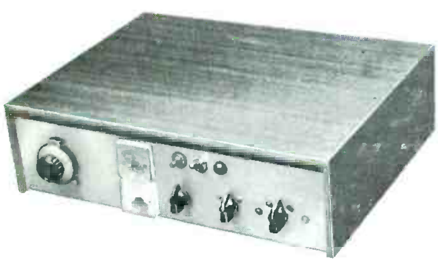
RADIO & ELECTRONICS CONSTRUCTOR

Vol. 26 No. 4 NOVEMBER 1972 20p

FEATURE 1

THE 'S·A·JUNIOR' PORTABLE RECEIVER



FEATURE 2

THE 'WYVERN' 160m SOLIDSTATE TRANSMITTER

ALSO FEATURED

LOW VOLTAGE TIMER

Each £3 unit of Home Unit Insurance gives you protection up to the limit shown

This is the simplified insurance you have been waiting for. Not just cover on the contents of your home but a package of personal protection you and your family need. And it's how we save you so much money: just ONE policy to issue instead of nine!
You can build up to the cover you need by additional units (or ½ units after the first) up to a maximum of five. So simple. So easy. Apply to your Broker, Agent or local office of a General Accident company.
The Home Unit Policy can replace your existing insurances. And remember – as you buy more possessions just add more Home Units at any time.

THE GENERAL ACCIDENT FIRE & LIFE ASSURANCE CORPORATION LTD

Metropolitan House, 35 Victoria Avenue,
Southend-on-Sea, Essex, SS2 6BT

It pays to be protected by a General Accident company

Please send me further particulars of the Home Unit Insurance.

Name ....

Address ....

....

....

5304

COMPONENTS

HOBBYIST - AMATEUR - DOMESTIC SURPLUS - INDUSTRIAL - BULK OFFERS

JUST A FEW OF OUR BARGAINS ARE LISTED BELOW - PAY US A VISIT OR SEND STAMPED ADDRESSED ENVELOPE FOR A QUOTE ON YOUR REQUIREMENTS

SEMICONDUCTORS

Full spec. marked by Mullard, etc. Many other types in stock

AF116	15p
AC127	12p
AC188	22p
AD149	30p
AD161	30p
AD162	30p
Matched pair	50p
BCY40	45p
BFY52	10p
ORP12	43p
2N3055	40p
2N2401	15p
Centercel Diodes 6–110 volt, 0.6 amp. nominal bridge rect. encapsulated with built in Heat Sink	5p
	15p
T.O.3 Mica washers	2p

UNMARKED TESTED

BY127	8p
BC179	10p
2N2926	5p

$1\frac{1}{4}$ glass fuses— 250 m/a or 3 amp (box of 12)	6p
3″ tape spools	4p
FX2236 Ferrox Cores	5p
PVC or metal clip on M.E.S. bulb holder	3p
All metal equipment Phono plug	2p
Bulgin, 5mm Jack plug and switched socket (pair)	20p
12 volt solenoid and plunger	25p
250 RPM 50 c/s locked frequency miniature mains motor	50p
200 OHM coil, $1\frac{1}{4}$″ long, hollow centre	10p
Relay, P.O. 3000 type, 1,000 OHM coil, 4 pole c/o	60p
R.S. 12 way standard plug and shell	50p

SWITCHES

Pole	Way	Type	
4	2	Sub. Min. Slide	10p
6	4	Wafer Rotary	12p each
1	11	Wafer Rotary	12p each
4	3	Wafer Rotary	12p each
3	7	Wafer Rotary	12p each
2	5	Wafer Rotary	12p each
1	3	+ off Sub. min. edge	10p
1	3	13 amp small rotary	12p
2	2	Locking with 2 to 3 keys	£1.50
2	1	2 Amp 250V A.C. rotary	20p

RESISTORS

$\frac{1}{8}$ $\frac{1}{4}$ $\frac{1}{2}$ watt	1p
1 watt	$1\frac{1}{2}$p
Up to 10 watt wire	8p
15 watt wire wound	10p

SKELETON PRESETS

5K or 500K 3p

SAFETY PINS

Standard size, 10 for 4p

VALVES – NEW AND BOXED

DY86	44p	EM87	90p	PL84	46p
EB91	26p	EL84	36p	PY81	40p
ECC82	36p	EY86	46p	PY82	42p
ECC83	36p	EZ80	30p	PY88	52p
ECH81	44p	PCC84	50p	UABC80	58p
EABC80	46p	PCC89	62p	UCL82	50p
EBF89	44p	PCF80	38p	UL84	50p
ECL82	44p	PCF82	50p	UY85	42p
ECL86	56p	PCL82	38p	UM84	32p
EF80	36p	PCL84	50p	UCH81	44p
EF85	44p	PCL85	64p	6BA6	26p
EF86	44p	PCL86	56p		
EF91	52p	PL36	78p	MANY OTHERS	
EF183	40p	PL81	72p		
EF184	44p	PL83	56p		

RESETTABLE COUNTER

English Numbering Machines LTD. MODEL 4436-159-989

6–14 volt, 6 digit, illuminated, fully enclosed. £2.50

DIE CAST ALLY BOX

$4\frac{5}{8} \times 3\frac{5}{8} \times 2\frac{1}{8}$ with lid 50p

5K switched volume control	15p
5K Log Pot	10p
1meg Tandem Pot	15p

BSR TD2 TAPE TRANSPORTER

With record-playback-erase heads £2.50

STEEL BOX WITH LID

$10 \times 5\frac{1}{2} \times 3$″ grey hammer finish £1

RELAY

6 volt, 2 pole c/o heavy duty contacts 50p

ELECTROLYTICS

Mullard C426, TCC, CRL, CCL, HUNTS, STC SUB MINIATURE, ETC.

MFD	Volt	
16	50	5p each
260	12	5p each
50	50	5p each
100	18	5p each
125	10	5p each
8	50	5p each
12	20	5p each
10	20	5p each
8.2	20	5p each
50	25	5p each
2.5	64	5p each
25	25	5p each

MFD	Volt	
20	12	4p each
500	6	4p each
100	25	
100	6	
6	3	2p each
8	6	2p each
25	6.4	3p
250	18	7p
400	16	6p
400	40	10p
8	500	9p
100	200	10p

CONDENSERS

MFD	Volt	
0.005	500	2p each
0.001	1,250	2p each
3.3PF	500	2p each
500 PF	500	2p each
2,200PF	500	2p each
3,300PF	500	2p each
0.1	350	3p each
0.1	500	3p each
0.25	150	3p each
0.056	5% 350V	3p each
0.061	5% 350V	3p each
0.066	5% 350V	3p each
0.069	5% 350V	3p each
0.075	5% 350V	3p each
0.08	5% 350V	3p each
0.1	1,500	4p each
0.25	350	4p each
0.5	350	5p
0.22	250	5p
0.25	500	5p

TUNING GANG

100PF, 50PF, 33PF 20p each

TRIMMERS

30 PF Beehive, 12PF P.T.F.E., 2,500PF 750V 10p each

WIREWOUND SLIDER

150 OHM, 250 OHM 5K 4p each

INDICATORS

12 volt red or mains neon amber, push fit round, chrome bezel 15p each

Rotor with neon indicator, as used in Seafarer, Pacific, Fairway depth finders 20p each

WIREWOUND POTS

250, 350 OHM, 1K, 4 watt, 10K, 20K, 50K, all at 10p each

RECORD PLAYER CARTRIDGE

ER.5XME Mono, with turn over stylii, single hole fixing 35p

GREEN INDICATOR

Takes M.E.S bulb 10p

CONNECTOR STRIP

Belling Lee L1469, 12 way polythene. 5p each

CAN CLIPS

1″ or $1\frac{3}{8}$″ or $\frac{3}{4}$″ 2p

T.O.5 HEATSINKS

Style 154 high conductivity 5p

PAXOLINE

$2\frac{3}{8} \times 4\frac{3}{4} \times \frac{1}{16}$″ or $3 \times 2\frac{1}{2} \times \frac{1}{16}$″	2p
$4\frac{3}{8} \times \frac{1}{2} \times \frac{1}{8}$″	2 for 1p
220K 3 watt resistors	2p

VALVE RETAINER CLIP, adjustable 2p

OUTPUT TRANSFORMERS

Sub-miniature Transistor Type 20p

THE RADIO SHACK

161 ST. JOHNS HILL, BATTERSEA, LONDON S.W.11

Open 10 a.m. till 8 p.m. Monday to Saturday **Phone 01-223 5016**

SMALL ORDERS, ENCLOSE SUITABLE STAMPED ADDRESSED ENVELOPE

LARGE ORDERS, ADD SUFFICIENT FOR POSTAGE, INSURANCE, ETC.

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

BRAND NEW FULLY GUARANTEED DEVICES

AC 107	20p	AD 149	50p	BC 143	30p	BD 131	50p	BF 179	30p	C 444	35p	2G 301	19p		
AC 113	20p	AD 161	33p	BC 145	45p	BD 132	60p	BF 180	30p	C 450	22p	2G 302	19p		
AC 115	23p	AD 162	33p	BC 147	10p	BD 133	65p	BF 181	30p	MAT 100	19p	2G 303	19p		
AC 117K	20p	AD 161 and		BC 148	10p	BD 135	40p	BF 182	40p	MAT 101	20p	2G 304	24p		
AC 122	12p	AD 162(MP)	55p	BC 149	12p	BD 136	40p	BF 183	40p	MAT 120	19p	2G 306	40p		
AC 125	17p	ADT 140	50p	BC 150	18p	BD 137	45p	BF 184	25p	MAT 121	20p	2G 308	35p		
AC 126	17p	AF 114	24p	BC 151	20p	BD 138	50p	BF 185	30p	MPF 102	42p	2G 309	35p		
AC 127	17p	AF 115	24p	BC 152	17p	BD 139	55p	BF 188	40p	MPF 104	37p	2G 339	20p		
AC 128	17p	AF 116	24p	BC 153	28p	BD 140	60p	BF 194	12p	MPF 105	37p	2G 339A	16p		
AC 132	14p	AF 117	24p	BC 154	30p	BD 155	80p	BF 195	12p	OC 19	35p	2G 344	18p		
AC 134	14p	AF 118	35p	BC 157	18p	BD 175	60p	BF 196	14p	OC 20	63p	2G 345	16p		
AC 137	14p	AF 124	30p	BC 158	12p	BD 176	60p	BF 197	14p	OC 22	38p	2G 371	16p		
AC 141	14p	AF 125	25p	BC 159	12p	BD 177	65p	BF 200	45p	OC 23	42p	2G 371B	12p		
AC 141K	17p	AF 126	28p	BC 160	45p	BD 178	65p	BF 222	95p	OC 24	56p	2G 373	17p		
AC 142	14p	AF 127	28p	BC 161	50p	BD 179	70p	BF 257	45p	OC 25	38p	2G 374	17p		
AC 142K	17p	AF 139	30p	BC 167	12p	BD 180	70p	BF 258	60p	OC 26	25p	2G 377	30p		
AC 151	15p	AF 178	50p	BC 168	12p	BD 185	65p	BF 259	85p	OC 28	50p	2G 378	16p		
AC 154	20p	AF 179	50p	BC 169	12p	BD 186	65p	BF 262	55p	OC 29	50p	2G 381	16p		
AC 155	20p	AF 180	50p	BC 170	12p	BD 187	70p	BF 263	55p	OC 35	42p	2G 382	16p		
AC 156	20p	AF 181	45p	BC 171	14p	BD 188	70p	BF 270	35p	OC 36	50p	2G 401	30p		
AC 157	24p	AF 186	45p	BC 172	14p	BD 189	75p	BF 271	30p	OC 41	20p	2G 414	30p		
AC 165	20p	AF 239	37p	BC 173	14p	BD 190	75p	BF 272	80p	OC 42	24p	2G 417	25p		
AC 166	20p	AL 102	65p	BC 174	14p	BD 195	85p	BF 273	35p	OC 44	15p	2N 388	35p		
AC 167	20p	AL 103	65p	BC 175	22p	BD 196	85p	BF 274	35p	OC 45	12p	2N 388A	55p		
AC 168	24p	ASY 26	25p	BC 177	19p	BD 197	90p	BFW 10	60p	OC 70	10p	2N 404	20p		
AC 169	14p	ASY 27	30p	BC 178	19p	BD 198	90p	BFX 29	27p	OC 71	10p	2N 404A	28p		
AC 176	20p	ASY 28	25p	BC 179	19p	BD 199	95p	BFX 84	22p	OC 72	14p	2N 524	42p		
AC 177	24p	ASY 29	25p	BC 180	24p	BD 200	95p	BFX 85	30p	OC 74	14p	2N 527	49p		
AC 178	28p	ASY 50	25p	BC 181	24p	BD 205	80p	BFX 86	22p	OC 75	15p	2N 598	42p		
AC 179	28p	ASY 51	25p	BC 182	10p	BD 206	80p	BFX 87	24p	OC 76	15p	2N 599	45p		
AC 180	17p	ASY 52	25p	BC 182L	10p	BD 207	95p	BFX 88	22p	OC 77	25p	2N 696	12p		
AC 180K	20p	ASY 54	25p	BC 183	10p	BD 208	95p	BFY 50	20p	OC 81	15p	2N 697	13p		
AC 181	17p	ASY 55	25p	BC 183L	10p	BDY 20	£1.00	BFY 51	20p	OC 81D	15p	2N 698	24p		
AC 181K	20p	ASY 56	25p	BC 184	12p	BF 115	24p	BFY 52	20p	OC 82	15p	2N 699	35p		
AC 187	22p	ASY 57	25p	BC 184L	12p	BF 117	45p	BFY 53	17p	OC 82D	15p	2N 706	8p		
AC 187K	20p	ASY 58	25p	BC 186	28p	BF 118	70p	BPX 25	85p	OC 83	20p	2N 706A	9p		
AC 188	22p	ASZ 21	40p	BC 187	28p	BF 119	70p	BSX 19	15p	OC 84	20p	2N 708	12p		
AC 188K	20p	BC 107	9p	BC 207	11p	BF 121	45p	BSX 20	15p	OC 139	20p	2N 711	30p		
ACY 17	25p	BC 108	9p	BC 208	11p	BF 123	50p	BSY 25	15p	OC 140	20p	2N 717	35p		
ACY 18	20p	BC 109	10p	BC 209	12p	BF 125	45p	BSY 26	15p	OC 169	25p	2N 718	24p		
ACY 19	20p	BC 113	10p	BC 212L	11p	BF 127	50p	BSY 27	15p	OC 170	25p	2N 718A	50p		
ACY 20	20p	BC 114	15p	BC 213L	11p	BF 152	55p	BSY 28	15p	OC 171	25p	2N 726	28p		
ACY 21	20p	BC 115	15p	BC 214L	14p	BF 153	45p	BSY 29	15p	OC 200	25p	2N 727	28p		
ACY 22	16p	BC 116	15p	BC 225	25p	BF 154	45p	BSY 38	18p	OC 201	28p	2N 743	20p		
ACY 27	18p	BC 117	15p	BC 226	35p	BF 155	70p	BSY 39	18p	OC 202	28p	2N 744	20p		
ACY 28	19p	BC 118	10p	BCY 30	24p	BF 156	48p	BSY 40	28p	OC 203	25p	2N 914	14p		
ACY 29	35p	BC 119	30p	BCY 31	26p	BF 157	55p	BSY 41	28p	OC 204	25p	2N 918	30p		
ACY 30	28p	BC 120	80p	BCY 32	30p	BF 158	55p	BSY 95	12p	OC 205	35p	2N 929	21p		
ACY 31	28p	BC 125	12p	BCY 33	22p	BF 159	60p	BSY 95A	12p	OC 309	40p	2N 930	21p		
ACY 34	21p	BC 126	18p	BCY 34	25p	BF 160	40p	Bu 105	£2.00	P 346A	20p	2N 1131	20p		
ACY 35	21p	BC 132	12p	BCY 70	14p	BF 162	40p	C 111E	50p	P 397	42p	2N 1132	22p		
ACY 36	28p	BC 134	18p	BCY 71	18p	BF 163	40p	C 400	30p	OCP 71	43p	2N 1302	14p		
ACY 40	17p	BC 135	12p	BCY 72	14p	BF 164	40p	C 407	25p	ORP 12	43p	2N 1303	14p		
ACY 41	18p	BC 136	15p	BCZ 10	20p	BF 165	40p	C 424	20p	ORP 60	40p	2N 1304	17p		
ACY 44	35p	BC 137	15p	BCZ 11	25p	BF 167	22p	C 425	50p	ORP 61	40p	2N 1305	17p		
AD 130	38p	BC 139	40p	BCZ 12	25p	BF 173	22p	C 426	35p	ST 140	12p	2N 1306	21p		
AD 140	48p	BC 140	30p	BD 121	60p	BF 176	35p	C 428	20p	ST 141	17p	2N 1307	21p		
AD 142	48p	BC 141	30p	BD 123	65p	BF 177	35p	C 441	30p	TIS 43	30p	2N 1308	23p		
AD 143	38p	BC 142	30p	BD 124	60p	BF 178	30p	C 442	30p	UT 46	27p	2N 1309	23p		

2N 1613	20p	2N 2926(R)	10p	2N 3906	27p		
2N 1711	20p	2N 2926(B)	10p	2N 4058	12p		
2N 1889	32p	2N 3010	70p	2N 4059	10p		
2N 1890	45p	2N 3011	14p	2N 4060	12p		
2N 1893	37p	2N 3053	17p	2N 4061	12p		
2N 2147	72p	2N 3054	46p	2N 4062	12p		
2N 2148	57p	2N 3055	50p	2N 4284	17p		
2N 2160	60p	2N 3391	14p	2N 4285	17p		
2N 2192	35p	2N 3391A	16p	2N 4286	17p		
2N 2193	35p	2N 3392	14p	2N 4287	17p		
2N 2194	35p	2N 3395	14p	2N 4288	17p		
2N 2217	22p	2N 3394	14p	2N 4289	17p		
2N 2218	20p	2N 3395	17p	2N 4290	17p		
2N 2219	20p	2N 3402	21p	2N 4291	17p		
2N 2220	22p	2N 3403	21p	2N 4292	17p		
2N 2221	20p	2N 3404	28p	2N 4293	17p		
2N 2222	20p	2N 3405	42p	2N 5172	12p		
2N 2368	17p	2N 3414	15p	2N 5457	32p		
2N 2369	14p	2N 3415	15p	2N 5458	32p		
2N 2369A	14p	2N 3416	28p	2N 5459	40p		
2N 2411	24p	2N 3417	28p	2S 301	50p		
2N 2412	24p	2N 3525	75p	2S 302A	42p		
2N 2646	47p	2N 3646	9p	2S 302	42p		
2N 2711	21p	2N 3702	10p	2S 303	55p		
2N 2712	21p	2N 3703	10p	2S 304	70p		
2N 2714	21p	2N 3704	11p	2S 305	84p		
2N 2904	17p	2N 3705	10p	2S 306	84p		
2N 2904A	21p	2N 3706	9p	2S 307	84p		
2N 2905	21p	2N 3707	11p	2S 321	56p		
2N 2905A	21p	2N 3708	7p	2S 322	42p		
2N 2906	15p	2N 3709	9p	2S 322A	42p		
2N 2906A	18p	2N 3710	9p	2S 323	56p		
2N 2907	20p	2N 3711	9p	2S 324	70p		
2N 2907A	22p	2N 3819	28p	2S 325	70p		
2N 2923	14p	2N 3820	50p	2S 326	70p		
2N 2924	14p	2N 3821	35p	2S 327	70p		
2N 2925	14p	2N 3823	28p	2S 701	42p		
2N 2926(G)	12p	2N 3903	28p	40361	40p		
2N 2926(Y)	11p	2N 3904	30p	40362	45p		
2N 2926(O)	10p	2N 3905	28p				

DIODES & RECTIFIERS

AA 119	8p	BY 130	16p	OA 47	7p
AA 120	8p	BY 133	21p	OA 70	7p
AA 129	8p	BY 164	50p	OA 79	7p
AAY 30	9p	BYX 38/30	42p	OA 81	7p
AAZ 13	10p	BYZ 10	35p	OA 85	9p
BA 100	10p	BYZ 11	30p	OA 90	6p
BA 116	21p	BYZ 12	30p	OA 91	6p
BA 126	22p	BYZ 13	25p	OA 95	7p
BA 148	14p	BYZ 16	40p	OA 200	6p
BA 154	12p	BYZ 17	35p	OA 202	7p
BA 155	14p	BYZ 18	35p	SD 10	5p
BA 156	13p	BYZ 19	28p	SD 19	5p
BY 100	15p	CG 62		IN 34	7p
BY 101	12p	(Eq) OA 91	5p	IN 34A	7p
BY 105	17p	CG 651 (Eq)		IN 914	6p
BY 114	12p	OA 70–OA79	6p	IN 916	6p
BY 126	14p	OA 5	35p	IN 414B	6p
BY 127	15p	OA 5SL	21p	IS 021	10p
BY 128	15p	OA 10	35p	IS 951	6p

Cut these 3 pages out and keep for reference

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C 1	250	Resistors mixed values approx. count by weight	0.50
C 2	200	Capacitors mixed values approx. count by weight	0.50
C 3	50	Precision Resistors .1%, .01% mixed values	0.50
C 4	75	⅛th W Resistors mixed preferred values	0.50
C 5	5	Pieces assorted Ferrite Rods	0.50
C 6	2	Tuning Gangs, MW/LW VHF	0.50
C 7	1	Pack Wire 50 meters assorted colours	0.50
C 8	10	Reed Switches	0.50
C 9	3	Micro Switches	0.50
C10	15	Assorted Pots & Pre-Sets	0.50
C11	5	Jack Sockets 3—3.5m 2 — Standard Switch Types	0.50
C12	40	Paper Condensers preferred types mixed values	0.50
C13	20	Electrolytics Trans. types	0.50
C14	1	Pack assorted Hardware – Nuts/Bolts, Gromets, etc.	0.50
C15	4	Mains Toggle Switches, 2 Amp D/P	0.50
C16	20	Assorted Tag Strips & Panels	0.50
C17	10	Assorted Control Knobs	0.50
C18	4	Rotary Wave Change Switches	0.50
C19	3	Relays 6 – 24V Operating	0.50
C20	4	Sheets Copper Laminate approx. 10″×7″	0.50

Please add 10p post and packing on all component packs, plus a further 10p on pack Nos. C1, C2, C19, C20. Component Lists for mail order available on request.

JUMBO COMPONENT PAKS

MIXED ELECTRONIC COMPONENTS
Exceptionally good value

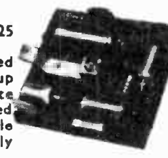
Resistors, capacitors, pots, electrolytics and coils plus many other useful items. Approximately 3lbs in weight. Price incl. P. & P. £1.50 only

BRAND NEW POST OFFICE TYPE TELEPHONE DIALS

ONLY 35p each

THE NEW S.G.S. EA 1000 AUDIO AMP MODULE Guar. 3 Watts RMS.

Module Tested and Guaranteed.



Qty. 1—9 £2.63; 10—25 £2.28. Price each. Larger quantities quoted on request. Full hook-up diagrams and complete technical data supplied free with each module or available separately at 10p each.

SYSTEM 12 STEREO

Each kit contains two amplifier modules, 3 Watts RMS, two loudspeakers, 15 OHMS, The pre-amplifier, transformer, power supply module, front panel and other accessories as well as an illustrated stage-by-stage instruction booklet designed for the beginner. Further details available on request.

ONLY £16.95 FREE P & P

NOW-TURN OVER FOR MORE FANTASTIC OFFERS

The largest selection

NEW LOW PRICE TESTED S.C.R.'S.

PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0.23	0.25	0.35	0.35	0.47	0.50	0.53	£1.15
100	0.25	0.33	0.47	0.47	0.50	0.58	0.63	£1.40
200	0.35	0.37	0.49	0.49	0.57	0.61	0.75	£1.60
400	0.43	0.47	0.56	0.56	0.67	0.75	0.93	£1.75
600	0.53	0.57	0.68	0.68	0.77	0.97	£1.25	—
800	0.63	0.70	0.80	0.80	0.90	£1.20	£1.50	£4.00

SILICON RECTIFIERS—TESTED

PIV	300mA £p	750mA £p	1A £p	1.5A £p	3A £p	10A £p	30A £p
50	0.04	0.05	0.05	0.07	0.14	0.21	0.60
100	0.04	0.06	0.05	0.13	0.16	0.23	0.75
200	0.05	0.09	0.06	0.14	0.20	0.24	1.00
400	0.06	0.13	0.07	0.20	0.27	0.37	1.25
600	0.07	0.16	0.10	0.23	0.34	0.45	1.86
800	0.10	0.17	0.11	0.25	0.37	0.55	2.00
1000	0.11	0.25	0.14	0.30	0.46	0.63	2.50
1200	—	0.33	—	0.38	0.57	0.75	—

TRIACS

VBOM	2A TO-1 £p	6A TO-66 £p	10A TO-88 £p
100	30	50	76
200	50	60	90
400	70	75	1·10

FULL RANGE OF ZENER DIODES VOLTAGE RANGE 2-33V. 400mV (DO-7 Case) 13p ea. 1½W (Top-Hat) 18p ea. 10W (SO-10 Stud) 25p ea. All fully tested 5% tol. and marked. State voltage required.

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10 amp POTTED BRIDGE RECTIFIER on heat sink. 100 PIV. 90p each.

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Coded and Guaranteed

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T2	8 D1374	OC75
T3	8 D1216	OC81D
T4	8 2G381T	OC81
T5	8 2G382T	OC82
T6	8 2G344B	OC44
T7	8 2G345B	OC45
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£p			
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Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 5p each. Any Qty.

SIL. G.P. DIODES 3p

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40PIV(Min.)	100	1·50
Sub-Min.	500	5·00
Full Tested	1,000	9·00

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U3	75 Germanium Gold Bonded Sub-Min. like OA5, OA47	50p
U4	40 Germanium Transistors like OC81, AC128	50p
U5	60 200mA Sub-Min. Silicon Diodes	50p
U6	30 Sil. Planar Trans. NPN like BSY95A, 2N706	50p
U7	16 Sil. Rectifiers Top-Hat 750mA Vltg. Range up to 1,000	50p
U8	50 Sil. Planar Diodes DO-7 Glass 250mA like OA200/202	50p
U9	20 Mixed Voltages, 1 Watt Zener Diodes	50p
U10	20 BAY50 charge storage Diodes DO 7 Glass	50p
U11	25 PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	50p
U12	12 Silicon Rectifiers Epoxy 500 mA up to 800 PIV	50p
U13	30 PNP-NPN Sil. Transistors OC200 and 2S 104	50p
U14	150 Mixed Silicon and Germanium Diodes	50p
U15	25 NPN Sil. Planar Trans. TO-5 like BFY51, 2N697	50p
U16	10 3Amp Silicon Rectifiers Stud Type up to 1,000 PIV	50p
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U18	8 6Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	50p
U19	25 Silicon NPN Transistors like BC108	50p
U20	12 1.5Amp Silicon Rectifiers Top-Hat up to 1,000 PIV	50p
U21	30 AF. Germanium Alloy Transistors 2G300 Series & OC71	50p
U23	30 MADT's like MHz Series PNP Transistors	50p
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U45	7 3A SCR. TO66 up to 600 PIV	£1.00

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

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Qty.	1-24	25-99	100 up
Price each	45p	40p	35p

F.E.T.'S

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2N3821	35p
2N3823	30p
2N5458	50p
2N5459	40p
BFW 10	40p
MPF105	40p

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Pack	Description	Price £
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Q2	16 White spot R.F. transistors PNP	50p
Q3	4 OC 77 type transistors	50p
Q4	6 Matched transistors OC44/45/81/81D	50p
Q5	4 OC 75 transistors	50p
Q6	5 OC 72 transistors	50p
Q7	4 AC 128 transistors PNP high grain.	50p
Q8	4 AC 126 transistors PNP	50p
Q9	7 OC 81 type transistors	50p
Q10	7 OC 71 type transistors	50p
Q11	2 AC 127/128 Comp. pairs PNP/NPN	50p
Q12	3 AF 116 type transistors	50p
Q13	3 AF 117 type transistors	50p
Q14	3 OC 171 H.F. type transistors	50p
Q15	7 2N2926 Sil. Epoxy trans. md colours	50p
Q16	2 GET880 low noise Germ. trans.	50p
Q17	5 NPN 2 x ST.141. and 3 x ST. 140	50p
Q18	4 MADT's 2 x MAT 100 & 2 x MAT 120	50p
Q19	3 MADT's 2 x MAT 101 & 1 x MAT 121	50p
Q20	4 OC 44 Germanium transistors A.F.	50p
Q21	4 AC 127 NPN Germanium transistors	50p
Q22	20 NKT transistors A.F. R.F. coded	50p
Q23	10 OA 202 Silicon diodes sub-min.	50p
Q24	8 OA 81 diodes	50p
Q25	15 IN914 Silicon diodes 75PIV 75mA	50p
Q26	8 OA95 Germanium diodes sub-min IN69	50p
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Q28	2 Silicon power rectifiers BYZ 13	50p
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Q30	7 Sil. switch transistors 2N706 NPN	50p
Q31	6 Sil. switch transistors 2N708 NPN	50p
Q32	3 PNP Sil. trans. 2x2N1131, 1x2N1132	50p
Q33	3 Silicon NPN transistors 2N1711	50p
Q34	7 Sil. NPN trans. 2N2369, 500MHz (code P397)	50p
Q35	3 Sil. PNP TO-5, 2x2N2904 & 1x2N2905	50p
Q36	7 2N3646 TO-18 plastic 300 MHz NPN	50p
Q37	3 2N3053 NPN Silicon transistors	50p
Q38	7 PNP trans. 4 x 2N3703, 3 x 2N3702	50p
Q39	7 NPN trans. 4 x 2N3704, 3 x 2N3705	50p
Q40	7 NPN trans. 4x 2N3707, 3 x 2N3708	50p
Q41	3 Plastic NPN TO-18 2N3904	50p
Q42	6 NPN transistors 2N5172	50p
Q43	7 BC 107 NPN transistors	50p
Q44	7 NPN trans. 4 x BC 108, 3 x BC 109	50p
Q45	3 BC 113 NPN TO-18 transistors	50p
Q46	3 BC 115 NPN TO-5 transistors	50p
Q47	6 NPN high grain trans. 3 x BC167, 3 x BC168	50p
Q48	4 BCY 70 PNP transistors TO-18	50p
Q49	4 NPN trans. 2 x BFY51, 2 x BFY52	50p
Q50	7 BSY 28 NPN switch trans. TO-18	50p
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OUR PRICE EACH:

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115 WATT SIL POWER NPN
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UIC13	8 × 7413	50p	UIC72	8 × 7472	50p	UIC121	5 × 74121	50p
UIC20	12 × 7420	50p	UIC73	8 × 7473	50p	UIC141	5 × 74141	50p
UIC30	12 × 7430	50p	UIC74	8 × 7474	50p	UIC151	5 × 74151	50p
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UIC41	5 × 7441	50p	UIC76	8 × 7476	50p	UIC193	5 × 74193	50p
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SILICON 50 WATTS MATCHED NPN/PNP
BIP 19 NPN TO-3 Plastic.
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SN7404	0.15	0.14	0.12	SN7494	0.77	0.74	0.68
				SN7495	0.77	0.74	0.68
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SN7410	0.15	0.14	0.12	SN74107	0.40	0.38	0.36
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Type No.	Price 1-24	25-99	100 up
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BP 702C—SL702C	63p	50p	45p
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BP 711—μA711	45p	43p	40p
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TA A350	170p	155p	150p

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BP944	13p	12p	11p
BP945	25p	24p	22p
BP946	12p	11p	10p
BP948	25p	24p	22p
BP951	65p	60p	55p
BP962	12p	11p	10p
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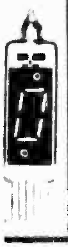
BP9094	40p	38p	35p
BP9097	40p	38p	35p
BP9099	40p	38p	35p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

NUMERICAL INDICATOR TUBES



MODEL	CD66	GR 116	3015F
Anode voltage (Vdc)	170 min	175 min	5
Cathode cur'nt(mA)	2.3	14	
Numeral h'ght (mm)	16	13	9
Tube height (mm)	47	32	22
Tube diameter (mm)	19	13	12
I.C. driver rec.	BP41 or 141	BP41 or 141	BP47
PRICE EACH	£1.70	£1.55	£1.90

All indicators 0.9 + Decimal point: All side viewing: Full data for all types available on request.

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TSO14 pin type	30p	27p	25p
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Low Cost No.			
BPS 14	15p	13p	11p
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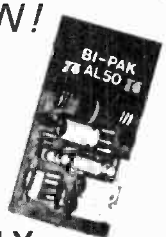

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ONLY **£3.25p** each

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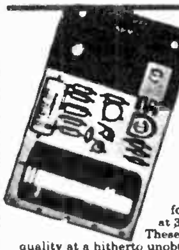

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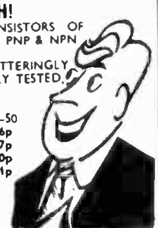

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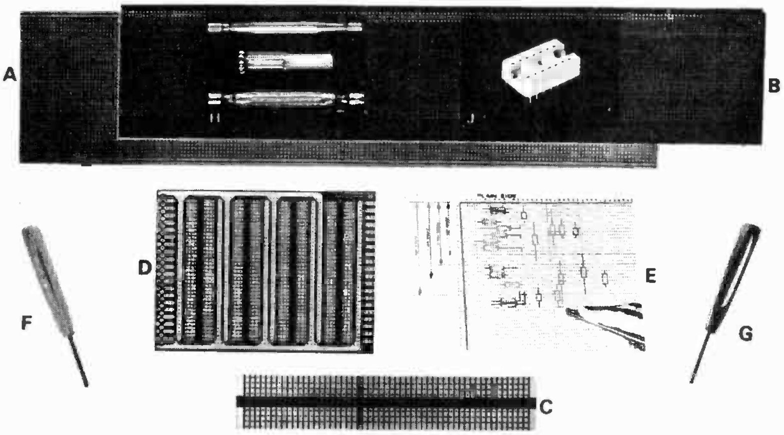

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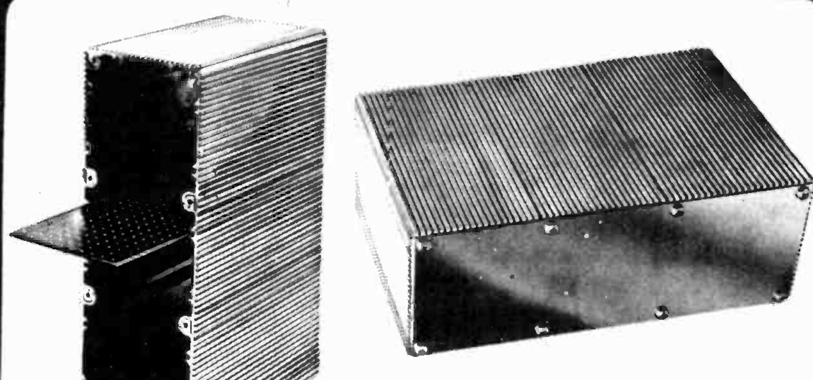

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DECEMBER ISSUE WILL BE PUBLISHED ON DECEMBER 1st

LOW VOLTAGE

This mechanically operated timing unit switches off a transistor radio after any preset period up to an hour.

THE DEVICE TO BE DESCRIBED CONSISTS OF A LOW voltage time switch and it is intended for use with transistor radio receivers. It must *not* be used to switch voltages or currents in excess of those employed for small battery-operated transistor radios.

The basis of the device is a Smiths 'Ringer', this being a clockwork timer manufactured by Smiths Industries Limited which, after the completion of a preset timing period, causes a bell to sound. The timer is suitable for domestic use and offers timing periods up to 1 hour. It has a disc on the front panel calibrated in minutes and this is rotated clockwise by means of an integral handle to the delay period required, as indicated by an arrow on the casing. The timer commences operation as soon as the disc is released; the disc rotates slowly anti-clockwise until its zero mark appears at the arrow on the casing. A bell then rings and the timing period is completed. The particular Smiths 'Ringer' employed by the author has a case diameter of approximately 2¾ in.

SWITCHING OPERATION

In order that the 'Ringer' may be employed for switching purposes, a small wedge-shaped cam is mounted on the front panel disc at or near the zero mark. This cam causes a moving contact to lift from a fixed contact when, at the end of a timing period, the disc returns to the zero position. It is necessary for the 'Ringer' to be securely fitted inside a suitable housing in order that the contacts may be mounted adjacent to the disc. The author's design is such that the 'Ringer' can be readily removed from the housing at any time. Similarly, the cam may easily be removed from the disc, allowing the 'Ringer' to be returned to normal usage.

An idea of the overall construction may be obtained from Fig. 1. It will be seen that there is a small adjusting screw on the contact which is raised by the cam at the end of the timing period. The timing unit couples to the receiver being switched by way of a length of twin flex terminated in jack plugs. In addition to the timer-actuated contacts, two miniature switches, one slide and one toggle, are fitted to the housing, as also is a miniature jack socket. However, the miniature slide switch is only required if an additional contact, to be discussed later, is to be incorporated.

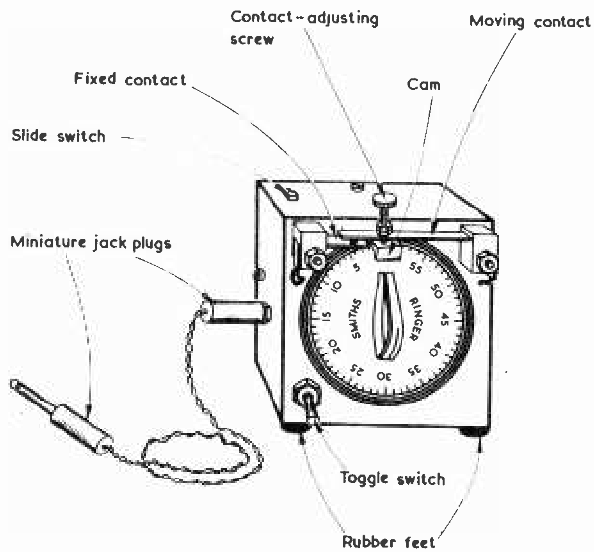
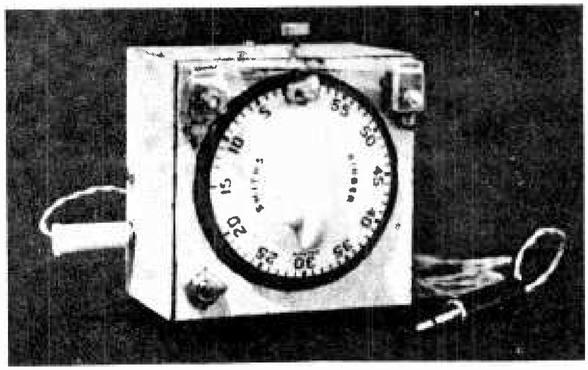


Fig. 1 The appearance of the completed timing unit. The front disc is calibrated in minutes from zero to 60 and rotates anti-clockwise as the timing period proceeds. At the end of the period the cam appears under the contact-adjusting screw and raises the moving contact

The main sections of the housing are illustrated in Fig. 2. The dimensions shown in this diagram exactly

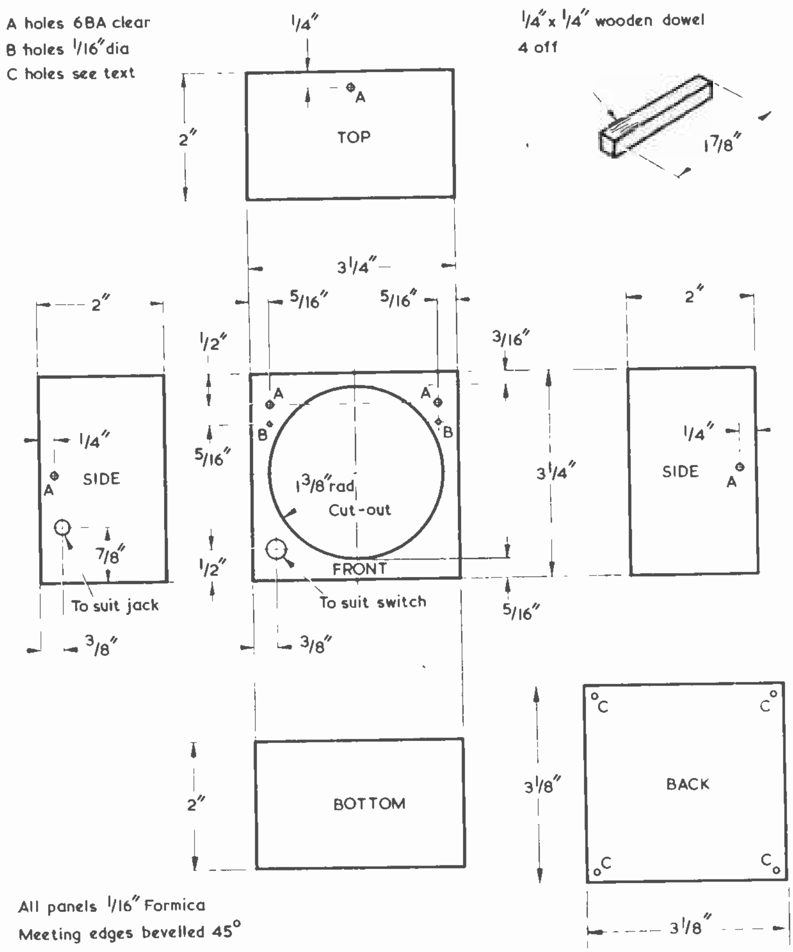
TIMER



The prototype timing unit. This photograph was taken before the addition of the 'switch-on' contact.

by
R.L. Graper

Fig. 2 The parts which are required for the timing unit housing



suited the 'Ringer' employed by the author, but readers are advised to measure up the particular timer to be used before constructing the case to ensure that it will fit comfortably. If necessary, the dimensions may be modified to suit.

All the panels shown in Fig. 2 are 1/16 in. Formica. The meeting edges are bevelled at 45° to give a neat finish. There are two pairs of panels having the same outside dimensions, these being the top and bottom and the two sides. These pairs should be matched together during construction. If it is found difficult to obtain a miniature toggle switch sufficiently small to fit into the position allocated for it on the front panel it may alternatively be mounted on the top panel with its body behind the 'Ringer' after the latter has been inserted.

Apart from the back, all the parts of the box are glued together with Evo-Stik contact adhesive, the corners being strengthened with the four lengths of dowel shown in Fig. 2. The assembly of the housing requires some patience and the Evo-Stik instructions should be strictly followed. If desired, the four dowels may be glued to the sides first, being just clear of the edge bevelling. When the glue has set, the top, bottom and front may be added. After assembly a length of nylon cord should be wound tightly a number of times round the box and the whole set aside for complete drying. All holes should, of course, be cut out before assembly. The back is fitted after the whole unit has been assembled and wired up. It is secured by short pins passing through holes 'C' in the back panel and thence into the ends of the four dowels.

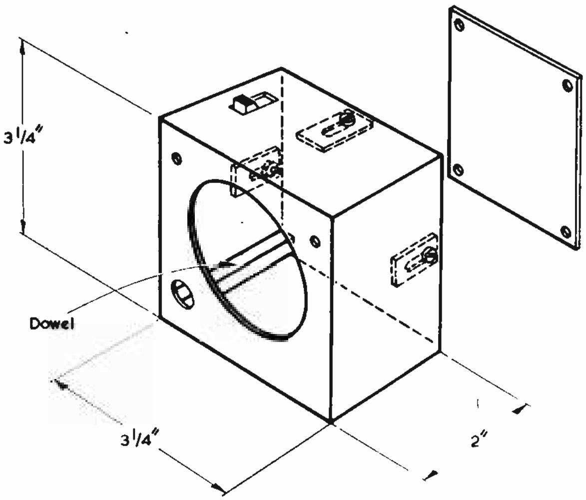


Fig. 3 The completed housing. The slide switch shown here is only needed if an extra 'switch-on' contact is added

When completed, the box has the appearance shown in Fig. 3. (This diagram also shows the slide switch, which as just stated may not be needed, and three Formica pieces which hold the 'Ringer' in position and which will shortly be described.)

The 'Ringer', in normal use, has a shape which causes its front panel to slope backwards slightly. In order that its front panel may be brought into the same plane as the front of the housing a wedge is inserted, inside the housing, beneath the bottom rear of the

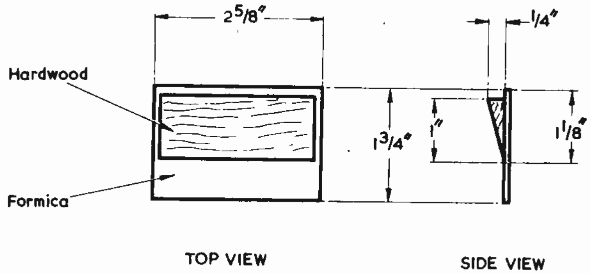


Fig. 4 The wedge assembly. This tilts the 'Ringer' slightly forwards so that its front is in the same plane as the front panel of the housing

'Ringer'. The wedge assembly is made up as shown in Fig. 4, and it consists of a piece of Formica with the wedge glued to it. After the 'Ringer' has been inserted in the housing the piece of Formica is slid in underneath it, whereupon the wedge provides the requisite tilting forwards of the 'Ringer'. The wedge assembly is not fastened permanently inside the housing; it may be removed at any time, thereby allowing the 'Ringer' to be taken out again. The width shown for the Formica piece, 2 5/8 in., assumes exact dimensioning of the housing and dowels. If the width available in the housing is fractionally smaller than 2 5/8 in., the width of the Formica piece in the wedge assembly should be reduced accordingly.

Also holding the 'Ringer' in position are three Formica strips having the dimensions shown in Fig. 5. These are mounted by means of 6BA nuts and bolts to the 'A' holes in the top and two sides, as indicated in Fig. 3. A plain 6BA washer is included under each nut. After the 'Ringer' has been inserted these three pieces are secured in place, being pushed forward until they bear against the rear top and side edges of the 'Ringer', whereupon the 6BA bolts are finally tightened. The slots in the three pieces have a width which allows a 6BA bolt to pass through. It may be necessary to add a spacing washer between any of the three pieces and the panel to which it is secured if it is found that the piece does not butt reliably against the rear surface of the 'Ringer'.

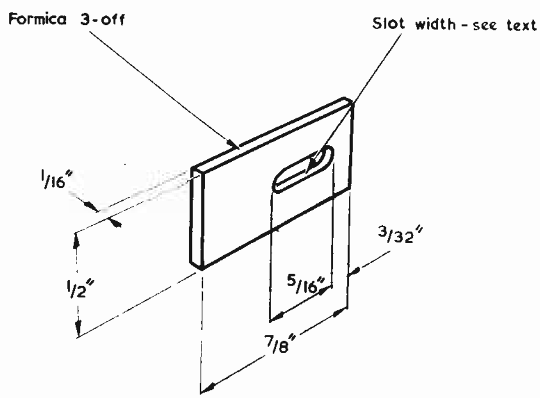


Fig. 5 One of three Formica pieces which assist in holding the 'Ringer' in position

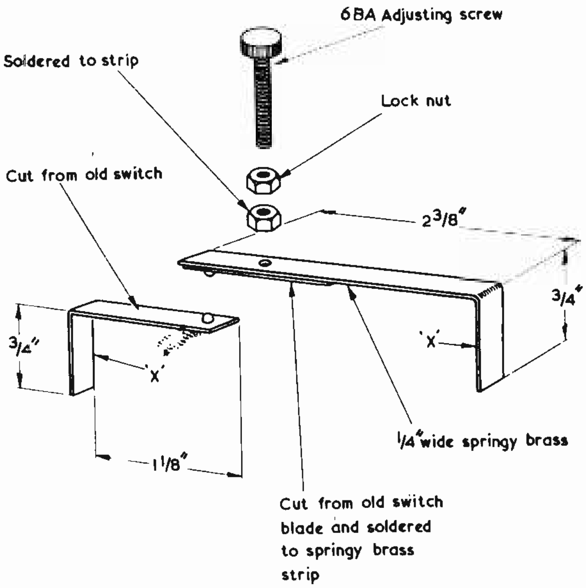


Fig. 6 Details of the contacts and their construction

CONTACTS

The construction of the contacts operated by the 'Ringer' depends to some extent upon the materials available to the reader. The author's method of construction is illustrated in Fig. 6, in which it will be seen that contacts cut from a discarded switch of the lever-operated type are employed, one of these being soldered to a length of springy brass strip. The width of the contacts and the strip is ¼ in. Also shown are the 6BA adjusting screw and two 6BA nuts. The lower of these is brass and is soldered to the brass strip (this may be achieved by holding it temporarily in position with a steel screw, which will not solder readily), whilst the upper nut is threaded onto the adjusting screw and acts, later, as a lock-nut.

The two contact mountings are made as illustrated in Fig. 7. Each mounting consists of two halves of Perspex which, when bolted together, give overall dimensions of ⅝ by 7/16 in. There is a saw-cut on the inside edge of each half which, when the pair are assembled, takes the contact strip. The distance of the saw-cut from the top of the mounting is best judged individually; that for the springy brass strip should be a little higher than that for the fixed contact.

Referring back to Figs. 1 and 2, the contact mountings are secured with ¾ in. 6BA bolts and nuts at holes 'A' of the front panel with the saw-cuts horizontal and above the securing bolts. The contacts are held in the saw-cuts with their ends 'X' (see Fig. 6) on the outside and pointing downwards. Thin p.v.c. insulated wires are soldered to the ends 'X' and are passed through holes 'B' in the front panel to the inside of the housing.

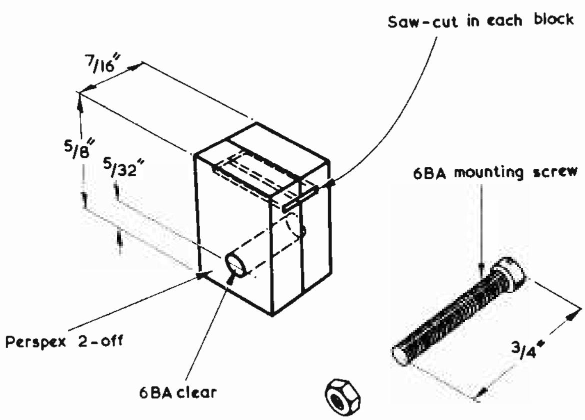


Fig. 7 The contact mountings are made up as shown here

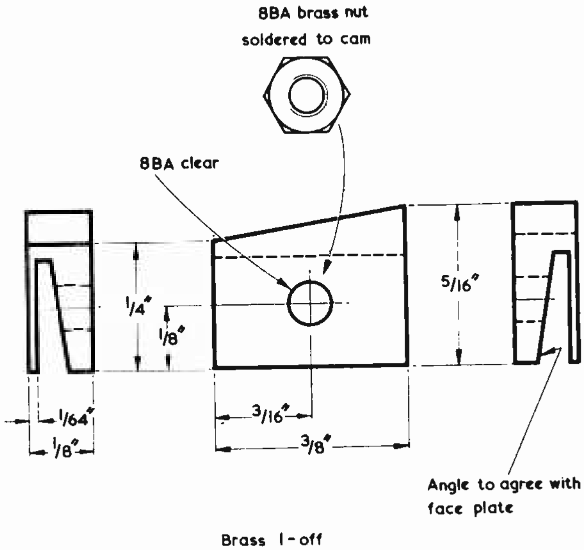


Fig. 8 Dimensions of the cam. This is secured to the front disc of the 'Ringer'

The cam has the dimensions given in Fig. 8. This is made of brass and has a wedge shape at its upper end which causes the moving contact to be raised when the front disc, or face plate, of the 'Ringer' approaches the zero setting. The slot in the cam passes over the edge of the front disc of the 'Ringer' and should be cut so that it is very nearly ¼ in. deep. The cam is secured to the front disc by an 8BA bolt passed through the 8BA nut soldered to the front surface of the cam. It is important for the upper surface of the cam to be as smooth as possible, in order to ensure minimum friction with the lower end of the contact adjusting screw. A little light lubricant, such as molybdenum disulphide, can be helpful here.

As a final operation, four rubber feet are added at the corners of the bottom panel of the housing. These may consist of four rubber grommets secured with adhesive.

When the construction of the timing unit has been completed, the moving contact is adjusted for the desired pressure on the fixed contact. The distance over which the moving contact is displaced upward at the end of the timing cycle is then preset by means of the 6BA screw which passes through it.

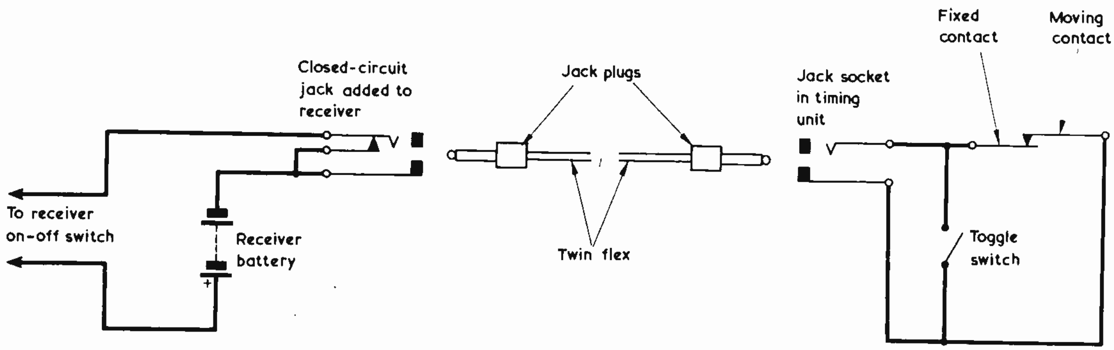


Fig. 9 The circuit of the timing unit and the manner in which it is coupled to the receiver. The closed-circuit jack may be inserted in the positive lead from the battery instead of the negative lead if desired

CIRCUIT

The timing unit connects to the receiver in the manner shown in Fig. 9. A miniature closed-circuit jack socket is added to the receiver, this being inserted in series with one of the battery leads. A closed-circuit jack socket is employed because this enables the receiver to function normally when the jack plug is removed. Since it is a little difficult to visually trace the appropriate tags of a closed-circuit jack socket, it will probably be best to identify them by a continuity test before installing and wiring in the socket.

The wire coupling the timing unit to the receiver consists of twin flex having a miniature jack plug at each end. One jack plug fits into the jack socket at the receiver whilst the other fits into a jack socket on the side panel of the timing unit. The twin flex can have any convenient length.

The internal wiring in the housing follows the circuit of Fig. 9. The timing contacts can be overridden by the miniature toggle switch, should this be desired.

EXTRA CONTACT

As so far described, the timing unit enables a circuit to be broken after any period up to an hour. A particularly useful application is the switching off of a bedside transistor radio. The radio can be tuned to any transmission and the timing unit set up. If the listener falls asleep during the timing period the receiver is automatically switched off at its end.

The writer felt it would be of value if the timing unit could also switch a transistor radio *on* after the timing period, rather than off, and he later added a second contact which achieved this requirement. Since most readers will only require the switching off facility the addition of the second contact will be dealt with only briefly.

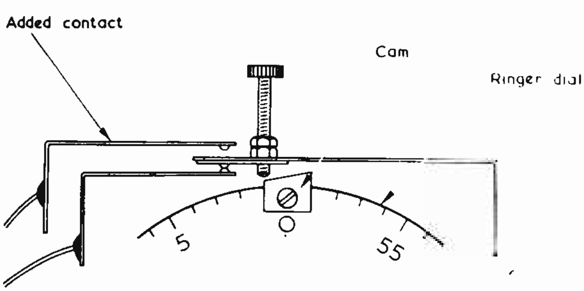


Fig. 10 Adding an extra contact to provide a 'switch-on' facility

The second contact is added in the manner shown in Fig. 10. Its method of operation is quite obvious: as the front disc of the 'Ringer' approaches the zero position the cam causes the moving contact to be raised, whereupon it connects to the added contact.

When the added contact is employed, it is necessary to alter the design of the left-hand contact mounting from that shown in Fig. 7. It needs to be made longer and have an extra saw-cut to take the upper contact.

Adding the extra contact necessitates the addition of the miniature slide switch referred to earlier and shown in Figs. 1 and 3. Also, the toggle switch requires to be a changeover type. The circuit employed is shown in Fig. 11 and it will be seen that the slide switch selects

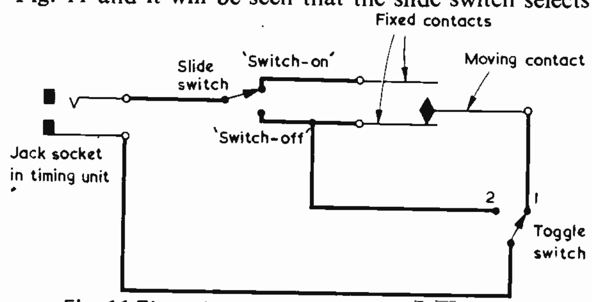


Fig. 11 The circuit employed with the extra contact

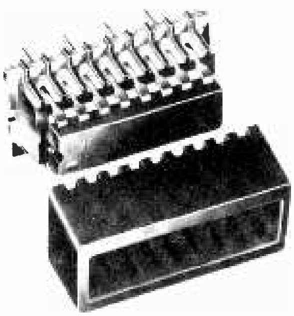
either the switch-off or switch-on facility. The toggle switch now overrides either of the contact operations. On Position 1 it enables both contacts to carry out their required operation. On Position 2 it both short-circuits the switch-off contacts and open-circuits the switch-on contacts.

EDITOR'S NOTE

It must be pointed out that the manufacturers of the 'Ringer' Timer, Smiths Industries Limited, state that, whilst they have no objection to the publication of details of the timing unit described here, it must be made clear that a Smiths timer so modified would not, normally, be covered by any guarantee given with their products. ■

New Products

DUAL-IN-LINE I.C. SOCKETS



Just introduced by Jermyn's Manufacturing Division, is an entirely new d.i.l. i.c. socket that represents a revolutionary concept in such socket design. In this product (the A23-2055 series), the separate contacts normally employed in conventional socket construction have been eliminated. Instead, contact between the i.c. legs and the pins connecting the socket to a p.c.b. is effected by means of gold or tin-plated copper areas, which are deposited on the plastic body of the socket using a special new plating technique. The plated body is in the form of a saddle, over which the i.c. legs are slipped to make a complete surface rather than the conventional point contact. The i.c. is located in open-sided slots, and is held in position by a plastic retainer, which presses the i.c. legs inwards to make perfect contact with the plated areas.

Further information from: Jermyn Industries, Manufacturing Division, Vestry Estate, Sevenoaks, Kent.

PRINTED-CIRCUIT-BASED LOUDSPEAKERS

What is believed to be the world's first ever printed-circuit-based loudspeaker has been successfully developed by Fane Acoustics Ltd., following over three years of laboratory work. This development consolidates Britain's position as world leaders in loudspeaker design and manufacture, and gives Fane a major export potential. Fane's development engineers, have now perfected the first unit, the 'Fane 910', and this has now entered full-scale production at the company's Batley, Yorkshire factory. The 'Fane 910' is a robust, high power tweeter horn unit for a 25 watt input. Typical applications include guitar, discotheque, organ and public address systems where improved high frequency reproduction – up to 15 KHz – is required. A major benefit of the printed circuitry employed is the resulting uniformity of the speakers. Furthermore, simplified assembly procedures have made possible a list price of £12.40, which is comparable with conventionally wired units. A dowelled assembly in the 'Fane 910' permits the components to be assembled only in the correct way. It can therefore be dismantled and re-assembled by the user, should a maintenance requirement ever result from damage, and the problems usually associated with sending goods away for repair are thus avoided. All Fane's dealers at home and abroad, will supply spares, and the amateur can replace any item in a minute or so. The export potential for such a loudspeaker in the booming world of 'pop' groups, discotheques etc. is enormous and Fane is currently planning a major assault on the Continent. The 'Fane 910s' exponential, die-cast aluminium horn section has a mouth opening measuring 6⅝in x 3½in (16.8cm x 9.1 cm) and the speaker employs a latest type high efficiency one-inch pole magnet with a 16,000 Gauss rating. Overall depth of the speaker – which is available initially in a black crackle finish – is 6½in (16.5cm). Fane Acoustics Ltd. – a member of the Audio Fidelity Group – is based at Hick Lane, Batley, Yorkshire.

Picture shows: TOP, a fully assembled "Fane 910" printed-circuit loudspeaker. A major advantage of the printed circuit is uniformity. BELOW, the unit is shown in component form. When required, component replacement can be undertaken quite simply by the user himself

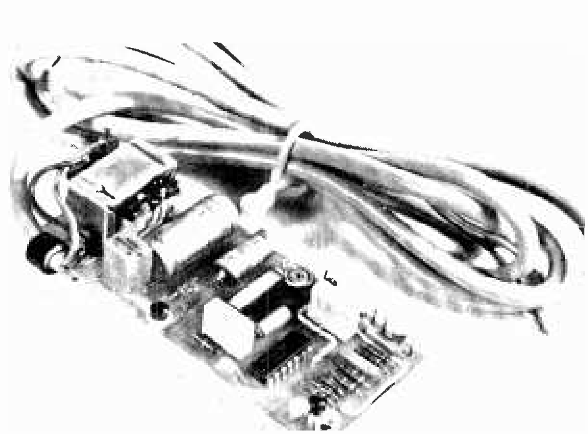
STEREO DECODER

A new stereo decoder from Tolliday-George-Ellam Ltd. of 37 City Road, Cambridge, brings to thousands of VHF receiver and tuner owners the chance to receive stereo broadcasts.

The ISA stereo decoder is being marketed exclusively by TGE for the makers, their associated company, Industrial Sub-Assemblies Limited of Cottenham, Cambridge.

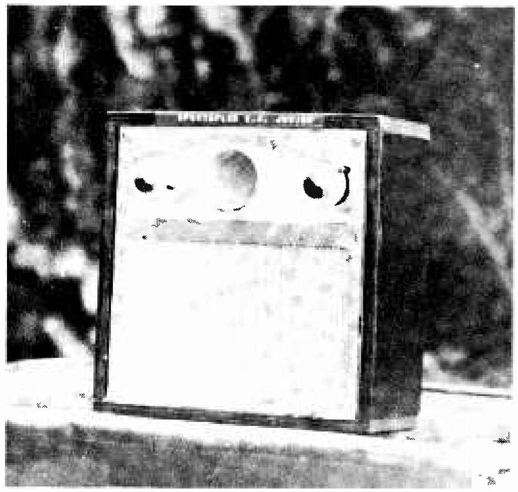
The launch coincides with the build-up of interest in the forthcoming Radio 2 stereo broadcasts to complement those already being transmitted on Radio 3.

Enthusiasts wanting stereo listening will be able to buy for their mono VHF equipment the bolt-on decoder, which incorporates a phase-locked loop stereo demodulator, for £16.50, to get the same results from existing equipment as from costly new stereo receivers or turners.



Cover Feature – 1

THE 'S.A. JUNIOR' PORTABLE RECEIVER



by

Sir Douglas Hall, K.C.M.G., M.A. (Oxon)

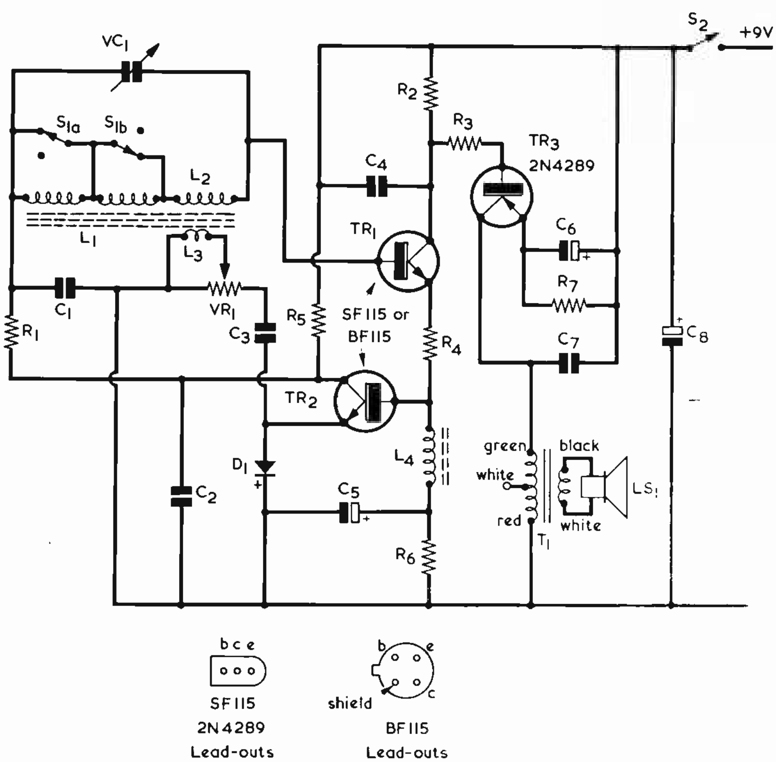


Fig. 1. The circuit of the "S.A. Junior" medium and long wave portable receiver

Using reflexing over two transistor stages, this receiver offers a high level of selectivity and sensitivity both on medium and on long waves.

THE AUTHOR HAS PUBLISHED THREE PORTABLE receiver designs using a 'Super Alpha' variant of his 'Spontaflex' circuit.*
He described the 'S.A.5' as the best medium and long wave design he has as yet published in this journal, and this opinion still holds good. The present design, whilst not possessing the output power nor the remarkable consistency of reaction setting which was given by the 'S.A.5', still offers the excellent sensitivity and selectivity inherent in the circuit. It is small (the case measures about 5½in. square by 2½in. deep) and employs only three transistors. It provides, on both medium and long waves, many alternative stations at good strength on a speaker after dark, and several during the hours of daylight in most places. Unlike the 'S.A.5', the long wave band is continuously tunable. Four programmes on each waveband are available at the author's home in South Devon.

Although the circuit used is basically similar to previous 'Super Alpha Spontaflex' circuits, certain modifications have been made which result in simplification and economy in the use of components and, in some cases, increased efficiency. The current taken from the PP6 batterv is only about 7 to 8mA.

*'The "Spontaflex" S.A.4 Transistor Portable', *The Radio Constructor*, May 1968; 'The "Spontaflex" Silicon S.A.3 Portable', *The Radio Constructor*, December 1969; 'The "Spontaflex" S,A.5 M. and L.W. Portable', *The Radio Constructor*, June 1971.

THE CIRCUIT

The circuit is given in Fig.1. In this diagram, wave-change switch S1(a) (b) is in the position which selects medium waves. It will be seen that TR1 and TR2 form the 'Super Alpha' pair at radio frequencies. The signal is picked up by L2, on a ferrite rod, this being tuned by VC1 which has a maximum capacitance of only 100pF. The whole of the tuned circuit is across the input to TR1. Because of the 'Super Alpha' arrangement, the input impedance of TR1 is extremely high and very little damping is offered to the tuned circuit. The signal at the output of TR1 appears across R4 and L4, the greater part being across L4, and is then applied to the input of TR2. This transistor acts as the second half of the 'Super Alpha' pair, and the amplified radio frequency signal is passed to the diode D1, which acts both as a load and as a demodulator.

The resulting audio frequency at D1 is returned to TR2, which now functions as a common base amplifier. In order to ensure that the radio frequency output from TR2 is not at an impedance that is too low for the desired operation of the diode, it is necessary for the tuned circuit to have extremely high impedance. This is achieved by employing an unusually large inductance-to-capacitance ratio and by the use of reaction, which will be found to be exceptionally beneficial with this circuit. As can be seen from Fig.1, reaction is obtained by coupling back from the emitter of TR1, and it is

COMPONENTS

Resistors
(All fixed values ½ watt 10%)

R1	10kΩ
R2	2.7kΩ
R3	1kΩ
R4	220Ω
R5	100kΩ
R6	1kΩ
R7	180Ω (see text)
VR1	5kΩ potentiometer, linear, with S2.

Capacitors

C1	1,000pF silvered mica
C2	1,000pF silvered mica
C3	0.01µF paper or plastic foil
C4	0.01µF paper or plastic foil
C5	100µF electrolytic, 2.5 V.Wkg.
C6	640µF electrolytic, 2.5 V.Wkg.
C7	0.1µF paper or plastic foil
C8	1,000µF electrolytic, 10 V.Wkg.
VC1	100pF variable, 'Dilecon' (Jackson Bros.)

Inductors

L1,2,3	Ferrite aerial assembly (see text)
L4	2.5mH r.f. choke type CH1 (Repanco)
T1	Output transformer type LT700 (Eagle)

Semiconductors

TR1	SF115 or BF115
TR2	SF115 or BF115
TR3	2N4289
D1	OA5

Switches

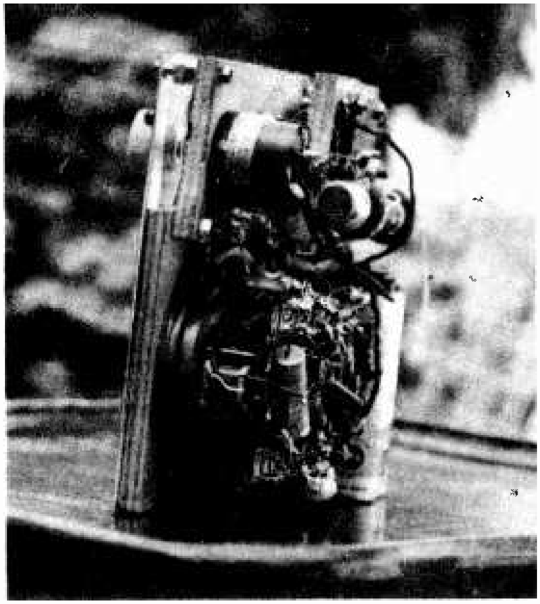
S1	2-pole 2-way rotary (see text)
S2	s.p.s.t. (with VR1)

Speaker

LS1	3Ω speaker, 5in. by 3in. (see text for magnet size)

Battery
9 volt battery type PP6 (Ever Ready)

Miscellaneous
Ferrite rod, 4½in. by ⅜in. dia
18-way R.S. Components Standard tagboard (Home Radio Cat. No. BTS10)
Epicyclic drive with flange type 4511/F (Jackson Bros.)
1 large knob
2 small knobs
Battery connectors
Speaker gauze
Plywood, Perspex, Fablon or Contact, etc.



A side view of the receiver "chassis"

consequently effective over both radio frequency stages.

If the tuning arrangements are compared with the variable inductance tuner used in the 'S.A.5' receiver, it will be found that the present receiver offers an even better inductance-to-capacitance ratio over the lower wavelength half of the medium wave band, whilst there is a somewhat inferior ratio from about 350 metres upwards. Indeed, at around 200 to 250 metres the ratio is so high that the increased amplitude of all signals, wanted or not, could in certain circumstances (e.g. if the tuner section were used with a powerful amplifier without a volume control) overcome the superior selectivity which is obtained as a result of the high inductance of the coil. At this part of the scale the present tuner is more sensitive than the 'S.A.5' but a little less selective.

When S1(a)(b) is switched to long waves, L1 comes into circuit. L1 had to be carefully designed. There is not very much room for it on the ferrite rod and it was found that a single pile-wound coil proved to have sufficient self-capacitance to allow medium wave breakthrough of strong stations and to restrict the coverage given on the long wave band with only 100pF as a variable tuning capacitance. On the other hand, a low capacitance high inductance coil, while satisfactory on the long wave band, caused trouble on the medium wave band due to damping of the medium wave coil when the long wave coil was short-circuited by the wavechange switch. Finally, a two-pie coil, with each pie individually short-circuited when listening to medium waves, proved satisfactory.

We left the demodulated signal passing through TR2. It emerges, in much amplified form, across R5, whence it is fed to the base of TR1 via the ferrite rod tuned windings. R1, C2 and C1 filter out the radio frequency component. From here the circuit differs from all the previous 'S.A.' designs, in which the first transistor acted as a common collector current amplifier at audio frequencies. In this case the amplified signal is taken from the collector of TR1, with R2 as collector a.f. load, and TR1 acts as a common emitter amplifier. Resistor R4, which is not bypassed, introduces a large amount of negative feedback. This is essential in order that the input impedance of TR1 be kept high at audio frequencies and consequently not damp the signal across R5, an occurrence which would drastically reduce the amplification given by TR2. But because the load resistance in the collector circuit of TR1 is higher in value than that in its emitter circuit, TR1 is able to give some voltage amplification while still maintaining its input impedance at a sufficiently high level. Extra gain is therefore given by this stage, as compared with that given in the earlier circuits. Remembering that the input impedance of TR3 (say 2kΩ) in series with R3, is in parallel with R2, it will be seen that the effective collector load is roughly 7 times the value of R4. A voltage gain of about 17dB may be expected.

TR3 functions as a normal high amplification common emitter output stage. C4 and C7 provide further radio frequency filtering.

It will be seen that TR1 obtains base bias from the collector circuit of TR2 which, in turn, obtains its base bias from the emitter circuit of TR1. This arrangement involves heavy negative feedback of direct current and results in good stability.

A warning is given not to use a separate battery switch rather than one combined with VR1. If the receiver is switched on with reaction adjusted to a critical setting, or to a setting providing oscillation, it is possible for the circuit to be shock-excited into parasitic oscillation. No harm is done, but no signals will be heard until the reaction control is backed right down and brought up again. The possibility of this nuisance is ruled out if S2 is combined with VR1, as specified.

It is important to use the specified semiconductors. There may be others that would work as well, but the chances are that several modifications would be involved for best results. Those specified are readily obtainable. If a BF115 is used for TR1 or TR2, no connection is made to its shield lead-out.

Before proceeding to details of construction, reference should be made to the switch employed for S1(a)(b). This should have a construction which ensures that it projects backwards from the panel on which it is mounted by a small amount only. The type may be recognised from the outline given in Figs. 2(b) and 4, and it is available from Henry's Radio as 'Type B'. Another point is that the magnet of the speaker should, preferably, not have a diameter greater than 1¼in.

CONSTRUCTION

The first constructional step is to take a piece of ¼in. plywood and cut out three sections, one measuring 5in. by 3½in., one 5in. by 2in. and one 3½in. by 2in. A hole for the speaker is cut in the 5in. by 3½in. piece such that the speaker will lie close to one 5in. edge, leaving a ¼in. strip of wood free at the other 5in. edge.

Place the 3½in. by 2in. piece over the 5in. by 2in. piece so that the long edges and the 2in. edges at one end are together. Clamp the pieces together when so positioned. Mark out the exact centre of the larger piece and drill a ⅜in. hole through both pieces at this point. Drill two further ⅜in. holes to take VR1 and S1 in the positions shown in Fig. 2(b). One of these holes will pass through the 5in. by 2in. piece only, and this is the hole that will later take VR1. Also drill two 4BA clear holes through both pieces, as indicated in Fig. 2(b). Unclamp the two pieces of plywood and put the 3½in. by 2in. piece to one side. Enlarge the centre hole in the 5in by 2in. piece to ¾in. diameter and fit a flange type epicyclic drive to it, as illustrated in Fig. 2(b). Also fit VR1 and S1. Bolt or screw this panel to the free ¼in. strip on

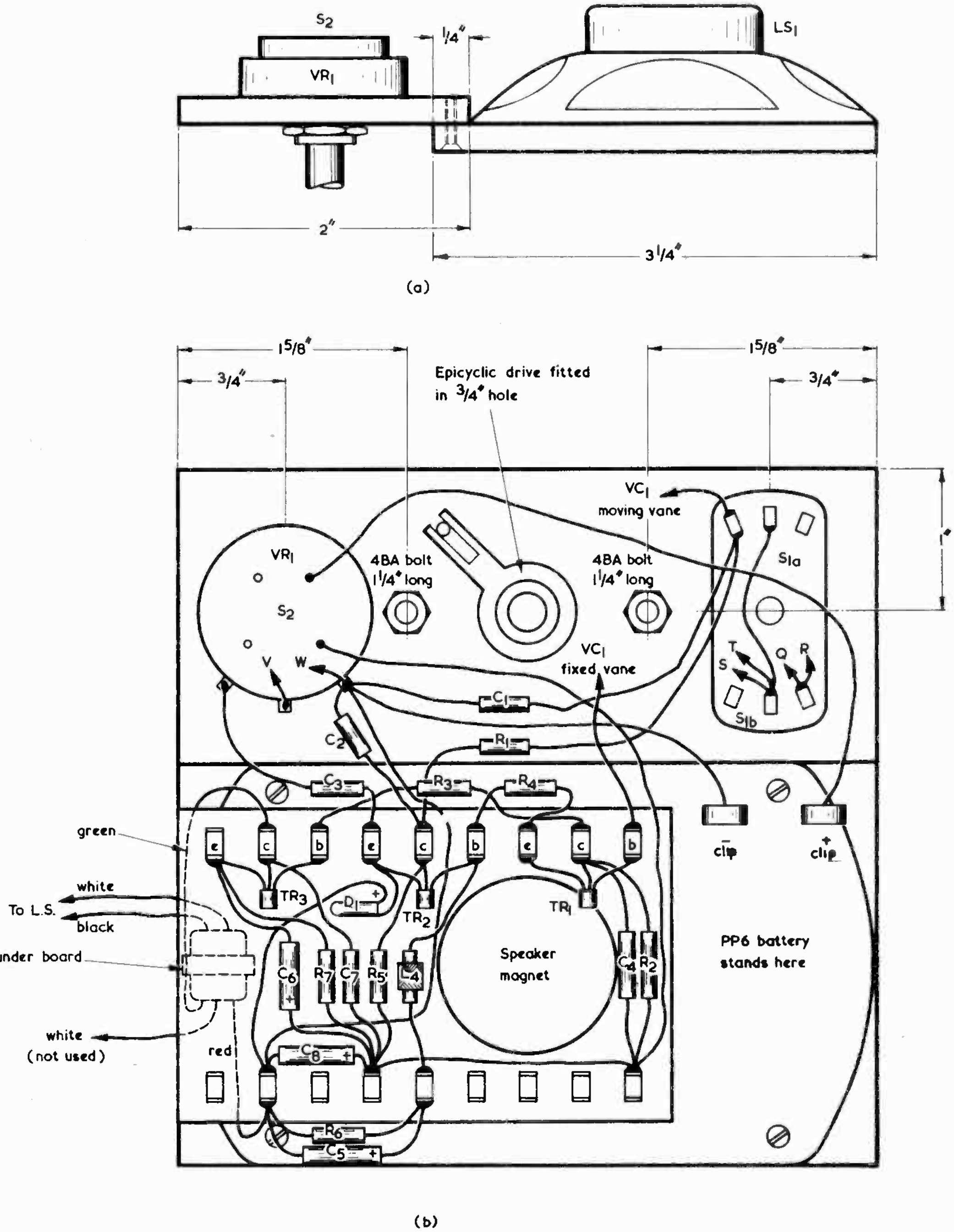


Fig. 2 (a). The two panels which form the "chassis" of the receiver
(b). Major wiring details. The tagboard fits over the speaker magnet. Tag positioning in S2 may vary from that shown here, and the required tags for connection should be identified with a continuity tester

the loudspeaker panel, as shown in Fig. 2(a).

Cut a section with 9 pairs of tags on it from a 16-way Standard size R.S. Components tagboard. Cut a hole in this 9-way tagboard to take the magnet of the speaker. See Fig. 2(b). As mentioned earlier, the speaker employed should have a magnet with a diameter not greater than 1¼in., or else a special tagboard will have to be made up by the constructor using a piece of Paxolin and 6BA bolts, nuts and solder tags, and providing room for the larger hole required.

The hole in the tagboard should be made very slightly larger than the diameter of the speaker magnet. A turn or two of Sellotape around the magnet will then ensure a tight fit later on. A piece of Fablon or Contact should be stuck to the underside of the tagboard to prevent the possibility of short-circuits to the speaker frame. Note also that transformer T1 is affixed, under the board, with a suitable adhesive.

Secure T1 in place and connect its white and black secondary leads to the speaker. Then fit the board over the speaker magnet, fit small components and complete the wiring shown in Fig. 2(b). Note the two lengths of wire from TR1 and S1 which will subsequently be connected to VC1. Fit two 1¼in. countersunk 4BA bolts to the 5in by 2in. panel, as indicated. The bolt heads are away from the reader.

L2 and L3 should now be wound on a tube which is free to slide on the ferrite rod. It is useful to employ a piece of Fablon or Contact about 2½in. square here, leaving on all the protecting paper except for a strip about ½in. wide. The piece of Fablon or Contact is wrapped round the rod, not too tightly, and made into a secure tube by means of the unprotected strip at one end. L2 consists of 130 turns of 32 s.w.g. enamelled wire close-wound, and L3, spaced ¼in. from L2, has 10 turns of the same wire close-wound in the same direction. The completed coil is then placed on the rod, which is fitted with rubber grommets as shown in Fig. 3. VC1 has its spindle cut down to ¼in. and is then fitted to the appropriate hole in the 3½in. by 2in. piece of plywood. The ferrite rod is also fixed to this piece of plywood by means of cord (*not* wire) passed through four suitably placed small holes. It will probably be necessary to place a ⅛in. thick strip of plywood or similar non-conducting material under the grommets to prevent the coils fouling the moving vane of VC1.

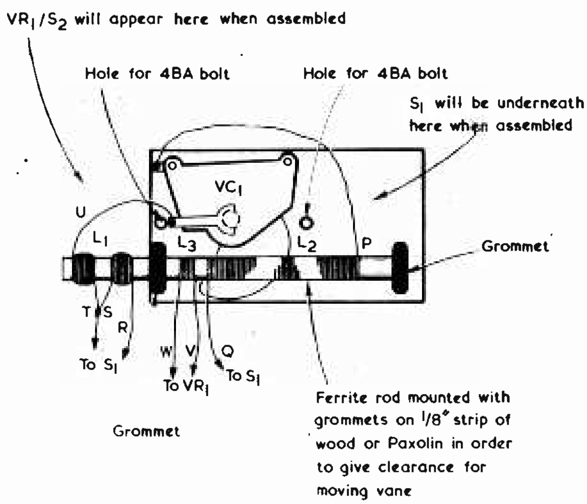


Fig. 3. The ferrite road assembly and the sub-panel on which this and VC1 are mounted. Winding details are given in the text

L1 should now be made and fitted to the rod, also as shown in Fig. 3. It consists of two pies of 200 turns each of 38 s.w.g. enamelled wire. Each pie is pile-wound to a width of about ⅜in., the two pies being separated from each other by ¼in. They are wound on a 1¼in. long tube of Fablon or Contact made up as described for L2 and L3. The two centre leads are soldered together to make a continuous coil. L1 is wound in the same sense as L2 and L3.

Fit the two assemblies together by means of spacing nuts on the 4BA bolts under the VC1 panel. Tighten the grub screws of the drive to the spindle of VC1 and connect the two relevant leads to the tags of VC1. Connect up coil leads as indicated in Fig. 3. Provided the two sections are correctly assembled together, S1 will be out of sight, but VR1/S2 will be visible. There will be an unused ⅜in. hole in the VC1 panel over S1; this is not shown in Fig. 3.

It will be found that the two 4BA bolts do not protrude through the small 3½in. by 2in. panel, and that it is impossible to fit nuts. In all probability the combined assembly will be found perfectly firm when the epicyclic drive grub screws have been tightened, but if this should not prove to be the case, VC1 should be temporarily removed and the holes in the small panel countersunk so that locking nuts can be fitted to the 4BA bolts. Bolts longer than 1¼in. are not used as they could foul VC1.

CHECKING PERFORMANCE

At this stage a PP6 battery may be fitted in the position indicated in Fig. 2(b) and the receiver tried out. It may prove helpful to contrive a temporary clip to hold the battery in position, though this is not essential. It should be found on medium waves that oscillation starts with the slider of VR1 advanced about one third of the way along its track when VC1 is at minimum capacitance, gradual further advancement in VR1 being required as the capacitance of VC1 is increased. The position for oscillation in VR1 will be fairly constant throughout the long wave band, where it should need to be advanced about half-way along its track. Reaction will be found to be beautifully smooth. There is no suspicion of backlash and a weak signal can be held with great sensitivity when the receiver is on the verge of oscillation. This condition does not produce the best quality, but on more powerful stations reaction will be turned back to some extent and quality will be found to be quite good for a small receiver. The reaction control acts as a true volume control since it damps the tuned circuit when it is at a low setting.

If the current drawn from the battery is less than 7mA the value of R7 may be reduced until this current is taken.

Medium wave coverage should be from about 190 to 540 metres, but it may be necessary to vary the number of turns from the 130 specified to suit some ferrite rods. The prototype uses a rod obtained from Amatronix Ltd., 396 Selsdon Road, South Croydon, Surrey, CR2 0DE. On the long wave band, coverage will be from about 1,000 to 1,900 metres.

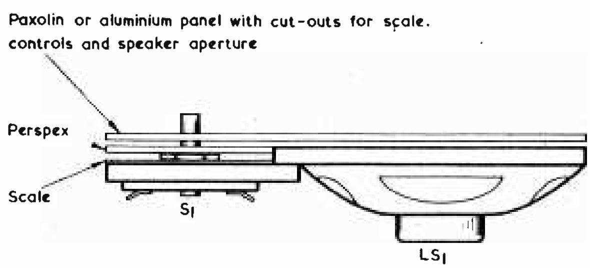
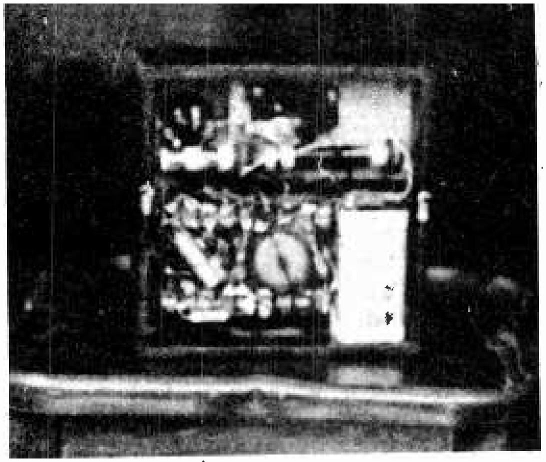


Fig. 4. Adding a tuning scale, Perspex panel and final "tidying-up" panel. For simplicity the tagboard fitted over the speaker magnet is omitted here

A scale may be made using a piece of card measuring 5in. by 1¾in. This is fitted as shown in Fig. 4, where the 'chassis' will be seen to be lying on its back. A wire pointer is fitted to the flange of the epicyclic drive, and the scale calibrated – an easy task if carried out after dark owing to the large number of stations which will be received. Next a piece of ⅛in. thick Perspex is cut to measure 5in. by 1¾in., after which three ⅜in. holes are cut out in it for the spindles. This is placed over the spindles, the locking nuts of which will space the Perspex away sufficiently far to leave room for the scale pointer. Finally, a 'tidying-up' frame is cut from Paxolin or aluminium to cover the whole of the 'chassis' front. The exact design of this frame is left to the constructor but Fig. 5(b) shows a suggestion. This frame is screwed to the front of the 'chassis' with a piece of speaker gauze held over the speaker aperture.



Rear view of the receiver with the back removed

CABINET

A suggestion for a simple case is illustrated in Fig. 5(a). Two pieces of ¼in. plywood are cut measuring 5in. by 2½in., and two pieces 5½in. by 2½in. These pieces are screwed together as shown. Before cutting out the pieces it is advisable to measure the actual 'chassis', in case this has not been made quite accurately in terms of dimensions. The dimensions of the pieces of plywood in Fig. 5(a) may then be modified accordingly. With the prototype it was found an easy matter to make the case a sufficiently tight fit for the chassis to be held securely in it without the need to use screws. One approach to this end consists of making the pieces for the case slightly oversize and then trimming them down with a file.

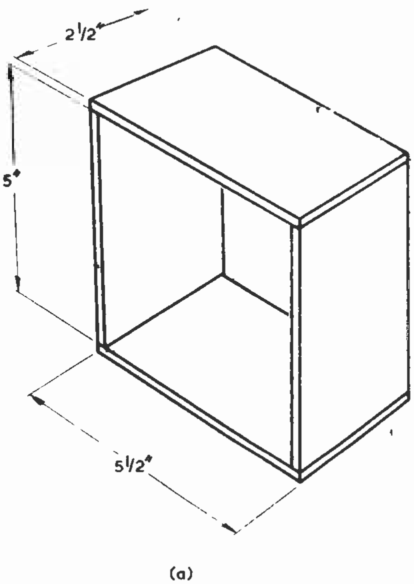
A back, 5in. square, is cut from ⅛in. peg-board or similar material with holes in it. This is pushed into the back of the case and is held by small solder tags which are screwed to the backs of the case sides and are free to swivel.

When completed, the case may be varnished in any colour favoured by the constructor.

A LARGER VERSION

If size is not a problem, better quality and greater output can be obtained by using a larger speaker. As a matter of interest, the author has rebuilt the prototype of the 'S.A.3' receiver mentioned at the beginning of this article to the circuit described here. The 'S.A.3' receiver is in a larger cabinet and has an 8in. by 5in. elliptical speaker. The original speaker, ferrite rod assembly, output transformer, reaction control, wave-change switch, battery and groupboard were retained, these all being wired up to the new circuit. The group-board was rewired with the new components needed.

The instability problem when first switching on with a switch not combined with the reaction control did not appear, this being due, no doubt, to the less crowded layout of the larger receiver. R7 may be reduced in value to obtain a greater undistorted output, the extra current passed by TR3 being well within the capacity of the PP9 battery used with the 'S.A.3'. Various values for R7 between 180Ω and 47Ω can be tried in this larger version of the circuit, a meter being inserted in one of the battery leads to monitor the current drawn for the different values. A good compromise is a value in R7 which causes a total current of about 14 to 15mA to be drawn. The final value of R7 which will produce this figure depends upon the characteristics of some of the components used. ■



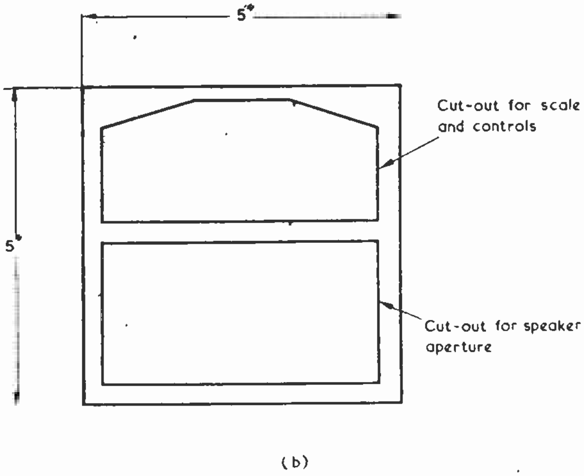
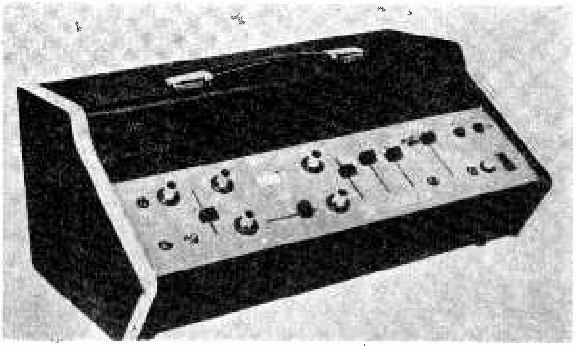


Fig. 5 (a). The cabinet may have the simple construction illustrated here
(b). Suggested design for the front covering panel

NEWS . . . AND .

D.J. DISCMAJOR DISCOTHEQUE PRE-AMP



The D.J. Discmajor Discotheque Pre-Amp will be of prime interest to the professional D.J., Clubs and organisations who demand first class sound quality. Slider controls are used for all of the main functions which facilitate ease of operation for the user. Added to this is a mic input with its own volume and tone controls, mic over-ride with a variable level control, tape input with its own volume control and a visual cue meter which in conjunction with the P.F.L. gives complete visual and audible control over all input channels. A single slider 'cross-fade' controls the two magnetic inputs, for total flexibility.

The Discmajor is also available complete with a 100 watt Power Amplifier. The complete power section will cut out instantly if the unit is misused or shorted and will only come on again when the fault has been cleared and the fault warning lamp on the front panel re-set.

VINTAGE RADIO MUSEUM

Crystal-sets with cats-whiskers, antique receivers with bright-emitter valves and plug-in coils, horn speakers half of wood and half of metal. All are on show – many are working – at the new Vintage Wireless Museum in Lincolnshire. Admission is free, and at any convenient time.

The Museum is supervised by the Wireless Preservation Society, a non-profit-making organisation, the objects of which are the preservation and restoration of vintage wireless and electronic equipment for purely cultural, educational and historical purposes.

President is Mr. W. K. E. Geddes, who is in charge of the Radio Section at the Science Museum in South Kensington. Vice-President is Mr. F. Ward, G2CVV, the Immediate Past-President of the Radio Society of Great Britain. The Chairman is Mr. D. Hoult, G400 and the Vice-Chairman Mr. N. Carter, G2NJ.

Hon. Secretary and Curator is Mr. D. Byrne, G3KPO, of Homa House, Quadring, near Spalding, who should be contacted at STD. 077-584-485 by readers wishing to look around the Museum.

It is interesting to note that it is probably the only museum in the world where visitors can actually handle the exhibits, but this makes it of particular value to research workers.

MIRACLE OF BROADCASTING

British religious dignitaries were among those initially suspicious of the apparently miraculous wireless devices in the 1920s.

In 1923, the then Dean of Westminster refused to allow the wedding service of the Duke of York to be broadcast from Westminster Abbey. It might be received, he said, by 'a considerable number of persons in an irreverent manner, and might even be heard by persons in public houses with their hats on.'

NEW SERVICE FOR THE HANDICAPPED

A National library has been established to help the many disabled people who are unable to read books in the normal manner. It is a library of 'Talking Books', and it will provide a wide variety of titles, all on purpose-made Tape-Cartridge, which contains up to thirteen hours of reading.

The National Library of Talking Books for the Handicapped is a registered charity and the Chairman of the Council, Major Frank Clarke, in announcing its foundation, said, 'The people we aim to serve fall into the category of severely disabled persons, many of whom are elderly.' The Chairman added, 'It is hoped that Local Authorities and organisations for the handicapped will co-operate with us so that "Talking Books" and Play-back Machines may be made freely available to those in need.'

. . . COMMENT

EMI MARINE INTRODUCES HIGH-PERFORMING, SOLID-STATE 12 CHANNEL RADIO-TELEPHONE

A self-contained, solid-state, 12 channel VHF/FM radio-telephone introduced by EMI Marine of Sevenoaks, Kent, combines high performance and straightforward operation in a package especially designed to withstand marine use.

Costing £310, the 'Mariner' uses the latest, fully-proven solid-state circuit techniques, and corrosion resistant materials, to ensure reliability and interference-free communication. It incorporates advanced design features to provide protection against accidental misuse, to enhance performance, and simplify maintenance and servicing.

The transistorised power amplifier has a unique safeguard so that even if inadvertently loaded with an open- or short-circuited aerial connection no damage will result to the amplifier. The circuitry of the 'Mariner' uses silicon integrated circuits, FET components, diodes and transistors. This gives excellent high-temperature performance and low power consumption.

The circuits provide full performance over the ambient temperature range -30°C. to +60°C. They have a rated capacity of double their working load, providing a wide safety margin.

The extremely low current drain (less than 0.15 amps.) allows continuous receiver operation in the standby mode, with only a single 12V to 14V wet-cell battery as the power source. The transmitter provides 1W or 25W RF output. In the transmit mode, on 25W output, d.c. current consumption is 3.5 amps.

The equipment conforms to the latest Post Office specification, incorporating 25 kHz channel spacing.

GOLDEN JUBILEE FOR RADIO APPRENTICE TRAINING

The BBC is not the only organisation celebrating a Golden Jubilee connected with radio.

Half a century of training RAF apprentices in the radio trades was marked by celebrations on Friday, October 13, at the No. 1 Radio School, RAF Locking, near Weston-super-Mare, Somerset.

It was in 1922 that the training of apprentices was first started at the Electrical and Wireless School, Flowerdown, near Winchester, Hampshire. From then on right up to the present day the training of radio and electronic apprentices has been of prime importance to the RAF.

The development of radar during World War II greatly increased the scope of radio trades. After the war, radio mechanics concentrated on servicing and ceased to be trained in operating skills. In 1948 the first of the apprentices to be trained specifically as ground or air radio mechanics graduated from Cranwell, to where the school had moved in 1929.

Since the apprentice training started in 1922, more than 9,750 radio apprentices have been trained. Over 2,000, more than one-fifth, have been commissioned and 13 have reached Air Rank.

As part of the Golden Jubilee celebrations, an Old Boys' Day was held at No. 1 Radio School, RAF Locking on Friday, October 13.

IN BRIEF

● A leaflet available from Coutant Electronics Ltd., of 3 Trafford Road, Reading, Berkshire, gives details of a range of high quality potted e.h.t. converters. The leaflet provides full mechanical and electrical details.

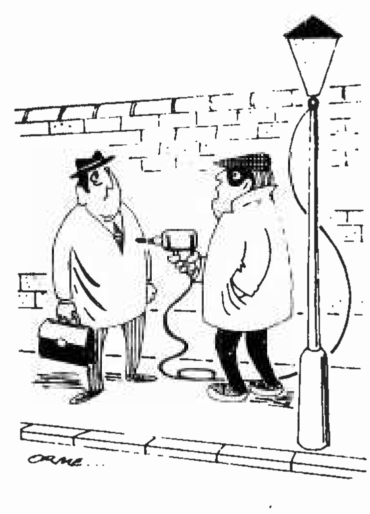
● To broadcast abroad today the BBC uses a total of 70 transmitters – 44 of them at sites in the United Kingdom and 26 of them at strategically placed relay bases overseas.

● A new version of its well-proven infra-red detector, the AFA Infrascan, has been introduced by AFA-Minerva (EMI) Ltd., Twickenham, Middlesex, an EMI company, for operation on 24 volt battery power supplies. The latest version of this scanning detector ensures continuous fire surveillance of installations even during periods of mains power failure – the detector automatically switching to battery supply in emergency situations.

● Any member of World Radio Club who reports accurately on reception of the Anniversary Edition on November 9th, 10th or 12th, will receive a special QSL card. Membership is free, and the address is: World Radio Club, BBC, Bush House, London.

● SGS (United Kingdom) Limited, the first UK semiconductor manufacturer to gain a British Post Office D3000 Grade 1 Approval, is now under contract to supply DTL Integrated Circuits under this Approval to STC Limited for use in TXE4 Electronic Telephone Exchanges.

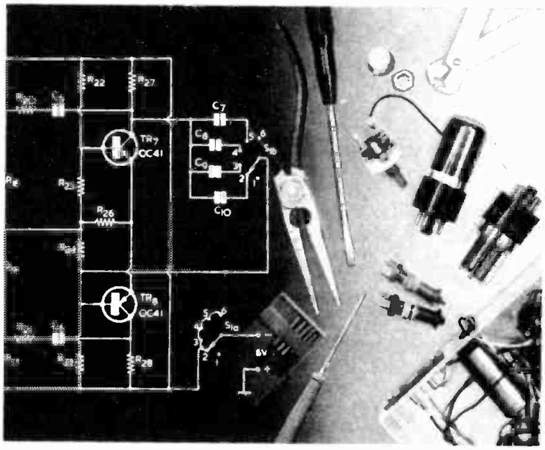
● The third edition of a handbook 'Noise measurement techniques', written by W. V. Richings Technical Director of Dawe Instruments Limited, specialists in the manufacture of sound level measuring equipment and internationally known makers of electronic and ultrasonic equipment, is available free on request from Dawe Instruments Limited, Concord Road, Western Avenue, London, W3 0SD.



Stick 'em up or I'll drill yer!

PHOTOGRAPHER'S METRONOME

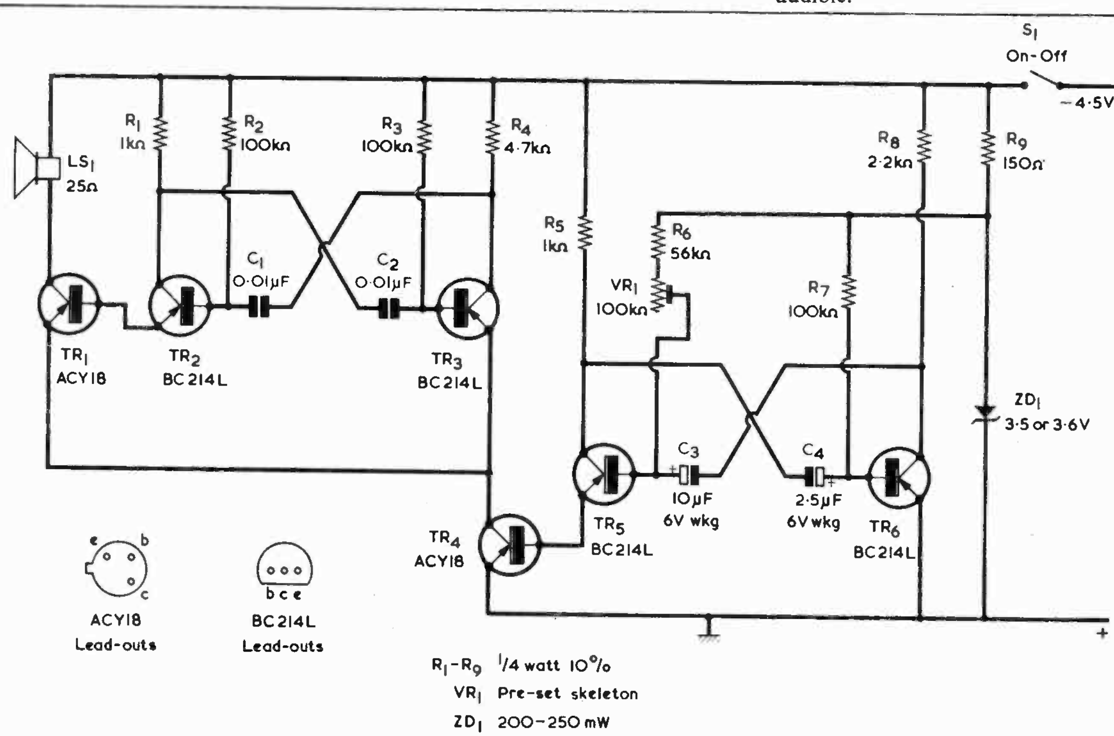
by G. A. FRENCH



THIS MONTH'S 'SUGGESTED CIRCUIT' IS the outcome of a suggestion made by a friend who is a professional photographer. Certain processes in the printing of photographs need to be timed accurately, the timing periods often varying from one photograph to the next. A common approach consists of counting seconds orally. Since it is difficult to assess the length of a second precisely, each number is preceded by a word which will bring the total uttered length up to approximately one second, whereupon a spoken succession such as 'Kodak one, Kodak two, Kodak three', and so on, is employed.

As was explained to the author, the printing processes could be carried out much more easily and reliably if some form of metronome could be devised which would produce 'clicks' or pulses of sound at intervals of exactly one second. Seconds could then be counted off accurately by counting in time with the metronome.

The production of an electronic metronome is not, of course, a particularly difficult requirement to meet, and a simple solution to the problem is given in the accompanying circuit diagram. This gives short bursts of an audio tone around 700Hz, the burst starts being spaced at one second intervals. The writer felt that a unit giving tone bursts was preferable to a device which merely produced 'clicks', as the latter would not be so readily audible.



The circuit of the photographer's metronome. This produces tone bursts spaced at 1 second intervals

CIRCUIT OPERATION

The circuit consists of two multivibrators. The multivibrator around TR2 and TR3 produces the 700Hz tone, and it is switched on and off by the multivibrator around TR5 and TR6 which operates at a speed of one cycle per second.

Dealing first with the 700Hz multivibrator, we may examine its functioning when transistor TR4 is turned hard on, thereby allowing the positive supply to be applied to the lower supply line of the multivibrator. TR2 and TR3 form a 50:50 multivibrator, the running frequency of which is governed by the values of R2, R3, C1 and C2. The emitter of TR2 is returned to the lower supply line via the base-emitter junction of TR1, with the result that when, during the multivibrator cycle, TR2 is conducting TR1 is turned hard on. The collector of TR1 couples to the negative supply rail via the 25Ω loudspeaker LS1, and this consequently reproduces the multivibrator frequency. The audio output level is more than adequate for normal dark-room requirements.

R1, in TR2 collector circuit, is given the relatively low value of 1kΩ, and it ensures that sufficient current flows in TR1 base to bring it hard on when TR2 is conducting. There is no necessity for the collector load of TR3 to have a value as low as this, and a small saving in average battery current is achieved by giving R4 a value of 4.7kΩ.

The second multivibrator turns TR4 on and off (thereby turning the first multivibrator on and off) in the same manner that the first multivibrator controls TR1. This second multivibrator is, however, asymmetric and capacitor C3, coupling to the base of TR5, has a larger value than capacitor C4, which couples to the base of TR6. Also, the final setting in VR1 will probably cause the total resistance inserted by this component and R6 to be greater than that of R7. Thus, TR5 is turned off during the multivibrator cycle for a period that is at least 4 times that during which TR6 is turned off. In practice, it is turned off for about 7 times as long, and the result is a series of tone bursts from the speaker which have a comfortably audible length in relation to the silent periods between them.

As with the collector load of TR1, TR5 collector load, R5, is given a value of 1kΩ to ensure that TR4 is turned hard on when TR5 conducts. Again in the interests of economy in battery current, R8 is given a value which is higher than that of R5. The value of R8 is not critical, but it was found empirically that the value specified, 2.2kΩ, offered the best performance.

It is necessary for the frequency of operation of the TR5, TR6 multivibrator to be as accurate as possible. This frequency is controlled by R6, VR1, R7, C3 and C4, and a measure of stabilization is obtained by returning R6 and R7 to the regulated voltage across zener diode ZD1. Even with this zener diode in circuit, however, it is desirable to discard the battery when its potential falls below some 4 volts. The length of the multivibrator cycle is set by means of the pre-set potentiometer VR1.

COMPONENTS

None of the components are critical or difficult to obtain. Loudspeaker LS1 can be a small inexpensive component with a nominal impedance of 25Ω and having a cone diameter of some 3 to 4 in. Transistors TR1 and TR4 are shown as ACY18, but any other transistors in the ACY17 to ACY22 'family' could be employed instead, as also could the ACY39, ACY40, ACY41 or ACY44. These all have the same lead-out disposition as the ACY18.

Capacitors C3 and C4 are shown as electrolytic, and these should be adequate for normal requirements. It is desirable to employ new capacitors here, rather than components which have seen a lot of service in other circuits. If a high degree of long-term accuracy is desired, plastic foil capacitors may be used instead of electrolytic components, in which case the value of C4 may be changed to 2.2μF. High value polycarbonate capacitors in 2.2μF and 10μF are available from V. Attwood, P.O. Box 8, Alresford, Hants. There is no necessity for C3 and C4 to be close-tolerance types as variances from nominal capacitance are taken up in the adjustment of VR1.

After the circuit has been assembled and constructed it is necessary for VR1 to be set up such that the tone bursts from the speaker appear at intervals of exactly one second. This process can be carried out with the aid of a watch having a sweep second hand. The unit is switched on and the number of tone bursts counted whilst observing the second hand of the watch. VR1 is then adjusted experimentally until 15 bursts are reproduced in quarter of a minute. An electrolytic capacitor in the C3 position which is at the extreme of its tolerance range could conceivably result in the required frequency being outside the range of adjustment offered by VR1. Should this occur, the value of R6 should be adjusted accordingly. The length of the multivibrator cycle increases as the sum of the resistance inserted by R6 and VR1 increases, and vice versa. If electrolytic capacitors which have been in store for a considerable period are used for C3 and C4, the unit should be run for several minutes or so to allow them to settle down to their final capacitance before setting up VR1.

The current drawn from the 4.5 volt battery by the prototype unit was 11mA between tone bursts and 80mA when tone bursts were generated. This corresponds to an average battery current of approximately 20mA. ■

'50 years on the air'

The BBC celebrates 50 years "on the air" this month. We give some of the background to the origins from which public broadcasting began.

FIFTY YEARS AGO BRITISH BROADCASTING WAS BORN in an ex-army hut near Chelmsford in Essex, when on 14th February 1922 a group of Marconi engineers began a series of regular experimental transmissions. Every Tuesday evening from a rigged-up transmitter, call sign 2MT Writtle, or more affectionately to its listeners, Two Emma Tock, transmitted programmes whose original purpose was entirely technical. Shortly afterwards, in May, another transmitter, later to be even better known, was opened up at Marconi House in the Strand in London. This was the famous 2LO station that provided the foundation from which the British Broadcasting Company grew after its formation on 14th November of the same year.

Two Emma Tock provided the first regular broadcast service in this country, and incidentally broadcasting's first audience, an audience which in its enthusiasm for the pioneering programmes, generated the original demand for public service broadcasting. The 2MT transmitter was set up for use in a series of experiments designed to establish the effective range of a wireless telephony transmitter. At the same time a number of radio amateurs were appearing, largely young ex-service men who had learnt about radio during the 1914-18 war, who had put together their own receiving sets, and who wanted transmissions to receive. Earlier experiments with entertainment, as when Dame Nellie Melba and later Lauritz Melchior, the Danish tenor, had broadcast from a makeshift studio in Chelmsford in 1920, had shown that there was a potential for wireless telephony outside official communication and navigation usage, but the official attitude had been discouraging, and the duty of granting licences for transmitters was the preserve of the Postmaster General. Government was unwilling to consider licences for more than a token number of even technical transmissions.

2MT was finally granted an experiemental licence to transmit early in 1922, though the permission was hedged about with many restrictions. But for half an hour on Tuesday evenings, experiments were to be allowed, though even then with three-minute breaks in every ten, to ensure that no interference with "legitimate services" was being perpetrated.

2MT opened regular broadcasts officially on behalf of the amateurs who needed a source against which they could calibrate their receivers, and to begin with its programmes were not very much more interesting than early 1920 transmissions made before the government clamp-down, when W. T. Ditcham read from Bradshaw's railway timetable, but the enthusiasm and gaiety of the young Marconi engineers who ran it very soon turned it into a half-hour's entertainment in its own right. The names of those men read like a roll-call of some of the great names in Broadcasting. In charge of the project was Captain P. P. Eckersley, who later went to the new British Broadcasting Company as its first Chief Engineer. It was his infectious and spontaneous humour which gave 2MT its unique flavour; he was not only the first engineer in charge, he was also the first of the true radio entertainers, with a gift for ad-libbing that constantly alarmed those of a less advanturous disposition who worked with and around him. Others in the team were Noel Ashbridge, later Sir Noel, who was the BBC's first technical director, till his retirement in 1952, R. T. B. Wynn, a later Chief Engineer of the BBC and B. N. MacLarty, who became Head of the BBC's Design and Installation team before he returned to Marconi's in 1947 as Engineer in Chief.

By contrast, Marconi's 2LO station, granted its licence in May, began a rather staid existence, a happy coincidence for the pioneers of 2MT, as it gave them an opportunity to provide skits and lampoons which were much appreciated by their listeners. 2LO operated on conditions of restricted timing, at first even no music, and low power, beginning with 100 watts, later raised to 1½kW. Its programmes had each to be individually licensed by the PMG, and were limited to private occasions often for charity, at which Marconi engineers installed the receiving apparatus and operated it. Each programme was notified to listeners by postcard by means of a special mailing list kept by The Marconi Company, and most of them consisted of light music.

The 2LO station transmitter was designed by Captain H. J. Round, installed by C. S. Franklin and run by A. R. Burrows who eventually became the much-loved Uncle Arthur of the BBC. Among the many papers in the Marconi archives which tell the story of the birth of British Broadcasting, not the least interesting is Arthur Burrows' letter requesting permission to recruit a young man of particular quality to compere the station's programmes, a young man with "technical tendencies . . . grace of manner . . . and an excellent telephone voice". Many of Burrows' requirements were couched in terser terms and it was his organisational skill and foresight that shaped the studio techniques which are still the basis of modern broadcasting.

By this time many wireless societies had been formed and more and more the demand for radio receivers was being felt. In the United States since 1919 'wireless' had become fashionable, but with no constitutional control of the use of wavelengths, chaos reigned in a commercially sponsored free-for-all. The British Government, seeking a way from the dilemma posed by popular demand on the one hand and a justifiable reluctance to allow free access to the air on the other, set up the Wireless Sub-Committee of the Imperial Communications Committee in April of 1922. After consideration, their recommendation to set up a single broadcasting company was accepted and in November 1922 the British Broadcasting Company was formed from six commercially interested companies with £100,000 share capital. ■

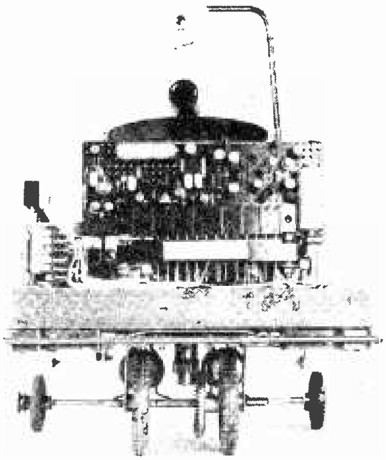
CYCLOPS

This is the fifth article in the series concerning robots and cybernetic devices, and it continues with the construction of Cyclops.

PART FIVE

by

L. C. Galitz



IN THE LAST ARTICLE, CONSTRUCTION of the basic reflexes – reflexes that are instinctive and innate – was discussed. In this article, another type of reflexive response is dealt with; one which is not inborn but is conditioned by the environment – the conditioned reflex.

The first person to study the realms of the conditioned reflex in great detail was Pavlov. In his experiments he would firstly show food to a hungry dog, and measure the amount of saliva produced. Here we have an innate reflex. There is a specific stimulus, which we shall designate Ss, evoking a specific effect, which we shall call Es. After measuring the extent of Es, on the second and subsequent times of feeding, just prior to showing the hungry animal the food Pavlov would present to the animal another stimulus. This second stimulus was a neutral stimulus, having no relevance to the specific stimulus. To the neutral stimulus we shall designate the symbol Sn, and to the effect it evokes we shall designate the symbol En. In Pavlov's experiments, this second stimulus was the ringing of a bell, producing say a pricking up of the dog's ears. Thus the animal would hear a bell and, immediately after this, would be given some food. After about twenty of these coincidences, Pavlov found that on hearing the bell, the animal commenced salivating. In other words, the animal had been conditioned to associate the bell with food.

Pavlov found that in order to build the conditioned reflex quickly, Sn had to be presented a very short time before Ss. He also found that the animal did not produce the conditioned reflex if the bell was rung after the food, or if the bell was rung a long time before the food. He also discovered that in order to maintain the conditioned reflex, the association had to be continually reinforced. It was no use ringing the bell without giving the animal the food; and if the conditioned response was produced it would fade away just as surely if the coincidence of signals never again occurred. Furthermore, if the food was presented without previously ringing the bell, the conditioned response would also fade away, but not as quickly as with the case where the bell is rung without the food.

The conditioned reflex is used with animals extensively today. One often sees an animal at a circus performing a trick and then getting a lump of sugar as a reward. He has been conditioned to associate a correct performance with food. However, we have also seen that some animals go through trick routines without getting a reward. This is accomplished by having two interlinked conditioned reflexes. The animal is given a pat and then receives some food. Hence, it associates a pat with food. Then after performing the trick successfully, it gets a pat, and begins to associate that a good performance means a pat. Thus we now have trick means pat means food, and in order that the animal performs his routine correctly without having to feed it in the circus ring, all the trainer has to do is pat the animal after the trick. This process is known as establishing a second-order-conditioned-reflex.

So far, we have dealt with conditioned reflexes where success means reward. There is another variety where failure means punishment. An example of the latter variety is where a crack of the whip follows an animal's misbehaviour, and all reflexes built up where the second stimulus is painful are known as defensive reflexes. With these defensive reflexes, often one association where the second stimulus is more than just discomfort is sufficient to establish a conditioned response, and it often never needs reinforcing.

BLACK BOX ANALYSIS

We can imagine the conditioned reflex unit in animals as a little black box with two inputs, Ss and Sn, and two outputs, Es and En. Normally there are two transmission lines inside; one joins Ss to Es, and the other joins Sn to En. After conditioning, the second transmission line breaks, and reforms to connect Sn to Es. The main problem in synthesizing a conditioned reflex black box is designing the 'bookmaker' which decides when two inputs are associated or not. The way in which our 'bookmaker' works will be described next. (The term 'bookmaker', employed by Dr. W. Grey Walter in his book 'The Living Brain', is applied here to a circuit which tries to work out whether conditioning is profitable or not).

Firstly, we must differentiate Ss and contract it. When our animal is feeding, there is a long output from its food detectors to the input of the black box, and this must be made of short duration. Contrary to this, the second step is to extend Sn from the short period the bell rings, to a much longer period, for it must be 'remembered' for a while. The third stage compares the differentiated Ss and the extended Sn. If there is any overlap, the overlap areas are fed to a summer, which executes the fourth stage of conditioning. The summer thus sums the coincidences between Ss and Sn, and it is also designed to 'leak' its output away very gradually, so that the summer level will fall if Ss and Sn never again coincide. Incorporated in the summer is a device which gives an output once the summer level has reached a critical level – the threshold of learning. It is this output which operates the switching of the transmission lines, and in Fig.24, details of the operations involved are given pictorially. The sections in Fig.24(c) go through a period of conditioning, which then finally becomes inhibited through lack of reinforcement.

BLOCK DIAGRAM

The operations just described must now be converted into electronic circuitry for it to be incoporated into Cyclops, and the block diagram equivalent is given in Fig.25. It will be noticed that both differentiation and extension are carried out by monostables. This is due to the fact that in order to give a sufficiently long pulse to the summer, a capacitor used in a differentiating circuit would have to be of gargantuan proportions. The differential monostable has a quasi-stable time of one second and the extension monostable has a quasi-stable period of seven seconds. The output of each is fed to one input of a 2-input And-gate. Thus, there will only be an output from this coincidence gate when both monostables are in their quasi-stable period. This will only happen if Sn is given within a period seven seconds before Ss, and the gate will not give an output if Sn is given more than seven seconds before Ss, or if it is given after Ss. The output will also be of reduced duration if Sn is given between six and seven seconds before Ss, because the extension monostable will cut off during the period that the differential monostable is in its quasi-stable state.

The output of the coincidence gate goes to a summer which sums the outputs of the gate, and also 'leaks' slightly during the periods that the gate is not giving an output, so that if reinforcement does not occur the summer level drops. The output of the summer is monitored by a Schmitt trigger whose output is normally at logic nought.

It can be seen from Fig.25 that, whenever Ss is applied, the stimulus also travels down the transmission line to an Or-gate which subsequently gives an output to the Es terminal. Thus Ss evokes Es. Similarly, Sn travels down the transmission line to a gate, but this time it is an And-gate. The other input of this And-gate comes from the Schmitt trigger via an inverter, so that when the Schmitt trigger is off, there is a logic one on the upper input of the And-gate, and thus the Sn pulse goes through the gate to the En terminal. At the same time, the

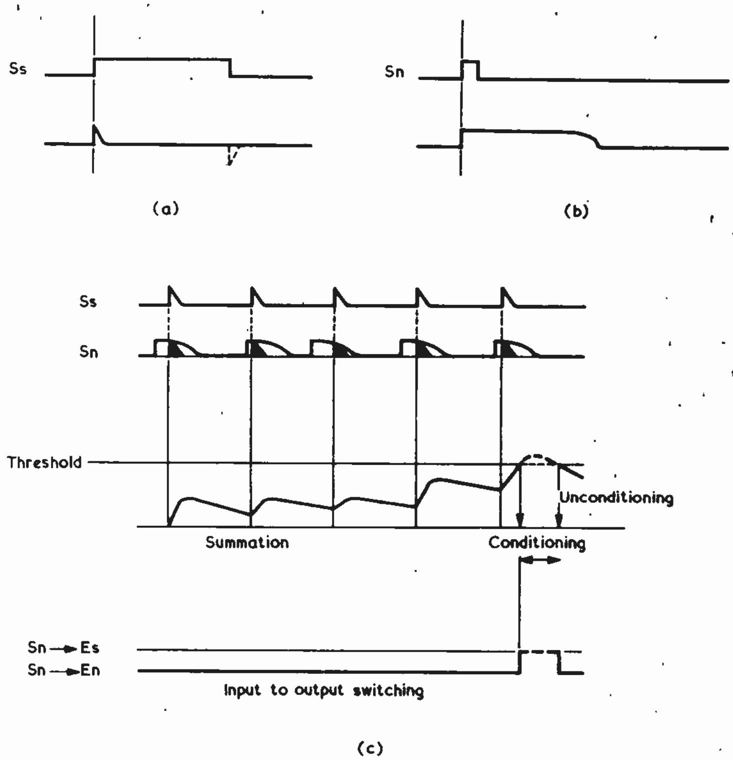


Fig. 24 (a). How Ss is differentiated
(b). The extension of Sn
(c). The creation of the conditioned reflex. Ss and Sn coincide a number of times, causing the summation which appears below them. When the summation characteristic exceeds the threshold level conditioning takes place, with the consequent input to output switching shown at the bottom

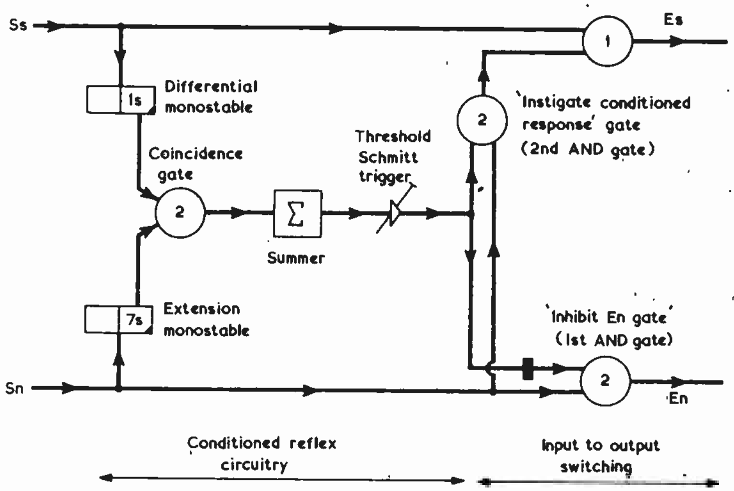


Fig. 25. Theoretical version of the conditioned reflex circuits

Sn pulse goes to another And-gate, whose other input goes directly to the Schmitt trigger; and so when the latter has not fired there will be a logic nought on the And-gate's input, and the second And-gate will not fire.

When the summer level reaches the input threshold of the Schmitt trigger, the trigger fires, making its output change to logic one. Once this happens, there will be a logic nought on the upper input of the first Sn And-gate, and therefore the Sn pulse coming along the lower transmission line will not get through this gate. On the other hand, there will now be a logic one input on the second gate, and when a pulse from Sn comes along the transmission line, there will be an output from this gate which leads to the other input of the Or-gate. Thus, after conditioning, instead of Sn evoking En, it now evokes Es.

THE PRACTICAL BLOCK DIAGRAM

The block diagram employed for the practical model differs from the theoretical diagram of Fig.25, the differences being mainly in the input and output stages rather than with the 'bookmaker'.

Firstly, the conditioned reflex in Cyclops is made to do two jobs. In one mode, the inputs and outputs are switched so that it is allowed to associate magnetism with touch, and

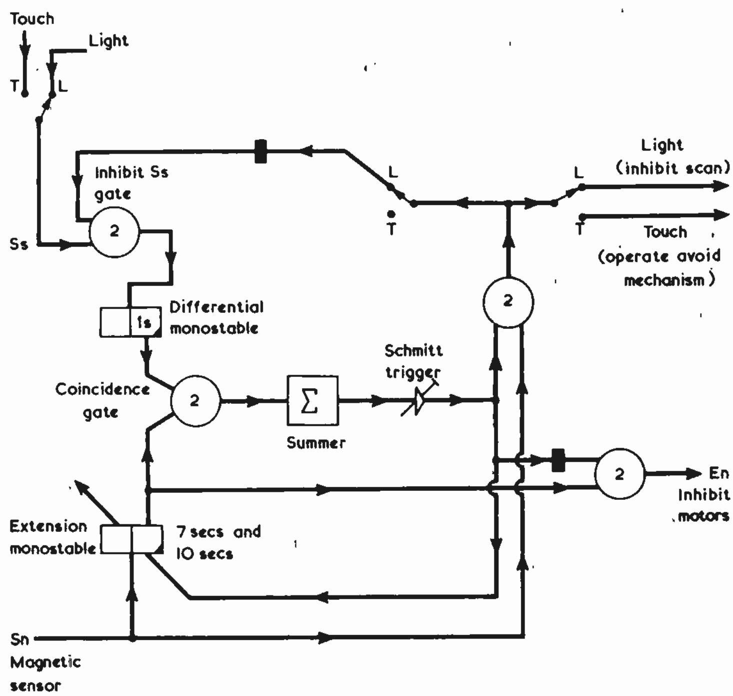


Fig. 26. Practical conditioned reflex unit. Note that the Ss to Es transmission line already exists in the basic circuitry.

COMPONENTS

Resistors
(All fixed values ½ watt 10%)

R23	1kΩ
R24	2.2kΩ
R25	2.7kΩ
R26	2.2kΩ (see text)
R27	6.8kΩ
R28	100kΩ
R29	2.7kΩ
R30	1kΩ
R31	1kΩ (see text)
R32	2.7kΩ
R33	100kΩ
R34	15kΩ
R35	15kΩ
R36	2.7kΩ
R37	1kΩ
R38	4.7kΩ
R39	22kΩ
R40	10kΩ
R41	470Ω
R42	4.7kΩ
R43	56kΩ
R44	1kΩ
R45	1kΩ
R46	56kΩ
VR4	10kΩ potentiometer, preset skeleton

Capacitors

C6	0.05μF
C7	125μF electrolytic, 10 V.Wkg.
C8	0.05μF
C9	400μF electrolytic, 10 V.Wkg.
C10	1,000μF electrolytic, 10 V.Wkg.

Semiconductors

TR15–TR18	Any p.n.p. transistor, e.g. OC71
TR19, TR20	2N2926
TR21, TR22	As TR15–TR18
TR23	Any p.n.p. transistor with low leakage
TR24, TR25	As TR15–TR18
TR26, TR27	Any n.p.n. transistor, e.g. AC127
TR28	Any p.n.p. transistor capable of driving relay, e.g. OC81
TR29, TR30	As TR15–TR18
TR31	As TR28
D4	Any silicon diode, e.g. OA200
D5	Silicon diode with high reverse resistance
D6–D9	As D4

Magnetic Sensor

X2	Dry reed switch, R.S. Components type 7RSR (Home Radio Cat No. WS121)

Battery

BY3	6V 225mA/H Deac rechargeable battery (Ripmax Ltd.)

Veroboard, Connector
Veroboard: 0.15in. matrix, 2 × 5in., 13 strips × 33 holes
Connector: Painton 15 pin in-line connector (see text)

Miscellaneous
Tank clip (for securing BY3) (Ripmax Ltd.)
2-off Meccano double brackets, part 11 (see text)
1-off Meccano rod and strip connector, part 212a
1-off Meccano rod, 3½in., part 16.

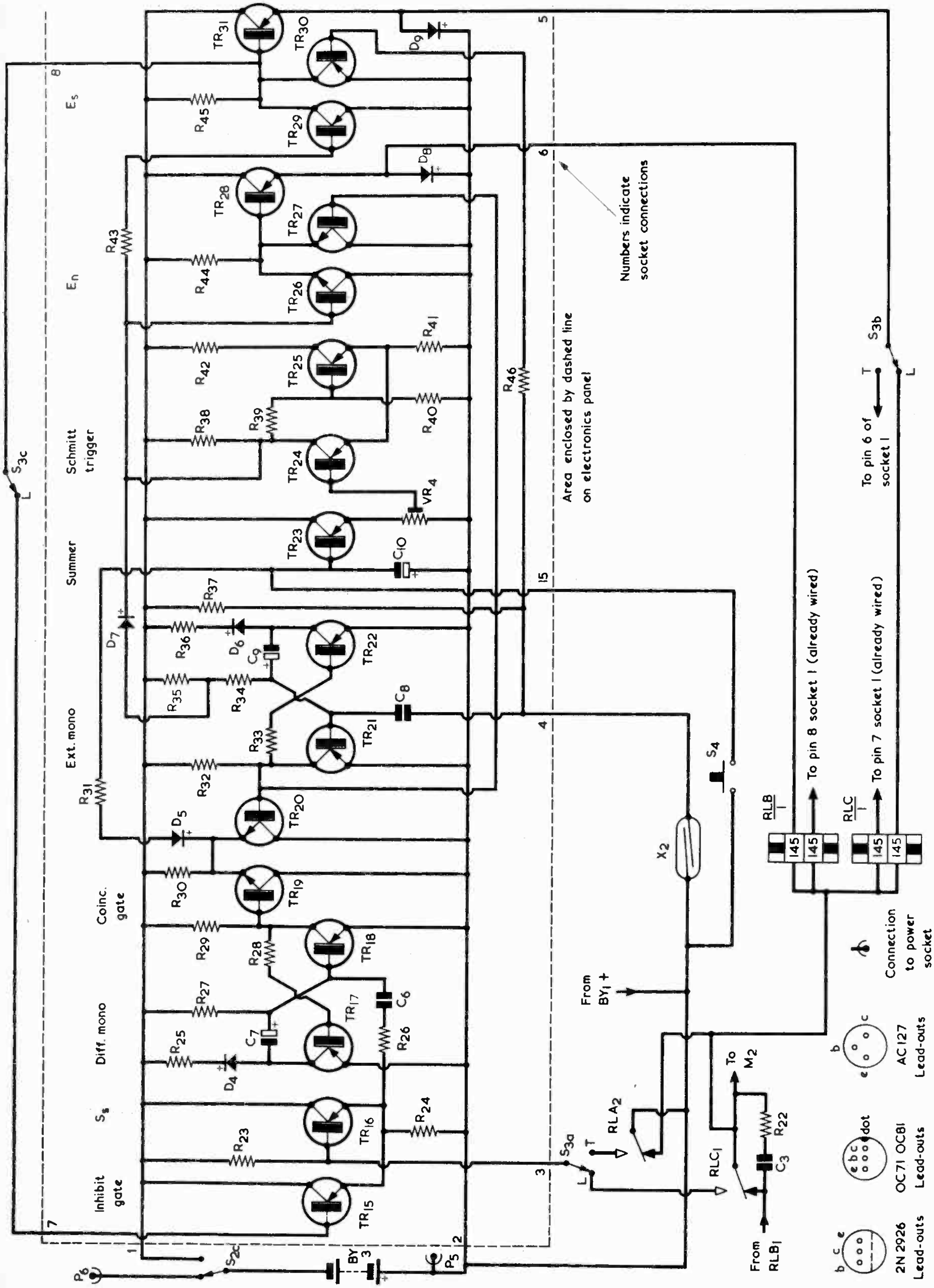


Fig. 27. Circuit diagram for the conditioned reflex unit

in the other mode, the inputs and outputs are switched so that Cyclops has the ability to associate magnetism with light.

An extra gate had to be included because of this since it was found that, when Cyclops was conditioned, giving Sn evoked Es, but in both cases, the action of Es was to produce Ss. Due to the fact that touch means pain in Cyclops, in the 'magnetism means touch' mode, this automatic reinforcement of the coincidence between Sn and Ss is desirable. The conditioning does not need to be reinforced – this being found in real life with defensive reflexes. However, the effect is undesirable with 'magnetism means light' conditioning, and the extra gate temporarily disconnects Ss whilst Es is being evoked in the 'magnetism means light' mode. In the other mode, there is no feedback supplied to the new And-gate via the inverter, and thus Ss is never inhibited, and automatic reinforcement is allowed to take place.

Another modification used concerns what is known as the trace reflex. After conditioning, an animal can allow Ss to occur after a longer period after Sn than before conditioning. Accordingly, the output of the Schmitt trigger alters the time constant of the extension monostable from seven seconds before conditioning to ten seconds after conditioning.

In Cyclops, Sn is always the output from a magnetism sensor. It will be appreciated that strong magnetic fields could upset the operation of Cyclops' circuitry by inducing unwanted voltages in the circuit whilst Cyclops roams around. (In actual fact, extremely powerful fields not normally encountered outside the research laboratory would be required to do this, but Cyclops is only demonstrating the principle involved.) To prevent this, whenever Cyclops encounters a strong enough magnetic field he stops dead to prevent these voltages being induced, and he 'plays possum' for a short while; after a few seconds, he slowly creeps off again. Thus, En is to stop the motors for a while. In the interests of economy, therefore, instead of having a third monostable to do this after the En And-gate, Cyclops uses his extension monostable instead, and the input of the En gate goes to the output of this monostable instead of directly to Sn. The altering of this monostable's time constant bears no relevance, because En is inhibited whenever the monostable runs with a ten second time constant. Fig.26 gives details of the modifications.

Therefore, when Cyclops operates in the 'magnetism means light' mode, in order to establish the conditioned reflex one must apply a magnet to his magnetic sensor, and then shine a light into his eye. After several such coincidences, instead of stopping when one applies the magnet he will continue in the direction he was going when the magnet was applied. He has thus built up the association that magnet means light which is food, and so keep going in the same direction in order to home into the magnet.

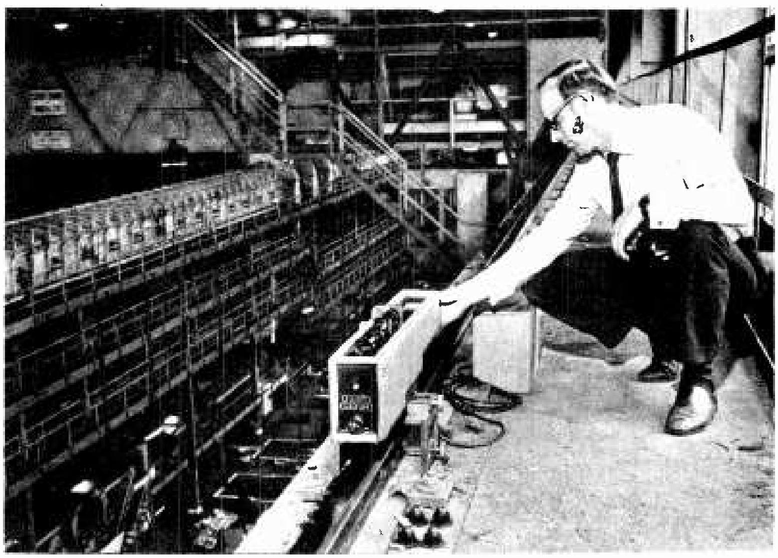
When Cyclops operates in the 'magnetism means touch' mode, to set up the conditioned response one must apply the magnet, which makes Cyclops stop in his tracks for a short while, and then jar his touch sensor, which makes him go through his avoid reflex. After a few coincidences, upon applying the magnet he will immediately start twisting and turning in an attempt to avoid the magnet, because the association that 'magnet means touch' which is pain, and so has to be avoided, has been set up.

CIRCUIT

The circuit for the conditioned reflex unit is given in Fig.27. This will be discussed in the next issue, in which the concluding article in the present series on Cyclops will be given. Also given this month is a Components List showing the additional parts required. Some of these are discussed in detail next month and readers are advised to wait until the appearance of the next article before obtaining any components over which they may have any doubt.

(To be concluded)

'LASER-LINE'



The accompanying photograph illustrates the Marconi-Elliott 'Laserline' in operation at the British Steel Corporation plant in Ebbw Vale, South Wales. The 'Laserline', is produced by Marconi-Elliott Avionic Systems Ltd., a member of GEC-Marconi Electronics Limited.

At the Ebbw Valve works B.S.C. surveyors have, with the aid of the 'Laserline', cut by 80% the time spent in checking the alignment of overhead crane rails. The first survey incorporating the 'Laserline' was of the 700 ft. rails in the No. 2 galvanising line, where 25 ton loads of steel strip are handled by an overhead crane with a span of 90 ft. The rails are 60 ft. above floor level and heat haze makes visual sighting difficult, whereupon survey work could only be carried out previously during the few hours when the plant was not fully operating. There are a score of overhead crane rails in the Ebbw Vale works.

The beam of the 'Laserline' penetrates haze and enables more accurate measurements to be obtained. It can be set up very quickly, so that a survey at Ebbw Vale can now be completed in three hours at any time of the year instead of over several days during the annual shut down period.

The 'Laserline' is a portable laser beam projector designed specifically for field operation, and it provides an accurate linear reference in pipe-laying, tunnel guidance and other civil engineering applications. It is rugged and waterproof, is fitted with a sighting telescope and levelling bubble and operates from a 12 volt battery. The advantages of a laser beam are that, once aligned, it operates unmanned and is not disturbed by people or vehicles passing through the reference line. The 'Laserline' is manufactured by the Neutron Division of Marconi-Elliott Avionic Systems Ltd. at Elstree Way, Borehamwood, Herts. ■

SHORT WAVE NEWS

FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT *Frequencies* = kHz

The lead story this month concerns the appearance of Radio Conakry, Guinea Republic, on a measured **4903** (61.18 metres) where it was first heard by us in early September at 1930 with identification in French followed by African music. This represents a shift in frequency from **4910**. The published evening schedule is from 1600 to 2400 and the address is – Radiodiffusion Nationale, B.P. 617, Conakry.

NOW HEAR THESE

Asian stations are being heard here in the U.K. somewhat earlier this year than is normal, during afternoon sessions Indian stations on the low frequency bands have been coming through at quite good signal strengths.

AIR Delhi on **4760** (63.03m) at 1659, Hyderabad on **4800** (62.50m) at 1700 and Madras on **4920** (60.98m) at 1720 (under Moscow) have all been logged according to the British Association of Dxers (BADX).

Other Asian stations that have been heard are – Radio Ceylon on **4870** (61.60m) at 1724; Radio Nepal on **5000** (60.00m) at 1615 to 1620 sign-off and Radio Singapore on **5010** (59.88m) and on **5052** (59.38m) with Asian music, identification, National Anthem and sign-off at 1627.

During late night sessions, the following Asian stations have been logged – Radio Bangkok on **4830** (62.11m) at 2257 with 14 or 15 note chime interval signal, anthem, more chimes, man speaking in Thai and then into Asian 'pops'; Radio Malaysia, Kajang, on **4845** (61.92m) at 2315 with Indian music and Tamil announcements; Lan-Chou in Kansu province of China on **4864** (61.67m) at 2252 with talk in Chinese; Radio Phonm-Penh on **4907** (61.14m) at 2226 with music and talk in Khmere; Radio Malaysia, Penang, on **4985** (60.18m) at 2316 with announcements in English, advert for ground coffee and western 'pops' and Radio Singapore around 2310 with Chinese songs on **4845** (61.92m), **4985** (60.18m), **5010** (59.88m) and on **5052** (59.38m).

We have recently logged Radio Phonm-Penh at 2215 on **4907** when continuous Buddhist chants were being radiated. Radio Singapore on **5052** was also logged during the same evening at 2255, a programme of dance music being marred by CW interference on the channel.

● IRAQ

Radio Baghdad, which was reported to have vacated **7240** for **7210** has in fact been using **7227** (41.51m). Following a lead from BADX, we heard it at 1920 with a programme of Arabic music and songs.

● PAKISTAN

Radio Pakistan has been logged on **11650** (25.75m), an experimental channel, at 1600 with opening melody, and news in dialect followed by local music. ●

● SEYCHELLES

FEBA may often be heard around 1745 on **11955** (25.09m), at which time we listened to a religious programme in English.

● CLANDESTINE

The Voice of the Malayan Revolution was recently logged by us on **15789** (19.00m) at 1347 when a talk in a Chinese vernacular was heard followed by a choral marching song at 1350, this pattern being followed until 1400 when identification (?) was made. Faded out by 1410.

● SRI LANKA

Colombo has been heard with a programme of dance music records and announcements in English at 1645 on **15120** (19.84m). The channel is subject to splatter from an adjacent jamming station, only brief 'snatches' of the programme being heard.

● ETHIOPIA

ETLF Addis-Ababa has been heard (following a lead from BADX) on **7145** (41.99m) with the news in English after station identification at 1900. BADX reports that the station is asking for reports on this channel.

● INDIA

AIR Delhi can be heard with news of Indian affairs in English at 1900 onwards on **7215** (41.58m), the channel being subject to QRM from an adjacent jamming station.

● EGYPT

For an evening newscast giving the Arabic view of world affairs, tune to **9805** (30.59m) where Cairo broadcasts the news in English at 2215.

● CHINA

Peking broadcasts on many differing channels, **15030** (19.96m) and **15060** (19.92m) being regularly heard during the evenings around 1915 but there are Chinese regional stations that can be heard if conditions are right and a little patience exercised. Of these, the Fukien Front transmitters on **3200** (93.75m), **3400** (88.23m) and **3900** (76.92m) are most often reported, usually around 2015 to 2045 or so – but what about listening for Kuei-yang, Kweichow, on **3260** (92.02m) when signing-on at 2158; Hupeh, Wuhan, on **3940** (76.14m) after sign-on at 2130; Hsi-ning, Tsinghai, on **3950** (75.95m) with gym exercises at 2245; Urumchi, Sinkiang, on **4110** (72.99m) at 2304 with talk in Uighur; Urumchi on **4500** (66.66m) at 2307 with talk in Chinese dialect or K'un-ming, Yunnan, on **4760** (63.02m) at 2205 with songs in Chinese – the latter station also being reported, in parallel, on **4785** (62.69m) and **6935** (43.29m). Information on Chinese local stations has been kindly provided by BADX.

● BRAZIL

ZYN32 Radio Nacional Brasilia may be heard, according to BADX, on **15448** (19.42m) at 2230 with a talk in English, request for reports and tapes.

TIME-CHECK

The stations mentioned in the foregoing paragraphs are listed here on a time-check basis for the convenience of readers.

GMT	*Freq.*	*Stn.*	*Revd.*
1347	15789	Voice Malayan Revolution	
1600	11650	R. Pakistan	
1615	5000	R. Nepal	
1645	15120	Colombo	
1659	4760	AIR Delhi	
1720	4920	AIR Madras	
1724	4870	Colombo	
1745	11955	Seychelles	
1900	7145	Addis-Ababa	
1900	7215	AIR Delhi	
1915	15030	Peking	
1915	15060	Peking	
1920	7227	R. Baghdad	
1930	4903	R. Conakry	
2015	3200	Fukien Front	
2015	3400	Fukien Front	
2015	3900	Fukien Front	
2130	3940	Hupeh	
2158	3260	Kuei-yang	
2205	4760	K'un-ming	
2215	9805	Cairo	
2226	4907	R. Phonm-Penh	
2230	15448	ZYN32 R.N. Brasilia	
2245	3950	Hsi-ning	
2252	4864	Lan-Chou	
2257	4830	R. Bangkok	
2304	4110	Urumchi	
2307	4500	Urumchi	
2310	4845	R. Singapore	
2310	5010	R. Singapore	
2310	5052	R. Singapore	
2316	4985	Penang	

CURRENT SCHEDULES

● HOLLAND

Radio Nederland broadcasts in English to Europe as follows – weekdays from 0930 to 1050 on **6020** (49.83m) and on **7275** (41.24m); from 1400 to 1520 on **6020**; from 1830 to 1950 on **6020** and **15375** (19.51m). On Sundays from 0930 to 1050 on **6020**, **6140** (48.86m) and on **7275**; from 1400 to 1520 on **6020** and from 1830 to 1950 on **6020** and on **15375**.

● KUWAIT

Radio Kuwait has replaced the **11825** channel with that of **15415** (19.46m) for the English transmission from 1730 to 1900.

● THAILAND

Bangkok has an external service in English from 1025 to 1117 and from 0415 to 0530 on **9655** (31.07m) and on **11905** (25.20m) the latter transmission being intended for North America.

● TURKEY

Radio Ankara broadcasts to the U.K. and N. Africa in English from 2200 to 2230 on **9515** (31.53m) and on **15195** (19.74m).

● NORWAY

Radio Norway, Oslo, broadcasts in English on Sundays as follows – from 1200 to 1230 on **6130** (48.94m), **15175** (19.77m), **21655** (13.85m), **21730** (13.80m) and on **25900** (11.58m). From 1600 to 1630 on **15345** (19.55m), **21655**, **21730**, **25730** and on **25900**. From 1800 to 1830 on **6130**, **17825** (16.83m), **21655**, **21730** and on **25900**. From 2000 to 2030 on **6130**, **17825**, **21655** and on **21730**. From 2200 to 2230 on **11850** (25.31m), **15175** and on **15345**. On Mondays from 0001 to 0030 on **9610** (31.22m), **11735** (25.56m) and on **11850**.

● LEBANON

Radio Lebanon, Beirut, radiates a programme in English from 1830 to 1900 on **15170** (19.77m), for Europe and from 0230 to 0300 on **9550** (31.41m) for North and Central America.

● PAKISTAN

Radio Pakistan, Karachi, broadcasts in English to Europe as follows – from 2000 to 2010 and from 2035 to 2040 on **7095** (42.28m) **9460** (31.71m) and on **15520** (19.33m).

AROUND THE DIAL

● GABON

Franceville is currently reported using **4830** (62.11m) by BADX, being heard from 2000 until 2200 sign-off. Identification "Ici Franceville, station Nationale, la Voix de la Renovation" being heard at 2115. Not in parallel on **4777**, so presumably a shift from that channel.

● SENEGAL

Dakar can often be heard on the regular **4890** (61.34m) channel around 1915, usually with local music and songs with announcements in French.

● GHANA

Accra has been heard often around 2110 with local news in English followed by station announcements on the normal **4980** (60.24m) channel.

● SOUTH AFRICA

Johannesburg, with 'pops' and announcements in English at 2133 on **4945** (60.66m).

● CEYLON

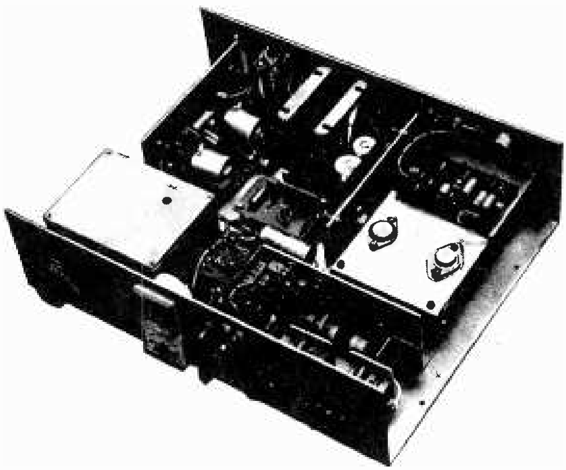
Radio Ceylon, logged often from 1700 until sign-off at 1730 with "All Asia Service of Radio Ceylon from Republic of Sri Lanka", on **9719** (30.86m).

Cover Feature - 2

The 'WYVERN' 160

Solid State

by
John R. Green, B.Sc., G3WVR



This view inside the transmitter illustrates the manner in which the circuit modules are assembled on the main chassis

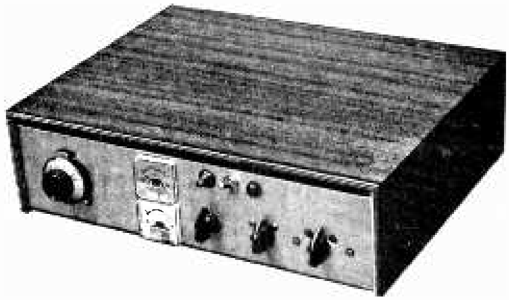
THIS ARTICLE REPRESENTS THE AUTHOR'S DEVELOPMENT of a solid state transmitter which has been in use for some two years.

Initial development of p.a. and modulation techniques began earlier, however, and the design presented is a v.f.o. controlled version of an earlier, simpler, crystal controlled transmitter. The design will appeal to those who are eager to experiment with the constructional challenge of an all-transistor transmitter, and good results should be obtained without difficulty.

The design is capable of running at least 10 watts input and provides excellent quality of modulation, good frequency stability and negligible frequency modulation. Although the overall system is quite large and complex in terms of component quantities, the modular construction simplifies the building and testing programme to a step-by-step process.

In this month's issue the v.f.o., wideband driver stage and frequency doubler and driver section are described, whilst the subsequent two articles will deal with the power amplifier stage, modulator, power supply and VU meter driver. Chassis assembly and the building and testing procedure will be discussed in the third article.

The overall system block diagram is shown in Fig.1, which is self-explanatory. The detailed operation of each section will be covered in the constructional information.



Metre Transmitter

This 3-part series deals with a comprehensive transmitter design which incorporates semiconductors throughout. The description of its construction is continued in Parts 2 and 3, which will be published in the next two issues.

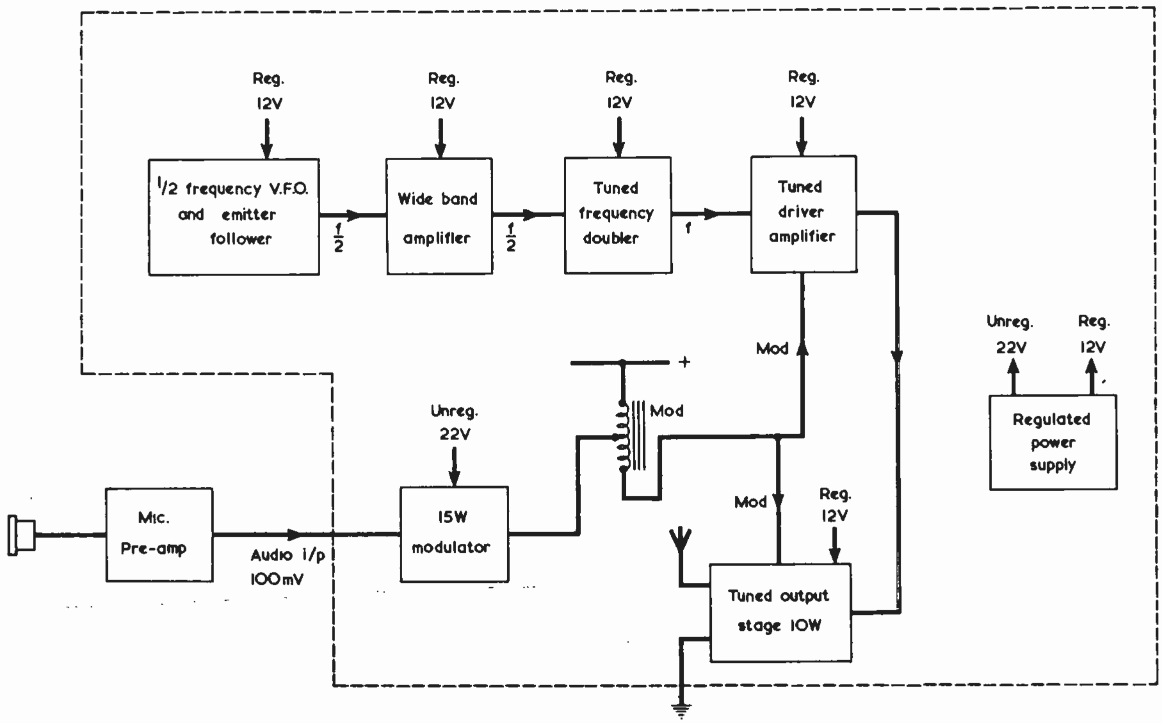


Fig. 1. Block diagram showing the sections of the all-transistor 160 metre transmitter

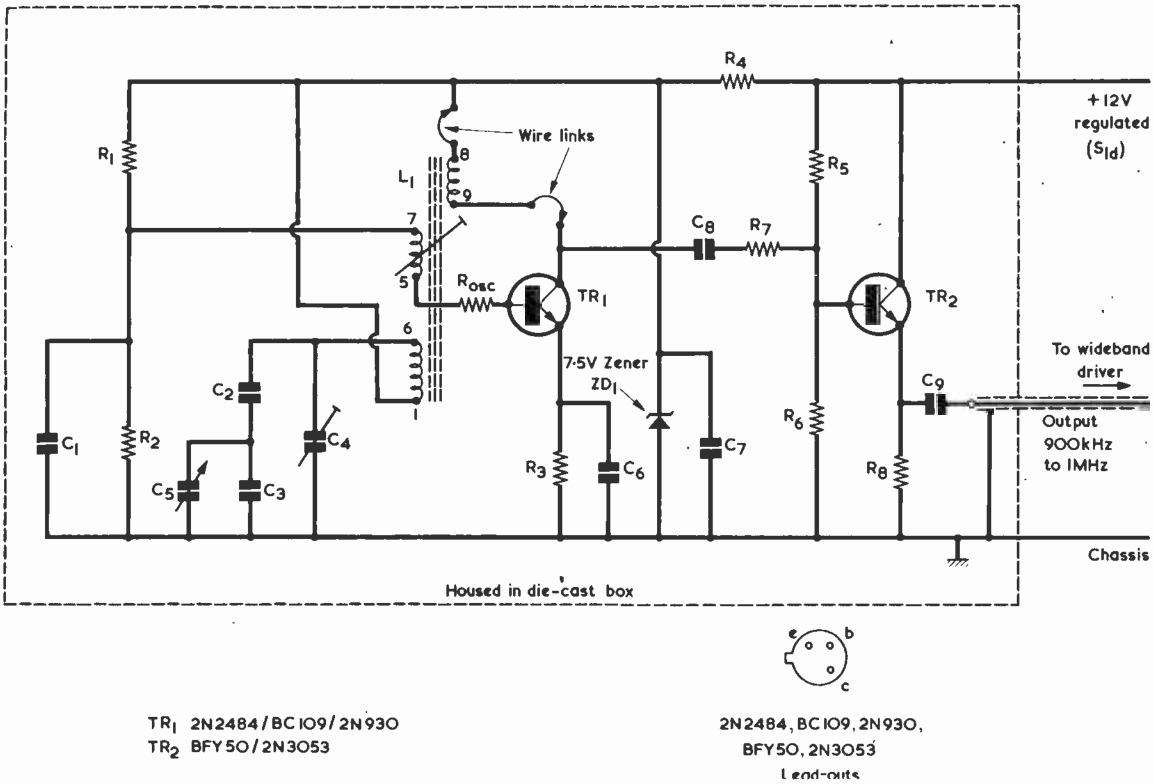


Fig. 2. Circuit diagram for the v.f.o. stage

THE V.F.O. STAGE

The circuit diagram of the v.f.o. stage is shown in Fig.2. The frequency range covered is 900kHz to 1MHz, i.e. half the output frequency, since during development it was found impractical to run the oscillator at the fundamental frequency due to serious 'f.m. pulling' and asymmetric modulation which this produced.

Oscillation is achieved with the Denco coil L1 (Yellow, Range 2T, Transistor) wired in a positive feedback mode. Frequency stability is maintained by:

(a) using a 7.5 volt zener stabilized supply;

(b) coupling the coil to TR1 as 'loosely' as possible (which maintains a high Q and also, incidentally, improves the output waveform and helps to prevent parasitic oscillations) by selecting Rosc;

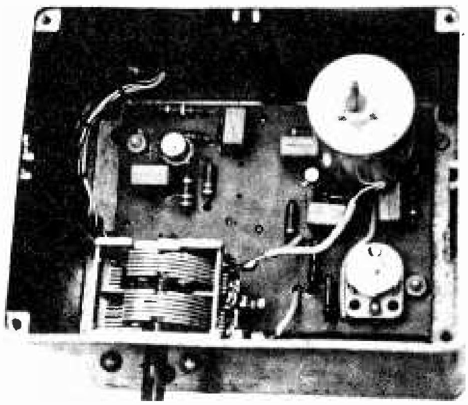
(c) running TR1 at low power to prevent heating.

Oscillation can only occur if the coil is wired for positive feedback so connections 8 and 9 may have to be reversed if the circuit will not oscillate. Pin 1 of the coil is returned to the positive supply rail as this simplifies the printed circuit layout.

When testing, start with Rosc as a short-circuit link. When oscillation is obtained in the correct frequency band (by adjustment of the coil core) begin increasing the value of Rosc, starting at say 2.2kΩ, and go on increasing until oscillation stops. Finally, reduce Rosc to the highest preferred value which still permits reliable oscillation.

The emitter follower, TR2, presents a high impedance to the oscillator, buffers it from the next stage and provides a low impedance output.

The regulated 12 volt supply is obtained from switch S1(d), which will be described in Part 2.



A view inside the v.f.o. box. Note the manner in which the coil can connect to chassis via the tuning capacitor frame.

COMPONENTS

Resistors
(All ½ watt 10%)

Rosc	See text	R13	220Ω
R1	18kΩ	R14	4.7kΩ
R2	8.2kΩ	R15	1kΩ
R3	1kΩ	R16	47Ω
R4	390Ω	R17	4.7kΩ
R5	10kΩ	R18	47Ω
R6	10kΩ	R19	47Ω
R7	100Ω	R20	47Ω
R8	470Ω	R21	See text
R9	18kΩ	R22	47Ω
R10	5.6kΩ	R23	47Ω
R11	680Ω	R24	22Ω
R12	390Ω	R25	See text

Capacitors

C1	0.1μF plastic foil
C2	390pF silvered mica
C3	200pF silvered mica
C4	30pF trimmer, air-spaced
C5	300pF variable
C6	0.1μF plastic foil
C7	0.1μF plastic foil
C8	0.1μF plastic foil
C9	0.1μF plastic foil
C10	25μF electrolytic, 25 V.Wkg.
C11	0.1μF plastic foil
C12	0.1μF plastic foil
C13	0.1μF plastic foil
C14	25μF electrolytic, 25 V.Wkg.
C15	68pF silvered mica
C16	0.1μF plastic foil
C17	240pF silvered mica
C18	68pF silvered mica
C19	0.1μF plastic foil
C20	240pF silvered mica
C21	0.1μF plastic foil
C22	0.1μF plastic foil

Inductors

L1	Denco Miniature Dual Purpose Coil, Yellow, Range 2T, transistor usage
L2, 3	Denco Miniature Dual Purpose Coil, Yellow, Range 3T, transistor usage

Semiconductors

TR1	2N2486/BC109/2N930
TR2	BFY50/2N3053
TR3	2N2484/BC109/2N930
TR4	BFX88
TR5, 6	2N3053
ZD1	7.5V, 200mW, zener diode

Miscellaneous

Die-cast box, 4¾ins. by 3¾ins. by 3 5/32ins.
3 B9A valveholders, printed circuit type (for L1, L2 and L3)
2 TO5 heat sinks (for TR5 and TR6)
Slow-motion drive, Eagle T502 or similar
Printed circuit board
16 s.w.g. aluminium
Coaxial cable

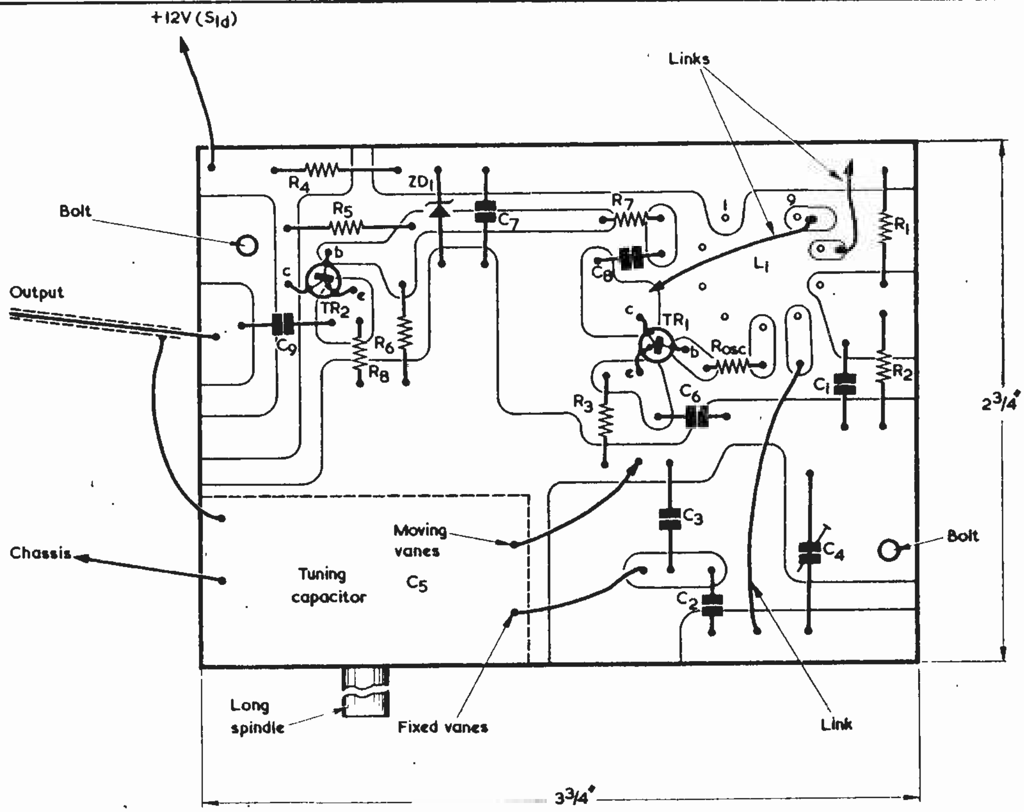


Fig. 3. The layout of the v.f.o. printed circuit board. This view is with the components towards the reader

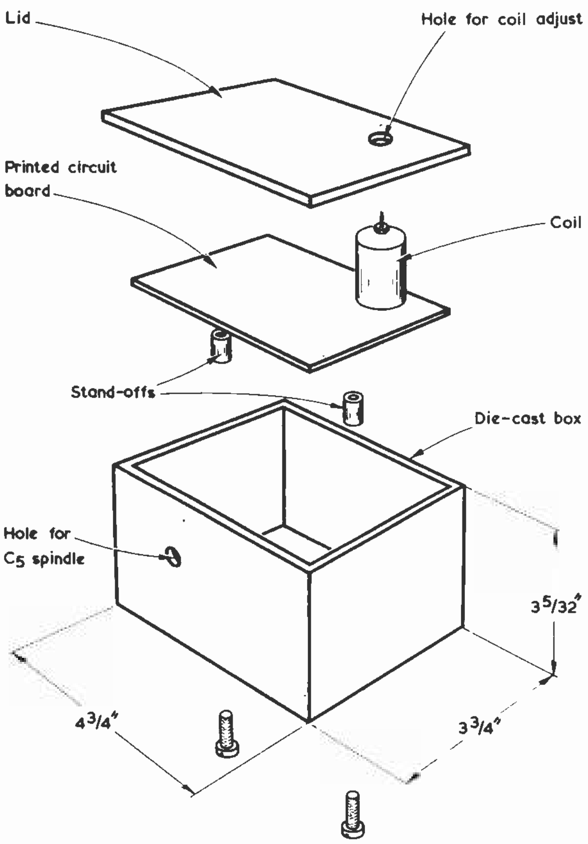


Fig. 4. How the v.f.o. printed circuit board is fitted in the die-cast box

The printed circuit layout is given in Fig. 3 and the housing details in Fig. 4. It is necessary for the v.f.o. to be screened and it is fitted in a die-cast box having the dimensions shown. The author obtained this box from G. W. Smith & Co. (Radio) Ltd., 3 Lisle St., London, W.C.2.

The printed circuit is shown full-size in Fig.3, and the diagram may be traced, if desired. The view is of the component side of the board. The tags of a printed circuit type B9A valveholder (in which the coil is fitted) pass through the board at the holes indicated and these holes should be marked out from the valveholder itself as the hole positioning in the diagram is approximate only. Since Fig.3 shows the component side of the board, the valveholder tags are numbered from 1 to 9 in an *anti*-clockwise direction. As may be seen from the photograph of the v.f.o. circuit, the coil is fitted with a screening can. This is made from the can in which the coil is supplied, it being cut down to clear components adjacent to the coil. The can has a solder tag at its lower end and is earthed to the frame of the tuning capacitor. The latter requires a long spindle (or needs to be fitted with a spindle extender) to enable it to couple to the slow-motion drive on the front panel of the complete transmitter. The tuning capacitor is bolted to the front of the die-cast box and is not mounted on the printed circuit.

Although printed circuit construction is neat and reliable, some constructors may prefer to use plain Veroboard and 'Cir-Kit'. This is, of course, quite permissible although it is wise to stick to a similar layout.

The use of Veroboard with copper strips is not recommended due to the multiple feedback capacitance paths this offers, which could produce instability.

Note the wire links between tags 8 and 9 of L1 and the remainder of the circuit. These enable the connections to these tags to be reversed, if necessary, to obtain positive feedback.

The printed circuit board is spaced off from the bottom of the die-cast box by means of suitable stand-off spacing washers. A hole in the lid provides access to the adjusting screw of the coil core. The supply and output leads are taken out in a laced-up harness through a hole in the rear of the die-cast box. This hole is not shown in Fig.4, but it may be seen in the photograph of the v.f.o. unit. The output, taken via coaxial cable, connects to the input of the wideband driver section.

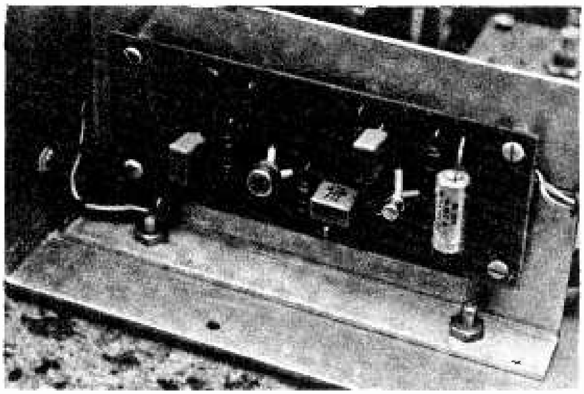
WIDEBAND DRIVER SECTION

This second section, whose circuit is given in Fig.5, uses a conventional amplifier stage (TR3) to raise the signal from the v.f.o. to a level which causes TR4 to be switched on and off. TR4 then provides pulses of current to drive the frequency doubler.

The printed circuit layout is shown in Fig.6. Again, the view is from the component side of the board, and as the board is reproduced full-size, the diagram may be traced. The board is mounted on Chassis Bracket No.1, which is illustrated in Fig.7. Four spacing washers stand the board off the bracket surface. As will be seen later, when the overall chassis assembly is dealt with, the board is mounted with its input end close to the v.f.o. box.

FREQUENCY DOUBLER AND DRIVER

The frequency doubler and driver section incorporates higher power transistors (2N3053) which are biased to be cut off and switched on only by incoming positive-going r.f. pulses. These pulses are obtained from the wideband driver. The circuit of the doubler and driver



The wideband driver board in position on Chassis Bracket No. 1

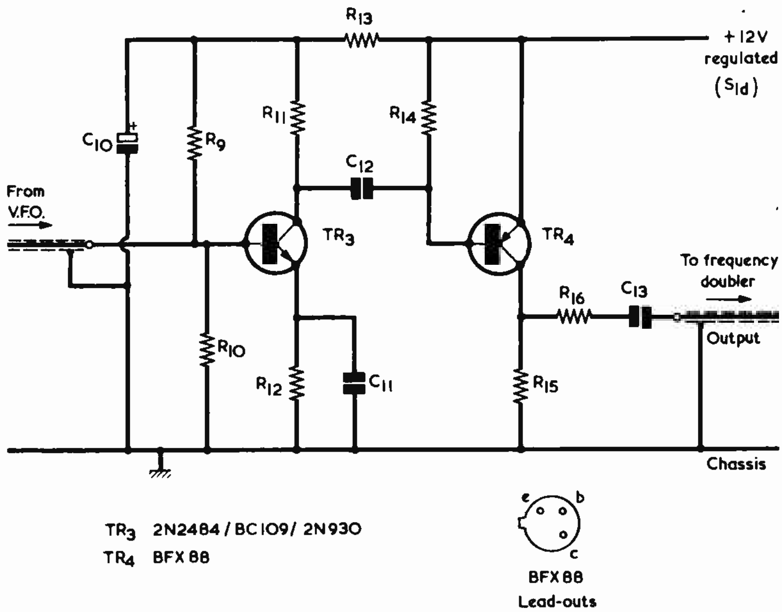


Fig. 5. The circuit of the wideband driver. Its output is passed to the frequency doubler

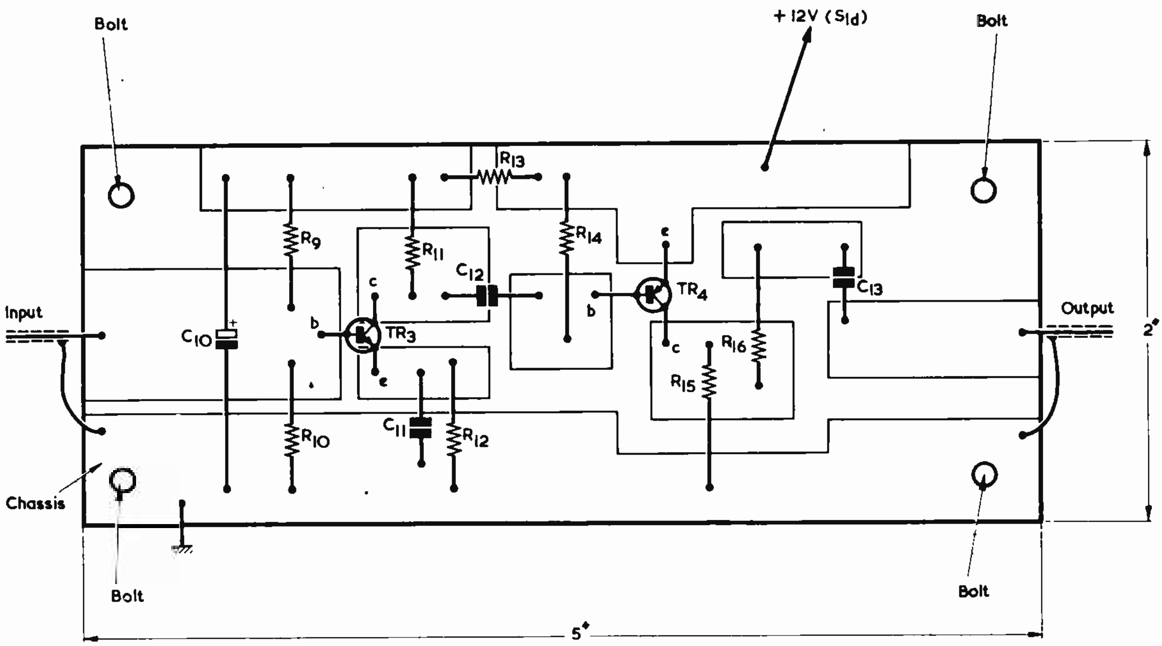


Fig. 6. Printed circuit layout for the wideband driver, as viewed from the component side

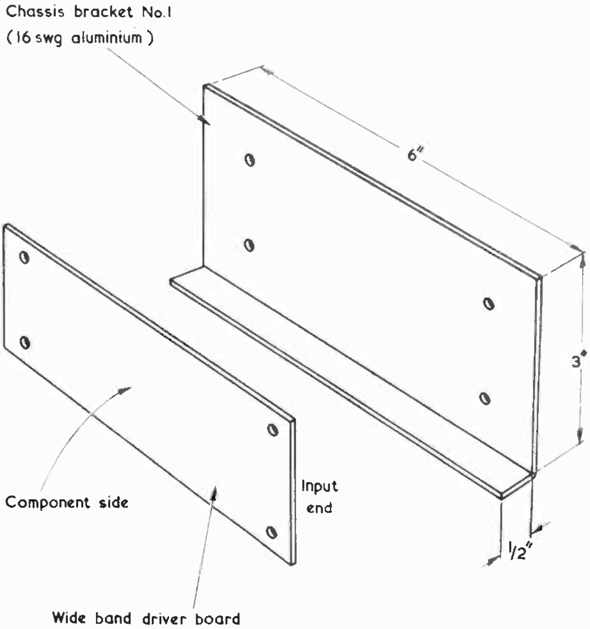
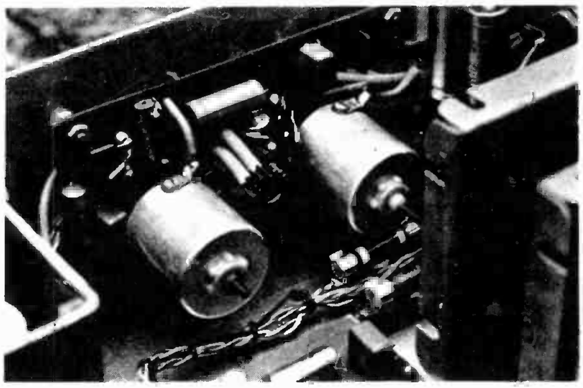


Fig. 7. The board is mounted on Chassis Bracket No. 1

section appears in Fig. 8. The references, at the supply input points, to S1(c) and S1(d) will be explained when the power amplifier stage is described.

Both the coils, L2 and L3, are Denco Yellow, Range 3T, transistor usage types, and they are tuned, by their cores, to approximately 1.9MHz. For optimum band coverage they should be stagger-tuned, say to 1.86MHz and 1.94MHz. Damping resistors R21 and R25 present a method of lowering the Q of the coils, but at the expense of drive. Their values are selected as necessary for the desired band coverage.



The frequency doubler and driver board. This is also mounted on Chassis Bracket No. 1

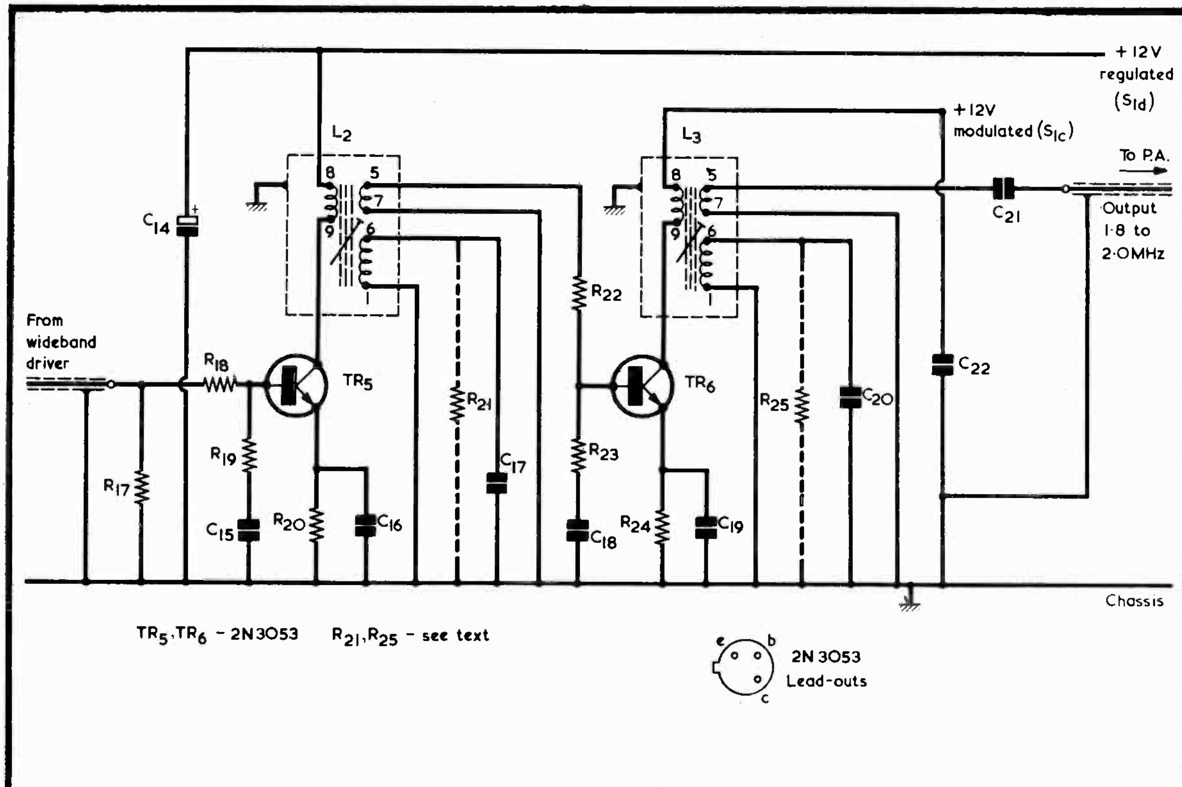


Fig. 8. The doubler and driver section of the solid state transmitter

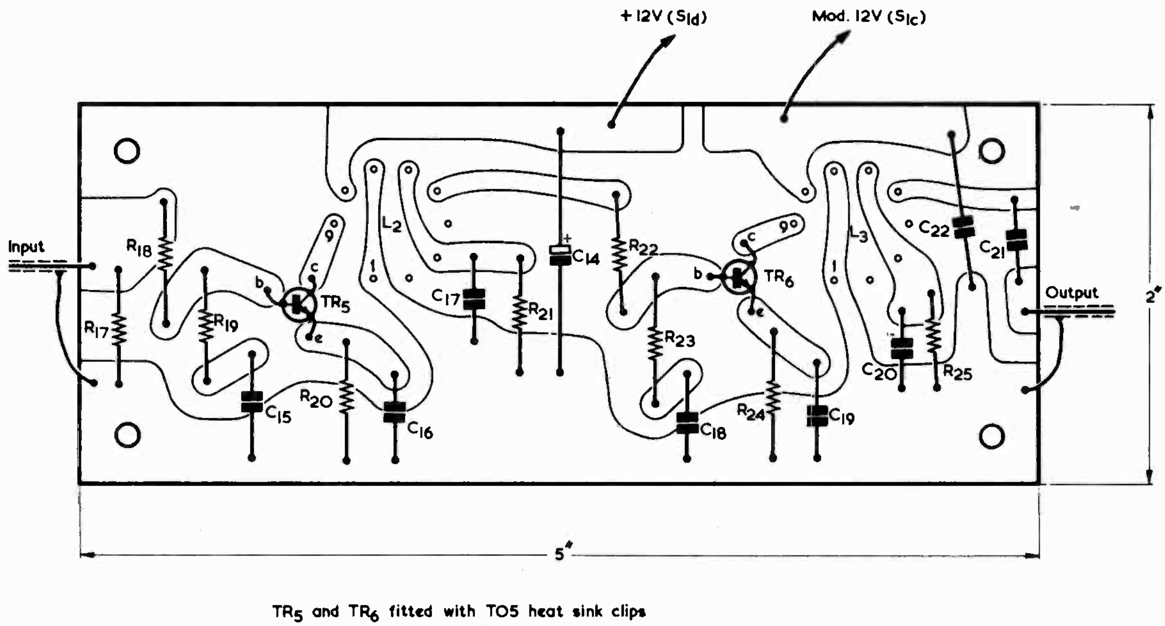


Fig. 9. Component side of the printed circuit board for the doubler and driver section

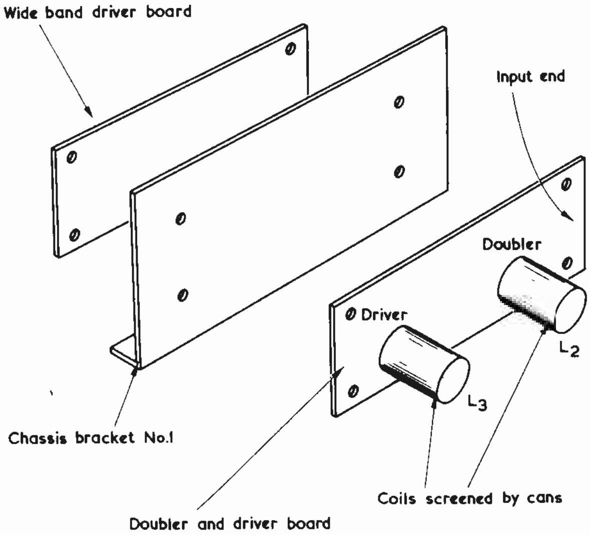


Fig. 10. The doubler and driver board is mounted on Chassis Bracket No. 1 on the opposite side to the wideband driver board

The pulses of current from TR4 in the wideband driver stage therefore switch TR5 at 900kHz to 1MHz, and this frequency is doubled by the tuning of L2. The pulses of current from L2 in turn switch TR6, which pulses L3 at 1.8 to 2.0MHz. The stage should provide approximately 500mW to 1W of drive.

The components R18, R19, C15, R22, R23 and C18 are included for stability. They prevent self-oscillation or the generation of parasitic oscillations.

Should the stage fail to provide sufficient drive, this may be increased by using two transistors in parallel for TR5 and TR6 and halving the value of resistors R20 and R24.

The printed circuit layout is shown in Fig.9, where it is reproduced full size and may be traced. The holes for the B9A coilholder tags are positioned only approximately in this diagram and they should be marked out on the board with the aid of the valveholders themselves. The view in Fig.9 is of the component side of the board. This results in the valveholder tags proceeding from 1 to 9 in an anti-clockwise direction.

A TO5 heat sink clip should be fitted to both TR5 and TR6.

The two coils are screened (as an additional precaution against instability) the screening cans being made from the cans in which the coils are supplied. Each can is cut down so that it does not foul components near the coils, and is fitted with a solder tag to enable it to connect to the copper section which is at chassis potential.

When completed, the board is fitted, using stand-off spacing washers, to the Chassis Bracket No.1 on the opposite side to the wideband driver board. The input end of the doubler board is at the rear of the bracket, adjacent to the output end of the wideband driver board. See Fig.10. The output of the wideband driver board is wired to the input of the doubler board.

(*To be continued*)

Multimeter Resistance

THE CIRCUIT TO BE DESCRIBED IS A SIMPLE EXTRA THAT can be added to a multi-testmeter having a 50µA direct current range. The circuit causes the input resistance to be boosted to valve voltmeter standards.

It must be pointed out that, since the two transistors employed in the circuit have a relatively wide gain spread and are operated at a low voltage, and since the testmeter input resistance may vary for different models of meter, the circuit has to be classed as experimental. It is possible that resistor values other than those specified here may be required in other units built up to the circuit, and construction should only be attempted

COMPONENTS

Resistors
(All fixed values ½ watt 5%)

R1	2MΩ
R2	5MΩ
R3	3MΩ
R4	10MΩ
R5	1MΩ
R6	1kΩ
R7	39kΩ
VR1	1.5kΩ potentiometer, skeleton
VR2	10kΩ potentiometer, wire-wound.

Transistors

TR1	BC169C
TR2	BC169C

Switches

S1(a)(b)	2 pole 3 way, rotary
S2(a)(b)	d.p.s.t., toggle

Batteries

B1	1.5 volt cell type HP7 (Ever Ready)
B2	1.5 volt cell type HP7 (Ever Ready)

Miscellaneous
4 insulated sockets
2 pointer knobs
Twin battery holder
Groupboard, case, etc.,

Input Booster

by M. N. Pointing and G. A. Miller

A simple experimental circuit which can enable a 20,000 ohms per volt testmeter to present a very high resistance to the circuit being checked.

by readers who appreciate the principles involved and are capable of making any adjustments to resistor values that may be required. The values quoted in the Components List are those used in the prototype. This was employed in conjunction with a 10,000 ohms per volt Japanese-made testmeter having the type number TE-200.

RANGES

The ranges offered by the prototype unit are 1 volt d.c. at 2MΩ input resistance, 2 volts d.c. at 7MΩ and 5 volts d.c. at 20MΩ input resistance. These were the ranges required by the authors but there is no reason why other higher voltage ranges could not be added by suitable alteration of the input resistors. The accuracy of the unit was found to be adequate for normal circuit checks.

The circuit is a greatly simplified version of that found in many commercial transistor voltmeters, and is shown in Fig. 1. Basically the meter, which is the multi-testmeter switched to read 50μA full-scale deflection and connected by its test leads to the unit, is driven by the high gain amplifier given by TR1 and TR2.

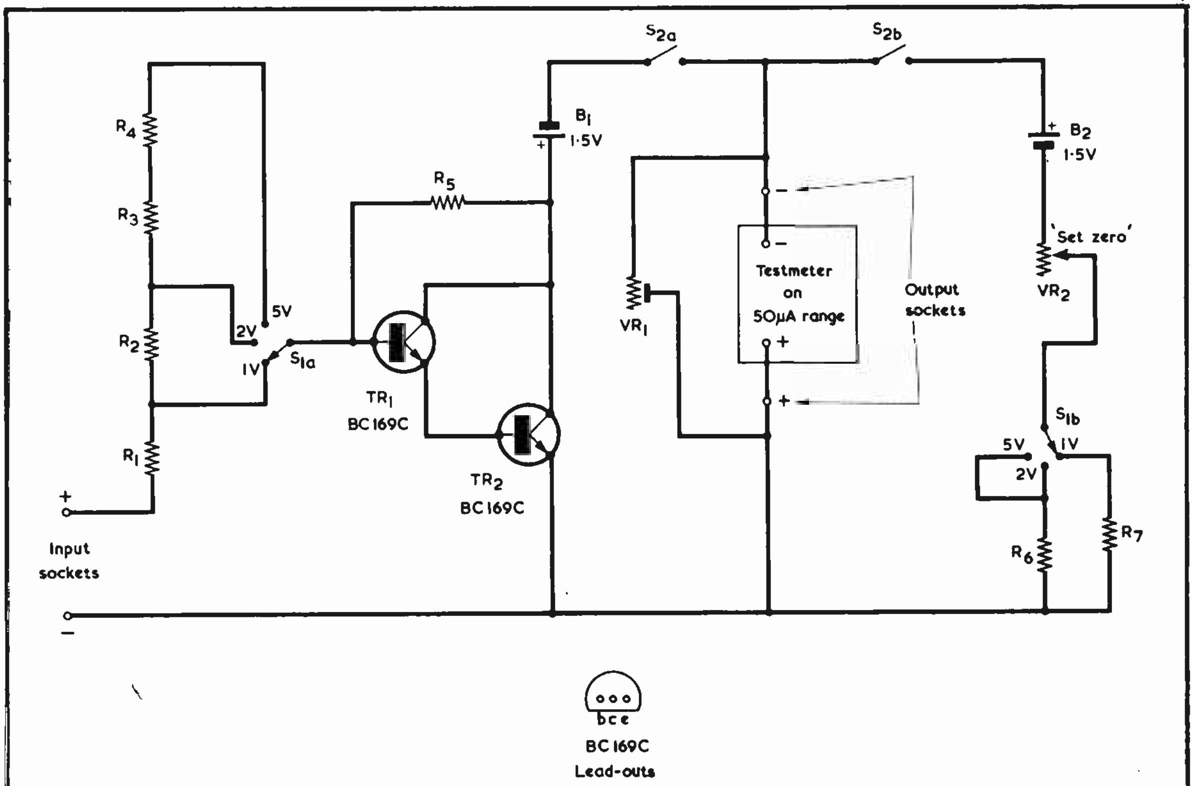


Fig. 1. The circuit of the input resistance booster. This, when used in conjunction with a standard testmeter switched to a 50μA range, offers very high input resistances

When a voltage is applied to the input sockets it causes a small current to flow through the input resistor and the base emitter circuits of TR1 and TR2. TR1 and TR2 are connected to form a Darlington pair, the gain of which is approximately equal to the product of the individual gains of the two transistors. As the maximum gain for a BC169C transistor is 900 it can be seen that the gain of the Darlington pair can be very high indeed. An amplified version of the current in the input circuit of the Darlington pair flows through the collector circuit and causes a corresponding deflection of the meter needle.

R5 is included to keep the transistors conducting as, otherwise, the input voltage would have to exceed that at which forward current flowed in the base-emitter junctions of the two transistors. Low input voltages, particularly on the 1 volt range, cause a reduction of the bias current available from R5. In practice, this effect is allowed for by zeroing the meter on each range with the input terminals short-circuited.

VR1 shunts the meter and is adjusted such that 1 volt, 2 volts and 5 volts cause full-scale deflection on the respective ranges. In the prototype, VR1 was a 1.5kΩ skeleton preset potentiometer. A 2kΩ or 2.5kΩ potentiometer could be employed instead if the 1.5kΩ value is difficult to obtain.

The transistor circuit is powered by the 1.5 volt cell, B1. A second 1.5 volt cell, B2, in company with VR2 and R6 or R7, supplies a current which cancels out the standing transistor current due to R5. VR2 is a panel-mounting wire-wound potentiometer and is adjusted for a zero reading in the meter. R6 and R7 have values which assist in the accurate setting of VR2.

Resistors R1 to R4 are specified as 5% in the Components List. This tolerance should be close enough for most requirements and it may, in any case, be necessary to slightly adjust the values of one or more of the resistors during setting up. Small increases in value can be achieved by inserting lower value resistors in series.

CONSTRUCTION

Many of the components in the prototype were wired up on a small groupboard in the manner shown in Fig. 2. However, layout is not important and any other method of wiring could be employed. The groupboard was fitted in a small metal case, on the front panel of which were mounted S1, S2, VR2 and two pairs of insulated sockets. One pair of sockets provides the input connections and the other pair of sockets the output connections to the testmeter. The cells were fitted in a small twin battery holder.

SETTING UP

Setting up consists of adjusting VR1 so that the test meter gives the desired reading on each range. The 5 volt range can be set up with the aid of a 4.5 volt battery which has been previously checked by the testmeter. The 2 volt range may be similarly set up with the aid of a 1.5 volt cell. A setting up voltage for the 1 volt range can be obtained by connecting a potentiometer having

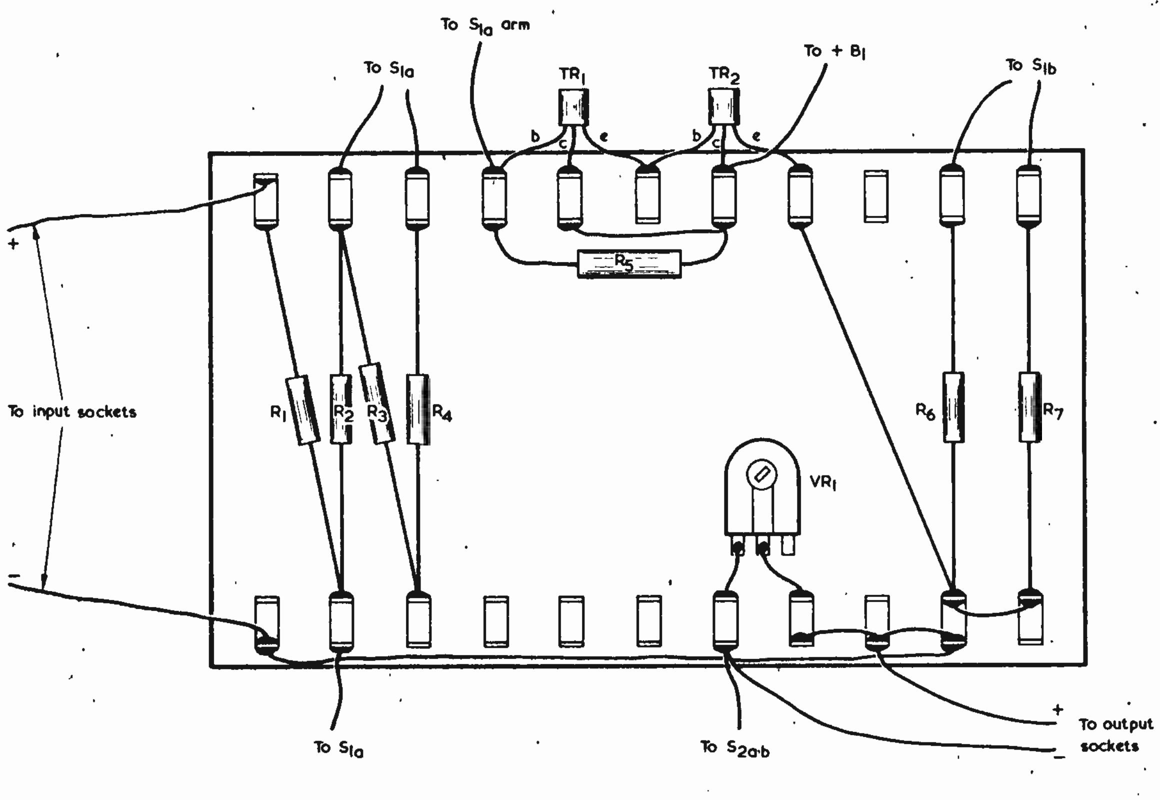


Fig. 2. In the prototype, some of the components were wired up on a groupboard, as shown here

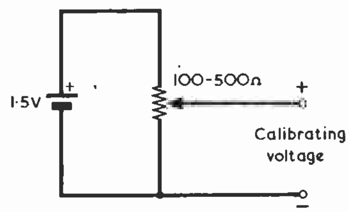


Fig. 3. A simple means of obtaining a calibrating voltage for the 1 volt range

a value between 100Ω and 500Ω across a 1.5 volt cell, as shown in Fig. 3. The potentiometer is previously set up so that 1 volt becomes available between the slider and one end, as measured with the testmeter.

Other sources of known voltage can also, of course, be used for setting up.

The guard against damage to the testmeter, when setting up, due to excessive current in the B1 or B2 circuits, the testmeter should be initially switched to a high current range, say 0–10mA, before turning the unit on. The meter can then be subsequently set to the 50μA range if the current indication is sufficiently low. On each range the unit is zeroed by adjusting VR2 for a zero current indication with the input sockets short-circuited.

If it is found that a single setting of VR1 cannot be obtained for all three ranges, the values of R1 to R4 may be slightly adjusted as required.

USE

The unit is simple to use and is not dependent on any external power supply. The current drawn from the cells is low and these should have a long life.

To measure a voltage, the testmeter, switched to read 50μA f.s.d., is plugged into the two output terminals. The range selector switch, S1, is set to the appropriate range. Two test leads connected to the input terminals are then short-circuited together and VR2 is adjusted for a zero reading. The test leads are next applied to the points at which the voltage to be measured appears, and this voltage is read from the appropriate scale of the testmeter.

The unit must be zeroed by means of VR2 each time it is used and each time the range is changed. ■

RECENT PUBLICATIONS

THE WAY THINGS WORK.
591 pages, 5½ × 8½ins. Published by George Allen & Unwin Ltd. Price £3.65.

"The Way Things Work" is a follow-up of a volume which appeared in this country as "The Universal Encyclopedia of Machines", and it is stated to contain twice as many subjects as the previous work.

The method of presentation is unique. Wherever possible each subject dealt with is presented on a double-page of the book, diagrams being printed on the right-hand page and a concise text discussing the subject on the left-hand page. In most instances, single subjects are dealt with in their entirety on a double-page, but in some cases they have to be carried over from one double-page to the next. The diagrams are detailed and excellently drawn, and they are reproduced in black and red. For the section on colour television a full colour range is used.

The matters illustrated cover a fantastically wide range and include such diverse subjects as nuclear reactors, prospecting for minerals, road intersections and junctions, cartography, artificial hearts, vertical-take-off-and-landing aircraft, liquid-propellant rocket systems and many, many more. The majority fall into the mechanical category but enough subjects are of an electronic nature to justify a review on these pages. The electronic items include high fidelity, electronic music, wave guides, v.h.f. stereo broadcasting and video tape recording. Obviously, the matters dealt with cannot be given a full treatment, but the potted descriptions are extremely concise and accurate. They give more than adequate background to enable the reader to grasp how the device or function dealt with works, and thereby justify the title of the book. There are, also, no "simplifications" in the descriptions.

The book provides fascinating reading and instruction for anyone who is interested in the chemical, mechanical and electrical world around him, and it will in particular prove to be an excellent and educational present for a youngster in his teens.

* * *

INTRODUCTION TO SEMICONDUCTOR DEVICES. By F. J. Bailey, C.Eng., M.I.E.R.E.
238 pages, 5½ × 8½ins. Published by George Allen & Unwin Ltd. Price £3.95.

This book is intended to provide sufficient basic information on semiconductor devices to enable the student, engineer or technician to understand their operation and the manner in which they may be used. The approach is non-mathematical, although simple equations are given when these are essential.

The first chapter discusses basic semiconductor theory, and is followed by chapters on diodes and bipolar transistors. Next to be dealt with are junction field effect transistors, insulated gate field effect transistors and thyristors. The final chapter is devoted to integrated circuits, and this is succeeded by a glossary of the more important terms and the index.

Illustrations are clear and the text is concise and lucid. It is obvious that care has been taken to see that description of devices and their functioning are precise. The volume forms a good standard text-book and it can be read with profit by anyone who is embarking on the subject of semiconductors. The price quoted at the head of this notice is for the hard-back issue. A paperback version at lower cost is also available.

UNUSUAL TRANSFORMER EFFECT

by

A. L. Chivers

How to make a step-down transformer step up a voltage!

THERE ARE QUITE A FEW LITTLE MYSTERIES IN electronics and the author discussed one of these in this journal some time ago.* At that time, an experiment was described which demonstrated that the brilliance of an electric light bulb could vary by quite a considerable factor despite the fact that a moving-coil voltmeter connected across it showed no change in indication.

TRANSFORMER EXPERIMENT

Here's another experiment which the author recently carried out. He connected a 1,750Ω 40 watt wire-wound resistor (actually a valve heater dropper resistor) in series with an m.e.s. pilot lamp having a nominal rating of 6.5 volts 0.15 amp. Connected across the lamp was an a.c. voltmeter with an f.s.d. of 10 volts, and the zero and 220 volt taps of the primary of a large mains transformer. The set-up is shown in Fig. 1 (a).

Next, the on-off switch was closed, whereupon the 240 volt a.c. mains was applied to the series combination of the bulb, with its parallel voltmeter and mains transformer winding, and the resistor. Now, a 1,750Ω resistor passes 137mA when 240 volts is applied across it. In Fig. 1 (a) a current of slightly less than 137mA will flow, because of the voltage dropped across the lamp. In practice, when the on-off switch was closed the lamp became illuminated and the a.c. voltmeter indicated 4.7 volts.

So far, so good. These are reasonable results to expect in a circuit of this nature. The lamp and meter were next disconnected from the 220 volt tap in the mains transformer primary and were then connected to the 240 volt tap, as in Fig. 1 (b). When the on-off switch was closed the lamp shone at *reduced* brilliance and the a.c. voltmeter indicated 3.9 volts only.

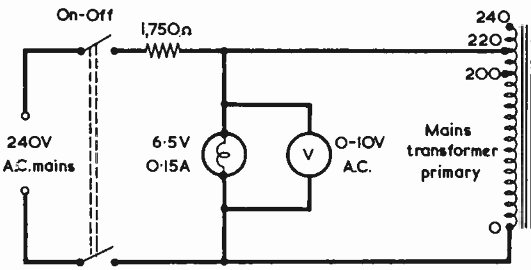
After this, the bulb and the a.c. voltmeter were transferred to the 200 volt tap, as illustrated in Fig. 1 (c). This time, when the on-off switch was closed the lamp shone much more brightly than on the two previous occasions and the a.c. voltmeter indicated 6 volts!

Pilot lamps are notorious for offering non-linear resistance, since the resistance of their filaments increases markedly with temperature. To ensure that this non-linear resistance was not confusing the issue, it was decided to repeat the experiment using a 30Ω 2 watt wire-wound resistor in place of the lamp. When the resistor was connected up to the 220 volt tap, as in the manner shown, with the bulb, in Fig. 1 (a), the a.c. voltmeter indicated 3.6 volts. The 30Ω resistor and meter were next connected to the 240 volt tap, following Fig. 1 (b), whereupon the meter reading dropped to 3.3 volts. Finally, the 30Ω resistor and meter were, as shown (with the bulb) in Fig. 1 (c), transferred to the 200 volt tap. The meter indication then rose to 4.3 volts.

EXPLANATION

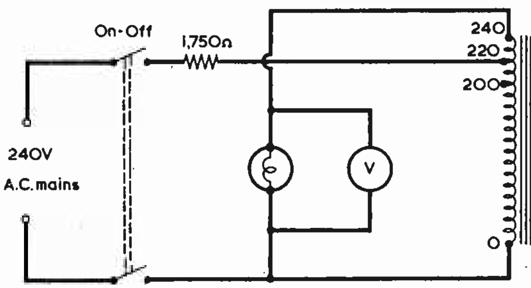
This experiment can easily be repeated by readers, provided that the mains transformer employed has a primary whose wire is capable of passing 0.15 amp. The transformer used by the author had an h.t. secondary rated at 250-0-250 volts at 120mA, plus several 6.3 volt heater secondaries, and so the wire in its primary winding could well carry 0.15 amp. Due to auto-transformer action the wire between the zero and 220

**A. L. Chivers, 'A.C./D.C. Mystery Bulb', 'The Radio Constructor', August 1971.*



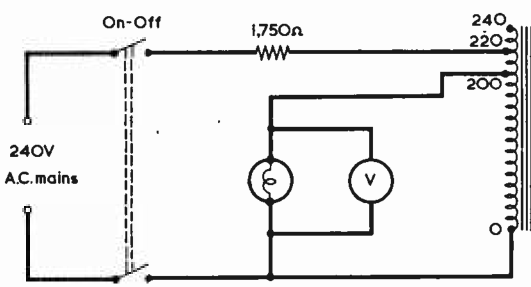
Lamp voltage = 4·7V

(a)



Lamp voltage = 3·9V

(b)



Lamp voltage = 6V

(c)

Fig. 1 (a). A practical experiment, in which a pilot lamp was connected up in the circuit shown hear
(b). Connecting the lamp to the 240 volt tap of the mains transformer primary caused the voltage across it to drop
(c). When the lamp was connected to the 200 volt tap the voltage across it increased

volt taps in Fig. 1 (b), and between the zero and 200 volt taps in Fig. 1 (c), actually has to carry much less than 0.15 amp, but that's another story.

The experiment proves conclusively that it is possible to have both a step-up autotransformer which provides a step-*down* in voltage and a step-down autotransformer which provides a step-*up* in voltage! What is the cause of this unexpected behaviour?

The answer lies in the fact that the current available to the transformer winding in the experiment is limited to what is virtually a constant current by the 1,750Ω series resistor. For small voltage changes at the transformer winding the current remains almost completely unaltered. When, in Fig. 1 (b), the bulb was connected to the 240 volt tap, the constant current still had to flow between the zero and 220 volt taps of the transformer primary. There was in consequence a step-down in current to the pilot lamp, whereupon less voltage appeared across it. In Fig. 1 (c) the bulb was connected to the 200 volt tap. The constant current once more flowed between the zero and 220 volt taps of the transformer winding, with a current step-up between the zero and 200 volt taps. The flow of increased current through the bulb resulted in an increased voltage across it. There were similar results with the 30Ω resistor but, since this offers a resistance which does not alter with current, the changes in voltage were not so dramatic.

Remember, a step-up transformer offers both a step-up in voltage and a step-down in current. And a step-down transformer offers both a step-down in voltage and a step-up in current. With the present experiment the current, being virtually constant, was the deciding factor and the small voltages which appeared at the transformer winding were of secondary performance.

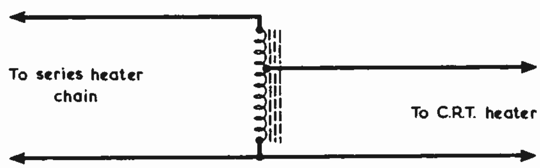


Fig. 2. Circuit of a 'booster' transformer, as used to increase heater voltage in a television picture tube

This effect can be put to practical use in any a.c. circuit having a high value of series resistance, and it enables a greater current to flow in a low voltage resistive component than is actually passed by the series resistance. A typical example is given by the TV c.r.t. filament 'booster' transformers that are used to increase the heater voltage of ailing picture tubes when these are connected in a series heater chain. Such transformers are autotransformers and have the voltage step-down, current step-up, circuit shown in Fig. 2. ■

'Jubilee' 8-Watt Amplifier

In Fig. 1 of the above article, published in the August 1972 issue, the non-earthy end of R17 should connect to the upper terminal of the 6.3 volt 3.5 amp winding of the mains transformer. The correct connection is specified in the circuit and constructional descriptions.

QSX

By
FRANK A. BALDWIN

(All Times GMT)

The reception of a rarely reported station on a new channel is always an event of some importance to the SWL, particularly when the channel in question is an "out of band' frequency. Such an event occurred during early September when the writer was searching the area of the dial around the **4600** mark.

On the 9th of September, at 1930, on a measured **4627**, a station was heard using Spanish announcements in addition to those in the Arabic language. Musical and song programmes of the Arabic type were featured. Reception conditions however were very poor, signal strength was low and utility QRM abounded, these precluding any definite and positive identification. Similar conditions prevailed for the next few evenings, although it was established that three separate trumpet fanfares were often used between programme items.

On the 13th September however, conditions were good and the clear identification "Radio Sahara" was taped. Previously, a landline contact with Alan B. Thompson of Neath had resulted in his equipment being brought into use on the channel – the result was therefore doubly confirmed at one and the same time.

Radio Sahara previously operated on the crowded 7MHz band and was only rarely heard here in the U.K. and even then only for very brief periods. It was known that the station was looking for a clear channel but nobody in the SWL world thought it would suddenly appear on **4627**, least of all the writer.

At 2000 there is a newscast in vernacular, probably Hassania; into Spanish at 2010; identification at 2015 then Arabic style music. Three fanfares are heard prior to the news at 2000. At 2110 there is a news review in Spanish to 2130. Prior to the 2158 sign-off, there is a four-note interval signal, identification in Spanish, 'Muy buenos noches' and a short National Anthem. The address for reports is – Radio Sahara, Apartado 7, El Aaiun, Spanish Sahara – although I think you will be rather lucky if any reply is received! The Hassania language, according to my information, is a mixture of Spanish and Arabic.

● THE CUROM AFFAIR

Earlier this year (May) reports appeared in the SWL press of Radio Curom in the Netherlands Antilles broadcasting on **20778** and later on **17513** (on the latter channel from 1500 to 0400 over a period of some days, although the frequency was said to vary at times).

A regular reader of this feature, E. Sloan of Belfast, logged the transmission on **20779** and duly reported this fact to **R. Curom**. In the reply, a station official confirmed that the reception details were correct but then added 'we never broadcast on short waves but on 855kHz only.' It transpires, from the information provided by reader E.S., that Curom rent a transmitter from the Government and **20634** is the frequency of their direct link to Holland via a three-channel telephone transmission. The letter added 'The last stage is modulating the signal on 1000kHz with an oscillator on **21634**. Due to false tuning of the modulation stage we got a mixing of **21634** and **855**, giving **20779** of sufficient strength to be heard in Europe'. What about the **17513** however?

● UNIDENTIFIED

Always of interest to many SWL's, perhaps some readers may care to tune to **4220** around 2030 or so. The channel is a difficult one with a continuous unmodulated carrier often on the air and marring reception. Recently at 2040 we heard a programme of music and songs in the Russian language. One well-known SWL has suggested that this might be Peking using the Urumchi transmitter for the Russian Service but, according to BADX, an unidentified Russian station, Peking and Urumchi are listed as occupying the channel with the latter transmitter signing-on in Kazakh at 2340. Tune your dial and take your choice!

● ANGOLA

Angolan stations are always of interest and the low-powered (1kW) CR6RB Radio Ecclesia can be heard, if conditions are right, on **4985**, where we recently logged it at 1925 with a talk in Portuguese. Based in Luanda, the station radiates programmes having a mainly religious content.

● SUPER DX

Reportedly one of the best Papua/New Guinea outlets for signal strength is Radio Milne Bay on **3360** with a 10kW transmitter (ex-**3235**). Sign-on with morning service is at 1945 and the channel is usually a clear one, all according to BADX. Listen out for VL8AS and that super Dx!

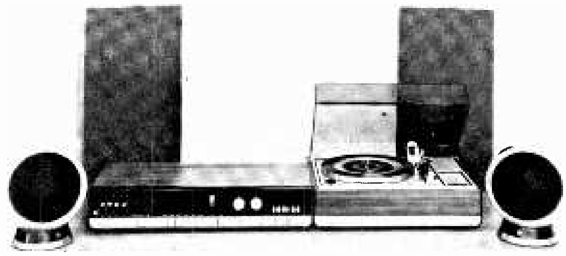
● LATIN AMERICA

Latin American stations are always of interest and in any list the Venezuelans usually predominate – ours is no exception.

4765	**0020**	ZYN37 Feira de Santana, Brazil, with station identification and LA music. Schedule from 0730 to 0400, 1kW (62.96m).
4790	**0016**	YVON Ondas Portenas, Puerto La Cruz, Venezuela, programme of local music and songs. Schedule from 1000 to 0300, 1kW (62.63m).
4825	**2250**	HIFA Voz de la Fuerzas Armadas, Santo Domingo, Dominican Republic, with local guitar music and songs. Schedule 1200 to 0500, 3kW (62.17m).
4870	**0010**	YVKP Radio Tropical, Caracas, Venezuela, with a newscast in Spanish. Schedule 1000 to 0400, 5kW (61.60m).
4890	**0100**	YVKB Radio Dif, Caracas, Venezuela, identification followed by the inevitable LA music. Schedule 1000 to 0400, 5kW (61.35 m).
4905	**2125**	ZYZ20 Radio Relogio, Rio, Brazil, talk in Portuguese, time checks of 3 'pips' every minute, short musical interludes. Schedule 24 hours, 5kW (61.16m).
4940	**0010**	YVPA Radio Yaracuy, San Felipe, Venezuela, Organ music and commercials with echo-effect. Schedule 1000 to 0400, 10kW (60.72 m).
4980	**0102**	YVOC Ecos del Torbes, San Cristobal, Venezuela, announcements in Spanish after identification. Schedule not published, 10kW (60.24m).
5010	**0030**	HIMI Radio Cristal, Santo Domingo, Dominican Republic, with LA songs rendered by young lady with a most charming voice. Schedule 24 hour, 1kW (59.88m).
15155	**2242**	ZYB9 Radio Dif. de Sao Paulo, Brazil, with station identification, announcements with echo-effect followed by LA music (without echo-effect). Schedule 1500 to 0300, 10kW (19.79m). ■

Trade News . . .

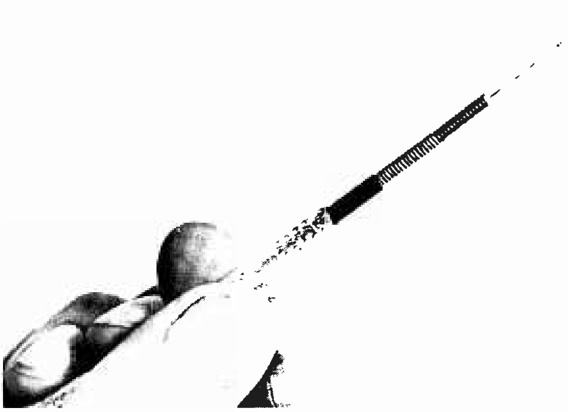
NEW RS303 TUNER AMPLIFIER AND RW346PE STEREO RECORD PLAYER FROM SIEMENS



The combination of the new RS303 four band tuner amplifier and the RW346PE Stereo record player from Siemens is launched by Interconti Electronics Ltd., Albany House, Petty France, London SW1. Shown here with two spherical and two cubic loudspeakers this unit provides the discerning hi-fi enthusiast with a truly advanced sound system.

Also available within the Siemens range is a wide selection of alternative speakers matched for this system.

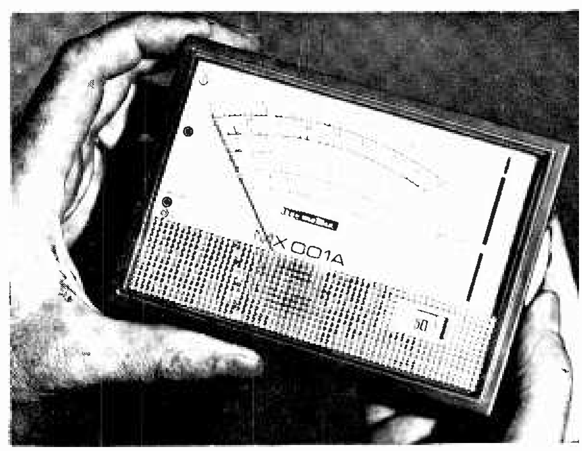
PRECISION FLEXIBLE COAXIAL CABLE



The Solidev Ltd. Plaxial coaxial cable showing the stranded centre conductor, the helical grooved dielectric, the electrodeposited outer conductor, the jacket and the braided protective sleeving.

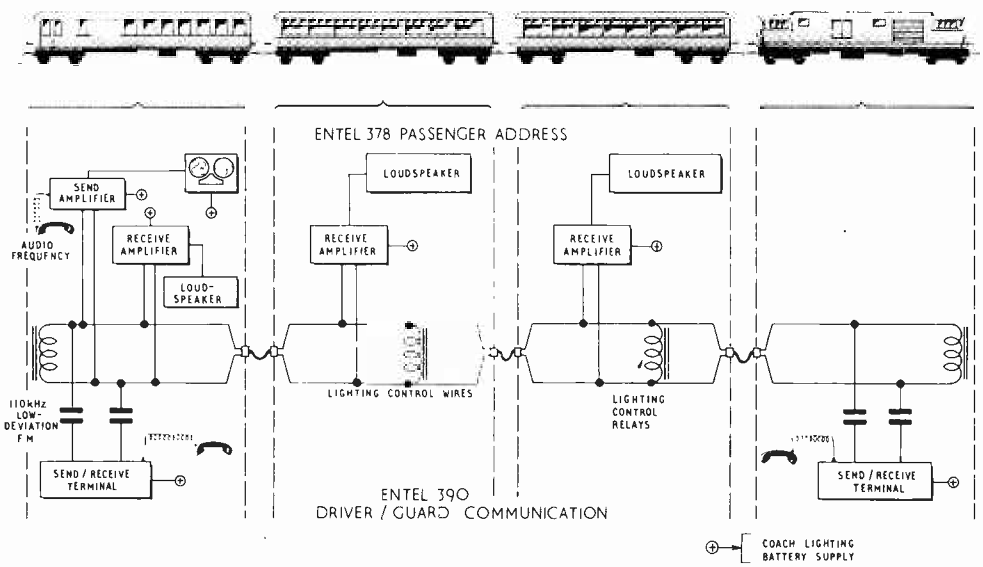
Plaxial coaxial cable is claimed by Solidev Ltd. to be the only precision flexible coaxial cable that provides 100% r.f. shielding with no degradation of attenuation of v.s.w.r. even with minimum radius bends of $\frac{1}{8}$in. The manufacturing method provides the inherent flexibility advantages because the dielectric material covering the inner conductor is formed with a continuous helical groove. The outer conductor is electrodeposited copper (0.001in) which follows the contours of the helical groove. This is covered by an irradiated polythene jacket; with an extra braided protective sleeving over a t.f.e./f.e.p. jacket. The centre conductor is formed in stranded copper wire. This method of construction enables cable harnesses to be made with constant, reproducible, electrical characteristics and permits interchanging of harness between systems without mismatch. The cable has a mechanical performance equivalent to semi-rigid cables but can, in addition, withstand many thousand of flexures without breaking. The cable can be used with either straight through or right angle connectors, without degradation of v.s.w.r. because the cable itself is flexed to provide even a $\frac{1}{8}$in minimum bend radius right angle without using separately machined parts. The shielding is effective up to 18GHz, and the attenuation is less than 2dB/100ft at 10MHz and less than 90dB/100ft at 100GHz. The temperature limits for the RG371 are –55 C. to +90°C. and for the type RG398 they are –65°C. to +125°C. For further information: Solidev Ltd., Tubs Hill House, North Entrance, London Road, Sevenoaks, Kent.

PRACTICAL LOW-COST POCKET MULTIMETER



A new pocket multimeter, the MX001A, has been introduced by ITT Metrix and is available in Britain from ITT Components Group Europe. Priced at £12.75 the MX001A is attractively styled with a shock-resistant plastic case. The MX001A can measure voltages up to 160 V d.c. and 500 V and 160 CV on separate sockets with a sensitivity of 20,000 ohm/V; up to 500 V a.c. with 1600 V on a separate socket; and currents up to 500 mA d.c. (5A on separate socket) and 1,6 A a.c. Resistances up to 5 megohm can also be measured. Weighing only 400 g, the MX001A is fully protected against overload by both fuse and diodes. It employs a moving coil movement with a high flux central magnet with minimal flux leakage. Range selection is by a thumbwheel switch, with the range selected being shown at a window below the scale. A full range of accessories is available including a filter probe for t.v. line voltage measurements, 15 kV a.c./d.c. probe, 30 kV d.c. probe, range multiplier resistor box (3000 to 6000 V a.c./d.c.) and an adaptor for resistance measurements from 20 kilohm to 50 megohm. In addition a carrying case and rubber shock protector are available. For further information contact ITT Components Group Europe, Instrument Sales, Edinburgh Way, Harlow, Essex.

HIGH-SPEED TRAIN COMMUNICATIONS



The plans of the British Rail Board for high-speed trains travelling at up to 150 m.p.h. have raised the acute necessity of improving communications between drivers and guards. There is, additionally, a demand for passengers to be kept informed of the progress of the journey, times of meal sittings and the like.

With this in mind, Nelson Tansley Limited, of 10 Shepherds Bush Road, London, W.6., who have already built up an excellent reputation in railway communications, have produced a range of equipment under the generic name "ENTEL" to fulfil the new requirements. Driver-guard communication sets and passenger address equipment are two separate systems designated ENTEL 390 and ENTEL 378 respectively. The accompanying diagram illustrates both systems, the top section being concerned with passenger address equipment, while the lower section shows the ENTEL 390 driver-guard communication system.

The main problem that Nelson Tansley engineers had to overcome in the development of the systems was the impossibility of providing a special cable, running the length of the train, on which the signals could be carried. The equipment was therefore designed to take advantage of any continuous circuit already in existence. Since the control wires for the lighting relays are, in British Rail, the only conductors which are always coupled throughout a passenger train, these were employed for the communications systems. In this case, departure from the ideal of a 600Ω noise-free line is caused chiefly by the connection across the wires of a large number of relay solenoids, the impedance of which is not only complex, but variable.

ENTEL 378

The passenger address system, ENTEL 378, consists of a "Send" amplifier driving "Receive" amplifiers and loudspeakers in each coach. The terminal impedances of the amplifiers are tailored to suit the complex impedance of the line, and the audio frequency signal is transmitted at a high level (10 volts at 1kHz for a rated 10 watts output to the loudspeakers) to reduce the effects of superimposed noise. Further noise reduction is obtained by the use of a curtailed bandwidth of 300 to 5,000 Hz. The system is operated by the guard, who is provided with a telephone hand-set. Announcements recorded on tape may also be made.

ENTEL 390

Designed solely for two-way voice communication between driver and guard, ENTEL 390 is capacitively coupled to the same pair of wires as the passenger address system, but the signal is transmitted on a low-deviation frequency-modulated carrier at around 110 kHz. Although well above frequencies used for train-control signals, this frequency is not yet so high as to require excessive attention to matching and attenuation problems. A "Send-Receive" terminal is located in the driver's cab (or cabs, if more than one locomotive is in use) and in as many guard's compartments of the train as required. Each terminal is provided with a hand-set having a "Press-to-Talk" button and a bulkhead-mounted electronics panel. The hand-set emits a call tone when a remote call button is pressed, the call being acknowledged by lifting the hand-set and pressing the "Talk" button. Simultaneous operation of "Talk" buttons gives duplex operation of the system, with a side tone caused by the heterodyne beat between the two carriers, which differs in frequency by a few hundred hertz. The tone helps to discourage indiscriminate talking-through which, it is felt, could result in vital information being misheard.

Solid-state electronics are used in all control and signal circuits of both ENTEL 378 and ENTEL 390, and all equipment has been thoroughly tested and approved by the British Rail Board for incorporation in the modern stock now coming into operation. ■

In your workshop

A quiet spell in the Workshop enables both Dick and Smithy to enjoy an elongated tea-break. It also allows them to test each other's knowledge (and the reader's) over a wide range of electronic topics having initial letters which cover the alphabet from A to Z.

WITH THE PROFESSIONAL AIR OF A Cordon Bleu master-chef putting the final touch to his *potage a la tortue*, Dick carefully inserted two tea-bags into the Workshop tea-pot. The battered kettle alongside the sink had just commenced to sing and Dick waited expectantly for it to burst into full voice. After a short period, steam started to jet from the kettle whistle, which spluttered into a series of intermittent high pitched chirps. These soon merged into a continuous note until, eventually, the kettle was producing its full shrill pipe. Satisfied that the water in the kettle had reached an acceptable 100°C, Dick picked it up, removed its whistle, and poured its contents into the tea-pot.

He next put milk into his cup and into Smithy's disreputable tin mug then, after allowing a decent interval for the brewing of the tea, filled both these vessels with the health-giving infusion. Walking over to Smithy's bench he placed the Serviceman's mug alongside him then retired to his own bench with the cup.

A cold and blustery November wind blew flurries of rain against the windows. It was, that afternoon, very cosy inside the Workshop.

A TO Z

Smithy sipped his tea approvingly.

"These tea-bags," he remarked, "aren't too bad after all, are they?"

"They're just the job," affirmed Dick warmly. "There's no more bother with the sink getting blocked up now, not since we changed over to using them instead of ordinary tea. We hardly ever have to use the plunger at all these days."

"Good, good."

The atmosphere, was redolent with the self-satisfaction of practical men who have, at a stroke, eradicated a problem of exceptionally long standing.

Dick drank quickly at his cup.

"You've no need to hurry," remarked Smithy comfortably. "There's hardly any work left to do today, and so we can have a good long tea-break."

"Fair enough," said Dick carelessly. "Still we ought to do *something* with the time."

An idea struck him.

"I tell you what," he continued keenly. "Let's have another go at the A to Z game! It must be more than a year since we last played it!"

"D'you mean the game where we go through the alphabet alternately?"

"That's right. We think of something in electronics which starts with each letter in order and then ask the other one what it is. The idea is to get a subject which catches the other one out. I'll start off with A."

"Very well then" replied Smithy indulgently. "You ask me something which begins with A."

"Right," said Dick briskly, as he creased his brow in concentration. "Now here's a good one to begin with. What does the word 'aperiodic' mean?"

"It's a rather loose term," replied Smithy promptly, "which is applied to untuned amplifiers or to the couplings between stages in such amplifiers. An ordinary a.f. amplifier does not have any resonant circuits which would cause it to offer a peak at a particular frequency, and so you can refer to it as being an aperiodic amplifier or as being an amplifier having aperiodic couplings between its stages. You very often have aperiodic r.f. amplifiers, too. For instance, the first stage in a radio receiver can be untuned, whereupon it amplifies all the signals picked up by the aerial and passes these on to the next stage, which is tuned. This first stage is called an aperiodic r.f. amplifier."

"Blow me," remarked Dick, somewhat crestfallen, "you certainly had your answer pat on that one."

"Not to worry, lad," replied Smithy comfortingly. "It's my go now, with B. Tell me, Dick, what is a biradial tip?"

"A biradial tip? Blimey, I've never heard of it before. Can you give me a clue?"

"You encounter it," Smithy prompted him, "in record player pick-ups."

"Do you?" said Dick slowly. "Then I suppose it must have something to do with the stylus. Would it be the same as an elliptical stylus tip?"

"You've got it right first go," commended Smithy. "A biradial or elliptical stylus tip has an outline which isn't round but which is in the form of an ellipse. The major axis of the ellipse, that is to say the longer axis, goes across the record groove and is sufficiently wide to prevent the stylus descending to the groove bottom, where ingrained particles of dirt are liable to introduce noise in the pick-up output. The minor axis of the ellipse is in line with the record groove and it allows the tip to present an arc of a circle of relatively small radius to the groove walls, whereupon the stylus is more readily capable of following high frequency modulation in the groove. Typical dimensions for a biradial stylus tip are 0.0007 inch radius for the curvature across the record groove and 0.0003 inch radius for the curvature against the groove wall." (Fig. 1).

"Well," said Dick complacently. "I gave you the right answer, didn't I?"

"You did, indeed," affirmed Smithy. "It's your turn now, with C."

"All right," replied Dick. "What's 'cryogenics'?"

"Cryogenics?" repeated Smithy. "Blimey, where did you dig that one out of?"

"I read about it in a science journal."

"It looks," stated Smithy thoughtfully, "as though I'll have to do a bit of guesswork here. Now, the prefix 'cryo' seems to be applied to things concerned with low temperatures, and

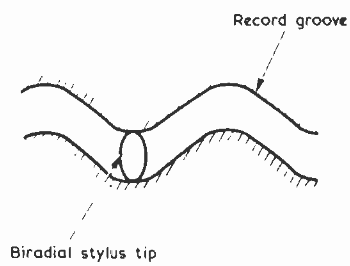


Fig. 1. Illustrating, in simplified form, the operation of a biradial or elliptical pick-up stylus tip

particularly with temperatures near absolute zero. I'll make a guess and say that 'cryogenics' is a science which has to do with materials maintained at temperatures near absolute zero."

"Darn it," said Dick irritably, "you're dead right, too."

"Good show," commented Smithy, cheerfully. "Now it's my turn. What's a decade?"

"That one's easy," replied Dick confidently. "In electronics it's the spacing between two frequencies which have a ratio of 10 to 1. The term is used also for the case where resistance and capacitance values go up in multiples of 10. Right, it's me now. What's an Esaki diode?"

"It's the same as a tunnel diode. What's 'fan-out'?"

"I *think* I know that one," replied Dick hesitantly. "Do you get it in logic circuits?"

"You do," confirmed Smithy.

"Then," replied Dick, emboldened, "it's the number of following gate inputs that a gate output can drive."

"That's correct," confirmed Smithy. "If a gate is said to have a fan-out of 10, that means it can drive up to 10 subsequent gates but no more."

GROUND WAVE

"Fair enough," commented Dick. "Well, we're now up to G, and it's my turn."

There was silence for some moments.

"Come on," grumbled Smithy impatiently. "I can think of lots of things beginning with G."

"That's the trouble," wailed Dick. "So can I! But they're all simple things like 'grid' and 'gain' and 'ground'. Hang on a jiff though, that gives me an idea! What's a ground wave?"

"That *is* a good one," said Smithy. "If you did but know it, ground waves represent one of the most complicated subjects going in electronics, and that's despite the fact that they were known about from the early days of broadcasting. When a transmitter sends out a signal, this can pass to the receiver over a number of routes. The signals in the different routes are referred to as tropospheric waves, ionospheric waves and ground waves. Tropospheric waves appear above 50MHz or so and are carried around the curvature of the earth due to refraction in the atmosphere. Ionospheric waves are those which are reflected back to the earth again by the ionosphere, and these fall within the frequencies from just below 1MHz up to around 60MHz or more. The ground wave comes into play at frequencies below some 2.5MHz and it consists mainly of a wave which follows the curvature of the earth, thereby allowing the signal to be taken some way beyond the transmitter aerial horizon. The ground wave can be split up into two components, one being the surface wave, which tends to hug the earth's curvature, and the other being the space wave. The space wave can, in turn, itself be subdivided into the direct wave and the reflected wave. The first of these is a direct wave from the transmitter aerial to the receiver aerial and the second is a wave reflected from the surface of the earth. Some of the complications I mentioned just now are caused by the fact that surface wave dissemination varies according to the nature of the surface over which it passes, conditions being best over sea water and worst over land with low electrical conductivity." (Fig. 2).

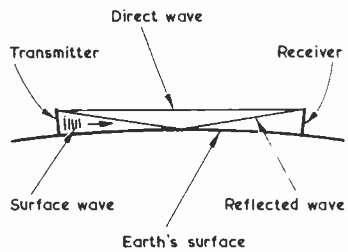


Fig. 2. The component parts of a ground wave. Only the start of the surface wave is shown; this extends to the receiver and beyond

"Well, that explains ground waves well enough for me," commented Dick. "Also, they've got me safely past the letter G! It's your turn now, Smithy, with H."

"I've got a good one here," said Smithy. "What's Hartley's Law?"

"Is it anything to do with oscillators?"

"Nothing whatever."

"Or jamming?"

Smithy threw an irritated glance at his assistant.

"Hartley's Law," he pronounced firmly, "is a fundamental law of communications and it states that the product of the time and bandwidth necessary for the transmission of a given amount of information is a constant. This assumes that the information is sent in a form which utilises bandwidth in the most economical manner possible."

"That sounds interesting," said Dick. "What it means, then, is that bandwidth goes up as the quantity of information rises. There's far more information in a television signal than there is in an a.m. sound signal, which explains why a televison channel is about 8MHz wide whilst an a.m. sound broadcasting channel need only be, say, 8kHz wide."

"Exactly," confirmed Smithy. "It's almost always desirable to keep bandwidth down and in radio transmission this can be done by making economical use of the sidebands involved. A simple illustration of bandwidth reduction is given by the use in TV transmissions of a system in which nearly all of one sideband is suppressed."

"It's nice," commented Dick, "to hear of one law that's being obeyed. What's the next letter?"

"It's I," stated Smithy, "and it's you to go."

"That sounds a bit Irish to me," grinned Dick, "but I get your meaning. Okay then, what's an igfet?"

"It's an insulated gate field effect transistor," said Smithy. "The gate is insulated from the channel between the source and the drain by a very thin layer of silicon oxide and it has an extremely high input resistance. Right now! J is next, so let's see what I can dream up for you."

Smithy took a large draught of tea from his mug and thought for a moment.

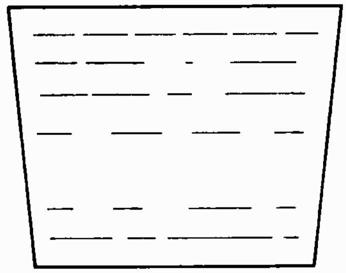
"Ah, yes," he remarked. "I'll return the compliment to you and ask you what a jugfet is."

"That's easy," replied Dick. "That's a junction gate f.e.t. It's the more common type which doesn't have an insulated gate."

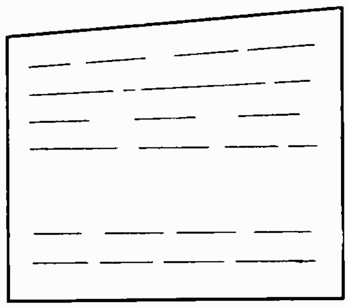
Smithy's assistant pondered for a moment.

"And now let me ask you one beginning with K. What's 'keystone distortion'?"

"It's distortion of the picture shape on a TV tube screen," said Smithy. "And it describes the case where the top is wider than the bottom, as occurs in the keystone of an arch. It's a form of trapezium distortion and the latter term applies to any case where two sides of the picture are parallel and two are not. Picture distortion of this nature is normally caused by shortcomings in deflector coil performance." (Figs. 3(a) and (b).)



(a)



(b)

Fig. 3(a). Keystone picture shape distortion
(b) Trapezium distortion applies to any case where two sides of the television picture are not parallel

LOAD LINE

Smithy took a further large draught from his mug.

"The letter L is next," he remarked. "So you tell me what you know about load lines."

Dick's face fell.

"I thought things were getting a bit too easy," he sighed. "All I know about load lines is that you use them in some mysterious way with the characteristic curves for valves or transistors. But as to how exactly they are used, I just haven't got a clue."

"It's quite easy to employ load lines," replied Smithy. "I think you'd better come over here and I'll give you an example of how you draw up a load line for a resistive load."

As Dick walked over to Smithy's bench, that worthy proceeded to take a book of valve data from a drawer.

"I'll show you how to draw a load line on top of a family of valve characteristic curves," resumed the Serviceman. "I'm using valve characteristics because the technique can be demonstrated a little more easily with these than with transistor curves."

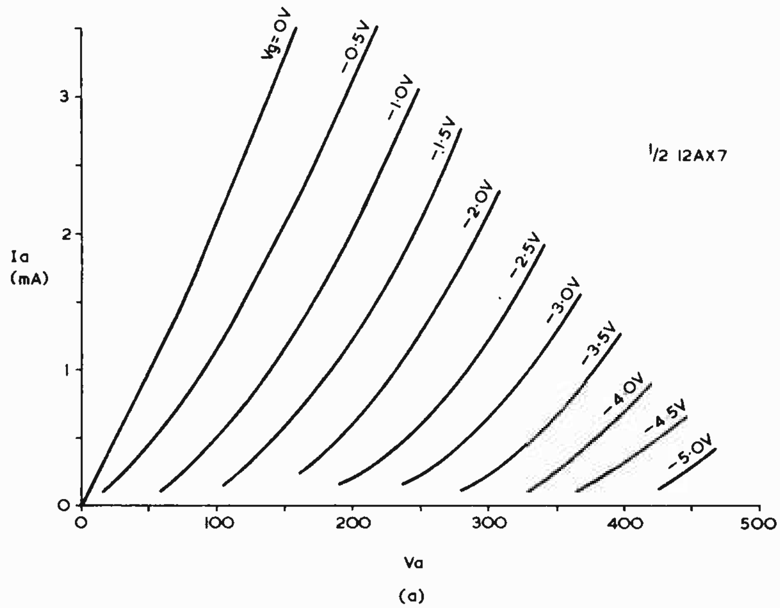
Smithy opened the valve book and selected a page which illustrated the Ia/Va curves for one section of the double-triode type 12AX7. (Fig. 4(a).)

"As you can see," he went on, "I've chosen a 12AX7 triode for this little exercise, but any other amplifier valve would have done just as well. The characteristic curves we work with are those for anode current against anode voltage. As you can see, each of the curves corresponds to a particular grid voltage, this being with respect to the cathode of the triode."

Smithy indicated the individual curves to his assistant.

"This is all okay up to now," put in Dick. "Keep on, Smithy!"

"Right-ho," said Smithy. "Now, the function of the load line we are going to add is to define the performance of the valve when it has a particular value of anode load resistor and there is a particular value of h.t. voltage. Let's say that we're going to use an anode load resistor of 100kΩ and that the h.t. supply voltage is 250. After we have drawn the load line, this will indicate the anode voltage at any anode current under these conditions. There



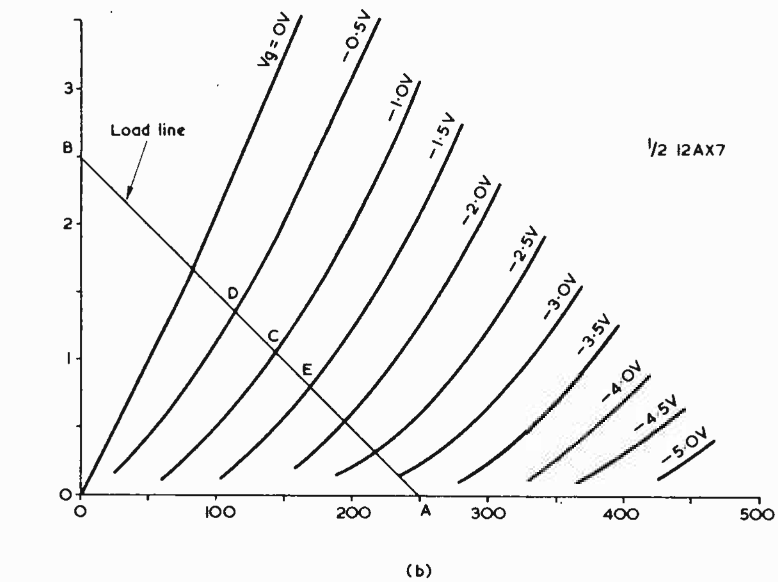


Fig. 4(a). Anode current-anode voltage curves for one section of a valve type 12AX7
(b). Adding a load line corresponding to an anode load resistor of 100kΩ and an h.t. voltage of 250 volts

are two points for the load line which we can mark in straight away, these corresponding to zero anode current and to zero anode voltage."

"You can't," interrupted Dick, "have zero anode voltage in a triode. There's bound to be *some* voltage between the anode and the cathode."

"I know there is," retorted Smithy, a little testily. "If you'd let me continue my explanation I would have been able to say that the zero anode voltage point was a theoretical one. Now, let's get on. When the anode current is zero the anode voltage becomes 250, because no voltage is dropped across the 100kΩ resistor. We can mark in the corresponding point on the curves graph as point A. If the anode voltage is zero then the full 250 volts is dropped across the 100kΩ resistor, resulting in an anode current of 2.5mA. This gives us point B. All that we now have to do is to draw a straight line between the two points. That straight line is the load line for 100kΩ anode load and 250 volts h.t., and it defines the anode voltage for any anode current.

Working from the line you can see, for example, that 1mA of anode current corresponds to an anode voltage of 150. This ties in with fact, because an anode current of 1mA would cause 100 volts to be dropped in the load resistor."

Smithy showed Dick the graph, complete with its load line. (Fig. 4(b).) Dick looked at it blankly.

"So where do we go from here?"

"Dash it all, boy, can't you see?" said Smithy irritably. "With 250 volts h.t. and an anode load of 100kΩ, the anode voltage must *always* fall on the load line at the point which corresponds to the anode current it passes. What we are now also capable of finding is the anode voltage at different grid voltages. These are the points where the grid voltage curves cut the load line. For instance, the 1 volt negative grid voltage curve cuts the load line at point C, and those for 0.5 volt and 1.5 volts negative at D and E."

Smithy inserted the letters.

"Point C," he went on, "corresponds to 140 volts on the anode, point D to 115 volts on the anode, and point E to 165 volts on the anode. This means that if we bias the valve at 1 volt negative and then apply a signal with a value of 0.5 volt peak, or 1 volt peak-to-peak, the anode voltage will swing down to 115 volts on one set of half-cycles and swing up to 165 volts on the other set of half-cycles. Thus, we find that the output signal has a peak-to-peak value of 50 volts, which means that the valve offers a voltage gain, under the conditions which the load line represents, of 50 times. Also since, in this instance, the swings of anode voltage on either side of the central figure are equal, we can assume that any distortion introduced in the process of amplification should be quite low."

"Stap me," exclaimed Dick. "I can see what you're getting at now! With this load line idea you can find the performance of the valve for *any* value of anode load resistor and for *any* h.t. voltage."

"Exactly," agreed Smithy. "To draw the load line you first of all mark off the h.t. voltage at the zero current point. You then mark off the anode current point at the current which would flow if the full h.t. voltage were applied across the anode load resistor. Join the two points with a straight line and you've got the load line. This will tell you the anode voltage at any of the grid voltages for which curves have been drawn in. You can do just the same thing with a family of transistor collector current and collector voltage curves representing operation in common emitter. With transistors, Vcc takes the place of the h.t. voltage. Anyway, that's enough of load lines, so let's get on to the letter M. And it's

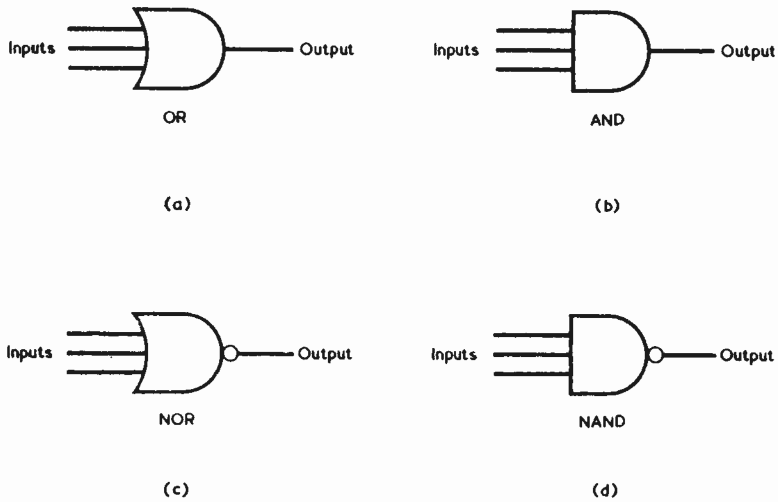


Fig. 5. Circuit symbol for (a) an OR gate, (b) an AND gate, (c) a NOR gate and (d) a NAND gate. Three inputs are shown, but the gates may alternatively have two inputs or more than three inputs

your turn."

Dick turned his thoughts away from load lines and concentrated.

"All right," he said, "what's a myriawatt?"

Myria, myria," repeated Smithy reflectively. "Let's just think a moment. Oh yes, I remember now! 'Myria' is the metric prefix for 10,000. A myriawatt is 10,000 watts. Okay?"

"Yep," said Dick. "I thought for a moment then that you were going to break into a 'myria, myria, on the wall' routine!"

"I'll do a metric one on you now," said Smithy, ignoring Dick's comments. "What's a nanosecond?"

"That's another easy one," replied Dick. "I always remember 'nano' by saying it comes between 'micro' and 'pico'. A nanosecond is one-thousand-millionth of a second, or a thousandth of a microsecond."

"Good," said Smithy. "What's the next letter?"

"O," replied Dick, "and it's me to go. I'll give you an easy one, too. What's an OR gate?"

"It's a gate which gives an output 1 when one or more of its inputs is 1," replied Smithy. "The common circuit symbol for it is a sort of elongated semicircle with a curved edge where the inputs go, as opposed to the straight edge at the input side that you have with an AND gate symbol. If a small circle is added at the output end, this represents an inverter and the gate becomes a NOR gate. Here, the output is O when one or more of the inputs is 1." (Figs. 5(a), (b) and (c).)

"A little circle at the output end of an AND gate makes that a NAND gate, too, doesn't it?" (Fig. 5(d).)

"It does," confirmed Smithy. "As I understand it, the official symbol nowadays for all gates is simply a rectangle with the gate function written inside, but the symbols I've just described are those that are commonly used throughout industry. It's me next with P. What do I mean by 'pre-emphasis'?"

" Pre-emphasis'?" repeated Dick frowning. "Blimey, I should know that."

He scratched his head helplessly.

"No," he said eventually, "I give up. What *is* 'pre-emphasis'?"

"It's the process of increasing the amplitude of a band of frequencies in a signal relative to the other frequencies," explained Smithy. "We get it for instance in the transmission of f.m. sound, in which the higher audio frequencies are pre-emphasised at the transmitter and are then de-emphasised at the receiver. This results in a higher signal-to-noise ratio. With British f.m. transmissions the pre-emphasis is 50 microseconds."

"How d'you mean, 50 microseconds?"

"The pre-emphasis," explained Smithy, "can be carried out by a simple filter incorporating inductance and resistance in series and the de-emphasis by another signal filter incorporating resistance followed by shunt capacitance. The 50 microsecond figure then applies to their time constant. Provided the time constant is correct, the right amount of pre-emphasis or de-emphasis will always be given by either filter. With the inductive pre-emphasis circuit the time constant is L in henrys divided by R in ohms, and suitable values would be 1 henry and 20kΩ. The time constant for the capacitive filter is the familiar C times R, and typical values for a 50 microsecond de-emphasis filter would be 100kΩ and 500pF." (Figs. 6(a) and (b).)

QUASAR

"Well now, that's something I've definitely learned today," stated Dick cheerfully. "I've got a smasher for the next letter, which is Q. What's a quasar?"

"A *what?*"

"A quasar."

"Spell it."

"Q-U-A-S-A-R."

Smithy looked at his assistant suspiciously.

"You wouldn't be trying to take the Michael, would you?"

"Of course not."

"I don't believe there is such a word," stated Smith with conviction. "You've just made it up."

"No, I haven't"

"Oh all right," said Smithy bad temperedly. "You tell me what it is then."

'It's a source of radio signals from outer space," explained Dick. "Quasars can be located by radio astronomy and have rather the same behaviour, from the radio signal point of view, as have stars."

"Humph," grunted Smithy grudgingly. "All I can say is that I didn't know *that* before. Very well then, I'll try an awkward one out on you for R. What's 'radiation resistance'?"

"Of an aerial?"

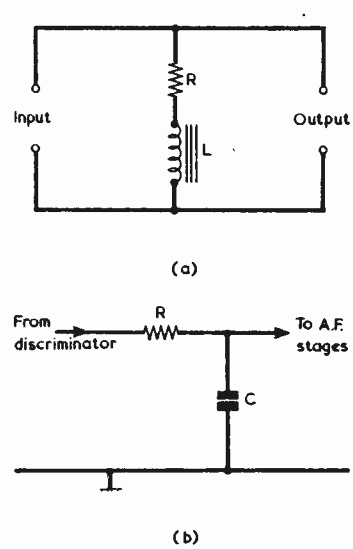


Fig. 6(a). A pre-emphasis filter. The input source should have an internal resistance much higher than the value of R
(b). A de-emphasis filter, as incorporated in an f.m. receiver. The filter can perform the secondary function of i.f. filtering

"Yes," said Smithy shortly, "of an aerial."

"It's the effective resistance presented by an aerial when it's used for transmitting," replied Dick confidently. "Since the aerial is dissipating energy in the form of radio signals it can be looked upon, so far as the power going into it is concerned, as a resistance, and this is the radiation resistance. As power is equal to I^2R, the radiation resistance of the aerial is equal to the power going into it divided by the square of the aerial current."

Dick smiled sweetly at the obviously nonplussed Serviceman. He forebore to mention that he had just happened to be reading about radiation resistance in a radio magazine during lunch-time.

"Shall I give you one for S?"

Ungraciously, Smithy grunted an assent.

"What," asked Dick, "is a see-saw circuit?"

A gleam of satisfaction came into Smithy's eyes.

"Ah now," he remarked, obviously pleased, "this is a question that's a bit more down to earth. The see-saw circuit first came into being in the earlier days of hi-fi valve amplifiers, in which it was used as a phase-splitter. It employed a double-triode in an arrangement where there were two equal value resistors between the anodes, with their junction coupled to the grid of the second triode." (Fig. 7(a).)

Smithy sipped for a moment at his mug.

"But it is easier nowadays to demonstrate see-saw operation with the aid of an operational amplifier," he went on. "If an input from a source which is assumed to have no internal resistance is fed via a resistor to the inverting input of an op-amp and a resistor of the same value is connected between the output and the inverting input, you get a set-up where the output is equal in amplitude but of opposite phase to the input." (Fig. 7(b).)

"I see," said Dick. "As the input goes one way the output goes the other way. Is that why it's called a see-saw circuit?"

"That's right," replied Smithy. "Another point is that, because of the very high gain of an op-amp the voltage at its inverting input terminal hardly varies at all, which is why the terminal can be looked upon as being a virtual earth. You still get the see-saw effect if the two resistors have different values but the output amplitude isn't then equal to the input amplitude. Which brings me up to T."

"Letter T or liquid tea?"

"Both," replied Smithy, draining his mug and handing it over to his assistant. "It's a good thing you reminded me!"

Smithy waited as Dick busied himself at the Workshop sink with the task of replenishing his mug.

"I'll give you a nice simple one now," he remarked as Dick returned. "What's a thermistor?"

"It's a device," said Dick without hesitation, "whose resistance goes down as its temperature goes up. What's 'unilateralisation'?"

"Dear me," chuckled Smithy. "You're going back a bit here. 'Unilateralisation' is the rather posh name given to the neutralising arrangements which were employed in the earlier medium and long wave transistor radios, particularly when these had OC45's and similar transistors in the i.f. stages. The output of each i.f. amplifier transistor was coupled back to the input via a capacitor on its own or via a capacitor in series with a resistor." (Fig. 8.)

Smithy drank from his recharged mug.

"Well now," he said musingly, "what shall I do about V? Ah, I know. Tell me what 'vertical blanking' is."

"That's the process," said Dick, "of cutting off the cathode ray tube beam in a TV receiver during vertical retrace at the end of each field. If you didn't do this the spot would trace out a pattern on the screen as it returned to the top to start another field."

"True," assented Smithy. "The blanking level is also, incidentally, automatically provided by the transmitted signal."

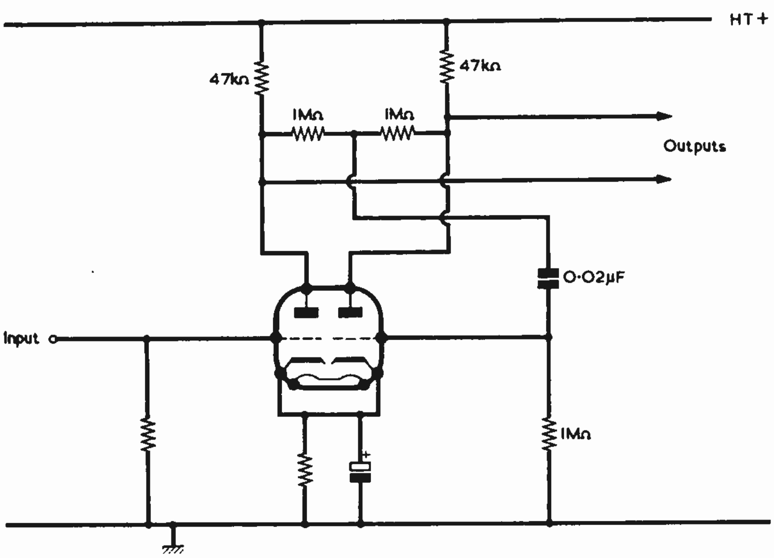
"Blow me," remarked Dick. "It's W next and we've nearly come to the end of the alphabet already. Anyway, what's a wave trap?"

"It's a tuned circuit," replied Smithy, "whose function is to reject an unwanted signal. You most often find it in the form of a parallel tuned circuit inserted in series with the aerial connection to a receiver. Since a parallel tuned circuit offers a maximum impedance at its resonant frequency, the wave trap is set up to be resonant at the frequency of the unwanted signal." (Fig. 9).

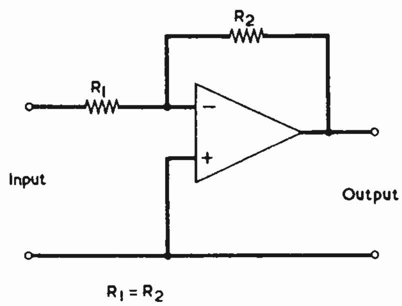
X-RAYS

Smithy frowned.

"There's only X, Y and Z left now,"



(a)



(b)

Fig. 7 (a). The original see-saw valve phase splitter, with suitable component values in the anode and second grid circuits
(b). A see-saw circuit employing an operational amplifier. When R1 is equal to R2 the output amplitude equals the input amplitude. See-saw operation is still given if the resistors are unequal

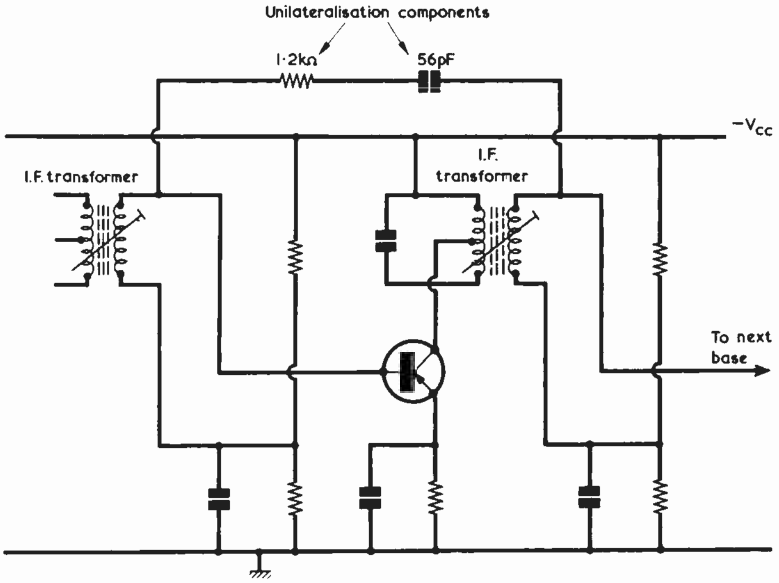


Fig. 8. An example of unilateralisation in a receiver i.f. amplifier, with typical component values. In some cases the resistor may be omitted

he commented, "and these are always difficult letters to deal with. I think I'd better ask you about X-rays."

"Well," said Dick, "X-rays are the invisible rays which pass through you and enable your innards to be photographed."

"An excellent and highly scientific description," stated Smithy. "It's worth adding, perhaps, that X-rays are in the electromagnetic family and that they cover higher frequencies than those of visible light, these frequencies starting at around the point where the ultra-violet band ceases."

"There's Y next," commented Dick. "I've got a good one here. What's a 'Y-cut crystal'?"

"It's a quartz crystal segment," replied Smithy, "which has been cut along a particular axis of the parent crystal. You don't normally encounter Y-cut crystals, the more common types being AT and BT cuts. These letters indicate planes inside the parent crystal before it's cut, and each of the cuts are at different angles inside the crystal. Blimey, I'm stuck with Z now! Ah, I know. Tell me what 'zero-beat' is."

"That's a good one to finish off with," said Dick. "If you tune an a.m. superhet with a b.f.o., or a t.r.f. receiver whose reaction is advanced beyond oscillation point, through a signal, you get the well-known heterodyne whistle with the carrier of the signal. You can tune the receiver so that the frequency of the heterodyne beat note becomes so low that it is inaudible. If you keep tuning, the beat note becomes audible again at a very low frequency, which then rises. The tuning point at the middle of the two points where the signal becomes inaudible is known as zero-beat."

"Very good," remarked Smithy, pleased. "The term also applies to any other case where two separate signals which heterodyne together have virtually equal frequencies. Well, we seem to have successfully made our way once more through the alphabet."

"What's more," chimed in Dick, "we've managed to find a subject for each letter, too. And that just can't be bad."

Whereupon, after having passed the letter Z, we must now take our leave of the pair, ensconced as they are in the warm comfortable Workshop with an unusually small amount of work in front of them and the consequent ability to take things nice and easy. Circumstances such as these can hardly be bad, either. ■

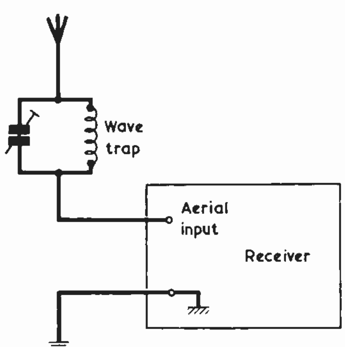


Fig. 9. A wave trap inserted in the aerial feed to a receiver

Radio Topics

By Recorder

Although noise is looked upon as one of the factors which pollute our environment there are times when, properly controlled, it has a level of usefulness. This is particularly true of white noise. White noise consists of random noise containing a wide band of frequencies without any peaks in the frequency response, and it is analogous to white light, which includes all the frequencies of the visual spectrum. It is common to refer to white noise as covering the audio frequencies only but the term nowadays seems to be applied to noise bands at radio frequencies as well.

White noise is of particular value in the testing and evaluation of high fidelity equipment since it enables any abnormalities in the frequency response of such equipment to be revealed under operating conditions. If white noise with a flat frequency response is fed into the input of the equipment then white noise with a similarly flat response should appear at the output. If it doesn't then there's something wrong with the equipment.

In the higher frequency ranges there are many applications for flat white noise in radar and communications systems. Here, it may be used for signal path verification and as a carrier for secure line operation.

NOISE GENERATORS

A company which specialises in the production of noise generators is Solidev Ltd., Tubs Hill House, North Entrance, London Road, Sevenoaks, Kent, who now announce the Solidev SD series of noise diode sources. These are available with or without their energising circuits in an eight frequency band range of between 5Hz to 20kHz and 1MHz to 500MHz. When the energising circuit is included, the diode, the current limiting resistor and the d.c. blocking capacitor in the output are encapsulated in one package designed for printed circuit mounting. All these units can be selected for response flatness, and they operate into a load impedance of 50Ω.

Other devices produced by Solidev Ltd. include noise reference test sets; units with extremely high levels of flat noise for use in band rejection noise calibration systems; panel mounted noise sources for incorporation into test equipment; and a range of custom built modules for a variety of electrical and physical conditions to MIL specifications.

Professional readers will be interested to learn about the wide range of noise generating equipment that is currently being manufactured. And the non-professional amateur may be impressed, also, to learn that a humble quantity such as noise can attract to itself such a diverse field in design and development.

TELEPHONE AMPLIFIER

All sorts of odd jobs tend to come my way these days, and a recent one consisted of the repair of a home-built telephone amplifier which had developed a nasty attack of distortion. It was simply a sensitive transistor a.f. amplifier complete with speaker, to the input of which was coupled a telephone pick-up coil. A telephone pick-up coil consists, as you will almost certainly already know, of a coil mounted in a small plastic moulding having a rubber sucker at one end. You simply affix this by means of the sucker to the base of the telephone instrument, choosing a position which offers optimum coupling to the internal transformer inside. Thus, there are no direct connections to Post Office lines and the operation of the telephone is unimpaired. These pick-up coils can be obtained, incidentally, from Henry's Radio, Ltd. The type sold by Henry's Radio has an impedance of about 2kΩ, is referred to as a 'telephone recording adaptor', and appears in the Henry's Radio catalogue in the section devoted to microphones.

My problem, whilst fixing the amplifier, was to find a source of signal which could be fed into the amplifier, via the telephone pick-up coil, for a length of about fifteen minutes or so whilst I chased the cause of the distortion.

The obvious approach here is to dial the time number and use the continual time announcements as a source of signal. However, I rejected this idea for two reasons. First, it seemed to me to be morally wrong to tie up a line to a public service number for as long a period of time as I would require. Second, I haven't got a telephone in my workroom.

The solution proved to be remarkably simple. The transistor radio I use in my workroom for news bulletins and the like has its output stage fed by a driver transformer. All I had to do was to tune in a station, set the volume of the radio to a low level and place the pick-up coil on top of that driver transformer. The coil picked up the field from the transformer at just the same level as it would have done from a telephone, and it enabled me to trace the fault in the amplifier without any difficulty. The fault, by the way, was simply a cold joint at one of the transistor bias resistors, and it required nothing more technical than a gentle prod with a screwdriver to reveal itself.

Before the war those of us in the radio game used to complain bitterly about what we considered to be the unnecessary multiplicity of valve types. There were certainly plenty of valves around in those days, and one of the complicating factors was the large quantity of different valve bases which were employed. These included the British 4-pin, the British 5-pin, the British 7-pin, the Mazda Octal, the International Octal and the Philips side-contact bases. From the States there were also the UX4, UX5, UX6 and UX7 bases. Later to descend on us were the B7G, B8A and B9A bases.

Even with this multiplicity of valve types, we would have held up our hands in horror could we have foreseen the myriad hordes of transistor types beneath which we are now being swamped. The home-constructor may imagine, from the lists of transistors published by component retailers, that the situation is not all that bad. But there are many more transistor types than those which find their way into the amateur market. If, for instance, the constructor ventures into the servicing field he will soon encounter receivers having transistors whose type numbers seem to have no relationship whatsoever with the more familiar ones we play around with at home. There is, one begins to suspect, just one copy of the specifications for each of these outlandish transistors, and this is locked firmly away in the safe of the receiver manufacturing company which employs them in its wares.

INTEGRATED CIRCUITS

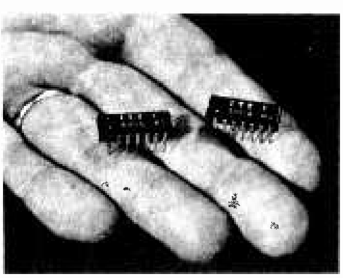
It is with something of a suprise, then, that I find that a degree of rationalisation has become evident in the world of integrated circuits. So far as operational amplifiers are concerned, the 709 and 741 appear to have carved out their own highly stable niche. And in logic i.c.'s the well-known 74 series of TTL packages seems to be meeting most of the general requirements that are apparent in this field. There are, admittedly, sub-divisions within the type numbers, these defining whether the devices in question are, say, dual-in-line or in flat package, and also their temperature limits. But these sub-divisions should not at any event trouble the home-constructor to any great extent, apart from the fact that he will probably find that the dual-in-line versions are the most easy to work with.

There are, of course, still a great many i.c. types other than the ones I've just mentioned. But the latter presumably represent the ultimate in performance for their particular applications and, since they are more than good enough for common-or-garden op-amp and logic functions, have become standardised types. And a jolly good thing, too.

An unusual development is that components other than semiconductor devices are now being designed to fit into the integrated circuit format! The two d.i.l. packages you see in the accompanying photograph are not semiconductor integrated circuits at all; they are, instead, resistor networks.

These new units are made by ITT Components Group Europe and are part of a range of standard resistor networks in 14 pin dual-in-line packages which are known as 'Key' resistor modules.

These networks offer groups of resistors connected in various patterns to meet circuit functions that repeat themselves many times in equipment assemblies. As such, they are capable of reducing costs by simplifying component ordering, inspection and storage and of easing assembly and inspection during equipment production.



Resistor networks are now being produced, by ITT Components Group Europe, in the d.i.l. package formerly assigned to integrated circuits. A range of modules with different internal circuits and varying resistance values is available

The networks include the following packages.

A module with seven different resistors, all of equal value, suitable for l.e.d. (light-emitting diode) current limiting.

A module with thirteen resistors, all of equal value in any one unit, and all commoned at one end to pin 14.

A module with twelve resistors, all of equal value in any one unit and commoned at one end to pin 14, plus a capacitor for decoupling connected between pins 7 and 14.

A module having two groups each of six resistors. Within each group the resistors are commoned at one end and brought out to pin 14 for one group and to pin 7 for the other group. These networks are available with resistors all of equal value in any one unit, or a single fixed ratio between the two groups of resistors in any one unit.

(Further information on these packages can, incidentally, be obtained from ITT Components Group Europe, Film Circuit Operation, Brixham Road, Paignton, Devon.)

The idea of multiple resistor packs is not new, of course, and these have been used quite a lot in the past. But it is interesting, to say the least, to see them now turning up in the d.i.l. style which has been brought about by the advent of the integrated circuit.

CONTRA ENTRY

A disturbing feature of the computer is that, so far as time is concerned, it is strictly a one-way device. No allegation written out by a computer can be expunged. The only rectification possible is the issuing of a balancing counter-allegation later.

This was brought home to me when I was checking a recent bank statement, which had been made up by the bank's central computer. There, in the 'Receipts' column, was an entry for £11 marked against 'Sundry Credit', but there was no corresponding record of this in my paying-in book. It looked as though I had become £11 richer through divine intervention via the bank central computer and that I'd be able to pay off the rent after all. But such was not to be the case. An entry 24 days later described as 'Contra Entry' put that £11 firmly in the 'Payments' column and I was back to square one once again.

Presumably it was a human agency that credited me with the money in the first place, and a second human agency that had initiated the 'Contra Entry' bit to correct the error after it had been found that the bank's central resources were light of £11. Or, spine-chilling thought, had the computer itself detected the error and then taken it upon itself to put it right before anyone found out? Perhaps, even more frightening, that computer is trying out its skill at embezzlement on a small scale. When it becomes sufficiently proficient, it will then salt away small sums from individual accounts into a private numbered account in Switzerland, this being done with the aid of an accomplice computer situated in that country.

Perhaps the most annoying thing about this story is that I didn't know I was the possessor of an illicit £11 until after the money had been debited back again. ■

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(Continued on page 273)

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(Continued from page 273)

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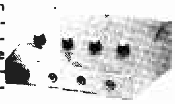

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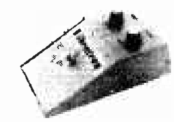

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COIL DATA I

The Table gives calculated inductance values, in microhenrys, of single-layer air-cored coils having diameters of $\frac{1}{4}$ and $\frac{3}{8}$ in. and lengths (l) as shown. Thus, a 10-turn coil of diameter $\frac{3}{8}$ in. and length $\frac{1}{2}$ in. has a calculated inductance of 0.53μH.

	Dia. $\frac{1}{4}$ in.				Dia. $\frac{3}{8}$ in.			
Turns	$l=\frac{3}{16}$ in.	$l=\frac{1}{4}$ in.	$l=\frac{5}{16}$ in.	$l=\frac{3}{8}$ in.	$l=\frac{5}{16}$ in.	$l=\frac{3}{8}$ in.	$l=\frac{7}{16}$ in.	$l=\frac{1}{2}$ in.
4	0.083	0.069	0.062	0.051	0.12	0.10	0.093	0.084
5	0.13	0.11	0.098	0.080	0.18	0.16	0.15	0.13
6	0.19	0.16	0.14	0.12	0.26	0.22	0.21	0.19
7	0.26	0.21	0.19	0.16	0.36	0.32	0.28	0.26
8	0.33	0.28	0.25	0.21	0.47	0.41	0.37	0.34
9	0.42	0.35	0.32	0.26	0.66	0.52	0.47	0.42
10	0.52	0.43	0.39	0.32	0.73	0.65	0.58	0.53
12	0.75	0.62	0.56	0.46	1.1	0.93	0.84	0.76
14	1.0	0.84	0.77	0.63	1.4	1.3	1.1	1.0
16	1.3	1.1	1.0	0.82	1.9	1.7	1.5	1.3
18	1.7	1.4	1.3	1.0	2.4	2.1	1.9	1.7
20	2.1	1.7	1.6	1.3	2.9	2.6	2.3	2.1
25	3.2	2.7	2.4	2.0	4.6	4.0	3.6	3.3
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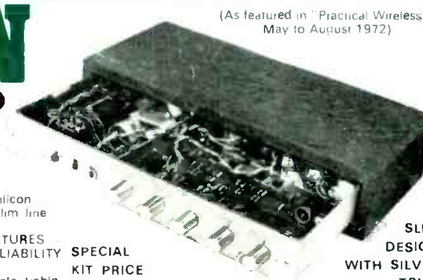

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Constructional details Ref. No. 21 30p
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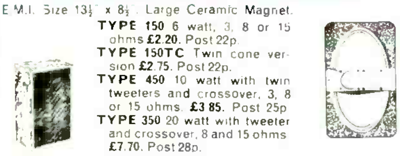

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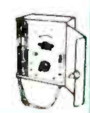

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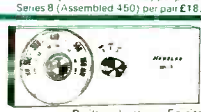

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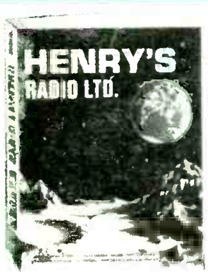

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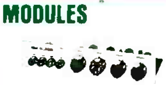

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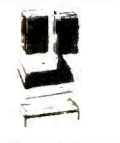

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