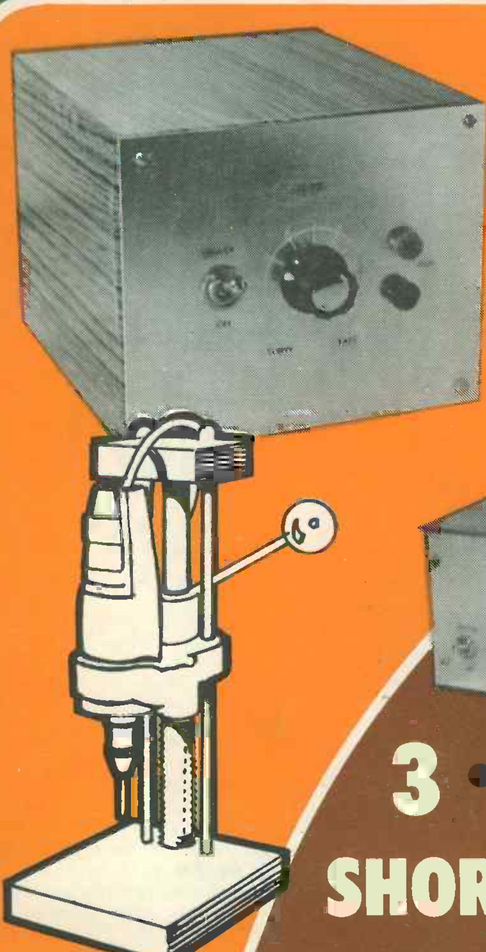
RADIO & ELECTRONICS CONSTRUCTOR

AUGUST 1976

35p



12 VOLT MOTOR SPEED CONTROLLER

PART ONE
(TWO PARTS)

3 • BAND SHORT WAVE RADIO

ALSO FEATURED **DYNAMIC NOISE LIMITER**

RADIO & ELECTRONICS CONSTRUCTOR

AUGUST 1976

Volume 30 No. 1

Published Monthly (1st of Month)
First Published 1947

Incorporating The Radio Amateur

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9 1SN

Telephone 01-286 6141
Telegrams Databux, London

Annual Subscription: £5.00 (U.S.A. and Canada $11.00) including postage. Remittances should be made payable to "Data Publications Ltd". Overseas readers please pay by cheque or International Money Order.

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.

Correspondence should be addressed to the Editor, Advertising Manager, Subscription Manager or the Publishers as appropriate.

Opinions expressed by contributors are not necessarily those of the Editor or proprietors.

Production.—Web Offset.

CONTENTS

Published in Great Britain by the Proprietors and Publishers, Data Publications Ltd, 57 Maida Vale, London W9 1SN

The *Radio & Electronics Constructor* is printed by Swale Press Ltd.

SEPTEMBER ISSUE WILL BE PUBLISHED ON 1st SEPTEMBER

SEMICONDUCTORS

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

AC107	20p
AC128	7½p
AC176	9p
ACY28	19p
AD149	40p
AD161/2	32½p
AF116	16½p
AF124	30p
AF126	22p
AF127	29p
AF139	31p
AF178/80/81	40p
AF239	34p
ASY27/73	31p
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BC187	26p
BC213L/214B	10p
BC216B	8p
BC327	8p
BC328	12p
BC337	17p
BC338	16p
BC547/8/8A	11p
BC557/8/9	9p
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BD133	54p
BD135	21p
BD137	24p
BD139	29p
BD142	56p
BD201	74p
BD202/3	79p
BD204	£1.00
BD232	60p
BD234	57p
BD235	24p
BDX77	£1.40
BF115	20p
BF167/173	22p
BF178	26p
BF179	30p
BF180/2/3	28p
BF181	31p
BF184/5	22p
BF194/5/6/7	7p
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BF200	25p
BF258	24p
BF262/3	56p
BF336	25p
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BFW11 F.E.T.	37p
BFW30	£1.35
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BFX29/30	22p
BFX84/88	20p
BFX89	35p
BFY51/2	14p
BFY90	65p
BR101	41p
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BRY56	32p
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BSY40	29p
BSY95A	9p
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CV7042 (OC41, OC44 ASY63)	12p
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OC35	43p
ON222	30p
TIP30	43p
TIP3055	45p
TIS88A F.E.T.	23p
ZTX300	13p
ZTX341	19p
2N393/MA393	30p
2N456A	60p
2N706	9p
2N929	14p
2N987	35p
2N1507/2219	17½p
2N2401/2412	25p
2N2483	30p
2N2904/5/6/7	15p
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2N3053	12p
2N3055 R.C.A.	50p
2N3704	8p
2N3133	18p
2N4037	34p
2N5036	60p
2SA141/2/360	31p
2SB135/6/457	20p
40250	54p

BRIDGE RECTIFIERS

Amp	Volt		
½	1,600	BYX10	30p
1	140	OSH01-200	25p
1.4	42	BY164	47p
0.6	110	EC433	15p
5	400	Texas	75p

OTHER DIODES

1N916	6p
1N4148	3p
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Centercel	10p
BZY61	10p
BB103/110 Varicap	23p
BB113 Triple Varicap	37p
BA182	13p
OA5/7/10	14p
BZY88 Up to 33 volt	6½p
BZX61 11 volt	17p
BR100 Diac	20p

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NE555v Timer	32½p
TAA550 Y or G	32p
TAA263 Amp	65p
7400/10	9p
7402/4/20/30	11p
7414	45p
7438/74/86	24p
7483	74p
LM300, 2-20 volt	£1.50
74154	£1.11

RECTIFIERS

	Amp	Volt	
IN4004	1	400	4p
IN4005/6	1	6/800	6p
BY103	1	1,500	15p
SR100	1.5	100	7p
SR400	1.5	400	8p
REC53A	1.5	1,250	14p
LT102	2	30	10p
BYX38-600	2.5	600	55p
BYX38-300R	2.5	300	43p
BYX38-900	2.5	900	60p
BYX38-1200	2.5	1,200	65p
BYX49-600	2.5	600	34p
BYX49-300R	2.5	300	26p
BYX49-900	2.5	900	40p
BYX49-1200	2.5	1,200	52p
BYX48-300R	6	300	40p
BYX48-600	6	600	50p
BYX48-900	6	900	60p
BYX48-1200	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
BYX46-300*	15	300	£1.00
BYX46-400*	15	400	£1.50
BYX46-500*	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	£1.80
25	900	BTX94-900	£4.00
25	1200	BTX94-1200	£6.00

12-0-12 50M/A Min. Txfmr. 90p

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

B7G or B9A valve can ... 9p

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

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BPX40	65p
BPX42	£1.00
BPY10	£1.00

(VOLTIAC)

BPY68, BPY69, BPY77 Diodes £1.00

Photo transistor

BPX29	£1.00
OCP71	44p

BIG L.E.D. 0.2" 2v 50m/A max.

RED	13p
ORANGE	19p
GREEN	15p
YELLOW	19p
CLIP	2p

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.3" red 7 segment L.E.D. 14 D.I.L. 0-9+D.P. display 1.9v 10m/a segment, common anode 75p
DL747.6" £1.75
Minitron 3" 3015F filament £1.11

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

Plastic, Transistor or Diode Holder 1p
Transistor or Diode Pad 1p
Holdersorpads 50p per 100

THYRISTORS

Amp	Volt		
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1	400	BTX18-300	40p
1	240	BTX30-200	35p
15	500	BT107	£1.00
6.5	500	BT101-500R	90p
6.5	500	BT109-500R	75p
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15	800	BTX95-800R Pulse Modulated	£8.00
30	1000	28T10 (Less Nut)	£3.00

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1MFD	250 volt	15p
2MFD	250 volt	20p
10MFD	500 volt	80p
4MFD	250 volt	20p

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Car Aerial
Coax
5 or 6 pin 240° din
Speaker din switched
3.5mm Switched Socket
9p

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SWG.	PER YD.
20-24	3p
26-42	2.5p

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Europlec HP1 TO3B individual 'curly' power transistor type. Ready drilled 20p

Tested unmarked, or marked ample lead ex new equipment

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BC186	11p
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BF115	10p
BY127	9p
HG1005	10p
HG5009	3p
HG5079	3p
L78/9	3p
M3	10p
OA81	3p
OA47	3p
OA200-2	3p
OC23	20p
OC71/2	5p
OC200-5	10p
TIC44	24p
2G240	2-50
2G302	10p
2G401	15p
2N711	25p
2N2926	7p
2N598/9	6p
2N1091	8p
2N1302	8p
2N1907	2-50
Germ. diode	1p
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GET872	12p
2S3230	30p

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U.E.C.L. 20 way pin connector 2A60000A1P20 20p

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U.E.C.L. 20 way pin socket B260800A1R20 20p

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Peerless KO40MRF 8 ohms	£9.50
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Helme XLK 40	pair £31.50
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Peerless 1120	each £45.00
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Peerless 2060	pair £53.00
Richard Allan Twin assembly	each £13.46
Richard Allan Triple 8	each £20.25
Richard Allan Triple 12	each £25.16
Richard Allan Super Triple	each £29.25
Richard Allan RA8 Kit	pair £37.80
Richard Allan RA82 Kit	pair £59.40
Richard Allan RA82L Kit	pair 65.70
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Videotone Saphir 1pr **£52.00**
Videotone Minimax II 1 pr. **£39.00**

We stock the complete Radford range of amplifiers, preamplifiers, power amplifiers, tuners etc., and also Radford Audio Laboratory equipment, low distortion oscillator, distortion measuring set, audio noise meter etc.

ALL PRICES INCLUDE VAT
(Prices correct at 15/7/76)

Send stamp for free 32-page booklet "Choosing a Speaker"

All units guaranteed new and perfect

Carriage and Insurance: Speakers 55p each, 12" and up 85p each, Kits £1 each (£2 per pair), Tweeters & crossovers 33p each.

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WILMSLOW AUDIO

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No.	Length		Width		Heigh	Price
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BA2	4"	x	4"	x	1½"	★0.45
BA3	4"	x	2½"	x	1½"	★0.45
BA4	5¼"	x	4"	x	1½"	★0.54
BA5	4"	x	2½"	x	2"	★0.45
BA6	3"	x	2"	x	1"	★0.39
BA7	7"	x	5"	x	2½"	★0.79
BA8	8"	x	6"	x	3"	★1.02
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(Each complete with ½" deep lid & screws)

PLEASE ADD 20p POSTAGE AND PACKING FOR EACH BOX

COMPONENTS

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These Paks contain a range of Carbon Resistors, assorted into the following groups:

R1	50	Mixed 100 ohms-820 ohms 1/8th W	0.60
R2	50	Mixed 1K ohms-8.2K ohms 1/8th W	0.60
R3	50	Mixed 10K ohms-82K ohms 1/8th W	0.60
R4	50	Mixed 100K ohms-820K ohms 1/8th W	0.60
R5	30	Mixed 100 ohms-820 ohms ½ W	0.60
R6	30	Mixed 1K ohms-8.2K ohms ½ W	0.60
R7	30	Mixed 10K ohms-82K ohms ½ W	0.60
R8	30	Mixed 100K ohms-820K ohms ½ W	0.60

THESE ARE UNREPEATABLE PRICES

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RF Chokes	CH1	2.5mH	0.27
	CH3	7.5mH	0.29
	CH5	1.5mH	0.26
	CH2	5.0mH	0.28
	CH4	10mH	0.31

COILS DRX1 Crystal set 0.29 DRR2 Dual range 0.42

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Log and Lin
4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M2.

VC1	Single Less Switch	0.20
VC2	Single D.P. Switch	0.40
VC3	Tandem Less Switch	0.60
VC4	1K Less Switch	0.20
VC5	100K Log anti-Log	0.60

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0.1 Watt 0.09 each
100, 220, 470, 1K, 2.2K, 4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4.7M.

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240V. Primary. Secondary voltages available from selected tappings. Up to 50V and 25V-0-25-V.

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MT/50/2	2	£5.00	0.60p

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⅜" Cores & Formers 0.09p

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DP/DT Toggle 0.28p SP/ST Toggle 0.22p

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1¼" and 20mm, 100mA, 200mA, 250mA, 500mA, 1A, 1.5A, 2A QUICK BLOW ★0.05p each
Anti-serge 20mm only ..... ★0.08p each

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VB1 containing approx. 30 sq. ins. various sizes all 0.1 matrix .... ★0.60p
VB2 containing approx. 30 sq. ins. various sizes all 0.15 matrix .... ★0.60p

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CABLES			per metre
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CP	2	Twin Common Screen	★0.11
CP	3	Stereo Screened	★0.12
CP	4	Four Core Common Screen	★0.21
CP	5	Four Core Individually Screened	★0.28
CP	6	Microphone Fully Braided Cable	★0.11
CP	7	Three Core Mains Cable	★0.11
CP	8	Twin Oval Mains Cable	★0.08
CP	9	Speaker Cable	★0.06
CP	10	Low Loss Co-Axial	★0.14

Add 8% V.A.T. to all prices marked ★
Remainder add 12½%

PLEASE NOTE THE ABOVE DIRECTIONS V.A.T.

COMPONENT PAKS

Pak. No.	Qty	Description	Price
C1	200	Resistors mixed values, approx. count by weight	0.60
C2	150	Capacitors mixed values approx. count by weight	0.60
C4	75	1/8th width Resistors mixed preferred values	0.60
C5	5	Pieces assorted Ferrite Rods	0.60
C7	1	Pak Wire 50 metres, assorted colours	★0.60
C8	10	Reed Switches	★0.60
C9	3	Micro Switches	★0.60
C10	15	Assorted Pots & Pre-Sets	0.60
C12	30	Paper Condensers preferred types mixed values	0.60
C13	20	Electrolytics Trans. types	0.60
C14	1	Pack assorted Hardware – Nuts Bolts, Grommets, etc.	★0.60
C16	20	Assorted Tag Strips & Panels	0.60
C19	2	Relays 6-24V Operating	0.60
C20		Sheets Copper Laminate, approx. 200 sq. ins.	★0.60

Please add 20p post and packing on all component packs, plus a further 10p on pack nos. C1, C2, C19 & C20

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S222	5 pin DIN plug to 5 pin DIN socket length 1.5m	68p
S237	5 pin DIN plug to 5 pin DIN plug, mirror image length 1.5m	£1.20
S238	2 pin DIN plug to 2 pin DIN socket length 5m	68p
S270	2 pin DIN plug to 2 pin DIN socket length 10m	80p
S271	5 pin DIN plug to 2 phono plugs connected to pins 3 & 5 length 1.5m	70p
S275	5 pin DIN plug to 2 phono sockets connected to pins 3 & 5 length 23cm	68p
S318	5 pin DIN socket to 2 phono plugs connected to pins 3 & 5 length 23cm	68p
S404	Coiled stereo headphones extension cord extends to 7m	£1.40
S217	3 pin DIN plug to 3 pin DIN plug length 1.5m	80p
S219	5 pin DIN plug to 5 pin DIN plug length 1.5m	80p
S474	3.5mm Jack to 3.5mm Jack length 1.5mm	68p
S600	5 pin DIN plug to 3.5mm Jack connected to pins 3 & 5 length 1.5m	80p
S700	5 pin DIN plug to 3.5mm Jack connected to pins 1 & 4 length 1.5m	80p

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FANTASTIC VALUE ONLY £1.20

Containing 75 of the C280 range of capacitors assorted values between .01µF to 2.2µF. Complete with identification chart.

P&P

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REF 'J' Tape Head Cleaning Kit	72p
REF 'P' Hi-Fi Cleaner	★30p
Model 9 Wire Stripper	★£1.00
REF 23 ¼" Tape Editing Kit	★£1.80
REF 24½" Cassette Editing Kit	★£1.84
REF 29A Salvage Cassette	★44p
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REF 33 Splicing Tape	★38p
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REF 53 Hi-Fi Stereo Test Cassette	★£2.40
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REF 71A Record 'Dust Off' (Bubble Pack)	★70p
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REF 83 Cassette Title & Container Labels (20 & 10)	★36p

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102 for model CN240 3/16"	★42p
104 for model CN240 ⅛"	★46p
106 for model CN240 3/32"	★46p
1100 for model CCN240 3/16"	★46p
1101 for model CCN240 ⅛"	★46p
1102 for model CCN240 ¼"	★46p
1020 for model G240 3/16"	★46p
1021 for model G240 ⅛"	★46p
1022 for model G240 3/16"	★46p
50 for model X25 3/16"	★46p
51 for model X25 ⅛"	★46p
52 for model X25 3/16"	★46p

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Model ECN 240	★£1.25
Model EG 240	★£1.60
Model ECCN 240	★£1.60
Model EX 25	★£1.40

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ST3 Suitable for all models	★£1.25
Antex heat shunt	★12p

PLUGS & SOCKETS

PLUGS			Price
PS	1	D.I.N. 2 Pin (Speaker)	0.10
PS	2	D.I.N. 3 Pin	0.10
PS	3	D.I.N. 4 Pin	0.14
PS	4	D.I.N. 5 Pin 180°	0.15
PS	5	D.I.N. 5 Pin 240°	0.15
PS	6	D.I.N. 6 Pin	0.16
PS	7	D.I.N. 7 Pin	0.17
PS	8	Jack 2.5mm Screened	0.17
PS	9	Jack 3.5mm Plastic	0.11
PS	10	Jack 3.5mm Screened	0.17
PS	11	Jack ¼" Plastic	0.14
PS	12	Jack ¼" Screened	0.20
PS	13	Jack Stereo Screened	0.33
PS	14	Phono	0.09
PS	15	Car Aerial	0.14
PS	16	Co-Axial	0.14

INLINE SOCKETS

PS	21	D.I.N. 2 Pin (Speaker)	0.13
PS	22	D.I.N. 3 pin	0.19
PS	23	D.I.N. 5 Pin 180°	0.19
PS	24	D.I.N. 5 Pin 240°	0.19
PS	25	Jack 2.5mm Plastic	0.16
PS	26	Jack 3.5mm Plastic	0.16
PS	27	Jack ¼" Plastic	0.28
PS	28	Jack ¼" Screened	0.32
PS	29	Jack Stereo Plastic	0.28
PS	30	Jack Stereo Screened	0.35
PS	31	Phono Screened	0.17
PS	32	Car Aerial	0.20
PS	33	Co-Axial	0.20

SOCKETS

PS	35	D.I.N. 2 Pin (Speaker)	0.07
PS	36	D.I.N. 3 Pin	0.09
PS	37	D.I.N. 5 Pin 180°	0.09
PS	38	D.I.N. 5 Pin 240°	0.10
PS	39	Jack 2.5mm Switched	0.11
PS	40	Jack 3.5mm Switched	0.11
PS	41	Jack ¼" Switched	0.19
PS	42	Jack Stereo Switched	0.28
PS	43	Phono Single	0.07
PS	44	Phono Double	0.09
PS	46	Co-Axial Surface	0.09
PS	47	Co-Axial Flush	0.19

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(In 2 sections. Vinyl covered top, sides and bezel in Black or Blue)

No.	Length		Width		Height	Price
BV1	8"	x	5¼"	x	2"	★£1.25
BV2	11"	x	6"	x	3"	★£1.62
BV3	6"	x	4¾"	x	1¾"	★0.92
BV4	9"	x	5¼"	x	2½"	★£1.39

AUDIO ACCESSORIES

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K4007 (2-way 3KHz) I/P Impedance 8 ohms. Insertion Loss 3dB. Crossover Frequency

PRICE; £1.12

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SEMI-CONDUCTORS

Linear IC's

Type	Quantities 1	25	100+	Type	Quantities 1	25	100+	Type	Quantities 1	25	100+
72702	0.46	0.44	0.42	SL701C	0.46	0.42	0.37	76003	£1.39	£1.34	£1.30
72709	0.23	0.21	0.19	SL702C	0.46	0.42	0.37	76023	£1.39	£1.34	£1.30
72709P	0.19	0.18	0.17	TAA263	0.74	0.65	0.56	76660	0.88	0.86	0.83
72710	0.32	0.31	0.28	TAA293	0.93	0.88	0.83	LM380	0.93	0.90	0.88
72741	0.28	0.27	0.26	TAA350	£1.71	£1.67	£1.57	*NE555	0.45	0.43	0.40
72741C	0.26	0.25	0.24	uA703C	0.26	0.24	0.22	*NE556	0.88	0.86	0.83
72741P	0.28	0.27	0.26	uA709C	0.19	0.18	0.17	TBA800	£1.39	£1.34	£1.30
72747	0.79	0.74	0.61	uA711C	0.32	0.31	0.28	ZN414	£1.11	—	—
72748P	0.35	0.33	0.31	uA712C	0.32	0.31	0.28				
SL201C	0.46	0.42	0.37	uA723C	0.45	0.43	0.40				

★ 74 Series TTL IC's

BI-PAK STILL LOWEST IN PRICE. FULL SPECIFICATION GUARANTEED.
ALL FAMOUS MANUFACTURERS

Type	1	25	100+	Type	1	25	100+	Type	1	25	100+
7400	0.09	0.09	0.08	7448	0.80	0.78	0.76	74122	0.50	0.48	0.46
7401	0.10	0.09	0.08	7450	0.12	0.11	0.10	74123	0.58	0.56	0.54
7402	0.11	0.10	0.09	7451	0.12	0.11	0.10	74141	0.60	0.58	0.56
7403	0.11	0.10	0.09	7453	0.12	0.11	0.10	74145	0.96	0.94	0.92
7404	0.13	0.12	0.11	7454	0.12	0.11	0.10	74150	£1.30	£1.25	£1.20
7405	0.13	0.12	0.11	7460	0.12	0.11	0.10	74151	0.76	0.74	0.72
7406	0.25	0.24	0.23	7470	0.25	0.24	0.23	74153	0.95	0.93	0.91
7407	0.25	0.24	0.23	7472	0.22	0.21	0.20	74154	£1.50	£1.45	£1.40
7408	0.15	0.14	0.13	7473	0.26	0.24	0.22	74155	0.80	0.78	0.76
7409	0.15	0.14	0.13	7474	0.27	0.25	0.23	74156	0.80	0.78	0.76
7410	0.09	0.09	0.08	7475	0.48	0.46	0.44	74157	0.95	0.93	0.91
7411	0.23	0.22	0.21	7476	0.25	0.24	0.23	74160	£1.00	0.98	0.96
7412	0.25	0.25	0.24	7480	0.50	0.48	0.46	74161	£1.00	0.96	0.96
7413	0.26	0.25	0.25	7481	£1.02	£1.00	0.98	74162	£1.00	0.98	0.96
7416	0.28	0.27	0.26	7482	0.83	0.81	0.79	74163	£1.00	0.98	0.96
7417	0.28	0.27	0.26	7483	0.98	0.96	0.94	74164	£1.25	£1.20	£1.15
7420	0.12	0.11	0.10	7484	0.90	0.88	0.86	74165	£1.25	£1.20	£1.15
7422	0.28	0.27	0.26	7485	£1.25	£1.20	£1.15	74166	£1.48	£1.44	£1.39
7423	0.30	0.28	0.26	7486	0.32	0.30	0.29	74174	£1.00	0.95	0.90
7425	0.30	0.28	0.26	7489	£2.90	£2.80	£2.70	74175	0.95	0.93	0.91
7426	0.30	0.28	0.26	7490	0.37	0.35	0.33	74176	£1.16	£1.11	£1.06
7427	0.30	0.28	0.26	7491	0.60	0.58	0.56	74177	£1.16	£1.11	£1.06
7428	0.42	0.38	0.36	7492	0.43	0.42	0.41	74180	£1.16	£1.11	£1.06
7430	0.12	0.11	0.10	7493	0.43	0.32	0.41	74181	£2.00	£1.90	£1.80
7432	0.30	0.28	0.26	7494	0.43	0.42	0.41	74182	0.90	0.88	0.86
7433	0.39	0.37	0.35	7495	0.68	0.66	0.64	74184	£1.67	£1.62	£1.58
7437	0.30	0.28	0.26	7496	0.68	0.66	0.64	74190	£1.50	£1.45	£1.40
7438	0.30	0.28	0.26	74100	£1.00	0.98	0.96	74191	£1.50	£1.45	£1.40
7440	0.12	0.11	0.10	74104	0.40	0.38	0.36	74192	£1.15	£1.10	£1.05
7441	0.64	0.62	0.60	74105	0.40	0.38	0.36	74193	£1.15	£1.10	£1.05
7442	0.65	0.63	0.61	74107	0.36	0.34	0.32	74194	£1.15	£1.10	£1.05
7443	£1.10	£1.05	£1.00	74110	0.56	0.54	0.52	74195	0.80	0.78	0.76
7444	£1.10	£1.05	£1.00	74111	0.83	0.81	0.79	74196	£1.00	0.98	0.96
7445	0.95	0.90	0.85	74118	0.90	0.86	0.86	74197	£1.00	0.98	0.96
7446	£1.10	£1.05	£1.00	74119	£1.25	£1.20	£1.15	74198	£2.10	£2.00	£1.90
7447	0.67	0.65	0.63	74121	0.26	0.26	0.25	74199	£1.95	£1.90	£1.85

Devices may be mixed to qualify for quantity price. (TTL 74 series only).
Data is available for the above series of IC's in booklet form. PRICE: 35p

★ DTL 930 Series

Type	Quantities 1	25	100+	Type	Quantities 1	25	100+	Type	Quantities 1	25	100+
BP930	0.14	0.13	0.13	BP944	0.15	0.14	0.13	BP962	0.14	0.13	0.12
BP932	0.15	0.14	0.13	BP945	0.28	0.26	0.23	BP9083	0.42	0.40	0.38
BP933	0.15	0.14	0.13	BP946	0.14	0.13	0.12	BP9094	0.42	0.40	0.38
BP935	0.15	0.14	0.13	BP948	0.28	0.26	0.23	BP9097	0.42	0.40	0.38
BP936	0.15	0.14	0.13	BP951	0.65	0.60	0.55	BP9099	0.42	0.40	0.38

★ DIL Sockets

	1	25	100+
BPS8 8 pin type (low cost)	0.14	0.12	0.10
BPS14 14 pin type (low cost)	0.15	0.13	0.11
BPS16 16 pin type (low cost)	0.16	0.14	0.12
BPS24 24 pin type (low cost)	0.35	0.33	0.30

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PLEASE ADD 8% TO ITEMS MARKED ★ REMAINDER ADD 12½%

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ULIC741 =	7 x 741	0.60
ULIC747 =	5 x 747	0.60
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P&P

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L.E.D.'s

Available in 0·125" and 0·2" dia lenses
RED 19p. GREEN 17p. YELLOW 17p.
Mounting clips 2p each

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Character height 13·46mm.
SPECIAL OFFER 5 for £2

★ Untested TTL Paks

Pak No.	Contents	Price	Pak No.	Contents	Price
UIC00 =	12 x 7400	0.60	UIC70 =	8 x 7470	0.60
UIC01 =	12 x 7401	0.60	UIC72 =	8 x 7472	0.60
UIC02 =	12 x 7402	0.60	UIC73 =	8 x 7473	0.60
UIC03 =	12 x 7403	0.60	UIC74 =	8 x 7474	0.60
UIC04 =	12 x 7407	0.60	UIC75 =	8 x 7475	0.60
UIC05 =	12 x 7405	0.60	UIC76 =	8 x 7476	0.60
UIC06 =	8 x 7406	0.60	UIC80 =	5 x 7480	0.60
UIC07 =	8 x 7407	0.60	UIC81 =	5 x 7481	0.60
UIC10 =	12 x 7410	0.60	UIC82 =	5 x 7482	0.60
UIC13 =	8 x 7413	0.60	UIC83 =	5 x 7483	0.60
UIC20 =	12 x 7420	0.60	UIC86 =	5 x 7486	0.60
UIC30 =	12 x 7430	0.60	UIC90 =	5 x 7490	0.60
UIC40 =	12 x 7440	0.60	UIC91 =	5 x 7491	0.60
UIC41 =	5 x 7441	0.60	UIC92 =	5 x 7492	0.60
UIC42 =	5 x 7442	0.60	UIC93 =	5 x 7493	0.60
UIC43 =	5 x 7443	0.60	UIC94 =	5 x 7494	0.60
UIC44 =	5 x 7444	0.60	UIC95 =	5 x 7495	0.60
UIC45 =	5 x 7445	0.60	UIC96 =	5 x 7496	0.60
UIC46 =	5 x 7446	0.60	UIC100 =	5 x 74100	0.60
UIC47 =	5 x 7447	0.60	UIC121 =	5 x 74121	0.60
UIC48 =	5 x 7448	0.60	UIC141 =	5 x 74141	0.60
UIC50 =	12 x 7450	0.60	UIC151 =	5 x 74151	0.60
UIC51 =	12 x 7451	0.60	UIC154 =	5 x 74154	0.60
UIC53 =	12 x 7453	0.60	UIC193 =	5 x 74193	0.60
UIC54 =	12 x 7454	0.60	UIC199 =	5 x 74199	0.60
UIC60 =	12 x 7460	0.60	UIC XI	25 Assorted 74's	£1.50

BI-PAK

P.O. BOX 6 WARE HERTS
COMPONENT SHOP: 18 BALDOCK STREET, WARE. TEL: 61593

TAKE AN S-DeC

No 15 Electronic Coin Tosser

David Gibson

This device generates a random sequence of binary digits. It has the advantage over tossing a coin in that there is no possibility of cheating.

When the battery is connected the lamp will glow at half its full brightness. To electronically "toss" a coin, connect a lead between sockets 19 and 51 on your S-DeC when the state of the lamp, ON or OFF, will represent a HEAD or a TAIL.

The n-p-n/p-n-p pair (the two transistors on the right) is connected as a Unijunction transistor which oscillates at a frequency determined by the 1μF capacitor and the resistor between sockets 48 and 53 on the S-DeC.

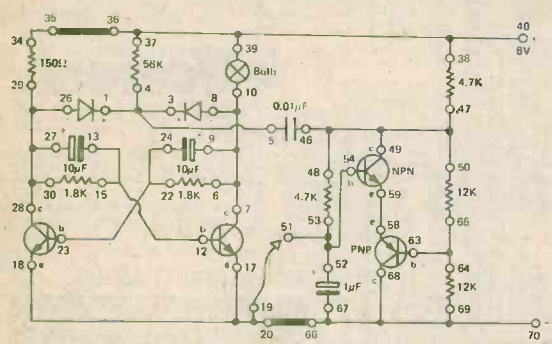

Fig. 1 Circuit diagram of Electronic Coin Tosser showing relevant hole numbers of S-DeC.

The output signal from the oscillator is made to switch a binary multivibrator, the two-transistor circuit on the left, and this in turn switches the bulb on and off. When S-DeC sockets 51 and 19 are connected, the oscillator stops and the binary freezes in the state it had immediately before stopping the oscillation.

Building circuits like this is simple if you use an S-DeC (see photograph). Component leads are plugged into the relevant numbered holes (see circuit diagram) and are automatically connected into circuit.

Beneath the holes are special sockets connected together in a pattern which is shown on the upper surface of the S-DeC. When you have finished building the Electronic Coin Tosser, simply unplug your components and use them again.

If you want to keep a circuit permanently wired, then for only a few pence you can buy a Super Solder Board. These printed circuit boards have holes and copper tracks which exactly match those on the S-DeC. To preserve your circuit, simply transfer the components from the S-DeC to exactly the same matching holes on the Super Solder Board and solder a permanent circuit. Holes on both S-DeC and Super Solder Board have the same letter/number marking. Making mistakes is almost impossible.

When you have built your Electronic Coin Tosser you can build other exciting projects on your S-DeC. Many of the circuits featured in the popular electronics construction journals can be built on your S-DeC. In addition, P.B. Electronics has written a special projects handbook for the S-DeC experimenter. The book contains 48 different projects to build. These include record player amplifiers, emotion meter, radio jammer, electronic tug-of-war, strength meter, radio microphone and dozens of others – and you can build every one on your S-DeC.

The S-DeC costs only £1.98 plus 37p post, packing and VAT. It also includes a booklet giving 9 S-DeC circuits you can build.

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NEW BSR HI-FI AUTOCHANGER
STEREO AND MONO

Plays 12", 10" or 7" records Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13½ x 11¼in. Above motor board 3¼in. Below motor board 2¼in.
With STEREO/MONO CARTRIDGE **£10.95** Post 75p

PORTABLE PLAYER CABINET £4.50
Modern design. Size 16" x 15" 7" approx. Post 50p
Large front grille. Hinged Lid. Chrome fittings. Motor board cut for Garrard or BSR deck. Rexine covered, in red or black or blue.

HEAVY METAL PLINTHS
With P.V.C. Cover. Cut out for most B.S.R. or Garrard decks. Silver grey finish. Size 12¼ x 14¾ x 7¼in. Size 16 x 13¾ x 7in. £6.95
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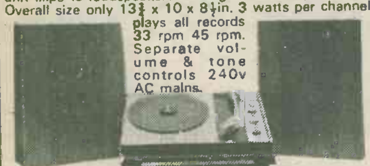

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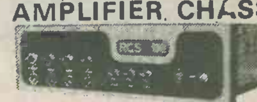

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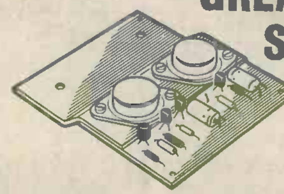

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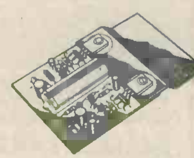
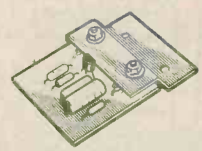
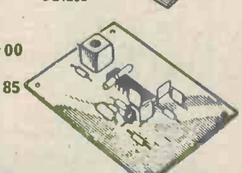


SS.125



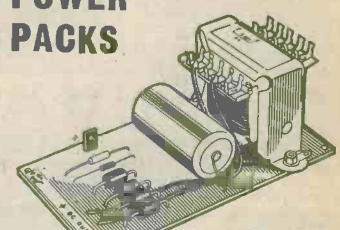
SS.105

SS.203



SS.202

Stirling Sound POWER PACKS



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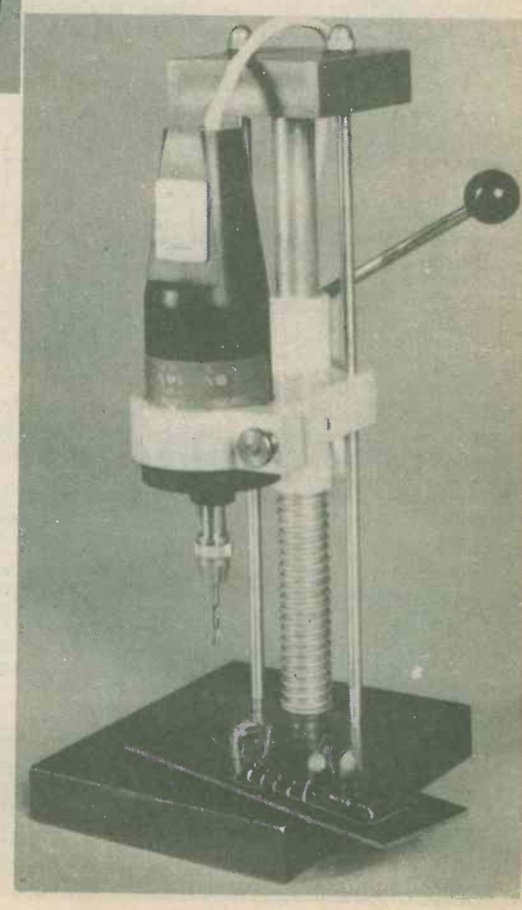

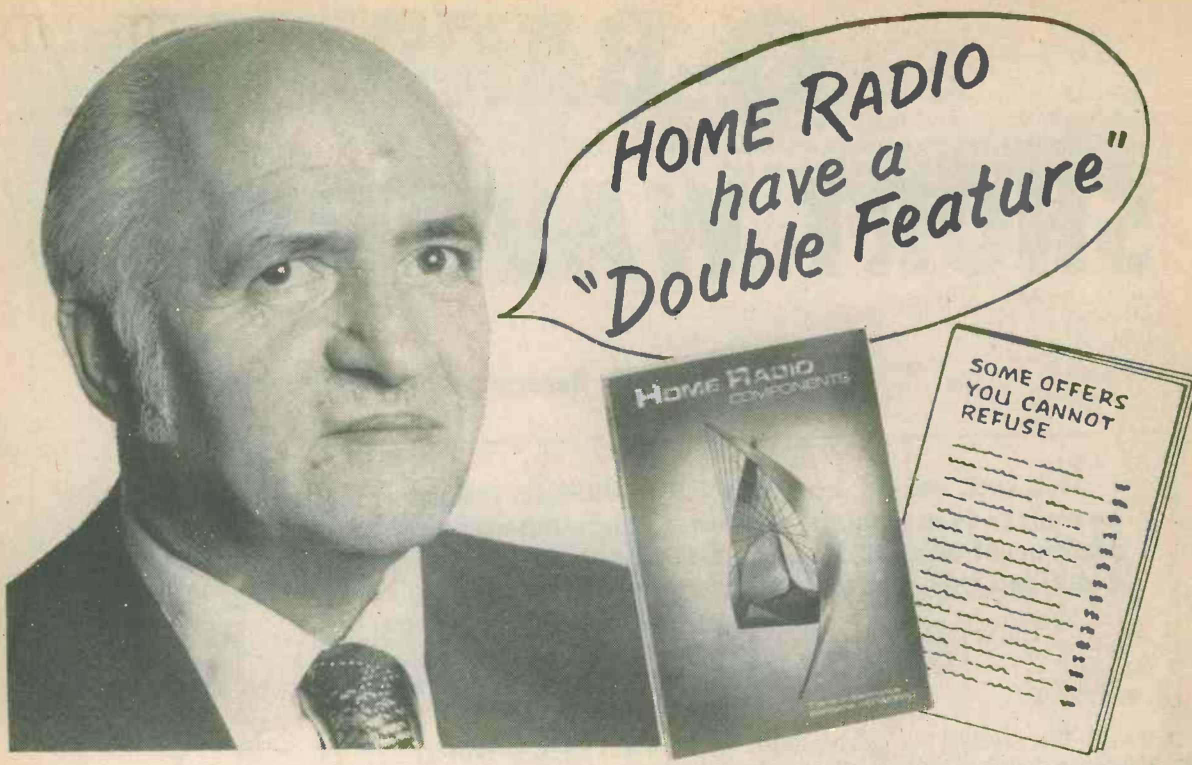

Perhaps you have to be of my vintage to know the phrase "a Double Feature," but up to a few years ago cinemas always ran a main film and a supplementary film. Perhaps they still do — I wouldn't know! However, that's by the way; it was just that I was reminded of it because with their new catalogue Home Radio Components are now giving away a supplementary catalogue of bargain lines.

It sounds to me like a very practical and sensible idea. After all, most electronic component firms are bound to accumulate surplus stocks of various items, and rather than dispose of them, why not offer them to their customers at really exceptionally low prices? I'm told that this bargain list will continue for several months and be up-dated from time to time . . . with new items being added and others deleted.

No constructor should be without the famous Home Radio Components Catalogue (it contains 5,000 items clearly listed and indexed plus about 2,000 illustrations) but now you have a double incentive for buying one. In addition to getting one of the finest component catalogues available, you also receive a list of bargains at unbelievably low prices. For example, Gemini Mains Transformers: normal price £11.48, bargain list price £5, saving £6.48! This means that with a single purchase from the bargain list you can save the price of your catalogue several times over!!

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3-BAND SHORT WAVE RADIO

By A. P. Roberts

This t.r.f. design, covering 1.5 to 32MHz, requires no alignment and can be built to feed a pair of medium to high impedance headphones or, with the addition of an output stage, a 25Ω loudspeaker. The headphone version is described this month, and next month's concluding article will give details of the optional a.f. output stage.

Although this receiver is a fairly simple design it is nevertheless capable of picking up many long distance (Dx) signals. Denco plug-in coils are employed and provide three ranges. Quoting the Denco range numbers, these are: Range 3, 1.5 to 5.5MHz, Range 4, 4.5 to 16MHz and Range 5, 10 to 32MHz. Thus the coverage of the set includes virtually the complete short wave spectrum from 1.5 to 32MHz, with comfortable overlap between ranges.

For the sake of simplicity a tuned radio frequency (t.r.f.) circuit is used, and this requires no alignment as would a more complicated superhet circuit. A certain degree of skill is required to obtain optimum results from a t.r.f. receiver, and this is the price which has to be paid for circuit simplicity. Nevertheless, the ease of assembly and relatively low cost of the receiver make it an excellent constructional project, particularly for someone who is just embarking on short wave listening as a hobby.

THE CIRCUIT

Fig. 1 illustrates the basic stages of the receiver in block diagram form, the transistor types employed being shown for each stage. As can be seen, there is a total of eight transistors, including two field-effect types. The output stage is optional and the receiver can be built without this, whereupon a pair of medium or high resistance headphones may be driven from the output of the second a.f. amplifier stage. Indeed, the receiver will initially be described without the output stage, whereupon constructors have the options of building the receiver without the output stage and, if desired, adding it at a later date, or of building the receiver complete with the output stage.

At the left of the diagram the aerial and earth couple to an untuned, or aperiodic, r.f. stage incorporating an f.e.t. This does not provide as much gain as could be obtained with a tuned stage, but it isolates

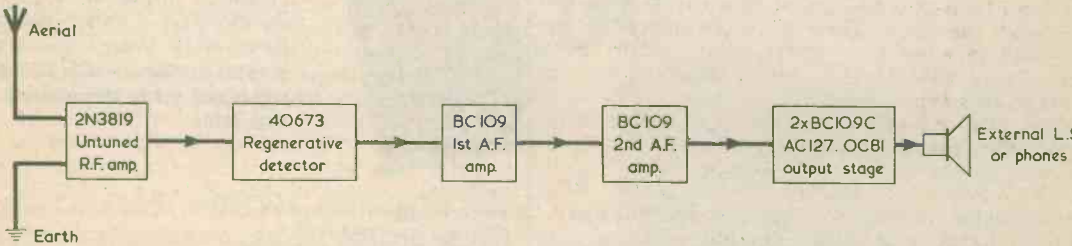


Fig. 1. Block diagram illustrating the stages in the receiver. If desired, the output stage can be omitted, whereupon the second a.f. amplifier feeds a pair of medium to high impedance headphones

The 3 band short wave radio, as assembled. The tuning scale is taken from 'Panel Signs' Set No. 5 (available from the publishers of this journal). The controls are comfortably spaced out for ease of operation

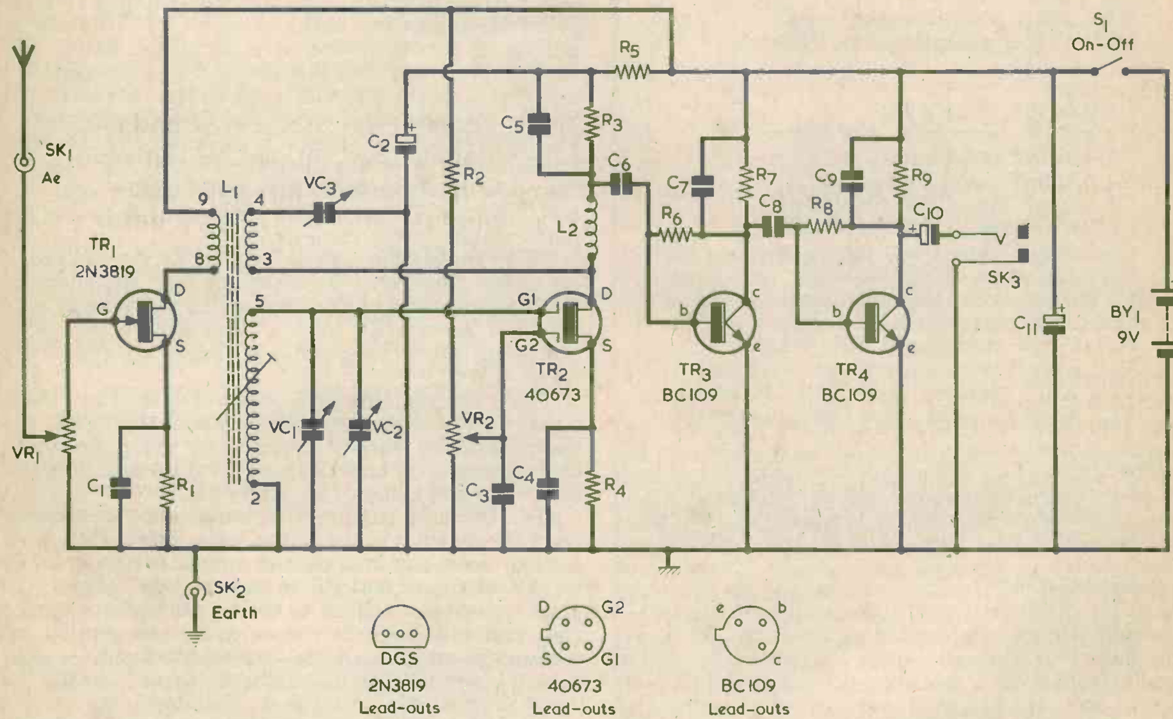


Fig. 2. The circuit of the short wave receiver less the optional a.f. output stage

the aerial from the following tuned stage, giving a consequent improvement in performance of the reaction circuit. It also enables an r.f. gain control to be incorporated, and a useful amount of amplification is still achieved at the lower short wave frequencies. The gain of the receiver as a whole tends to fall away slightly above 20MHz, but this is common with a receiver of this type.

A dual-gate m.o.s.f.e.t. is used as a regenerative detector. This provides extremely efficient detection and gives the receiver a performance which is well above the average t.r.f. design.

The detector is followed by two low-noise a.f. amplifier stages, and these provide most of the receiver gain. The optional output stage employs a simple Class B circuit with two driver transistors.

The full circuit diagram of the receiver less the output stage is shown in Fig. 2. The untuned r.f. amplifier, TR1, is a junction gate f.e.t. employed in the common source mode, with VR1 functioning as gate bias resistor and r.f. gain control. This control is turned back on strong signals to prevent the detector from being overloaded. The drain of TR1 provides an output to the coupling winding of L1.

TR2 is the detector. The dual-gate m.o.s.f.e.t. used here has an extremely high input impedance at its gate 1 input, and so the tuned winding of L1 can be connected directly to it with negligible loading on the tuned circuit. This assists in giving good selectivity, an extremely important feature as the present-day short wave bands are very congested. The tuned winding of L1 also provides the bias for gate 1 of the transistor.

VC1 is the main tuning, or Bandset, control, whilst VC2 is the Bandspread control. Tuning with VC1 alone is rather difficult as a small movement of its control knob covers a wide range of frequencies.

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)
R1 680Ω
R2 1.2MΩ
R3 5.6kΩ
R4 3.3kΩ
R5 680Ω
R6 2.2MΩ
R7 4.7kΩ
R8 2.2MΩ
R9 4.7kΩ
VR1 22kΩ potentiometer, linear
VR2 470kΩ potentiometer, linear

Capacitors
C1 0.047μF plastic foil
C2 125μF electrolytic, 10V Wkg.
C3 0.047μF plastic foil
C4 5,600pF polystyrene
C5 0.01μF type C280 (Mullard)
C6 0.47μF type C280 (Mullard)
C7 0.022μF type C280 (Mullard)
C8 0.1μF type C280 (Mullard)
C9 0.01μF type C280 (Mullard)
C10 10μF electrolytic, 10V Wkg.
C11 470μF electrolytic, 10V Wkg.
VC1 365pF variable, type 01 (Jackson)
VC2 25pF variable, type C804 (Jackson)
VC3 50pF variable, type C804 (Jackson)

Inductors
L1 Miniature Dual-Purpose Coils, valve usage. Green, Ranges 3, 4 and 5 (Denco)
L2 19mH r.f. choke, type RFC7A (Denco)

Semiconductors
TR1 2N3819
TR2 40673
TR3 BC109
TR4 BC109

Switch
S1 s.p.s.t. toggle

Sockets
SK1 Insulated socket
SK2 Insulated socket
SK3 3.5mm. jack socket

Battery
BY1 9 volt battery type PP6 (Ever Ready)

Miscellaneous
B9A valveholder
Battery connector
Large knob
4 small knobs
Veroboard, 0.15in. matrix
Aluminium sheet (see text)
18mm. timber (see text)
Hardboard (see text)
Fablon or Contact
Nuts, bolts, wire, etc.

Therefore, VC1 is set to the band of frequencies which is to be searched for signals and VC2 is then used to tune over this band. Since VC2 has a considerably lower value than VC1 it provides coverage of a much smaller range of frequencies, whereupon tuning is much easier with this control.

R4 is the source bias resistor with C4 as its r.f. bypass capacitor. C4 has a lower value than the other r.f. bypass capacitors; this value is chosen since a higher value could give noticeable treble boost to the detected a.f. signals, an effect which is not wanted in a short wave receiver. L2 is the r.f. load for TR2, and the detected a.f. output is developed across R3. C5 bypasses R3 for r.f. signals.

Regeneration, or reaction, is provided by VC3 and the third winding of L1. Regeneration simply consists of feeding back some of the r.f. signal at TR2 drain to the tuned circuit so that it is amplified again. The amount of r.f. fed back is controlled by adjusting VC3 and, for a.m. signals, this is set so that the circuit is just below oscillation level. The use of regeneration has three beneficial effects. It increases the detection efficiency, it increases the gain given by the detector stage and it increases the selectivity of the tuned circuit. The use of regeneration thus vastly improves the performance of the receiver.

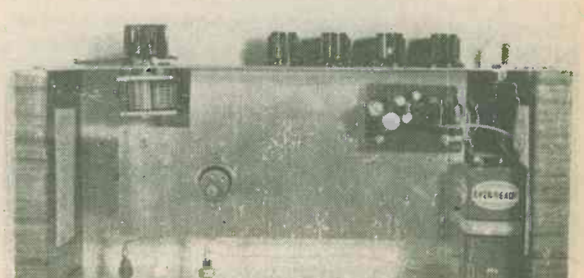
VR2 controls the gain of TR2 by varying its gate 2 potential. Gain is at a maximum with the slider of VR2 near the end of the track which connects to VR2 (but not necessarily fully at that end) and is at a minimum when the slider is at the earthy end of the track.

The coils specified have pins which fit into a standard B9A valveholder, and bandchanging is accomplished by simply plugging in the appropriate coil. The receiver case has a push-on lid which can be easily removed when changing coils.

D.C. blocking capacitor C6 couples the a.f. output from the detector to the first a.f. amplifier, TR3. This is a low-noise common emitter amplifier having R7 as its collector load and R6 as its base bias resistor. C7 gives a degree of roll-off to the higher audio frequencies, and this helps to reduce noise and general interference present on the detected output. It also assists in preventing instability in the a.f. stages.

C8 couples the output from TR3 to the input of a virtually identical a.f. amplifier stage incorporating TR4. The collector of TR4 feeds, via C10, a pair of medium or high impedance headphones (600Ω to 4,000Ω) plugged into the output socket, SK3.

C2, R5 and C11 are decoupling components, and S1 is the on-off switch. Power is provided by a 9 volt



The upper side of the chassis. The Veroboard panel visible is that for the optional a.f. output stage battery type PP6. This should have a long life as the current consumption of the receiver, without the output stage, is about 6mA only.

Two of the components require some comment at this stage. L1 is a Denco miniature dual-purpose coil intended for valve, and not transistor, usage. This type of coil is employed because the high input impedance at gate 1 of TR2 is similar to the high input impedance at the signal grid of a valve. The r.f. choke L2 may be encountered as type RFC7 instead of RFC7A. Both type numbers have the dimensions and inductance required here.

CASE AND CHASSIS

The case and chassis are home-constructed. Two pieces of timber 18mm. thick and measuring 120 by 95mm. form the end pieces, and these are covered with a plastic self-adhesive material such as Fablon or Contact to provide an attractive finish.

The front and rear panels, and the chassis, are cut out from aluminium sheet. 20 s.w.g. aluminium sheet was used for the prototype, but a thicker gauge can be used if it is more readily obtainable, and it will provide a slightly more rigid and stronger construction.

Drilling details for the front and rear panels are given in Fig. 3. VC1 is mounted by three short 4BA countersunk bolts which pass into tapped holes in the front plate of the capacitor. The positions of these are marked out on the front panel with the aid of a paper template. A small hole is cut out in the centre of a piece of paper and this is placed on the front plate of the capacitor with the spindle passing through the hole. The point of a pencil is then pushed through the paper at the centres of the three tapped holes. The paper is then removed and used to mark out the corresponding hole positions on the front panel.

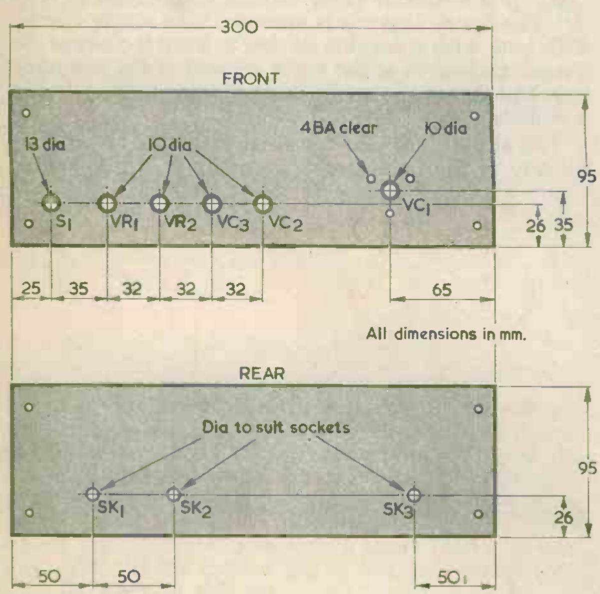


Fig. 3. Dimensions and drilling details for the front and rear panels. The material is aluminium sheet

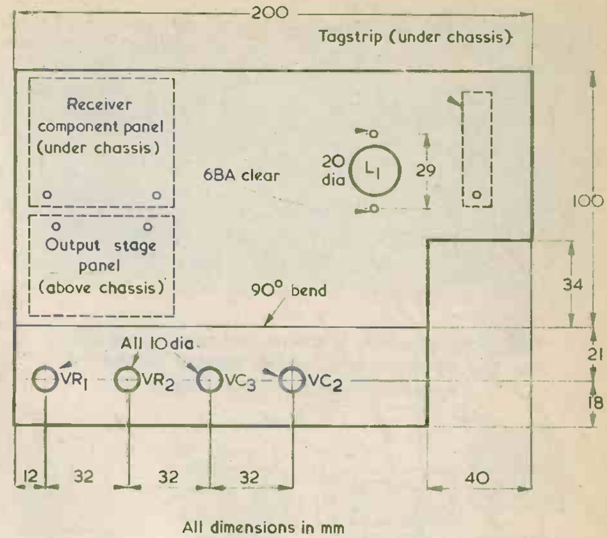


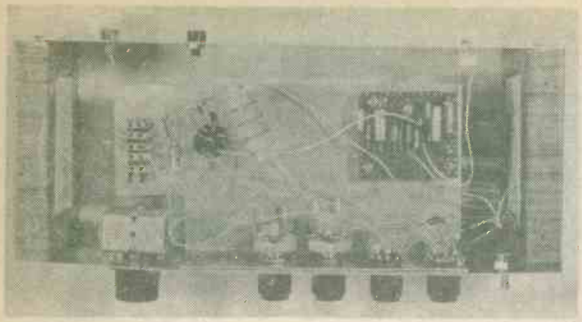
Fig. 4. The chassis, also made in aluminium sheet, has the dimensions given here. Also shown are the positions taken up by the receiver component panel and the output stage panel

The ends of the three 4BA bolts securing VC1 must not pass more than fractionally beyond the inside surface of the capacitor front plate as they could then cause damage to the fixed or moving vanes. The bolts must in consequence be quite short, and it will help if spacing washers are fitted over them at the rear of the front panel. The spacing washers could consist of 2BA nuts, if desired.

Chassis dimensions are shown in Fig. 4. The circular cut-out for the B9A valveholder is made using a 20mm. or ¾in. chassis cutter. Alternatively, a number of small holes may be made inside the periphery of the hole, allowing the centre to be pushed out. The hole is then cleaned up with a half-round file. When the valveholder is mounted later, a solder tag is secured under one of its mounting nuts, as in Fig. 6. The chassis is bent through 90 degrees along the line indicated. The four 10mm. holes on the front section of the chassis must be positioned accurately, so as to match the corresponding 10mm. holes drilled in the front panel.

Eight woodscrews are used to secure the completed front and rear panels to the wooden end pieces. The mounting bushes of VR1, VR2, VC3 and VC2 pass through the holes in the chassis and the front panel, thereby securing the two together.

The top and bottom panels of the receiver consist of pieces of hardboard measuring 124 by 300mm. These are covered with self-adhesive material of the same type as is used for the case ends. The base panel is fitted with four rubber feet near the corners, and is secured to the case ends by four woodscrews. Two pieces of timber, 100 by 10 by 10mm., are glued to the underside of the top panel near the edges. These are in contact with the inside surfaces of the end pieces when the top panel is in place, locating it in position and providing a tight push fit.



The receiver panel is below the chassis, as also are the components which appear in the r.f. amplifier and detector stages

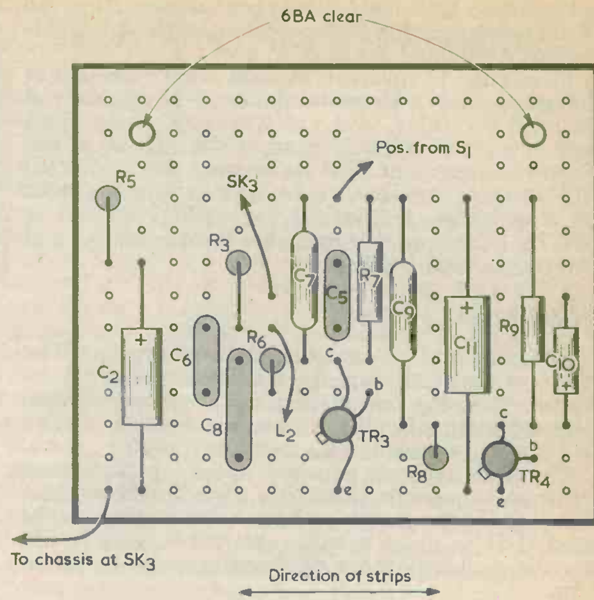


Fig. 5. Layout and wiring of the components on the receiver Veroboard panel. There are no cuts in the copper strips

COMPONENT PANEL

The components for the audio amplifier stages and some of the other circuitry are assembled on a Veroboard panel of 0.15in. matrix having 15 by 13 holes. The layout is shown in Fig. 5. There are no cuts in the copper strips.

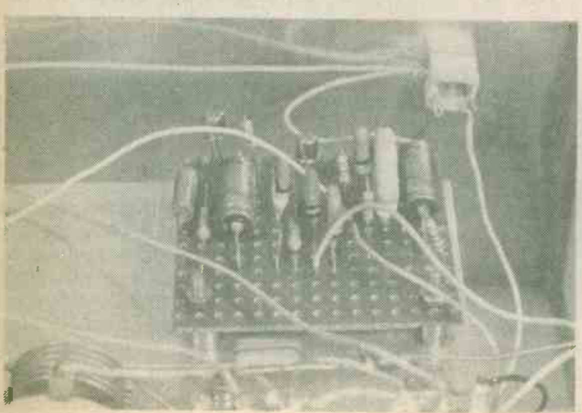
The panel is first cut out with a small hacksaw, after which the two 6BA clear holes are drilled. The various parts are then soldered into position. There are four flying leads to the remainder of the circuit but these are not fitted yet.

Two 6BA clear holes for the panel are then marked out and drilled in the chassis, using the panel itself as a template. When the panel is mounted later it will take up the approximate position shown in Fig. 4. Also, it will be mounted by means of two 12mm. 6BA screws, with spacing washers between the chassis and the panel underside to keep the panel connections clear of the chassis. The board will be mounted after it has been wired, by way of the four flying leads, to the remainder of the circuit.

R.F. WIRING

The r.f. wiring is illustrated in Fig. 6. This incorporates a 5-way tagstrip which is cut from one end of a 28-way R.S. Components tagstrip. The 28-way tagstrip is available from Doram Electronics as type 'B'. The 5-way tagstrip is mounted by a single 12mm. 6BA bolt, with a spacing washer to keep it clear of the chassis surface. A solder tag is secured at the mounting hole and this is soldered to the adjacent tag to provide a chassis connection to the latter.

The aluminium rear panel is earthed to the chassis by way of the mounting bush of SK3. If this socket



A close-up view of the receiver panel

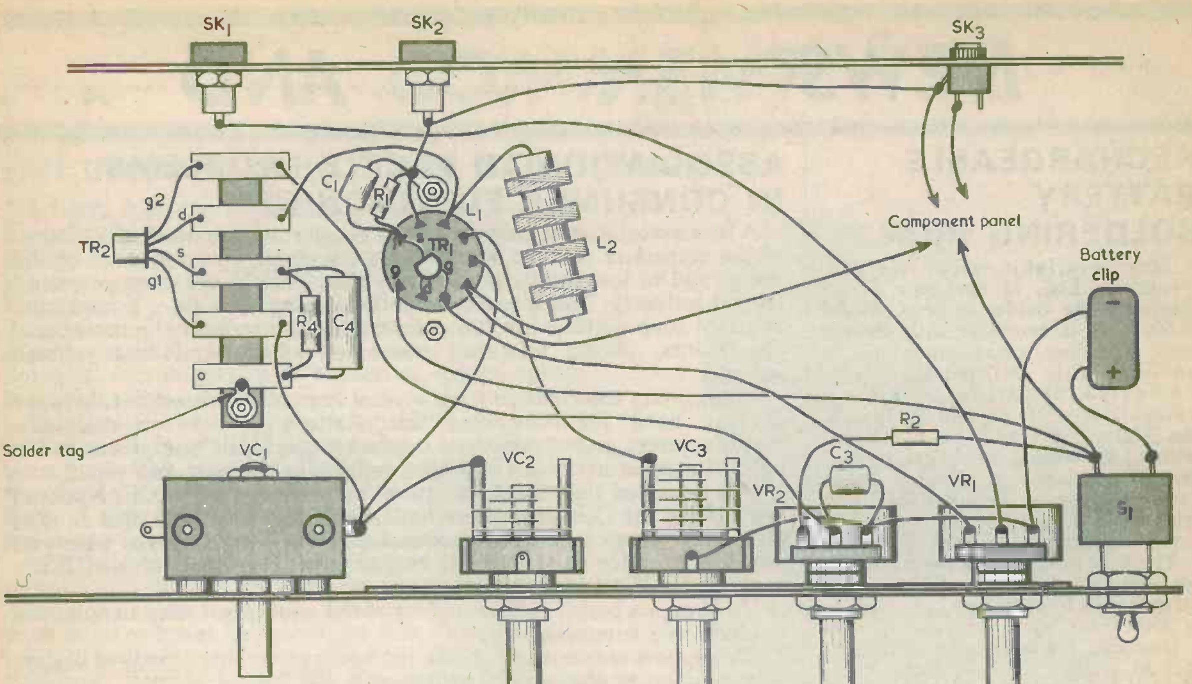
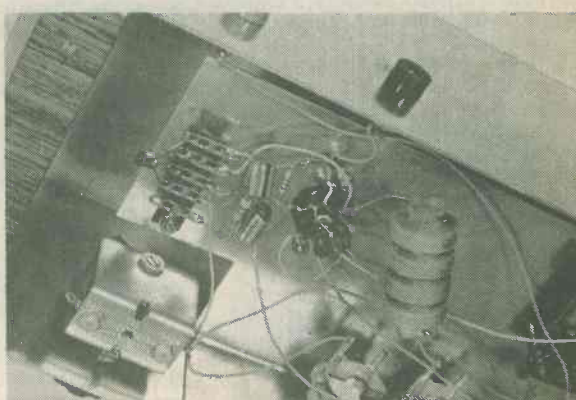


Fig. 6. The remainder of the receiver wiring. The wires should be kept reasonably short; they are shown spaced out here for clarity

The components which make up the r.f. amplifier and detector stages



has an open construction the tags to which connection should be made may be located by means of a continuity tester or by visual examination. Should the socket employed have an insulated construction which does not provide the requisite connection to the panel, a 6BA clear hole should be drilled near it and a solder tag mounted here with a short 6BA bolt and nut. The chassis connection to the rear panel may then be made at this tag.

Wiring up is quite simple and straightforward. Tags on the B9A valveholder which do not take coil connections are used as anchor tags for some of the components. Wires should be kept reasonably short and direct. In the diagram they are shown spaced out for reasons of clarity.

NEXT MONTH

The concluding article in next month's issue will give details of receiver operation and will also cover the assembly and fitting of the optional a.f. output stage. The Components List which accompanies the present article lists the components required for the receiver as so far described. The parts required for the output stage will be listed next month.

(To be concluded)

NEWS . . . AND .

RECHARGEABLE BATTERY SOLDERING IRON

Now available from Kelgray Products Ltd. is the new Engel Rechargeable Soldering Iron, Model B.50. This is complete with charger unit. The iron incorporates long-life rechargeable Nickel-Cadmium batteries ensuring maximum reliability. Of compact design, the B.50 will give up to 100 operations without recharging, which can be performed overnight in about 8 hours (overcharging is impossible). The trigger-switch is fitted with a safety catch to prevent accidental operation.

The B.50 is fitted with the B.50D bit for work up to 2.5mm², and heats up to an operating temperature in the region of 350°C in about 7 seconds.

Designed for recharging from normal AC mains, the B.50 comes complete with cleaning pad and screwdriver, and is ideal for repair, assembly and "D.I.Y." applications, particularly "on-site" work where no mains supply is available. The price complete is £13.55 (plus VAT) and it is available at the moment only from the sole U.K. agents, Kelgray Products Ltd. of South Godstone, Surrey.

New Engel battery operated soldering iron with recharging unit

ASSOCIATION TO TACKLE PROBLEMS IN CONSUMER ELECTRONICS

A new association is being set up to support and promote the interest of the consumer market in the home electronic entertainment equipment, and to look into the problems that exist in the consumer electronics industry. There has been an increasing amount of mixed comment on such matters involving development, marketing, international agreements, public relations, consumer advice and do-it-yourself aspects.

Preliminary information from several sources indicates that there is a growing need for improving the relationship between designers, manufacturers and suppliers of consumer electronic equipment in the light of complaints about supplies, reliability, service, and repairs.

It is expected that the Association, to be known as NACE, National Association for Consumer Electronics, will highlight problems as they arise and, where specifically requested, to investigate areas where an improved service to the public is justified. The Aims of NACE are quoted as follows in broad terms:

1. To promote better understanding of the equipment used in domestic electronic entertainment.
2. To support measures to obtain the best possible standards of design, manufacture and service of domestic electronics.
3. To promote the dissemination of information about domestic electronic equipment between manufacturers and users.

Within these aims, it is hoped to encourage groups, clubs, societies and traders to foster discussion and opinion so that they and their needs are recognised and the general service improved.

Readers requiring further information should write, enclosing an s.a.e., to The General Secretary, NACE, 282 Hatfield Road, St Albans, Herts, AL1 4UN.

FISH, FRESH OR FOUL?

An instrument for measuring the freshness of fish has been invented in Britain. It will certainly attract attention in the fish markets, where for centuries the prime method of assessing freshness has been the human nose. The instrument was described in a BBC science programme.

It is similar in size and shape to a child's shoe, and in use it can be held in one hand. One end — the 'toe' of the shoe, if you like — is pressed against the fish. You press a button, and a number between zero and sixteen lights up in a window at the top of the instrument.

This number is a measure of an electrical property of the fish (the dielectric loss angle) which is known to change as a fish deteriorates. Perfectly fresh cod might read 16, but after a week on ice the reading would have dropped, perhaps to 12. Readings near zero indicate fish in a really putrid and inedible condition.

An important point is that the measuring operation does not damage or mark the fish in any way.

Since individual fish vary somewhat, the instrument can automatically work out the average of 16 readings — which should be enough to give an indication of the general quality of a batch of fish.

The instrument has been named the Torrymeter because it was developed by the Government's Torry Research Station at Aberdeen, in collaboration with a private firm, G. R. International Electronics Ltd. The project has been supported by the National Research Development Corporation.

At a price of approximately £400, this is not an instrument for the high street fishmonger, but it may interest people in the wholesale fish trade, and public health officials. Though the nose will probably remain the ultimate arbiter of fish freshness, the Torrymeter has the advantages that it does not need years of training and experience, it can work tirelessly for hours on end. And of course, it never catches a cold.

. . . COMMENT

EMI INVESTS IN HOT AIR BALLOONING

An 80ft. high hot air balloon, nicknamed "Sounds Great", is to play an important role in the promotional plans of leading British magnetic recording tape producer, EMI Tape Limited, of Hayes, Middlesex. To put its name ahead (and above!) the competition in the rapidly expanding tapes and cassettes market, the company is taking to the air by flying its own 65,000 cu.ft. balloon at special events throughout Britain and abroad.

The Emitape balloon is being organised and piloted by David Claridge, EMI Tape's new advertising and sales promotion manager. David, a pilot of 2½ years experience, aims to cover most of the major pop concerts in this country, as well as county shows and venues as far away as Scandinavia and Australia.

The attractive orange and mauve balloon was recently unveiled at the first Emitape International Sales Conference held at Stratford-upon-Avon in front of 30 overseas delegates. An International Class AX 7 balloon, made by London firm Thunder Balloons, 'Sounds Great' has the slogan 'Emitape' emblazoned around it in 6ft. high letters with the world-famous 'Dog and Trumpet' EMI trademark above.

For the technically-minded, the balloon operates on propane gas and is fitted with a burner that has an output of 6,000,000 BTu/Hr — the equivalent to 200 gas ovens operating together.

Peter Mitchell, EMI Tapes's marketing manager, said, "With the new products we are introducing in both consumer and professional areas, 'Sounds Great' is the perfect vehicle for Emitape. Not only will this type of publicity venture provide support to different national dealer promotional campaigns organised by EMI Tape, but it will lend itself to special local promotional functions."

BRITISH AMATEUR TV CLUB CONVENTION

The B.A.T.C. is holding its next Amateur Television Convention on Saturday the 18th September 1976 in Parkinson Court at the University of Leeds, from 10 a.m. until 5.30 p.m.

Admission will be free, and everyone with an interest in amateur television will be most welcome.

There will be displays and demonstrations of members equipment, including slow scan as well as 625 line systems. In addition, there will be some trade stands and a bring and buy stall.

Further details are avilable from: A. R. Watson, Somerby View, Bigby, Barnetby, South Humberside.

BBC HENRY WOOD PROMENADE CONCERTS — SOME STATISTICS

During the 1976 season there are 205 works being played, 57 of them British, and 72 of them new to the Proms. Out of 139 soloists, 105 are British, with 41 making their debut at the Proms. The conductors, of whom there are 34, share 19 orchestras, 11 other ensembles and 10 choirs.

All the concerts will be broadcast in stereo by Radio 3, with a majority of Tuesdays simultaneously on Radio 4. All or part of ten concerts will be shown on BBC-tv. All those on BBC-2 are live, with stereo sound on Radio 3; most of the six on BBC-1 are recordings, to be shown on Sunday evenings. The BBC World Service will broadcast 23 concerts live, and 20 recordings. On radio and television the total audience for the Proms, including listeners to the World Service, is estimated at 100 million.

"Have you ever thought of transistorising those things, O Vulcan?"

JACK PLUG KEY

By G. A. French

In his article in the March 1976 issue of this journal the writer described a 'Capacitor Combination Lock' by means of which a latch could be released by pressing a series of buttons in a specific order.

It is possible to conceive a simpler type of electrical or electronic lock, this being released by the insertion of a jack plug into a jack socket. The jack socket is mounted on the door or lid which is secured by the lock, whereupon the process of inserting the jack plug is analagous with that of inserting a key. As in the previous article, the lock is released by passing an energising current through a solenoid, which then retracts a mechanical latch.

SIMPLE CIRCUIT

A very simple jack plug operated lock is illustrated in Fig. 1. Here, the jack plug has its tip and sleeve connected together, with the result that its insertion in the socket completes the circuit between the battery and the solenoid. The solenoid then energises and releases the lock. The jack plug and socket may be 2.5mm., 3.5mm. or ¼ in. types, and the socket can be positioned at an inconspicuous point on the protected surface.

An obvious disadvantage with the circuit of Fig. 1 is that the lock can be readily released by the insertion of any small metal object capable of short-circuiting the two socket contacts. Nevertheless, the scheme has its attractions for applications where a high level of security is not required, and it serves to introduce the more complex circuit which will next be discussed.

This is shown in Fig. 2, and it will be seen that the tip and sleeve of the plug are not now connected together directly, but by way of the 4.7kΩ resistor Rx. The socket circuitry is designed

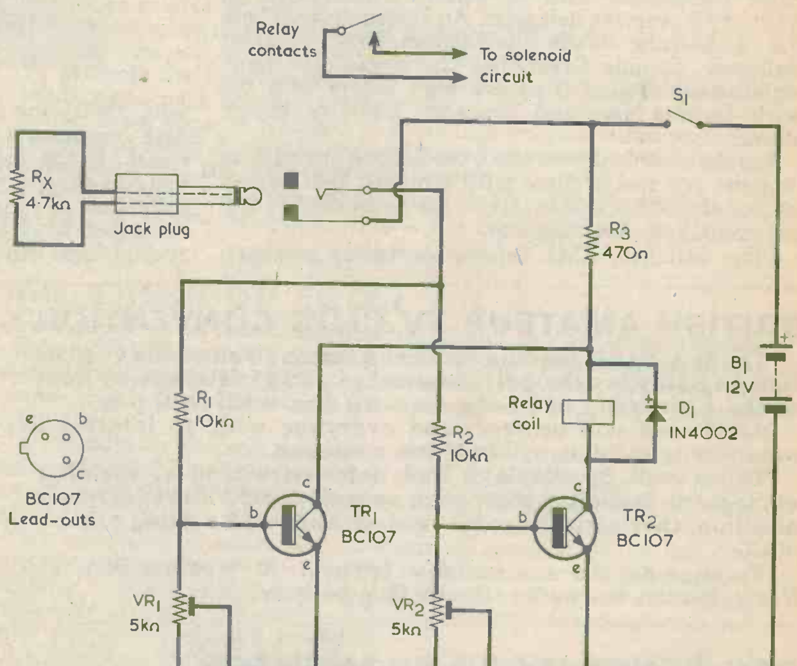


Fig. 2. A more comprehensive lock circuit. The lock releases with the insertion of a jack plug having a resistance between its contacts which falls within a specific range

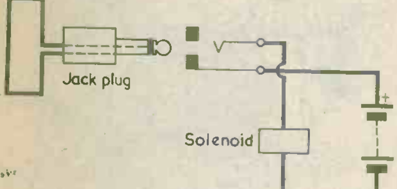


Fig. 1. A very simple jack plug lock. Inserting the plug completes the circuit to the solenoid, which then releases the lock latch

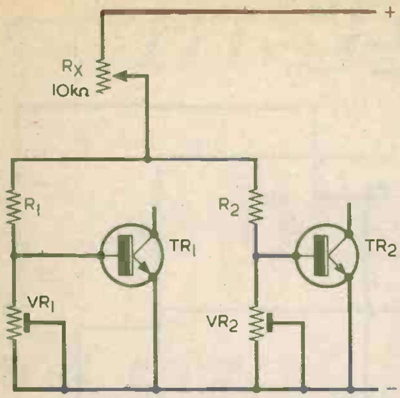


Fig. 3. The description of circuit operation is eased by assuming that Rx is a variable 10kΩ resistor

such that the lock will only release when a resistance of around 4.7kΩ is applied to the socket contacts, i.e. by inserting the jack plug. The lock does not release if the socket contacts are short-circuited, and the lock is therefore very much more secure than is that that of Fig. 1. In practice, the 4.7k Ω resistor may be a miniature ¼ watt 5% type and, with ¼ in. jack plugs or 2.5 and 3.5mm. jack plugs having large bodies, can in most instances be positioned inside the body of the plug itself.

When the plug is inserted in the socket, the 4.7kΩ resistor connects between the positive supply rail and the upper ends of R1 and R2. To understand how the circuit functions, let us assume that Rx is replaced by a 10kΩ variable resistor, as in Fig. 3, and that this is initially set to insert maximum resistance into circuit.

With Rx at 10kΩ, the voltage at the base of TR1 with respect to its emitter is below the 0.6 volt level needed to make a silicon transistor conductive, and so TR1 is cut off. The voltage at the base of TR2 is just around 0.6 volt and this transistor passes a low collector current. This current flows through the relay coil and R3 of Fig. 2, but is too low to cause the relay to energise.

The value of Rx is then reduced by adjusting the assumed variable resistor of Fig. 3. As it approaches 4.7kΩ the collector current of TR2 increases until, somewhat before the 4.7kΩ level, it is sufficient to operate the relay. The relay energises and its contacts complete the solenoid circuit, thereby releasing the lock. At this point the base of TR1 has just reached the 0.6 volt bias level and TR1 passes a small collector current through R3.

As the value of Rx is further reduced, it passes the 4.7kΩ figure and presents resistances below this value. TR2 still remains conductive, but the collector current of TR1 increases as the value of Rx decreases. When Rx is significantly below 4.7kΩ the collector current of TR1 causes a marked voltage drop across R3 of Fig. 2. This is sufficiently high to bring the voltage across the relay coil below the energising level. Reducing the value of Rx further merely causes TR1 collector current to increase and produce yet a higher voltage drop across R3, with still less voltage available for the relay coil.

The situation may be summed up by looking at the action of the two transistors. If Rx is significantly higher than 4.7k Ω, TR1 is cut off and TR2 does not pass sufficient collector current to energise the relay. When Rx is significantly lower than 4.7k Ω, TR2 is capable of providing the energising current but TR1 is now conductive and causes the voltage available for the relay to be too small for it to operate. It is only when Rx is at about 4.7kΩ that the two transistors allow the relay to energise and the lock to be released.

The responses of the two transistors to different values of Rx are governed by the settings of pre-set potentiometers VR1 and VR2. These two components are adjusted in a manner which is described later.

RELAY TYPE

The relay employed in the circuit is the popular 'Miniature Open P.C. Relay' with 410Ω coil which is retailed by Doram Electronics. This is specified as having a coil energising voltage range of 4.8 to 35 volts, and the writer's experience with a number of these components is that they just energise at a coil voltage slightly below 4 volts. If it should happen that a par-

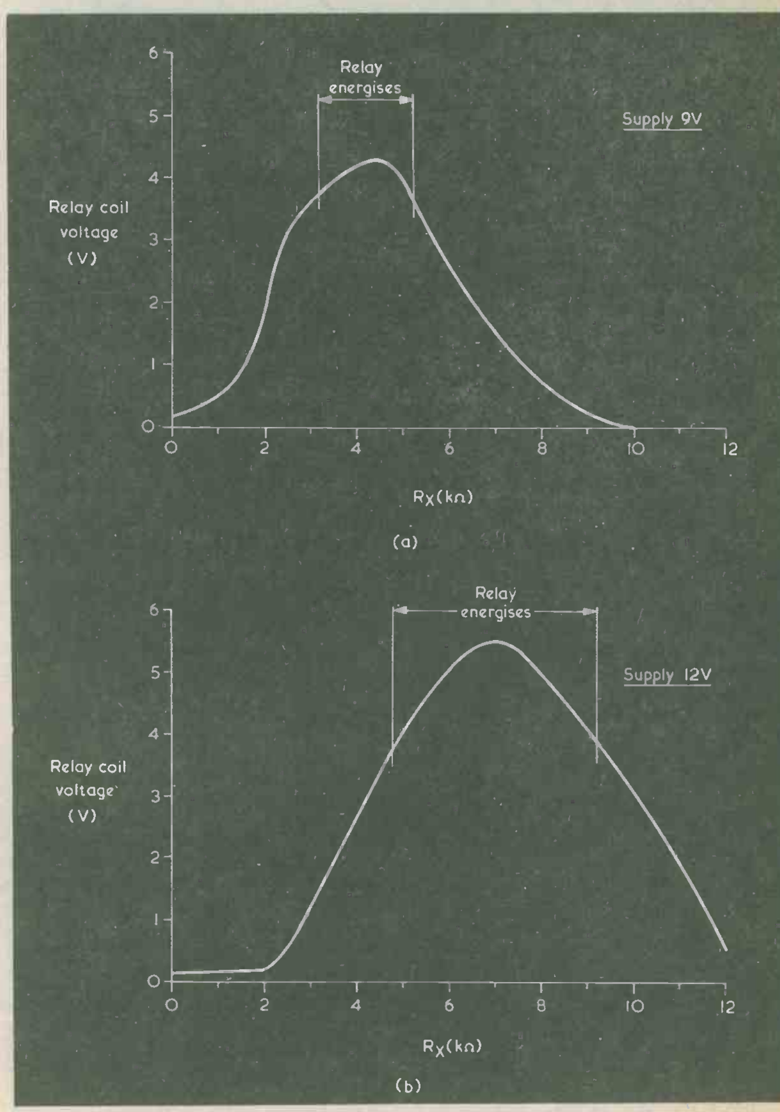


Fig. 4(a). Graph showing the response of the prototype circuit to different values of Rx when the supply voltage is 9 volts (b). The performance given with a supply of 12 volts ticular specimen of the relay energises at a higher voltage (which is at or below the 4.8 volt of the maker's specification) it is merely necessary to reduce the value of R3 accordingly. The relay is intended for fitting to a printed board, but it may also be mounted in conventional manner by means of two 8BA bolts passed through holes in its metal frame. This frame, incidentally, is common with its moving contact. D1, connected across the coil, is the usual diode which prevents the formation of a high back-e.m.f. voltage when the relay releases.

The three fixed resistors, R1, R2 and R3, may be ½ watt 10% tolerance components. VR1 and VR2 are small skeleton potentiometers. Switch S1 will normally be fitted behind the protected door or lid and will be turned on before this is closed and locked. The current drawn from the battery with no plug inserted in the socket is the very low leakage current of the two transistors. In the prototype circuit, this current was so small that it produced no deflection in the needle of a meter switched to read 0-50μA.

The battery, B1, has a nominal voltage of 12 volts and it is intended that the circuit be still capable of operating when this has fallen to 9 volts. A fairly large battery is required and a good choice would be given by four twin-cell cycle lamp batteries (Ever Ready No. 800) connected in series. A separate battery is employed in the solenoid circuit.

SETTING UP

Setting up is carried out with the aid of a variable voltage supply offering outputs at 9 volts and 12 volts, or by the use of dry batteries offering these voltages. Although not essential, it is very helpful also to have a voltmeter connected across the relay coil, this being switched to read voltages around 3 to 6 volts.

With Rx at 4.7kΩ, and assuming a useful battery voltage range of 9 to 12 volts, VR2 is adjusted such that the relay just energises on a 9 volt supply, whilst VR1 is adjusted so that TR1 is at the point of preventing the relay from energising with the supply at 12 volts. The setting up procedure is then carried out in the following manner.

1. Connect the voltmeter, if available, across the relay coil, with negative to the collector of TR2.

2. Adjust VR1 and VR2 to give minimum resistance between the transistor bases and the negative rail.

3. Apply a 9 volt supply, close S1 and plug in the jack plug with Rx connected to it.

4. Slowly increase the resistance inserted by VR2 until the relay just energises. This will normally be at a coil voltage slightly below 4 volts. If the relay does not energise because it requires a higher coil voltage than is available in the circuit, reduce the value of R3, trying first a value of 430Ω and then, if necessary, 390Ω. Under worst-case conditions, a value as low as 360Ω may be required. In most instances, it should not be necessary to adjust the value of R3. Also, the provision of a coil voltage lower than the nominal 4.8 volt figure only arises with supply voltages below about 10.5 volts.

5. Remove the jack plug and Rx, and apply a 12 volt supply.

6. Set VR1 to insert maximum resistance, then plug in Rx once more.

7. Slowly reduce the resistance inserted by R1 until the relay just energises.

8. Remove Rx, and re-apply the 9 volt supply. Plug in Rx and, if the relay does not energise, slightly increase the resistance inserted by VR2 until it does.

The setting up procedure is then completed. The curves of Figs. 4(a) and (b) were obtained with the prototype circuit, and show relay coil voltage against different values of Rx at supply voltages of 9 and 12 volts respectively. With a 9 volt supply the relay energises for values in Rx from 3.2kΩ to 5.2kΩ, whilst with the 12 volt supply the range is from 4.7kΩ to 9.1kΩ. The extended range in excess of 4.7kΩ at 12 volts is to be expected, as this is gover ned by VR2 which is set up at the lower 9 volt supply level. The results are acceptable for the circuit to be employed as an electronic lock. It should be noted that the same resistor that is employed for Rx during setting up must be retained for use afterwards. That used with the prototype had a value, within tolerance, that was slightly higher than 4.7kΩ.

The current drawn from the 12 volt supply with the plug inserted was 16mA. When the jack socket contacts were short-circuited, this rose to 24mA. Proportionately lower currents are drawn with supply voltages less than 12 volts.

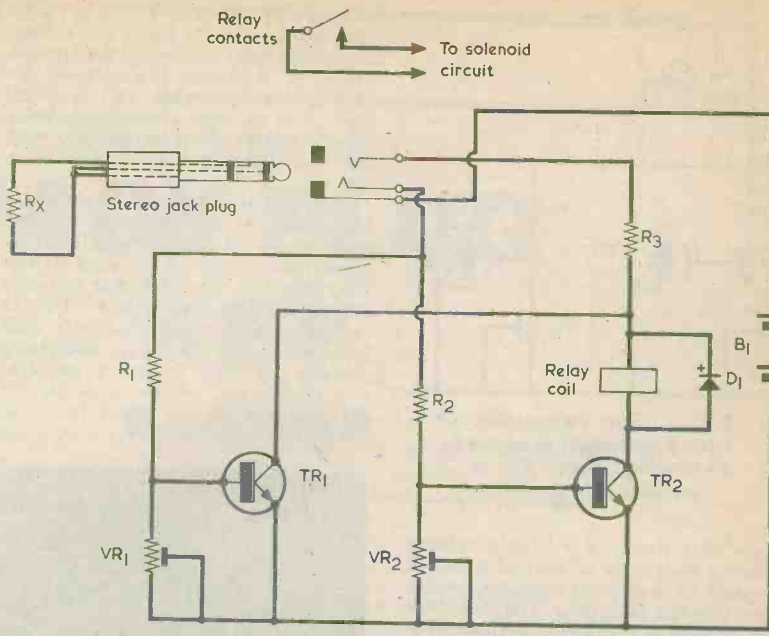


Fig. 5: An alternative version of the circuit using a 3-way jack plug and socket. The supply is switched on when the plug is inserted

SWITCHLESS CIRCUIT

Despite the fact that the circuit draws a negligibly small current when it is switched on and no plug is inserted, some constructors may prefer to have a physical switching action instead of relying on low leakage current in the transistors.

On-off switching can be readily arranged with the use of a 3-way stereo jack plug and socket, as in Fig. 5. The plug has its tip and sleeve connected together, with Rx between this common connection and the centre plug connector. With the plug out of the socket there is no connection between the positive terminal of the battery and the remainder of the circuit. Inserting the plug causes the battery positive terminal to connect directly to the upper end of R3 and to connect, via Rx, to the upper ends of R1 and R2.

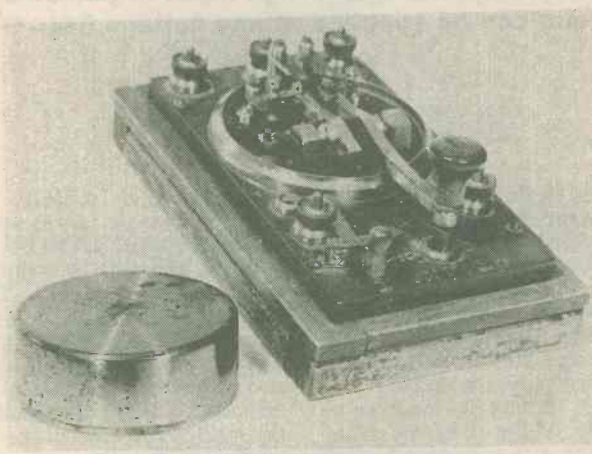
Component values in Fig. 5 are the same as in Fig. 2 and the same setting up procedure is followed.

Solenoids for both versions of the circuit are available from several retail sources or can be home-constructed. Two miniature solenoids are listed in the Henry's Radio catalogue, one having a coil resistance of 55Ω and operating at 15 to 28 volts, and the other having a coil resistance of 15Ω and operating at 4.5 to 9 volts. ■

HISTORIC MORSE KEY

By Ron Ham

Enjoying a renowned past, this relic from the earlier days of short wave communication now holds an important place in a private collection of antique and wartime radio equipment.



Manufactured to Government order during the First World War, this time-honoured morse key has played its part over four decades of short wave history.

Sixty years ago Muirhead & Co. Ltd. manufactured a number of 'double current' morse keys to meet a special order for the British Government. One of these keys, No. 374, adorned with the Government broad arrow and dated 1915, is now in the private collection of the author at Storrington, Sussex.

The moving parts, heavy contacts and send-receive switch of this beautifully engineered key are made of brass and are mounted on an ebonite base measuring 8 by 4 in.

RADIO HISTORY

Until her sudden death on June 25th, 1974, this morse key was used by Miss Nell Corry who, for over forty years, made radio history.

Miss Corry was granted a transmitting licence in 1932, and her call sign G2YL (giving the initials of Young Lady) became famous throughout the world. During her first few months on the air she made 650 contacts in 56 different countries, using c.w. in the 20 and 40 metre bands.

At the end of October 1935, ten national newspapers reported at length that on October 27th Miss Corry had established radio communication with all continents in six hours and twenty minutes on the 10 metre band. She carried out this feat using the Muirhead key.

Muirhead components have been associated with progress in the world of radio over very many years, and it is therefore fitting that a Muirhead key was used by Nell Corry when she wrote her page in the story of short wave radio communication.

VERSATILE POWER AMPLIFIER

By J. P. Macaulay

Incorporating several novel features, this amplifier has a high input impedance and can be supplied at any voltage from 9 to 28 volts.

The a.f. amplifier described in this article has been designed to work with a wide range of supply voltages and to offer a high input impedance with good sensitivity. A great many projects incorporate power amplifiers, and it is surprising how often such an amplifier is required for test purposes. Apart from general uses, the amplifier also functions as an inexpensive mono record player amplifier or can provide one channel of a stereo record player amplifier.

An output of 10 watts r.m.s. into an 8Ω load can be obtained with a 28 volt supply. At the other end of the scale, 300mW is possible with a 9 volt supply. The author does not have access to equipment capable of measuring total harmonic distortion, but can say that there is no noticeable distortion according to subjective listening tests except at very high volume levels. The latter could probably never be employed in most urban environments without annoyance to neighbours.

Despite the simplicity of its circuit, this amplifier is not recommended as a project for the beginner. This is partly because, due to its versatility, no details are given for suitable power supplies. It will, however, be of interest to the experienced constructor who fully understands the principles of a.f. amplifier operation and who can arrange a suitable power supply for a particular application.

CIRCUIT FUNCTIONING

The amplifier circuit is shown in Fig. 1. Here, the input signal is fed to the non-inverting input of IC1, which is a 741 op-amp in 8-pin d.i.l., by way of C1 and volume control VR1. At low volume settings the input impedance is approximately equal to the value of the volume control, whilst at high volume levels it is slightly reduced by the input resistance of the i.c., which is typically 2MΩ.

Since a single power supply with only two rails is used the input must be biased at half the supply voltage, and this is arranged by the voltage divider given by R1 and R2. The junction of these two resistors connects to the earthy end of VR1 track and is bypassed to chassis via C2.

The amplified output of the i.c. is taken from pin 6 and applied to the base of TR1. This transistor is an emitter follower; it presents a low impedance drive to the output transistors and prevents excessive loading on the i.c. output.

TR2, connected between the bases of the output transistors, acts as a VBE multiplier and also compensates for temperature rise in the output pair. R4, effectively in TR1 emitter circuit, determines the driver current.

The complementary output pair, TR3 and TR4, are also connected in the emitter follower mode, R5 and R6 being incorporated as an extra precaution against thermal runaway. Preferably, TR3 and TR4 should be a matched pair.

Overall feedback is applied to the inverting input at pin 2 of the i.c. through VR2. Disregarding C5, the overall voltage gain is determined by VR2 and R3 at 50 times. C3 isolates pin 2 from chassis and reduces the d.c. gain to unity. In conjunction with C5, VR2 provides a top-cut tone control. With VR2 inserting zero top-cut, the frequency response at the high frequency end is determined by the internal roll-off of the i.c. employed and, with the gain chosen, the upper –3dB limit appears at 15kHz. The lower frequency –3dB limit occurs when the reactance of C4 is equal to the impedance of the speaker used. With 8Ω units this appears around 10Hz, with 3Ω at 25Hz and with 15Ω units at 5Hz.

The amplifier has an input sensitivity of 130mV for

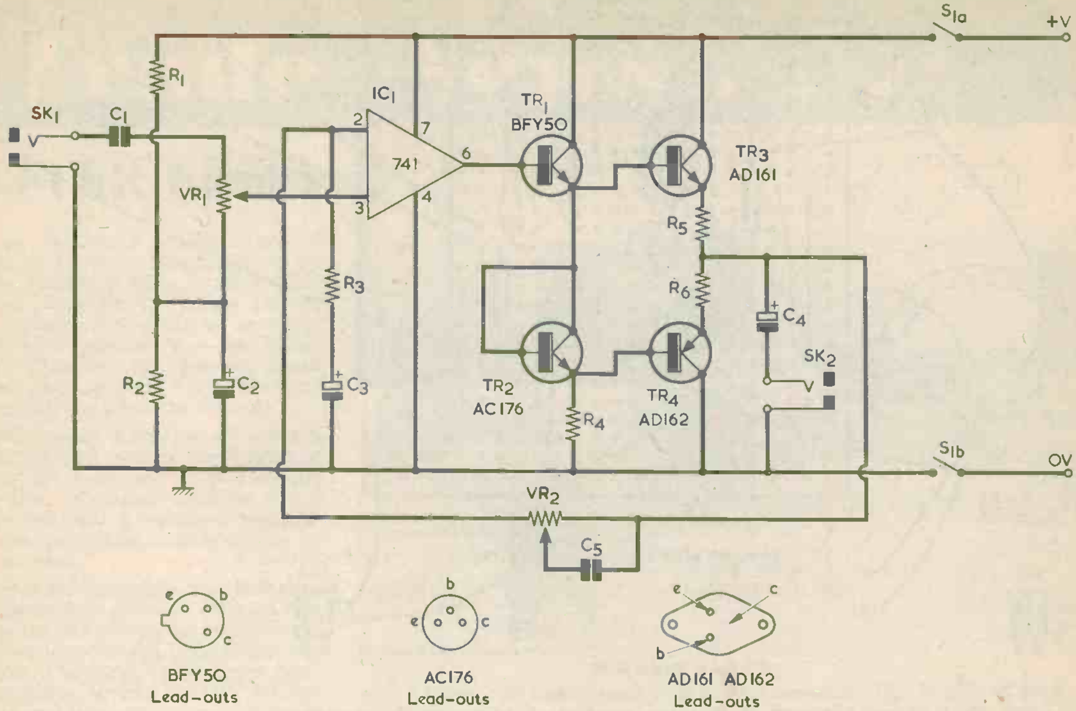


Fig. 1. The circuit of the power amplifier. This is capable of operating with a wide range of supply voltages

COMPONENTS

Resistors

(All fixed values ½ watt 5% unless otherwise stated)

R1 47kΩ
R2 47kΩ
R3 1kΩ
R4 270Ω, 1 watt
R5 0.47Ω, 1 watt
R6 0.47Ω, 1 watt
VR1 2.2MΩ potentiometer, log, with switch S1(a)(b)
VR2(a) 47kΩ potentiometer, linear

Capacitors

C1 0.1μF disc ceramic
C2 100μF electrolytic, 25V Wkg., vertical mounting
C3 100μF electrolytic, 25V Wkg., vertical mounting
C4 2,000μF electrolytic, 25V Wkg., wire ended
C5 0.01μF plastic foil

Semiconductors

IC1 741 in 8-pin d.i.l.
TR1 BFY50
TR2 AC176
TR3 AD161
TR4 AD162
(TR3, TR4, matched pair with mica washers and insulated mounting bushes)

Sockets

SK1, 2 ¼in. jack sockets

Switch

S1(a)(b) d.p.s.t., part of VR1

Miscellaneous

Veroboard, 0.1in. matrix, 24 x 24 holes
2 knobs
Heatsink for TR1 (see text)
Chassis, nuts, bolts, etc.

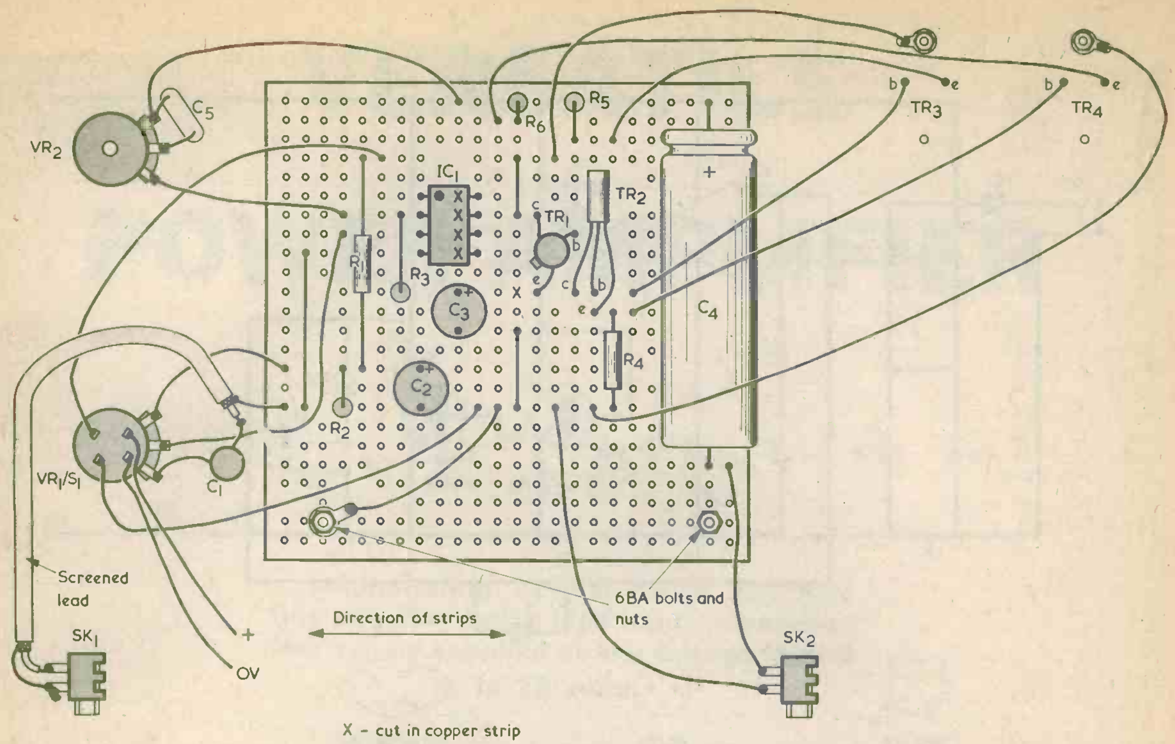


Fig. 2. A suitable method of wiring up the amplifier

5 watts output into an 8Ω load from a 20 volt supply. If TR1 is fitted with a push-on heatsink, the circuit will provide 10 watts r.m.s. into an 8 Ω speaker from a 28 volt supply. At the other extreme the amplifier will work quite happily from a 9 volt supply although the output power will be severely limited. Below 15 volts the amplifier is safe operating into a 3Ω speaker. TR1 requires the heatsink for all supply voltages above 20 volts.

If battery operation is chosen, a large value electrolytic capacitor, of around 1,000μF, must be connected across the supply rails. A PP9 or similarly large battery is required for 9 volt operation as a smaller one would be rapidly exhausted. The possiblity exists that the amplifier could be employed in a car since, running from a 12 volt source and driving a 3 Ω speaker, the circuit will deliver several watts of good quality sound.

CONSTRUCTION

The smaller components of the prototype amplifier are mounted on a piece of 0.1in. matrix Veroboard having 24 by 24 holes, using the layout shown in Fig. 2. There are five cuts in the copper strips, four between the pins of the i.c. and one between TR1 emitter and the positive lead-out of C3.

Chassis layout can be as desired by the constructor. The author mounted the board, the controls, the sockets and the output transistors on a flat 18 s.w.g. aluminium plate measuring 8 by 3in. This provided the heat sink for the output transistors, which were fitted to it near one end. Both transistors were insulated from the plate by mica washers and insulating bushes. The Veroboard was mounted with two 6BA bolts and nuts, spacing washers being employed to space off the board underside.

If the input and output sockets have an insulated construction the board components pick up their chassis connection from a solder tag under the left-hand 6BA securing nut, as in Fig. 2. If the sockets are of a non-insulated construction, this solder tag and its lead are not required since the chassis connection is provided via the sockets. The socket employed for SK2 must not be a type which could allow its two connections to be momentarily short-circuited as the plug is inserted.

A disadvantage with direct coupled amplifiers such as this one is that a single wiring mistake can have catastrophic consequences. It is therefore recommended that, before trying out the amplifier, a thorough check is made of all the wiring, particularly that connected with the output stage.

When satisfied that all is well, a loudspeaker and a power supply can be connected. On switch-on a 'plop' should be heard from the speaker. Also, a finger applied to the slider of the volume control, if this is partly advanced from the minimum volume position, should produce a loud buzzing sound.

No setting up is required, since TR2 automatically regulates the quiescent current in the output pair.

Because of its high impedance the input is especially subject to hum pick-up, and care is needed in screening the input wiring. The situation here is similar to that given with valve amplifiers having a high input impedance. For many applications the high input impedance is not required, whereupon VR1 may be reduced in value to 100kΩ, with a considerable easing of the hum problem.

A 28 volt supply should have a current capability of some 1.75 amps. Smaller currents will be drawn, with 8Ω speakers, from supplies offering lower voltages. The quiescent current drawn by the prototype amplifier was 22mA at 9 volts, 38mA at 16 volts, 47mA at 20 volts and 65mA at 28 volts. ■

Trade News . . .

Hi-Fi kit furniture

Latest additions to the range of Modus kit furniture manufactured by Modus Furniture Ltd., Bradley Mill, Bradley Lane, Newton Abbot, Devon, are four new items designed specially for the Hi-Fi enthusiast — the Music Centre Console, the Entertainment Centre, the de luxe Entertainment Centre and the Cassette Console.

"Hi-Fi users continue to top the popularity poll among purchasers of Modus kit furniture", declared Mr John Cox, Managing Director, "and we are now getting increased demands for more specialised units which we intend to meet."

Modus kit furniture was launched last September and was selected this year to furnish a bedroom in the Evening News house at the Ideal Home Exhibition. The range is the most comprehensive in Britain for DIY kit furniture, and now comprises nearly 40 items, including sofas, easy chairs, beds, wardrobes, tables, chairs, shelves and many other units to furnish a home with less expense than any other way.

The larger version of the Entertainments Centre, this unit has room for nearly 400 LPs as well as 88 cassettes. The length of each section from the corner is 6ft. 3ins.; height is 16½ins.; and depth is 15ins. The price is £34.75 including VAT, carriage and insurance.

Motorola publish semiconductor data library

Motorola have published a seven-volume Semiconductor Data Library with a combined thickness of about nine inches which gives full specifications for all the semiconductor devices manufactured by Motorola. Additionally, the library also lists the function and the significant electrical and mechanical characteristics of all E.I.A. registered semiconductor devices including those that are not manufactured by Motorola.

The product range is divided into six groups (1N-2N, 3N-4N, in-house type numbers, MECL, CMOS and linear i.c.'s) and there is a volume for each group. The seventh volume is a Master Index which has a multi-purpose role. It functions as an Index to the rest of the library, as a device selector guide, it highlights new devices and capabilities, it contains brief data on all Motorola and all EIA devices, it is an equivalents guide, it contains outline drawings, it has a list of Motorola publications and contains an index of application notes.

The Semiconductor Data Library is available from Motorola Distributors at the recommended price of £15 for Set 1 and Set 2.

Laskys launch Hi-Fi charter

Laskys, Europe's largest Hi-Fi retailer, on 30th June launched a Hi-Fi Charter. This was introduced by Michael Adler, the Deputy Managing Director, who is personally responsible for all aspects of Laskys' Consumer Services.

Mr Adler said: "Hi-Fi is now a major growth area of the leisure market, with 75% of all households owning some form of record-playing equipment. In fact, research published only last week shows that Hi-Fi beats even a colour television set as the 'most-wanted' item in the home. As Hi-Fi is a considered purchase — in many cases involving substantial sums of money — we felt that the consumer should be given the best possible written assurances of the quality of the products he is buying, and the service and advice available."

The Charter covers a new 14-day money-back offer, trade-in facilities, quality control and after-sales service.

"It has been drawn up with the advice and help of the Office of Fair Trading, and other consumer protection organisations, to whom we would like to express our thanks," Mr Adler added.

'NOTES FOR NEWCOMERS'

HIDDEN RESISTANCE

An element of electricity that is always with us.

By F. G. Lloyd

If you take certain metal wires down to a temperature which is within a few degrees of absolute zero (minus 273 degrees Centigrade) they become superconductors and exhibit virtually zero resistance. Should a current be induced in a loop of superconductive metal wire by means of a magnetic field, that current continues to flow even after the field has been taken away.

In ordinary electronics we cannot indulge in the practice of creating superconductors and we deal with metal wires and conductors at normal temperatures, these exhibiting common-or-garden Ohm's Law resistance. Usually, the inevitable resistance in a conductor does not cause us any serious problems because most of the currents we deal with are sufficiently low to be carried by quite thin connecting wire with no perceptible voltage drop along the wire.

There are, on the other hand, a number of *hidden* resistances in electronics and we have to keep our eyes open for these because they can play an important part in circuit functioning.

INTERNAL RESISTANCE

One of the most commonly encountered hidden resistances is the internal resistance of a battery. When a current is drawn from the terminals of a battery a current of the same amplitude flows through the battery itself. In other words, a current circulates through the loop given by the battery and the external circuit, and it is the function of the battery to keep that current moving.

In its simplest form, a battery consists of two metal plates with an electrolyte between them, and both the plates and the electrolyte possess resistance. There is, in consequence, an unavoidable resistance inside the battery. With dry batteries this internal resistance increases as the battery ages due to chemical changes inside it. Although the resistance is integral with the battery it has the same effect as if the battery were 'perfect' and the resistance were in series with it, as shown in Fig. 1(a). When the internal resistance is high we then have the commonly encountered

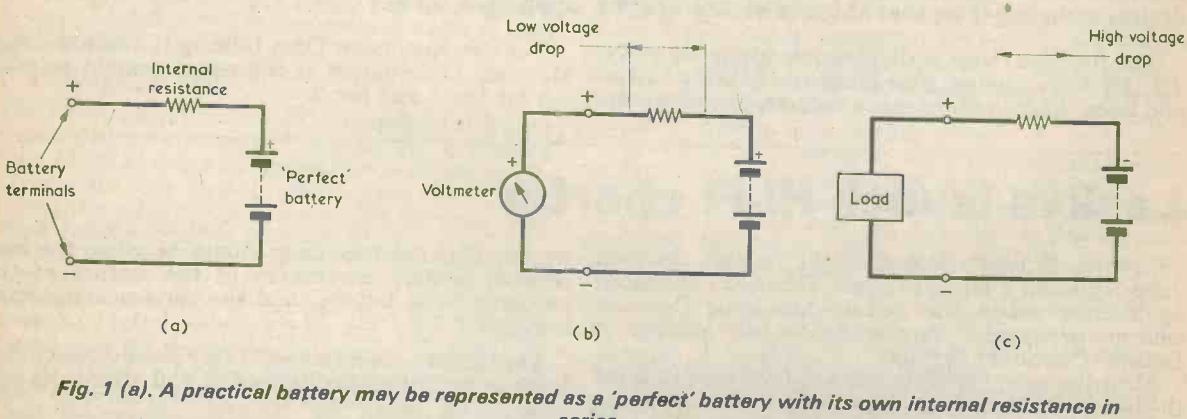


Fig. 1 (a). A practical battery may be represented as a 'perfect' battery with its own internal resistance in series
(b). If a voltmeter, which draws a low current, is connected to a battery having a large internal resistance the voltage drop across the resistance is small and the voltmeter reading is misleadingly high
(c). When a load drawing a much higher current is connected to the battery, a large voltage is dropped across the internal resistance. The moral is to always measure battery voltage on load

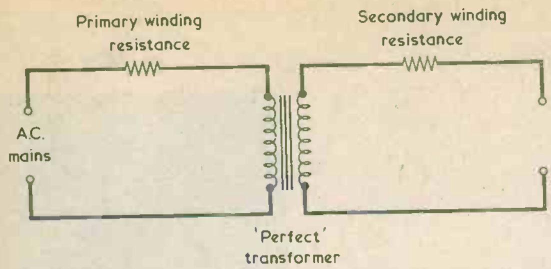


Fig. 2. The primary and secondary winding resistances of a mains transformer can be looked upon as resistances in series with the windings of a 'perfect' resistance-free transformer

phenomenon of a battery which shows quite a high terminal voltage when we connect a voltmeter across it, as in Fig. 1(b), but which exhibits a much lower terminal voltage when we connect it to a load, as in Fig. 1 (c).

The existence of internal battery resistance can be readily demonstrated by applying a voltmeter across a nearly exhausted battery coupled to a transistor radio which is adjusted to a high volume level. The voltage indicated by the meter drops noticeably with the louder signals because these cause the radio output stage to draw an increased current through the internal resistance of the battery and therefore drop a greater voltage across it.

TRANSFORMERS

The windings of iron cored transformers possess resistance, too, and the internal winding resistances of a transformer may be represented as series resistances in the manner illustrated in Fig. 2. These resistances are one of several factors which govern the maximum secondary current rating of a mains transformer. Current flowing through a resistance produces heat, and too high a secondary current can produce excessive heat in both the primary and secondary windings of a transformer. The probable result is that one of the transformer windings burns out, or the inter-turn insulation breaks down, and we then have to go out and buy a new transformer.

Internal resistance appears in electrolytic capacitors, especially the lower voltage types, although it is more proper to refer to it as impedance. An internal impedance of several ohms can be assumed in even the larger values, which explains why some cases of power supply hum in mains driven audio amplifiers can never be completely cured by simply stacking up thousands of microfarads immediately after the rectifier.

PLUGS AND SOCKETS

If there is hidden resistance in plugs and sockets carrying heavy currents this can also be the harbinger of trouble. Should a contact in a plug or socket become so oxidised or tarnished that it presents a resistance to the flow of current, a potential fault situation exists. Once again, the flow of current in a resistance produces heat. If sufficient heat is generated in the resistance between the plug and socket to cause further oxidation of the contact, or of both the contacts, a vicious spiral is set up. The oxidation of the contact surface increases with time, the resistance correspondingly becomes larger and a greater amount of heat is generated. The end result is a catastrophic failure of either the plug or socket, or both, due to the breakdown of the insulating material in which they are mounted. So, if ever you notice that an adequately rated plug or socket which carries a fairly high current is running warm, either attempt to clean up the contact surfaces or, better, replace it. If left unattended the situation can only get worse, and never better. ■

'New Transistorised Oscilloscope'

This design, which was described in the issues for September, October and November 1975, has proved to be extremely popular and a considerable number of oscilloscopes have been constructed. In consequence, some specialised or surplus components which were readily available when the articles originally appeared have now become unobtainable.

The 4μF 600V Wkg. capacitor specified for C3 is not now available, and a suitable alternative is the polycarbonate 10% 440VAC 2μF capacitor advertised by Marco Trading elsewhere in this issue. Satisfactory e.h.t. smoothing is given with the lower capacitance.

The 100 volt zener diode specified for D7 has recently become very difficult to obtain. It is in order here to connect two or more lower voltage diodes in series, with the individual zener voltages adding up to 100 volts. A suitable chain would consist of three 33 volt diodes, each rated at 1.3 or 1.5 watts.

The chassis mounting c.r.t. holder is also proving difficult to obtain and alternative holders may be supplied with the c.r.t. These require the making up of a flat adapter plate to enable the holder to be fitted to the c.r.t. rear mounting bracket.

12 V

MOTOR

CONTR

By R. A?e

Primarily designed fœs Petite miniature electridril be employed to controlthe motors drawing currentof

This unit powers a 12 volt d.c. motor from the mains supply, and also provides a control of the motor speed. The prototype was built to operate in conjunction with the miniature electric drill made by Precision Petite, Ltd., but the circuit could be used equally well with other small 12 volt motors having current requirements of the order of 1 amp or less.

THE CIRCUIT

As may be seen from the circuit of Fig. 1, few components are required.

Mains transformer T1 provides a secondary voltage of 12.6 volts. This component can be any mains transformer having two 6.3 volt secondary windings rated at 1.5 amps or more, the windings being connected in series to provide the 12.6 volts required here. Quite a number of mains transformers with suitable secondaries are available, a typical example being an R.S. Components 'Filament Transformer' which has two 6.3 volt 1.8 amp secondaries.

S1 is the on-off switch. Diodes D1 to D4 are a silicon bridge rectifier giving full-wave rectification and applying an unsmoothed direct voltage to the motor by way of thyristor TH1. A d.c. motor will operate quite satisfactorily with this voltage; also, the operation of the speed control circuitry depends upon the rectified voltage being unsmoothed.

TH1 controls the duration of the output current in

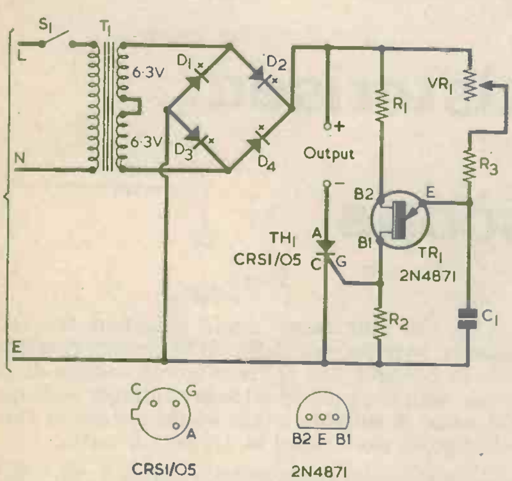
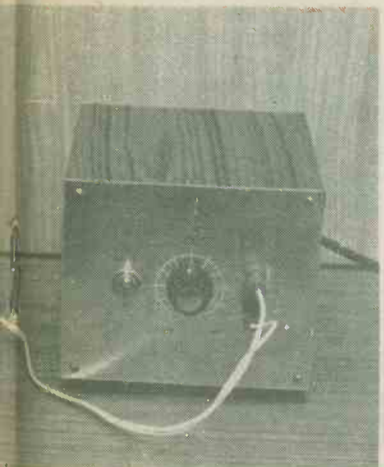


Fig. 1. The circuit of the motor speed control unit



...OLT ...SPEED ...OLLER

...Penfold

...r use with the Precision ...drill, this unit may also ...other small 12 volt d.c. ...s of the order of 1 amp.

each half-cycle, and acts as an electronic switch. Normally it is turned off but if, whilst the anode is positive with respect to the cathode, the gate is taken about 0.6 volt positive of the cathode, it turns on. It then remains in the conductive state even if the triggering voltage at the gate is removed, and only turns off again when the anode-to-cathode current is reduced to a low value. The thyristor can then be turned again by the application of another triggering voltage to its gate when the anode is positive of the cathode.

RELAXATION OSCILLATOR

TR1, a unijunction transistor connected as a relaxation oscillator, triggers the thyristor on. At the start of each unsmoothed half-cycle from the bridge rectifier the thyristor has been made non-conductive because there is no voltage across its anode and cathode. At the same time, C1 commences to charge via VR1 and R3. Under these conditions, only a small current flows through the base 2 and base 1 of the

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)
R1 390Ω
R2 180Ω
R3 4.7kΩ
VR1 500kΩ potentiometer, linear

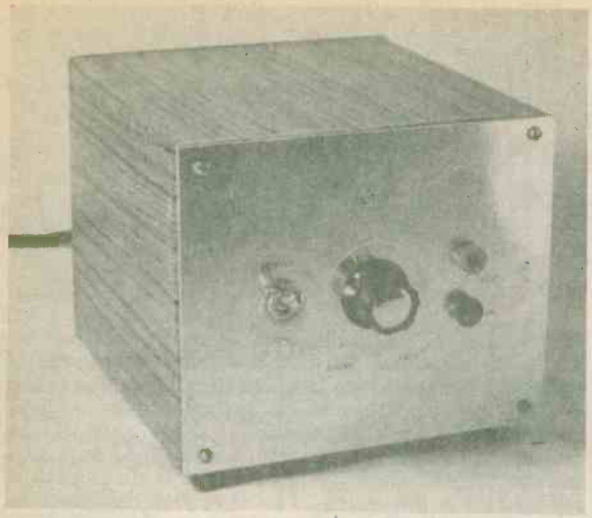
Capacitor
C1 0.015μF plastic foil (see text)

Transformer
T1 mains transformer, secondaries 2 x 6.3V at 0.15A or more (see text)

Semiconductors
TR1 2N4871
TH1 CRS1/05
D1-D4 silicon bridge rectifier, 100PIV 2A

Switch
S1 s.p.s.t. toggle

Miscellaneous
2 insulated sockets
Control knob
TO5 clip-on heatsink
Veroboard, 0.15in. matrix
4 rubber feet
3-core mains lead
Materials for case (see text)
Wire, solder, etc.



A simple case having an attractive appearance can be assembled with readily available materials

transistor. When the voltage across C1 rises to approximately half that on the base 2 of the unijunction transistor the transistor fires, causing the capacitor to discharge rapidly into the emitter and base 1 of the transistor and the gate-cathode junction of the thyristor. The surge of gate current turns the thyristor on.

The positive voltage applied to R1 and VR1 is the unsmoothed rectified voltage, which varies from zero to about 17 volts peak, and the time taken for C1 to charge to firing level is dependent upon the instantaneous supply voltage potential and the setting of VR1. When VR1 is set to insert minimum resistance into circuit the voltage across C1 is close to the supply voltage level and causes the unijunction transistor to fire very shortly after the start of a half-cycle. TH1 is therefore turned on at an early point in the half-cycle, giving an output voltage waveform similar to that shown in solid line in Fig. 2(a). This represents maximum output and maximum speed in the motor supplied by the unit.

If VR1 is adjusted to a central setting, capacitor C1 charges more slowly after the start of each half-cycle, whereupon the unijunction transistor fires at a later point in the half-cycle, giving an output voltage waveform like that of Fig. 2(b). This represents about half the maximum output power. When VR1 is adjusted close to, or at, the maximum resistance setting, the capacitor charges more slowly again and the unijunction transistor fires near the end of the half-cycle. The resultant output waveform appears in Fig. 2(c) and corresponds to minimum output power.

The unit thus functions by having the thyristor conductive over a controlled fraction of each successive half-cycle. Output power becomes smaller as the period during which the thyristor is conductive decreases. The advantage of the unit is that relatively little power is dissipated in the thyristor, as it is either switched off or is fully conductive with a voltage drop across it of some 0.7 to 1 volt. In consequence, the thyristor can be a small device, the type employed being encapsulated in a TO5 can.

A mains transformer with a 12.6 volt secondary, rather than one with a 12 volt secondary, is specified to compensate for the small voltage lost in the thyristor when it is conductive. With VR1 set to give maximum output there is also a small amount of power lost at the start of each half-cycle before TH1 turns on, but this loss is of less significance. The prototype gave a measured output voltage of 11.5 volts with VR1 adjusted for maximum.

A maximum continuous current of 1 amp can be handled by the unit, but brief surges up to 1.5 amps or so (as can occur when the motor is heavily loaded) will not harm the circuit.

COMPONENTS

Turning to components, the mains transformer has already been discussed. The thyristor specified is referred to as type CRS1/O5AF in some catalogues. In the present application it is fitted with a clip-on TO5 heatsink. The 2N4871 unijunction transistor is available from Henry's Radio, Ltd. VR1 is a standard small panel-mounting carbon track potentiometer.

Due mainly to spread in the firing potential of the unijunction transistor, it may be necessary to slightly alter the value of C1 in some units. This will only be necessary if it is found that a significant amount of power is still being applied to the motor when VR1 is adjusted for minimum output. The value of C1 should then be increased to 0.018μF or 0.022μF, as determined by experiment.

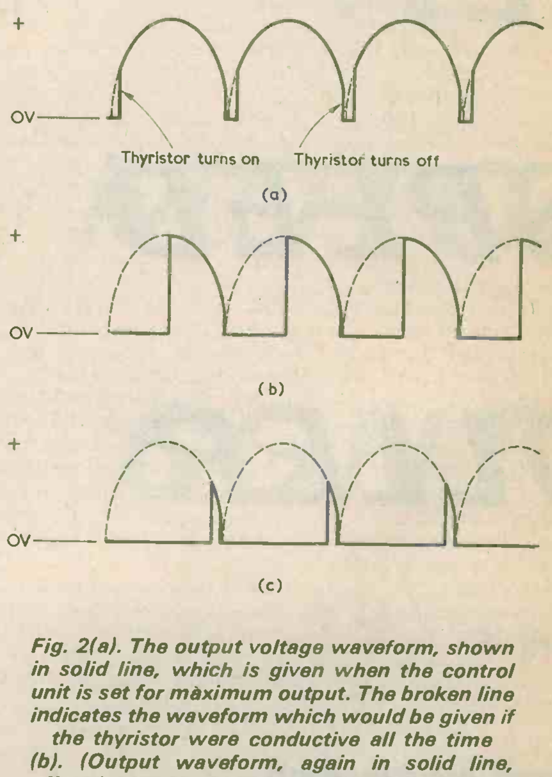
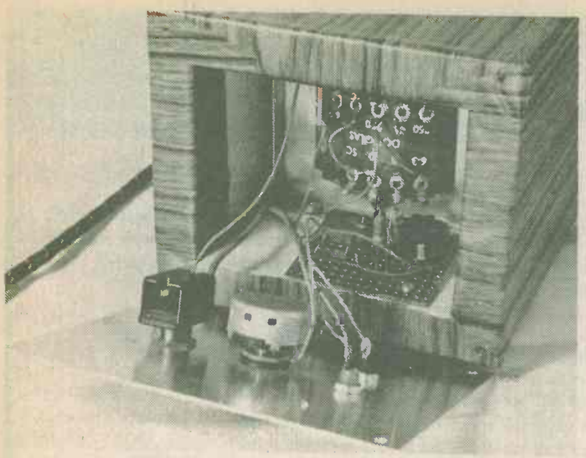


Fig. 2(a). The output voltage waveform, shown in solid line, which is given when the control unit is set for maximum output. The broken line indicates the waveform which would be given if the thyristor were conductive all the time
(b). (Output waveform, again in solid line, offered when the control unit is adjusted for approximately half maximum output
(c). At settings close to minimum output the thyristor is turned on for a brief period only at the end of each half-cycle



The smaller components are assembled on a piece of Veroboard. Flying leads couple this to the controls and output sockets mounted on the front panel

CASE

A simple home-made case for the unit can be readily assembled and details will now be given of that employed for the prototype. Before making up the case, constructors should check that it will accommodate the particular mains transformer to be employed and, if necessary, modify the dimensions accordingly.

The author's case has outside dimensions of approximately 120 by 140 by 150mm. Chipboard about 15mm. thick is used for the top, base and side panels. The top and base panels measure 140 by 150mm., and the sides are 90 by 150mm. These pieces are glued together, using a good general purpose adhesive, and then the completed assembly is covered with a self-adhesive plastic material, such as Fablon, to give an attractive finish.

The front and rear panels are cut from 20 s.w.g. aluminium and each measures 120 by 140mm. If the chipboard forming the frame of the case has a thickness other than 15mm. the dimensions of the panels will need to be altered to correspond. The aluminium panels are each held in place by four small woodscrews passed into the chipboard through holes at the corners. A hole is drilled in the rear panel for the mains lead, and this must be fitted with a grommet. Another hole in the rear panel is also needed, this being used for securing a 6BA solder tag on the inside which allows the rear panel to be earthed. The front panel is drilled to take S1, VR1 and the two insulated output sockets, and the general layout here can be seen in the photographs. Note that S1 and the output sockets cannot be mounted close to the front panel edges as they would then be obstructed by the chipboard case sides.

T1 is mounted towards the rear of the case. In the prototype this transformer was secured to the base panel of the case with woodscrews before the chipboard pieces were glued together. Alternatively, it can be secured after the case has been assembled by countersunk bolts passed through holes in the base panel. If this method of mounting is employed, a solder tag should be secured under one of the mounting nuts inside the case to allow the transformer frame to be earthed. A small plastic clip is also required at the inside case rear to provide an anchor for the mains lead.

COMPONENT PANEL

All the small components are wired up on a piece of 0.15in. Veroboard having 15 holes by 13 strips. This panel is illustrated in Fig. 3, and there are no breaks in the copper strips.

First cut the board to size and drill the two mounting holes to accept small woodscrews. Then wire up the components on the panel and connect it to the mains transformer secondary, VR1 and the output sockets. All the connecting leads should be flexible and not single strand, and the leads to the front panel components should be sufficiently long to enable this to be positioned clear of the case as shown in the photograph of the interior. An earth lead connects to the metal casing of VR1 and thence to the panel. If VR1 is examined, a solder lug should be found which connects via the metalwork of the potentiometer to its mounting bush. Some potentiometers with plastic housings do not have this lug, whereupon it is necessary to secure a 6BA solder tag to the front panel on the inside by means of a countersunk 6BA bolt and nut, and take the earth connection from the component panel to this. The tag may be positioned at any convenient point on the front panel. An earth lead also passes from the component panel to the tag on the aluminium rear panel. If the mains transformer frame is to be earthed, this lead connects first to the solder tag under the transformer securing nut mentioned earlier, and then proceeds to the tag on the rear panel.

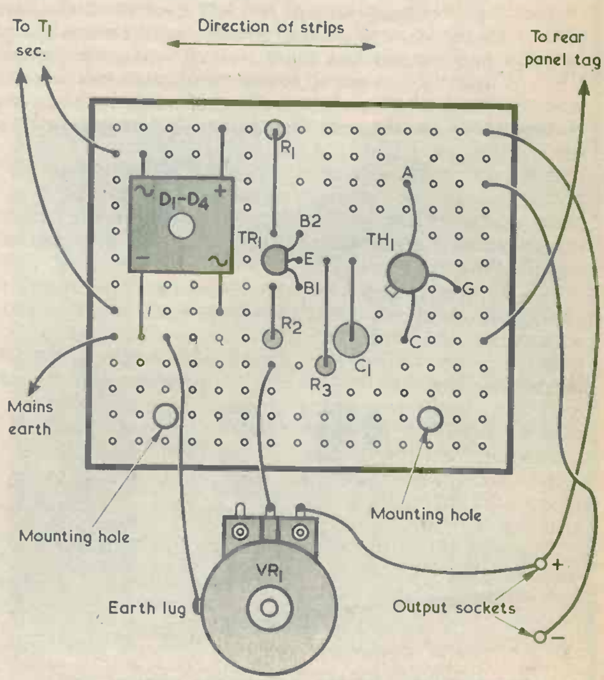
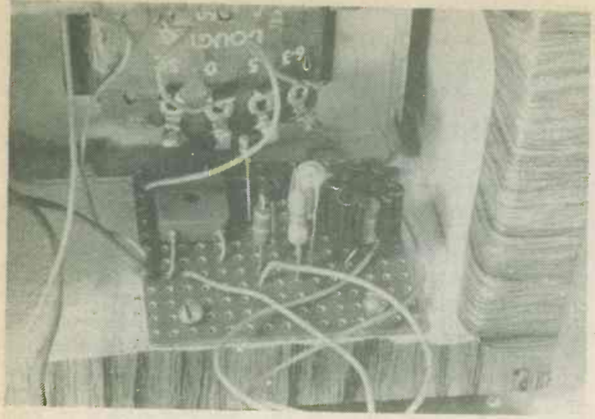


Fig. 3. Layout of components on the Veroboard panel



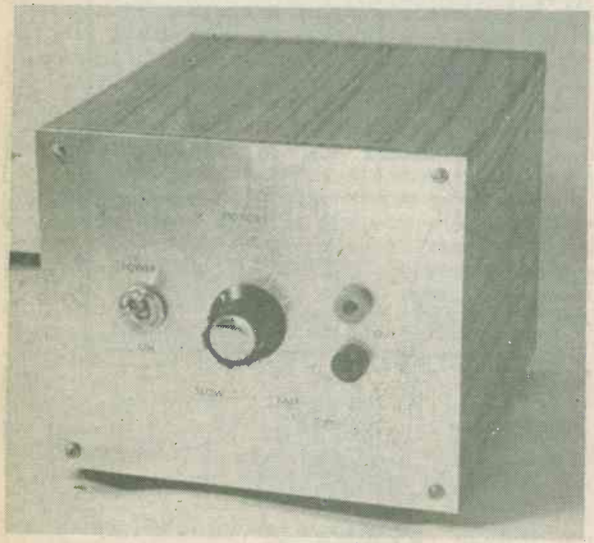
A more detailed view of the component board. The earth lead to the rear panel was added after this photograph was taken

When making connections to the 6.3 volt transformer secondaries it should be remembered that these must be connected in series with the correct phase if they are to produce a total voltage of 12.6 volts. If one of the windings is connected wrong way round the voltage applied to the bridge rectifier will be zero.

After this, it only remains to wire the mains lead to S1 and the mains tranformer primary and to complete the primary wiring to S1. This wiring follows the circuit diagram of Fig. 1.

The component panel is fitted at the front of the base panel of the case by means of two woodscrews, with a few washers between the Veroboard underside and the chipboard surface. Without these washers there is a risk of the component panel cracking as the woodscrews are tightened.

Four cabinet feet are screwed to the bottom of the case near the corners, and the power control unit is then complete and ready for testing.



Another view of the completed control unit. Legends and a scale taken from Panel-Signs Sets Nos. 4 and 5 give an added professional touch. (Panel-Signs are available from the publishers of this journal)

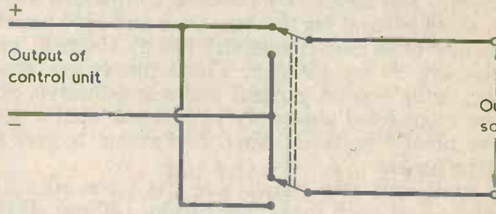


Fig. 4. A polarity reversing toggle switch may be added, if desired. The circuit required is shown here

REVERSE SWITCH

In some applications it may be required to have a switch which reverses the polarity of the control unit output. It is quite a simple matter to add this facility and all that is needed is a d.p.d.t. toggle switch interposed between the output points of the component panel and the two output sockets. The required circuit is shown in Fig. 4. There is plenty of space on the front panel for the additional switch.

As was stated at the start of this article, the motor speed controller is employed by the author in conjunction with the Precision Petite electric drill. This drill has proved excellent for such jobs as the drilling of printed circuit boards, and is much more convenient for small work than the full-size electric drill the author used in the past. ■

RECENT PUBLICATIONS

110 COS/MOS DIGITAL I.C. PROJECTS. By R. M. Marston. 121 pages, 215 x 135mm. (8½ x 5¾in.) Published by The Butterworth Group. Price £2.75.

The simpler types of COS/MOS digital i.c. gate are now becoming available on the home constructor market at quite low prices, and there is little doubt that amateur interest in these fascinating devices will increase accordingly. A COS/MOS gate has two important advantages over its t.t.l. equivalent, these being an exceptionally low current demand when it is stable in one of its two output states, and the ability to work with a wide range of supply voltages. COS/MOS (COSMOS and CMOS are alternative abbreviations) digital i.c.'s are more robust than their very high input impedances would at first sight indicate, and they require only that a small number of common-sense precautions be taken in the circuits in which they are wired.

In '110 COS/MOS Digital I.C. Projects' R. M. Marston commences with an introductory chapter for the reader who has had no previous experience with the devices, and then proceeds to further chapters which describe the 110 projects of the book's title. The first of these employ inverter, gate and logic circuits, followed by a wide range of multivibrator circuits and d.c. lamp control circuits. After these come circuits for relay control and for the generation of sound and alarm signals. The final projects in the work provide counting and dividing facilities.

The book is concisely written with clear diagrams, and will be of considerable assistance to anyone who is embarking on constructional, experimental or design work in this new technology.

MAKING YOUR OWN ELECTRONIC GADGETS. By R. H. Warring. 136 pages, 205 x 150mm. (8 x 5¼in.) Published by Lutterworth Press. Price £2.20.

The title is the latest in the 'Beginners' Guide' series of books on simple amateur electronics by R. H. Warring, and is concerned with the assembly of electronic devices incorporating a small quantity of transistors. Many of the circuits employ one transistor only.

The number of gadgets which are described is wide and varied, including amplifiers, oscillators, metal detectors, multivibrators, light operated devices, a modulated light transmitter and receiver, and an inductive loop radio control system. Also to be found in the book is a list of near-equivalent transistors as well as a short list of common abbreviations encountered in electronics.

ELECTRONIC COMPONENTS. By Morris A. Colwell. 106 pages, 215 x 130mm. (8½in.x 5in.) Published by The Butterworth Group. Price £1.80.

Intended primarily for the amateur constructor, this attractive book deals in detail with the many different types of electronic component that are available these days. The first chapter, headed 'Getting Started', discusses the practicalities of building and assembling electronic projects at home, after which successive chapters deal with the components themselves. In turn, these are resistors and potentiometers, capacitors, inductors and transformers, semiconductor devices, integrated circuits and electromechanical devices. An appendix offers common abbreviations encountered with components, wire gauge details and B.A. screw thread tapping and clearance hole dimensions.

ELECTRONIC DIAGRAMS. By Morris A. Colwell. 109 pages, 215 x 130mm. (8½ x 5in.) Published by The Butterworth Group. Price £1.80.

This book is produced with the same style and format as 'Electronic Components' by the same author, and it also has two-colour printing, the subsidiary colour being blue. It deals exhaustively with circuit symbols for virtually all the components likely to be encountered in electronic work, and shows British, European and American standard symbols. The components whose symbols are given range from switches to cathode ray tubes and integrated circuits, and the accompanying text provides brief details of the devices illustrated and their general functions.

Also given are chapters on 'black boxes' and block diagrams, and on circuit diagram layout (with examples illustrating how poor layouts can cause confusion instead of providing assistance for the reader).

'Electronic Diagrams' is intended primarily for the beginner, and it will help him to successfully come to grips with the initially confusing world of electronic circuitry and the symbols employed.

THE ELECTRONIC MUSICAL INSTRUMENT MANUAL. By Alan Douglas, Sen. Mem. I.E.E.E. 213 pages, 245 x 190mm. (9¾ x 7½in.) Published by Pitman Publishing Limited. Price £7.50.

This book is now in its sixth edition, and has been completely updated to take in advances resulting from recent developments with semiconductors and integrated circuits. It deals extensively with the techniques and principles involved in the production of electronic music, covering the subject from the relatively simple Theremin (basically a beat frequency oscillator whose a.f. output can be varied in frequency and volume by varying the distance between the player's hands and two electrodes) to the highly complex modern electronic organ. There are many circuits for oscillators, filters, dividers, and keyers, together with diagrams for mechanical tone forming devices and the like.

'The Electronic Musical Instrument Manual' contains a wealth of information on the creation of electronic music and draws extensively from commercial practice in this always interesting field.

BINARY RESISTANCE BOX

by S. P. Swan

How to build a resistance box with only a small quantity of resistors.

A resistor decade box, with which any desired value of resistance within its range may be selected by means of switches, is a useful item of equipment for experimental work. However, decade boxes tend to be expensive so far as the number of resistors they require is concerned. Since the resistors have to be close tolerance types, their cost becomes quite an important matter.

This article describes a simple approach towards the assembly of a resistance box in which the number of resistors required is considerably reduced. The reduction is at the expense of a slightly more complicated switching procedure but, as will be seen, the latter is not particularly difficult to carry out.

DECADE BOX

Fig. 1 shows the circuit of a resistor decade box which offers resistance values, in increments of 1Ω from zero to 99Ω. The box is very simple to use. If a resistance of 57 Ω is required, the 'Tens' switch is set to 5 and the 'Units' switch to 7. The required value of 57Ω is then presented to the terminals. Again, for a value of say 8Ω, the 'Tens' switch is set to zero and the 'Units' switch to 8.

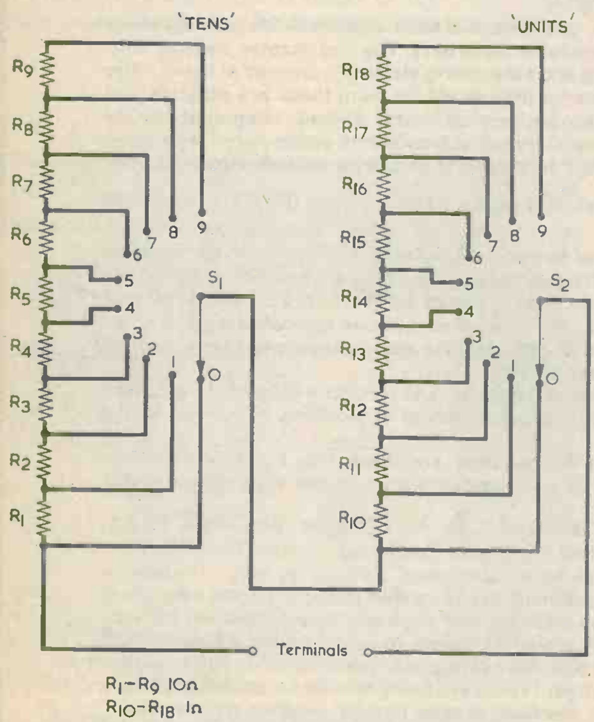


Fig. 1. A decade resistance box offering resistances from zero to 99 Ω in increments of 1 Ω

Although the box extends only up to 99 Ω it requires no less than 18 resistors, i.e. 9 for each power of 10. (The units, incidentally, are multiples of 10 to the power of zero.) If the box extended to 999Ω it would need 27 resistors. A box extending to 1 Ω short of 1M Ω would employ 54 resistors.

Fig. 2. An alternative approach towards making up a switched resistance box. There can be any number of switches and resistors

An alternative switching process for a resistance box is shown in Fig. 2. If all the switches in this circuit are closed the total resistance is zero. If one or more switches are open the total resistance is the sum of the values of the resistors whose switches are open. For the circuit to be of practical use, the resistance values should be such that a minimum quantity of resistors is employed.

The smallest quantity of resistors is given if they have ascending values equal to powers of 2 in binary notation. As is shown in Fig. 3 (a) the required progression is binary 1, binary 10, binary 100, and so on. If, to take an example, resistances of binary 10, binary 1000 and binary 10000 are added together (by opening their switches) the resultant sum is binary 11010, as indicated in Fig. 3(b). It will be apparent that the individual resistances can be added to form any number up to the maximum possible without any resistance being duplicated. Figs. 3(a) and (b) also give the decimal equivalents of the binary numbers shown.

Thus, a resistance box having the lowest possible number of resistors could incorporate resistors with

BINARY	DECIMAL
1	1
10	2
100	4
1000	8
10000	16
100000	32
1000000	64
10000000	128

(a)

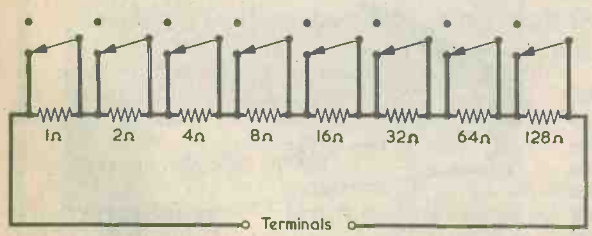
BINARY	DECIMAL
10	2
1000	8
10000	16
11010	26

(b)

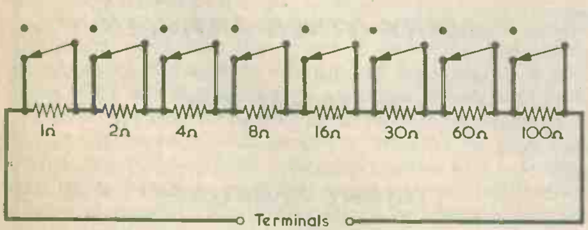
Fig. 3(a). The minimum number of resistors is given if their values ascend in the progression shown here
(b). This typical binary sum demonstrates how the individual resistance values add together

the values shown in Fig. 4(a). By opening the appropriate switches, any value from zero to 255 Ω may be obtained in increments of 1 Ω. For example, a value of 99 Ω is given by opening the switches at the 64 Ω, 32 Ω, 2 Ω and 1 Ω resistors, whereupon the total resistance at the terminals is 99 Ω.

Unfortunately, the mental arithmetic required to calculate the total resistance tends to be difficult with the larger values, and a considerable improvement, at a slight departure from the ideal progression, is given by modifying the series after 16. This is done by changing the 32 to 30, the 64 to 60 and the 128 to 100.



(a)



(b)

Fig. 4(a). A resistor chain incorporating the binary series of values. (b). A modification to the progression eases calculations

The result is illustrated in Fig. 4(b). Some constructors may feel that a slight further simplication would be given by changing the 16 to 15, and this revised value could also be used, if desired

USING THE SWITCHES

The circuit of Fig. 4(b) offers resistance values, in increments of 1 Ω, up to 221 Ω. The use of the switches is reasonably simple if one works from right to left. Let us assume that a value of 48 Ω is required. Both the 100 Ω and the 60 Ω resistors have values which are larger than 48 Ω and so their switches are left in the closed position. The next number, 30 Ω, is lower than 48 Ω, and so this switch is opened, leaving 18 Ω to be made up. 16 Ω is lower than 18 Ω and so the 16 Ω switch is opened. The remaining 2 Ω is given by opening the 2 Ω switch.

The circuit, up to and including the 60 Ω resistor, offers a range from zero to 121 Ω. Yet only 7 resistors are required, as opposed to the 18 resistors in the decade circuit of Fig. 1, which merely extends to 99 Ω.

The 100 Ω resistor and switch of Fig. 4(b) may be shifted to a lower line, where they start a new progression extending to 6k Ω. A further progression commencing at 10k Ω may then be started, giving the resistance box circuit of Fig. 5. This allows resistance

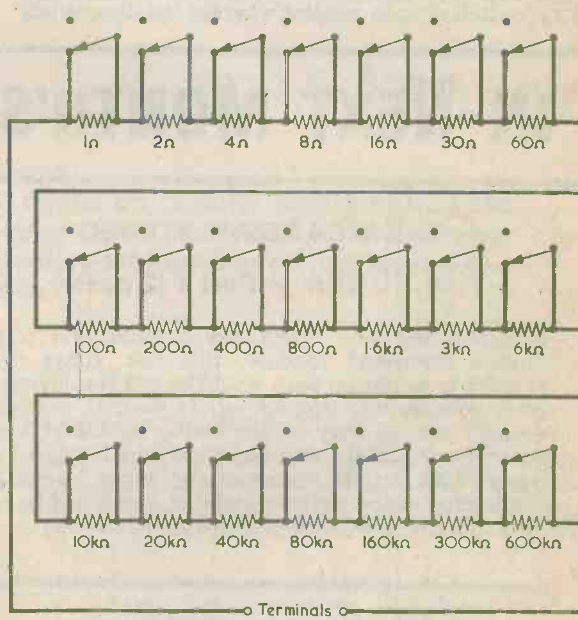


Fig. 5. A comprehensive resistance box offering a very wide range of values

values to be selected from zero to greater than 1.22M Ω. Not all of the circuit of Fig. 5 need be employed, of course. If, for instance, it is taken up to and including the 6k Ω resistor, only 14 resistors are required and the maximum total resistance value is in excess of 12.2k Ω.

For much practical work, increments of 1 Ω are smaller than is really required. Fig. 6 shows the progression for steps of 5 Ω each. The total resistance here is in excess of 1.6M Ω, and 19 resistors are used.

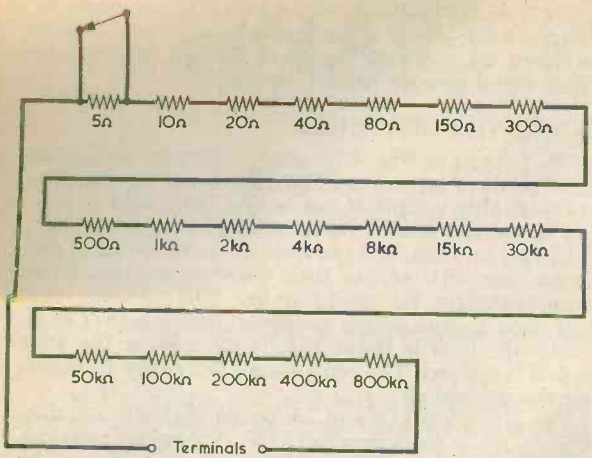
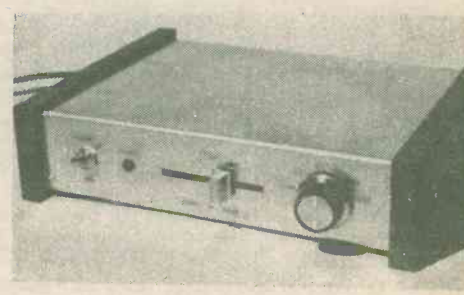


Fig. 6. A somewhat simpler circuit in which the increases are in steps of 5 Ω each. Only one switch is shown, and there are further switches across each resistor in the same manner as in the previous circuits

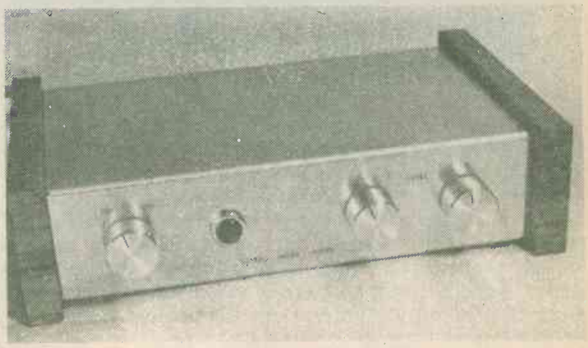
It might be considered surprising that, despite an increase of 5 times in the increment, the number of resistors in the circuit of Fig. 6 is only 2 less than that in Fig. 5. This can be explained, however, by the fact that the progression of Fig. 6 is much the same as that of Fig. 5 with the 1 Ω and 2 Ω resistors omitted.

The series resistor circuits require an individual s.p.s.t. switch at each resistor whereas the decade box type requires a smaller quantity of rotary switches. The circuit of Fig. 5 employs 21 switches, which could be low cost slide types, whilst a decade box extending up to 1 Ω short of 1M Ω requires six 10-way rotary switches. Even if the latter are inexpensive 1-pole 12-way switches with 2 ways unused, the costs of the different types of switch work out (with a little careful shopping around) at roughly the same level. ■



AUDIO CONTROL CIRCUITS — 2

DYNAMIC NOISE LIMITER



By P. R. Arthur

In this second article in our 3-part series on circuits incorporating the MC3340P electronic attenuator, our contributor describes a noise limiter which functions by increasing high frequency attenuation on low level audio signals.

Despite large improvements in both cassette recorders and cassette tapes since their introduction, unless the recorder is fitted with some form of noise reducing system a relatively high level of background noise is likely to result. A dynamic noise limiter is one of the simpler forms of noise reducing equipment, but can, nevertheless, be very effective.

The limiter to be described is only used during playback, and has the effect of reducing the treble response of the system when a low level signal is present. Full treble response is available when high level signals are present. Reducing the treble response gives a significant reduction in the noise level, as tape hiss consists largely of high frequency noise, and it is during quiet passages that the noise is most noticeable. On loud passages the noise cannot be heard above the main signal, even with full treble.

The dynamic noise limiter thus gives a worth-while reduction in tape noise at the expense of reduced treble response on low level signals. As the noise is less noticeable in the presence of treble signals than it is in the presence of bass and middle frequency signals the unit is designed to respond more readily to treble frequencies.

BASIC OPERATION

A block diagram which illustrates the basic operation of the limiter is shown in Fig. 9. The input signal is split into three parts, the main part being applied to a passive mixer. A second part is first fed to a high

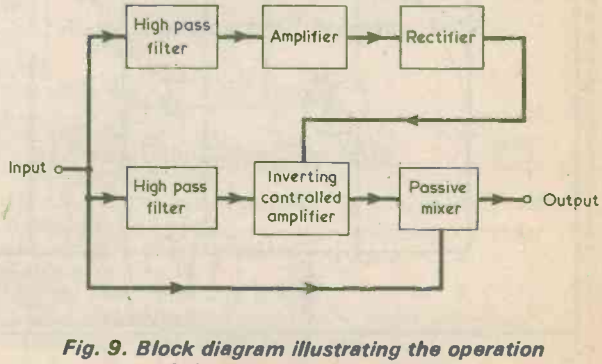
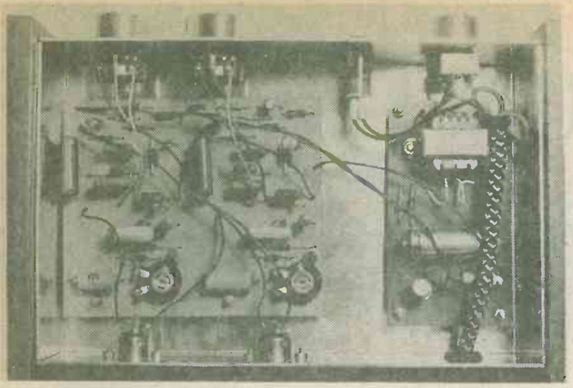


Fig. 9. Block diagram illustrating the operation of the dynamic noise limiter



The noise limiter components and the power supply are wired up on two printed circuit boards

pass filter which removes the bass and middle frequencies and is then passed to an inverting amplifier, the gain of which is governed by a control voltage. The output of the controlled inverting amplifier is fed to the remaining input of the mixer. Here the two sets of signals are processed in such a way that any signals which are common to both inputs cancel each other out to some degree, and are in effect filtered from the output. The only common signals are, of course, the treble ones.

The third part of the input signal is taken to another high pass filter, the output from which is rectified and smoothed after receiving a high level of amplification. The resultant d.c. voltage is used as the control voltage for the inverting amplifier, which is arranged such that increasing control voltage results in decreasing amplifier gain. Therefore, the higher the level of the input signal, the lower the gain of the inverting amplifier. On high level signals the gain of the amplifier is so low that it supplies virtually no signal to the mixer, whereupon there is no cancellation of the higher frequencies and the treble cut is eliminated.

CIRCUIT DESCRIPTION

Fig. 10 gives the circuit for one channel of the dynamic noise limiter. The other channel is, of course, identical to this.

R3 and R4 form the mixer, and they receive the main input via C4 and the output from the controlled amplifier (the MC3340P) direct. The output from the mixer is fed to a low gain common emitter amplifier, TR2. This compensates for the small losses in the mixer.

The high pass filter at the input to the controlled amplifer is formed by the low value of C5 in relation to the input impedance of the MC3340P. A separate inverter stage is not required, as it so happens that the MC3340P is an inverting amplifier.

The gain of the i.c. at low signal levels is controlled by R5. This is adjusted to give the amplifier approximately unity voltage gain so that the inputs to the mixer are balanced at high frequencies. Thus, if the input to R3 goes positive by say 100mV, the input to R4 will go negative by 100mV. The total voltage across the resistors would increase by 200mV but (assuming that they are of equal value) the voltage at their junction does not alter.

At slightly lower frequencies the signal output from the i.c. will be less than that passed via C4, and so only partial cancelling of the signal will occur. At still lower frequencies the output from the i.c. will be negligible, and the input signal will pass via C4, R3 and C8 to the output amplifier.

R3 and R4 are not, in practice, specified as close tolerance resistors, but this does not affect the basic operation of the circuit. It merely makes it necessary to adjust R5 for slightly more or less than unity gain in the inverting amplifier to compensate for any inequality in these resistors.

The input signal is also applied by way of C6, VR1 and C3 to the base of TR1, which offers a high level of voltage gain. The values of C3 and C6 are such as to provide an effective high pass filter. The

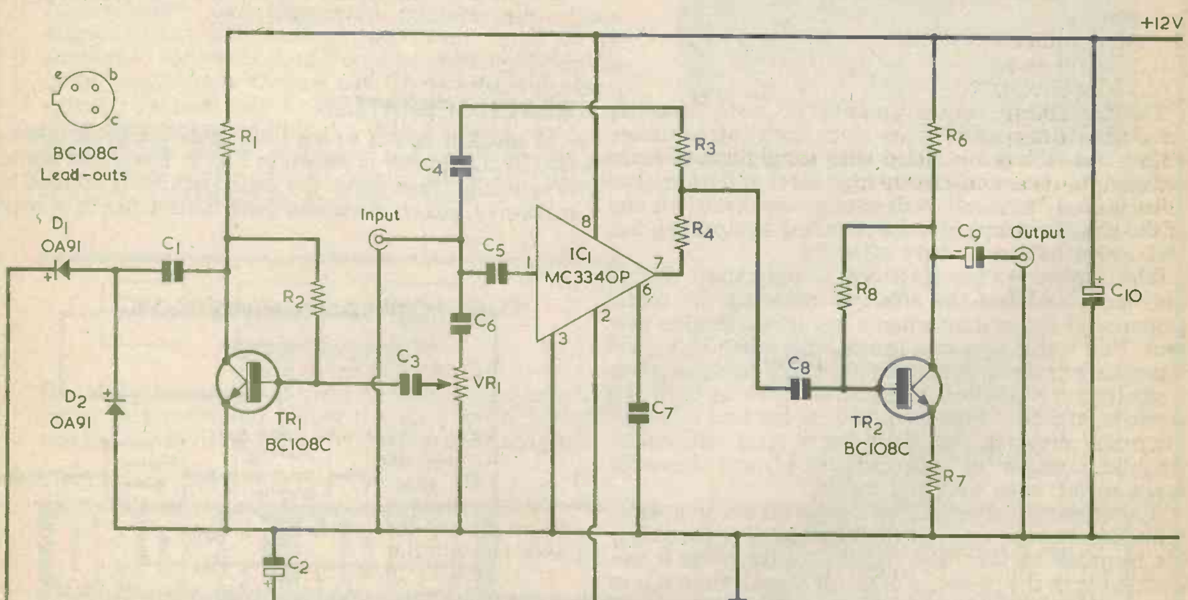
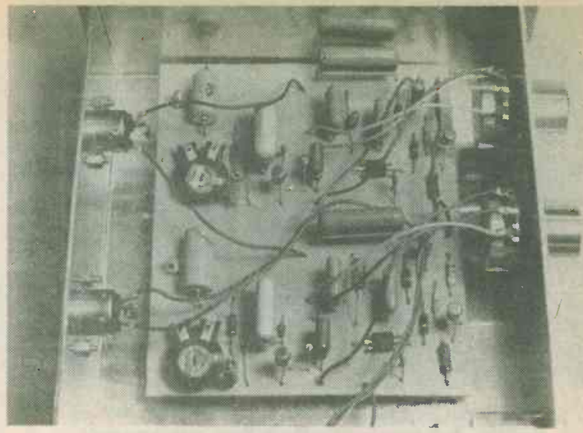


Fig. 10. Circuit of one channel of the dynamic noise limiter. This is duplicated in the other channel

amplified signal at TR1 collector is next passed to the voltage doubling rectifier circuit consisting of C1, D2, D1 and C2. The rectified voltage on the positive terminal of C2 is then applied to the control terminal of the MC3340P. VR1 controls the input signal amplitude passed to TR1, and it therefore sets the threshold level at which treble attenuation commences to reduce.

POWER SUPPLY

A stabilized mains power supply is used, this having a full-wave bridge rectifier and an emitter follower series regulator. The circuit diagram is shown in Fig. 11. The supply provides approximately 12 volts at a current of about 50mA. Note that the two outside ends of the secondary connect to the bridge rectifier and that there is no connection to the secondary centre-tap.



A closer look at the board with the noise limiter channels

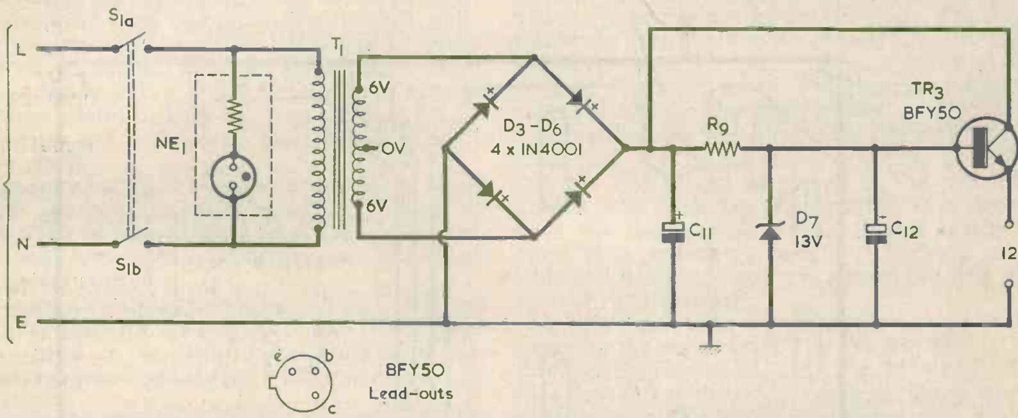


Fig. 11. The power supply section provides power for both channels of the limiter

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)
- R1, R1a 3.3k Ω
- R2, R2a 560k Ω
- R3, R3a 10k Ω
- R4, R4a 10k Ω
- R5, R5a 47k Ω or 50k Ω pre-set potentiometer, horizontal skeleton (see text)
- R6, R6a 4.7k Ω
- R7, R7a 2.2k Ω
- R8, R8a 2.2M Ω
- R9 1k Ω
- VR1, VR1a 47k Ω or 50k Ω potentiometer

Capacitors
- C1, C1a 0.47μF type C280 (Mullard)
- C2, C2a 10μF electrolytic, 16 V. Wkg.
- C3, C3a 0.1μF type C280 (Mullard)
- C4, C4a 1μF type C280 (Mullard)
- C5, C5a 0.001μF polystyrene
- C6, C6a 0.22μF type C280 (Mullard)
- C7, C7a 470pF polystyrene
- C8, C8a 0.22μF type C280 (Mullard)
- C9, C9a 10μF electrolytic, 16 V. Wkg.
- C10, C10a 100μF electrolytic, 16 V. Wkg.
- C11 1,000μF electrolytic, 25 V. Wkg.
- C12 47μF or 50μF electrolytic, 16 V. Wkg.

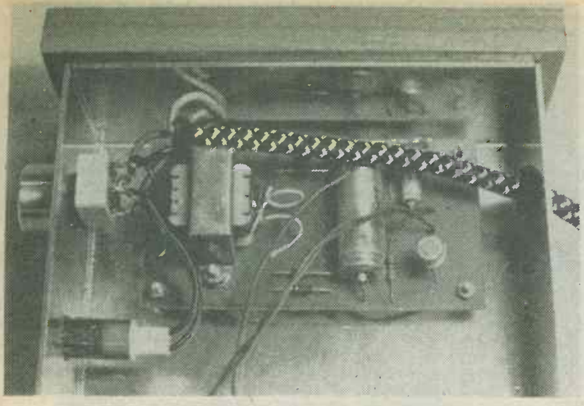
Transformer
- T1 Subminiature mains transformer, secondary 6-0-6V at 100mA, type MT6 (Eagle)

Semiconductors
- IC1, IC1a MC3340P
- TR1, TR1a BC108C
- TR2, TR2a BC108C
- TR3 BFY50
- D1, D1a 0A91
- D2, D2a 0A91
- D3-D6 1N4001
- D7 BZY88C13V

Neon
- NE1 Panel mounting neon assembly, 240V

Switch
- S1(a)(b) d.p.s.t., rotary toggle

Miscellaneous
- 2-off 3-way DIN sockets (see text)
- 3-off control knobs
- 16 s.w.g. aluminium chassis, 8½ x 5½ x 2in., with baseplate (see text)
- ½in. chipboard (see text)
- Fablon, or similar
- Copper clad laminate board
- 3-way mains lead
- Connecting wire, nuts, bolts, etc.



The power supply section is straightforward in design and employs only a few components

The power supply is assembled on a printed circuit board, the component and copper sides of which are illustrated in Fig. 12. This is reproduced full size and may be traced, if desired. The transformer mounting holes should, however, be marked out with the aid of the transformer itself.

The board is etched and prepared in the usual way, and the four mounting holes are drilled 6BA clear. There are two positive output leads and one negative output lead. These will later connect to the main printed board. The live and neutral mains leads from the board will later connect to the on-off switch, S1. When the board is mounted, a solder tag at the mounting hole indicated is secured by the mounting nut and the earth wire of the mains lead will connect to this.

If the mains transformer is the Eagle type specified in the Components List it should run cool on the

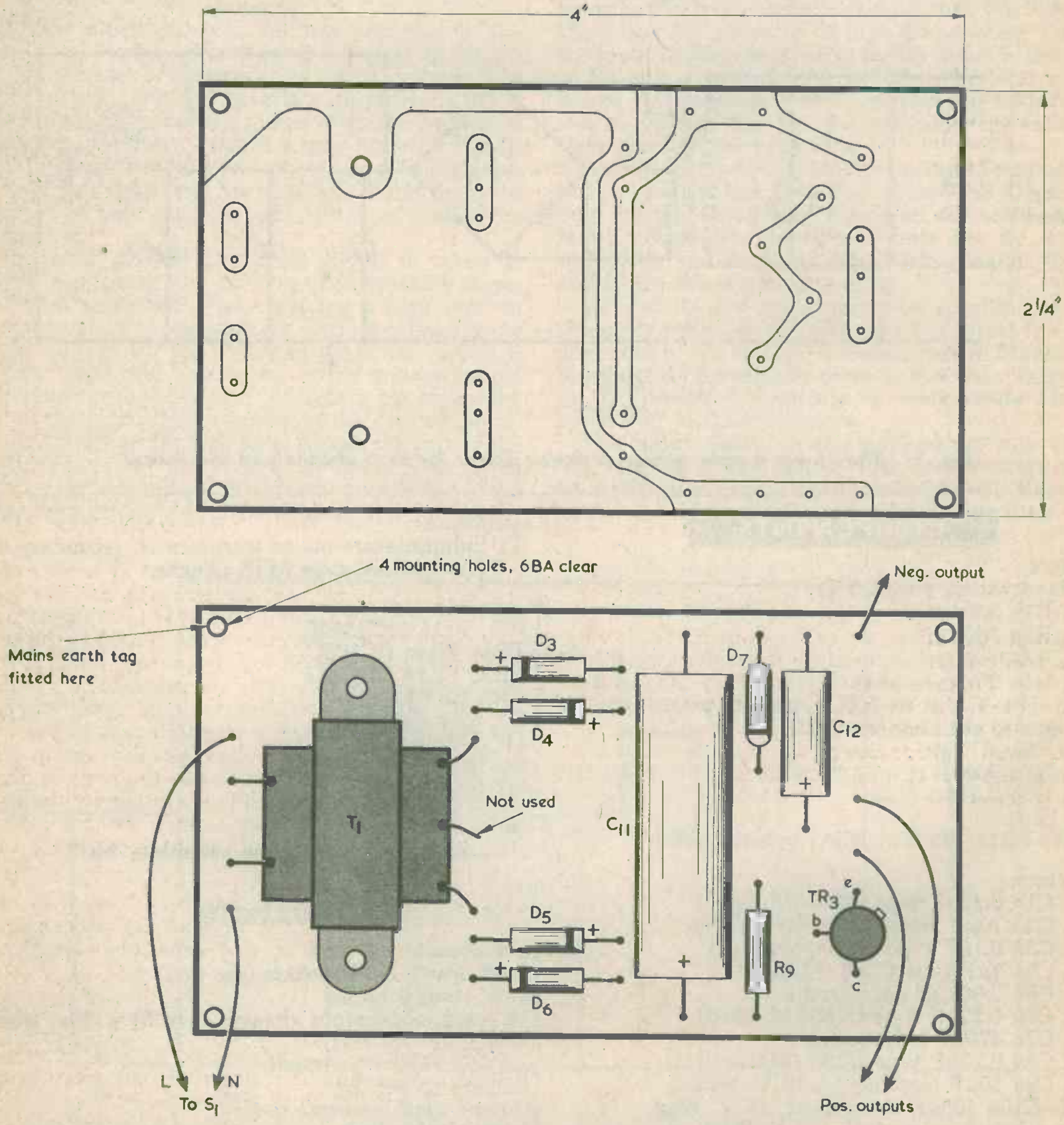


Fig. 12. The copper and component sides of the power supply printed board. This is reproduced full size and the diagram may be traced

board. If another subminiature mains transformer with the same secondary voltage and current figures is employed there is a risk of its overheating, as some of these transformers tend to be optimistically rated. The best plan in this case is to shorten the printed board and mount the transformer direct to the chassis, which will then act as a heatsink.

MAIN PRINTED BOARD

The copper and component sides of the main printed board, on which the two channels incorporating the circuit of Fig. 10 are assembled, are illustrated in Fig. 13. This board is also reproduced full size. Since there are two channels, the components of the second channel are given the suffix 'a' after their identifying numbers.

Of the three leads connecting to VR1, the centre one in the diagram will later connect to the slider. The earthy lead (the right-hand lead of the three) will connect to the track tag corresponding to full anticlockwise rotation of the spindle. VR1a will be wired up in the same manner. The two signal input leads will connect to one socket and the two output leads to another socket, both sockets being on the rear panel. All these wires are unscreened and should be kept reasonably short.

If it is required to have a mono version of the noise limiter, the components with the suffix 'a' may be omitted and the corresponding part of the board need not be etched. Also, only one positive lead is needed from the power supply.

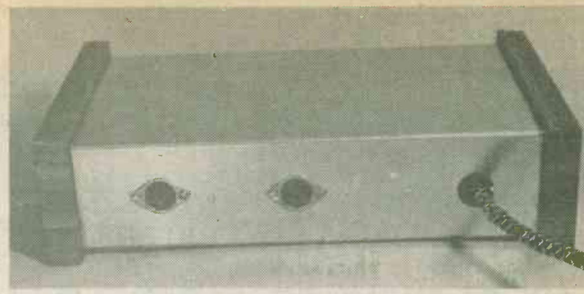
A final point concerning the main printed board has to do with the holes for the tags of R5 and R5a. These holes may need to be slightly repositioned if the potentiometers employed differ from those fitted in the prototype.

The integrated circuits visible in the photographs are MFC6040's, which have been superseded by the MC3340P. As was explained last month, these are electrically identical with the MC3340P but have different pin spacing. Pin functions for both i.c.'s were also given last month.

CASE

A simple but attractive case can be made by adapting a ready-made aluminium chassis complete with baseplate. This measures 8½ by 5½ by 2in., and the author obtained it from H. L. Smith & Co. Ltd., 287 Edgware Road, London, W2 1BE. The chassis is, in effect, used upside-down so that the baseplate becomes the lid. It may be secured with small self-tapping screws.

A three-quarter view of the interior from the rear



The input and output sockets, together with a grommet for the mains lead, appear on the rear panel

The two side pieces consist of chipboard measuring 6 by 2½in. by ½in. These are covered with a self-adhesive plastic material, having a woodgrain pattern, on the edges and outside and over part of the surface which will be against the chassis edges. The chipboard pieces are then glued to the chassis edges with a strong adhesive, such as epoxy resin, applied to the uncovered chipboard areas. The general arrangement is clearly visible in the photographs.

Since the unit is dealing with signals of fairly high amplitude the layout inside the case is not unduly critical. The layout employed in the prototype can also be seen from the photographs. It is desirable to have the two printed circuit boards spaced as far apart as is reasonably possible. The front panel controls and neon indicator are spaced out in a neat and symmetrical manner.

A hole fitted with a grommet is needed in the rear panel for the mains lead. The live and neutral wires of this lead connect to S1, as in Fig. 11, whilst the earth wire connects to the solder tag under the power supply securing nut, as already mentioned. The mains lead should be suitably anchored inside the case. The two leads of the neon indicator also connect to S1. The indicator must be of a type having its own integral series resistor which is intended for operation from 240 volt a.c. mains.

The printed boards are mounted by means of 1in. 6BA bolts with the heads underneath, and are spaced away from the chassis surface by ⅜in., using extra nuts or spacing washers. A chassis connection to the earthy print area of the power supply board is made at one of the mounting screws. The chassis surface should be covered with plastic insulating tape under the board areas to prevent possible short-circuits to the board undersides. Alternatively, pieces of thin s.r.b.p. ('Paxolin'), of the same dimensions as the boards, may be secured directly to the chassis surface by the mounting screws. The printed boards are not mounted finally in position until all the interconnecting wiring has been completed.

The author employed 3-way DIN sockets at the rear panel for the inputs and outputs. Any other type of socket favoured by the constructor may alternatively be employed.

ADJUSTMENT

The dynamic noise limiter is connected between the cassette deck and the amplifier. An input level of about 500mV to 900mV into 8k Ω is required, and the limiter has been designed to give approximately unity gain at middle audio frequencies. Care must be taken to ensure that the left and right channels are not ac-

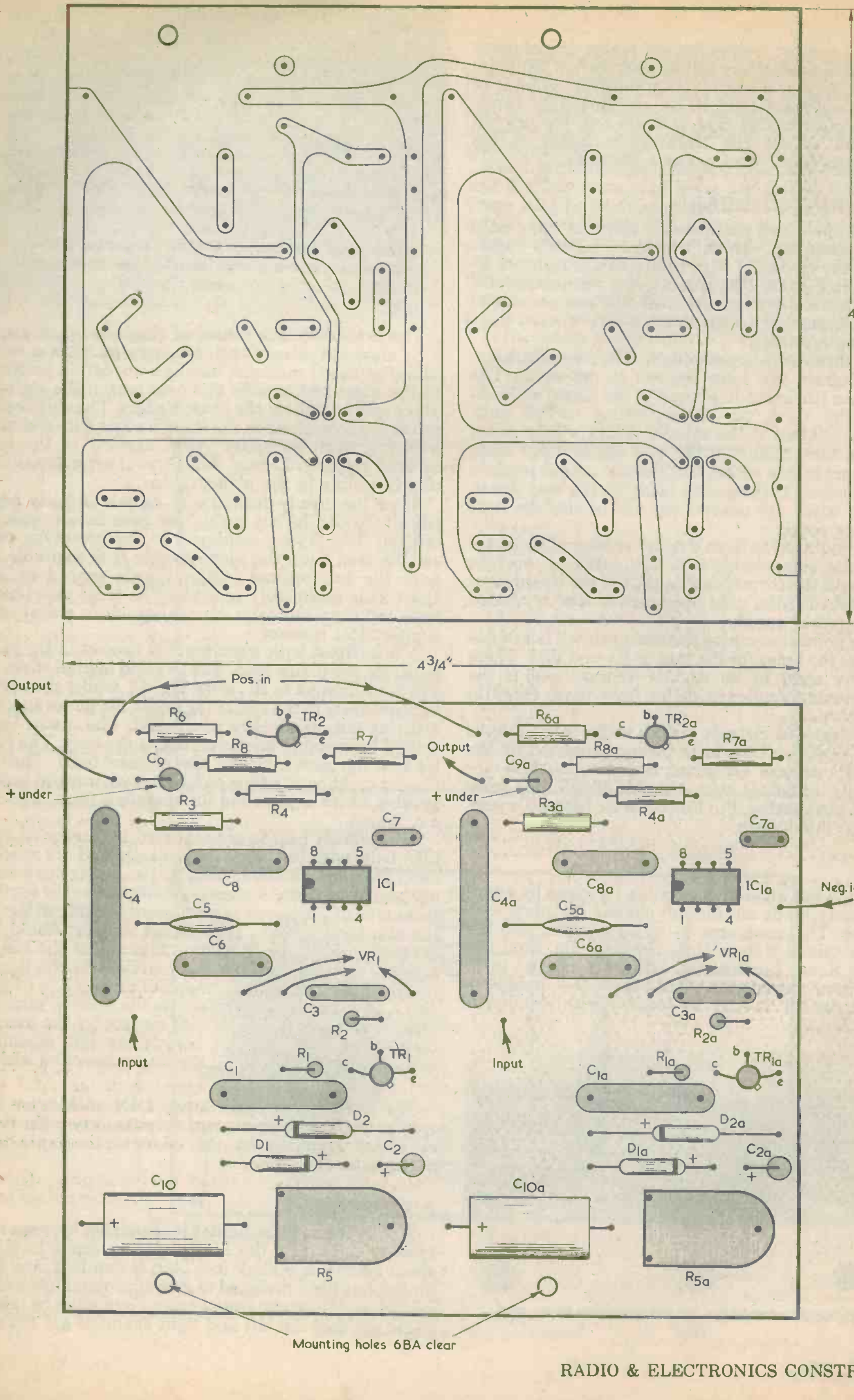
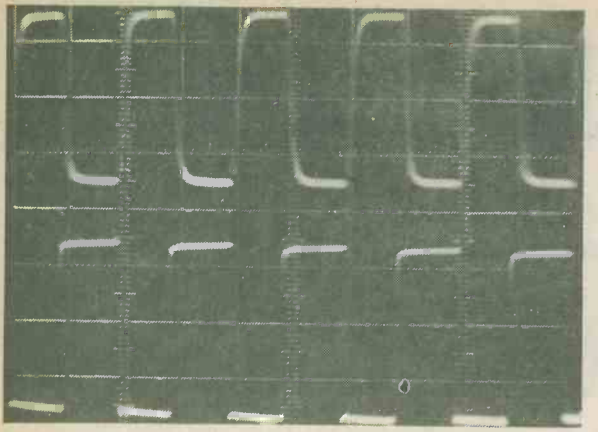
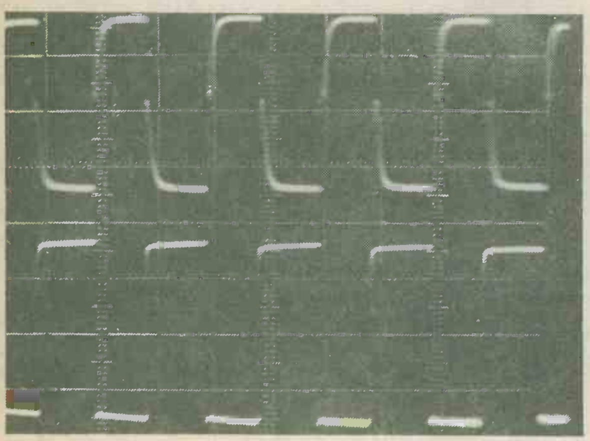


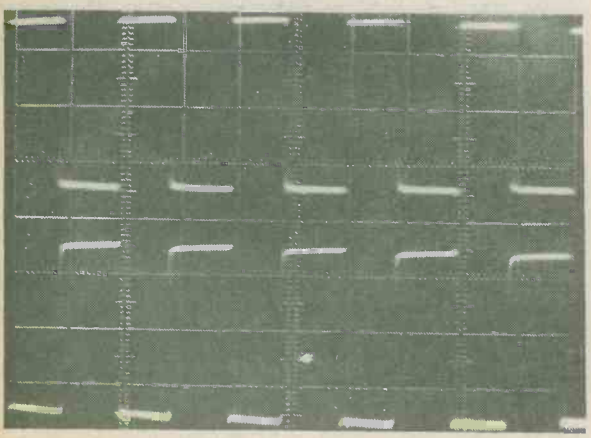
Fig. 13. The main printed board, on which the two channels are wired up. This is also reproduced full size



Applying a low level square wave input (lower waveform) to the noise limiter results in an output having very noticeable high frequency attenuation



Increasing the amplitude of the square wave input results in less high frequency attentuation



A high level square wave input suffers no high frequency attenuation

cidentally transposed between the deck and the amplifier, as this can easily be done. The choice of channel in the unit is quite arbitrary, but it will be found helpful to choose for the left-hand signal the channel whose components have the suffix 'a'.

There is only one pre-set adjustment per channel, and this consists of the setting up of R5 and R5a to phase out the high frequency noise. The simplest approach here consists of playing a blank cassette through the whole system with the gain and treble controls well advanced, and with VR1 and VR1a set fully anticlockwise. R5 and R5a are then adjusted for minimum tape noise from each channel. Well defined areas of decreased noise should be found with the potentiometers adjusted towards the minimum resistance ends of their tracks (anticlockwise). Adjustment to either side of this area should result in increased noise.

If it is felt that the full amount of treble filtering is too great, it can be reduced slightly by adjusting R5 and R5a slightly clockwise of the optimum position. It is essential that they are not adjusted in the opposite direction to achieve this effect, as such adjustment would reverse the phase of treble signals.

If increased treble cut is required, the values of C5 and C5a could be increased a little, say to $0.0015\mu F$ or $0.002\mu F$.

The two threshold level potentiometers, VR1 and VR1a, are front panel controls rather than pre-set types. This is because their optimum settings will vary according to the noise content of individual cassettes, and it is obviously much more acceptable for them to be readily accessible. In use, they are adjusted as far as possible in a clockwise direction without the treble cut being removed on low level signals. It is obvious when they have been adjusted too far as the noise level will be heard increasing and decreasing as low level signals rise and fall about the threshold level.

The adjustment of VR1 and VR1a for maximum benefit is fairly critical, but when these are set up correctly the unit should make a worth-while improvement to any cassette system which does not already have some form of noise reduction circuit.

OSCILLOGRAMS

Three photographs taken from the screen of a double-beam oscilloscope accompany this article and clearly show the effect of one channel of the noise limiter. In each the input signal is the lower waveform, with the output waveform above. All inputs are square waves at 2.5kHz.

The first oscillogram shows a low level square wave, and illustrates the slowing up of the rise and fall times due to the treble cut imposed by the unit. The second photograph illustrates the effect with an input at slightly higher level, and it will be seen that there is significantly less high frequency attenuation. In the third oscillogram, for a high level input, the treble cut has been totally removed.

The input and output signals are out of phase due to the inverting action of the common emitter amplifiers at the outputs of the noise limiter.

In next month's concluding article in this series, a further application for the electronic attenuator type MC3340P will be given. The article will describe an automatic fader unit with which the application of one input causes a second input to be automatically faded out. *(To be concluded)*

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT *Frequencies* = kHz

The war on the radio waves rages on unabated, as evidence of this one only has to listen to jamming transmitters, with their identification letters in morse, busily trying to drown all broadcasts directed to them by means of a (hopefully) barrage of impenetrable noise. These jamming transmitters are located just outside the upper and lower edges of every broadcast band, where they 'sit' until an offending programme comes on the air, at which time one of the jammers quickly locates itself well and truly right on top of the (to them) miscreant.

Another facet of this war is the so-called 'black' station. This purports to be a local transmitter but is in fact located well and truly in the opposing camp. We British pioneered this type of transmitter during World War II, broadcasting to Germany programmes designed to convince listeners they were tuned to a local station.

Soviet-based black stations, including a fake "Radio Peking", operate on various channels at unpredictable times. We recently logged this one at 0545 on **17600**, listening to OM & YL in Chinese and some typical music. How to tell the difference between the fake and the real R. Peking? Easy, the Russian blacks feature an awful lot of shouting, presumably slogans and exhortations, whereas the genuine Peking programmes are 'softer' in presentation.

Other blacks are, according to my information, Voice of the Liberation Army, Central People's Broadcasting Station, Red Army Radio Station, Sparks, and Proletarian Battle Division, all signing on and off with the "Internationale", either orchestral or choral versions.

CURRENT SCHEDULES

● SWEDEN

"Radio Sweden", Stockholm, presents an External Service in English to Europe as follows — from 1100 to 1130 on **9630** and **21690**; from 1600 to 1630 on **6065, 9770** and on **15240**; from 1830 to 1900 on **6065, 15240** and **17730**; from 2030 to 2100 on **6065, 9605** and on **11790**.

● SOUTH KOREA

"Radio Korea, the Overseas Service of KBS" (Korean Broadcasting System), Seoul, has the following programmes in English directed to Europe. From 0200 to 0230 on **11860**; from 1130 to 1200 on **7150, 9640** and on **11860**; from 2000 to 2030 on **9640** and on **11860**.

● SAUDI ARABIA

"Broadcasting Services of the Kingdom of Saudi Arabia", Jiddah, schedules programmes in English to Europe from 1100 to 1250 on **11855** and also from 1900 through to 2200 on the same channel.

From Riyad the "Holy Qur'an Station" broadcasts readings in Arabic from 0630 to 1030 to North and Central Africa on **9730** and on **17755**; from 1400 to 1700 to South and East Asia on **21595** and from 1700 to 2000 to North and Central Africa on **15245**.

● SOUTH AFRICA

"Radio RSA — The Voice of South Africa", Johannesburg, radiates programmes in English to both Europe and West Africa from 2100 to 2150 on **4875, 9585** and on **11900**. The English programme for North America is broadcast on the same channels from 2230 to 2320.

AROUND THE DIAL

● PAKISTAN

Karachi on **4735** at 1840 with a programme in Arabic which closes at 1845, with the National Anthem but re-opens at 1900 in French until sign-off at 2000 with the National Anthem. This is the Foreign Service link to Islamabad which is scheduled to operate from March to October and has a power of 10kW.

● CAMEROON

Radio Garoua on **5010** at 0424, the interval signal of native flute and Tam-Tam (drum) repeated many times until 0426 when the daily proceedings commence with the station identification in English and French, the whole being repeated twice, then the National Anthem and programme in French. One of my favourite stations, Garoua can often be a good 'pointer' to current conditions on the Africa to U.K. signal path — if you can hear Garoua well on any particular occasion then the odds are that you have struck a patch of good conditions for signals from the Dark Continent in general. Programmes are radiated from 0430 to 0700 and from 1700 to 2000, the power being 30kW.

● **SOUTH AFRICA**

SABC Meyerton on **3285** at 0411, OM with a world and local newscast in English. This is the English Service which operates from May to October, Monday to Friday inclusive from 0358 to 0520 and from 1620 to 2115; Saturdays from 0430 to 0520, 1600 to 2205; Sundays from 0500 to 0520 and from 1600 to 2115. The power is 100kW.

SABC Meyerton on **3320** at 1956, programme of light orchestral music followed by songs in Afrikaans. This is the Afrikaans Service which operates on this channel from May to October, Mondays to Fridays inclusive from 0358 to 0520, from 1621 to 2115; Saturdays from 0430 to 0520 and from 1600 to 2205; Sundays from 0500 to 0520 and from 1600 to 2115. The power is 100kW.

RSA/SABC Meyerton on **4875** at 0407, OM with local news in English with identification as "RSA Johannesburg" then into programme of pop records. This is the Overseas Service which operates on this channel from May to October in Portuguese, French and English, from 0256 to 0426 and from 1856 to 2150. This channel is also used from November to April by the Afrikaans Home Service which operates from 0358 to 0636 (opens at 0458 on Sundays) and from 1521 to 2115 (closes at 2205 on Saturdays). The power is 100kW.

● **EQUATORIAL GUINEA**

Bata on **4926** at 2023, programme of local music and songs in typical local style. The schedule is from around 0430 (it varies) to 2130 closing (this can also vary and has been reported closing at 2200 on occasions). The power is 5kW.

● **GABON**

Franceville on **4830** at 1820, African drums then local music with OM's in chorus, announcements in French. This is the Regional Network which operates from 0430 to 0700 and from 1800 to 2200, the power being 20kW.

● **RHODESIA**

Gwelo on **3396** at 1932, piano solos New Orleans style, YL announcer in English. This is the General Service which operates weekdays from 0355 to 0545 and daily from 1545 to 2200 (Sundays until 2100) with a power of 100kW. From 0545 (Sundays 0500) until 0615 the power used is 20kW.

● **CHINA**

Radio Peking on **9860** at 1428, OM in English to South Asia in the External Service.

Radio Peking on **6645** at 1802, OM in Standard Chinese, songs and music in the External Service to Europe, North Africa and West Asia.

Radio Peking on **6560** at 1808, OM in Farsi (Persian) to Iran and Afghanistan, also in parallel on a measured **7482**.

Radio Peking on **11650** at 1750, YL in Hakka to South East Africa and Asia. Sign-off with the "Internationale" at 1755.

Radio Peking on **11675** at 1800, sign-on with "The East is Red" then identification in Russian "Govorit Peking" ("Here is Peking").

● **ALGERIA**

Algiers on **7245** at 1815, OM with fast-moving harangue in Arabic in the "Voice of Palestine, Voice of the Palestine Revolution" programme, the schedule of which is from 1800 to 1900.

● **NORTH KOREA**

Pyongyang on a measured **6576** at 1825, choral songs and music, OM in Russian to Europe which is scheduled from 1800 to 1900, also logged in parallel on **9420**.

● **SRI LANKA**

Colombo on **11800** at 1935, OM in English with a talk about the local cricket scene (for sportsmen not entomologists!) in the English programme for Europe.

● **KUWAIT**

Radio Kuwait on **11845** at 1905, pop recordings with English announcements in the English programme to Europe and the U.K., the schedule of which is from 1700 to 2000.

● **HOLLAND**

Radio Nederland on **17700** at 1920, OM with the English programme in which a talk about stamp collecting was featured.

● **ROMANIA**

Bucharest on **17840** at 0530, YL with station identification and the local news in English.

● **SWITZERLAND**

Berne on **11715** at 0438, OM with both local and world news then a news commentary in English.

● **BRAZIL**

Radio Dif. Acreana, Rio Branco, on **4885** at 0418, OM with announcements and identification in Portuguese then songs and LA music, schedule is from 0900 to 0500, power 5kW.

● **ECUADOR**

Radio Splendit, Cuenca, on a measured **5024** at 0430, LA music then OM with announcements, station identification and then suddenly off without National Anthem. Schedule is from 1100 to 0430 and the power is 5kW.

● **VENEZUELA**

Radio Continente, Caracas, on **5030** at 0437, OM with identification then typical local music and songs. The schedule is from 0830 to 0500 and the power is 10kW.

Radio Mundial, Caracas, on **5050** at 0420, OM with station identification then YL with song in Spanish. The schedule is on a 24-hour basis and power is 1kW.

● **COLOMBIA**

Emisora Nuevo Mundo, Bogota, on **4755** at 0425, piano music then soft ballads in Spanish. The schedule of this one is around the clock and the power is just 1kW.

● **HONDURAS**

Radio Progresso, El Progresso, on **4920** at 0403, song in Spanish with YL's in chorus, LA music. This one operates from 1100 to 2200 with a power of 1.5kW and then with a power of 10kW from 2200 to 0530.

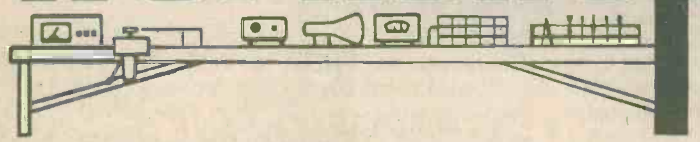
● **DOMINICAN REPUBLIC**

Radio Mil, Santo Domingo, on **4930** at 0407. OM with songs in Spanish, guitar music in local style. Radio Mil operates from 1000 to 0400 according to the schedule but has been reported closing as late as 0600 and even, on occasions, radiating on a 24-hour stint.

● **BELIZE**

Belize on **3300** at 0108, pop records with English vocals, announcements in English. The schedule is from 1200 to 0500 and the power is 5kW.

In your workshop



As is their custom at August, Dick and Smithy decide to leave the Workshop and take a trip into the countryside. Before doing so they undertake the small task of delivering a television receiver, and Smithy is also able to give Dick an insight into the operation of seven-segment numerical displays.

Toot-toot!

The cheery sound of the car horn woke Dick from his reverie, and he glanced away from the menswear shop window to see Smithy's car pulling smoothly into the kerb. The Serviceman leaned over and unfastened the passenger door.

"Hiya, Smithy," said Dick cheerfully, as he climbed in. "You're a bit earlier than I expected."

"Good," commented Smithy. "Then that gives us more time to spend together on today's outing. I always look forward to our annual break away from the Workshop."

Dick glanced back at the rear seat of the car. A rectangular wicker basket occupied a quarter of the seat. The remainder was taken up by a large 26 inch colour television receiver.

JUST A LITTLE JOB

"Hey," he asked suspiciously, "what's that?"

"It's a picnic basket," replied Smithy as he changed gear. "I've had it from before the war. You don't see picnic baskets like that these days."

"I didn't mean the basket," said Dick. "I meant that dirty great colour TV set that's lurking there."

"Oh that," returned Smithy carelessly. "That's just a little job I've got to drop off on our way out to the country."

"Fair enough," commented Dick. He dismissed the television receiver from his mind and concentrated on the road in front of him. "Well, we certainly picked the right day for this trip of ours. The sun's shining fit to bust."

The sun was, indeed, laying on a most commendable performance. Dick looked at the pedestrians on the pavements as they went happily about their business. Whilst the more dedicated observers of the human scene might well mourn the general demise of the mini-skirt, bounteous nature in her benevolence has at least partly compensated for the loss by the introduction of amply filled Levis. Dick settled himself comfortably alongside the Serviceman and, as the Americans say, watched the Fords go by.

"You know," Smithy's voice broke into his thoughts, "whenever you feel bored with electronics, there's always some different sort of gadget which is available to play around with."

"Is there?"

"There definitely is," averred Smithy, overtaking a cyclist. "For instance, I've been messing around at home over the last few evenings with some of those seven-segment l.e.d. numerical displays."

"Seven-segment displays? What are they?"

"They're light-emitting diode assemblies," explained Smithy. "They've got seven red or green segments laid out in the shape of an 8, together with a decimal point, and you light up different segments to form different numbers. The ones I've been trying out have connecting pins spaced out at the same intervals as those on a d.i.l. integrated circuit, and the characters are quite large, being about 0.3 inch high." (Fig. 1).

Dick detached his interest from the people bustling along the sun-lit streets and bestowed it fully on the Servicemen.

"Now you mention it," he said ruminatively, "I seem to have seen them advertised quite a lot in the mags recently. Aren't they meant to give a read-out for a small computing device or something like that?"

"That's their prime function," concurred Smithy. "They're an excellent alternative to neon and filament numerical indicator tubes and are easier to read. But they're quite amusing things to play around with in their own right. Ah, here we are!"

Smithy turned the wheel to the left,

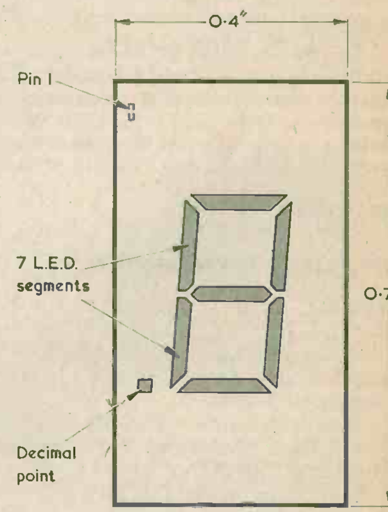


Fig. 1. General appearance, with approximate outside dimensions, of the seven-segment display described by Smithy

and the car swung into a courtyard. He stopped in front of a large open double door and switched off.

"Where's this?"

"It's where we drop off that colour TV," replied Smithy, opening the door and getting out of the car. "And when we've done that we've got the rest of the day free. Could you give me a hand?"

"Yes, sure," replied Dick obligingly.

He got out of the car and looked up at the building in front of them. It was a new, glaringly white, high-rise block of flats.

"Blimey," he remarked. "It makes you giddy just looking up at these places."

"Well," said Smithy, "we shan't be here long. Can you take the inside end of that TV?"

Dick entered the rear of the car and helped Smithy manoeuvre the receiver off the back seat. After a struggle they had the set safely positioned at the door on the car floor, whereupon Dick came round to the outside and took the set from Smithy, holding it in front of him with his hands at the two ends. Briskly, Smithy slammed the car doors shut and locked them, then led Dick into the building.

Almost immediately inside were two lift doors, side by side; Smithy pressed one of the lift buttons but there was no answering glow in the lamp beside it. Smithy pressed the button at the other lift door, but the lamp here did not light, either.

"That's funny," he remarked. "You don't expect to have *two* indicator lamps burnt out."

"Perhaps," grinned Dick, "they should have fitted some of those l.e.d. display indicators you've just been talking about. At least they wouldn't burn out. Does each of the segments in these indicators consist of an l.e.d. on its own?"

"You could say," said Smithy in reply, "that each segment consists of what is effectively half an l.e.d. The indicators I've been examining are common anode ones. Each segment then has a separate l.e.d. cathode and lights up when the energising circuit to that cathode is completed."

SEGMENT IDENTIFICATION

The Serviceman put his hand in his pocket and pulled out a small diary. He turned the pages.

"I made a few notes in my diary about the indicators," he announced, "as I didn't want to go to the bother of lugging gen-books home from the Workshop. Now, here's a sketch of the seven segments and, as you can see, they're identified by the letters A to G. The letters proceed from A to F in a clockwise order starting at the top segment. Letter G then identifies the central horizontal segment."

Smithy showed the page in his diary to Dick. (Fig. 2).

"Just a minute," said Dick, "let's put this TV down on the deck for a moment."

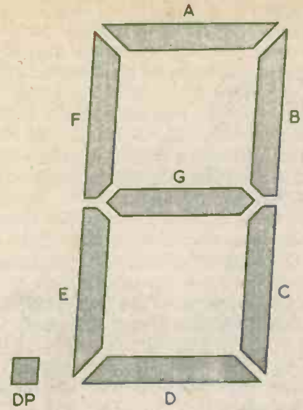


Fig. 2. The segments are identified by letters, as here

He carefully placed the set on the carpet in front of the lift doors, then took the diary from Smithy.

"That seems clear enough," he remarked. "What's this bit which is marked DP?"

"That's the decimal point," replied Smithy.

"Oh yes, of course."

"Are you two waiting for a flaming lift?"

Smithy and Dick turned to face a thin elderly man dressed in faded blue overalls. He leaned on a broom.

"Well, yes we are," said Smithy.

"You'll be waiting a long time, mate," said the elderly man with relish.

"Why's that?"

"They're both out of order."

"*Both* of them? That's pretty bad organisation, isn't it?"

"Not here, mate, it flaming isn't."

"Why's that?"

"Here," said the elderly man, a note of venom entering his voice, "we count ourselves lucky if we've got *one* flaming lift working. If you only flaming knew the number of times I've had to traipse up and down the flaming stairs you wouldn't flaming credit it, mate. They don't want a porter here, they want an astro-flaming-naut."

Smithy flinched at this concentration of verbal spontaneous combustion.

"I suppose," he remarked doubtfully, "we'd better take the stairs ourselves, er, mate. Where are they?"

The elderly man pointed to a narrow staircase at one side of the hall.

"There they are, mate. And the best of flaming luck to you."

"Come on then, Dick," said Smithy.

The Serviceman returned his diary to his pocket, and Dick picked up the colour television receiver. The walls of the stairway were close and cramping, and the pair had to negotiate two right angle turns before arriving at the first floor. Around them were four doors, numbered 11, 12, 13 and 14 respectively. Another identical stairway, positioned vertically above the one from the hall, led upwards, and they climbed up this, to be confronted after two further right angle turns by another four doors, these being numbered 21, 22, 23 and 24. Yet another stairway was available and they entered this, emerging eventually at a third group of four doors bearing the legends 31, 32, 33 and 34. It was obvious that there were four flats on each floor, and that their first numbers denoted the floor on which they were situated. Dick put the television set down on the floor and mopped his brow.

"Hey, let's have a rest for a minute," he said. "These stairs are flaming steep."

"That word seems to be catching," remarked Smithy. "Okay, we'll take it easy for a bit."

"Show me that sketch of the seven-segment indicator again," said Dick. "I was getting really interested in it before we started this flaming mountain-climbing business."

"Now, that's enough bad language for the present," stated Smithy sternly, as he took out the diary and opened it up at the sketch of the indicator. "You're getting as bad as that porter."

He handed the diary to Dick.

"It seems pretty obvious how the numbers are made up," commented Dick, looking closely at Smithy's sketch. "I suppose you light up all the outside segments for O, and light up segments F and E for figure 1."

"You're right about O," replied Smithy, "but you're wrong about figure 1. This is given by lighting up segments B and C. Lighting up these two segments for 1 gives better spacing between numbers if there are a row of indicator displays side by side." (Fig. 3).

"Oh, I see," remarked Dick brightly. "Let's try number 2. That will be A, B. G, E and D, won't it?"

"That's correct," confirmed Smithy, leaning over and looking at the sketch. "And you only need to change one segment for 3. This is given by A, B, G, C and D."

"Which brings us up to 4," said Dick thoughtfully. "Hey, this is rather difficult. How *do* you make up a 4?"

"The 4 is the one which is most removed from the written number," said Smithy. "It's made up of F. G, B and C. After that you get 5, which is A, F, G, C and D, followed by 6, which is the same but with A out and E in."

"Figure 7," broke in Dick, "is bound to be A, B and C. And 8 *must* be all the segments turned on."

"You've got it," confirmed Smithy. "That just leaves 9, which is given by F, A, B, G and C. And that's the lot. In some applications, the remaining combinations of the segments may be used to give another five patterns, but these don't resemble any physical numbers. And, of course, there is a sixteenth possibility, in which all the segments are turned off."

FOURTH FLIGHT

Smithy glanced at his watch.

"Here, come on Dick," he said briskly. "We can't spend all day talking about l.e.d. indicators. We want to get out into the country."

Dick handed the diary back to Smithy, then stooped to pick up the television set. He paused as a thought occurred to him.

"Just a minute," he said aggressively. "Why am I doing all the work here? Why can't *you* carry this set for a bit?"

"Now Dick," replied Smithy in a conciliatory tone, "you know the trouble I have with my back."

Dick snorted.

"It's funny," he remarked bitterly, "how your back always plays up whenever there's something heavy to be carried."

"My old army doctor explained it to me once," stated Smithy. "He said I had a conditioned reflex."

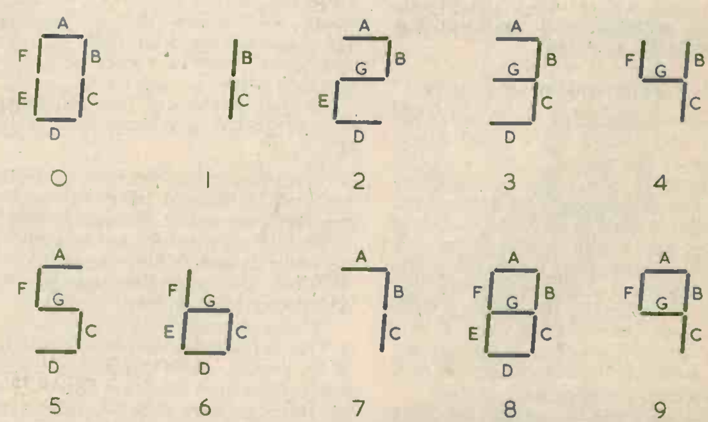


Fig. 3. How the segments can be illuminated to form figures from 0 to 9

Dick grunted then, grumbling, picked up the television set. They arrived at the next landing, with doors 41, 42, 43 and 44, then proceeded up yet a further stairway, to arrive at flats 51, 52, 53 and 54. By now, Dick had begun to stagger a little. He put the set on the floor unsteadily.

"That porter was right about these stairs," he snarled. "You do need to be a cosmo-flaming-naut to live here."

"I think," said Smithy mildly, "the definitive term is astro-flaming-naut. Come on, Dick, let's just get another flight out of the way and then we'll have a decent rest."

Mutinously, Dick picked up the set once more and tottered up to the sixth floor. Smithy walked behind him. Dick stumbled onto the landing and placed the set on the floor.

"Hey, Smithy, I've just thought of something. What flat are we supposed to be taking this set up to?"

"Well," said Smithy hesitantly, "it's rather a high number."

"Up in the 80's?"

"A bit more than that."

"Not the 90's."

"Er, no. It's a bit more than that again."

Dick sighed.

"Just break it to me gently, Smithy. What is the number of the flat?"

"It's number 112!"

"It's *what*?" shrieked Dick. "Are you saying that we've got to get up no less than five more flights of stairs?"

"Take it easy," said Smithy soothingly. "We're more than half-way there already."

"Why, you rotten twister," stormed Dick. "You deliberately refrained from telling me what the flat number was until I'd got this set more than half-way up."

There was a click and the door to flat number 63 opened. A middle-aged shrewish female face crowned by a forest of curlers poked out.

"What's all this flaming row out here?"

Her voice had a spine-shuddering scraping quality.

"We are delivering a television receiver, madam," said Smithy in his most majestic manner.

"Not to me you're flaming not."

"It's to a floor higher up."

"Then get on with it. You don't have to shout the flaming place down just to deliver a TV."

"We're taking a short rest," said Smithy, with a touch of asperity. "What's happened is that the flaming lifts are out of order."

"The flaming lifts are always out of order," screeched the woman, "and don't you flaming well swear at me, my man. Now take that TV off this landing at once."

Wearily, Dick bent down to pick up the set.

"No, not you," she shrilled. "You look whacked. Let the fat one do it. It will get some of his flaming weight off."

"Now, really," began Smithy.

She fixed him with a steely eye, against which even Smithy quailed.

"Go on, flaming move!"

Red-faced, Smithy stooped and took up the television set. Panting, he carried it up the next flight of stairs, followed by a patently delighted Dick. He stumbled on to the seventh landing and began to place the set on the floor.

"And you ain't flaming stopping here either," rose the woman's strident voice from behind him. Unnoticed, she had followed the pair up the flight of stairs.

Raging, Smithy snatched at the set and carried it up the next flight. At last, flats 81, 82, 83 and 84 hove into view, followed shortly after by the slam of a door two floors down. Smithy slowly lowered the set onto the carpet then leaned, trembling, against the wall.

"Dear oh dear, has she gone?"

But Dick had become too convulsed with hilarity to reply. He laughed helplessly as the Serviceman threw a furious glare at him. Finally, he wiped his eyes and then, with a sudden determination, picked up the set and carried it without a pause up to the next floor. Sheepishly, Smithy followed. As an afterthought, he rubbed the small of his back vigorously.

PIN CONNECTIONS

"That," said Dick, as he deposited the set on the ninth landing, "has been the funniest thing I've seen for ages. I'll have to ask that woman if she'd like a cleaning job in the Workshop."

"You'll do no such thing," retorted Smithy, aghast at the idea. "Blimey, what a *voice*."

"Well," said Dick, "we've got as far as the ninth floor, so I'm going to have another spell. Let's get back to those seven-segment displays we were talking about."

Smithy stared incredulously at his assistant.

"I've never met anybody like you, ever," he pronounced at length. "Once you get curious about something electronic you just never let it go."

"But I'm really taken up with these displays," protested Dick. "You've got the dope on them and so I naturally want to find out what I can from you. You said earlier on that you were playing around with common anode displays. Can you get common cathode displays?"

"Oh yes," said Smithy, his mind gradually re-entering the world of electronics. "When you have a common anode type, you connect the anode to the positive supply and light up each segment by connecting it to the negative rail via a suitable resistor." (Fig. 4).

"And I suppose," said Dick, "that if it's a common cathode type you connect this cathode to the negative rail, and take the segments up to positive via resistors."

"That's the idea," said Smithy. "The common anode displays seem to be the better for amateur use, but

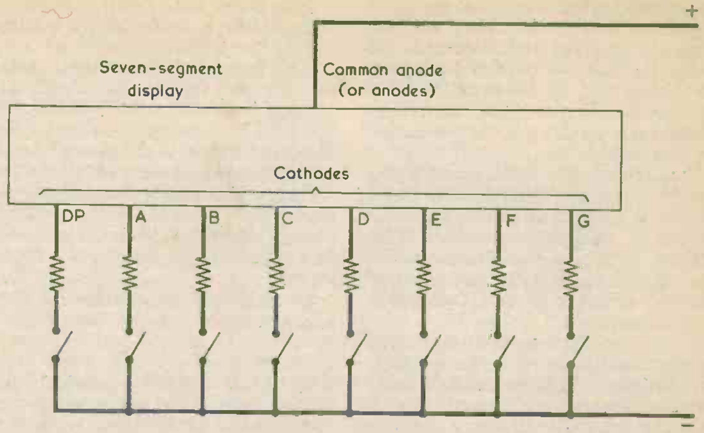


Fig. 4. Illustrating the manner in which the segments of a common anode display are powered. In normal usage the switches would be replaced by a decoder-driver i.c. such as the SN7447

that's just a personal opinion of mine. With these, the maximum forward continuous current per segment is rated at 30 to 40mA according to make and type, but in practice 15mA per segment is more than adequate for a good bright image. When calculating series resistor values you can assume a forward voltage drop in each segment of about 2.25 volts, although manufacturers' ratings here range from around 1.9 volts to as much as 3.8 volts. Normally, the displays are coupled to decoder-driver gates, such as the SN7447, but you can also light up the individual segments by simply applying the appropriate voltages and resistors. A suitable supply voltage would be 9 volts, with a resistor of 470Ω in series with each segment."

"Are the displays easy to connect up to?"

"The ones I've handled in the 0.3 inch size are," replied Smithy. "Representative type numbers for the common anode displays are SLA7 and TIL302, and these have pins with the same spacing as a 14 pin dual-in-line integrated circuit. They will also plug into a 14 way d.i.l. integrated circuit holder. Here's the pinning for the devices."

Smithy produced his diary again, opened it and showed Dick two pinning drawings. (Fig. 5).

"Now," he went on, "the SLA7 has just the one anode pin, this being pin 14. The TIL302, on the other hand, has three separate anode pins and all three have to be connected to the positive rail if all the individual segments are to light up. The segment

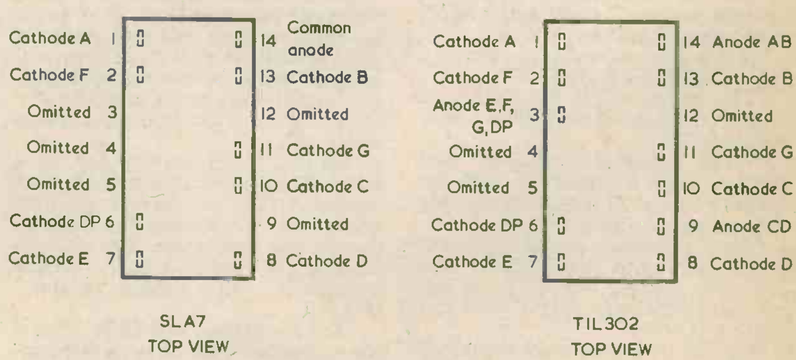


Fig. 5. Pin allocations for the SLA7 and the TIL302. These are common anode red displays with the decimal point on the left. Common anode displays with the decimal point on the right have different pinning

pins themselves are the same for both types."

"I see," said Dick, his curiosity at last apparently satisfied. "Hallo, what's the funny rumbling noise upstairs?"

"I didn't hear anything," commented Smithy. "Look, we've only got two more sets of stairs to get up, so shall we press on again?"

With the realisation that the job was nearly finished to spur him on, Dick picked up the colour television set yet once more. As they reached the tenth landing a look of strain became evident on Dick's face.

"It's no good, Smithy," he said, gasping. "I'll have to put it down again. My hands have gone all sweaty and the darned thing keeps slipping."

"Nonsense, lad," retorted Smithy firmly. "Don't give up now when we're nearly there."

Protesting, Dick climbed the stairs with Smithy purposefully following him close behind. They negotiated the first right angle bend and proceeded to the next.

"Smithy, we'd better go back," said Dick, clutching fiercely at the television receiver. "There seems to be something around this last corner. It must be what was causing that rumbling noise I heard just now."

"Just keep going, Dick," said Smithy inexorably, urging his assistant on.

Dick reached the corner and looked round it.

"Ye gods," he breathed in awe.

"Hey, get out of the flaming way," came a chorus of male voices above him.

"You go on, Dick," said Smithy.

"You can't," wailed Dick despairingly, "see what I can see."

"Hey," one of the new voices became audible over the hubbub. "We're moving this flaming piano down to the tenth floor, mate, and we aren't going to get it down the stairs if you're going to stand in the way with that flaming great TV set."

"You just take that piano back up again," called out Smithy, looking at long last round the corner.

"You must be off your flaming rocker, mate," replied the owner of the voice, who had now become the spokesman for the four piano movers. "It's as much as we can do to get the flaming thing *down*."

"Smithy," moaned Dick in anguish. "I'm losing my grip on this set."

"Look out," yelled a voice from behind the piano in equal anguish. "We can't hold this thing any longer."

The two men at the lower end of the piano jumped to one side whilst it trundled past them, gathering speed as it bumped down the stairs towards Dick. Frenziedly, Dick turned round and moved back into Smithy, pushing the television set into Smithy's stomach. Instinctively, Smithy grabbed the set from his assistant and, with the agility of a portly latter-day Nijinski, pirouetted round on his left foot whilst the piano clattered down behind him, narrowly missing both himself and his assistant before it crashed resoundingly into the wall with a dissonant jangle from all its strings.

Smithy completed his movement, turning to face the now stationary piano. He looked up the stairs, to see that there were no injuries amongst the men who had been moving the piano. He glanced at his ashen-faced assistant, who was also similarly undamaged.

Carefully, Smithy placed the colour television receiver on top of the piano.

JOB COMPLETED

"Well," said Smithy airily, "we did have a bit of trouble getting the set up here."

He sat comfortably on the settee in flat number 112, with his assistant beside him. They both drank cups of tea prepared by the set-owner, an attractive woman in her early thirties. In front of them, the colour television receiver displayed a perfect picture and reproduced a perfect sound signal.

"It's the lifts," went on Smithy. "They're not working."

The woman laughed.

"Those flaming lifts," she chuckled, "they're never flaming well working."

"One thing that puzzles me," said Dick, putting his cup down on a table at his side, "is that everybody here keeps saying 'flaming' all the time."

The woman's eyebrows rose.

"Do they?" she said. "I haven't flaming noticed it." ■

INTERNATIONAL VHF CONVENTION

The 22nd VHF Convention was held at Brunel University, Uxbridge, Middlesex, on 8th and 9th May.

The lecture programme was divided into three streams. Stream A covered such topics as "The GB3SN Project", "Moonbounce", "Audio Distortion in Transmission and Reception" and an open Forum on VHF Contests. Stream B covered OSCAR, with Joe Kasser from AMSAT — USA as a guest speaker. Stream C covered various aspects of Microwave techniques.

At the opening Ceremony on the Saturday afternoon, the President of the Society of Great Britain, E. J. Allaway, G3FKM, in his opening address, took the opportunity of reviewing the work of the R.S.G.B. He pointed out that much of the work was done by volunteers and that the R.S.G.B. represents **all** radio amateurs and their interests. Through R.S.G.B. support, the Class B licence; extension of the microwave band; repeaters; to mention but a few spheres of activity, had all been made available to all radio amateurs. In passing, he noted that in spite of rumours, no changes in the Class B Licence were being proposed. The importance of R.S.G.B. cooperation with other radio societies throughout the world was stressed, in view of the ITU worldwide frequency allocation conferences scheduled to take place shortly.

This latter point was enlarged upon by Roy Stevens, G2BVN, Hon. Sec., I.A.R.U. Region 1, in his address, supporting the President. He stressed how important a strong membership of the national society was, and also referred to the question of "behaviour" on the amateur bands. If membership of national radio societies drops, or if the authorities get too disgusted at some of the things their monitoring stations report about conduct on the amateur bands, then we stand a real chance of losing the amateur bands altogether. A major brief for band retention and the future requirements of the amateur radio service, must be prepared in the near future. In the ITU there is one vote per country and as a number of newly emerging countries are not sympathetic to the cause of amateur radio, it could be "touch and go" as to whether we retain the use of the amateur bands.

In addition to the lectures, there was a good representation of "the trade" with much of interest to be seen on their Stands.

Altogether a very successful occasion, for which the organisers deserve much commendation.

A.C.G.

SWITCH-OFF REMINDER

by
T. Miles

A useful additional circuit which helps to ensure that battery operated equipment is not left switched on.

Portable battery powered test equipment is very convenient — provided one remembers to switch it off after use! A pilot lamp cannot be fitted to an item of test equipment to indicate that it is switched on since the current consumed by the lamp would be excessively high. An l.e.d. with series resistor is more attractive but, even here, a current of at least 5mA is required if the l.e.d. is to give noticeable illumination. A continuous current drain at this level does not represent economic battery usage, particularly with batteries at their present high cost.

SWITCH-OFF CIRCUIT

An alternative approach has been employed by the writer and is illustrated by the circuit of Fig. 1. The on-off switch used here is changed from the usual s.p.s.t. type to an s.p.d.t. component.

When the switch is set to the "On" position, the battery supplies the equipment circuit in the usual way and also causes C1 to become charged by way of D1. The only additional current drawn from the battery is the initial charging current for C1 and the subsequent negligibly low leakage current in this capacitor.

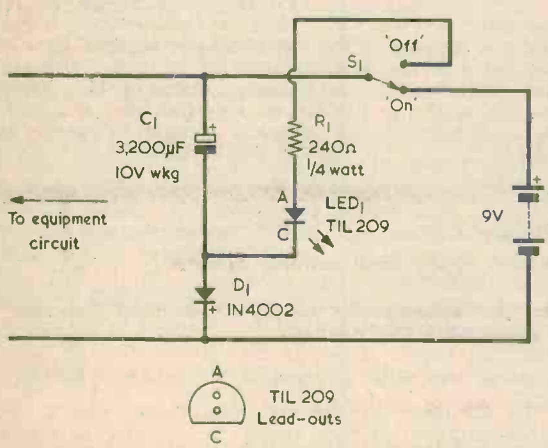


Fig. 1. The switch-off reminder circuit. Setting S1 to "Off" causes the l.e.d. to be illuminated for a short period

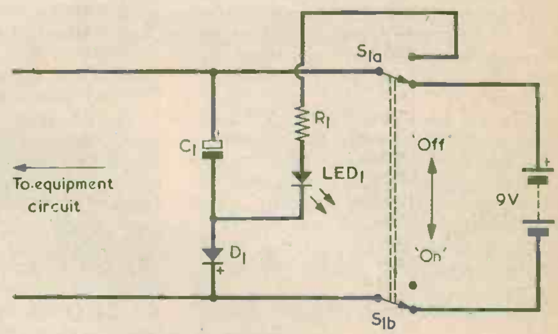


Fig. 2. The circuit is employed with double-pole on-off switches in the manner shown here

Putting the switch to "Off" disconnects the battery from the equipment circuit and applies the series combination of R1 and LED1 across the charged capacitor. This now discharges into R1 and LED1, causing the l.e.d. to give a relatively bright flash which then dims until, after about 4 seconds, the l.e.d. extinguishes. The capacitor can only discharge into R1 and LED1; it cannot discharge into the equipment circuit because current flow in this direction is blocked by D1.

The fact that switch-off is accompanied by a flash in the l.e.d. has a psychological effect which aids the memory. This is due to the fact that setting the switch to "Off" produces a *positive* result which can be readily observed and which the mind associates with the act of switching off. A positive indication is not otherwise given at switch-off in items such as electronic testmeters or signal generators.

The flasher can also be added to equipment having double-pole on-off switches. All that is required is that one of the switch sections be double-throw, as in Fig. 2. The operation of the circuit is the same as with the single-pole on-off switch. ■

Radio Topics

By Recorder

COMPUTER DEVELOPMENT

Looking back over computer development, the early computers were relatively enormous installations incorporating valves. These were rapidly made obsolete by the arrival of the transistor, which enabled much smaller computers to be made with discrete semiconductors and passive components. Then along came the logic integrated circuit, in which a single module could contain one or more flip-flops, four NAND gates, and so on. A system built from these integrated circuits was an improvement on the previous 'random logic designs' but it still contained a very large number of separate packages, interconnected by complicated printed circuits and backplane wiring. Although now taken for granted, they did succeed in reducing the size and cost of the equipment in which they were used.

As semiconductor technology improved, so smaller and more complex integrated circuits were produced. P-channel, then N-channel, followed by combinations of P- and N-channel circuits were made available and provided the means to include the equivalent of thousands of transistors on one chip. The resultant package was very complex, highly specialised and expensive; and unless mass production of sufficient numbers was ensured the development cost could not be recovered. The potential of large scale integration was likely to be unrealised because increasing miniaturisation meant greater complexity, resulting in greater specialisation to the exclusion of large production volume. And so the situation arose where it was only possible to make l.s.i. integrated circuits economically if sufficiently long runs of a single chip design could be undertaken. Whereupon the microprocessor concept was devised and developed.

The microprocessor is therefore a general purpose device, as it were, of very small size and having a high processing power. Also, it can be programmed to carry out a specific data handling task which may differ between one microprocessor and the next. Thus, the engineer dealing with microprocessors has to acquire a new skill: that of learning the fairly simple programming techniques which have to be carried out. Indeed, the setting up of a microprocessor system is nowadays a quite involved combination of work on the hardware (the physical electronics) and work on the software (the program).

MICROPROCESSORS

Electronics advances at such a fantastic rate these days that, like the Red Queen, you have to keep running just to stay in the same place. In the computing field, for instance, an entirely new technology has crept up on us over the past four years in the form of the microprocessor. Microprocessors are very important devices indeed, but not a great deal of information about them has slipped out to the general reader from the ranks of those who work closely with these new and highly advanced computing tools. I have just received a helpful press release on the subject from T. Jeffrey Burton Associates, P.R. consultants for Motorola Limited, and this in company with some general digging on my own part enables me to give some background details.

The term 'microprocessor' simply means that a microprocessor is a very small unit which seeks to emulate a computer's central processor. And the central processor is that part of the computer which controls all the data operations and which holds the programme instructions. The microprocessor is a large scale integrated circuit which provides engineers with an alternative to massive logic circuit design, and it offers a significant reduction in development and manufacturing costs when compared with conventional small or medium scale integrated circuit assemblies.

The economics of microcomputers are such that the designer can consider an entirely new range of applications which require computing power, but for which a minicomputer's cost would be too great. Particularly in the field of information management, the microprocessor provides the opportunity to distribute processing power, moving processing away from the computer installation to individual remote sites. This trend can be observed in the pages of computer publications, in which references are made to 'intelligent terminals', data entry devices (rather than data preparation equipment), point-of-sale cash terminals and source data encoders which include data validity checks.

Areas in which microprocessors are already well established are factory automation systems, machine tool control, advanced oscilloscopes and signal generators. Future applications which will benefit include domestic appliances (programmable washing machines, for example), traffic control systems and, perhaps, a diagnostic and control unit for cars. ■

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(Continued on page 63)

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(Continued from page 61)

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