	0.12	BCY30	0.55	BF185	0.20	BU133	1.60*	2N2394A	0.14			4046BE	1.52
BC107B	0.12	BCY31	0.55	BF186	0.10*	BU204	1.90*	2122A-6	3.60			4049BE	0.34
BC108	0.12	BCY32	0.60	BF187	0.12*	BU205	1.90*	2122A-4	4.75			4050BE	0.54
BC108B	0.12	BCY33	0.55	BF197	0.12*	BU206	2.40*	22646	0.50			4069BE	0.30
BC109	0.12	BCY34	0.55	BF261	0.70	BU208	2.60*	22711	0.20			4070BE	0.50
BC109B	0.12	BCY38	0.50	BF262	0.18*	MJ480	0.80	22712	0.15			4071BE	0.26
BC109C	0.15	BCY39	1.15	BF267	0.30	MJ481	1.05	22904A	-0.20			4072BE	0.25
BC117	0.19*	BCY40	0.75	BF336	0.35*	MJ481	1.05	22905A	0.18			4081BE	0.26
BC119	0.25	BCY42	0.30	BF337	0.32*	MJ491	1.15	22906	0.18			4082BE	0.26
BC125	0.18*	BCY54	1.90	BF338	0.45*	MJE340	0.40*	22925	0.14*			4510BE	1.42
BC128	0.19*	BCY70	0.12	BFW30	1.25	MJE520	0.45	22928	0.10*			4511BE	1.50
BC140	0.32	BCY71	0.18	BFW59	0.30	MJE521	0.55	22929	0.10*			4518BE	1.35
BC141	0.28	BCY72	0.12	BFW60	0.36	OC43	0.25	22929B	0.09*			4519BE	1.25
BC142	0.23	BD115	0.55	BFX29	0.28	OC44	0.32	22929G	0.10*			4520BE	1.20
BC143	0.23	BD131	0.36										

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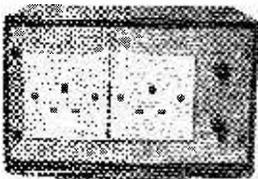
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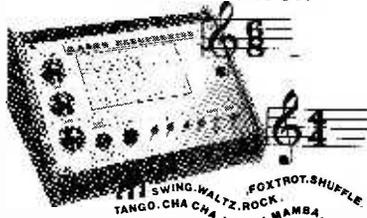
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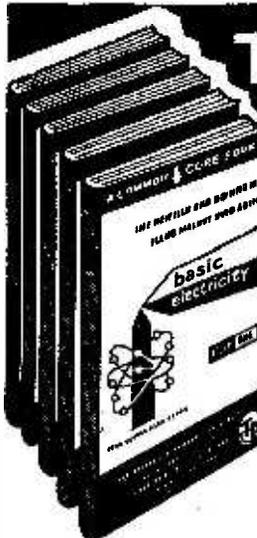
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OA9	8p	2A400V	53p	8A400V	160p
OA47	8p	2A800V	53p	10A500V	185p
OA79	12p	4A100V	65p	15A400V	200p
OA81	15p	4A200V	75p	15A500V	285p
OA85	12p	4A400V	79p	30A400V	350p
OA90	6p	4A600V	79p	30A400V	350p
OA91	6p	4A800V	79p	40A30V	99p
OA95	8p	4A100V	75p	40669	104p
OA200	8p	6A100V	75p	DIAC*	
OA202	8p	6A200V	75p	ST2	25p
IN914	4p	6A400V	85p	ZENERS	
IN916	5p	BY164	59p	Rng: 3V-33V	
IN4001/2*	5p	VM18	40p	400mW	75p
IN4003*	5p	VARICAPS		1-3W	17p
IN4004/5*	5p	MVAM2	135p	3A/100V*	18p
IN4006/7*	7p	MVAM115	95p	3A/400V*	27p
IN4148	4p	BB104	40p	3A/600V*	20p
IS44	20p	BB105B	40p	6A/100V	50p
3A/100V*	18p	BB106	40p	SCR's*	
3A/400V*	27p	Noise Diode		Thyristors	
3A/600V*	20p	Z5J	105p	1A50V	38p
6A/100V	50p	ALUM. BOXES		1A100V	42p
6A/600V	50p	3x3"	45p	1A200V	47p
6A/100V	50p	2 1/2 x 1 1/2"	64p	1A400V	53p
6A/600V	50p	4x4x1 1/2"	64p	1A600V	70p
3A50V	38p	4x2 1/2 x 1 1/2"	63p	3A100V	43p
3A100V	43p	4x2 1/2 x 1 1/2"	63p	3A200V	60p
3A200V	60p	4x2 1/2 x 1 1/2"	63p	3A400V	110p
3A400V	110p	4x2 1/2 x 1 1/2"	63p	3A600V	120p
3A600V	120p	4x2 1/2 x 2"	84p	5A400V	120p
5A400V	120p	5x4x2"	84p	7A400V	125p
7A400V	125p	NJHC 1	85p	8A400V	150p
8A400V	150p	NJHC 2	275p	BT106	150p
BT106	150p	NJHC 3	114p	C106D	55p
C106D	55p	VERO	142p	TIC44	25p
TIC44	25p	75 1239K	322p	TIC45	45p
TIC45	45p	1237J	215p	2N4444	191p
2N4444	191p	1238D	269p		
		1798K	399p		

OPTO ELECTRONICS*		7 Segment Displays	
LED5 + Clip	13p	5-LT-01 Futaba	460p
TIL209 Red	13p	TIL312-3" C.An	23p
TIL211 Grn	23p	TIL313 3" C.Cth	125p
TIL212 Yellow	27p	TIL321 5" C.A.An	130p
0-2" Red	17p	TIL322 5" C.Cth	130p
0-2" Yellow, Grn, Amber	21p	DL704 3" C.Cth	99p
OC70	40p	DL707 3" C.Anod	99p
ORP12	53p	DL747 6" An	180p
2N5777	53p	FND357	149p
ISOLATORS		XAN351 3" Green	225p
TIL111/2	105p	XAN625 6" Green	225p
TIL114	110p	MINITRON 3015F	240p
TIL117	110p	DRIVERS	
		75491/75492	85p

VOLTAGE REGULATORS*		PLASTIC CASE	
723 DIL	45p	78L82A VC 1A 8V	51p
TBA625B	95p	LM320-12	150p
TO3 Can Type		MC7805 1A 5V	115p
1A 5V	170p	MC7812 1A 12V	115p
1A 12V	180p	MC7815 1A 15V	120p
1A 15V	190p	MC7818 1A 18V	125p
1A 18V	210p	FTN24 1A 24V	130p
LM309K	150p	Variable Type	
LM323K	62p	LM325N ± 15V	240p
MVR5	180p	LM326N ± 12V	240p
MVR12	180p	LM327N ± 5 -12	260p
1A 5V	220p	LM317K 20W 1.5A	350p
1A -12V	220p	+ 1.2V to 37V	

SWITCHES*		SLIDE 250V	
TOGGLE 2A 250V	250p	1A DP	14p
SPST	29p	1A DP CO	16p
DPST	31p	1A DP	13p
DPDT	35p	4 pole 2-way	24p
4 pole on off	50p	PUSH BUTTON	
SUB-MIN TOGGLE		Spring loaded	
SP changeover	59p	SPST on off	55p
SPST on off	54p	SPDT C over	65p
SPST biased	85p	DPDT 6 Tag	85p
DPDT 6 tags	78p	FOOT SWITCH	
DPDT C/OFF	92p	Bulgin DPDT	
DPDT Biased	115p	Unmounted	180p

SWITCHES* PUSH BUTTON:	
Miniature Non Locking	
Push to Make 15p	Push to Break 25p
ROCKER (white): 10A 250V	28p
SP changeover centre off	23p
ROCKER: (black) on/off 10A 250V	23p
ROCKER: Illuminated (white)	52p
lights when on: 3A 240V	
ROTARY: (Adjustable Stop)	
1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way	41p
ROTARY: Mains 250V AC, 4 Amp	42p
KNOBS* fit 1/2" shaft with grub screws, except K2 (push fit) & K8 (for sliders).	
K1 Black or White pointer type	9p
K4 Black serrated. Metal top with line indicator 33mm diam.	22p
K4A As above but 25mm diam.	20p
K5 Black fluted metal top and skirt calibrated 0-10, 37mm diam.	26p
K6 PK2 as K5, pointer on skirt	26p
K7 Black, knurled, tapered. Metal top & skirt. Calif. 0-10, 30mm	25p
K8 Black or silvered for slider pot	10p
K10 Solid Aluminium, Amplifier Knob, Professional type with etch line indicator, tapered 18.5 x 17mm diam.	30p
K15 Black plastic ribbed body, white indicator line, 18mm diam., tapered coloured insert tops, Red, Blue, Yellow 19mm height.	16p
K16 As above but 23mm diam	20p

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	Screened chrome	Plastic body	Open metal	Moulded with break contacts	0-1 (copper clad)	0-15 (plain)
2-5mm	12p	8p	8p	2 1/2 x 3 1/2"	36p	28p
3-5mm	15p	10p	8p	2 1/2 x 5"	43p	39p
MONO	23p	15p	13p	3 1/2 x 3 1/2"	43p	40p
STEREO	31p	18p	15p	3 1/2 x 5"	48p	53p
				2 1/2 x 17"	134p	107p
				3 1/2 x 17"	173p	143p
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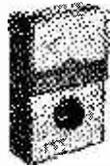


TYPE	U4312	U4313	U4315
Sensitivity D.C.	667 o.p.v.	20,000 o.p.v.	20,000 o.p.v.
Sensitivity A.C.	667 o.p.v.	2,000 o.p.v.	2,000 o.p.v.
D.C. Current	300 $\mu$ A-6A	60 $\mu$ A-1.5A	50 $\mu$ A-2.5A
A.C. Current	1.5mA-6A	0.6mA-1.5A	0.5mA-2.5A
D.C. Volts	75mV-900V	75mV-600V	75mV-1000V
A.C. Volts	300mV-900V	15V-600V	1V-1000V
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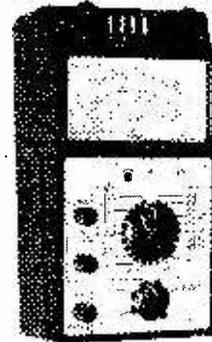
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D.C. Voltage:	0.6-1.2-3-12-30-60-120-600-1200V
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 3300 $\Omega$ /V A.C.  
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 0.6-60-600mA  
 A.C. current 0.3-3-30-  
 300mA  
 D.C. Voltage: 0.3-1.5-  
 6-30-60-150-300-  
 900V  
 A.C. Voltage: 1.5-7.5-  
 30-150-300-750V  
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 Transistor collector  
 cut-off current 60 $\mu$ A  
 Transistor D.C. cur-  
 rent gain in two  
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 current gain  
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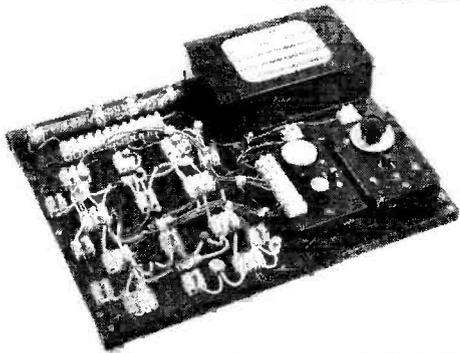
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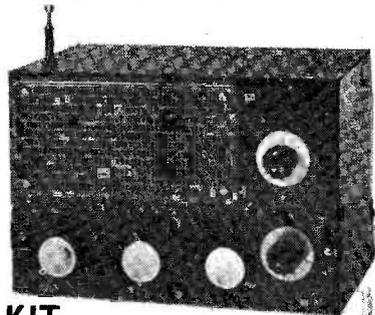
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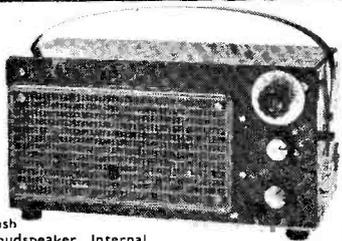
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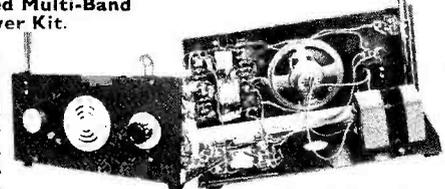


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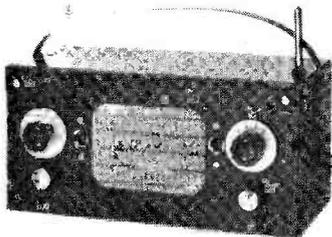
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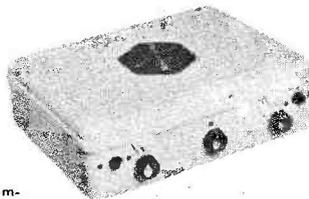
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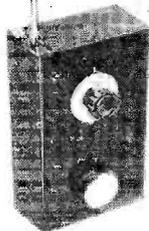


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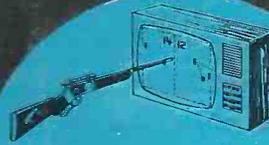
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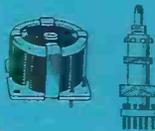


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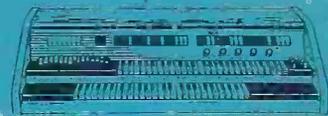
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