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Technical Queries. We regret that we are unable to answer queries other than those arising from articles appearing in this magazine nor can we advise on modifications to equipment described. We regret that such queries cannot be answered over the telephone; they must be submitted in writing and accompanied by a stamped addressed envelope for reply.

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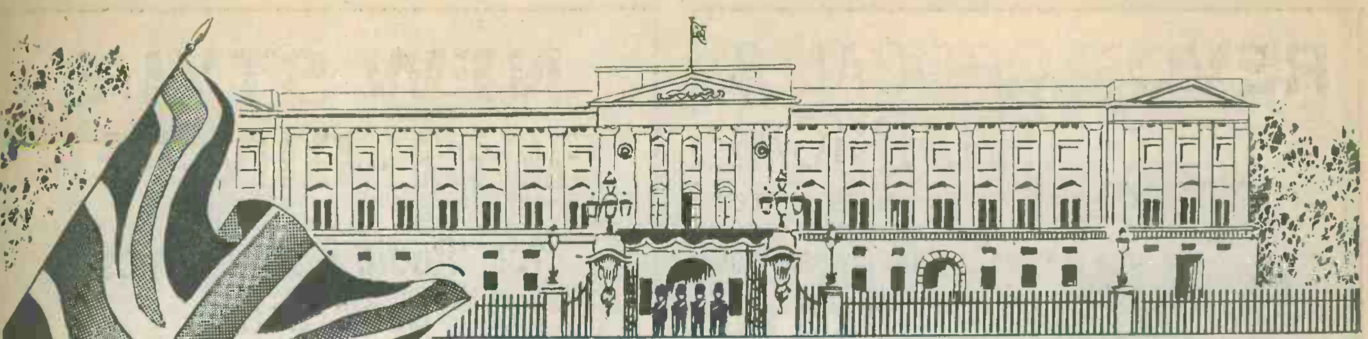

JUBILEE SALE

74 SERIES TTL IC's

Type	Quantity 1 £ p	100 £ p	Type	Quantity 1 £ p	100 £ p	Type	Quantity 1 £ p	100 £ p
7400	0.09	0.08	7448	0.70	0.68	74122	0.45	0.42
7401	0.11	0.10	7450	0.12	0.10	74123	0.65	0.62
7402	0.11	0.10	7451	0.12	0.10	74141	0.68	0.65
7403	0.11	0.10	7453	0.12	0.10	75145	0.75	0.72
7404	0.11	0.10	7454	0.12	0.10	74150	1.10	1.05
7405	0.11	0.10	7460	0.12	0.10	74151	0.65	0.60
7406	0.28	0.25	7470	0.24	0.23	74153	0.70	0.68
7407	0.28	0.25	7472	0.20	0.19	74154	1.20	1.10
7408	0.12	0.11	7473	0.26	0.22	74155	0.70	0.68
7409	0.12	0.11	7474	0.24	0.23	74156	0.70	0.68
7410	0.09	0.08	7475	0.44	0.40	74157	0.70	0.68
7411	0.22	0.20	7476	0.26	0.25	74160	0.95	0.85
7412	0.22	0.20	7480	0.45	0.42	74161	0.95	0.85
7413	0.26	0.25	7481	0.90	0.88	74162	0.95	0.85
7416	0.28	0.25	7482	0.75	0.73	74163	0.95	0.85
7417	0.26	0.26	7483	0.88	0.82	74164	1.20	1.10
7420	0.11	0.10	7484	0.85	0.80	74165	1.20	1.10
7422	0.19	0.18	7485	1.10	1.00	74166	1.20	1.10
7423	0.21	0.20	7486	0.28	0.26	74174	1.10	1.00
7425	0.25	0.23	7489	2.70	2.50	74175	0.85	0.82
7426	0.25	0.23	7490	0.38	0.32	74176	1.10	1.00
7427	0.25	0.23	7491	0.65	0.62	74177	1.10	1.00
7428	0.36	0.34	7492	0.43	0.35	74180	1.10	1.00
7430	0.12	0.10	7493	0.38	0.35	74181	1.90	1.80
7432	0.20	0.19	7494	0.70	0.68	74182	0.80	0.78
7433	0.38	0.36	7495	0.60	0.58	74184	1.50	1.40
7437	0.26	0.25	7496	0.70	0.68	74190	1.40	1.30
7438	0.26	0.25	74100	0.95	0.90	74191	1.40	1.30
7440	0.12	0.10	74104	0.40	0.35	74192	1.10	1.00
7441	0.60	0.57	74105	0.30	0.25	74193	1.05	1.00
7442	0.80	0.70	74107	0.30	0.25	74194	1.05	1.00
7443	0.95	0.90	74110	0.48	0.45	74195	0.80	0.75
7444	0.95	0.90	74111	0.76	0.72	74196	0.90	0.85
7445	0.80	0.76	74118	0.85	0.82	74197	0.90	0.85
7446	0.80	0.75	74119	1.30	1.20	74198	1.90	1.80
7447	0.70	0.68	74121	0.28	0.26	74199	1.80	1.70

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CD4000	£0.18	CD4022	£0.80	CD4046	£0.95
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CD4006	£0.80	CD4025	£0.18	CD4050	£0.46
CD4007	£0.18	CD4026	£1.85	CD4054	£0.95
CD4008	£0.80	CD4027	£0.48	CD4055	£1.60
CD4009	£0.50	CD4028	£0.80	CD4056	£1.15
CD4010	£0.50	CD4029	£0.95	CD4069	£0.32
CD4011	£0.18	CD4030	£0.46	CD4070	£0.32
CD4012	£0.18	CD4031	£1.80	CD4071	£0.20
CD4013	£0.42	CD4035	£1.40	CD4072	£0.20
CD4015	£0.80	CD4037	£0.78	CD4081	£0.20
CD4016	£0.42	CD4040	£0.78	CD4082	£0.20
CD4017	£0.80	CD4041	£0.68	CD4510	£1.10
CD4018	£0.85	CD4042	£0.68	CD4511	£1.25
CD4019	£0.46	CD4043	£0.78	CD4516	£1.10
CD4020	£0.95	CD4044	£0.78	CD4518	£1.10
CD4021	£0.85	CD4045	£1.15	CD4520	£1.10

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V.A.T.

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Add 25p for postage and packing unless otherwise shown. Add extra for Airmail. Minimum Order £1.00

TESTED TRANSISTOR PAKS

All devices brand new, tested and coded

J1 3 each AC128/AC176
J2 10 off BC107
J3 10 off BC108
J4 10 off BC109
J5 3 each BC14B/149-2 BC147★
J6 3 each BC169/171/172★
J7 2 each BC177/8/9
J8 2 each BC182/3/4★
J9 2 each BC212/213/214★
J10 2 x BC327 3 x 8C328★
J11 2 x BC337 3 x BC338★
J12 2 each BF115-BF167-BF173
J13 2 x BF194/5/6★
J14 2 x BF258
J15 2 x BFX29 3 x 8FX84
J16 2 each BFY50/51/52
J17 6 x OC71
J18 4 each ZTX108/9 2 x ZTX107★
J19 2 each ZTX301/2 4 x ZTX300★
J20 2 each ZTX500/1/2
J21 4 each 2N706/2N708
J22 1 each 2N2218/19/21/22
J23 2 each 2N2904/05
J24 3 x 2N2907 2 x 2N2906
J25 7 x 2N2926 G★
J26 4 x 2N3053
J27 2 x 2N3055
J28 3 each 2N3702/03/04★
J29 3 each 2N3904/06★

PRICE 60p PER PAK

TESTED DIODE PAKS

J30 12 x OA81
J31 12 x OA91
J32 12 x OA200
J33 12 x OA202
J34 15 x IN4148
J35 20 x IN4001
J36 15 x IN4002
J37 10 x IN4004
J38 8 x IN4007
J39 5 x IN5400
J40 5 x IN5401
J41 4 x IN5404
J42 3 x IN5408

PRICE 60p PER PAK

OPTOELECTRONICS

J43	4 x DL707 + Data	£2.80
J44	5 x .125 Red LED	£0.50
J45	5 x .2 Red LED	£0.50
J46	5 x 2 and .125 LED's mixed colours	£0.50
J47	3 x ORP12 equivalent	£1.20
J48	5 x OCP71	£1.00

THYRISTOR PAKS

J49	1amp SCR's 2 x 50V, 1 x 400V, 1 x 600V	£1.00
J50	5amp SCR's 1 x 50V, 2 x 400V, 1 x 600V	£1.50

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J51	6 x TIS43/UT46	£1.00
J52	4 x 2N3819	£0.60

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J53	2 x Etch resist pens	£1.00
J54	2 x Etchant paks	£1.00

D.I.Y. PRINTED CIRCUIT KIT

CONTAINS 6 pieces copper laminate, box of etchant powder and measure, tweezers, marker pen, high quality pump drill, Stanley knife and blades, 6" metal rule.
FULL easy-to-follow instructions

J59 SALE PRICE £5.50

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J55	240 first quality ⅛/¼w resistors-mixed from 100ohm - 820k	£1.60★
J56	160 first quality ½w resistors-mixed from 100ohm - 820k	£1.60★

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J57	54 first quality miniature electrolytics from .47uF - 1000uF	£1.20★

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J58	93 first quality ceramic capacitors-mixed from 22pF - .047uF	£1.60★

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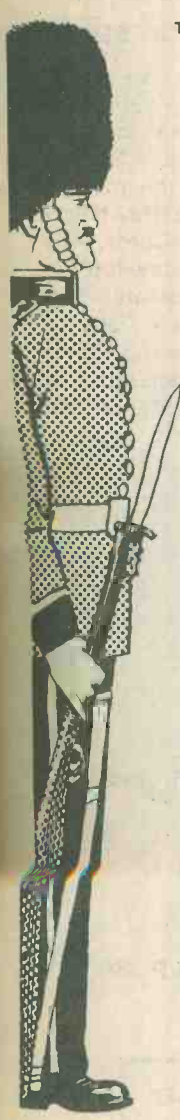
J61	10 x 14 pin D.I.L. Sockets	£1.00
J62	9 x 16 pin D.I.L. Sockets	£1.00

ZENER PAKS

J63	20 mixed value 400mW zener diodes 3-10V	£1.00
J64	20 mixed value 400mW zener diodes 11-33V	£1.00



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COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS

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ACY28	19p
AD149	40p
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AF139	20p
AF178/80/81	30p
AF239	30p
ASY27/73	30p
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BC147/8/9 + A/B/C/S	6p
BC157/8/9 + A/B/C	6p
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BC184C/LC	9p
BC186/7	20p
BC213L/214B	10p
BC261B	8p
BC327/8, 337/8	8p
BC547/8/8A/8C	10p
BC555/6/7/8/9	9p
BCX32, 36	12p
BCY40	50p
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BD113	50p
BD115/6	31p
BD131/2/3	35p
BD135/6/7/9	30p
BD140/142	30p
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BF336	27p
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BFW57/58	17p
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BFX84/88/89	17p
BFY50/51/52	13p
BFY90	50p
BR101	30p
BRY39/56	26p
BSV64	30p
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BSV81 Mosfet	90p
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BSY40	27p
BSY95A	12p
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GET111	40p
ON222	20p
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ZTX300/341	7p
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2N456A	50p
2N929	14p
2N987	40p
2N1507/2219	15p
2N2401	30p
2N2412	70p
2N2483	23p
2N2904/5/6/7/7A	15p
2N3053	14p
2N3055 R.C.A.	50p
2N3704	8p
2N3133	20p
2N4037	34p
2N5036 (Plastic 2N3055)	30p
2SA141/2/360	31p
2SB135/6/457	20p
40250 (2N3054)	30p

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Ferromag C core. Screen-95-105-115-125-200-220-240v input: output 17v ¾A x 2 + 24-0-24v 1.04A + 20v 1mA. These current ratings can be safely exceeded by 50%.
£3.50 + £1.00 p&p.

WOODS 240V A.C. Approx. 2,500 r.p.m. continuous rated 5 or 6in. FAN (ex-computer) **£3.60 plus £1 p&p**

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1N916	6p
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BA145	14p
Centercel	24p
BZY61/BA148	10p
BB103/110 Varicap	15p
BB113 Triple Varicap	37p
BA182	13p
OA5/7/10	15p
BZY88 Up to 33 volt	7p
BZX61 11 volt	15p
BR100 Diac.	15p

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TAA700	£2.00
TBA800	£1.00
741 8 pin d.i.l. op.	24p
SN76013N	£1.20
TAD100 AMRF	£1
CA3001 R.F. Amp	50p
CD4013 CMOS	36p
TAA300 1wt Amp	£1
TAA550 Y or G	22p
TAA263 Amp	65p
7400	10p
7402/4/10/20/30	14p
7414	56p
7438/74/86	24p
7483	69p
LM300, 2-20 volt	£1
74154	90p
TBA550Q	£1.50

BRIDGE RECTIFIERS

Amp	Volt		
½	1,600	BYX10	30p
1	140	OSH01-200	26p
1.4	42	BY164	40p
0.6	110	EC433	6p
5	400	Texas	90p

RECTIFIERS

	Amp	Volt	
IN4004/5/6	1	4/6/800	5p
IN4007/BYX94	1	1250	5p
BY103	1	1,500	18½p
SR100	1.5	100	7p
SR400	1.5	400	8p
REC53A	1.5	1,250	14p
LT102	2	30	10p
BYX38-300R	2.5	300	40p
BYX38-600	2.5	600	45p
BYX38-900	2.5	900	50p
BYX38-1200	2.5	1,200	55p
BYX48-300R	2.5	300	26p
BYX49-600	3	600	35p
BYX49-900	3	900	40p
BYX49-1200	3	1,200	52p
BYX48-300R	6	300	40p
BYX48-600	6	600	50p
BYX48-900	6	900	60p
BYX48-1200R	6	1,200	80p
BYX72-150R	10	150	35p
BYX72-300R	10	300	45p
BYX72-500R	10	500	55p
BYX42-300	10	300	30p
BYX42-600	10	600	65p
BYX42-900	10	900	80p
BYX42-1200	10	1,200	95p
BYX46-300R*	15	300	£1.00
BYX46-400R*	15	400	£1.50
BYX46-500R*	15	500	£1.75
BYX46-600*	15	600	£2.00
BYX20-200	25	200	60p
BYX52-300	40	300	£1.75
BYX52-1200	40	1,200	£2.50

**Avalanche type*

TRIACS

Amp	Volt		
6	800	Plastic RCA	£1.20
25	900	BTX94-900	£4.00
25	1200	BTX94-1200	£6.00

RS 2mm Terminals Blue & Black .... 5 for 40p

Chrome Car Radio facia .. 15p
Rubber Car Radio gasket .. 5p

DLI Pal Delayline .. 50p

Relay socket .. 10p
Take miniature 2PCO relay

B9A valve can .. 5p

0-30, or 0-15, black pvc, 360° dial, silver digits, self adhesive, 4½" dia. .. 10p

OPTO ELECTRONICS

Diodes		Photo transistor	
TIL209 Red	12p	BPX29	80p
BPX40	50p	OCP71	34p
BPX42	80p		
BPY10	80p		

(VOLTIAC)

BPY68, BPY69, BPY77 80p

BIG L.E.D. 0.2" 2v 50m/A max.
ORANGE 14p
YELLOW 14p
RED 14p

PHOTO SILICON CONTROLLED SWITCH BPX66 PNPN 10 amp £1.00

THYRISTORS

Amp	Volt		
1	240	BTX18-200	30p
1	400	BTX18-300	35p
1	240	BTX30-200	30p
15	500	BT107	£1
6.5	500	BT101-500R	90p
6.5	500	BT109-500R	£1.00
20	600	BTW92-600RM	£3.00
15	800	BTX95-800R Pulse Modulated	£8.00
30	1000	28T10 (Less Nut)	£3.00

.3" red 7 segment L.E.D. 14 D.I.L. 0-9+D.P. display 1.9v 10m/a segment, common anode 61p

Minitron 3" 3015F filament £1.10

CQY11B L.E.D. Infra red transmitter £1
One fifth of trade

Plastic, Transistor or Diode Holder 1p
Transistor or Diode Pad 1p
Holdersorpads 50pper100

PAPER BLOCK CONDENSER

0.25MFD	800 volt	30p
1MFD	250 volt	15p
2MFD	250 volt	20p
4MFD	250 volt	20p

I.C. extraction and insertion tool 32p

CHASSIS SOCKETS

Car Aerial 9p, Coax 3p, 5 pin 180° 9p, 5 or 6 pin 240° din 6p, speaker din switched 5p, 3.5 mm switched 5p, stereo ¼" jack enclosed 10p.

Push-to-Break or Push-to-Make Panel Switch 24p

ENAM. COPPER WIRE

SWG.	PER YD.
24	3p
26 to 42	2.5p

GARRARD
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HANDLES
Rigid light blue nylon 6¼" with secret fitting screws .. 5p

Belling Lee white plastic surface coax outlet box 20p

Philips Iron Thermostat ... 15p
MoMurdo PP108 8 way edge plug 10p

TO3 HEATSINK

Europlec HP1 TO3B individual 'curly' power transistor type. Ready drilled 12p

Tested unmarked, or marked ample lead ex new equipment

ACY17-20	8p	OC200-5	8p
ASZ20	8p	TIC44	24p
ASZ21	30p	2G240	£1
BC186	11p	2G302	5p
BCY30-34	8p	2G401	5p
BCY70/1/2	8p	2N711	25p
BY126/7	4p	2N2926	4p
HG1005	10p	2N598/9	6p
HG5009	3p	2N1091	8p
HG5079	3p	2N1302	8p
L78/9	3p	2N1907	£1
M3	10p	Germ. diode	1p
OA81	3p	GET120 (AC128 in 1" sq. heat sink	15p
OA47	3p	GET872	12p
OA200-2	3p	2S3230	30p
OC23	20p		

CRAZY OFFERS

2000 mfd.	50v	16p
2500 mfd.	40v	30p
8 mfd.	500v	6p
400 mfd.	16v	4p
.1 mfd.	350/500v	1½p
.1 mfd.	1500v	2p
2200 mfd.	25v	30p
1000 mfd.	200v	25p
10000 mfd.	15v	12p
1250 mfd.	35v	10p
6800 mfd.	10v	6p
32+32 mfd.	275v	8p
16+32 mfd.	350v	12p
8+8 mfd.	350v	8p
150 mfd.	35v	4½p
100 mfd.	70v	4½p
1 mfd. non-polar	350v	3p
680 mfd.	100v	10p
15 mfd.	160v	3p
4700 pf. sub min	500v	1½p
4700 mfd.	63v	70p
250 mfd.	300v	16p
4700 mfd.	40v	35p
25000 mfd.	25v	20p
1000 mfd.	63v	30p
1500 mfd.	70v	16p

Philips electronic engineer kits add on series E1004 75p each

G.E.C. 5% Hi-stab, capacitors .013, .056, .061, .066, .069, .075, .08, .089 2p each

Miniature Axial Lead Ferrite Choke formers 2p

RS 10 Turn Pot 1% 250, 500 Ω, 1K, 50K £1

Copper coated board 10" x 9" approx 25p

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Nylon self locking 3½" 2p

Geared Knob 8-1 ratio 1⅞" diam, black 70p

KLIPPON 25A 440v TERMINAL BLOCKS professional leaf spring clamp, strip of 12 for 15p or twin with clip-over cover 7p

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£10.00 p&p £1.30

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200 pages **$9\frac{3}{4}''$ x $6\frac{3}{4}''$** **PRICE £2.50**
Inclusive of postage

The primary aim of this outstanding manual is to provide a simplified approach to the understanding of data processing — (previous knowledge of the subject is not necessary).

The 40 chapters and appendices cover the following topics: Introduction to Data Processing; Organisation and Methods; Conventional Methods; Introduction to EDP and Computers; Hardware; Computer Files; Data Collection and Control; Programming and Software; Flowcharts and Decision Tables; Systems Analysis; Applications; Management of EDP, etc.

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L.E.D. VU ME

By A. P. Roberts

THIS INGENIOUS DESIGN INCORPORATES TWO QUAD NORTON AMPLIFIER I.C.'S TO CONTROL SEVEN L.E.D.'S.

The latter give comparative signal level indications ranging from –18dB to +3dB, the 0dB level being pre-set to suit the associated audio equipment.

Probably most readers will be familiar with a device known as a peak level indicator, and these are now fitted to a substantial proportion of the cassette decks and recorders that are currently available. The purpose of the indicator is to provide a visual indication if the audio signal exceeds a certain amplitude on peaks. It is used to augment an ordinary VU meter, which is an average reading device and therefore lacks reliability when rather spiky waveforms are involved.

The device which forms the subject of this article is really just a form of peak level indicator. However, whereas most peak level indicators have only one, or occasionally two indicator lamps, the unit described here has seven. Thus it is not necessary to use it in conjunction with an ordinary VU meter; it can be used to replace it. Furthermore, it provides more reliable results since it is a peak reading rather than an average reading indicator. Peak reading VU meters are the type that are employed in professional recording establishments.

Of course, the unit is not only suitable for tape recording applications, and it is increasingly common for some form of volume unit indicator to be fitted to other types of audio equipment, such as amplifiers or mixers.

QUAD NORTON AMPLIFIERS

Only two active devices are employed in the circuit, and these are both quad Norton amplifiers. The prototype has been constructed as a completely self-contained unit which is powered from an internal 9 volt battery, but in many cases it would be possible for an experienced constructor to build the unit into the main equipment. The seven indicator lamps light up at the following levels: –18dB, –12dB, –9dB, –6dB, –3dB, 0dB and +3dB. The sensitivity of the unit is pre-set, and when it is at maximum only about 350 to 400mV r.m.s. is required at the input to cause all the indicator lamps to turn on.

Each of the seven indicator lamps appears in the basic circuit which is given in Fig. 1. Here the output of a Norton amplifier is fed to a light-emitting diode via current limiting resistor RL. The Norton amplifier is used as a form of electronic switch, and the indicator will be off when the output of the amplifier is high, and on when it is low.

Which of these states the output of the amplifier assumes depends upon the levels of the currents flowing into its inputs. Like a standard operational amplifier, a Norton amplifier has both inverting

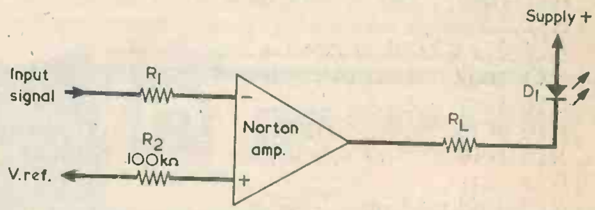

Fig. 1. The basic switching circuit which operates each l.e.d. in the VU meter. Sensitivity is controlled by the value of R1

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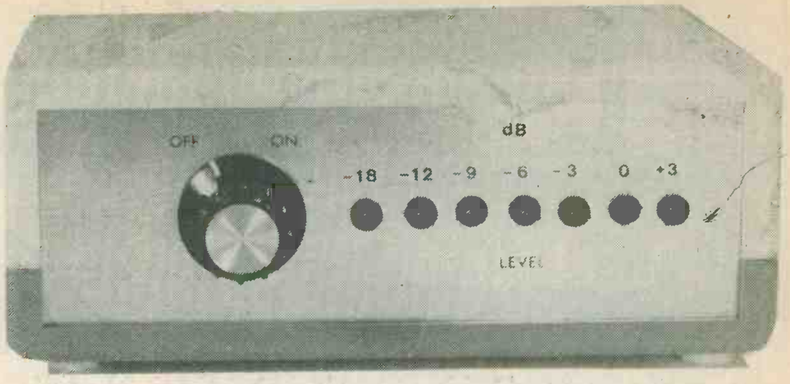


Housed in a 2-tone plastic case with an anodised aluminium front panel, the l.e.d. VU meter has a striking presentation

(–) and non-inverting (+) inputs. If the current which flows into the inverting input is significantly higher than the one which flows into the non-inverting input, then the output goes low. If, on the other hand, the current flow into the inverting input is less than the flow into the non-inverting one, then the output takes up the high state.

The non-inverting input is taken to a stabilised reference voltage via a 100kΩ resistor, and the input signal is coupled to the inverting input via a resistor whose value determines the sensitivity. If, for example, this resistor has a value of 100kΩ the indicator lamp will not come on until positive input signal peaks exceed the reference voltage. The current flow in R1 will then exceed that in R2, since the voltage across R1 will be higher than that across R2 for the duration when the input signal exceeds the reference voltage. The output of the amplifier thus goes low, and supplies current to the l.e.d. indicator lamp.

If the value of R1 were reduced to 50kΩ the sensitivity of the circuit would be doubled, as now only half the previous signal voltage would be required across R1 in order to produce the same level of current flow. Increasing R1 to 200kΩ would obviously halve the sensitivity. The sensitivity of the circuit can thus be varied over a wide range by choosing a suitable value for R1.

COMPONENTS

Resistors
(All fixed values ¼ watt 5% unless otherwise stated. See text for close tolerance resistors).

R1 120kΩ
R2 1.2MΩ
R3 150kΩ close tolerance
R4 100kΩ close tolerance
R5 1kΩ
R6 110kΩ close tolerance
R7 100kΩ close tolerance
R8 1kΩ
R9 100kΩ close tolerance
R10 75kΩ close tolerance
R11 1kΩ
R12 2.2kΩ
R13 51kΩ close tolerance
R14 100k close tolerance
R15 1kΩ
R16 36kΩ close tolerance
R17 100kΩ close tolerance
R18 1kΩ
R19 100kΩ close tolerance
R20 27kΩ close tolerance
R21 13kΩ close tolerance
R22 1kΩ
R23 100kΩ close tolerance
R24 1kΩ
VR1 100kΩ pre-set potentiometer, standard skeleton, horizontal

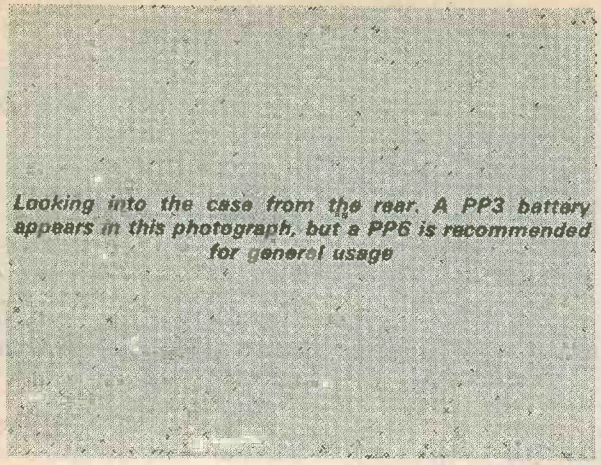
Capacitors
C1 0.1μF type C280 (Mullard)
C2 100μF electrolytic, 10 V. Wkg.

Semiconductors
IC1 CA3401E or LM3900N
IC2 CA3401E or LM3900N
D1 small l.e.d., red, with mounting bush
D2 small l.e.d., yellow, with mounting bush
D3-D7 small l.e.d., green, with mounting bush
D8 BZY88C3V9

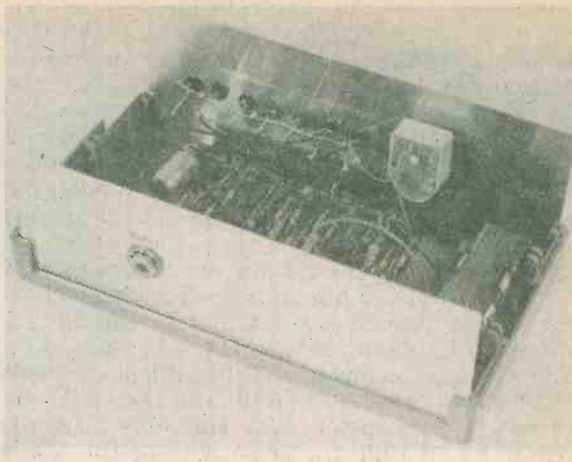
Switch
S1 s.p.s.t., rotary

Socket
SK1 3.5mm. jack socket

Miscellaneous
Verobox type 75-1238D
Veroboard, 0.1 in. matrix
2 i.c. sockets, 14 way (optional)
Control knob
9 volt battery type PP6 (Ever Ready)
Battery connector.



Looking into the case from the rear. A PP3 battery appears in this photograph, but a PP6 is recommended for general usage



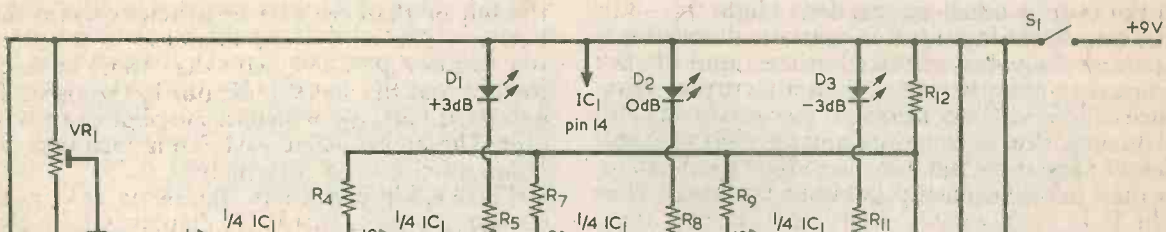


Fig. 2. The complete circuit of the l.e.d. VU meter. The l.e.d.'s light up at the decibel levels shown alongside them

PRACTICAL CIRCUIT

The complete circuit diagram of the l.e.d. VU meter is shown in Fig. 2, and it will be seen that seven of the Norton amplifiers are used in the configuration just described. They are all fed from the same reference voltage source, which is provided by a simple zener circuit incorporating R12 and D8. It is essential that a stabilized voltage be used here, since any changes in the reference potential result in similar changes in the sensitivity of each indicator.

All the inverting inputs are fed from pin 5 of IC1, and the series input resistors have been given values which provide approximately the correct relationship between the various indicators. As a simple example of this, the –3dB indicator circuit has a 75kΩ series resistor (R10) and the +3dB circuit has a 150kΩ resistor (R3). Therefore the –3dB indicator has double the sensitivity of the +3dB one, and the correct 6dB difference in sensitivity is obtained.

In some cases the required resistor values do not coincide with preferred values, and so the nearest value in the E-24 series is used. This provides perfectly adequate accuracy in practice. It is necessary to use close tolerance components for both sets of input resistors, and 5% should be regarded as the widest acceptable tolerance. Ideally, 2% or, better, 1% types should be employed.

One problem with the very simple indicator circuits is that they are not very sensitive, with a peak input of over 5 volts being needed to light the +3dB indicator. Another and more serious drawback is that about 0.6 volt is required at the input of each Norton amplifier before any input current commences to flow. This makes it necessary to both add an amplifier at the input and provide a 0.6 volt quiescent input voltage for the indicators. Without this bias the relationship between the sensitivites of the indicators would be seriously inaccurate.

Both these difficulties are overcome by using the eighth Norton amplifier as an input stage. This is the first amplifier of IC1. R1 and R2 provide this amplifier with a voltage gain of about 10 times. Normally the non-inverting input of the amplifier would be connected to the positive supply rail via a resistor having a value which would bias the output of the amplifier to about half the supply rail potential. However, by omitting this resistor the amplifier assumes a quiescent output voltage of approximately 0.6 volt, which is of course exactly what is required.

C1 provides d.c. blocking at the input, and VR1 is a pre-set sensitivity control. The input impedance of the circuit is quite high, and varies from approximately 55kΩ at maximum sensitivity to about 100kΩ at minimum sensitivity. S1 is the on-off switch, and C2 is the only supply decoupling component which is required.

The circuit has a quiescent current consumption of about 12mA, and this rises to some 30mA when all the l.e.d. indicators are illuminated. Bearing in mind that each l.e.d. has a current limiting series resistor of 1kΩ, it might at first appear that the 30mA current consumption figure is surprisingly low. It has to be remembered, however, that the l.e.d.'s are only illuminated when positive signal half-cycles are applied to the indicator circuits, with the result that they are alight for only half or less than half of the time. If desired, the brightness of the l.e.d.'s can be increased by reducing the value of the 1kΩ series resistors to about 470Ω, but this will considerably increase the current consumption of the unit.

CONSTRUCTION

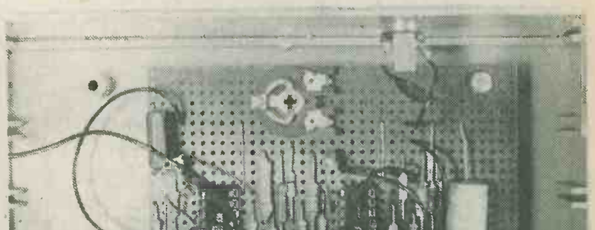
The prototype l.e.d. VU meter is housed in a Verobox which has outside dimensions of 154 by 60 by 85mm., but any case of a similar size should be satisfactory. The battery fits inside the case at the extreme left hand side. S1 is mounted to the left on the front panel; it must not be mounted too far to the left or there will be insufficient space for the battery. The l.e.d.'s are mounted in a horizontal row to the right of S1, with the –18dB indicator to the left and the +3dB indicator to the right. These details are clearly shown in the photographs of the unit. The input socket is a 3.5mm. jack type, and it is mounted on the rear panel.

The l.e.d.'s can all be the same colour, but a clearer and more attractive display will be given if two or three colours are employed. With the prototype, green l.e.d.'s are used for –18dB to –3dB, the 0dB l.e.d. is a yellow type and the +3dB l.e.d. is red.

The remaining components are mounted on a piece of Veroboard of 0.1 in. matrix having 37 holes by 24 copper strips. Full details of this board are given in Fig. 3.

Cut out the board with a hacksaw, then drill the two mounting holes clearance size for the self-tapping screws supplied with the Verobox (or 6BA clear if a different case is employed). Next, make

Top view of the Veroboard panel assembly. This is secured inside the case by means of two self-tapping screws



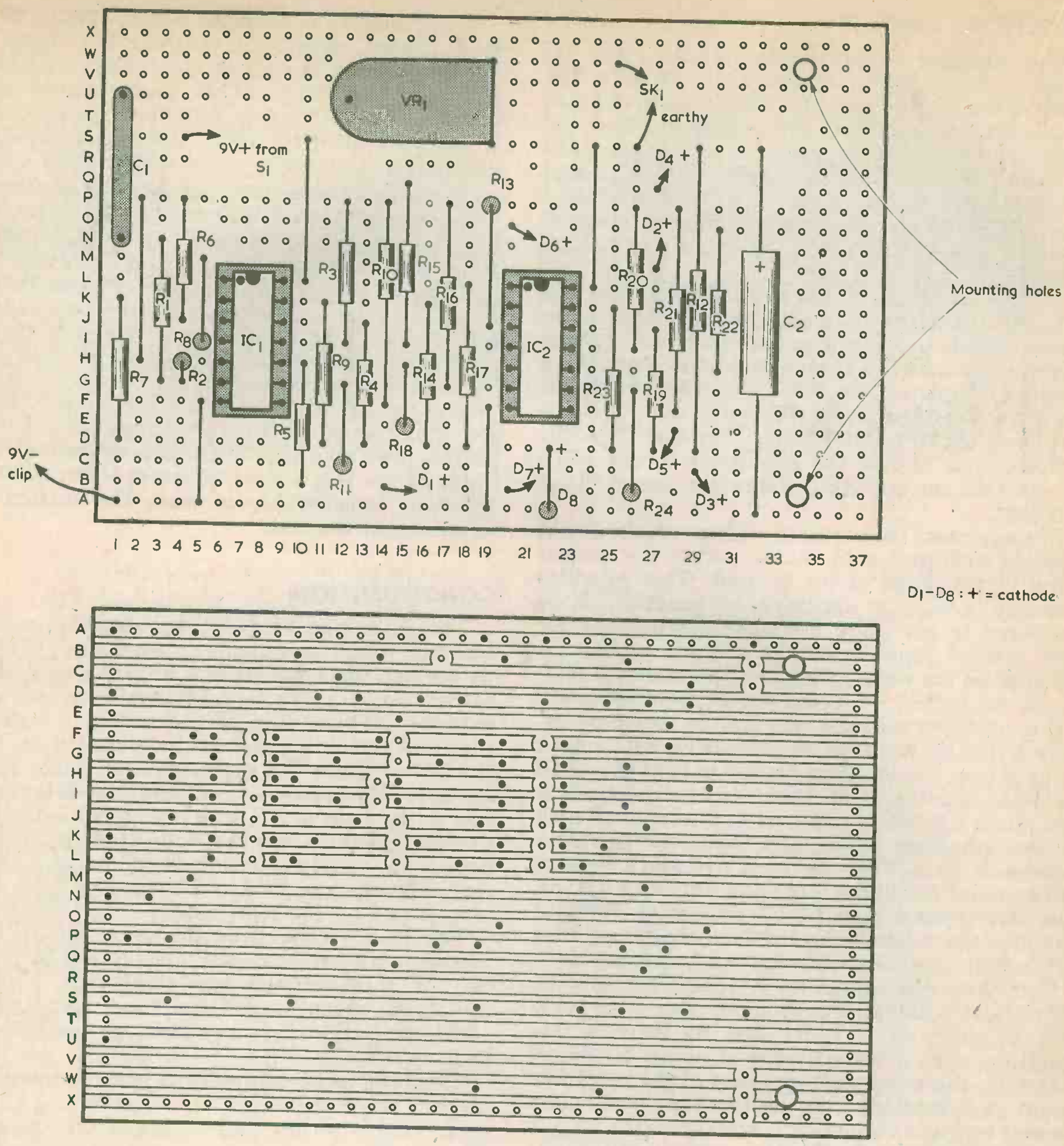


Fig. 3. Nearly all the components are assembled on a Veroboard panel. The component and copper sides are shown here

the breaks in the copper strips as shown in the diagram. The components and link wires are then soldered into circuit. The author used two 14 way integrated circuit holders, these being soldered to the Veroboard and the i.c.'s plugged in afterwards. However, the i.c. holders can be dispensed with and the integrated circuits soldered directly to the board if this is preferred. With some potentiometers, the slider tag of VR1 may need to be fitted to a different hole along strip U than is shown in the diagram.

The Veroboard is wired up to the other components, by means of thin stranded p.v.c. covered wire, before it is mounted in the case. It is secured to the two mounting pillars on the right hand side which are moulded into the case, using two of the self-tapping screws.

There are several connections which are not shown in Fig. 3. The positive battery lead connects to the unused tag of S1. The anodes of the l.e.d.'s are all wired together and are then connected to the tag of S1 which connects to the board. The wiring at S1 should then conform with the circuit diagram of Fig. 2.

ADJUSTMENT

Only one adjustment needs to be made to the finished unit before it is ready for use, and that is to set the correct sensitivity by means of VR1. The prototype unit is used to monitor the output from a mixer which has a nominal output level of 500mV. In order to set up the l.e.d. VU meter a 500mV r.m.s. signal (at a frequency of 1kHz) was fed to SK1. VR1 was then adjusted to a point at which

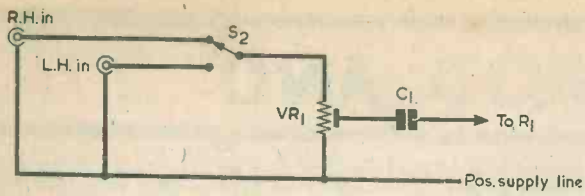
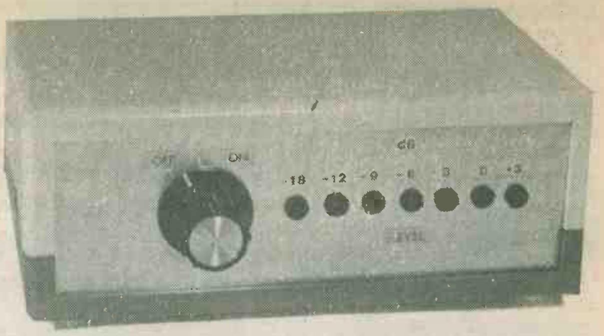


Fig. 4. A simple input switching circuit can be added for monitoring stereo signals



Another view of the VU meter. The legends on the front panel are all taken from Panel Signs, Set No. 4

the 0dB l.e.d. was just noticeably illuminated.

The same basic method of calibration can be employed whatever type of equipment the unit is used in conjunction with. The audio level of the equipment is adjusted to that which it is desired should correspond to an indication of 0dB, and VR1 set up accordingly.

As described here the unit is only suitable for monitoring mono equipment. For stereo operation two circuits can be used, one monitoring each channel. Alternatively, switching could be added at the input so that the unit could be switched to monitor one or other of the channels. All that are required are an s.p.d.t. switch and an extra socket connected in the manner shown in Fig. 4. There is plenty of space for these on the rear panel. ■

Ultraviolet Depolymerization

By Michael Lorant

Dr. Donald E. Bolon, electronic research scientist of General Electric Research and Development Center, Schenectady, New York State, has developed a unique process called "Ultraviolet Depolymerization" which uses intense ultraviolet light to speed and simplify the fabrication of semiconductor wafers.

With the process, ultraviolet irradiation cleans excess photoresist from semiconductor wafers, thereby solving a long-standing problem in the semiconductor processing industry. The photoresist, a polymer film sensitive to light, is used in etching microscopic circuit patterns onto the wafer. After etching takes place, the left-over plastic film has to be completely removed.

Depolymerization of semiconductor wafers by ultraviolet light. Dr. Bolon, developer of the process, prepares to run sample wafers through a test chamber. The process is continuous and does not have the disadvantages inherent in other methods of polymer removal.

The photoresist is exposed to intense ultraviolet light in the presence of air, causing the material to break down and vaporise. A typical film of photoresist plastic (depending upon its composition and thickness) can be completely removed from a semiconductor wafer in 25 to 40 minutes. The process is the first that lends itself to the continuous removal of excess photoresist material. All other techniques require the processing of wafers in batches, and are thus inherently slower.

In addition, ultraviolet depolymerization is the first dry process that operates at atmospheric pressure and at modest temperatures (about 250°C). The most widely used alternative methods for removing photoresists involve soaking the polymer films, either in a solvent which causes it to swell after which it is shaken or abraded off, or in acid solvent which destroys the polymer.

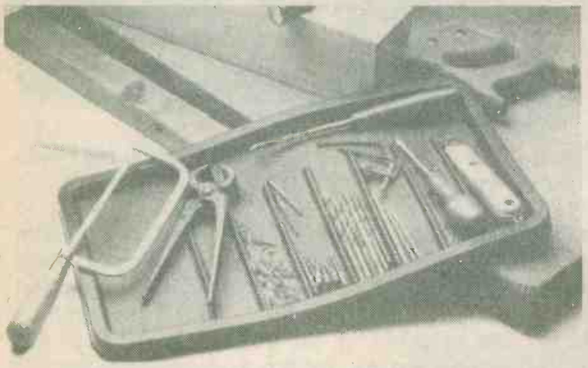
In many cases, however, a semiconductor processor desires to remove the photoresist without subjecting the substrate to solvents or acids. This is especially important where there are soft metal overlays which would be damaged by abrasion or by corrosive solvents, or where the presence of carbon contaminants would interfere with subsequent fabrication steps.

In tests, Dr. Bolon has found that ultraviolet depolymerization of photoresists proceeds at a rate of about 1,000 Angstroms per minute. But the process can be made to operate ten times faster simply by injecting two per cent ozone gas into the processing chamber.

Semiconductor wafers subjected to the ultraviolet depolymerization process have been inspected with Auger-emission spectroscopy, and this has confirmed that their surfaces are extremely clean and are free of any carbonaceous residue. Furthermore, the process is non-polluting as its only byproducts are carbon dioxide and water. ■

NEWS . . . AND .

RUBBER TRAY FOR YOUR TOOLS



Lost tools, scratched paintwork and bad temper should be saved by a new rubber tool tray, just introduced by Cannon Rubber Ltd. of Ashley Road, Tottenham, London.

The 'Autotidy', made from flexible, non-slip rubber, can be draped over an irregular surface such as a car wing, or laid flat on a polished table top. Internal dividers and a 1-in. lip around the tray provide for a variety of small tools and hardware to be kept conveniently sorted and near at hand, very useful when you are engaged on a constructional project.

Recommended price of the 'Autotidy' is £1.38 including VAT, from motor accessory, hardware and DIY stores.

INAUGURAL MONTREUX ACHIEVEMENT GOLD MEDAL AWARD

An IBA engineer — John L. E. Baldwin — recently received the inaugural Achievement Gold Medal Award at the 10th International Television Symposium at Montreux, Switzerland, for 'the development of the world's first digital intercontinental standards converter'. We extend to him our congratulations on winning this 'first'.

This is the first time that an Achievement Gold Medal Award has been presented at the Montreux technical symposia. At the same time a 10th Anniversary Gold Medal was presented to a French engineer, Claude Mercier.

John Baldwin is Head of the Video and Colour Section of IBA's Experimental and Development Department and was responsible for the conception and successful design of DICE (Digital Intercontinental Conversion Equipment). This equipment has greatly improved the exchange of programmes between countries using different television standards.

100 YEARS OF RECORDED SOUND

Edison invented sound recording 100 years ago this year. The prospect of 'storing up' the human voice, particularly of great men and women, was as sensational in the 19th century as stepping on the moon was in the 20th.

Edison's talking machine established the principle of sound recording. The quality of it had yet to be proved. Meanwhile Edison was diverted for ten years from this discovery to experiment with systems of electric lighting, and two Englishmen, Bell and Tainter, renewed interest in the project by replacing tin foil with wax and producing the gramophone.

Joe Pengelly recalled the tremendous technical achievements and played some of the best recordings of those early days in two Radio 4 programmes — 'The Centenary of Recorded Sound'. Broadcast in June, the programmes included the speech by Lord Stanley, Governor General of Canada, at the Toronto Exhibition in 1888, the voice of Caruso, who demanded, and got, a staggering £100 for recording ten songs in 1902, and the incredible falsetto of the last of the Sistine Chapel castrati.

COVER DATE

The cover date on our next issue, to be published 1st September, will be September/October. The issue to be published in October will be dated November and future issues will continue to be pre-dated.

The revision of cover dates will bring us into line with other radio and electronic journals.

Subscribers will, of course, continue to receive 12 issues per year.

ELECTRIC PIANO FEATURED IN 'TOMORROW'S WORLD'

A musical trio starring a conventional pianoforte, presenter Mike Rodd on flute, and General Instrument Microelectronics' electric piano featured in the BBC's 'Tomorrow's World' recently.

The prototype electronic piano was built round GIM's new AY-1-1320 microcircuit which simulates the sound and touch of hammer action instruments.

In the picture, Mike Rodd compares a sustaining flute note with a decaying piano note simulated by the AY-1-1320.

We gave a short technical description and general notes on this electronic piano in 'News and Comment' in our May issue.

. . . COMMENT

'AMBISONICS' TEST BROADCAST

The first experimental 'on-air' tests of a British-developed surround-sound system known as 'Ambisonics' or 45J were made recently on an Independent Local Radio station — Radio City in Liverpool. As part of the celebrations of the Queen's Jubilee visit to Liverpool, Radio City broadcast a specially commissioned performance of Mahler's Eighth Symphony, the 'Choir of a Thousand Voices', from Liverpool Anglican Cathedral.

This test, formed part of a continuing investigation by engineers of the Independent Broadcasting Authority into a number of systems for broadcasting sound radio programmes for reproduction as 'surround sound' in the home. The system to be used during these experimental broadcasts is known as Ambisonics and has been developed by Michael Gurzon of Oxford University, Professor Fellgett of Reading University and J. S. Wright, D. Brown and J. Hayes with the support of the National Research Development Council.

During the past few years a number of different systems have been proposed for broadcasting additional directional information on stereophonic VHF/FM transmissions. Such systems are usually known as 'quadraphony' (four-channel stereo) or 'surround sound' to distinguish them from existing two-channel stereophony. The systems differ in the manner of carrying or encoding the additional information on the transmitted signal. Some systems use matrixing techniques to allow the additional information to be carried on the conventional two channels of a stereo transmission; others use either one or two additional subcarriers.

Many variations have been proposed for using stereo channels in this enhanced way, each offering some desirable, some less desirable, features.

Details of BBC Quadraphonic broadcasts were given in 'N & C' June issue.

NORTHERN RADIO SOCIETIES EXHIBITION

Along with the RSGB's Alexandra Palace event and the ARRA exhibition at Leicester — it looks as if Belle Vue is now one of the "big three" national amateur radio events of the year.

The exhibition of amateur radio equipment, both commercial and home built, was the largest and best attended of these annual events ever staged by the NRSA. All the well known trade names were represented as well as most of the amateur radio societies in the North West of England. The photograph shows part of the scene inside the exhibition hall, and indicates the large attendance.

The Club Stand Trophy was won by the South Manchester Radio Club and the Inter-Club Quiz was won by the Bury Radio Society.

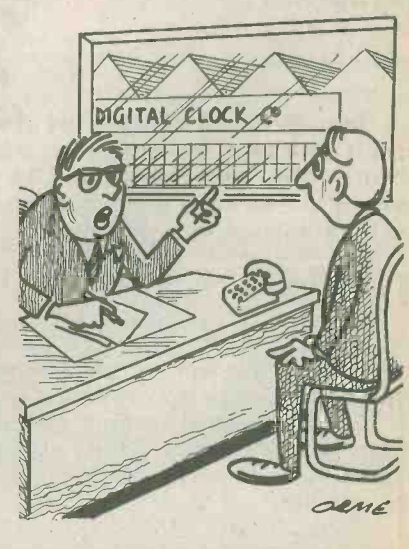
The date provisionally booked for the NRSA Belle Vue Convention & Exhibition in Manchester next year is Sunday, 2nd April, 1978. Discussions have already taken place regarding the use of an even larger hall at Belle Vue for the 1979 exhibition.

INTERNATIONAL BROADCASTING CONVENTION 1978

The 7th International Broadcasting Convention — IBC 78 — will take place in London, 25-29 September 1978.

IBC 78 will be held at the new Wembley Conference Centre instead of Grosvenor House which has been the venue for the past five of the six IBCs. This move, heralded in May last year, to London's first purpose-built convention centre will enable the IBC to benefit from the first class facilities at Wembley while still being based in London, one of the main centres of broadcasting in the world, and be able to offer all the amenities of the Capital.

IBC 78 is the seventh in a series of biennial broadcasting conventions which have become firmly established as an international forum for new techniques in broadcasting and allied services and one of the world's leading international market places for the latest broadcasting equipment and systems. Each of these events has shown a dramatic growth in the number of delegates attending and countries participating. Records were again broken at IBC 76 when more than 2,600 delegates from 51 countries attended and at the complementary exhibition, 72 exhibitors representing leading manufacturers of the world displayed and demonstrated the latest professional broadcasting equipment and services. It is expected that this continued growth will again be highlighted at IBC 78.



"If you're going to work here remember — we won't tolerate finger trouble!"

SPECIAL SERIES **Blob-a-job**

No. 3

12-NOTE TONE GENERATOR

CAN FORM THE BASIS OF AN ELECTRONIC KEYED OR STYLUS ORGAN.

Incorporating two t.t.l. integrated circuits, this very simple circuit offers twelve pre-set tones which are set up to form a complete twelve note scale.

This tone generator is designed to produce a complete set of twelve notes for a musical scale. By itself, it can be used as the basis of a simple "stylus organ", or it can be combined with dividers and filters to form the basis of quite a useful electronic organ. The number of components that are needed is remarkably small, only two i.c.'s, twelve capacitors and twelve skeleton pre-set potentiometers for a complete twelve note scale. The penalty for all this simplicity is rather a large current consumption of about 200mA, so that a mains supply or a large capacity battery is needed.

HEX SCHMITT INVERTER

The type of i.c. used is the 7414 hex Schmitt inverter. The 7414 has a set of six high gain inverting amplifiers with a snap-over action, each of which can be used as an oscillator by simply connecting output to input via a resistor, and the input to earth by way of a capacitor. The waveshape is a series of pulses with unequal mark-to-space ratio; the mark-to-space ratio can be improved

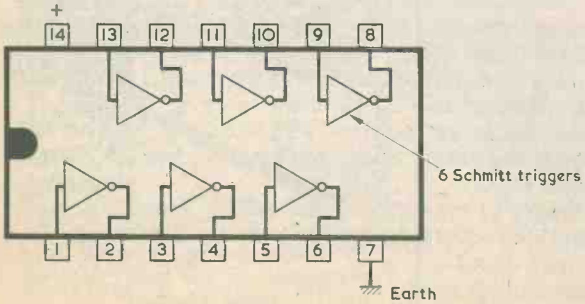


Fig. 1. Pinout diagram of the 7414 i.c.

but the additional components that are needed hardly make the effort worthwhile, and the tuning then becomes much more difficult.

Since these are t.t.l. circuits, the supply voltage should be limited to 5 volts. In practice the tone generator will work from a 4.5 volt battery, and in the type of circuit used will not be damaged by operation from 6 volts (via a diode), but the frequency of operation is rather sensitive to voltage, so that a stablilized supply (see "Blob-A-Job No. 1" in the June 1977 issue) should be used if a complete organ is to be built up. For a portable stylus organ a 4.5 volt battery of large capacity will serve fairly well, and a very simple output stage will be enough to drive a speaker.

Fig. 1 shows the pin connections for the 7414, whilst Fig. 2 gives the circuit of the 12-note generator. All the potentiometers are 1kΩ standard vertical mounting skeleton types and all the capacitors are 6.8μF electrolytic. These are specified in the Components List as 10 volts working but, if difficulty is experienced in obtaining this working voltage, a higher voltage is satisfactory. Mullard miniature 6.8μF 40 volt capacitors with a diameter of 4.8mm. and a length of 12.5mm. can be employed, and these are quite readily available. It may be necessary to alter the capacitor values for some notes.

BLOB BOARD

The circuit is built on a ZB-2-IC Blob Board, with the components arranged as shown in the assembly diagrams. The twelve pre-sets should be mounted so that each can be easily adjusted to obtain the correct note from each inverter. Because of capacitor tolerances it may sometimes be necessary to substitute capacitor values if the range of the pre-sets is insufficient; this is easily done when Blob Board is used for construction. A larger value of capacitance will give a lower note, a

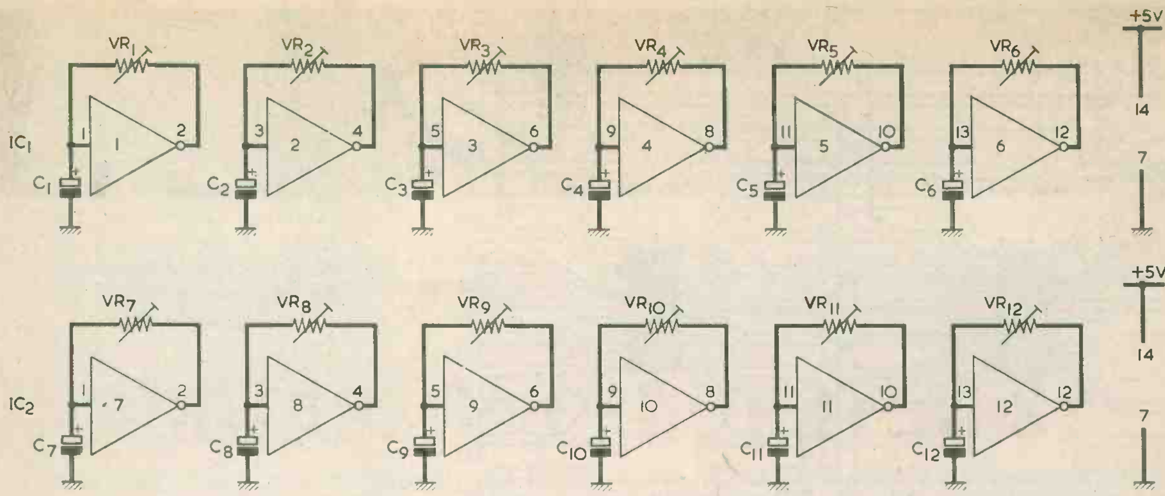


Fig. 2. The circuit of the tone generator. All six Schmitt trigger inverters of each i.c. are employed

COMPONENTS

Resistors	*Semiconductors*
VR1-VR12 1kΩ pre-set potentiometer, standard skeleton, vertical	IC1 7414 IC2 7414
Capacitors	*Blob Board*
C1-C12 6.8μF electrolytic, 10 V. Wkg.	Blob Board type ZB-2-IC

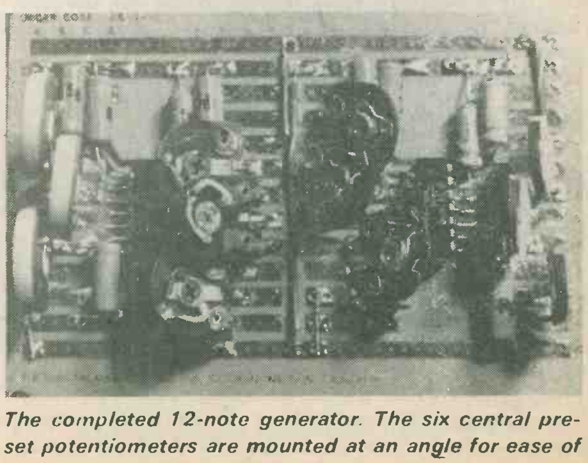
smaller value a higher note. The cheapest skeleton pre-sets should be used; those employed in the prototype were taken from a mixed bag offered at low cost.

Start construction by soldering the 7414's to the Blob Board. See Fig. 3. Tin the end of each of the i.c. pins, and place the i.c. on the bench with the index mark facing away from you. Set down the Blob Board such that the maker's name is at the bottom and the type number is at the top as you look at it on the bench. Now place each i.c. on its solder pads, with the top set of pads left unused, so that pin 1 of the i.c. is placed on pad 7 and pin 1 of IC2 is on pad 28. This leaves two spare mounting pads above each integrated circuit.

Once you are satisfied that the i.c.'s are correctly placed, line up one i.c. on its solder pads and solder pin 1 to its pad by bringing up a hot iron freshly charged with a blob of solder. When the iron is touched against the i.c. pin and the solder pad, a blob-joint will form almost immediately, and the iron can be taken away. Now check the i.c. again. If all is well, solder on pin 8 in the same way, and check again. At this stage the i.c. can be easily removed; any removal later will have to be carried out with solder braid. Solder pins 1 and 8 of the second i.c.

Now solder on the remaining pins of the two i.c.'s With a bare wire connect pads 19 and 21 to 23, and similarly connect pads 40 and 42 to 23, both as shown in Fig. 3. Using an insulated wire, link together tracks 2 and 23. Track 2 is the earth line and takes the negative supply. Track 1 is the 5 volt positive supply line.

Next, solder capacitor C1 from pad 7 (connected to pin 1 of IC1) to earth, at track 2. Keep the capacitor close to the i.c., as we shall want to



The completed 12-note generator. The six central pre-set potentiometers are mounted at an angle for ease of adjustment

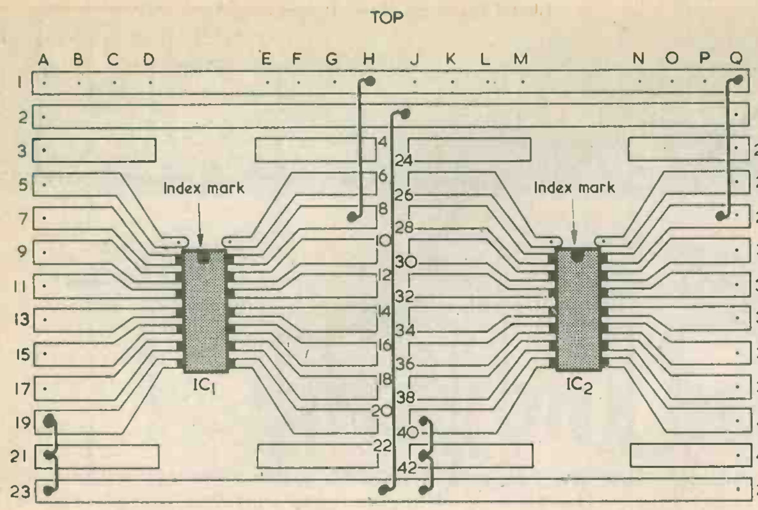
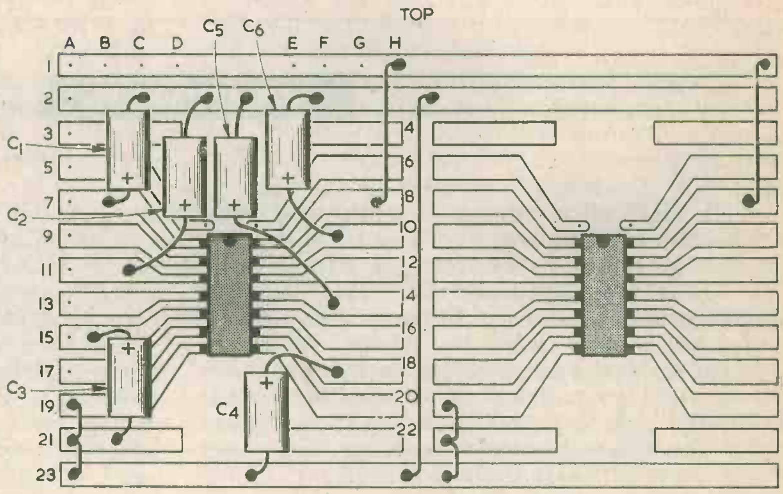


fig. 3. Positions of the integrated circuits on the board. If the i.c.'s are not mounted in these positions the pad numbers in the text will not apply

Fig. 4. Fitting capacitors C1 to C6 to the Blob Board. Capacitors C7 to C12 are not shown; these are positioned similarly around IC2



mount the pre-sets nearer to the edge of the board where they are more easily adjusted. Solder C2 from pad 11 to earth at pad 2, and C3 from pad 15 to its nearest earth, pad 21. Note that we can leave the leads of these capacitors long, or trim them, as we please. Using long leads has the advantage that we can adjust the positions of the capacitors to make the assembly look neater when all the construction is finished. The negative leads of all capacitors connect to earth.

Now use a piece of insulated wire to connect pad 8 (pin 14 of IC1) to the positive 5 volt supply line on track 1. The wire is shown in Fig. 3 and should be routed as illustrated. Now solder in the remaining capacitors for IC1, between pad 10, pad 14, pad 18, and earth, as in Fig. 4. This completes the capacitor connections for IC1.

After this, the pre-sets are prepared for soldering. Only two of the three legs of each pre-set will be used and the spare leg, which may be either of the outer legs, should be bent up out of the way. We may have to splay the two legs which are used slightly apart to fit the Blob Board pads. One pre-set connects between pads 7 and 9, another between pads 11 and 13, and a third between pads 15 and 17. See Fig. 5. On the other side of the i.c.

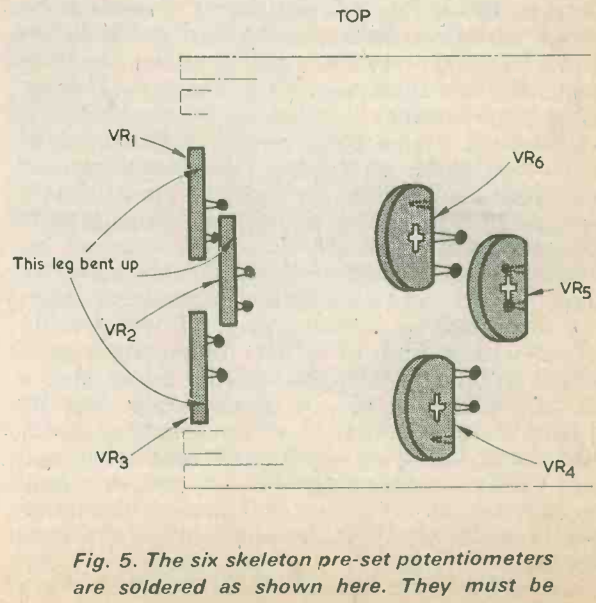


Fig. 5. The six skeleton pre-set potentiometers are soldered as shown here. They must be mounted so that they can be easily adjusted.

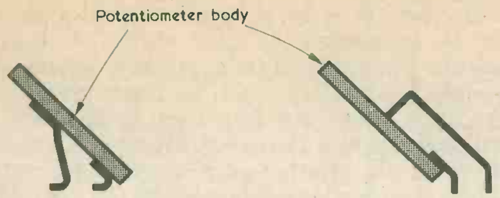


Fig. 6. Two methods of bending the legs of VR4 to VR9 so that they may be mounted at a suitable angle

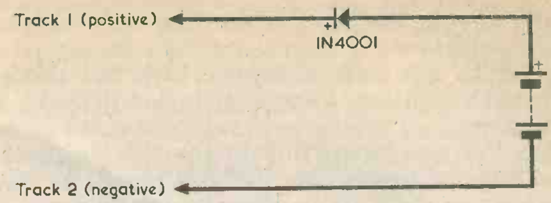


Fig. 7. Connecting a silicon rectifier, such as the 1N4001 or equivalent, in series with track 1 will ensure that the battery cannot be applied with incorrect polarity

the pre-sets are fitted between pads 10 and 12, 14 and 16, 18 and 20. Pre-sets VR1 to VR3 are mounted vertically in normal manner so that they may be adjusted from the edge of the board. VR4 to VR7 need to be mounted at an angle so that their adjustment slots are available from above the board. This is achieved by suitably bending their legs using either of the methods shown in Fig. 6.

Now repeat these assembly methods for IC2. We start with capacitors C7 to C12, soldering each capacitor between an input pin and earth as before. An insulated link wire connects pad 29 to pad 1. The pre-sets are attached as for IC1, with the three soldered between pads 28 and 30, pads 32 and 34 and pads 36 and 38 mounted at an angle which permits adjustment from above the board. The assembly is completed by soldering on the supply (battery) leads, and these should be arranged so that their polarity cannot be accidentally reversed. If this is impossible, then a silicon rectifier should be inserted in the positive line as shown in Fig. 7. The rectifier will drop the voltage slightly, enough to make operation from a 6 volt accumulator which is not charging safe, but making operation from a 4.5 volt battery possible only when the battery is fresh. Never use a 6 volt accumulator which is still on charge.

TESTING AND TUNING

An amplifier, earphone or headphones is needed for testing and tuning, and care is needed here on two counts. The first of these is that connecting a low resistance load to a 7414 output will damage the i.c., and the second is that the output level will overload most amplifier inputs. Fig. 8 shows three suitable methods of coupling to the i.c. outputs. An earphone with an impedance lower than 250 Ω must not be connected to an i.c. output without a series resistor.

Start by setting all the pre-sets to maximum resistance, with the sliding contact on each pre-set touching the track end at the leg which has been folded up. Clip the earth lead of the headphones, earphone or amplifier to the negative (earth) line of the Blob Board, and clip the other lead to the output from the first oscillator of IC1, on pad 9. Listen to this note, which will be the lowest on your scale. If there is no note to be heard, adjust the pre-set, VR1, until oscillation starts (oscillation is not possible with too high a resistance value, and some 7414's will not oscillate with 1kΩ in circuit). Check that the oscillator will start again reliably when the power supply is switched off and on again. With this oscillator now running at the lowest frequency of the scale, take the headphone, earphone or amplifier lead from pad 9 to pad 13 to hear the next note. Adjust this by means of its pre-set, VR2, so that the note is a semitone higher than the note from the first oscillator. If you have a reasonably musical ear you should find this process not too difficult, but if not you will need a piano to help you. Locate the note of the lowest oscillator on the piano, and adjust the oscillator to match exactly the piano note. Now sound the next

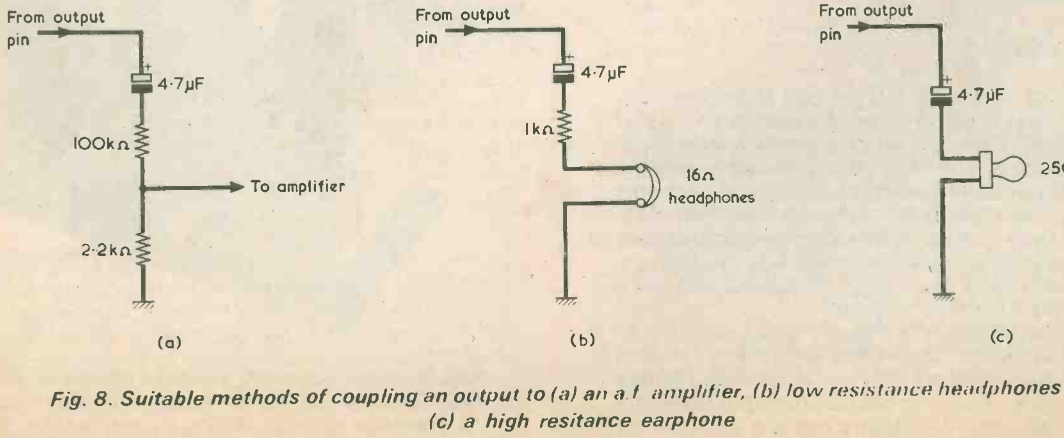


Fig. 8. Suitable methods of coupling an output to (a) an a.f. amplifier, (b) low resistance headphones and (c) a high resitance earphone

piano key on the right of the first note (black or white, whichever is nearer) and tune the second oscillator to this note. Continue with this process, with each oscillator a semitone higher than the one before until all twelve oscillators are at the correct pitch. You now have a full chromatic scale of notes. The range of frequencies available cannot be stated precisely as there are so many tolerances in the circuit. It should, however, be possible to obtain a scale where the first oscillator starts at, say, the C below middle C or at middle C itself. Other starting otes may be chosen.

To incorporate the 12-note generator into a stylus organ, you need a small amplifier whose input connection is to a metal stylus, and whose earth is connected to the earth of the tone generator. Each output from the tone generator can be coupled to a strip, such as those given by the tracks of a piece cut out from a ZB-2V5 Blob Board, by way of a 1kΩ $\frac{1}{4}$ watt resitor. Twelve 1kΩ resistors in all, one for each output, are required and they ensure that no damage to the i.c.'s can occur if two strips are short-circuited together.

For an organ a set of keys operating microswitches could couple the generator outputs to the amplifier. Again, a 1kΩ resistor should be inserted in series with each output and the corresponding switch. ■

A nostalgic glance back to the early 1920's.

Times Past

by

H. Ross Macdonald

It is compact in its walnut box, utilitarian, even a little sad-looking, enlivened only by the reflections on its shiny valves. Yet this, the Marconiphone V2, was one of the most advanced radio sets of its time.

In 1923 it was so contemporary that it almost hurt to look at it. The first commercial wireless set that looked and really was functional, while most of its competitors were covered in engraved dials and switches hinting at the most complex adjustments and calling for deft operational skills.

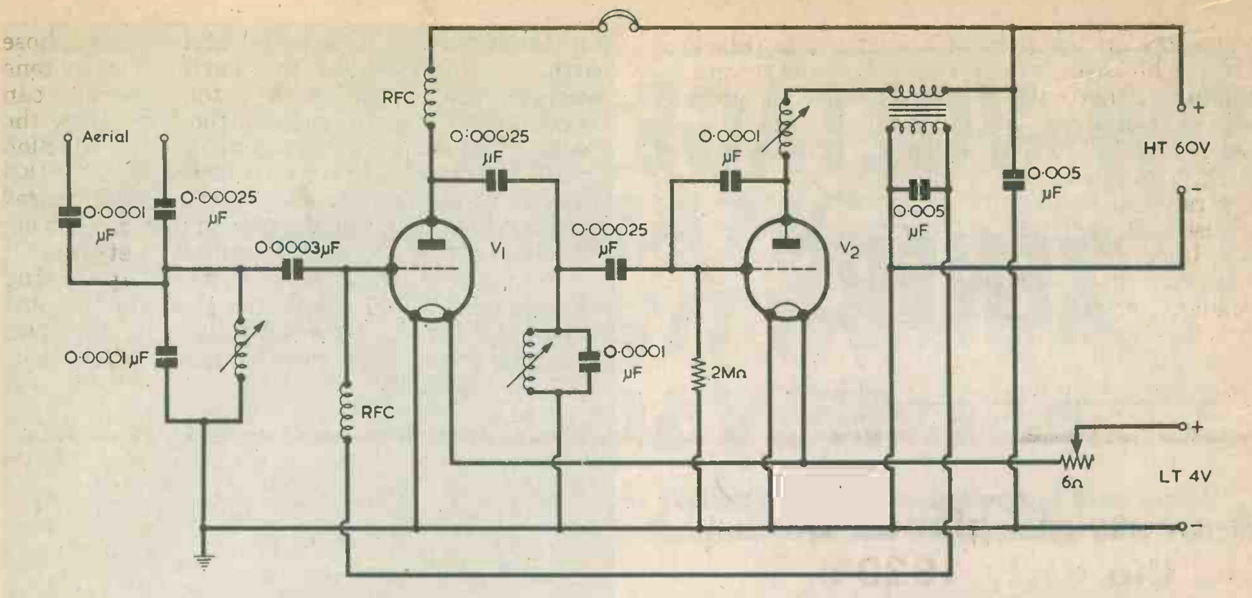
But with this magic little brown box you just switched on, turned the two knobs, and at once there were music and strange voices in the room. As one ad. writer of the period stated with unconscious humour: "You could even hear foreigners speaking in real foreign voices."

REFLEX SYSTEM

This wireless set — we did not call them radios in those days — was the first Marconiphone to enjoy real popularity and many thousands must have been sold. It was designed in late 1922 by the almost legendary Capt. J. H. Round and, considering the state of the art at that time, it remains a tribute to his enormous skill. He used the then popular reflex system but discarded the use of a crystal detector and ended up producing a very stable set that was easy to adjust and gave reliable results over long periods.

A normal experience of a listener in the early twenties was that when one switched off a station programme say at seven o'clock in the evening, there was no guarantee that it would be present at the same volume or even dial indication when one switched on

The Marconiphone V2 receiver. Produced in 1923 this 2-valve set was in the forefront of domestic receiver design of the period



The basic circuit of the V2 receiver. Valve V1 provides a measure of r.f. amplification whilst V2 functions as a grid leak detector. The detected signal at V2 anode is coupled via the a.f. transformer back to V1, which then also amplifies the a.f. signal

again to hear the nine o'clock news. By contrast this particular receiver (providing the batteries were charged) always gave repeatable results.

Owning a valve operated wireless set in 1923 was quite an expensive affair. The basic set, valves and royalty for this model cost £16.3.6d; with headphones, h.t. battery, 4 volt accumulator and aerial and earth installation the cost rose to some £24.

Now, £24 was a great deal of money in 1923. When one remembers that about 65 per cent of the population were earning under £2 per week and paying rent and bringing up a family on this salary, £24 for a wireless set was indeed a lot of money.

There were of course cheaper alternative family entertainments. If you lived close enough to a broadcasting station you could get results with a crystal set costing £1 to £3 complete, but then you were stuck with one programme as well as endless fiddling with the cat's whisker. Should you want to hear music of your choice the alternative was a wind-up gramophone and lots of records (78's of course). You could buy a nice noisy gramophone for about £3, not of course an H.M.V., which were always nice and seldom noisy.

The ownership of a valve set, especially if it would operate a loudspeaker, was for the lucky few something special indeed, equivalent to today's ownership of colour TV, central heating and double glazing. Captain Round may have supplied the technical magic but it was left to Colonel Stanley of the Marconiphone Company to make the magic easy for people to acquire, for he made it possible to own this wireless set on hire purchase. I think this was another first for the Marconiphone Company. It was the first domestic receiver to be sold on H.P. directly from the manufacturer.

EARLY MEMORY

My first encounter with this set was in the North of Scotland in 1924, where it performed as well as could be expected in a place so far distant from broadcasting stations. The owner was a choleric Irishman and a retired Sergeant Major who had spent some 25 years in India. He was a large man, a loud man, and was accustomed to always being right! He wanted to hear Dublin on his "machine" as he called it. After consulting what at that period passed for expert advice, he was told he needed a bigger aerial. So for the not inconsiderable sum of 2 shillings I was inveigled on to the roof of his house and erected more than 150 feet of wire pointing, according to his exact instructions, towards Dublin. When I suggested that according to my school atlas and Scout's compass there was some variance between his sense of direction and mine, he brushed my advice aside. He was accustomed to being always right.

We did not get Dublin on that occasion but, due to the fact that the Grand Fleet was stationed off Cromarty, the set got more than its fair share of messages in morse code at 600 metres. However, the Sergeant Major brushed this interference aside and said it was due to the machinations of his ever-present enemies who had always been jealous of his military career and his advancement.

However, his receiver and several others in the district continued to give good and useful service for many years. The set in the photograph was acquired by me some 10 years ago. When I rescued it, the set was covered in grime in a cellar where it had stood for 15 years. After restoration and finding some valves of the period, it was connected up to batteries and a horn speaker of like vintage and it worked moderately well. During the BBC 50 year Jubilee programme, at the request of some friends it was again put to work. Despite its 50 years of age it again acquitted itself favourably.

To my mind the Marconiphone V2 represents a tribute to its designer and to the assemblers who built it. The individual components have scarcely departed from their original values, the soldered joints are still sound and the cabinet, despite the damp cellar, shows no sign of warping or cracks.

The Marconiphone Company made many other sets after this period until in 1929 they joined with Columbia and H.M.V. to form the grand triumvirate of E.M.I. After that date the name of Marconiphone still continued to appear before the public on the fronts of many successful radio and television receivers. ■

LOW VOLTAGE ZENERS

By R. J. Caborn

Some care is needed when using zener diodes with voltages lower than 6 volts.

We tend to look upon zener diodes as useful voltage stabilizing devices which drop almost exactly the voltage with which they are credited. This is fairly true with zener diodes rated at 6 volts or more, but does not apply so readily with zener diodes of lower voltage.

CHARACTERISTICS

Fig. 1 shows static voltage-current curves for three diodes from the popular 400mW BZY88 range. These are the BZY88C9V1, the BZY88C6V8 and the BZY88C6V2. Note that the 9.1 and 6.8 volt diodes commence a straight slope as soon as they pass a zener current of 2mA or even less. With the BZY88C6V2, on the other hand, we see quite a pronounced curvature until zener current reaches about 8mA. Above 8mA the curve becomes linear. Table 1, which is taken from Mullard data, lists the characteristics of the BZY88C9V1 and the BZY88C6V2 for zener currents of 1mA, 5mA and 20mA.

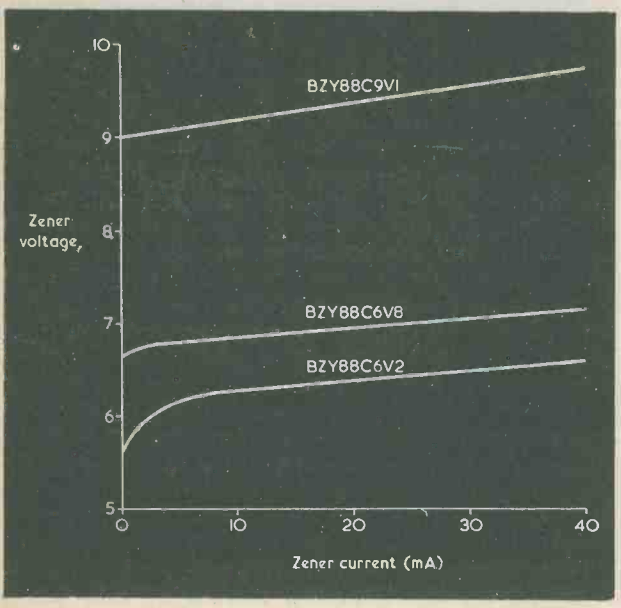


Fig. 1. Voltage-current curves for three BZY88 zener diodes. The onset of curvature at low zener currents becomes noticeable with the lowest curve.

TABLE 1
ZENER VOLTAGES

Zener Current	BZY88C9V1 Min.	Typ.	Max.	BZY88C6V2 Min.	Typ.	Max.
1mA	8.55	9.0	9.5	5.7	5.9	6.5
5mA	8.6	9.1	9.6	5.8	6.2	6.6
20mA	8.7	9.4	9.7	5.95	6.4	6.7

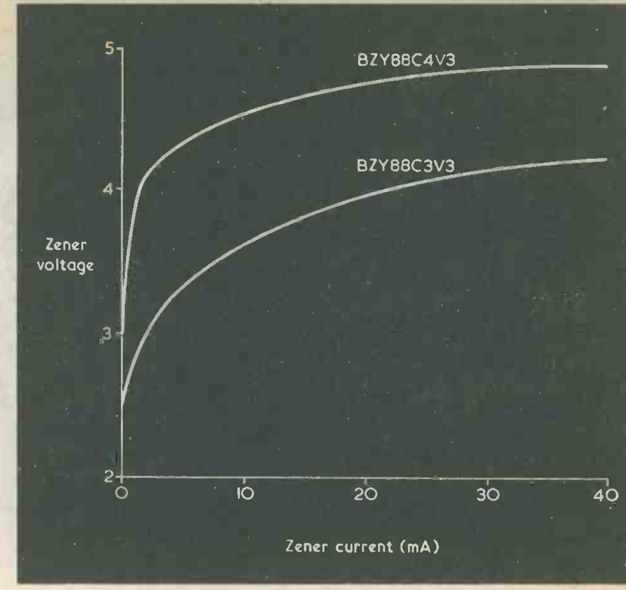


Fig. 2. The curvature becomes very pronounced with lower zener voltages. The curves here apply to diodes with nominal zener voltages of 4.3 and 3.3 volts

TABLE 2
ZENER VOLTAGES

Zener Current	BZY88C4V3 Min.	Typ.	Max.	BZY88C3V3 Min.	Typ.	Max.
1mA	3.3	3.6	3.9	2.4	2.75	3.0
5mA	4.0	4.3	4.5	3.1	3.3	3.5
20mA	4.45	4.7	4.95	3.5	4.0	4.2

We turn, next, in Fig. 2, to curves for two lower voltage diodes, these being the BZY88C4V3 and the BZY88C3V3. Here, curvature is extremely pronounced for all zener currents up to some 30mA. Table 2, also taken from Mullard data, gives the characteristics for these two diodes at the three currents of 1mA, 5mA and 20mA, and fully demonstrates the story implicit in the curves. With a typical BZY88C3V3, zener voltage at 1mA is only 2.75 volts whilst at 20mA the voltage is as high as 4 volts.

The tables tell us also that all the diodes are typically at their nominal voltages at 5mA, and this current is, indeed, that recommended by the manufacturer for acceptance testing purposes.

The moral is simple. When using lower voltage zener diodes expect quite wide variations in zener voltage at different zener currents. If you want a low voltage BZY88 zener diode to stabilize at a voltage within its tolerance, operate it at 5mA. ■

SUGGESTED CIRCUIT

AUTOMATIC POLARITY/BASE RESOLVER

By G. A. French

In the "Suggested Circuit" article which appeared in the April 1977 issue the author described a very simple piece of test equipment which was capable of indicating whether a bipolar transistor was n.p.n. or p.n.p. and of also identifying its base lead-out. The circuit is extremely useful for sorting out unbranded transistors such as those which have been purchased as job lots at low cost.

The circuit of the polarity/base resolver is reproduced in Fig. 1. The unknown transistor is connected to the three test terminals and the unit is switched on at S2. S1 is then taken through its three positions. If all three l.e.d.'s light up at one switch position and only one l.e.d. lights up at the remaining two positions then the test transistor is n.p.n. and the switch position at which all three l.e.d.'s are alight corresponds to its base lead-out. Should all three l.e.d.'s light up at two positions of the switch and only one l.e.d. lights up at the third position the test transistor is p.n.p., and the position of S1 which causes the single l.e.d. to be illuminated corresponds to the transistor base.

A full explanation of circuit operation was provided in the previous article, and only a quick summary will now be given. When an n.p.n. transistor is connected to the test terminals and the switch arm connects to its base, forward current flows in both the base-emitter and base-collector junctions, causing all three l.e.d.'s to be illuminated. At the other two switch positions there is no current flow through the transistor, which presents a reverse biased emitter-base or collector-base junction to the current. A p.n.p. transistor presents reverse-biased junctions when the switch connects to its base. When the switch arm connects to its emitter the transistor functions as an amplifying transistor in the common emitter mode, and when the switch arm connects to its collector the transistor functions as an amplifying transistor with the collector acting as an emitter and the emitter functioning as a collector. This assumes that the transistor has a current gain of at least unity when operated in this manner, and the author has not yet found a transistor which does not offer this performance.

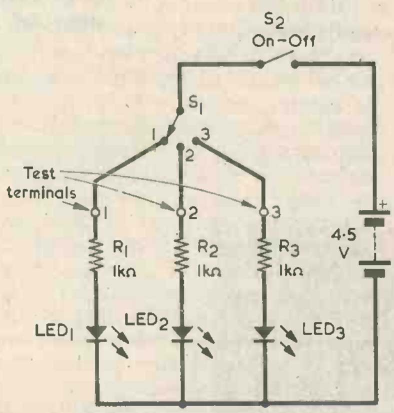


Fig. 1. The circuit of the polarity/base resolver in its initial form

Regrettably, the diagrams for Figs. 5(b) and 6(b) were transposed in the earlier article.

AUTOMATIC OPERATION

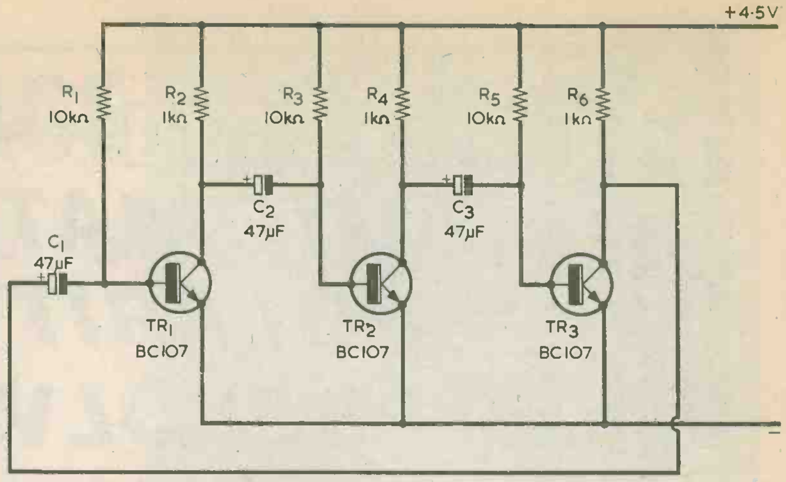
Since writing this article, it has occurred to the writer that performance would be enhanced if the 3-way switch of Fig. 1 could be dispensed with and the positive supply applied successively to the test terminals by an automatic switching circuit. It would then be necessary merely to connect up the transistor and observe the lighting of the l.e.d.'s. In some instances the transistor leads could simply be touched against the terminals, giving an even quicker means of checking.

The automatic switching circuit would have to apply the positive supply to the test terminals following the sequence 1,2,3,1,2,3,1, etc., and it would be essential for there to be a significant gap between the cessation of voltage at one terminal and the application of voltage to the next. If this were not done the two situations with a p.n.p. transistor where all three l.e.d.'s are alight would merge into each other, as also would the two situations with an n.p.n. transistor where only one l.e.d. is alight, and it would be more difficult to differentiate between a p.n.p. and an n.p.n. transistor.

A simple oscillator circuit capable of offering the sequential switching required is shown in Fig. 2. This oscillator has appeared in earlier "Suggested Circuit" articles and was described in the May and June 1975 issues. The oscillator is self-starting and offers reliable performance for electrolytic coupling capacitor values between some $10\mu F$ and $500\mu F$. It will also run with capacitor values from $10\mu F$ down to $2\mu F$ provided the capacitors have very low leakage current. When the capacitors are $47\mu F$, as they are in Fig. 2, it is only necessary that they be good quality modern components. The author employed Mullard miniature electrolytic capacitors in the prototype circuit.

Between the instants of changeover, one transistor in the oscillator is always off and the other

Fig. 2. A 3-step oscillator capable of offering automatic operation of the resolver



two are always on. Let us examine the circuit at a moment when TR1 is changing from the off to the on condition. At this instant C2 will be charged up to the supply potential less the 0.6 volt dropped across the base-emitter junction of TR2. As TR1 turns on its collector potential falls from that of the positive rail to a value which is about 0.2 volt positive of the negative rail. Because of the presence of C2, the base of TR2 is taken negative by a similar voltage, whereupon TR2 turns off. The circuit now remains in this condition as C2 discharges via R3. After a period C2 discharges

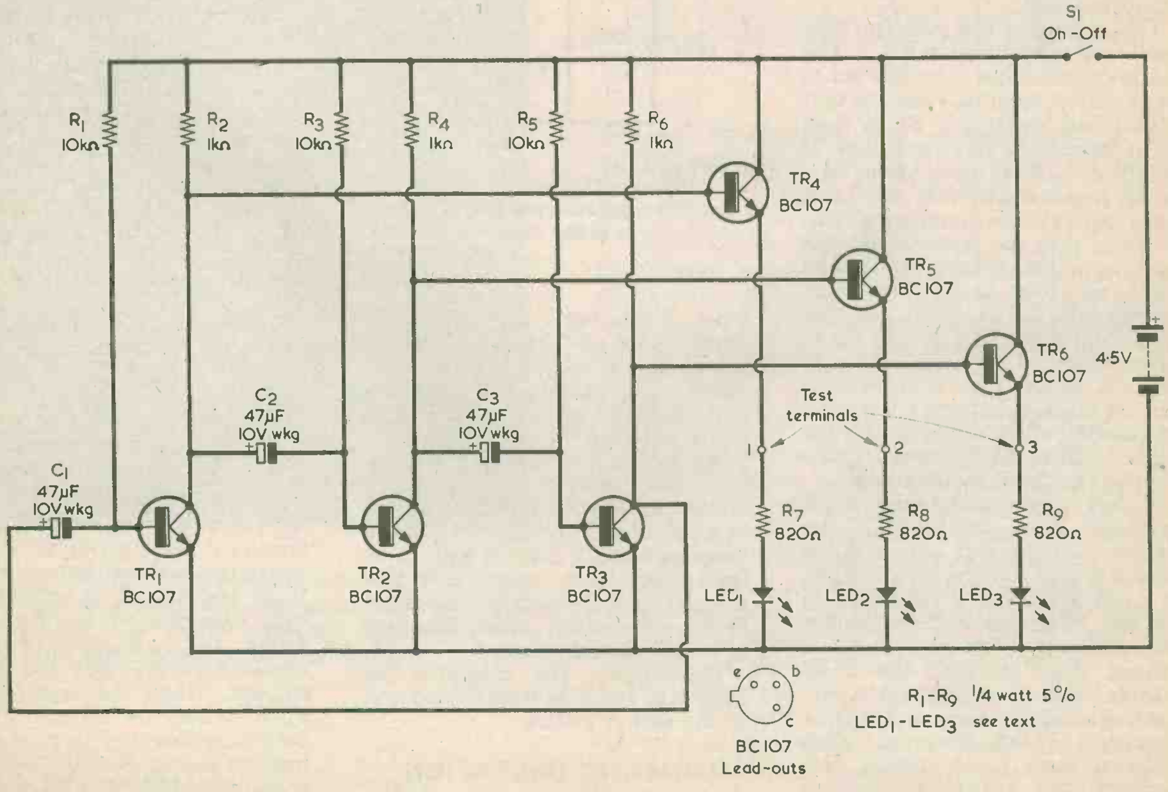
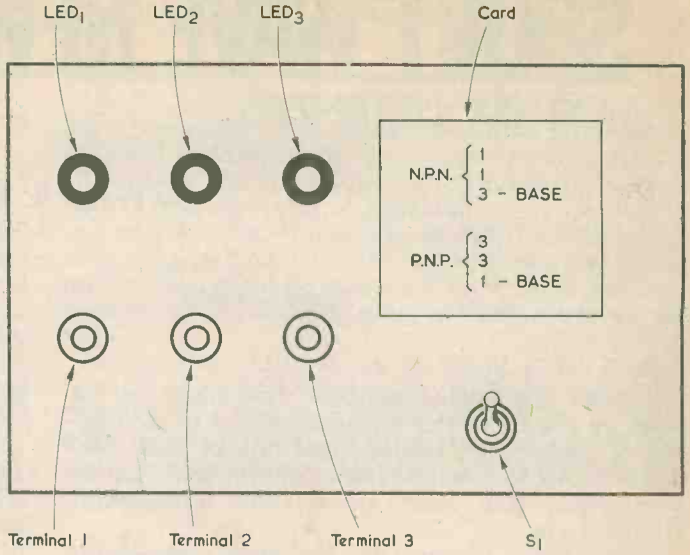


Fig. 3. The complete circuit of the automatic polarity/base resolver. It is merely necessary to switch on at S1, connect the transistor to be checked and observe the l.e.d.'s

Fig. 4. The resolver can be assembled in a small plastic case. A suggested front panel layout is shown here



sufficiently for the base of TR2 to become some 0.6 volt positive of the negative rail, whereupon TR2 turns on. Its collector voltage falls rapidly, with the result that the base of TR3 is taken negative by way of the charged C3, and TR3 turns off. When C3 has discharged sufficiently into R5, TR3 turns on again and, in so doing, causes TR1 to turn off. The cycles proceed in this manner with each transistor turning off in turn. Using the component values shown, the length of a complete three-transistor cycle, from TR1 turning off to TR1 turning off the following time, is approximately 1.25 seconds.

It will be seen that the oscillator is capable of controlling the application of a positive voltage to the test terminals of Fig. 1. What has not been mentioned so far, with respect to Fig. 2, is that the collector of any transistor does not rise to the potential of the positive rail immediately after the transistor turns off. When, for instance, TR2 turns off its collector potential rises relatively slowly because C3 charges via R4 and the forward biased base-emitter junction of TR3. This slow rise in collector potential can provide the gap between periods of l.e.d. illumination which was referred to earlier.

Before leaving the circuit of Fig. 2 it should be pointed out that, when two successive transistors are on, the coupling electrolytic capacitor between them has a small reverse polarity applied to it. When, for example, TR2 and TR3 are on, C3 has a potential of 0.6 volt on its negative plate and a potential of about 0.2 volt on its positive plate. This small reverse voltage does not appear to affect circuit operation in practice with the component values specified. In the 1975 articles on the oscillator the transistors were germanium, whereupon there is no application of a reverse voltage to the electrolytic coupling capacitors. Experimenters who wish to use the oscillator circuit with alternative capacitor values may find it desirable to employ germanium transistors if any difficulties are experienced with silicon transistors. Whatever transistors are used, the supply rail voltage must not be greater than the maximum reverse base-emitter voltage rating of the transistors concerned. With the BC107 this rating is 6 volts.

COMPLETE CIRCUIT

The complete circuit of the automatic polarity/base resolver appears in Fig. 3. Here, TR1, TR2 and TR3 are in the oscillator circuit of Fig. 2, with emitter followers TR4, TR5 and TR6 coupled respectively to their collectors. The emitters of TR4, TR5 and TR6 connect to test terminals 1, 2 and 3. Thus, when a transistor in the oscillator turns off its collector goes (relatively slowly) positive, causing the corresponding emitter follower to apply a positive supply to the test terminal to which it connects. If, during the cycle and with no transistor connected to the test terminals, TR1 is turned off, test terminal 1 is at a positive potential and LED1 is alight. When TR1 turns on, LED1 extinguishes immediately. LED2 does not, however, light up until the collector of TR2 has gone sufficiently positive for the l.e.d. forward voltage to be present at the emitter of TR5. The l.e.d.'s light up successively, with a perceivable gap between the extinguishing of one l.e.d. and the lighting of the next.

The series l.e.d. resistors, R7, R8 and R9, have a slightly lower value than the series resistors in Fig. 1. This is because the positive voltage applied to the test terminals is 0.6 volt lower, due to the presence of the emitter followers. The l.e.d.'s should be red types and the author employed Doram type 4 components, which have good sensitivity at the low currents appearing in the circuit. With these particular diodes the anode lead-out is shorter than the cathode lead-out. The latter connects to the negative rail.

If a p.n.p. transistor is connected to the test terminals the l.e.d.'s take up the rhythm 3-3-1, the figures signifying the number of l.e.d.'s which are alight. When the single l.e.d. lights up, this indicates the base lead-out of the test transistor. With an n.p.n. transistor the rhythm is 1-1-3. The base is indicated by the l.e.d. which has not been lit up on its own during the sequence. Since the l.e.d.'s light up in order, that l.e.d. is the one which would have lit up next on its own had not all three l.e.d.'s turned on.

There is no need to keep S1 switched off when connecting a test transistor, as the voltages and currents at the test terminals are quite low. No damage will result if the test terminals are inadvertently short-circuited together. The current drawn from the 4.5 volt battery is about 11mA with one l.e.d. lit, rising to approximately 17mA when all three l.e.d.'s are alight.

The circuit can be assembled in a small plastic case having a front panel layout similar to that shown in Fig. 4. A card glued to the cover shows the rhythms resulting from the two kinds of transistor and acts as a reminder of these. ■

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT *Frequencies* = kHz

In the last issue, mention was made in the opening gambit of this series of articles to the logging of clandestine stations and one in particular that is back to front, but more of that later. Let us commence with more news about clandestine transmitters.

The "Voice of the One Lebanon" (in Arabic "Sawt Lubnan al-Wahid") operates from 1030 to 1130 and from 2030 to 2130 in Arabic on **6170** and on **9510**. Broadcasts are anti-Syrian and against the Syrian presence in Lebanon.

The "Voice of Arab Syria" (in Arabic "Sawt Suriya al-Arabiya") is on the air from 0400 to 0500, 0700 to 0800 and from 1700 to 1800 on (surprise, surprise) **6170** and **9510**. According to the BBC Monitoring Service, to whom I am indebted for the foregoing information, programmes include a newscast, press quotations and anti-Syrian regime talks.

The back to front programmes? Oh yes, not strictly speaking clandestine but perhaps the nearest one can get, and certainly very interesting to those of us who are aware of the current 'battles' being fought on the short wave bands. I refer of course to the broadcasts from Radio Peking on reversed tape which are always in Russian. Several theories have been advanced by Dxers as to just why these broadcasts are carried out in such a mode, the current favourite being that it is done to avoid Russian jamming, such radiations being intended for Chinese provincial stations near the Soviet border, not equipped with landline facilities, who promptly record the programme and retransmit 'right way up'. However, more about this next month, meanwhile listen on **6550** from 1830 to 1925, you'll hardly be expected to understand Russian backwards but you can always tape it and do the reversing bit yourself!

CURRENT SCHEDULES

● ETHIOPIA

The "Radio Voice of Revolutionary Ethiopia", Addis Ababa, lists a tramission in English from 1630 to 1700 on **6015** and on **7180**.

● HUNGARY

"Radio Budapest" has an External Service in which the following broadcasts, in English to Europe, are made. From 1200 to 1240 (not on Saturdays or Sundays) on **7155, 9585, 11910, 15160, 17785** and on **21525**; from 1515 to 1530 on Tuesdays and Fridays a Dx programme is featured; from 2130 to 2200 on **5965, 7200, 9655, 11910, 15415** and on **17780**.

● ISRAEL

"Kol Yisrael", Jerusalem has the following frequency schedule for its service in English to Europe. From 1200 to 1230 on **11655, 15100, 15405** and on **17815**; from 2000 to 2030 on **9815** and **11655**.

● CHINA

"Radio Peking" radiates programmes in English to Europe from 2020 to 2130 on **5090, 6590, 6860, 7590** and on **9030**; from 2130 to 2230 on the same channels.

● NETHERLANDS

"Radio Nederland Wereldomroep", Hilversum, is in English to Europe at the following times — from 0930 to 1050 on **5955, 6045, 7240, 9660** and on **9895**; from 1400 to 1520 on **5955, 6045, 9895, (11740** Madagascar Relay), **15185** and on **17810**; from 1830 to 1950 on **6020, 11730** and on **17700**; from 2000 to 2120 on **11730** from Madagascar Relay.

● NIGERIA

The Domestic Service National Programme from Lagos may be heard from 0700 to 1630 on **7255**; from 0430 to 1000 and from 1500 to 2305 on **4990**. Most of the programmes are in English.

AROUND THE DIAL

● CHINA

Radio Peking on **7080** at 1930, OM with a newscast in English in a programme directed to North and West Africa, scheduled from 1930 to 2030.

Radio Peking on **3920** at 2039, YL in Chinese, orchestral music in local style in the Domestic Service 1, scheduled on this channel from 2000 to 0100 and from 1100 to 1735.

Radio Peking on **9020** at 1920, OM with a talk in Chinese in the Domestic Service 2, scheduled from 2100 to 1600 except Wednesdays and Fridays when the schedule is from 2100 to 0600 and from 0950 to 1700.

Checking on the PLA (Peoples Liberation Army) Fukien Front transmissions recently the following were logged — **2490** at 2025, YL in Chinese in Network 1, scheduled from 1200 to 0118; **3000** at 2030, Chinese orchestral music in Network 1, scheduled from 1227 to 2314; **3400** at 1847, OM in Chinese, scheduled from 1120 to 1900; **3535** at 1950, YL in Chinese and local music in Network 1, scheduled from 1300 to 2244; **4045** at 1945, OM in Chinese and local music in Network 1, scheduled from 1000 to 0530; **4330** at 1943, YL with songs, orchestral music in Network 1, scheduled from 1100 to 0158; and, last but not least, **4380** at 1843, OM and YL alternate in Chinese in Network 2, scheduled from 0230 to 1900.

All transmissions from the PLA Fukien Front are directed to the Offshore Islands and Taiwan and are in Standard Chinese or Amoy.

● NORTH KOREA

Radio Pyongyang on a measured **6398** at 2050, YL's in chorus, local music in a programme directed to South Korea, scheduled from 2000 to 2130.

Radio Pyongyang on a measured **6398** at 2050, OM in French in the programme of that language directed to the Near and Middle East and Africa, scheduled from 2000 to 2150 on this channel.

● KUWAIT

Radio Kuwait on the out-of-band frequency **12085** at 1837, OM with a talk on Zionism in English.

● EGYPT

Radio Cairo on **15475** at 1331, Islamic chants in a "Voice of the Arabs" programme, scheduled from 0800 to 1400 and from 1500 to 1900.

● USSR

Radio Moscow on **15100** at 1325, OM with identification "Radio Station Peace and Progress" in the English programme directed to Asia.

● ALBANIA

Radio Tirana on **9375** at 1450, YL in Polish to Europe, scheduled from 1430 to 1500.

● MALAWI

Blantyre on **3380** at 1800, OM with station identification and a newscast in English.

● SRI LANKA

Colombo on a measured **4902** at 1939, Buddist chants on a full-moon day. To log this one, consult the calender and then, hopefully, listen!

● NIGERIA

Lagos on **15140** at 1945, YL in English, local pops on records.

● ECUADOR

This country is easy to log by virtue of the HCJB transmissions but Dxer colleague Gordon Bennett of Stockport has brought to notice, in a recent letter. that some readers may care to try for the following Ecuador stations on the lower frequencies.

Radio National Espejo, Quito, on **4679** at 0200 (and often through to 0700).

Radio Splendit, Cuenca, on **5025** at 0355, LA music programme with several identifications interspersed.

Emisoras Progreso, Loja, on **5060** at 0410, local music with station identification. All these loggings by G.B.

● HONDURAS

La Voz Evangelica, Tegucigalpa, on **4820** at 0417, OM in English presenting a religious programme. G. Bennett also mentions this station, having logged it on several occasions during the 0300-0430 English programme.

● PERU

Radio Atlantida, Iquitos, on **4790** at 0530, local style pop music. G.B. finds this station interesting in that it features hardly any typical Andean music of the type regularly heard when tuned to R. Andina, Chinchaycocha or Libertad.

Radio Andina, Huancayo, on **4996** at 0434, YL with song in Spanish, OM announcer, local style music. The schedule is from 0100 to 0600 but has been reported closing as early as 0450; the power is 1kW.

Radio Eco, Iquitos, on **5010** at 0340, dance music Latin American style, YL with songs in Spanish. The Schedule of this one is from 1100 to 0500 (Sundays 0400) but often operates around the clock and sometimes identifies as "Radio El Sol"; the power is 1kW.

● VENEZUELA

Radio Universidad, Merida, on **3395** at 0221, OM with songs in Spanish, guitar music. Schedule is from 1000 to 0400 and the power is 1kW.

Radio Bolivar, Cuidad Bolivar, on **4770** at 0240, OM with songs in Spanish. local style dance music. Schedule is from 1000 to 0400 and the power is 1kW.

Radio Difusora Venezuela, Caracas, on **4890** at 0250, OM with identification, songs in Spanish. The schedule is from 1000 to 0400, the power is 5kW and the identification is given as "La Estacion de la Alegria".

Ecos del Torbes, San Cristobal, on **4980** at 0318, Latin American dance music, announcements and jingles in Spanish. Schedule is from 1000 to 0400 and the power is 10kW, making this (and the three that follow) the easiest of Venezuelans to log.

Radio Juventud, Barquisimeto, on **4900** at 0301, OM with announcements in Spanish, local style music. Schedule is from 1000 to 0400 and the power is 10kW.

Radio Rumbos, Caracas, on **4970** at 0535, local style recorded pops, announcements, jingles. Schedule is from 0830 to 0400 and the power is 10kW.

Radio Continente, Caracas, on **5030** at 0340, Latin American dance music, identification at 0345 as "Radio Reloj Continente". Schedule is from 1000 to 0500 and the power is 10kW.

● COLOMBIA

Radio Colosal, Neiva, on **4945** at 0312, OM announcer, ballads in Spanish, light music. Schedule is on a 24-hour basis and the power is 2.5kW.

Radio Sata Fe, Bogota, on **4965** at 0316, OM with songs in Spanish, guitar music. Schedule is also around the clock and the power is also 2.5kW.

● BRAZIL

Radio Tabajara, Joao Pessoa, on **4795** at 2040, excited OM with an excited commentary on an exciting futebol match! Schedule is from 0800 to 0400 and the power is an exciting 2kW.

● DOMINICAN REPUBLIC

Radio Norte, Santiago, on a measured **4807** at 2113, songs in Spanish, pops in local style. Schedule is continuous and the power is 1kW.

Incorporating two integrated circuits — ZN414 and LM380N.

MEDIUM WAVE POCKET R

By R. A. Penfold

Covers standard medium wave ba... after constr...

Although perhaps not as numerous as they once were, pocket radio sets still seem to be quite prevalent. Ready-made receivers of this type are usually electrically much the same as larger sets, with the small physical size being accomplished by means of special miniature components and almost unbelievably compact layouts. It is virtually impossible for the amateur constructor to emulate these sets, and so home-made pocket receivers tend to use circuitry which is as simple as possible, and this often results in a comparatively poor performance.

However, such need not be the case and with the intregrated circuits that are now available it would seem to be quite feasible to produce a simple high performance medium wave receiver circuit. Bearing this in mind, the radio which forms the subject of this article was designed.

Only two semiconductor devices, both integrated circuits, are used in the set, which has outside dimensions of approximately 114 by 76 by 36mm. excluding control knobs. The sensitivity of the receiver is good, and even during daylight hours it is possible to receive quite a number of stations on the prototype. The audio quality is also surprisingly good, the main limitation on quality and volume being the comparatively poor performance of the miniature speaker which has to be used. There is only one tuned circuit and so the selectivity is not as high as would be given with a more complex superhet design.

The receiver is completely self-contained, with an internal ferrite rod aerial and 9 volt battery.

THE CIRCUIT

An obvious choice for the r.f. and detector circuitry is the well-known ZN414 i.c., and it is indeed this device which is used here. The popular LM380N i.c. provides the a.f. amplification for the receiver. The complete circuit diagram appears in Fig. 1.

Basically, the ZN414 is a high gain r.f. amplifier which has a high input impedance. This enables the ferrite aerial coil, L1, and tuning capacitor, VC1, to be coupled direct into the input of the i.c. without employing the usual low impedance winding on the aerial. C1 is an earth return capacitor and R2 is a bias resistor. The i.c. includes a transistor detector and a.g.c. circuitry. The audio output is developed across R3, with C3 acting as an r.f. filter capacitor. The i.c. requires a supply potential of about 1.3 volts, and this is derived from the main 9 volt supply by means of the voltage divider circuit consisting of R1, R4 and R5. R5 is adjusted to provide the correct supply voltage.

If instability is to be avoided it is essential that no significant r.f. signal is allowed to reach the audio amplifier section. Therefore, additional r.f. filtering is provided at the output of IC1 in the form of R6 and C5. C4 provides d.c. blocking.

The LM380N i.c. is ideal for the present application since it requires very few discrete components.

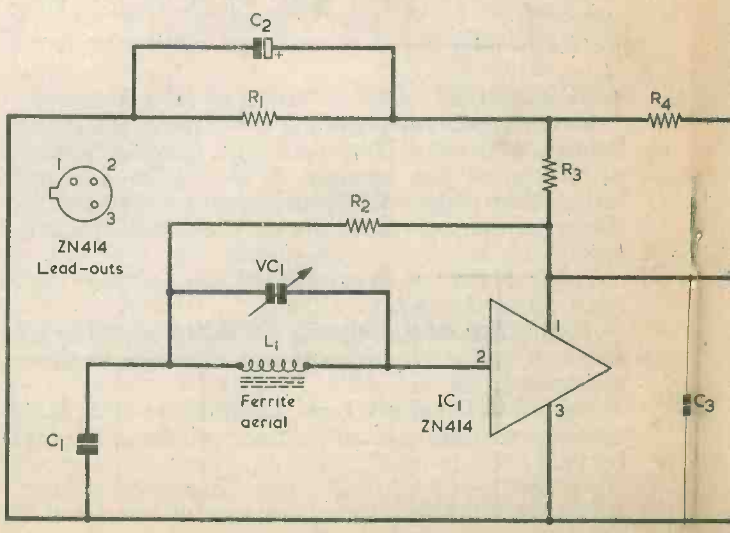


Fig. 1. The circuit of the medium wave pocket ra... quires few dis...

IUM WAVE POCKET RADIO

By R. A. Penfold

Covers standard medium wave band and requires no alignment after construction.

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If instability is to be avoided it is essential that no significant r.f. signal is allowed to reach the audio amplifier section. Therefore, additional r.f. filtering is provided at the output of IC1 in the form of R6 and C5. C4 provides d.c. blocking.

The LM380N i.c. is ideal for the present application since it requires very few discrete components.

Resistors
(All fixed values ¼ watt 5%)
R1 680Ω
R2 100kΩ
R3 820Ω
R4 2.7kΩ
R5 2.2kΩ pre-set potentiom-
horizontal skeleton
R6 560Ω
VR1 5kΩ potentiometer, log, w
text)

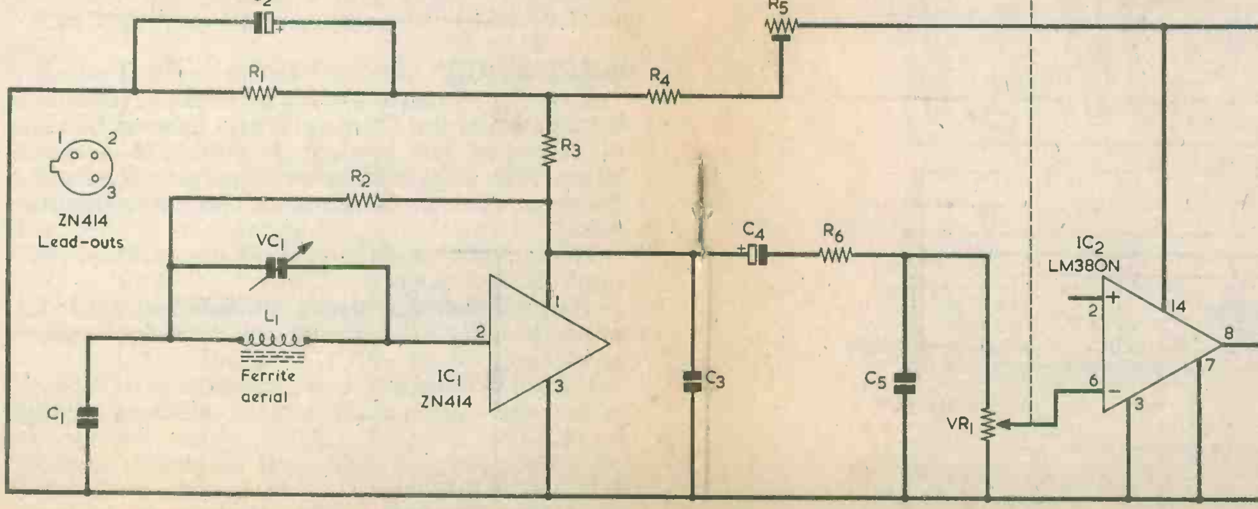
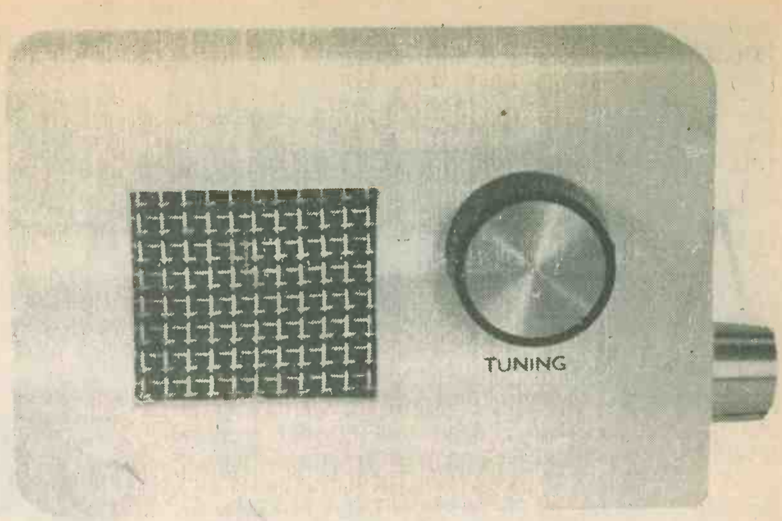


Fig. 1. The circuit of the medium wave pocket radio. Due to the use of two integrated circuits this quires few discrete components

RADIO



Simplicity is the keynote of this little radio. The two controls are for tuning and volume/on-off

band and requires no alignment
struction.

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)
R1 680Ω
R2 100kΩ
R3 820Ω
R4 2.7kΩ
R5 2.2kΩ pre-set potentiometer, 0.1 watt, horizontal skeleton
R6 560Ω
VR1 5kΩ potentiometer, log, with switch S1 (see text)

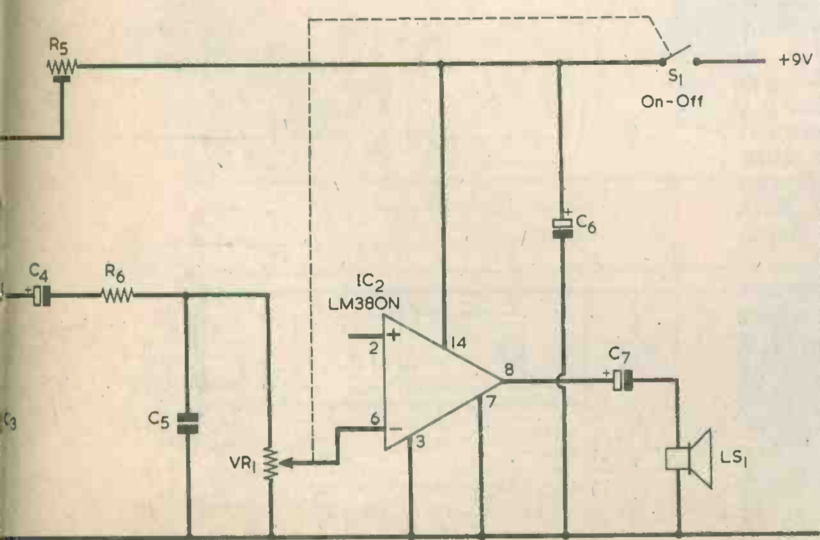
Capacitors
C1 0.01μF type C280 (Mullard)
C2 6.8μF electrolytic, 10 V. Wkg.
C3 0.1μF type C280 (Mullard)
C4 1μF electrolytic, 10 V. Wkg.
C5 0.047uF type C280 (Mullard)
C6 47μF electrolytic, 10 V. Wkg.
C7 220μF electrolytic, 10 V. Wkg.
VC1 20-250pF mica trimmer (see text)

Semiconductors
IC1 ZN414
IC2 LM380N

Speaker
LS1 8Ω speaker, 45mm. (see text)

Switch
S1 s.p.s.t., part of VR1

Miscellaneous
Plastic case type PB1
Veroboard, 0.1 in. matrix
Trimmer converter (see text)
Ferrite rod, 110 x 8mm. diameter
28 s.w.g. enamelled copper wire
PP3 battery
Battery connector
2 control knobs
14 pin i.c. holder (optional)
Speaker fabric
18 s.w.g. aluminium
Insultation tape, wire, etc.



radio. Due to the use of two integrated circuits this re-
discrete components

In fact, the only external component which is used is the output d.c. blocking capacitor, C7, There is no need to use an input d.c. blocking capacitor, and the inverting input of the device connects direct to the slider of the volume control, VR1. The LM380N also has a non-inverting input, but this is simply ignored.

The voltage gain of the LM380N is fixed at a typical figure of 50 times, and with the ZN414 providing an audio output level of about 30mV r.m.s., this is just about the required level.

C2 and C6 are supply decoupling capacitors and S1 is the on-off switch. The latter is ganged with the volume control. The quiescent current consumption of the receiver is about 7mA, but the output stage is a Class B type and at high volume levels the consumption can rise to some 25mA.

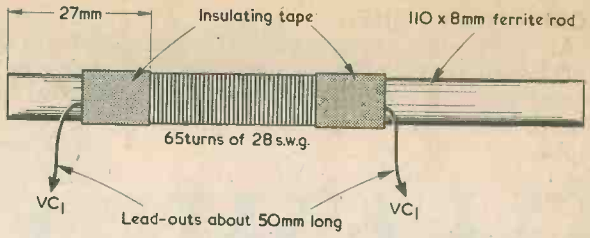
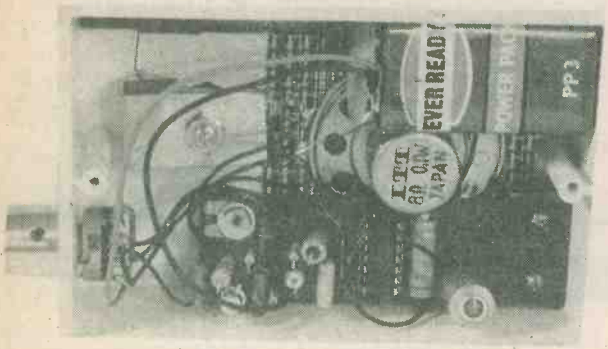


Fig. 2. The ferrite aerial coil is close-wound with enamelled copper wire.



The components fit comfortably inside the small plastic case

FERRITE AERIAL

The ferrite aerial is home constructed, and the coil is wound on a 110 by 8mm. ferrite rod using 28 s.w.g. enamelled copper wire. Details are provided in Fig 2.

It is unlikely that a rod of suitable length will be available, and it will be necessary to break a 110mm. length from a longer rod. Ferrite is very hard and brittle, and it is not practicable to cut right through the rod using an ordinary hacksaw. A V-cut should be filed all round the rod at the point where it is desired to break it, and it may then be tapped against the edge of the bench.

The winding starts 27mm. from one end of the rod, and the lead-out wire is held in place by a band of insulating tape. The coil consists of 65 turns of wire close-wound in a single layer. Due to the relatively thick wire that is used it is easy to make a neat job of the coil. When the winding has been completed, the second lead-out wire is taped in place.

MOUNTING BRACKET

VC1 cannot be mounted in the usual manner because the mounting bush and nut are situated at the rear of the component. A mounting bracket is constructed from 18 s.w.g. aluminium, and details of this are shown in Fig. 3. The aluminium is bent along the lines indicated to produce a U-shaped bracket. VC1 is mounted on the larger of the two holes, and the smaller one is used to enable the bracket to be bolted to the front panel of the set by means of a short M3 or 6BA countersunk screw.

COMPONENTS

Most of the components are standard readily available items, but some are special miniature types. VR1/S1 is a "Japanese Volume Control" which is available under this description from Maplin Electronic Supplies. The miniature 45mm. diameter 8Ω speaker is available from the same source, as also is the plastic case type PB1.

VC1 is not an ordinary variable capacitor, and it is actually a modified trimmer. The trimmer is a type TP4 (20-250pF) which has its adjustment screw replaced by a trimmer converter. The latter is a cylinder of ¼in. diameter, on which a knob can be fitted, terminated in a threaded section. Both this and the trimmer are available from Home Radio.

The resistors and capacitors are all miniature types, and C280 capacitors should be used where specified. The pre-set potentiometer, R5, is a miniature component having 0.2in. spacing between track tags and 0.4in. spacing between track and slider tags. The low value electrolytic capacitors C2 and C4 are specified as 10 V. Wkg., but in practice it may be difficult to obtain them in this voltage. It is quite in order to use capacitors with a high working voltage such as 40 or even 63 volts. Mullard miniature electrolytic capacitors will be found suitable.

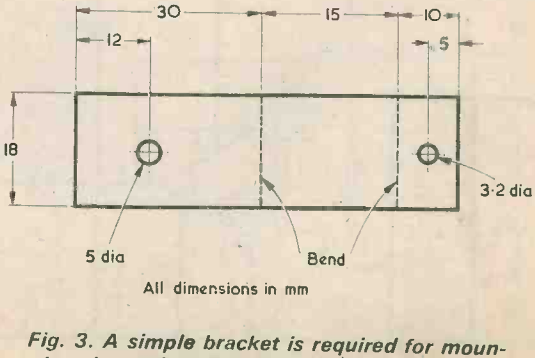


Fig. 3. A simple bracket is required for mounting the tuning capacitor, VC1. This has the dimensions shown here.

COMPONENT PANEL

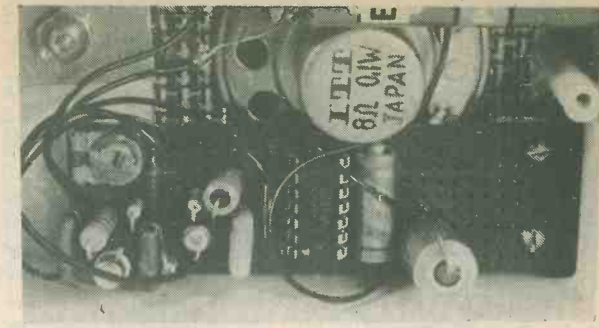
All the small components are assembled on a Veroboard panel of 0.1in. matrix. The componet layout and other details of this panel are shown in Fig. 3. Start by cutting out a panel which has 9 copper strips by 32 holes, using a hacksaw. Then the two mounting holes are drilled to take small woodscrews. Next, the breaks in the copper strips are made, making quite sure that none of these are accidentally overlooked. After this, the components and link wires are soldered into position. In the prototype a 14 pin i.c. holder was soldered to the Veroboard and the LM380N fitted into this later. Alternatively, the LM380N can be soldered directly to the board.

Flexible insulated leads leave the board for connection to VR1 (at points A, B and C), S1, VC1 and the speaker. It is advisable to make these a little longer than will eventually be required and cut them to length when the connections are later made to the external components. A further lead from the board connects to the negative battery clip.

CASE LAYOUT

Reference to the accompanying photographs should help to clarify the general layout of the receiver inside the case. VR1/S1 is mounted towards the bottom of the right hand side panel, and it requires a 7mm. diameter mounting hole. VC1 is mounted on the front panel towards the right hand side, slightly above centre. The speaker is situated to the left of this, and it requires a cut-out which measures about 36 by 40mm. This can be made with either a fretsaw or a miniature round file. A piece of speaker fret or material is glued in position behind the cut-out, and then the speaker is glued onto this. A good quality adhesive must be used, and care must be taken to apply only a conservative amount to the rim of the speaker, ensuring that none gets on to the speaker cone or surround. The speaker should be positioned such that there is space above its magnet for the PP3 battery and space below it for the Veroboard panel.

The ferrite aerial is glued in place at the top and towards the front of the case. A high quality gap filling adhesive must be used here, and the author employed an epoxy resin. The coil is to the right, i.e. at the VC1 end.



The Veroboard panel fits below the speaker and is mounted by means of two small woodscrews

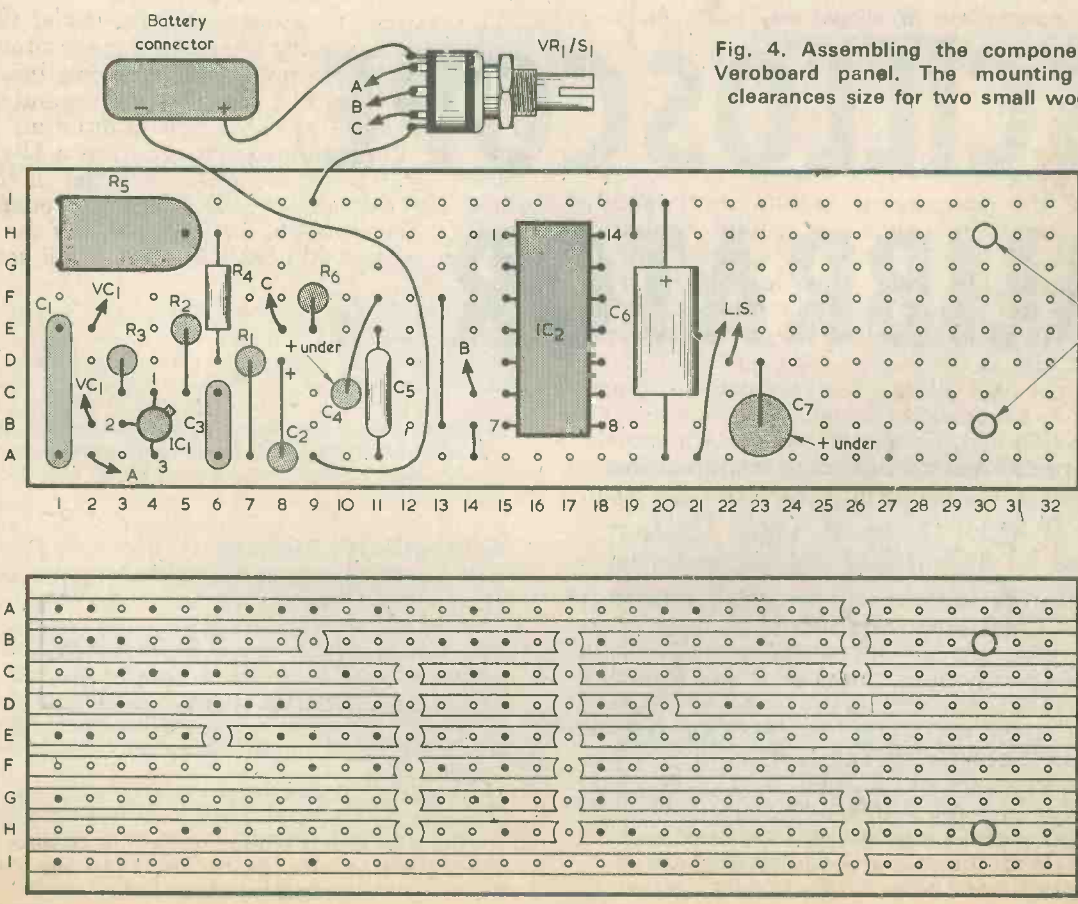


Fig. 4. Assembling the components on the Veroboard panel. The mounting holes are clearances size for two small woodscrews.

The component panel fits into the bottom of the case, and it is mounted on a small block of wood which measures approximately 27 by 12 by 6mm. using two small woodscrews. The block of wood is glued to the inside face of the front panel at the bottom left hand corner, as viewed from the front of the case. The component panel is not finally mounted until it has been wired up to the remainder of the set. If there is any risk of the connections under the Veroboard panel touching the speaker frame apply insulating tape to the frame at the appropriate place. At this stage the two lead-outs of the ferrite aerial coil are soldered to the tags of VC1.

There is space for the battery in the top left hand corner of the case, again as viewed from the front. It should be placed as far to the left as possible, since it will otherwise have a slight screening effect on the aerial coil, and this would result in a loss of performance. A piece of sponge rubber or fabric is fitted between the battery and the speaker frame and inside front of the case, whereupon the battery is held in place when the back of the case is screwed on.

ADJUSTMENT

Before switching on the completed receiver, thoroughly check the wiring for errors and set R5 at about half its maximum resistance. The set requires no alignment, and so it should work properly immediately after switching on. If a multimeter having a sensitivity of 10kΩ per volt or more on its voltage ranges is available, this can be set to the 0-5 volt range (or a similar low voltage range) and then used to measure the voltage between the negative supply rail and the junction of R1 and R3. R5 is then adjusted to produce a reading of 1.3 volts in the meter.

If a multimeter is not available, perfectly adequate results should be obtained if R5 is simply left at its central setting. Do not adjust R5 up to or near the fully anticlockwise setting if a meter is not used as this could inadvertently cause too high a voltage to be applied to the ZN414.

The tuning of the set is broad, and there should be no difficulty in tuning in stations accurately even when these are at the high frequency end of the band. One reason for this is the fairly wide bandwidth of the set, but it is mainly due to the unconventional tuning capacitor. Whereas the capacitance swing of an ordinary tuning capacitor is covered by a 180 degree turn of the spindle, about three complete turns are required with the present capacitor.

Subminiature speakers are not very efficient and they are not capable of handling more than very modest output powers. This means that the volume from any set of this type is not very high, although it is perfectly adequate for most purposes. ■

VARIABLE OSCILLOSCOPE CALIBRATOR

By N. R. Wilson

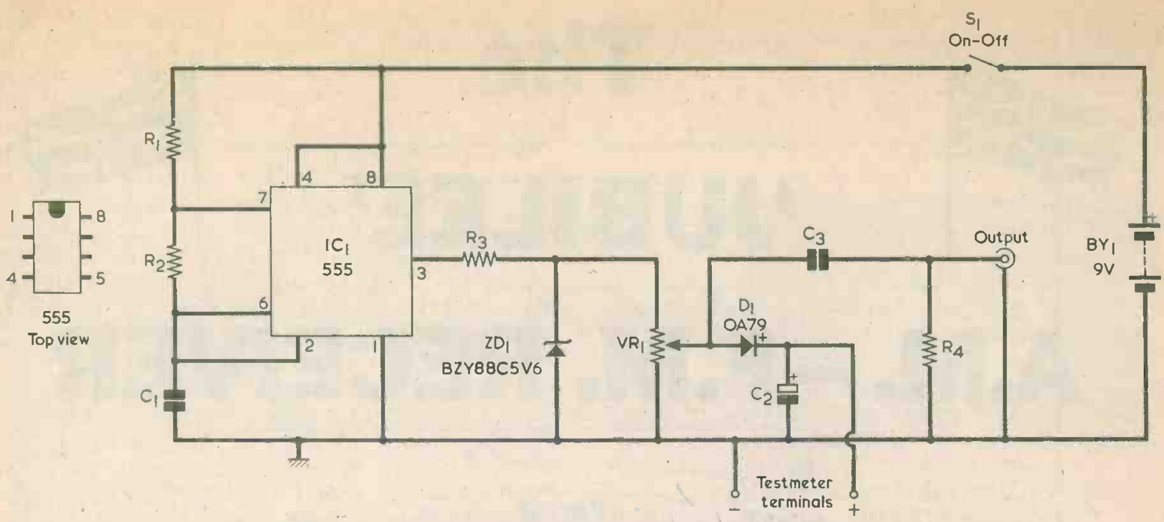
This oscilloscope voltage calibration generator can have its output level set for any value from 1 to 5 volts. Output amplitude is monitored by an external testmeter switched to an appropriate voltage range.

Home-constructed oscilloscope voltage calibration generators are not normally complicated items of equipment. Frequently, they employ a multivibrator whose output is fed into a clipping circuit given by a zener diode or a pair of silicon diodes connected back to back. The generator to be described is basically of this simple nature, but it has the unusual feature that its peak-to-peak output amplitude is continuously variable between 1 and 5 volts and can be monitored by an external testmeter switched to a suitable d.c. volts range.

CIRCUIT OPERATION

The calibration generator circuit appears in the accompanying diagram, in which the multivibrator consists of a 555 timer i.c. in a standard configuration. This runs at a frequency of approximately 350Hz. Its output is not a true square wave because C1 has to charge via R1 and R2 in series and to discharge via R2 on its own. As a result, the positive part of the output waveform at pin 3 is slightly longer than the negative section.

The output couples to the zener diode ZD1 via R3. The output of a 555 does not rise close to the positive rail when it is high, and it is usually about 1.5 volts below that rail in this condition. In consequence about 12mA flows in R3 when the 555 output is high.



The circuit of the oscilloscope voltage calibration generator. The output is continuously variable by means of VR1, and its amplitude is measured by a voltmeter connected to the testmeter terminals

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)
R1 10kΩ
R2 100kΩ
R3 150Ω
R4 470kΩ
VR1 10kΩ potentiometer, linear

Capacitors
C1 0.022μF polyester
C2 10μF electrolytic, 10 V. Wkg.
C3 0.47μF polyester

Semiconductors
IC1 555
ZD1 BZY88C5V6
D1 OA79

Switch
S1 s.p.s.t. toggle

Battery
BY1 9 volt battery

Miscellaneous
Case (see text)
Battery connector
Control knob
Output socket (see text)
Insulated terminal, red
Insulated terminal, black

This current takes the slope resistance of the zener diode down to about 10Ω, ensuring hard clipping and a low impedence for the positive part of the waveform. When the 555 output goes low its pin 3 is very close to the potential of the negative rail, with a low output impedance. The impedance for the negative part of the waveform is virtually that of R3.

The voltage across the zener diode appears across VR1 and a proportion is then tapped off by this potentiometer and applied by way of C3 to the output socket. R4 ensures that the output waveform is approximately symmetrical about the negative supply rail.

VOLTAGE MONITOR

The voltage tapped off by the slider of VR1 is applied to the simple half-wave rectifier circuit comprising D1 and C2. An external testmeter switched to a volts range is connected across C2 and will give a reading slightly lower than the peak-to-peak amplitude of the generator output signal. If the meter were a relatively insensitive type having a resistance of 1kΩ per volt it would present a resistance of 10kΩ if it were switched to, say, a 0-10 volt range. C2 has a value of 10μF and the time constant of 10μF and 10kΩ is 0.1 second, which is considerably longer than the length of each cycle in the signal. C2 can, therefore, be assumed to charge almost fully to the peak value of the signal. The time constant with more sensitive meters will naturally be longer. If VR1 is quickly adjusted from a high setting to a low setting the meter may take a short time to produce the new reading as C2 discharges into it.

To be precise, the reading indicated by the testmeter is the peak-to-peak voltage less about 0.1 volt forward voltage drop in diode D1. For accurate calibration, VR1 should therefore be set for a voltmeter reading 0.1 volt below the desired output voltage.

The current drawn from the 9 volt battery is 10mA. Any type of 9 volt battery, from PP3 to PP9, would be suitable. The output socket may be a coaxial type or a jack socket, as preferred.

The circuit can be assembled in any small case, which may be either metal or plastic. If the case is metal it is made common with the negative supply rail, as indicated by the chassis symbol in the diagram. This symbol is ignored if the case is plastic. Mounted on the front panel are VR1, S1, the output socket and the two terminals for the testmeter. ■

The 'JUBILEE' A.M. – F.M. RECEIVER

Part 2

By Sir Douglas Hall, K.C.M.G.

Constructional details are completed and the simple process of setting up is described.

In the last month's issue we examined the circuit of this receiver and then commenced its construction. We now continue with this, after which we deal with the process of setting up and making a case. References will be made to Figs. 1, 2 and 3; these were published in Part 1.

SPEAKER PANEL

We turn next to Fig. 4, which shows the back of the speaker panel. Cut out piece of ¼in. plywood to the dimensions shown. Also to be cut out is a smaller piece of plywood which functions as a battery platform. When all the holes in the main plywood panel have been cut out, the battery platform is secured to the bottom right of the panel, at right angles, employing thin wood screws.

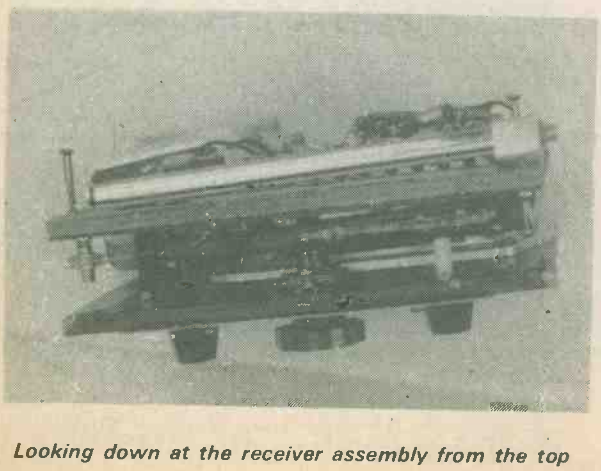
Cut out the three holes at the top and drill hole G. The central hole takes the epicyclic ball drive flange, with its spindle pointing away from the reader and its body on the reader's side of the panel. Temporarily place the drive in position and use it to mark out a 6BA clear hole for a screw which will secure its anchor lug. Drill the hole.

The left hand edge of the speaker is flush with the left hand side of the panel, and its lower edge is similarly flush with the bottom of the panel. Cut out a suitable speaker aperture and secure the speaker with four countersunk bolts, the nuts being on the same side as the speaker. Note that the heat clip of TR5 is secured under one of the speaker mounting nuts, whereupon the speaker frame acts as a heat sink for this transistor.

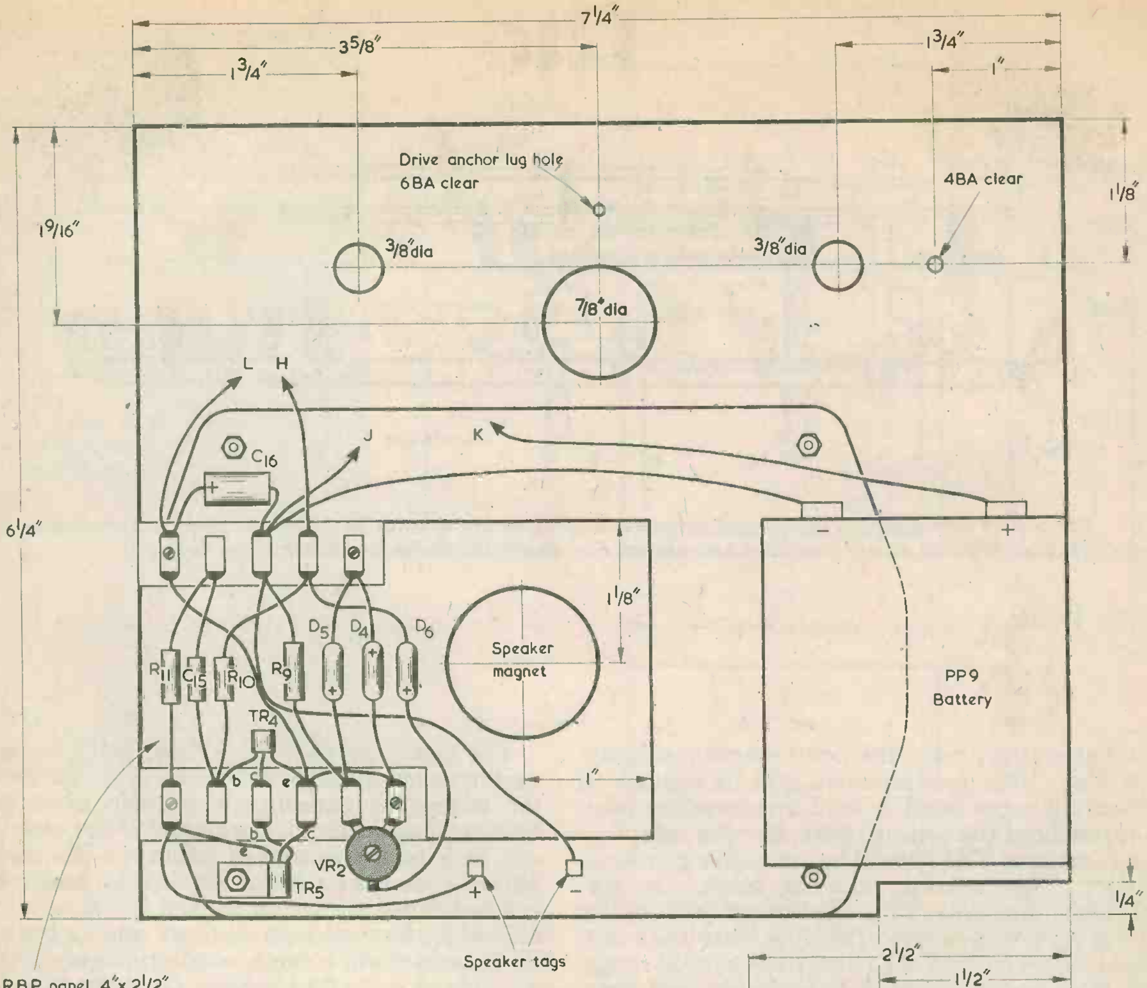
Cover the upper front of the panel, down to the speaker aperture, with Fablon of a suitable colour.

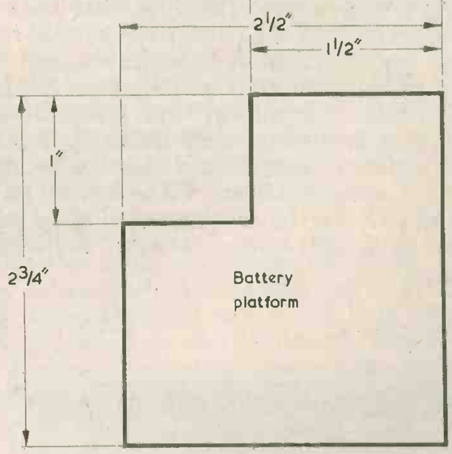
Next, cut out a piece of s.r.b.p. 4 by 2½in. and prepare a hole in this which will pass tightly over the speaker magnet. As was mentioned last month, the speaker obtained should be similar to that employed by the author, and panel dimensions are modified to suit if there are any serious discrepancies. Cut out a 5 way and a 6 way tagstrip from the tagboard, and secure these to the s.r.b.p. panel as shown in Fig. 4, using small screws passing through the centres of the end tags. Make certain that none of the screws or their nuts can touch the frame of the speaker and, if necessary, apply insulating tape here. The panel is passed over the speaker magnet and secured with adhesive.

Fit and wire up the components as shown. The leads identified as H, J, K and L will connect, later, to similarly identified points in Fig. 3. Fit the epicyclic drive in position, and pass a 2in. 4BA countersunk bolt through hole G in Fig. 4, with its head underneath. Secure it with a nut, then place another nut over the bolt. Assemble the panel of Fig. 3 to that of Fig. 4 by having the 4BA bolt pass through its hole G and by inserting the spindle of VC2 into the epicyclic drive. Tighten up the drive grub screws and fit a further nut over the 4BA screw. Tighten up the two nuts such that the panel



Looking down at the receiver assembly from the top





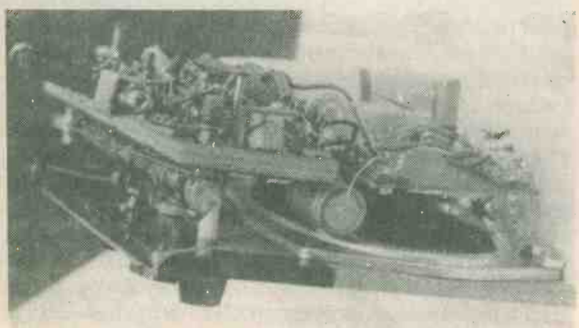


Fig. 4. Dimensions and wiring on the speaker panel. The s.r.b.p. panel fits over the speaker magnet. TR5 has its heat clip secured under one of the speaker mounting nuts.

of Fig. 3 is parallel with the panel of Fig. 4. The two panels are thus secured together by the 4BA bolt and the epicyclic drive and spindle of VC2, as is illustrated in the top view of Fig. 5. Complete the connections H, J, K and L.

SETTING UP

The receiver may now have VR2 set up, and this should be done with a new battery and no signal input. The slider of VR2 is turned fully anticlockwise, as shown in Fig. 4. Insert a meter, switched initially to a high current range, in series with the positive battery connection and switch the receiver on. If the initial reading indicates that it is safe to do so, switch off, select a range that will enable a clear reading of 12mA to be taken, and switch on again. Slowly advance VR2 for a reading of 12mA. Repeat this procedure once more after the battery has been in use for about 20 hours. No further adjustment to VR2 is required.

For the most sensitive reception of stations on the medium and long wave bands VR1 should be

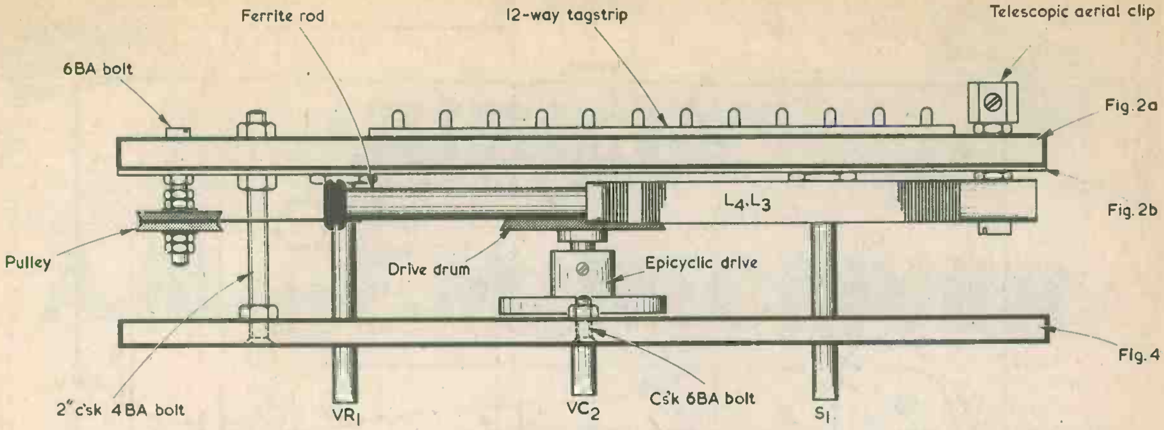
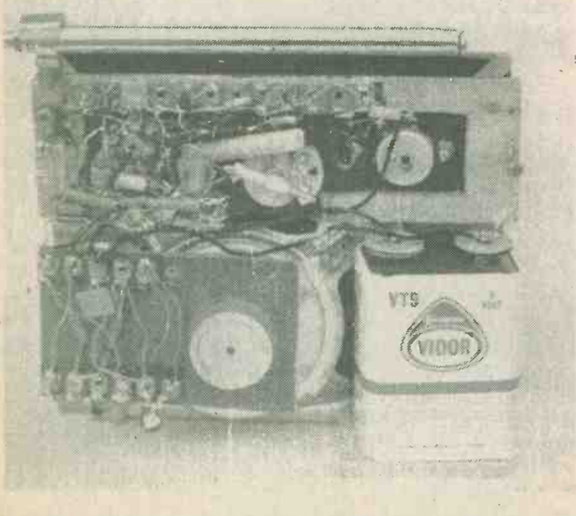


Fig. 5. Top view showing the disposition of parts between the speaker panel and the panel on which the r.f. and detector components are assembled. For simplicity, these components are omitted.

set just at, or very near, the point where oscillation starts. Very little readjustment will be needed on the medium wave band to hold this sensitive position throughout the tuning range. For the reception of v.h.f. stations VR1 should be set to give gentle oscillation. This setting will be back, i.e. anticlockwise, somewhat from the critical position for medium and long waves. In order that the v.h.f. stations appear correctly within the tuning range, set VC2 to near maximum capacitance and tune, by means of an insulated screwdriver adjusting VC1, until Radio 2, or a local v.h.f. transmission if this is lower in frequency than Radio 2, is picked up. Other transmissions should then be found by turning VC2 anticlockwise. VR1 should be adjusted so as to keep the receiver oscillating gently — denoted by a light hiss — as v.h.f. stations are tuned in.



Another view of the receiver assembly, as seen from the rear

The components, as specified, will allow a good performance to be given. If, however, the constructor wishes to experiment a little after he has become used to the performance of the receiver, he can look for an optimum value for R6. As is apparent from the circuit of Fig. 1, this resistor causes a small forward current to flow in D3, and it only affects performance on medium and long waves. If R6 has too small a value, oscillation may prove impossible at some frequencies. If, on the other hand, R6 has too large a value, adjustment of VR1 may cause a sudden and noisy burst into oscillation. In particular, R6 settles the constancy of the reaction setting on the medium wave band. It can be temporarily replaced by a 47kΩ pre-set potentiometer which is adjusted for maximum constancy of setting of VR1 for full sensitivity over the whole of the medium wave band. The potentiometer is then removed, the resistance it inserted into circuit is measured, and a fixed resistor of the appropriate value fitted in the R6 position.

If necessary, C7 may have its value varied to ensure full coverage of the medium wave band, and C8 may need changing in the same way for proper coverage of the long wave band. These changes will most probably be required if the ferrite rod is other than orange grade.

RECEIVER CASE

A case for the receiver can be made as illustrated in Fig. 6, which shows the front, sides, top and bottom before assembly. Note that the dimensions defining case height, width and depth are tentative only, as they assume that the "chassis" has been made exactly to dimensions and can be inserted in the case without clearance. In practice, slightly increase the appropriate dimensions so that the case will take the particular chassis which has been assembled. It may be necessary, also, to modify the depth if the speaker employed differs significantly from that used by the author.

The front section has two apertures, one for the controls and one for the speaker. The top, bottom and sides are screwed together, and the front is

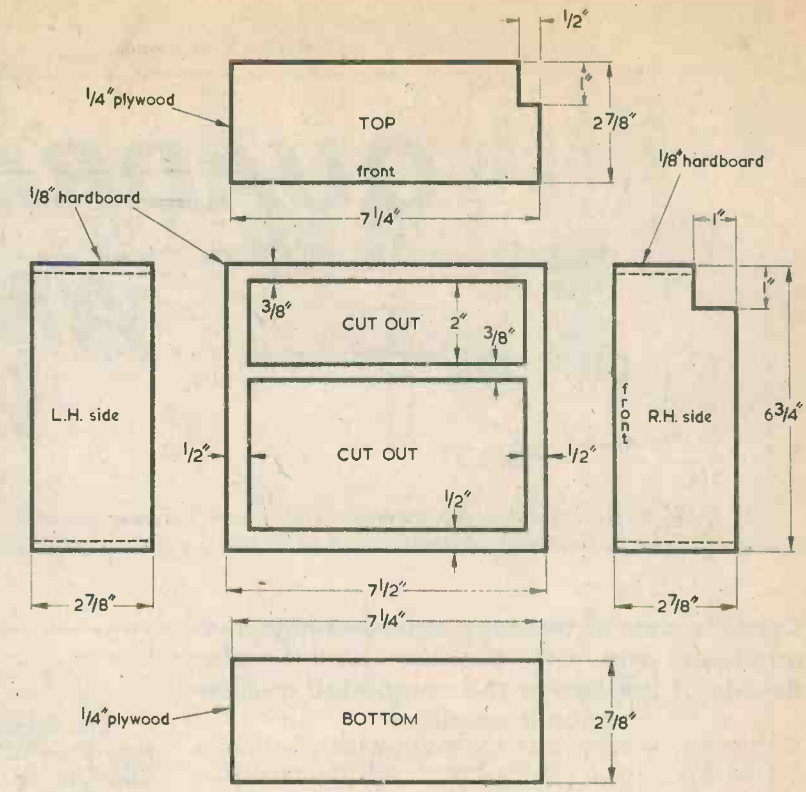


Fig. 6. Details of the case. The dimensions shown are tentative and the actual dimensions employed should suit the particular receiver assembly constructed.

then screwed to the top and bottom. Note the opening at back right for the telescopic aerial bracket and clip. The case is covered with Fablon of the same type as that already applied to the speaker panel. A rectangular white card with suitable holes may be passed over the spindles and marked up with control functions and a tuning scale. The flange of the tuning drive has two 8BA tapped holes, by means of which a tuning cursor can be attached.

A piece of metal speaker gauze is dropped into place behind the lower front aperture and the receiver is then pushed in from the rear.

The case back consists of a piece of $\frac{1}{8}$in. pegboard and, working to the dimensions in Fig. 6, measures $6\frac{1}{4}$ by $7\frac{1}{4}$in. Again, these dimensions may be modified slightly as required in practice. The two woodscrews shown in Fig. 3 as "to be fitted later" are now screwed into position such that their heads are $\frac{1}{8}$in. inside the open rear of the case. These ensure that the back will fit in flush at the top. The rear edge of the battery platform should ensure that the back fits flush at the bottom. The back is held in place by two small solder tags screwed to the case top rear and a further tag screwed to the case bottom rear. These are swivelled to press against the pegboard.

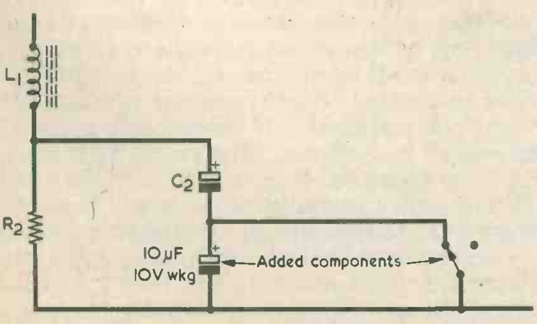


Fig. 7. A modification which offers bass cut when the added switch is opened. This improves reproduction of weak signals on the long wave band.

BASS RESPONSE

Because of its very high selectivity, the receiver may cause attenuation of the higher audio frequencies when listening to distant long wave stations with the reaction well advanced. This can result in an apparent excess of bass when speech is being reproduced.

Constructors who anticipate listening to such stations can, if they desire, add a bass cut control. The modification required is very simple and is illustrated in Fig. 7. The negative lead of C2 is disconnected from its tag and a 10μF electrolytic capacitor inserted between that lead and the tag from which it has been disconnected. The positive lead of the 10μF capacitor connects to the negative lead of C2. A small toggle switch short-circuts the 10μF capacitor when it is not required and this can be fitted to the back of the receiver close to the added capacitor, being wired to the appropriate tag with a stiff wire. The mounting nut of the switch is unscrewed when the back of the case is removed. Other means of mounting the switch can also be devised.

With the switch open, bass cut takes place due to negative feedback. With the switch closed, full bass is reproduced.

(Concluded)

SIMPLE QUADRAPHONIC AMPLIFIER

Part 3

(Conclusion)

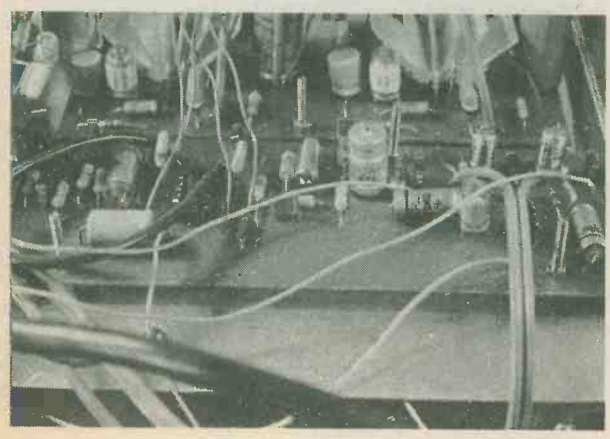
By R. A. Penfold

Construction of the magnetic cartridge pre-amplifier and SQ decoder circuit, plus details of the use of the completed quadraphonic amplifier.

In the previous two articles we described the construction of the power supply section of the amplifier, then carried on to the power amplifiers and a description of the magnetic cartridge pre-amplifier and SQ decoder circuits. In this concluding article we proceed next to the construction of the board on which are assembled the pre-amplifier and decoder components.

PRE-AMPLIFIER AND DECODER

A single printed circuit board measuring $6\frac{1}{2}$ by $2\frac{1}{2}$in. holds both the pre-amplifier and decoder circuitry. A full size diagram showing the copper pattern and component layout of this board appears in Fig. 10. This is constructed in the usual fashion. The holes in the board for the MC1312PQ decoder i.c. have the spacing applicable to a quad-in-line package. Should a constructor wish to fit an MC1312P, the hole positioning may be modified for dual-in-line pins. Pin numbering is the same for both versions of the device.



Internal view giving a close-up of the magnetic cartridge pre-amplifier and SQ decoder board

The board is mounted in the same way as the previous two boards, and is positioned on the underside of the chassis as close to the power amplifier board as possible, with IC2 towards the rear of the case. This positioning puts the decoder components well away from T1, and results in a low level of mains hum pick-up. As with the other boards, the present board is mounted by M3 (or 6BA) bolts and nuts, and it takes up its chassis connection by way of the metal spacers on these bolts. The board is not finally mounted until all the external connections to it have been completed.

The outputs from the decoder to the C7 capacitators on VR1 are at low impedance and do not need to be screened. Make sure that these outputs connect to the correct channels and that each of the four outputs carries through to the appropriate speaker socket.

The two C22 capacitors are mounted at SK3 and do not appear on the board. Two screened leads connect the magnetic cartridge inputs to the board, the braiding being connected to chassis at the appropriate points on the boards. The braiding is connected to the earthy contact or contacts of SK3 but, to avoid hum loops, should not connect to chassis at this point on the rear panel. This should raise no problems if a DIN socket is employed. However, with a double phono socket, as was used in the prototype, it is necessary to insulate the earthy metal part of the socket from the rear panel. This can be achieved by means of p.v.c. insulating tape.

The two output leads from the pre-amplifier to S3 are not screened. All the remaining wiring to this switch is screened. The leads from SK1 and SK2 have their braiding earthed to chassis at these sockets, and the braiding is also connected to chassis at the switch end. This chassis connection is to a solder tag secured under the adjacent nut holding the front panel and chassis together. (The resistors R6 are already connected to this tag.) The screened wires from S3 arms to the RT and LT inputs of the decoder on the board also have their braiding connected to chassis at this solder tag. There is no connection to their braiding at the board end.

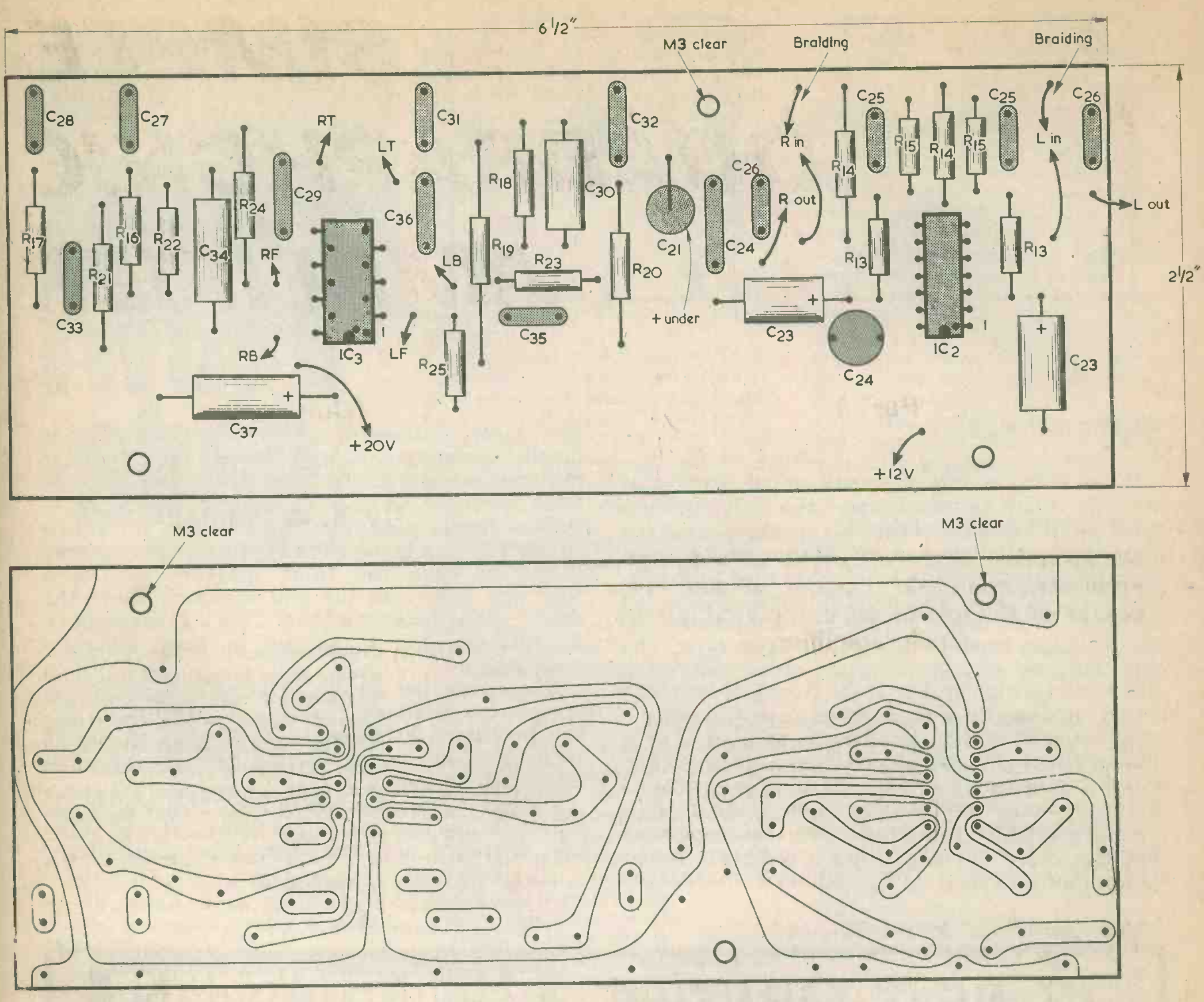


Fig. 10. Illustrating the layout of components and the copper pattern on the pre-amplifier and SQ decoder board

Fig. 11 shows the connections to S3 as seen from the rear. Before making the connections, check the three outer tags which correspond to the centre tag of each pole. With some rotary switches the relative positioning may differ from that shown in the diagram. It will be noted that S3 is a 4-pole 3-way switch with two of the poles unused.

The only two remaining leads to the board are those which carry the 12 volt and 20 volt supplies from the power supply section. These pass over the chassis edge at the mains transformer end. Take great care to ensure that these leads are correctly connected and are not accidentally transposed, as the maximum supply voltage rating for the MC1339P is only 16 volts.

After a final check of the wiring the amplifier is finished and ready for use.

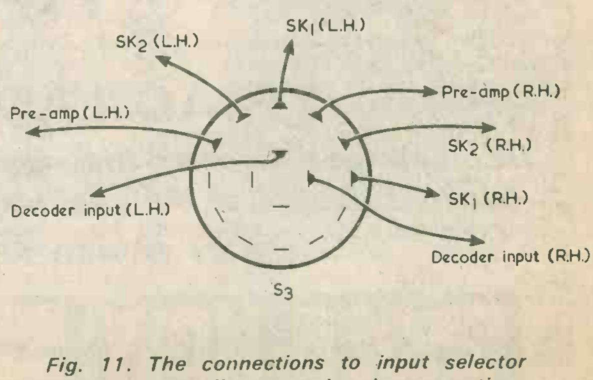


Fig. 11. The connections to input selector switch S3. Details concerning the connections to screened wire braiding are given in the text

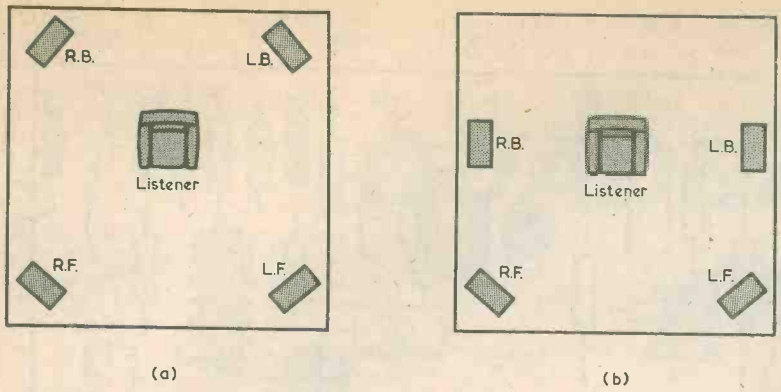


Fig. 12(a). The classic speaker arrangement for a quadraphonic system (b). An effective alternative arrangement for the speakers

NOTES ON USE

When using simple surround sound systems of the type which employ synthesisers only, and not decoders, the quality of the rear speakers is not too important, and they can be inferior to the front speakers without significantly detracting from performance. With a true quadraphonic system, on the other hand, this is not the case and ideally the four speakers should all be of the same type. The quadraphonic system will work quite well using different types of speaker at the front and rear, but it will not then be giving optimum performance.

Any type of matrix decoder can be used to synthesise a four channel output from a stereo source of two channels only, and the SQ decoder employed in the present amplifier has been found to give quite an effective performance in this respect. If the user of the amplifier prefers to have a stereo source reproduced in a two channel format rather than have synthesised four channel sound, it is merely necessary to operate S2 so that the two rear channels are muted. The result is perfectly acceptable stereo sound from the front speakers.

The classic placing of the speakers for a four channel system is shown in Fig 12(a). Many people prefer to have the front speakers positioned relatively low, with the rear speakers above the height of the listener's head. This arrangement is, also, fairly easy to set up in most domestic situations.

There are other speaker arrangements which can provide good results, and it is worthwhile experimenting a little here to see if a set-up suiting both the room layout and the listener's personal tastes can be found.

The arrangement shown in Fig. 12(b) is often used, and is one that the author considers very effective. There are, of course, many other possibilities.

(Concluded)

In your workshop

As is their custom every August, Dick and Smithy leave the confines of the Workshop to take a day out together. On this occasion they choose to drive out into the country, well away from the bustle and hurry of their normal urban life.

"Ye gods," called out Dick in alarm, "you aren't going to overtake *that*, are you?"

"Of course I am," replied Smithy confidently, "hang on to your seat."

Ahead of them in the bright August sun raced an enormous articulated lorry, carrying on its back a large mobile crane secured with a network of cables and chains. The entire equipage rattled and clattered deafeningly and the crane swayed ominously from side to side as the lorry scorched along.

Smithy pressed resolutely on the accelerator. Looking out of the window a quaking Dick watched the manifestly superfluous legend "Long Vehicle" gradually draw past. He closed his eyes, and attempted to close his ears to the clamorous metallic clangour which was now inching back alongside them. Eventually the sound was behind them and Dick blinked briefly. They had passed the mobile crane but still had what appeared to Dick to be several cricket pitches of articulated lorry to overhaul. Dick gave a furtive side glance at the Serviceman. Smithy was crouched over the wheel with the grim determination of the driver who is going to get in front if it kills him which, given the odd loose nut in the steering system, it could one day very well do.

Eventually they were alongside the driving cab of the immense speeding vehicle. Smithy gave a last spurt and they were then, at last, clear of the multi-wheeled monster. With a smile of satisfaction Smithy continued for a safe distance then crept back into his previous lane.

DAY OUT

"What about that, then," he stated proudly. "That's just about made my day."

"It's ruined mine," retorted Dick aggrievedly. "I've secreted so much adrenalin it will take me ages to get back to normal again. I can never understand what gets into you, Smithy, when you get on to a motorway. You change from an easy-going quiet sort of a bloke into a fiend incarnate."

"Nonsense," snorted Smithy. "Here am I, taking you out for a day in the country away from the Workshop, and all you do is complain. Anyway, we're getting near the turn-off point."

"Thank goodness for that!"

Smithy reduced speed and then steered away from the motorway. It was not long before they were driving, much more sedately, along a road more reminiscent of G. K. Chesterton's rolling English drunkard than the soulless soaring strip of six-segment cement stretching from nowhere to nowhere along which they had previously been hurtling.

Dick sighed contentedly.

"This is more like it," he said happily. "A complete break from radio and electronics. Hey, how about putting the radio on?"

"I thought we were having a break from radio."

"Ah, but this time we'll just be listening to it."

Obligingly, Smithy extended his left hand and turned on the little medium and long wave car radio fitted under the dashboard. He selected Radio 2 on long waves and the strains of a light classical melody became audible from the speaker.

The car drove over a bump and the music stopped.

Smithy frowned and adjusted the controls of the radio. It was completely silent, not only on long waves but also on the medium wave band as well. Irritably, Smithy switched it off.

Shortly afterwards he turned off unexpectedly down a narrow deserted side road. They were now well out into the country and he eventually found a space where he could pull off from the road. Smithy favoured large cars, and this fact often made it difficult to find suitable parking places. He slowed down and stopped the car, positioning it close to, and parallel with, a gate behind which was a big empty field.

"What," enquired Dick, "is all this about?"

"It's that darned radio," replied Smithy. "I want to see why it stopped working."

"You've got to be joking," expostulated Dick incredulously. "You've only just now said that we're supposed to be getting away from radio. Dash it all, it's our annual day out together and now you want to waste it fixing radios."

"I can't help it," replied Smithy irritably. "It's just that I can't drive along knowing there's something wrong with that set. I like everything around me to be fully serviceable."

"A fine outing this is going to be," grumbled Dick. "What are you going to use for a meter?"

"I'm going to see if there are any obvious faults."

"Perhaps it's got a fuse that's blown."

Smithy switched on the set again. The bulb illuminating its tuning scale lit up but there was no other sign of life.

"If the fuse had gone," stated Smithy, "that bulb wouldn't light up."

"How do you know that?" persisted Dick. "That bulb could be wired across the supply lines before the fuse."

Vexedly, Smithy plunged his hand into the glove compartment and produced a number of papers. He glanced through these, extracted one and returned the rest to the compartment.

"This is the service manual for the set," he announced. "I keep it in the car because that seems to me to be the most obvious place to have it. If you look at the circuit you'll see what I mean about the fuse and the bulb."

Dick opened the manual and studied the circuit for a short while, after which he concentrated on the supply input section. (Fig. 1)

"Well, you're right about the lamp being after the fuse," he conceded, "and I'll agree with you that the fuse can't be blown. This circuit is rather interesting, though. For a start there are no fewer than three chokes after the fuse before you even get to the on-off switch."

"Those chokes are needed to prevent noise from the car electrics getting into the set. As you can see, there are two 0.1 μF capacitors providing decoupling to the receiver chassis."

"That's funny," remarked Dick. "I'd have thought you'd have needed a nice fat electrolytic there."

"A capacitance of 0.1 μF is enough to kill off most r.f. noise," replied Smithy, "and you couldn't have electrolytics in that part of the circuit anyway because the 12 volt input could be either positive or negative, depending upon whether the car has a negative or positive

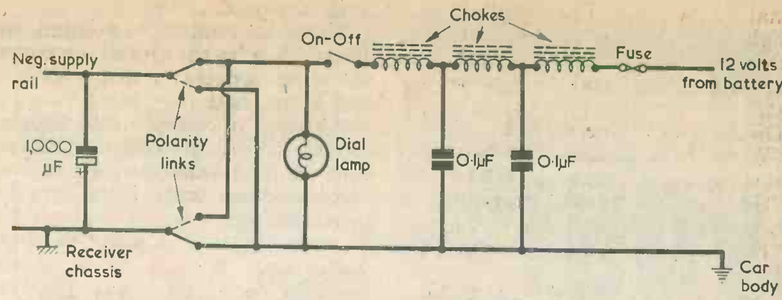


Fig. 1. The power supply circuit of Smithy's car radio. The polarity links are set up to cater for positive or negative earth. The receiver has a negative upper supply rail

earth. Immediately after the on-off switch are the tuning scale lamp and the polarity selection links. You set the links up to suit the car the radio is installed in."

CLASS A OUTPUT

"Oh, I see," stated Dick. "Ah, it's *after* the polarity links that we get the electrolytic. There's a nice big 1,000µF one connected across the supply rails."

Dick beamed at the capacitor symbol in the circuit. Smithy looked round at him.

"You're really happy about finding that electrolytic, aren't you?"

"I am," responded Dick. "No radio supply circuit should be without one!"

He turned to the a.f and output stages of the receiver. (Fig. 2)

"Hey," he said, "this a.f. section is a bit unusual, isn't it? The first transistor is transformer coupled to the output transistor, and the output transistor is transformer coupled to the speaker. Most transistor output stages these days don't use transformers at all, you just have two output emitter followers, one above the other, with the emitters coupling to the speaker."

"This set of mine," confessed Smithy, "is not quite as recent as all that, as you can tell by the fact that the a.f. transistors are germanium types. But a.f. transformers still keep cropping up in a surprising number of fairly recent ordinary transistor radios, appearing between the driver transistor and the two Class B output transistors."

"There's only one output transistor here."

"I know," retorted Smithy. "It's operating in Class A. It draws a standing collector current under no-signal conditions and this current increases or decreases in sympathy with the signal when a

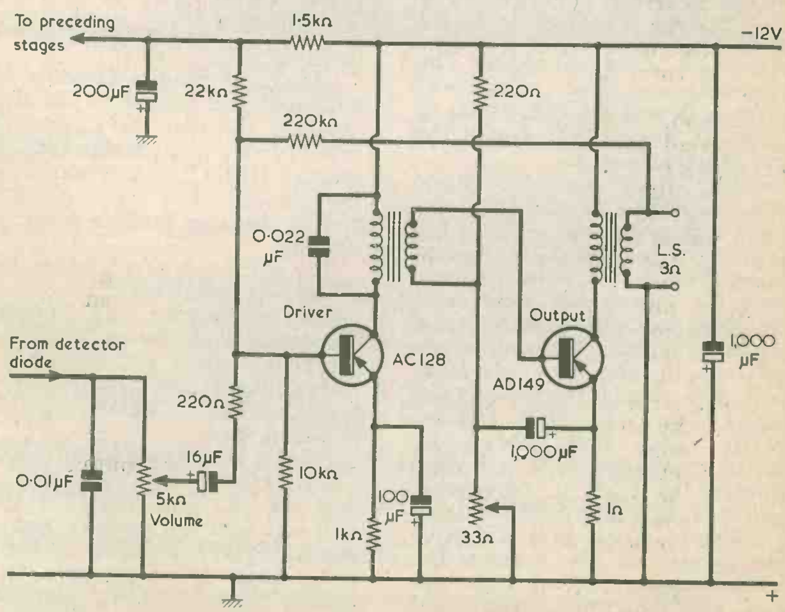


Fig. 2. The a.f. stages of the receiver comprise a driver and an output transistor functioning in Class A. The 1,000µF capacitor across the supply rails is the same component as that which appears in Fig. 1

signal is applied. The result is a delightfully simple output circuit with no problems at all about cross-over distortion and things like that."

Dick gazed at the circuit.

"What," he enquired, "would that standing collector current be?"

"Oh," replied Smithy carelessly, "about half an amp."

"Half an amp? You're having me on!"

"No, I'm not. This is a car radio drawing current from a car battery, and to a car battery half an amp is a mere drop in the ocean. The current is set up by adjusting the 33 Ω pre-set. Despite the fact that the amplifier has two transformers in it the circuit still gives quite good quality. You will note that there's negative feedback from the secondary of the second transformer back to the base of the driver transistor via a 220k Ω resistor."

But Dick's attention had now wandered to another section of the receiver circuit.

"Here, this is crazy," he remarked. "There's no tuning capacitor in the mixer-oscillator stage at all!"

Smithy glanced at the r.f. and oscillator stage in the circuit of the receiver.

"There won't be a tuning capacitor," he stated. "Most car radios use permeability tuning instead. They are tuned by having iron-dust cores going in and out of the aerial and oscillator coils."

"Why's that, Smithy?"

"Mainly because car radios have to withstand a lot of vibration and bumping around, and a permeability tuning assembly is more robust mechanically than is a tuning capacitor. The usual idea is to have the tuning spindle coupled to a coarsely threaded rod on which is affixed a carriage for the iron-dust cores. As the threaded rod rotates the carriage moves along it and the iron-dust cores go in or out of the coils."

"Humph," commented Dick as he digested this information. He was struck by a sudden inspiration. "I've just thought about something! If variable capacitors aren't robust enough for car radios, why not use varicap diodes instead?"

"Why not, indeed? Varicap diodes having a capacitance swing wide enough to tune the medium and long wave bands have been available for several years now, and they are the obvious choice for tuning car radios. We haven't had any very recent car radios in for servicing at the Workshop, but it could well be that the latest versions are already incorporating varicap diodes."

An expression of bewilderment spread over Smithy's face, and he looked at the pastoral scene around him.

"What in the world am I doing, talking about the Workshop?" he said bemusedly.

"You started it," pointed out Dick. "You're the one who wants to do radio repairs in the middle of the countryside."

"Ah yes, of course," said Smithy. "Well, I'll just get this car radio out and see if I can see anything obviously wrong with it."

He got out of the car, opened the boot and selected a small spanner. Returning, he got back in the driver's seat and proceeded to fumble under the dashboard. Dick opened his door and got out of the car to allow the Serviceman more room.

A VISITOR

Dick stood and leaned against the gate, savouring the fresh rural air. Looking down the road he espied a small figure walking towards them. As it approached, the figure revealed itself to be a little boy. As the distance between them decreased, Dick was able to observe him with greater resolution and he noted that he appeared to be a singularly dirty little boy. When the boy was very close to him Dick revised his opinion: the boy was an unbelievably dirty little boy. The little boy stopped at the car and gazed inside with interest. A rich country smell, redolent of the Augean stables, wafted across the top of the car.

"What yer doing there?" said the little boy.

Surprised, Smithy looked up then sniffed unconsciously.

"Why, who are you?"

"I live here. What yer doing there?"

"If you must know," said Smithy with some asperity, "I'm trying to get this radio going."

By now he had removed the set from under the dashboard and had it resting on his lap. The back of the radio was towards the boy, who looked at it keenly.

"There's a wire off," he pronounced.

"Now, be a good boy," stated Smithy patronisingly, "and run along."

He sniffed again, then grimaced.

"Funny," he remarked. "That smell wasn't here before."

"It's me," remarked the boy proudly. "When I've been helping with mucking-out, I pong something vile. I'm famous for it; I'm the strongest ponger in these here parts."

"No doubt that's very creditable," said Smithy hastily. "But please go away. I want to see what's wrong with this set."

"There's a wire off," repeated the boy.

He leaned in and pointed a black-nailed finger at the back of the radio. Smithy recoiled and glanced, whilst attempting to cease breathing, at the radio. A wire was indeed off.

"Well, well, well," said Smithy with attempted joviality. "You have now found for me what was wrong."

"If I was running a shop and you brought in that set," said the little boy, "I'd have charged you a quid for finding that loose wire."

"Perhaps so," remarked Smithy. "But seeing as how we're out in the open, like, I reckon 50p would be all right."

Resignedly, Smithy reached into a pocket and produced a 10 pence piece.

"50p."

The boy came closer to Smithy, who blenched visibly. Furiously, he reached into his pocket again, this time to produce a 50 pence piece. Shuddering, he dropped it into the little boy's filthy outstretched hand.

"Ta, skip," said the boy. "I've really *saved* you 50p, you know. If you'd taken that set to someone who knows how to mend radios he'd have charged you a quid."

The boy circled round the car and approached Dick, who retreated rapidly. The boy unfastened the clasp of the gate and opened it wide, pushing it into the field.

"You and your grand-dad," he said, "had better get moving soon."

With which remark he left the pair and proceeded leisurely up the road. The air gradually cleared and Dick and Smithy breathed deeply.

"I'll have to get the car fumigated," complained Smithy. "What did he say to you?"

"He said that me and my grand-dad should get moving soon."

"Cheeky little devil. Do you know, he spotted the fault on this set and made me give him 50 pence for doing so?"

"And you paid him?"

"I had to. It was either that or asphyxiation."

"Well," said Dick, "we won't see him again. Did he truly find the fault?"

"Yes, truly," confessed Smith ruefully. "That output transistor is a T03 type and it's bolted to the back of the set chassis, which acts as a heat sink. Also, it's insulated from the chassis by a mica insulating washer. A wire comes through a hole alongside and connects to the collector, which is of course the transistor case, by way of a solder tag held under one of the insulating bushes. As that horrible little boy noticed, that wire had broken away from the tag." (Fig. 3.)

Dick examined the broken wire and the tag.

"Blimey," he remarked, "you certainly had an obvious fault there. But you still can't fix it. Not unless you've got a 12 volt soldering iron."

"I haven't," admitted Smithy, "but I can still make a temporary

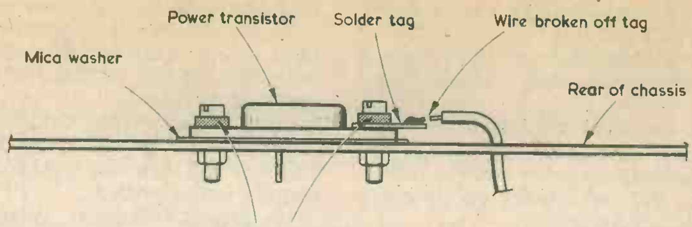


Fig. 3. The output transistor in the radio is mounted, with mica washer and insulating bushes, to the rear of the chassis, which functions as a heat sink. A lead to a solder tag in contact with the transistor case had broken off at the solder tag.

repair. All I need to do is to strip off a bit of the insulation at the end of the wire and trap it between the solder tag and the transistor case."

A. F. STAGES

Deftly, Smithy proceeded to carry out the temporary repair, after which he returned the radio to its position under the dashboard. He switched on, and a pleased expression spread over his face as the radio once more operated correctly. He checked both wavebands then switched off again.

"Phew," he said, pulling out a handkerchief and mopping his brow. "It's hot working in here. I'll cool off a bit before we get going."

He got out and leaned against the bonnet of the car, leaving the driver's door open. The front passenger door was also open and Dick was now leaning on the bonnet as well.

"I think," said Smithy, "it would be a good idea to leave the two rear doors open as well. I fancy I can still smell that stinking little kid, so we'll give the car a complete airing."

Dick and Smithy opened the rear doors wide then returned to the bonnet. Smithy noticed that Dick had the service manual in his hand.

"Oh no," he groaned, "don't tell me that you're going to start on about the circuit of that set again."

"It's just the permeability tuning bit," said Dick. "When you're used to r.f. stages with tuning capacitors, it throws you a bit when you bump into something which is so entirely different."

"Permeability r.f. tuning circuits can be a little difficult to understand," admitted Smithy. "Let's have a look at this one and see if we can sort it out."

Dick walked round to Smithy's side of the car and laid out the service sheet circuit on the bonnet. He pointed to the aerial and mixer-oscillator section of the receiver circuit. (Fig. 4.)

"Ah yes," said Smithy. "Well, this is fairly straightforward once you start digging into it. L2 and L4 are the permeability tuned coils and their inductance is altered as the tuning control is adjusted. L3 and L5 are coils with pre-set iron-dust cores. The easiest part of the circuit is the oscillator section and the coils for this are L4 and L5."

Smithy traced out the oscillator connections. (Fig. 5(a).)

"Positive feedback," he went on, "is from the collector of the mixer-oscillator back to its emitter, the feedback path being via part of the first i.f. transformer primary, R6 and C10. Don't forget that the collector and emitter of a transistor are in phase, and so there's no need to introduce phase reversal as would be needed if the feedback was from the collector back to the base."

"When the wavechange switch is set to medium waves," broke in Dick quickly, "it short-circuits L5. Presumably, then, the frequency of oscillation is governed by L4, C8 and C9."

"That's right," agreed Smithy. "C9 is the oscillator trimmer for medium waves. The circuit is unusual by normal standards but it obviously works. When the wavechange switch is set to long waves, L5 is inserted in series with the medium wave tuned circuit. The added inductance then lowers oscillator frequency to the range required for long wave coverage."

"That seems to be fair enough," commented Dick slowly. "Now, what about the signal frequency part?" (Fig. 5(b).)

"That," stated Smithy, "is more complex, but only because we're used to the more simple circuits involved with tuning capacitors. On medium waves, the aerial signal is applied via C2 to C1 and C3 in parallel. C3 is the medium wave aerial trimmer. This is a form of bottom-end coupling in which the aerial is applied to a tap in the capacitive part of the tuned circuit

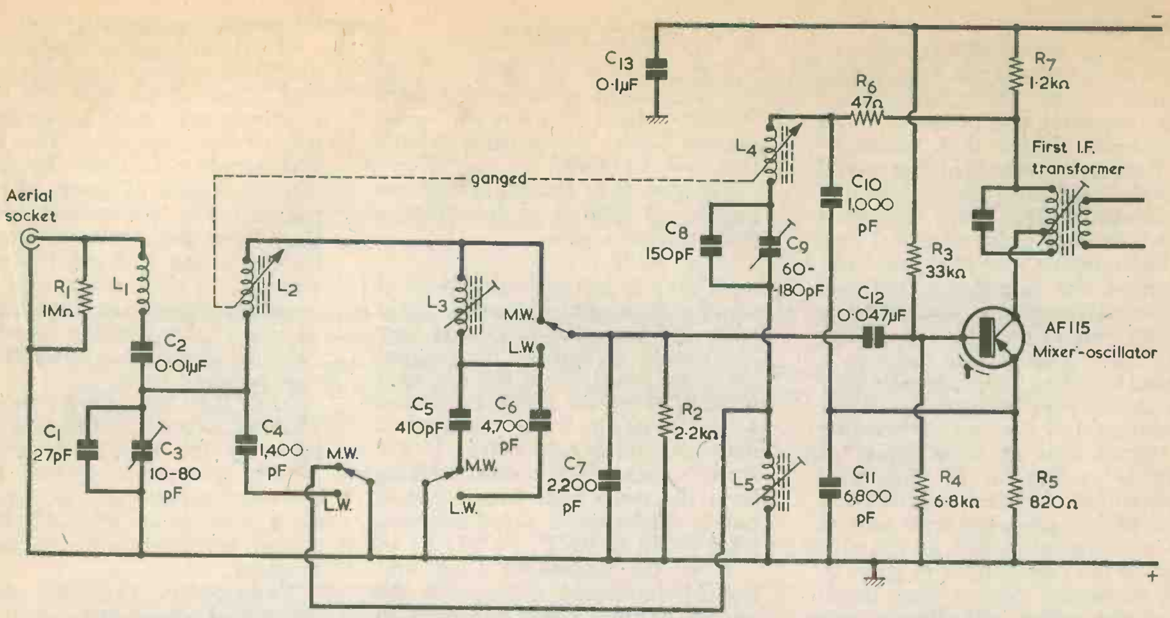


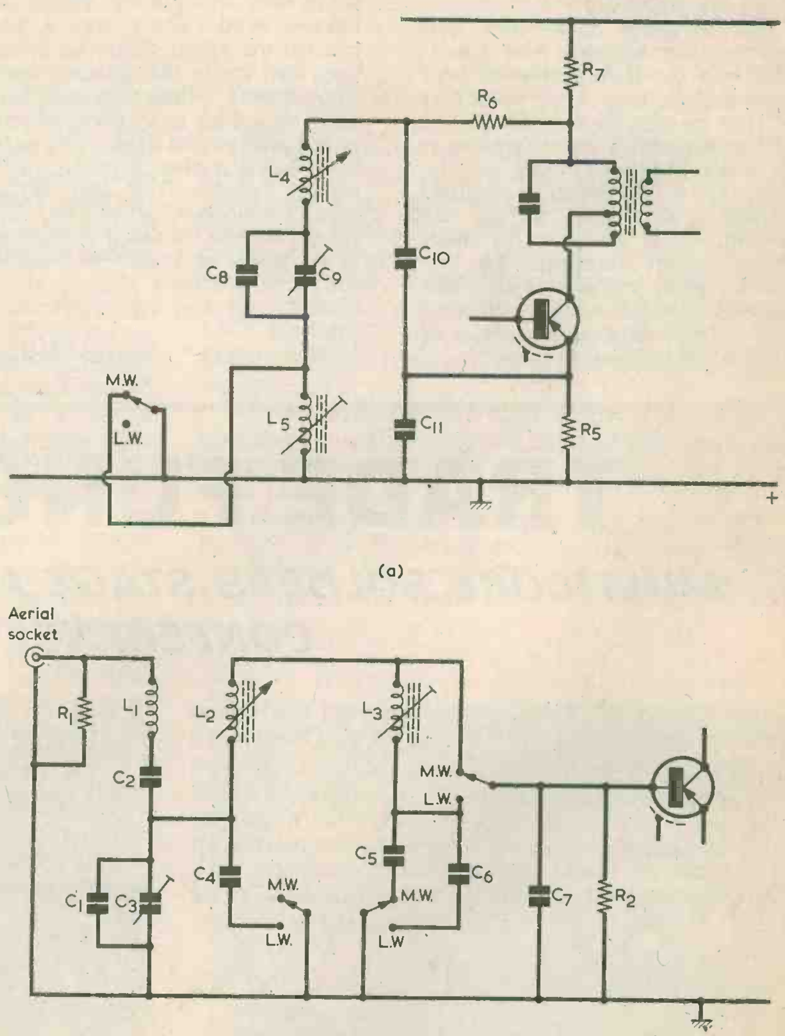
Fig. 4. The signal frequency and oscillator circuits of the radio. L2 and L4 are permeability tuned. This, and the circuits of Figs. 1 and 2, are slightly simplified versions of the circuits employed in the Pye model 2040 car radio. The three switches are sections of the medium-long wavechange switch.

instead of to a tap in the inductance part. The overall resonant frequency on medium waves is governed by the inductances of L2 and L3, the capacitors C1, C3, C5 and C7, and the capacitance of the aerial to earth, which is the car body of course, together with the self-capacitance of the screened aerial feeder wire. The aerial to earth capacitance has quite a significant effect, especially at the high frequency end of the medium wave band. Admittedly, it's odd to find two inductors in a frequency selective circuit, but there's no reason why there shouldn't be. We think nothing of having two or more capacitors in such a circuit."

"What happens," queried Dick, "when we go to long waves?"

"Well," said Smithy, "one thing that happens is that C4 is connected in parallel with C1 and C3. The next thing is that L3 is connected in series with L2, and the base of the mixer-oscillator transistor is transferred to the other end of L3. Also, C5 is taken out of circuit and replaced by the higher value C6. All these changes bring the resonant frequency down to the range needed for long waves. A complicated circuit, admittedly, but the complications will be due to the necessity for getting good tracking both on medium and on long waves."

A perceptive listener could have heard a very faint bleating from the direction in which the mendicant and malodorous little boy had disappeared. But Dick and Smithy were too preoccupied with the circuit of the car radio to be aware of



(b)

Fig. 5(a). The essential components in the oscillator section of Fig. 4

(b). The signal frequency circuitry. Taking an input for the transistor base from a relatively high value capacitance in the tuned circuit is equivalent to taking a low impedance tap from a coil

the sound.

"You say," stated Dick, "that the aerial to earth capacitance plays an important part, particularly at the high frequency end of the medium wave band. Why is that, Smithy?"

"Because a standard car aerial provides very little signal pick-up," explained Smithy. "You only have about six feet or so of aerial rod, and at medium and long wave frequencies the impedance between the aerial and the car body is almost entirely capacitive. The aerial is coupled to the radio by a special screened cable having a very low capacitance between the centre conductor and the outside braiding to ensure that as little signal as possible is lost in it. The total capacitance between aerial and earth is then assumed to be part of the input tuned circuit. In practice most of the capacitance is given in the screened cable. The usual procedure when installing a new radio in a car is to trim the medium wave tuned circuit to suit the particular aerial and screened lead which are employed."

The bleating noise had now become more distinct. Also discernible was the faint clatter of very many tiny hooves.

"How do you do that, Smithy?"

"You tune in to a weak station at the high frequency end of the medium wave band," replied Smithy, "and then adjust the medium wave trimmer for maximum signal strength. In our receiver that trimmer is C3. The trimmer only has to be readjusted if, at a later date, a new aerial or aerial screened lead is fitted."

STATIC VOLTAGE

"That seems to cover all I want to know about this circuit," commented Dick. "No it isn't! What's that coil, L1, for?"

"It's an r.f. choke. It reduces pick-up of impulsive interference from the car engine."

"And R1?"

"That's to prevent a build-up of static voltage on the aerial. On a very dry day it's surprising how much static voltage can be acquired by a car aerial when the car is in motion. Some car radios even have a little neon bulb connected between aerial and earth. If the static voltage rises to neon striking level the neon bulb turns on and partly discharges it. Good heavens, what's that racket?"

Even the engrossed Dick and Smithy could not now ignore the animal hubbub which impinged on their ears. They turned round and gazed open-mouthed at a vast army of sheep running busily towards them and completely filling the narrow road. There was a purposeful air about them, as though they had made this journey many times before. When they were level with the open gate they wheeled round to enter the field, those in the front being pushed forward by the masses behind. Dick and Smithy found themselves jostled away from the car bonnet by sheep determined to exchange, as quickly as possible, the hard confined surface of the road for the lush open softness of the field.

"The doors," shouted Smithy. "Shut the car doors!"

But it was too late. One sheep had already been forced past the outside rear door of the car, to find a relatively easy entry to the field by way of the other door. This leader was at once followed by a continuous retinue of sheep, all pressing their way behind each other as they crowded through the car. Several sheep had got themselves trapped in the front and were bleating helplessly as they struggled against the unfamiliar hazards of steering wheel, gear lever and the now repaired radio.

And still the sheep came on. Fuming helplessly as he was thrust back by the volume of animals, Smithy groaned in despair at the devastation wrought in his car. Dick gave up the unequal struggle and sat at the roadside, roaring with laughter.

Eventually, the end of the column of sheep came into view. Behind them was the dirty little boy, whistling tunelessly and waving a stick at the stragglers in the rear. Smithy watched with hapless resignation as the last sheep forced its way through the rear of the car. The boy poked at the sheep trapped in the front and these, too, at last made their way out and into the field. The boy followed them, closed the gate and then leaned over it to address the shattered Serviceman.

"Don't blame me, grand-dad. I said you ought to move on."

"But," spluttered Smithy, "what about my car?"

"You was lucky," said the boy. "Last week it was cows I brought into this field." ■

TRADE FUNCTION

MULTICORE SOLDERS STAGE A WORLD SALES CONFERENCE

London Airport's Heathrow Hotel was the venue recently of the first ever World Sales Conference held for overseas Distributors by Multicore Solders Limited. Over 40 delegates representing 30 countries flew in for the two day Conference which included lectures by senior Multicore executives on all aspects of Soldering and Solder products.

Many delegates' wives accompanied their husbands, and guided sightseeing and shopping expeditions were arranged for them during Conference hours.

Other highlights included a gala dinner at the hotel and a tour of the Multicore plant.

The assembled delegates pose for a happy souvenir of the conference

R.S.G.B. at Alexandra Palace

The RSGB International Radio Communication Exhibition and Convention, held at Alexandra Palace, London, was officially opened at noon on Friday, May 6th by Councillor Vic Butler, Mayor of Haringey and closed at 1700 the following Sunday. This ambitious 3 day event was visited by some 6,000 people which fully rewarded both the RSGB and its organiser, John Hitchins.

AROUND THE STANDS

By David Gibson

Pots of gold are commonly found (so we are reliably informed) at the end of rainbows. Fantastic radio and electronics bargains, on the other hand, are found underneath TV transmitting aerials; and without the need for a metal detector! The truth of this can be verified by all who visited the RSGB International Radio Communication Exhibition and Convention.

Bargains were interspersed with the unusual and, often, unexplicable. One dealer offered an oscilloscope with a clockwork mechanism which gave a pulse trace once a minute for eight days! The cost was £15 and the mind boggled. In a more simple vein, Future Scientist transistor radio kits were offered at £1 complete and were seen clutched in the hot little hands of more than a few prospective radio 4 listeners.

The exhibition was certainly a place for opportunists and evidence of their presence was rife. Even the walls of the gents loo bore advertisements for various items on sale. In place of the customary graffiti, one was caught staring at a colour brochure urging the purchase of a Trio TS-700G 2 metre all-mode transceiver. While next to it was an assurance that six TIL 209 LEDs could be had for only 50p if one applied at the "undermentioned stand".

For the constructor, the show was an absolute gold mine. Four-gang 500pF variable capacitors were offered at only 80p, and the Amateur gardener was catered for by one company displaying 240V 1.5A soil heaters for 25p each.

Even eccentrics could find items of interest, such as an enormous moving coil meter with two scales marked in microseconds and thousands of feet. Just the thing for your mantlepiece and cheap at half the price.

Even nostalgia was catered for by the showing of items like EF50 valves and Type 2G barretters not to mention an original Mullard VP4B. Contrasting with these ancient friends were newer brothers in components.

People who went looking for quartz crystals were in luck, many types were on display.

One stand doing continually brisk trade was that of J. Birkett. Dealing in a wide range of components there was a constant stream of money going one way and packages going the other across the counter. Silicon solar cells were on sale, a smile from the sun would encourage them to give 0.5V at up to 5mA. Not a huge power, but three would give 1.5V which is more than enough for a solar powered MW receiver using the popular ZN414 Ferranti IC.

There seemed to be a huge quantity of very large electrolytic capacitors on sale everywhere. Ten thousands microfarads was average, but many were larger!

Exhibitions within exhibitions were also a feature. The Havering and District Club gave a convincing demonstration of 3cm television transmitted live from Ilford. In demand on the

A general view at the exhibition

Tom Hook, talking with other 10 GHz enthusiasts about some of the equipment he has constructed

Havering stand was Tom Hook, who despite being partially blind, manufactures all the plumbing necessary for 10.1GHz and displayed some directional coupler ports, 10GHz wavemeters and other items he's made at home. Anyone wanting to get started on 10GHz but is put off by the plumbing should contact Tom.

Best component bargain spotted on the Garex stand was a pack of resistors (preferred values) from 22Ω to 1MΩ for only £4.50p. Oh yes, there were 10 of each value, too!

New products were also in evidence. Some were so new that you could only look — but not actually purchase! Just such an item was the new Datong active antenna. Connect the receiver to one side, and two pieces of wire each only 2 metres long and you're in business. Ideal for receiving — especially if you want an extremely tiny aerial, the device is broadbanded from below long waves to 30MHz. On the stand, David Tong claimed that even Rugby on 16kHz was received well and the device works just as efficiently at 30MHz. The new active antenna should be available in about three months' time.

Some people break records but one stand marked "Home Test" sold them. One was even able to find "A nightingale sang in Berkely Square" by the Glenn Miller orchestra (number BD 5850) nestling comfortably next to a large heap of G401 transistors offered at only 2p each. At that low price, the transistor bargain must have been a record, too!

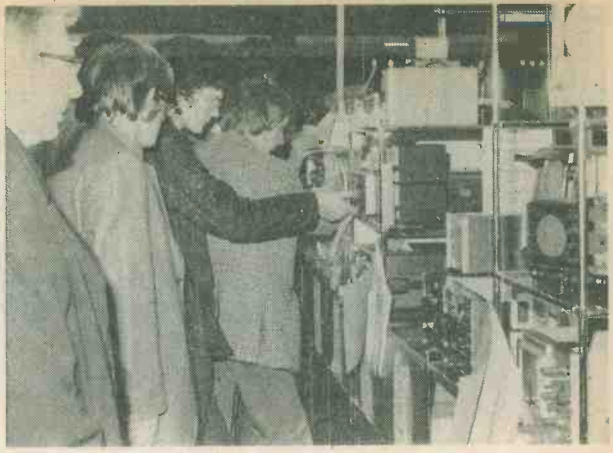
This years' exhibition can claim contrasts if nothing else. In among stands offering the very latest in sophisticated Amateur Radio transceivers was an unnamed stand showing semi-rusty handles at 10p each complete with even more rusty fixing nuts. Also shown was a pile of Stylophone records at 10p each. Now there's variety for you!

One stand owner commented that the "Black Box Boys" were here and this had helped the show. Most noticeable in this area was the number of sophisticated Amateur Stations now offered for sale. The Icom IC-240 for example, is a 22 channel synthesised 144MHz transceiver requiring no crystals. This entirely solid state unit runs from 13.8V and has a 10W power output of FM. Receiver sensitivity is at least 0.4μV and there's an audio output of 1.5W.

Interesting, too, that many units are now appearing with auto-scanning facilities. An example here is the Multi-U11 432MHz transceiver with a scanning speed of 4 channels per second. This unit costs £249 complete with 9 channels and auto tone burst. The receiver has three IFs; 45MHz, 10.7MHz and 455kHz with a receiver sensitivity of 0.5μV. As the man said in Fiddler on the Roof; "If I were a rich man."

For visitors interested in scanning, Modular Electronics showed its FM 10A sequential scanner module. This little unit, ready built and tested, is designed to automatically switch between each of up to 10 channels of a crystal controlled receiver,

The lovely Brenda demonstrates an Icom 144MHz transceiver on the Amateur Radio Exchange stand



Caught in the act — your actual knob-twiddler. One of many who twiddled on the Lowe Electronics stand.

stopping on receipt of a signal for as long as the signal is present.

In one corner was the RAIBC stand. The Radio Amateur Invalid Bedfast Club now has some 1,000 members. Listen for their net on 3.5MHz at 1000hrs Tuesdays, and 1400hrs Wednesdays. If you know of anyone who is bedridden and interested in radio, why not drop the secretary a line at 14 Queen's Drive, Bedford MK41 9QB.

For anyone interested to learn more about some aspect of Amateur Radio, there were many lectures taking place each afternoon. These covered most popular interests such as getting started as an SWL, aerials, synthesisers and phase locked loops — and even one intriguing talk entitled, "Some confessions of a VHF columnist". I wonder if this will appear in paper-back version, "Forty years before the Mast"?

If you missed this years' show, make a note in your diary for next year.

AT THE CONVENTION

By Ron Ham

On Saturday evening, it was praise all the way for the Society as about 180 members and guests listend to the after dinner speakers in the Palace Suite, presided over by Lord Wallace of Coslany, the Society's President.

Mr. R. W. Cannon, Technical Director, Cable and Wireless Ltd., proposing the toast to the Society, referred to amateur radio as one of our national assets, because, by introducing young people to amateur radio it often spurs them on to take up a career in a similar field. The speaker was very impressed with the large exhibition and admired the way in which the "trade" had produced some very technical equipment at prices which most amateurs could afford. The RSGB, he said, shaped the amateur effort in the same way that the technical institutes helped the professional engineers.

Replying, Dr John Allaway, Immediate Past President, mentioned the many countries where Cable and Wireless staff had used their own amateur stations to keep in touch with the UK, and he took this opportunity to thank Cable and Wireless for supplying the monthly HF Predictions table which appears in *Radio Commication*. Dr. Allaway stressed the need for the RSGB to work with other national societies in persuading new countries to accept amateur radio. Among the dinner guests were representatives from France, Belgium, Yugoslavia, and USA and they all joined in the spontaneous applause when Dr. Allaway congratulated Lord Wallace on his appointment as first Lord in waiting to Her Majesty the Queen.

Proposing the toast to the Guests, Dr. Dain Evans, Executive Vice-President, spoke of the many sides to amateur radio and referred to Ed Tilton, who had given a lecture in the afternoon, as "a legend in amateur radio".

Replying for the Guests, Dr. J. A. Saxton, Director, Appleton Laboratory, and past President of the Society, emphasised his well worn theme that every amateur in the UK should give his wholehearted support to the RSGB. It was obvious, he said, that this event had been well supported, and he congratulated all who were responsible for its organisation.

BACK NUMBERS

For the benefit of new readers we would draw attention to our back number service.

We retain past issues for a period of two years and we can, occasionally, supply copies more than two years old. The cost is 40p plus 12p postage.

Before undertaking any constructional project described in a back issue, it must be borne in mind that components readily available at the time of publication may no longer be so.

We regret that we are unable to supply photo copies of articles where an issue is not available. Libraries and members of local radio clubs can often be very helpful where an issue is not available for sale.

'NOTES FOR NEWCOMERS'

COLLECTOR SPECIFICATIONS

By F. T. Jones

How to ensure that small transistors are operated within their collector voltage, current and dissipation ratings.

Bipolar transistors are liable to break down if their voltage, current and wattage dissipation ratings are exceeded. With small transistors (as opposed to large power transistors which are designed to be mounted on a heat sink) it is, fortunately, a simple matter to ensure that these ratings are not exceeded. A general procedure will be described here.

VOLTAGE RATINGS

The maximum collector voltage rating for a transistor is usually specified in terms of Vceo max. and Vcbo max. Vceo refers to collector-emitter voltage with the base open-circuit whilst Vcbo applies to collector-base voltage with the emitter open-circuit. Sometimes the voltages are simply referred to in transistor data as Vce and Vcb respectively. Where there is a difference between the two voltage ratings the Vcbo (or Vcb) figure is usually higher than the Vceo (or Vce) value. Neither figure should be exceeded, and in general it is a good plan to ensure that a transistor does not approach more than say, 75% of its maximum voltage rating. In most instances a transistor is employed in the common emitter configuration, as in Fig. 1(a), whereupon the supply voltage should preferably be lower than 75% of the Vceo or Vcbo figure. With most practical circuits the supply voltage will be considerably below the maximum collector voltage rating.

The transistor of Fig. 1(a) will in many cases be passing a steady collector current, whereupon the actual voltage across its collector and emitter will be the supply voltage less the voltage dropped in the collector load resistor. Such a state of affairs should not tempt the designer into employing a supply voltage higher than the maximum rated voltage for the transistor unless circuit requirements make this absolutely unavoidable; accidents can happen and a sudden large input signal, a faulty connection or the onset of instability can cause the transistor to be cut off, whereupon no voltage is dropped across the collector load and the full supply voltage is applied across the transistor. With all transistor ratings it is wise to anticipate the worst-case effect.

We do not normally, of course, choose a supply voltage to suit a particular transistor. Instead, the supply voltage is usually given and we select a transistor to suit that voltage. With most home-constructor projects the supply is limited to about 9 to 18 volts or so, with the result that the choice of a transistor with an adequate collector voltage rating raises few problems.

A different aspect arises when the collector load is not resistive but has a relatively high value of inductance. The most common example here occurs when the collector load is the coil of a relay. When the transistor cuts off to release the relay the lines of magnetic force in the relay coil collapse, to generate a back-e.m.f. of opposite polarity which can be much greater than the supply voltage. In the circuit shown in Fig. 1(b) the collector voltage of the transistor would go well positive of the positive supply rail. We overcome this problem by connecting a diode across the relay coil, as in Fig. 1(c), with a polarity which causes it to be non-conductive when the transistor is turned on and energises the relay. When the transistor cuts off the relay coil attempts to produce its high back-e.m.f., but the diode then conducts and prevents the e.m.f. rising above the diode forward conducting voltage.

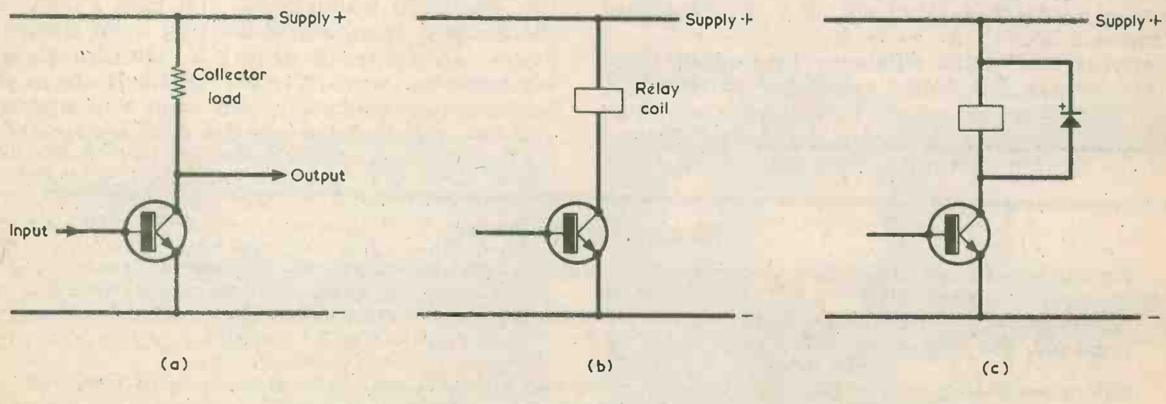


Fig. 1(a). A simple common emitter amplifier with bias components omitted. An n.p.n. transistor is assumed here and in the succeeding diagrams
(b). In this circuit the collector load is a relay coil
(c). A diode across the relay coil prevents the formation of a high back-e.m.f. when the relay releases

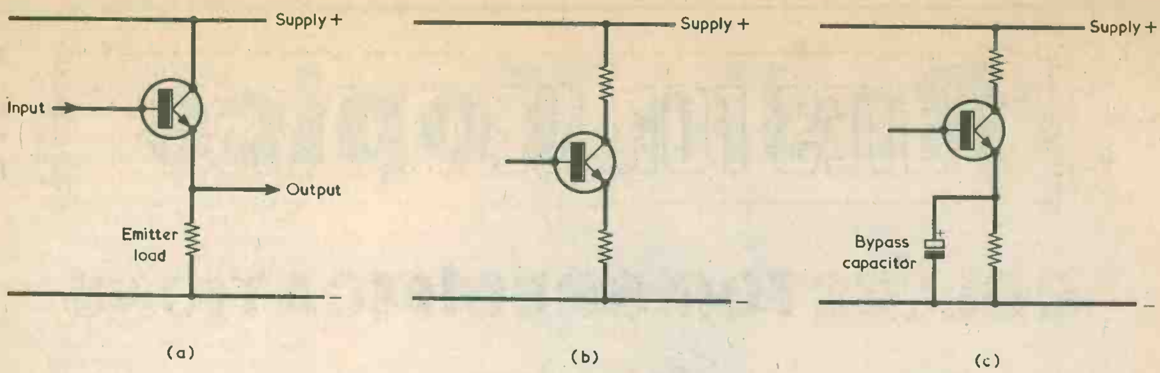


Fig. 2(a). With an emitter follower the resistive load is in series with the emitter (b). Here there are resistors in both the collector and emitter circuits (c). Frequently, a high value bypass capacitor is connected across one of the resistors

COLLECTOR CURRENT

The maximum collector current rating for a transistor is normally expressed as Ic max. There is another term, Icbo, which applies to collector-base current when the emitter is open-circuit. This is not a limiting rating and merely defines the collector-base leakage current.

A circuit should always be designed so that the transistor maximum collector current rating cannot be exceeded for any foreseeable circuit condition. In Fig. 1(a) the maximum collector current which can flow is given when the transistor is turned hard on, whereupon the highest possible voltage appears across the collector load resistance. A little exercise in Ohm's Law soon settles the situation here, and we assume that there is zero voltage across the transistor when it is hard on. If, for example, the supply voltage is 10 volts and the load resistance is 100 Ω the maximum collector current which can flow is 0.1A (10 divided by 100) or 100mA. We would select a transistor with a maximum collector current rating of at least 150mA, and preferably 200mA or more, for use in such a circuit. Happily, most collector load resistance values are much higher than 100 Ω and transistors can be employed more than comfortably within their maximum collector current ratings. A minor exception here is given by such items as a.f. output transistors. It would be in order to take these up to, but not beyond, the maximum current rating during part of the a.f. cycles they handle.

If the transistor is an emitter follower, as in Fig. 2(a), we say that the emitter current is the same as the collector current. We then treat the value of the emitter load resistor in the same way as we did with the collector load resistor. Should there be resistive loads in both the collector and emitter circuits, as in Fig. 2(b), we add their values and treat the result as a single collector (or emitter) resistor. When there is a high value bypass capacitor across one of the resistors, as in Fig. 2(c), it is advisable to assume that this will be discharged and act as a short-circuit at the instant of switch-on. The collector current is then limited, at that instant, only by the resistor which does not have the capacitor across it.

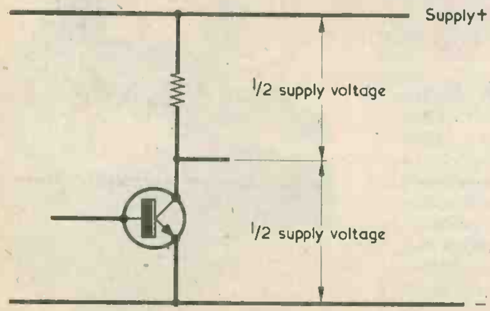


Fig. 3. The situation when half the supply voltage appears across a collector load resistor and the remaining half appears across the transistor

POWER DISSIPATION

Maximum power dissipation is referred to as Pt max. or Ptot max. and requires a different type of calculation. The dissipation is equal to the voltage across the transistor multiplied by its collector current. If a transistor is connected in the manner illustrated in Fig. 3 it can be demonstrated that maximum power is dissipated in the transistor when half the supply voltage appears across it. Obviously, half the supply voltage will then also appear across the collector load resistance. Since the same current passes through the transistor and the resistor, the same power is dissipated by both.

It is an easy process to find the maximum possible transistor dissipation which the circuit can cause. If we once more assume that the supply voltage is 10 volts and the collector load resistance is 100 Ω, maximum dissipation in the transistor occurs when the load resistance has 5 volts across it. The dissipation given by 5 volts across 100 Ω is 0.25 watt (5 squared divided by 100) or 250mW. For our circuit we would be wise to choose a transistor with a Ptot max. rating of say 350mW or, preferably, higher. With power output transistors we could allow the maximum dissipation figure to be approached but not exceeded.

In the emitter follower circuit of Fig. 2(b) we find the maximum dissipation figure by working out the dissipation when half the supply voltage appears across the emitter load resistor. When there are resistors in both the emitter and collector circuits we add their values and find the dissipation which occurs when half the supply voltage is applied across a single resistor having their total value.

These approaches are also applicable to power transistors which are intended for mounting on a heat sink. The only difference is that the power dissipation figures for the latter type of transistor assume that the transistor is mounted on a heat sink of adequately large dimensions and low thermal resistance to air.

■

Radio Topics

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RESISTORS AND CAPACITORS

These make up the grist for the electronic mill and, as the years go by, they become smaller and smaller and more and more delightfully simple to handle. My stock of resistors goes back to the early 1960's and what we used to treat as ½ watt types in those days are almost ten times the volume of the tiny little ½-watters we deal with nowadays. Especially pleasing are the lead-out wires, which tin and solder immediately the iron is placed on them. In the old days resistor lead-outs used to tarnish quite noticeably if they were held in stock for any length of time, and sometimes it was even necessary to scrape and tin them before they could be soldered into a circuit.

SMALL SIZE

The small size of modern resistors has some disadvantages because, of necessity, the width of the colour coding bands reduces in proportion. The human eye has a reduced perception of colour as the size of the object diminishes, which explains why colour television has been able to flourish in its present form. Particularly difficult to distinguish in small areas are orange and red or orange and some of the shades of brown which resistor manufacturers employ. I recently had a mixed batch of 47k Ω (yellow, violet, orange) and 4.7k Ω (yellow, violet, red) resistors to sort out, all of these being identical in size and general body colour and differing only in the orange and red third bands. After a little practice I was able to sort them out visually, but I had to rely on the meter when I started, just to make certain that I wasn't making any errors. Rather a similar happening occurred with a mixture of 22k Ω (red, red, orange) and 220 Ω (red, red, brown) resistors with which the brown of the 220 Ω resistors had a strong orange tinge, although these weren't so bad as the 47k Ω and 4.7k Ω resistors.

When dealing with resistors sold on the home constructor market it is a good plan to assume that the wattage rating is the absolute maximum that the resistor can stand without burning out. It's always best to play safe in matters of this nature, and I never knowingly allow a resistor to dissipate more than half its rated wattage. Fortunately most modern transistor circuits involve extremely low resistor dissipations and these are an almost minute fraction of ½ watt.

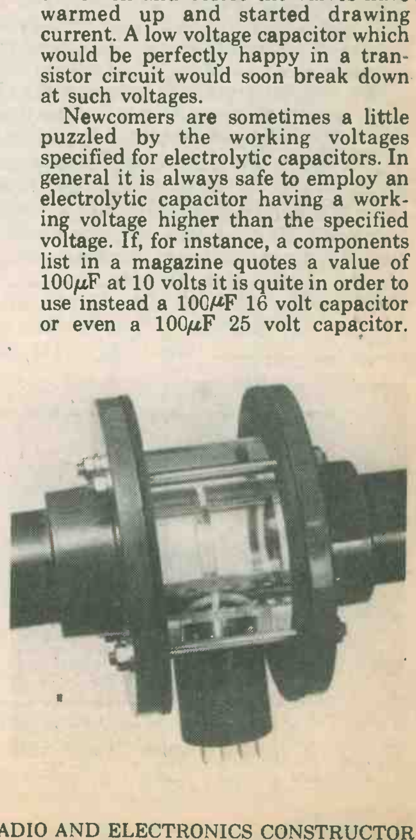
WATTAGE RATING

As an example of what a resistor may be called upon to dissipate, assume that we have a 470 Ω transistor emitter bias resistor and that a current of 3mA passes through it. The voltage across the resistor will be just a little short of 1.5 volts, whereupon the power dissipated by the resistor is 3mA times 1.5 volts, or 4.5 milliwatts. Since ½ watt is equal to 250 milliwatts the resistor, in a typical transistor application, is obviously running more than comfortably within its dissipation figure.

The ease with which resistor leads can be soldered pays off an unexpected bonus when you are making up a quick experimental circuit in "lash-up" form. If relatively long lead lengths can be tolerated, it is a good idea to solder the first few resistors to their tags or circuit points with their leads uncut. Quite a few other components and wires can then be readily soldered to the resistor leads themselves. The result admittedly looks extremely untidy and the technique should never be employed for any permanent assembly. But it pays off with quick experimental circuits and allows rapid changes of components and wiring.

Turning to capacitors, these have undergone a similar diminution in size accompanied by a corresponding ease of lead soldering. With the introduction of plastic dielectrics, the modern capacitor is almost completely leak free, whereas the old paper dielectric capacitors were always a possible cause of trouble here. A word of warning is necessary with respect to working voltages. Since nearly all electronic equipment these days is low voltage solid state we have got into the habit of using capacitors with maximum working voltages in the order of 100 to 160 volts without bothering a great deal about such voltages. If it becomes necessary to fit a replacement capacitor to, say, a TV set having valves it is advisable to check the voltage the capacitor will be subjected to. Quite often this may be well in excess of 250 volts immediately after switch-on and before the valves have warmed up and started drawing current. A low voltage capacitor which would be perfectly happy in a transistor circuit would soon break down at such voltages.

Newcomers are sometimes a little puzzled by the working voltages specified for electrolytic capacitors. In general it is always safe to employ an electrolytic capacitor having a working voltage higher than the specified voltage. If, for instance, a components list in a magazine quotes a value of 100μF at 10 volts it is quite in order to use instead a 100μF 16 volt capacitor or even a 100μF 25 volt capacitor.



One of a range of Metre Meter fluid flowmeters manufactured by Litre Meter Ltd. By adapting a small turbine and orifice plate an output is obtained which is directly proportional to fluid flow. Also the range of flow measurement is considerably increased

Provided, of course, that there is space for the larger component.

FLUID FLOW

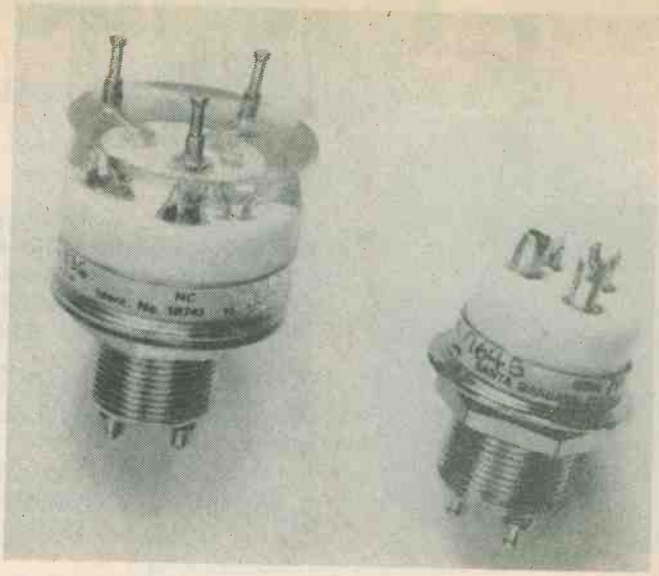
The accompanying photograph shows a flowmeter, which is a device for measuring the flow of a fluid, and is one of a range which has been introduced by Litre Meter Ltd., Ryefield Crescent, Northwood, Middlesex, HA6 1NN. The Northwood air must be conducive to alliteration because the flowmeter is referred to as a Metre Meter.

The old and most commonly used method of flowmetering is by means of an orifice plate where a flow produces a differential pressure on the plate which is proportional to a square of the flow across the orifice. The typical flow range which can be measured is 6:1, producing a 36:1 pressure change. This pressure is expensive to measure accurately and it is even more expensive to extract the square root for display.

However, engineers at Litre Meter Ltd. have found that the flow through a modified Litre Meter turbine flowmeter has an interesting characteristic, in that the flow caused by the differential pressure obeys a square law. If this is combined with an orifice plate the square root is extracted at source and a linear digital output is obtained. Not only is this extremely useful in itself, but in addition the dynamic flow range measurable becomes increased from 6:1 to 60:1, an impossible range with a normal orifice plate. The converted orifice plate has in fact become a complete Linear Digital Orifice Plate.

The Litre Meter turbine flowmeter has a tiny rotor which revolves in the fluid flow, sending pulses according to its speed of rotation through a simple electronic device, which then sends signals to appropriate recording instruments. The rate of rotation indicates the rate of flow, and the total of rotations the total flow. The associated instruments can display rate and/or total.

The combination of this cost-effective system with the established orifice plate method has resulted in the new Metre Meter appearing in a highly versatile set of flow rate transmitters, all of which employ the same miniature turbine and simple electronics. The range of the Metre Meter flowmeters now being marketed by Litre Meter Ltd. has been correspondingly increased enormously and are together capable of metering fluid flow from 1 drop per second to 5 tonnes per minute, a ratio of over 500,000:1.



Two vacuum dielectric ceramic relays in the Walmore Electronics HC-1 series. The larger relay has been recently introduced and it can switch voltages up to 8kV at 18 amps maximum

HIGH VOLTAGE RELAY

My second photograph shows what I can only describe as two really man-sized relays. Manufactured by Walmore Electronics Ltd., the relays can switch exceptionally high voltages and currents.

The larger relay is a newly introduced version of the Kilovac HC-1 vacuum dielectric ceramic relay, of which the small relay is a standard example. The large relay is the type HC1/S43, and it retains the advantages of light weight, small size, high-strength ceramic housing, 6 millisecond operating speed and low contact resistance exhibited by its predecessors in the HC-1 range. However, design modifications, including the potting of the relay housing, have enabled the voltage rating to be increased from the normal 2.5kV to 8kV. The r.f. ratings have also been enhanced. Current carrying capacity is 18 amps maximum, contact resistance is 0.01Ω maximum and the coil resistance is 335Ω.

All HC-1 Series relays are suitable for high voltage and high peak current applications such as are given in radar, communications, pulse forming networks and aerial tuning units. They exhibit high reliability and long life, and their low dielectric loss and the use of high conductivity, non-magnetic materials in the switching circuit make them particularly suitable for r.f. applications.

Further details are available from Walmore Electronics Ltd., 11-15 Betterton Street, Drury Lane, London WC2H 9B3.

NUTS AND BOLTS

I suppose that the day is coming when we shall see the end of BA nuts and bolts as we go more and more metric. The metric nuts and bolts are denoted by the letter "M" followed by a number which gives an idea of the full diameter in millimetres. Common sizes available at the time being are M2.5, M3, M4 and M5. For the record, the M2.5 is just slightly smaller in diameter than 6BA, the M3 is about half-way between 6BA and 4BA, the M4 is half-way between 4BA and 2BA whilst the M5 is approximately midway between 2BA and 1BA. They're covered by British Standards, that for the screws being B.S.3643 and that for the nuts being B.S.3692.

TRANSFORMERS

There are some very small mains transformers creeping onto the scene, including in particular those offering low voltage outputs at currents of 100mA or even 50mA for transistor equipment. Some of these little transformers tend to be of the "no-name" variety, and I must confess that I look upon them with a little distrust.

If you are using one of these transformers near its maximum secondary current rating you may find that it runs quite warm, particularly if it is mounted on an insulating material such as s.r.b.p. Should a metal chassis be in use for the equipment concerned it is probably a good idea to mount the transformer on this, as the chassis will then act as a heat sink. I may be a little over-fussy here but I never feel quite happy with unbranded components of this nature and, in any case, I always like to keep things cool!

My colleagues on this journal receive a few queries from time to time about suitable output transformers for valve receivers. Most valve transformers have now been discontinued, of course, but some retailers are still retaining stocks of multi-ratio types. The usual queries are concerned with output valves of the 6V6 and 6BW6 type. The 6V6 is on an octal base whilst the 6BW6 is on a 9-pin B9A base and, electrically, the two valves are virtually identical. For the benefit of readers who wish to know the best output transformer ratios for these two valves, the information is that a 40:1 ratio is suitable for working into a 3Ω speaker and a 20:1 ratio can be used with a 15Ω speaker. The ratios are not very critical, and ratios close to those I have just mentioned will be quite satisfactory.

New Products

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A range of loudspeaker drive units of interest to professional and amateur constructors alike has recently been announced by Dalesford Speakers Ltd. All the models are Bextrene coned and fitted with high power voice coils.

All HiFi bass and midrange applications are covered by nine models ranging from 4in to 12in diameter.

Details are available from the sole distributors: Wilmslow Audio, Swan Works, Bank Square, Wilmslow, Cheshire.

THE NEW PROSSER PS1 1211 FUNCTION GENERATOR

Market research in the function generator field exposed the following criticisms of some existing instruments: limited waveforms available; limited attenuation; single output impedance; need for a "floating" instrument in many applications.

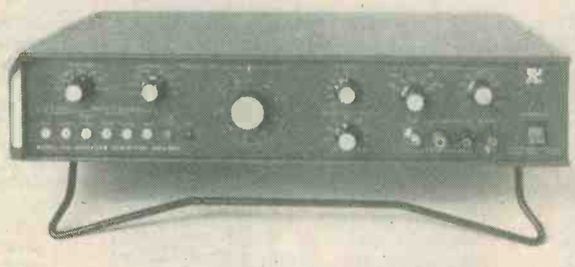
The PSI 1211 claims to satisfy all these requirements in addition to providing many other refinements. It is an all-purpose function generator which provides a wide choice of precise output waveshapes and amplitudes while simultaneously offering monitor outputs of all the other functions.

The instrument has a significant edge, both technical and costwise over comparable competitive types. It combines many functions in a single package thereby eliminating the need for several different instruments with a consequent cost saving.

British designed and manufactured, the PSI 1211 has a frequency range from 0.04MHz to 5MHz. It offers output functions of sine, square, triangular, positive ramp, negative ramp, with variable duty cycle pulses. The main output is 20V pk-pk from two output impedance sources: 50ohm and 600ohm.

A front panel control provides full adjustment of the pulse duty cycle from 10% to 90% independent of frequency.

The main output level is controlled by a high accuracy attenuator which provides five fixed levels from 20V down to 200mV. Additionally, a further fine attenuator control allows fully continuous attenuation down to 40mV yet still retains the same signal purity.



The Prosser 1211 5MHz Function Generator

The PSI 1211 is fully protected against damage should any output be inadvertently shorted. An internal DC offset control permits all waveshapes to be referenced to a DC level, in addition the maximum level of DC offset is ±10V. The instrument has been designed to be fully floating.

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(Continued on page 61)

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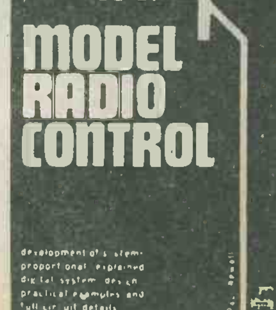

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