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Technical Queries. We regret that we are unable to answer queries other than those arising from articles appearing in this magazine nor can we advise on modifications to equipment described. We regret that 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.

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THE JULY ISSUE WILL BE PUBLISHED ON 4th JUNE

SEMICONDUCTORS POTS & IRONS

SOCKETS

1611	8 pin DIL	£0·11
1612	14 pin DIL	£0·12
1613	16 pin DIL	£0·13
1614	24 pin DIL	£0·25
1615	28 pin DIL	£0·30
1616	TO18 Transistor	£0·12
1617	TU3 Transistor	£0·35
16117	TO5 Transistor	£0·12

VOLTAGE REGULATORS

Positive

MVR7805 v.a. 7805 TO220	£0·70
MVR7812 v.a. 7812 TO220	£0·70
MVR7815 v.a. 7815 TO220	£0·70
MVR7818	
MVR7824 v.a. 7824 TO220	£0·70

Negative

MVR7905 v.a. 7905 TO220	£0·80
MVR7912 v.a. 7912 TO220	£0·80
MVR7918	
MVR7915 v.a. 7915 TO220	£0·80
MVR7924 v.a. 7924 TO220	£0·80
v.a. 723C TO99	£0·45
72723 14 pin DN	£0·45
LM309K TO3	£1·50

ZENER DIODES

400mw (*Bzy88*) DO7 Glass *encapsulated* range of voltages available. 1·3v, 2·2v, 2·7v, 3 3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 39v.

No. Z4 8p ea.

1w-1·5w *Plastic and metal encapsulated* Range of voltages available. 1·3v, 2·2v, 2 7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v

No. Z13 15p ea.

10w *Metal stud type SO10* case. Range of voltages available, 1·3v, 2·2v, 2·7v, 3·3v, 3·9v, 4·3v, 4·7v, 5·1v, 5·6v, 6·2v, 6·8v, 7·5v, 8·2v, 9·1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v.

No. Z10 35p ea.

SILICON RECTIFIERS

200mA	
IS920 50v	£0·06
IS921 100v	£0·07
IS922 150v	£0·08
IS923 200v	£0·09
IS924 300v	£0·10
1 Amp	
IN4001 50v	£0·04½
IN4002 100v	£0·05
IN4003 200v	£0·06
IN4004 400v	£0 07
IN4005 600v	£0·08
IN4006 800v	£0·09
IN4007 1000v	£0·10
1·5 Amp	
IS015 50v	£0·09
IS020 100v	£0·10
IS021 200v	£0·11
IS023 400v	£0·13
IS025 600v	£0·14
IS027 800v	£0·16
IS029 1000v	£0·20
IS031 1200v	£0·25
3 Amp	
IN5400 50v	£0·14
IN5401 100v	£0·15
IN5402 200v	£0·16
IN5404 400v	£0·17
IN5406 600v	£0·21
IN5407 800v	£0·25
IN5408 1000v	£0·30
10 Amp	
IS10/50 50v	£0·19
IS10/100 100v	£0·21
IS10/200 200v	£0·23
IS10/400 400v	£0·35
IS10/600 600v	£0·42
IS10/800 800v	£0·51
IS10/1000 1000v	£0 60
IS10/1200 1200v	£0·69
30 Amp	
IS30/50 50v	£0·56
IS30/100 100v	£0·69
IS30/200 200v	£0·93
IS30/400 400v	£1·25
IS30/600 600v	£1·76
IS30/800 800v	£1·94
IS30/1000 1000v	£2·31
IS30/1200 1200v	£2·88
60 Amp	
IS70/50 50v	£0·75
IS70/100 100v	£0·84
IS70/200 200v	£1·20
IS70/400 400v	£1·75
IS70/600 600v	£2·25
IS70/800 800v	£2·50
IS70 1000 1000v	£3·00
BYX38/300 6A 300v	£0·45
BYX38/600 6A 600v	£0·60
BYX38/300 Rev 6A 300v	£0·45
BYX38/600 Rev 6A 600v	£0·60

POTENTIOMETERS

CARBON POTS (Linear Track)

Single gang with wire end terminations, 6mm × 50mm plastic shaft 10mm bushes supplied with shake proof washer & nut. Tolerance ± 20% of resistance.

1831 1k ohms	£0·26*	1836 47kohms	£0·26*
1832 2k2ohms	£0·26*	1837 100kohms	£0·26*
1833 4k7ohms	£0·26*	1838 220kohms	£0·26*
1834 10kohms	£0·26*	1839 470kohms	£0·26*
1835 22kohms	£0·26*	1840 1Meg	£0·26*
1841 2M2	£0·26*		

CARBON POTS (Log Track)

1842 4k7ohms	£0·26*	1846 100kohms	£0·26*
1843 10kohms	£0·26*	1847 220kohms	£0·26*
1844 22kohms	£0·26*	1848 470kohms	£0·26*
1845 47kohms	£0·26*	1849 1Meg	£0·26*
1850 2M2	£0·26*		

DUAL CARBON POTS (Lin Track)

These high quality dual gang pots are fitted with wire end terminations and 6mm × 50mm plastic shaft 10mm, bush and supplied with shake proof washer & nut track tolerance ± 20% but matched to within 2db of each other. VC3

1851 4k7	£0·86*	1855 100kohms	£0·86*
1852 10kohms	£0·86*	1856 220kohms	£0·86*
1853 22kohms	£0·86*	1857 470kohms	£0·86*
1854 100kohms	£0·86*	1858 1Meg	£0·86*
1859 2M2	£0·86*		

DUAL CARBON POTS (Log Law)

1860 4k7ohms	£0·86*	1864 100kohms	£0·86*
1861 10kohms	£0·86*	1865 220kohms	£0·86*
1862 22kohms	£0·86*	1866 470kohms	£0·86*
1863 47kohms	£0·86*	1867 1Meg	£0·86*
1868 2M2	£0·86*		

SINGLE GANG SWITCHED (Lin Law)

These potentiometers are fitted with double pole on-off switches. The switch is incorporated within the rotary action of the pot. Specification of pot is as VC1. Switch rating 1·5amps at 250v AC.

1870 4k7ohms	£0·65*	1874 100kohms	£0·65*
1871 10kohms	£0·65*	1875 220kohms	£0·65*
1872 22kohms	£0·65*	1876 470kohms	£0·65*
1873 47kohms	£0·65*	1877 1Meg	£0·65*
1878 2M2	£0.65*		

SWITCHED POT (Log Track)

Specification as VC2 but track having (log) law.

1879 4k7ohms	£0·65*	1833 100kohms	£0·65*
1880 10kohms	£0·65*	1884 220kohms	£0·65*
1881 22kohms	£0·65*	1885 470kohms	£0·65*
1882 47kohms	£0·65*	1886 1Meg	£0·65*
1887 2M2	£0·65*		

DUAL GANG LOG-ANTI-LOG POT

1888 Track specification as dual gang pots VC3, but tracks mounted to log-anti-log action 100kohms £0·75*

SPECIAL VOLUME CONTROLS

A miniature 16mm type replacement volume control incorporating single pole on-off switch. Resistance value 5kohms. Tolerance ± 20% 1/8watt rating.

1889 £0·27* VC8

MINIATURE ROTARY VOL CONTROL

5kohms log law with on/off switch. 20mm grooved spindle. Tag connections 17mm dia. Supplied with fixing nut. Used mainly for replacement.

1890 £0·54* VC9

WIRE WOUND POTS

A range of wire wound single gang pots with linear tracks of 1 watt rating, fitted with 10mm bush and supplied with shake-proof washer and nut.

VC6

1891 10ohms	£0.80/	1895 220ohms	£0.80/
1892 22ohms	£0.80/	1896 470ohms	£0.80/
1893 47ohms	£0.80/	1897 1kohms	£0.80/
1894 20ohms	£0.80/	1898 2k2 ohms	£0.80/
1899 4k7ohms	£0.80		

PRE-SET POTS HORIZONTAL MOUNTING

Miniature type for transistor circuits. The wiper of the preset is provided with a slot for screw driver adjustment. The tags of the preset will fit printed wiring boards with a pitch of 2·54mm. All tracks are linear law.

VC7

1801 100ohms	£0·09*	1808 22kohms	£0·09*
1802 220ohms	£0·09*	1809 47kohms	£0·09*
1803 470ohms	£0·09*	1810 100kohms	£0·09*
1804 1kohms	£0·09*	1811 220kohms	£0·09*
1805 2k2ohms	£0·09*	1812 470kohms	£0·09*
1806 4k7ohms	£0·09*	1813 1Mohms	£0·09*
1807 10kohms	£0·09*	1814 2M2ohms	£0·09*
1815 4M7ohms	£0·09*		

PRE-SET POTS VERTICAL MOUNTING

Miniature type for transistor circuits. Wiper adjustment is made by a screw driver slot. Designed to fit 2·54mm pitch board. All tracks are linear law.

VC7

1816 100ohms	£0·09*	1823 22kohms	£0·09*
1817 220ohms	£0·09*	1824 47kohms	£0·09*
1818 470ohms	£0·09*	1825 100kohms	£0·09*
1819 1kohms	£0·09*	1826 220kohms	£0·09*
1820 2k2ohms	£0·09*	1827 470kohms	£0·09*
1821 4k7ohms	£0·09*	1828 1Megohms	£0·09
1822 10kohms	£0·09*	1829 2M2ohms	£0·09
1830 4M7ohms	£0·09*		

ANTEX IRONS

O/No. 1943. 15 watt high quality soldering iron totally enclosed element in a ceramic shaft fitted with 3/32" bit. £3·80

O/No. 1947. Replacement element for 1943 iron. £1·90

O/No. 1944. Iron coated bit 3/32" for 1943 iron. £0·46

O/No. 1945. Iron coated bit 1/8" for 1943 iron. £0·46

O/No. 1946. Iron coated bit 3/16" for 1943 iron. £0·46

O/No. 1948. General purpose 18 watt iron fitted with iron coated bit. £3·60

O/No. 1952. Replacement element for 1948 iron. £1·90

O/No. 1949. Iron coated bit 3/32" for 1948 iron. £0·46

O/No. 1950. Iron coated bit 1/8" for 1948 iron £0·46

O/No. 1951. Iron coated bit 3/16" for 1948 iron. £0·46

O/No. 1931. Highly popular X25 25 watt quality soldering iron ceramic shafts to provide near perfect insulation break-down voltage of 1500 volts AC and a leakage current of only 3-5uA and another shaft of stainless steel to ensure strength. £3·60

O/No. 1935. Replacement element for 1931 iron. £1·60

O/No. 1932. Iron coated bit 1/8" for 1931 iron. £0 50

O/No. 1933. Iron coated bit 3/16" for 1931 iron. £0·50

O/No. 1934. Iron coated bit 3/32" for 1931 iron. £0·50

O/No. 1953. SK1 soldering kit—this kit contains 15 watt soldering iron fitted with a 3/16" bit plus two spare bits, a reel of solder, heat-sink and a booklet 'how to solder'. In presentation display box. £5.55

O/No. 1939. ST3 soldering iron stand. Stand made from high grade bakelite material chromium plated strong steel spring, suitable for all models, includes accommodation for six spare bits and two sponges which serve to keep the soldering iron bits clean. £1·50

PRINTED CIRCUIT BOARD TRANSFERS

Draw your own boards with the new BI-PAK etch-resistant transfers. Lay the symbols on the board, rub over with a soft pencil. The transfer will adhere to the board. Then complete the circuit with your BI-PAK etch-resist pen.

Each pack contains 11 sheets of transfers 1 of each as shown above.
Illustration — approx. ½ size.
O/No. TR400 @ £1.50 p&p £0.10.

BRIDGE RECTIFIERS

Type	Order No.	Price
SILICON 1 amp		
50V RMS	BR1/50	£0·20
100V RMS	BR1/100	£0·22
200V RMS	BR1/200	£0·25
400V RMS	BR1/400	£0·36
SILICON 2 amp		
50V RMS	BR2/50	£0·45
100V RMS	BR2/100	£0·48
200V RMS	BR2/200	£0·52
400V RMS	BR2/400	£0·58
1000V RMS	BR2/1000	£0·68

OPTOELECTRONICS

NEW INCREASED RANGE – ALL 1ST QUALITY

LED'S (diffused)

O/no.	Type	Size	Colour	Price
1501	ARL209(TIL209)	.3mm (.125)	RED	£0·10
1502	MIL3232(TIL211)	.3mm (.125)	GREEN	£0·15
1503	MIL3331 (OPL212A)	.3mm (.125)	YELLOW	£0·15
1504	ARL4850(FLV117)	.5mm (.2)	RED	£0·10
1505	MIL5251(TIL222)	.5mm (.2)	GREEN	£0·15
1506	MIL5351(MV5353)	.5mm (.2)	YELLOW	£0·15
1509	FLV111	.5mm (.2)	CLEAR (ill., Red)	£0·11

SUPER 'Hi-Brite' Type

1521	MIL32	.3mm (.125)	RED	£0·10
1522	MIL52	.5mm (.2)	RED	£0·10
1514	ORP12 Light dependent resistor			£0·55
1520	OCP71 Photo transistor			£0·35

LED CLIPS

1508/125	pack of 5	125 clips	£0·15
1508/2	pack of 5	2 clips	£0·18

ALL @ 8% V.A.T.

DISPLAYS

DL303	7 segment D.P. left (.30" height)	Common Anode	
RED	Single Digit	O/NO: 1523	£0·70
DL707	7 segment D.P. left (.0.3" height)	Common Anode	
RED	Single Digit	O/NO: 1510	£0·95
DL527	7 segment D.P. left (.50" height)	Common Anode	
RED	Two-Digit Reflector	O/NO: 1524	£1·70
DL727	7 segment D.P. right (.510" height)	Common Anode	
RED	Two-Digit Light Pipe	O/NO: 1521	£2·20
DL747	7 segment D.P. Left (.630" height)	Common Anode	
RED	Single-Digit Light Pipe	O/NO: 1511	£1·70

ALL @ 8% V.A.T.

OPTO-ISOLATORS

Isolation Breakdown – Voltage 1500 – continuous fwd current 100mA

CIL74 — Single-Channel 6 pin DIP standard type – optically coupled pair with Infra-red LED Emitter and NPN Silicon Photo Transistor. O/NO: 1497 £0·50

CILD74 — Multi-Channel 8 pin DIP Two Isolated Channels. O/NO: 1498 £1·00

CILQ74 — Multi-Channel 16 pin DIP Four Isolated Channels. O/NO: 1499 £2·20

ALL @ 8% V.A.T.

2nd GRADE LED PACK

A pack of 10 standard sizes and colours which fail to perform to their very rigid specification, but which are ideal for amateurs who do not require the full spec.

O/No. 1507 £1.50

THYRISTORS

600ma — TO 18 Case

Volts	No.	Price
10	THY600/10	£0·15
20	THY600/20	£0·18
30	THY600/30	£0·20
50	THY600/50	£0·22
100	THY600/100	£0·25
200	THY600/200	£0·38
400	THY600/400	£0·44

1 amp — TO 5 Case

Volts	No.	Price
50	THY1A/50	£0·26
100	THY1A/100	£0·28
200	THY1A/200	£0·32
400	THY1A/400	£0·38
600	THY1A/600	£0·45
800	THY1A/800	£0·58

3 amp — TO 66 Case

Volts	No.	Price
50	THY3A/50	£0·28
100	THY3A/100	£0·30
200	THY3A/200	£0·33
400	THY3A/400	£0·42
600	THY3A/600	£0·50
800	THY3A/800	£0·65

5 Amp — TO 66 Case

Volts	No.	Price
50	THY5A/50	£0·36
100	THY5A/100	£0·45
200	THY5A/200	£0·50
400	THY5A/400	£0·57
600	THY5A/600	£0·69
800	THY5A/800	£0·81

5 Amp — TO 220 Case

Volts	No.	Price
400	THY5A/400P	£0·57
800	THY5A/600P	£0·69
800	THY5A/800P	£0 81

7 Amp — TO 48 Case

Volts	No.	Price
50	THY7A/50	£0·48
100	THY7A/100	£0·51
200	THY7A/200	£0·57
400	THY7A/400	£0·62
600	THY7A/600	£0·78
800	THY7A/800	£0·92

10 Amp — TO 48 Case

Volts	No.	Price
50	THY10A/50	£0·51
100	THY10A/100	£0·57
200	THY10A/200	£0·62
400	THY10A/400	£0·71
600	THY10A/600	£0·99
800	THY10A/800	£1·22

16 Amp — TO 48 Case

Volts	No.	Price
50	THY16A/50	£0·54
100	THY16A/100	£0·58
200	THY16A/200	£0·62
400	THY16A/400	£0·77
600	THY16A/600	£0·90
800	THY16A/800	£1·39

30 Amp — TO 94 Case

Volts	No.	Price
50	THY30A/50	£1·18
100	THY30A/100	£1·43
200	THY30A/200	£1·63
400	THY30A/400	£1·79
600	THY30A/600	£3·50

No.	Price
BT101/500R	£0·80
BT102/500R	£0·80
BT106	£1·25
BT107	£0·93
BT108	£0·98
2N3228	£0·70
2N3535	£0·77
BTX30/50L	£0·33
BTX30/400L	£0·46
C106/4	£0·60

CABLES

DESCRIPTION	O/NO	PRICE/ Metre
Microphone Cable	3126	£0·10
Twin Microphone	3127	£0·20
Twin Stereo Screened Cable	3128	£0·15
Multicore Standard 4-Core Screened	3129	£0·30
4-Core Individually screened	3130	£0·22
Heavy Microphone Cable	3131	£0·18
Light 3-Core mains	3132	£0.10
Twin Oval Mains	3133	£0·09
Speaker Cable	3134	£0·07
Low Loss Co-axial Cable	3135	£0·22
15 Way Multi Coloured Ribbon Cable	3136	£0·40

SEMICONDUCTORS

TRANSISTORS

Type	Price
AC107	£0·22
AC113	£0·20
AC115	£0·20
AC117	£0·30
AC117K	£0·34
AC121	£0·20
AC122	£0·14
AC125	£0·18
AC126	£0·18
AC127	£0·18
AC128	£0·16
AC128K	£0·26
AC132	£0·20
AC134	£0·20
AC137	£0·20
AC141	£0·22
AC141K	£0·30
AC142	£0·20
AC142K	£0·30
AC151	£0·20
AC153	£0·22
AC153K	£0·30
AC154	£0·20
AC155	£0·20
AC156	£0·20
AC157	£0·25
AC165	£0·20
AC166	£0·20
AC167	£0·20
AC168	£0·25
AC169	£0·20
AC171	£0·25
AC176	£0·18
AC176K	£0·26
AC178	£0·25
AC179	£0·25
AC180	£0·20
AC180K	£0·28
AC181	£0·20
AC181K	£0·28
AC187	£0·18
AC187K	£0·28
AC188	£0·18
AC188K	£0·28
ACY17	£0·35
ACY18	£0·35
ACY19	£0·35
ACY20	£0·35
ACY21	£0·35
ACY22	£0·35
ACY27	£0·35
ACY28	£0·35
ACY29	£0·50
ACY30	£0·35
ACY31	£0·35
ACY34	£0·35
ACY35	£0·35
ACY36	£0·50
ACY40	£0·35
ACY41	£0·35
ACY44	£0·35
AD130	£0·70
AD140	£0·60
AD142	£0·85
AD143	£0·75
AD149	£0·60
AD161	£0·35
AD162	£0·35
AD161/162	£0·70
ADT140	£0·55
AF114	£0·25
AF115	£0·25
AF116	£0·25
AF117	£0·25
AF118	£0·40
AF124	£0·30
AF125	£0·30
AF126	£0·32
AF127	£0·32
AF139	£0·35
AF178	£0·60
AF179	£0·60
AF180	£0·60
AF181	£0·58
AF186	£0·50
AF239	£0·38
AL102	£1·20
AL103	£1·18
ASY26	£0·38
ASY27	£0·40
ASY28	£0·38
ASY29	£0·38
ASY50	£0·30
ASY51	£0·30
ASY52	£0·30
ASY54	£0·30
ASY55	£0·30
ASY56	£0·30
ASY57	£0·30
ASY58	£0·30
ASY73	£0·30
AU104	£1·40
AU110	£1·40
AU113	£1·40
BC107	£0·08
BC107A	£0·08
BC107B	£0·09
BC107C	£0·10
BC108	£0·08
BC108A	£0·08
BC108B	£0·09
BC108C	£0·10
BC109	£0·08
BC109A	£0·08
BC109B	£0·09
BC109C	£0·10
BC113	£0·16*
BC114	£0·16*
BC115	£0·19*
BC116	£0·19*
BC116A	£0·19*
BC117	£0·20*
BC118	£0·14*

Type	Price
BC119	£0·25
BC120	£0·40
BC125	£0·17*
BC126	£0·22*
BC132	£0·18*
BC134	£0·18*
BC135	£0·15*
BC136	£0·18*
BC137	£0·18*
BC139	£0·32
BC140	£0·30
BC141	£0·28
BC142	£0·22
BC143	£0·22
BC145	£0·46
BC147	£0·07*
BC148	£0·07*
BC149	£0·07*
BC150	£0·20*
BC151	£0·22*
BC152	£0·20*
BC153	£0·25*
BC154	£0·19*
BC157	£0·10
BC158	£0·10*
BC159	£0·10*
BC160	£0·26
BC161	£0·38
BC167	£0·12*
BC168	£0·12*
BC169	£0·09*
BC169C	£0·10*
BC170	£0·09*
BC171	£0·09*
BC172	£0·09*
BC173	£0·09
BC174	£0·15*
BC175	£0·35*
BC177	£0·16
BC178	£0·16
BC179	£0·16
BC180	£0·25
BC181	£0·25*
BC182	£0·09*
BC182L	£0·09*
BC183	£0·09*
BC183L	£0·09*
BC184	£0·09
BC184L	£0·09*
BC186	£0·22
BC187	£0·22
BC207	£0·11*
BC208	£0·11*
BC209	£0·12*
BC212	£0·09*
BC212L	£0·09*
BC213	£0·09*
BC213L	£0·09*
BC214	£0·09*
BC214L	£0·09*
BC225	£0·26*
BC226	£0·36*
BC227	£0·16*
BC238	£0·16*
BC251	£0·18*
BC251A	£0·16*
BC301	£0·28
BC302	£0·29
BC303	£0·28
BC304	£0·38
BC327	£0·16*
BC328	£0·15*
BC337	£0·15*
BC338	£0·15*
BC440	£0·30
BC441	£0·30
BC460	£0·38
BC461	£0·38
BC477	£0·20
BC478	£0·20
BC479	£0·20
BC547	£0·10*
BC548	£0·10*
BC549	£0·10*
BC550	£0·14*
BC556	£0·14*
BC557	£0·13*
BC558	£0·12*
BC559	£0·14*
BCY30	£0·55
BCY31	£0·55
BCY32	£0·60
BCY33	£0·55
BCY34	£0·60
BCY70	£0·15
BCY71	£0·15
BCY72	£0·14
BCZ10	£0·60
BCZ11	£0·60
BCZ12	£0·60
BD115	£0·50
BD116	£0·80
BD121	£0·65
BD123	£0·65
BD124	£0·70
BD131	£0·35
BD132	£0·35
BD131/132	£0·80
BD133	£0·40
BD135	£0·38
BD136	£0·35
BD137	£0·35
BD138	£0·36
BD139	£0·36
BD140	£0·36
BD139/140	£0·80
BD155	£0·80
BD175	£0·60
BD176	£0·60
BD177	£0·68
BD178	£0·68
BD179	£0·75
BD180	£0·75
BD181	£0·85
BD182	£0·90

Type	Price
BD183	£0·95
BD184	£1·10
BD185	£0·68
BD186	£0·68
BD187	£0·75
BD188	£0·75
BD189	£0·78
BD190	£0·78
BD195	£0·90
BD196	£0·90
BD197	£0·95
BD198	£0·95
BD199	£0·99
BD200	£0·99
BD201	£0·80
BD202	£0·80
BD201/202	£1·70
BD203	£0·80
BD204	£0·80
BD203/204	£1·70
BD205	£0·80
BD206	£0·80
BD207	£1·00
BD208	£1·00
BD222	£0·47
BD225	£0·47
BD232	£0·55
BD233	£0·48
BD234	£0·55
BD235	£0·55
BD236	£0·58
BD237	£0·55
BD238	£0·60
BDX32	£2·20
BDY11	£1·30
BDY17	£1·80
BDY20	£0·80
BDX77	£0·90
BF115	£0·22
BF117	£0·50
BF118	£0·75
BF119	£0·75
BF121	£0·50*
BF123	£0·60*
BF125	£0·50*
BF127	£0·60*
BF152	£0·25*
BF153	£0·25*
BF154	£0·22*
BF155	£0·35
BF156	£0·28
BF157	£0·28
BF158	£0·28*
BF159	£0·28*
BF160	£0·30*
BF162	£0·30*
BF163	£0·30*
BF164	£0·50*
BF165	£0·50*
BF167	£0·24
BF173	£0·20
BF176	£0·38*
BF177	£0·26
BF178	£0·28
BF179	£0·30
BF180	£0·30
BF181	£0·30
BF182	£0·30
BF183	£0·30
BF184	£0·20
BF185	£0·20
BF186	£0·26*
BF187	£0·26
BF188	£0·40
BF194	£0·10*
BF195	£0·10*
BF196	£0·10*
BF197	£0·12*
BF198	£0·14*
BF199	£0·14*
BF200	£0·30
BF202	£0·90*
BF222	£0·90
BF224	£0·17
BF240	£0·17*
BF241	£0·17*
BF244	£0·30*
BF257	£0·25
BF258	£0·25
BF259	£0·35
BF262	£0·60*
BF263	£0·60*
BF270	£0·36
BF271	£0·31
BF272	£0·80
BF273	£0·36*
BF274	£0·38*
BF324	£0·35*
BF336	£0·30
BF337	£0·30*
BF338	£0·38
BF457	£0·37
BF458	£0·37
BF459	£0·38
BF594	£0·30*
BF596	£0·28*
BFR39	£0·24
BFR40	£0·25*
BFR79	£0·28*
BFR80	£0·28*
BFX29	£0·22
BFX30	£0·30
BFX84	£0·22
BFX85	£0·24
BFX86	£0·25
BFX87	£0·22
BFX88	£0·22
BFX90	£0·55*
BFY50	£0·16
BFY51	£0·16
BFY52	£0·16
BFY53	£0·16
BIP19	£0·38
BIP20	£0·38
BIP19/20	£0·80

Type	Price
BPX25	£1·45
BSX19	£0·18
BSX20	£0·18
BSY25	£0·16
BSY26	£0·16
BSY27	£0·16
BSY28	£0·16
BSY29	£0·16
BSY38	£0·19
BSY39	£0·19
BSY40	£0·29
BSY41	£0·29
BSY51	£0·25
BSY95	£0·13
BSY95A	£0·13
BRY39	£0·45
BU105	£1·40
BU105/02	£1·95
BU204	£1·40
BU205	£1·40
BU208	£1·90
BU208/02	£2·25
E1222	£0·38
MAT100	£0·19
MAT101	£0·20
MAT120	£0·19
MAT121	£0·20
MJ480	£0·95
MJ481	£1·05
MJ490	£0·95
MJ491	£1·15
MJE340	£0·45
MJE370	£0·65
MJE371	£0·60
MJE520	£0·45
MJE521	£0·65
MJE2955	£0·90
MJE3055	£0·60
MJE3440	£0·52
MP8113	£0·52
MPF102	£0·28
MPF104	£0·35
MPF105	£0·35
MPSA05	£0·20*
MPSA06	£0·20*
MPSA55	£0·20*
MPSA56	£0·20*
ND120	£0·18
DC19	£0·85
DC20	£1·85
OC22	£1·50
OC23	£1·50
OC24	£1·35
OC25	£1·00
OC26	£1·00
OC28	£0·80
OC29	£0·95
OC35	£0·90
OC36	£0·90
OC41	£0·20
OC42	£0·22
OC44	£0·24
OC45	£0·20
OC70	£0·24
OC71	£0·15
OC72	£0·24
OC74	£0·26
OC75	£0·30
OC76	£0·35
OC77	£0·50
OC81	£0·22
OC81D	£0·24
OC82	£0·24
OC82D	£0·30
OC83	£0·26
OC84	£0·38
OC139	£0·80
OC140	£0·80
OC169	£0·35
OC170	£0·35
OC171	£0·35
OC200	£0·38
OC201	£0·95
OC202	£1·20
OC203	£0·65
OC204	£0·90
OC205	£1·15
P346A	£0·35
P397	£0·45
R200088	£2·50
R2010B	£2.60
ST140	£0·15
ST141	£0·20
TIC44	£0·29
TIC45	£0·35*
TIP29A	£0·40
TIP29B	£0·42
TIP29C	£0·44
TIP30A	£0·40
TIP30B	£0·42
TIP30C	£0·44
TIP31A	£0·40
TIP31B	£0·42
TIP31C	£0·44
TIP32A	£0·40
TIP32B	£0·42
TIP32C	£0·44
TIP41A	£0·44

Type	Price
TIP41B	£0·46
TIP41C	£0·48
TIP42A	£0·44
TIP42B	£0·46
TIP42C	£0·48
TIP2955	£0·60
TIP3055	£0·50
TIS43	£0·22
TIS90	£0·18*
UT46	£0·20
ZTX107	£0·10*
ZTX108	£0·10*
ZTX109	£0·10*
ZTX300	£0·12*
ZTX301	£0·12*
ZTX302	£0·16*
ZTX303	£0·16*
ZTX304	£0·20*
ZTX330	£0·15*
ZTX500	£0·13*
ZTX501	£0·12*
ZTX502	£0·16*
ZTX503	£0·12*
ZTX504	£0·25*
ZTX531	£0·25*
ZTX550	£0·16*
2G301	£0·22
2G302	£0·22
2G303	£0·22
2G304	£0·30
2G306	£0·40
2G308	£0·36
2G309	£0·36
2G339	£0·20
2G339A	£0·18
2G344	£0·20
2G345	£0·18
2G371	£0·18
2G371B	£0·12
2G373	£0·18
2G374	£0·18
2G377	£0·32
2G378	£0·18
2G381	£0·18
2G382	£0·18
2G401	£0·32
2G414	£0·32
2G417	£0·28
2N388	£0·36
2N388A	£0·56
2N404	£0·20
2N524	£0·40
2N527	£0·50
2N598	£0·40
2N599	£0·46
2N696	£0·13
2N697	£0·12
2N698	£0·12
2N699	£0·32
2N706	£0·10
2N706A	£0·12
2N707	£0·48
2N708	£0·14
2N711	£0·30
2N717	£0·30
2N718	£0·25
2N718A	£0·50
2N726	£0·29
2N727	£0·29
2N743	£0·20
2N744	£0·20
2N914	£0·15
2N918	£0·30
2N929	£0·20
2N930	£0·18
2N946	£0·40
2N1131	£0·18
2N1132	£0·18
2N1302	£0·15
2N1303	£0·18
2N1304	£0·18
2N1305	£0·18
2N1306	£0·25
2N1307	£0·25
2N1308	£0·30
2N1309	£0·30
2N1599	£0·35
2N1613	£0·20
2N1711	£0·20
2N1889	£0·45
2N1890	£0·45
2N1893	£0·30
2N2147	£0·75
2N2148	£0·70
2N2160	£1·00
2N2192	£0·38
2N2193	£0·38
2N2194	£0·38
2N2217	£0·22
2N2218	£0·22
2N2218A	£0·20
2N2219	£0·20
2N2219A	£0·24
2N2220	£0·20
2N2221	£0·20
2N2221A	£0·22
2N2222	£0·20
2N2222A	£0·20
2N2368	£0·18
2N2369	£0·14
2N2369A	£0·14
2N2411	£0·25
2N2412	£0·25
2N2646	£0·47
2N2711	£0·22

Type	Price
2N2712	£0·22
2N2714	£0·22
2N2904	£0·18
2N2904A	£0·21
2N2905	£0·18
2N2905A	£0·20
2N2906	£0·16
2N2906A	£0·19
2N2907	£0·20
2N2907A	£0·22
2N2923	£0·15*
2N2924	£0·15*
2N2925	£0·15*
2N2926G	£0·09*
2N2926Y	£0·08*
2N2926O	£0·08*
2N2926R	£0·08*
2N2926B	£0·08*
2N3010	£0·65
2N3011	£0·15
2N3053	£0·16
2N3054	£0·40
2N3055	£0·40
2N3391	£0·20*
2N3391A	£0·22*
2N3392	£0·20*
2N3393	£0·20*
2N3394	£0·20*
2N3395	£0·22*
2N3402	£0·21*
2N3403	£0·21*
2N3404	£0·29*
2N3405	£0·42*
2N3414	£0·16*
2N3415	£0·16*
2N3416	£0·29*
2N3417	£0·29*
2N3614	£1·00
2N3615	£1·05
2N3616	£1·05
2N3646	£0·09*
2N3702	£0·08*
2N3703	£0·08*
2N3704	£0·07*
2N3705	£0·07*
2N3706	£0·08*
2N3707	£0·08*
2N3708	£0·07*
2N3708A	£0·07*
2N3709	£0·07*
2N3710	£0·07*
2N3711	£0·07*
2N3772	£1·60
2N3773	£2·20
2N3819	£0·18
2N3820	£0·35
2N3821	£0·60
2N3823	£0·60
2N3903	£0·10*
2N3904	£0·10*
2N3905	£0·10*
2N3906	£0·10*
2N4058	£0·12*
2N4059	£0·14*
2N4060	£0·14*
2N4061	£0·12*
2N4062	£0·12*
2N4284	£0·18*
2N4285	£0·18*
2N4286	£0·18*
2N4287	£0·18*
2N4288	£0·18*
2N4289	£0·18*
2N4290	£0·18*
2N4291	£0·18*
2N4292	£0·18*
2N4293	£0·18*
2N4921	£0·55*
2N4923	£0·65*
2N5135	£0·10*
2N5136	£0·10*
2N5138	£0·10*
2N5172	£0·14*
2N5194	£0·56
2N5245	£0·40
2N5294	£0·34
2N5296	£0·36
2N5257	£0·32
2N5458	£0·32
2N5459	£0·35
2N5551	£0·36*
2N6027	£0·34
2N6121	£0·70
2N6122	£0·70
2S301	£0·50
2S302	£0·43
2S302A	£0·43
2S303	£0·56
2S304	£0·71
2S305	£0·80
2S306	£0·80
2S307	£0·80
2S321	£0·57
2S322	£0·43
2S322A	£0·43
2S323	£0·57
2S324	£0·71
2S325	£0·71
2S326	£0·71
2S327	£0·71
40360	£0·36
40361	£0·36
40362	£0·38
40406	£0·45
40407	£0·35
40408	£0·52
40409	£0·75
40410	£0·75
40411	£2·70

TT2 ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
7400	£0·09	7427	£0·24	7472	£0·20	74105	£0·38	74163	£0·62
7401	£0·11	7428	£0·26	7473	£0·25	74107	£0·24	74164	£0·68
7402	£0·11	7430	£0·11	7474	£0·25	74110	£0·36	74165	£0·68
7403	£0·11	7432	£0·22	7475	£0·29	74111	£0·58	74166	£0·78
7404	£0·11	7433	£0·30	7476	£0·25	74118	£0·80	74174	£0·65
7405	£0·11	7437	£0·21	7480	£0·44	74119	£1·18	74175	£0·62
7406	£0·22	7438	£0·21	7481	£0·85	74121	£0·24	74176	£0·58
7407	£0·22	7440	£0·12	7482	£0·68	74122	£0·39	74177	£0·58
7408	£0·13	7441	£0·50	7483	£0·58	74123	£0·40	74180	£1·50
7409	£0·13	7442	£0·40	7484	£0·88	74136	£0·52	74181	£0·58
7410	£0·11	7443	£0·70	7485	£0·68	74141	£0·55	74182	£0·70
7411	£0·17	7444	£0·70	7486	£0·22	74145	£0·55	74184	£0·70
7412	£0·15	7445	£0·65	7489	£1·70	74150	£0·68	74190	£0·68
7413	£0·24	7446	£0·60	7490	£0·32	74151	£0·48	74191	£0·62
7414	£0·50	7447	£0·48	7491	£0·64	74153	£0·48	74192	£0·60
7416	£0·23	7448	£0·56	7492	£0·35	74154	£0·82	74193	£0·58
7417	£0·23	7450	£0·11	7493	£0·30	74155	£0·50	74194	£0·62
7420	£0·11	7451	£0·11	7494	£0·75	74156	£0·60	74195	£0·60
7421	£0·20	7453	£0·11	7495	£0·50	74157	£0·50	74196	£1·05
7422	£0·16	7454	£0·11	7496	£0·60	74160	£0·58	74197	£1·05
7423	£0·21	7460	£0·11	74100	£0·85	74161	£0·62	74198	£1·85
7425	£0·19	7470	£0·25	74104	£0·39	74162	£0·62	74199	£1·85
7426	£0·23								

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0·14	CD4015	£0·76	CD4026	£1·20	CD4043	£0·88	CD4070	£0·17
CD4001	£0·15	CD4016	£0·42	CD4027	£0·50	CD4044	£0·82	CD4071	£0·17
CD4002	£0·16	CD4017	£0·75	CD4028	£0·68	CD4045	£1·40	CD4072	£0·17
CD4006	£0·92	CD4018	£0·85	CD4029	£0·85	CD4046	£1·30	CD4081	£0·17
CD4007	£0·17	CD4019	£0·42	CD4030	£0·48	CD4047	£0·87	CD4082	£0·18
CD4008	£0·92	CD4020	£0·90	CD4031	£2·00	CD4049	£0·42	CD4510	£0·99
CD4009	£0·45	CD4021	£0·82	CD4035	£1·00	CD4050	£0·42	CD4511	£0·95
CD4010	£0·48	CD4022	£0·82	CD4037	£0·95	CD4054	£1·10	CD4516	£1·00
CD4011	£0·15	CD4023	£0·15	CD4040	£0·88	CD4055	£1·00	CD4518	£1·00
CD4012	£0·16	CD4024	£0·65	CD4041	£0·76	CD4056	£1·35	CD4520	£1·00
CD4013	£0·42	CD4025	£0·15	CD4042	£0·72	CD4069	£0·17	CD4014	£0·80

LINEAR ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CA3011	£0.08*	CA3031	£0.93	MC1350	£1.20*	UA710C	£0.40*	SN76115	£1.90*
CA3014	£1.35*	CA3140	£0.70	MC1352	£1.40*	72710	£0.30*	SN76660	£0.75*
CA3018	£0.86*	LM301	£0.29*	MC1469	£2.95	UA711C	£0.32*	SL414A	£1.95*
CA3020	£1.70*	LM304	£1.60	MC1496	£0.90*	72711	£0.32*	TAA550B	£0.35
CA3028	£0.80*	LM308	£1.00*	NE536	£2.66*	UA723C	£0.46	TAA621A	£2.00*
CA3035	£1.40*	LM309	£1.50	NE550	£0.96	72723	£0.46	TAA621B	£2.50*
CA3036	£1.00*	LM320-5V	£1.50	NE555	£0.24	UA741C	£0.24*	TAA661	£1.50*
CA3042	£1.50*	LM320-12V	£1.50	NE556	£0.60	72741	£0.24*	TAD100	£1.30*
CA3043	£1.86*	LM320-15V	£1.50	NE565	£1.20*	741P	£0.20*	TBA540	£2.10*
CA3046	£0.70*	LM320-24V	£1.50	NE566	£1.50*	UA747C	£0.60*	TBA810S	£0.75*
CA3052	£1.60*	LM380	£0.85*	NE567	£1.70*	72747	£0.60*	TBA810	£0.98*
CA3054	£1.10*	LM381	£1.45*	UA702C	£0.46*	UA748	£0.35*	TBA820	£0.70*
CA3075	£1.50*	LM3900	£0.68*	72702	£0.46*	72748	£0.36*	TBA9200	£2.50*
CA3081	£1.50*	MC1303L	£0.85*	UA703	£0.25*	748P	£0.36*	TCA270S	£2.00*
CA3089	£2.00*	MC1304	£1.90*	UA709	£0.25*	SN76013N	£1.75*	TBA800	£0.80*
CA3090	£3.60*	MC1310	£0.95*	72709	£0.46*	SN76023	£1.75*		
CA3123	£1.90*	MC1312	£1.90*	709P	£0.25*	SN76110	£1.50*		

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA119	£0.08	BAX13	£0.07	BY164	£0.51	OA5	£0.60	OA200	£0.08
AA120	£0.08	BAX16	£0.08	BY176	£0.75*	OA10	£0.35	OA202	£0.08
AA129	£0.08	BY100	£0.22	BY206	£0.30	OA47	£0.08	SD10	£0.06
AAY30	£0.09	BY101	£0.22	BYZ10	£0.45	OA70	£0.08	SD19	£0.06
AAZ13	£0.15	BY105	£0.22	BYZ11	£0.45	OA79	£0.10	IN34	£0.07
BA100	£0.10	BY114	£0.22	BYZ12	£0.45	OA81	£0.10	IN34A	£0.07
BA102	£0.32	BY124	£0.22*	BYZ13	£0.40	OA85	£0.10	IN914	£0.06
BA148	£0.15	BY126	£0.15*	BYZ16	£0.41	OA90	£0.10	IN916	£0.06
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BB104	£0.15	BY133	£0.21*						

TRIACS

2 amp Volts	TO5 Case No.	Price	10 Amp Volts	TO48 Case No.	Price
100	TR12a/100	£0·31	100	TR110a/100	£0·77
200	TR12a/200	£0·51	200	TR100a/200	£0·92
400	TR12a/400	£0·71	400	TR100a/400	£1·12

6 Amp Volts	TO66 Case No.	Price	10 Amp Volts	TO220 Plastic Case No.	Price
100	TR16a/100	£0·51	400	TR110a/400p	£1·12
200	TR16a/200	£0·61			
400	TR16a/400	£0·77			

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4008	80p	4068	25p	4531	141p
4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4016	52p	4075	20p	4541	141p
4017	80p	4076	90p	4543	174p
4018	80p	4077	20p	4549	399p
4019	60p	4078	20p	4553	440p
4020	93p	4081	20p	4554	153p
4021	82p	4082	20p	4556	77p
4022	90p	4085	82p	4557	386p
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4024	76p	4089	150p	4559	388p
4025	17p	4093	50p	4560	218p
4026	180p	4094	190p	4561	65p
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4029	100p	4098	110p	4568	281p
4030	58p	4099	122p	4569	303p
4031	250p	4160	90p	4572	25p
4032	100p	4161	90p	4580	600p
4033	145p	4162	90p	4581	319p
4034	200p	4163	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
4037	100p	4194	95p	4585	100p
4038	105p	4501	23p		
4039	250p	4502	91p		
4040	83p	4503	69p		
4041	90p	4506	51p		
4042	85p	4507	55p		
4043	85p	4508	248p		
4044	80p	4510	99p		
4045	150p	4511	149p		
4046	130p	4512	98p		
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	'N'	'LSN'
7400	13	20
7401	13	20
7402	14	20
7403	14	20
7404	14	24
7405	18	26
7406	38	
7407	38	
7408	17	24
7409	17	24
7410	15	24
7411	20	24
7412	17	24
7413	30	52
7414	51	130
7415		24
7416	30	
7417	30	
7420	16	24
7421	29	24
7422	24	24
7423	27	
7425	27	
7426	36	27
7427	27	29
7428	35	32
7430	17	24
7432	25	24
7433	40	32
7437	40	24
7438	33	24
7440	17	24
7441	74	
7442	70	99
7443	115	
7444	112	
7445	94	
7446	94	
7447	82	
7448	56	99
7449		99
7450	17	
7451	17	24
7453	17	
7454	17	24

	'N'	'LSN'
7455	35	24
7460	17	
7463		
7470	28	
7472	28	
7473	32	
7474	27	38
7475	38	40
7476	37	
7478		
7480	48	
7481	86	
7482	69	
7483A		
7484	97	
7485	104	99
7486		40
7489	205	
7490	33	90
7491	76	110
7492	38	78
7493	32	99
7494	78	
7495A	65	99
7496	58	120
7497	185	
74100	119	
74104	63	
74105	62	
74107	32	38
74109	63	38
74110	54	
74111	68	
74112	88	
74113		38
74114		38
74116	198	
74118	83	
74119	119	
74120	115	
74121	25	
74122	46	
74123	48	
74124		
74125	38	44

	'N'	'LSN'
74126	57	44
74128	74	
74132	73	78
74133		29
74136		40
74138		60
74139		60
74141	56	
74142	265	
74143	312	
74144	312	
74145	65	
74147	175	
74148	109	
74150	99	
74151	64	84
74153	64	54
74154	96	
74155	54	110
74156	80	110
74157	67	55
74158		60
74159	210	
74160	82	130
74161	92	78
74162	92	130
74163	92	78
74164	104	
74165	105	
74166		
74167	20	
74168		
74169		200
74170	230	200
74172	625	
74173	170	
74174	87	120
74175	87	110
74176	75	
74177	78	
74180	85	
74181	165	350
74182	160	
74183		210
74184	135	

	'N'	'LSN'
74185	134	
74188	275	
74190	115	92
74191		
74192	105	180
74193	105	180
74194	105	187
74195	95	137
74196	99	110
74197	85	110
74198	150	
74199	160	
74248		90
74249		93
74251		90
74253		105
74257		108
74258		153
74259		420
74260		153
74261		353
74266		40
74273		124
74275		312
74279		52
74283		120
74290		90
74293		95
74295		120
74298		100
74324		157
74325		242
74326		247
74327		237
74352		100
74353		100
74362		715
74365		49
74366		49
74367		43
74368		49
74373		77
74374		77
74375		60

	LSN
74377	124
74378	93
74379	130
74386	37
74390	140
74395	139
74396	133
74398	180
74399	150
74445	92
74447	90
74490	·140
74668	110
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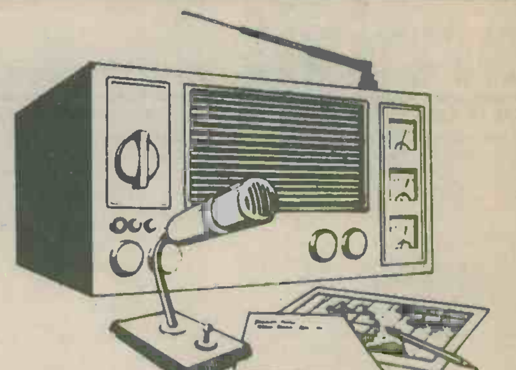

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25uF/30v	4p
32uF/40v	5p
32uF/160v	6p
40uF/16v	5p
47uF/25v	5p
56uF/25v	5p
64uF/10v	4p
64uF/70v	5p
75uF/9v	4p
100uF/6.3v	4p
100uF/40v	5p
125uF/10v	5p
125uF/10v	5p
150uF/6.3v	4p
150uF/16v	5p
150uF/25v	5p
200uF/10v	5p
250uF/16v	5p
300uF/9v	5p
300uF/25v	5p
320uF/18v	5p
320uF/18v	5p
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V.H.F. Receivers SR-9 for 2-metres F.M., fully tunable 144-146MHz, 2-speed slow-motion dial, also 11 xtal controlled channels. Compact, sensitive, ideal for fixed or mobile listening. Built-in L.S., 12v D.C. operation **£57.35 inc. VAT.** Crystals, if required: **£2.50** each. All popular 2m. channels in stock. Marine band version (156-162MHz) **£57.35** (xtals **£2.79**). Mains psu for above **£11.25**. Credit terms available, s.a.e. details.

Amplified Mobile Extn. Speaker boosts audio from small receivers. Single compact unit. 12vDC built-in 6W amplifier, with leads and jack plug, 4-8 Ω input **£11.25**. **Amplifier** only from above **£2.70.**

Neons min wire end 55p/10; £4/100

Slide switches min DPDT **18p** ea; 5+: **14p**

Resistor Kits E12 series, 22 Ω to 1M Ω 57 values. 5% carbon film, ⅛W or ¼W Starter pack, 5 each value)285) **£2.95**

Mixed pack, 5 each ⅛W + ¼W (570) **£5.40**

Standard pack, 10 each (570) **£5.40**

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I.C's (new) 7410 **25p** CD4001AE **25p** SN76660 **75p** NE555 **55p** 723(TO5) **75p** 709 (TO5). 741 (DIL-8) Op.amps **30p**; **BNC Cable mtg socket** 50 Ω **20p**; 5+: **15p** PL259 UHF Plug & Reducer **68p**; 5+: **60p**; SO239 UHF Socket panel mtd. **55p**; 5+: **45p** **Nicad rechargeables** physically equiv. to zinc-carbon types: AAA (U16) **£1.64**; AA(U7) **£1.20**, C(U11) **£3.15**; D(U2) **£4.94**; PP3 **£5.20** Any 5+: less 10%. Any 10+ less 20%.

We stock V.H.F. mobile aerials, s.a.e. details.

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Name ....

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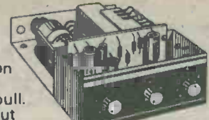
....

SUPERSOUND 13 HI-FI MONO AMPLIFIER



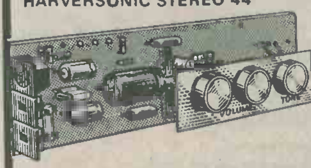
A superb solid state audio amplifier. Brand new components throughout. 5 Silicon transistors plus 2 power out-put transistors in push-pull. Full wave rectification. Output approx 13 watts r.m.s. into 8 ohms. Frequency response 12Hz. 30KHz ±3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high x 6" wide x 7½" deep. AC 200/250V. PRICE £18.00. P&P £1.20.

HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram, etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp). Input 1, 15mv into 47k. Input 2, 15mv into 47k (suitable for use with mic or guitar etc). Input 3, 200mv into 1 meg suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass and treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 20 watts R.M.S. Very attractively finished purpose-built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240v. Size approx 12¼" w x 5" h x 7¼" d.

Special introductory price **£28.00** + £2.50 carr & pkg.

HARVERSONIC STEREO 44



A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built-in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets and 5 pin din tape rec/play socket are mounted on the printed circuit panel, size approx 9⅛" x 2¾" x 1" max depth. Supplied brand new and tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically), at only **£10.00** plus 50p P&P. Mains transformer with an output of 17V a/c at 500 m/a can be supplied at **£2.00** plus 40p P&P if required. Full connection details supplied.

STEREO DECODER SIZE 2" x 3" x ½"

Ready-built. Pre-aligned and tested. Sens. 20-560mV for 9-16V neg earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. **£6.00** plus 20p P&P. Stereo beacon light if required 40p extra.

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

200/240V Mains operated Solid State A/M F/M Stereo Tuner. Covering MW AM 540-1605 KHZ, VHF/FM 88-108 MHZ. Built-in Ferrite rod aerial for MW. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built-in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600 m/v RMS into 20K. Simulated teak finish cabinet. Will match almost any amplifier. Size 8¼" w x 4" h x 9½" d approx. LIMITED NUMBER ONLY at **£28.00** plus £1.50 P&P.

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T/O stylus Diamond Stereo LP and Sapphire 78. **ONLY £2.80.** P&P 20p. Also available fitted with twin Diamond T/O stylus for Stereo LP, £3.00 P&P 20p.

LATEST CRYSTAL T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo 78, £2.20 P&P 20p.

LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only £2.20 P&P 20p.

STEREO MAGNETIC PRE-AMP sens 3mVin for 100m Vout 15 to 35V neg earth. Equ ± 1db. From 20Hz to 20KHz. input impedance 47k. Size 1⅜in x 2⅜in x 5⅜H. £3.00 plus 20p P&P.

SPECIAL OFFERS

Mullard LP1159 RF-IF Double Tuned Amplifier Module for nominal 470kHz. Size approx 2⅜" x 1¼" x ¾" 7.6V + earth. Brand new pre-aligned. Full specification and connection details supplied. **£2.25** + P&P 20p.

Pye VHF/FM Tuner Head covering 88-108M/Hz. 10.7M/Hz IF output 7-8V + earth. Supplied pre-aligned with full circuit diagram. Connection details supplied. Beautifully made with precision-geared FM Gang and 323 Pf + 323 Pf AM Tuning Gang only **£3.15** + P&P 35p.

SPECIAL OFFER Limited Number only!
New but very slightly shop soiled transistor radios by well known manufacturer. Very smart and attractive, vinyl covered with carrying handle. Size 7"H x 9½"W x 4"D approx. Telescopic aerial for VHF/FM band and internal ferrite aerials for AM bands. AC mains or battery operated and covering VHF/FM and MW bands. Uses four HP11 or SP11 batteries (not supplied). **£10.00 + £1.30 P&P**

SPECIAL OFFER Limited Number only!
Goodmans speakers. 6½"-8 ohm, long throw, ceramic magnet, full range rated 10 watts RMS (when fitted in enclosure). **£4.00 + 80p P&P** (P&P on two **£1.20**)

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Push Button Switch bank. 8 Buttons giving 16 S/P C/O interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size 5" x 2½" x 1". Supplied complete with chrome finished switch buttons 2 for **£1.80** + 20p P&P

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11⅝" x 14. 11/16" x 1. 7/16" deep. Weight 19oz. Power handling 20W RMS (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, etc and used with or without baffle. Send SAE for details. Only **£8.40** each. P&P 90p for one **£1.10** for two. Now available in 8" round version. 10 watts RMS 60Hz-20KHz. **£5.25** + P&P (one 65p, two 75p).

HARVERSONIC SUPER SOUND 10+10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge — instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts — no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specifications: Power output: 14 watts RMS per channel into 5 ohms. Frequency response ± 3dB 12-30,000 Hz. Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12-15,000 Hz. Bass, boost approx to ± 12dB. Treble cut approx to —16dB. Negative feedback 18dB over main amp. Power requirements: 35v at 1.0 amp. Overall size 12"W x 8"D x 2¾"H. Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large SAE. AMPLIFIER KIT **£14.50** P&P 80p (Magnetic input components 33p extra)

POWER PACK KIT £6.00 P&P 95p
CABINET £6.00 P&P 95p

SPECIAL OFFER — ONLY £25.00 IF ALL 3 UNITS ORDERED AT ONE TIME + £1.25 P&P

Full after sales service

Also available ready built and tested **£31.25** P&P **£1.50**

10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech with negligible hum. Separate inputs for mike and gram. allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p x SAE (free with parts). All parts sold separately. ONLY **£18.00** P&P **£1.40**. Also available ready-built and tested. **£22.00** P&P **£1.40**.

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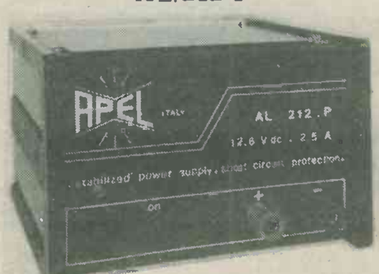
STABILIZED POWER SUPPLIES WITH ELECTRONIC SHORT CIRCUIT PROTECTION

AL.212 P



£14.75

INPUT VOLTAGE	220 V ac ± 10% 50-60 Hz
OUTPUT VOLTAGE RANGE	12,6 V dc
OUTPUT CURRENT MAX	2,5 Amp
LOAD REGULATION	<0,3% 0÷2,2 Amp
RIPPLE	<5mV 2,2 Amp
DIMENSIONS (mm)	W140 × H90 × D140
WEIGHT	1,490 Kg.

AL.315 P

£29.50

INPUT VOLTAGE	220 V ac ± 10% 50-60 Hz
OUTPUT VOLTAGE RANGE	1,7÷15 V. dc
LOAD REGULATION	<0,2% 0÷2,8 Amp
DIMENSIONS (mm)	W140 × H90 × D155
RIPPLE	3mV 2,8 Amp
WEIGHT	2,330 Kg.

AL.330 P

£46.50

INPUT VOLTAGE	220 V ac ± 10% 50-60 Hz
OUTPUT VOLTAGE RANGE	3,4÷30 V. dc
OUTPUT CURRENT RANGE MAX	3 Amp
LOAD REGULATION	< 5% 0-2,8 Amp
RIPPLE	10mV 2,8 Amp
DIMENSIONS (mm)	W270 × H90 × D155
WEIGHT	4,250 Kg.

STOCKISTS

Alpha Sound Service,
50 Stuart Road, Waterloo, Liverpool L22 4QT. England.

Anson Electronics,
1133 Hessle High Road, Hull, England.

Amateur Radio Shop,
13 Chapel Hill, Huddersfield, HD1 3ED. England.

Brent Electronics,
Seaview Street, Cleethorpes, Lincolnshire, England.

J. Birkett,
26 The Strait, Lincoln, England.

Bradford Consultants Limited,
25 Regent Parade, Harrogate, Yorkshire, England.

F. Brown & Co. Ltd.,
44/46 George IV Bridge Street, Edinburgh, Scotland.

N. R. Bardwell Limited,
Sellers Street, Sheffield, England.

Casey Brothers,
235 Boundary Road, "Saint Helens," Lancashire, England.

Electronic Services Limited,
33 City Arcade, Coventry CU11 HX, England.

A. Fanthorpe Limited,
6 Hepworth Arcade, Silver Street, Hull, England.

G. W. M. Radio,
Portland Road, Worthing, Sussex.

Leeds Amateur Radio,
27 Cookridge Street, Leeds LS2 3AG, England.

Target Electric Limited
16 Cherry Lane, Bristol, England.

New Cross Radio,
6 Oldham Road, Manchester, England.

Progressive Radio,
93 Dale Street, Liverpool L2 2JD. England.

R. E. Pitt Electrical Services Limited,
60/64 Bath Buildings, Mont Pelier, Bristol, England.

Peats Electronics, Parnell Street, Dublin.

R. F. Potts,
68 Bobbington Lane, Derby, England.

Brian A. Pearson Limited,
66 Moncur Street, Glasgow, Scotland.

R M E Supplies Limited,
143 Stockwell Street, Glasgow, Scotland.

Stephan James Limited,
Warrington Road, Leigh, Lancashire.

Stewarts Radio,
4 Chance Street, Blackpool, England.

The Radio Shop,
16 Cherry Lane, Bristol BS 3NG, England.

Q. C. Trading,
1 St. Micheals Terrace, Woodgreen M22 4FT, England.

Stan Willets Limited,
37 High Street, West Bromwich.

M/S Waltons,
55a Worchester Street, Wolverhampton WV2 4LL, England.

AL.1 P5

£78.00

INPUT VOLTAGE	220 ± 10% 50 Hz
OUTPUT VOLTAGE RANGE	1 ± 15 V. dc
OUTPUT CURRENT MAX	5 Amp
LOAD REGULATION	< 0,1% 0-45 Amp
RIPPLE	< 2mV 4,5 Amp
DIMENSIONS (mm)	W210 × H155 × D250
WEIGHT	5,100 Kg.

AL.212 PS

£18.00

INPUT VOLTAGE	220 V ac ± 10% 50-60 Hz
OUTPUT VOLTAGE RANGE	12,6 V dc
OUTPUT CURRENT MAX	2,5 Amp
LOAD REGULATION	<0,3% 0÷2,2 Amp
RIPPLE	<5mV 2,2 Amp
DIMENSIONS (mm)	W140 × H90 × D140
WEIGHT	1,490 Kg.
AMPEROMETER	

AL.315 P2

£54.00

INPUT VOLTAGE	220 V ac ± 10% 50-60 Hz
OUTPUT VOLTAGE RANGE	± 1,7 ± 15 V dc
OUTPUT CURRENT RANGE MAX	3 Amp
LOAD REGULATION	< 0,2% 0-2,8 Amp
RIPPLE	< 3mV 2,8 Amp
DIMENSIONS (mm)	W270 × H90 × D155
WEIGHT	4,140 Kg.

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Printed circuit B7G ... 7p
Chassis B7-B7G ... 11p
Shrouded Chassis B7G-B8A ... 13p
B12A tube. Chassis B9A ... 13p

Car type panel lock and key 65p

Transformer 9V 4A £3.78

Speaker 6" x 4" 5 ohm ideal for car radio £1.55
4¾" diam. 30 Ω ... £1.75
2½" diam. 32 or 8 Ω ... £1.07

Aluminium Knobs for ¼" shaft. Approx. ⅝" x ⅞" with indicator Pack of 5 **95p**

TAG STRIP—6 way **5p** 8 way **10p** Single **2p**

5 x 50pF or 1000 + 300pF trimmers **35p**

BOXES — Grey polystyrene 61 x 112 x 31mm, top secured by 4 self tapping screws **57p** clear perspex sliding lid, 46 x 39 x 24 mm **15p.**

ABS, ribbed inside 5mm centres for P.C.B., brass corner inserts, screw down lid, 50 x 100 x 25mm orange **65p**; 80 x 150 x 50mm black **97p**; 109 x 185 x 60mm black **£1.52.**

DIECAST ALI superior heavy gauge with sealing gasket, approx 6½" x 2⅝" x 1⅜" **£1.50**; 3¾" x 2⅝" x 1⅜" **£1.25.**

VARIABLE CAMM PROGRAMMER 10, 12 or 15 pole 2 way, 50VAC motor — series with 1mfd, or 3k 10W or 15W pygmy bulb for mains operation. Ex equipment **£4.32**

SWITCHES

Pole	Way	Type	
1	2	Slide	15p
6	2	Slide	24p
2	1	Rotary Mains	28p
2	Alternating	Micro with roller	30p
2	3	Miniature Slide	20p
2	1	Toggle	42p
1	2	Sub-Min Toggle	75p
2	Alternating	2A Mains Push (⅜" hole)	43p
2	Alternating	Slide	15p

S.P.S.T. 10 amp 240v. white rocker switch with neon. 1" square flush panel fitting **60p**; 1 pole 2 way 10 amp oblong clip in mains rocker appliance switch ... **38p**
Standard thumb-wheel switch 0-9 in 1248N or B.C.D., or Comp. 1242 also 2p co. **£1.20**
Standard Lever Key Switch D.P.D.T. locking plus D.P.D.T. and S.P.S.T. Heavy Duty non latching ... **82p**

AUDIO LEADS

3 pin din to open end, 1½yd, twin screened 45p
5 pin din 180° to 2-phono 70p
3 pole jack plug to tag ends, 4ft ... 45p

COMPUTER & AUDIO BOARDS/ASSEMBLIES VARYING CONTENTS INCLUDE ZENER, GOLD BOND, SILICON, GERMANIUM, LOW AND HIGH POWER TRANSISTORS AND DIODES, HI STAB RESISTORS, CAPACITORS, ELECTROLYTICS, TRIMPOTS, POT CORES, CHOKES, INTEGRATED CIRCUITS, ETC.
3lb for **£2** 7lb for **£3.70**

1k horizontal preset with knob 10 for **40p**

3" Tape Spools 5p
1" Terry Clips ... 5p
12 Volt Solenoid 40p

ENM Ltd. cased 7-digit counter 2¼ x 1¾ x 1¼" approx. 12V d.c. (48 a.c.) or mains **£1.10**

Auto charger for 12v Nicads, ex-new equipment ... **£5.19**

RESISTORS

⅛-¼-½ watt ... 1½p
1 watt ... 3p
Up to 15w w/wound 10p
1 or 2% 4 times price

Cinch 8 way std 0.15 pitch edge connector **25p**

RELAYS

RS/Alma reed relay, 3k Ω 18-30v d.c. coil, normally open ... 60p
12v d.p.c.o. heavy duty octal ... £1
700Ω, 11-13v Min. Sealed 2 p.c.o. £1. 4 p.c.o. £1.20.

POTS

Wirewound 38p
Log. or Lin., carbon rotary or slide. Single 30p With switch 40p Dual 45p Dual switch 55p 1.5m Edgetype 10 for 40p

Skeleton Presets
Slider, horizontal or vertical standard or submin 8p

THERMISTORS and V.D.R's

CZ1/2/6/11/14, KR22, KT150, VA1005/6/8/1010/1033/4/7/8/9 1040/1053/5 /1066/7/1074/6/7 / 1082/6/1091/6/7/8 / 1100/3/8/8602. Rod with spot blue/fawn/green. E299DDP120 / 218 / 224 / 338 / 340 / 350 / 352 · YF020 E220ZZ/02 · KR150 ... All 22p
E23 glass bead 85p
YG150-S534 bead, KB13, E299 DHP230, 116-121 401 (TH7. VA1104. OD10) 35p. R53 Glass £1.20

Miniature 0 to 5mA d.c. meter approx ⅞" diameter ... **£1.25**
RS Yellow Wander Plug Box of 12 ... **40p**
18 SWG multicore solder ... **3½p foot**
SAPHIRE STYLII. 15 different; dual and single point, current and hard to get types. My mix **£2.**

JAP 4 gang min. sealed tuning condensers 40p

ELECTROLYTICS Many others in stock

MFD	Up to 10V	25V	50V	63–75V	100V	200–250V	300–350 V	450–500V
10	6p	7p	7p	10p	13p	15p	26p	32p
25	6p	7p	7p	10p	13p	18p	32p	37p
50	6p	7p	7p	12p	16p	23p	32p	37p
100	7p	8p	13p	15p	24p	26p	–	–
250	12p	13p	15p	22p	36p	–	£1.10	£1.30
500	13p	15p	22p	30p	55p	–	£1.48	£1.60
1000	16p	27p	50p	60p	–	£1.05	–	–
2000	28p	47p	55p	93p	£1.20	–	–	–

As total values are too numerous to list, use this price guide to work out your actual requirements 8/20, 10/20, 12/20, 22/50, 47/25. Tub. Tant **24p** each 16-32/275V, 100/150V, 100-100/275V 40p 50-50/385V, 2+2/200V non polar, 32-32-50/300V, 20-20-20/350V 0.1+0.1/500V AC **80p** 200V, 100-200-60/300V **£1.30** 100-300-100-16/300V **£1.85**

RS 100-0-100 micro amp null indicator Approx. 2" x ¾" x ¾" ... £1.85

INDICATORS

Bulgin D676 red, takes M.E.S. bulb ... 38p
12 volt, or Mains neon, red pushfit ... 23p
R.S. Scale Print, pressure transfer sheet ... 12p

CAPACITOR GUIDE — maximum 500V
Up to .01 ceramic **4½p.** Up to .01 poly **6p** .013 up to .1 poly etc. **7p.** .12 up to .68 poly etc. **8p.** Silver mica up to 360pF **10p,** then to 2,200pF **13p**; then to .01 mfd **21p.**
1/750 **13p.** .01/1000, 8/20, .1/900, .22/900, 4/16, 25/250 AC (600v/DC), 3/600 **15p.** 5/150, 10/150, 40/150 **50p.**
Many others and high voltage in stock.

SONNENSCHEIN/POWERSONIC DRI-FIT RECHARGEABLE SEALED GEL (Lead Antimony) BATTERY, 6V 1 amp.hr. (3⅞" x 2" x ⅞") **£3.70.** 6 amp. hr. (4½" x 2" x 3") **£7.60**
Ex-equipment, little used.

CONNECTOR STRIP

Belling Lee L1469, 4 way polythene. **9p each**

1¼ glass fuses 250 m/a or 3 amp (box of 12) 20p
Bulgin 5mm Jack plug and switched socket (pair) 40p

Reed Switch 28mm, body length 11p

Aluminium circuit tape, ⅛ x 36 yards—self adhesive. For window alarms, circuits, etc. **95p**

TV MAINS DROPPERS

5 assorted multiple units for ... 75p

100pF air-spaced tuning capacitor ... £1.30
5¼" x 2¼" Speaker, ex-equipment 3 ohm 65p
2 Amp Suppression Choke ... 10p
3 x 2½ x 1/16" } PAXOLINE 5 for 35p
4⅝ x ½ x ⅛" } 10 for 15p
PVC or metal clip on MES bulb Holder 5 for 30p
VALVE RETAINER CLIP, adjustable 5 for 15p

Sub-miniature Transistor Transformer **35p**
Valve type output transformer **90p**
POT CORES with adjuster LA2508-LA2519 **43p per pair**
16 Watt Power Amp. Module 35v 1A power required, giving 16 watt RMS into 8 Ω **£3.45**
REGULATED TAPE MOTOR
Grundig 6V approx., 3" x 1½", inc. shock absorbing carrier; or Jap 9V, 1½" diam. **£1.05**
3.5mm metal stereo plug **30p**
Fane 8 ohm 3" sq. heavy duty communications speaker **£1.60**
RS neg. volt regulator 103, 306-099 (equiv. MPC900) 10A, 100 watt 4-30 volt. Adjustable short circuit protection. Normally £12.50+. **£6.65**

Digital count unit. Counts in steps of 1, 2, 5 or 10 with total limit switch (2 x D.I.L. BCD), reed relay remote output. Mains power supply, relay and delay unit. UNUSED. Displays on 2 Minitron. 7 segments sold separately. **£5.40**

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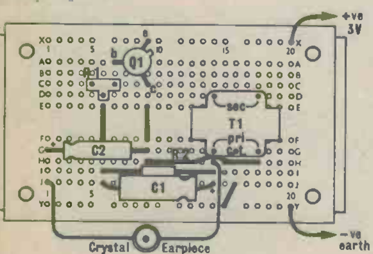

YOU WILL NEED

- B1, B2 – 2xl.5V AAA batteries
- C1, C2 – 50 uF, 12-VDC electrolytic capacitor
- E1 – Crystal earphone
- Q1 – Motorola HEP-230 pnp transistor
- R1 – 5000-ohm pot
- R2 – 27000-ohm, ¼ watt resistor
- S1 – Spst switch part of R1
- T1 – Mini transistor output transformer; 500-ohm center tapped primary to 8-ohm secondary
- **EXP – ANY EXP. BREADBOARD.**

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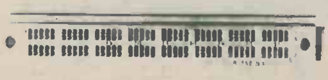

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PC. 16-18 Dual Clip.			£12.15
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The Great Big 'Bazaar' for the hobbyist, amateur, and small buyer.

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PP9 ELIMINATOR UNIT

By M. V. Hastings

● Supplies current up to 100mA

● Fully regulated

● Fantastic savings in running costs

This simple and inexpensive eliminator unit is designed to fit into the battery compartment of a transistor radio which normally employs a PP9 battery, thereby enabling the radio to run from the mains supply. When the portability given by battery operation is not required, or is required only occasionally, the eliminator unit offers far lower running costs, these being of the order of 300 to 400 hours of use for one penny! The initial price of the eliminator is obviously higher than that of a replacement battery, but the extra expense involved will soon be recovered in saved battery costs. Fitting the eliminator does not preclude future battery operation; the unit is built in a case slightly smaller than a PP9 battery, and it can be fitted and removed as easily as can a battery.

A power supply of this type is also very useful to have in the electronics workshop when building, testing and servicing small items of equipment intended for 9 volt operation. The unit gives a nominal output of 9 volts at currents up to 100mA maximum. It incorporates output current limiting which prevents the current from rising much above 100mA even if the output is short-circuited. The output is well stabilized and the voltage drop between zero load and full output current is only about 100mV. The output is also well smoothed, with hum and noise level being a fraction of a millivolt at low load currents and only a few millivolts at full load.

THE CIRCUIT

Fig. 1 gives the complete circuit of the PP9 battery eliminator.

The mains supply is applied via the fuse FS1 and on-off switch S1 to the primary of the isolating and step-down transformer T1. The fuse and the on-off switch are not included with the other circuitry of the unit. The fuse is fitted in the 13 amp 3-way mains plug which supplies the eliminator, and the switch is inserted in the mains lead at any convenient point. It is, of course, desirable to have the mains on-off switch separate from the eliminator as, otherwise, it would in most instances be necessary to open the back of the receiver to switch the unit on and off. The receiver on-off switch may be left turned on all the time, the set being switched on and off by the eliminator mains switch. This is preferable to having the eliminator permanently running and switching on and off at the receiver switch.

T1 is a sub-miniature mains transformer having a secondary rated at 12-0-12 volts at 100mA. Transformers with these secondary ratings are available from a number of suppliers, including Home Radio. The secondary connects to the full-wave rectifier circuit given by diodes D1 and D2, and reservoir capacitor C1.

The voltage regulator circuit incorporates TR1, TR2 and TR3, and employs a well-known configuration. TR1 is conducting all the time, and its

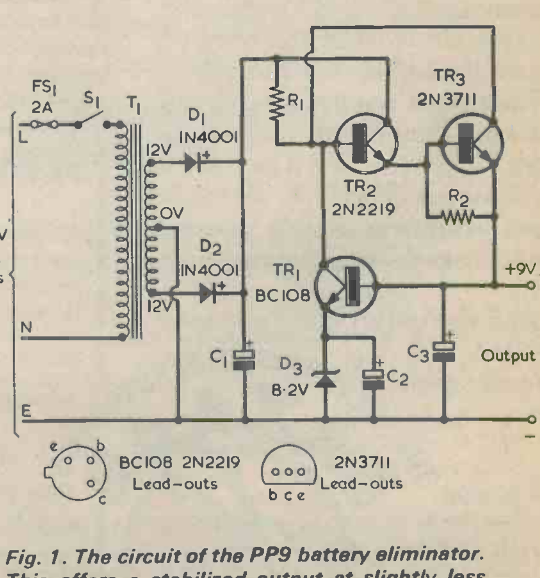
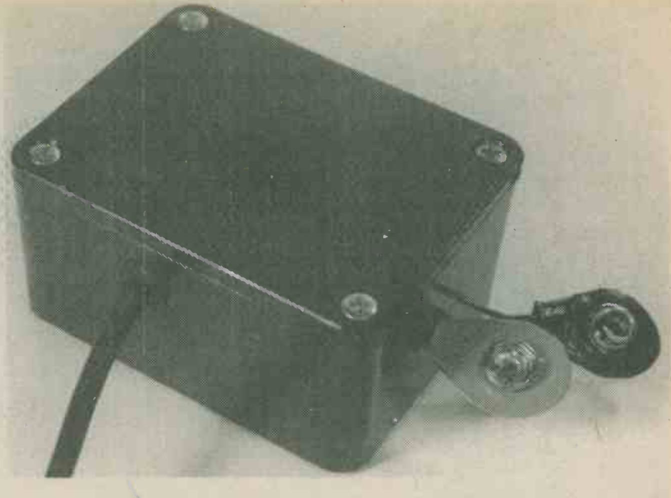


Fig. 1. The circuit of the PP9 battery eliminator. This offers a stabilized output at slightly less than 9 volts with a current limit of 100mA



The eliminator unit is housed in a plastic case having approximately the same dimensions as a PP9 battery

emitter is held at about 8.2 volts above the negative rail by zener diode D3. TR2 is an emitter follower and its emitter couples via R2 (part of the current overload circuit, which is described shortly) to the base of TR1. After switch-on, the voltage at the emitter of TR2 rises until it reaches 8.85 volts, whereupon the consequent 0.65 volt across the base-emitter junction of TR1 causes this transistor to pass collector current. If the voltage at TR1 base attempts to rise higher it causes TR1 to pass a heavier collector current, thereby reducing the voltage at TR2 base and counteracting the rise in voltage at TR1 base. As can be seen, a negative feedback loop is set up as soon as TR1 commences to pass collector current, and this stabilizes the output voltage at the zener diode voltage of 8.2 volts plus the 0.65 volt in the base-emitter junction of TR1.

If a load current is now drawn from the output, it will attempt to take TR1 base negative. The collector current of TR1 will then reduce and allow more current to flow into TR2 base via R1, whereupon the output current available from TR1 emitter increases and brings the output voltage back to the stabilized level.

C2 smoothes any noise or hum present across D3 and its presence gives a lower noise and hum level on the output. The final smoothing capacitor, C3, also reduces noise and hum. C3 is beneficial when the eliminator is supplying a receiver having a Class B a.f. output stage since it enables brief current peaks in excess of the output current limit to be supplied. The stablilizing action of TR1 and TR2 gives further electronic smoothing of the output voltage and is, indeed, largely responsible for the very low noise and hum levels.

The output current flows through R2, and this has no effect on circuit operation until the current rises to around 100mA. The voltage dropped across R2 then exceeds 0.65 volt, causing TR3 to turn on and draw a collector current through R1. It then becomes impossible to draw on increased output current, since this merely results in TR3 reducing the voltage at TR2 base with the consequence that the output voltage falls. Even if the output is short-circuited the output current will still only be typically a little in excess of 100mA, with TR3 conducting sufficiently to bring the output voltage down to zero.

The unit cannot then be damaged due to temporary overloading, although an output short-circuit cannot be maintained indefinitely unless TR2 is provided with adequate heatsinking. TR2 would otherwise overheat and be damaged. In practice it is as unlikely that a continual short-circuit would be put on the output of the unit as it would be on the terminals of the PP9 battery it replaces, and it was considered not worth-while equipping TR2 with a heatsink.

CONSTRUCTION

The prototype eliminator is housed in a black A.B.S. plastic box measuring 75 by 56 by 35mm, which is available from Progressive Radio, 31 Cheapside, Liverpool 2. This box fitted comfor-

COMPONENTS

Resistors
(All ¼ watt 5%)
R1 1.5kΩ
R2 6.8 Ω

Capacitors
C1 680μF electrolytic, 25V Wkg.
C2 10μF electrolytic, 25V Wkg
C3 100μF electrolytic, 10V Wkg

Transformer
T1 Mains transformer, secondary 12-0-12V at 100mA

Semiconductors

TR1 BC108	D1 1N4001
TR2 2N2219	D2 1N4001
TR3 2N3711	D3 BZY88C8V2

Switch
S1 s.p.s.t. "pressil" (see text)

Fuse
FS1 2A (see text)

Miscellaneous
A.B.S. plastic case (see text)
Verobox type 75-1469-L
Veroboard, 0.01 in. matrix
13A mains plug
PP9 battery connectors
Connection block (see text)
3-core mains lead
Nuts, bolts, wire, solder etc

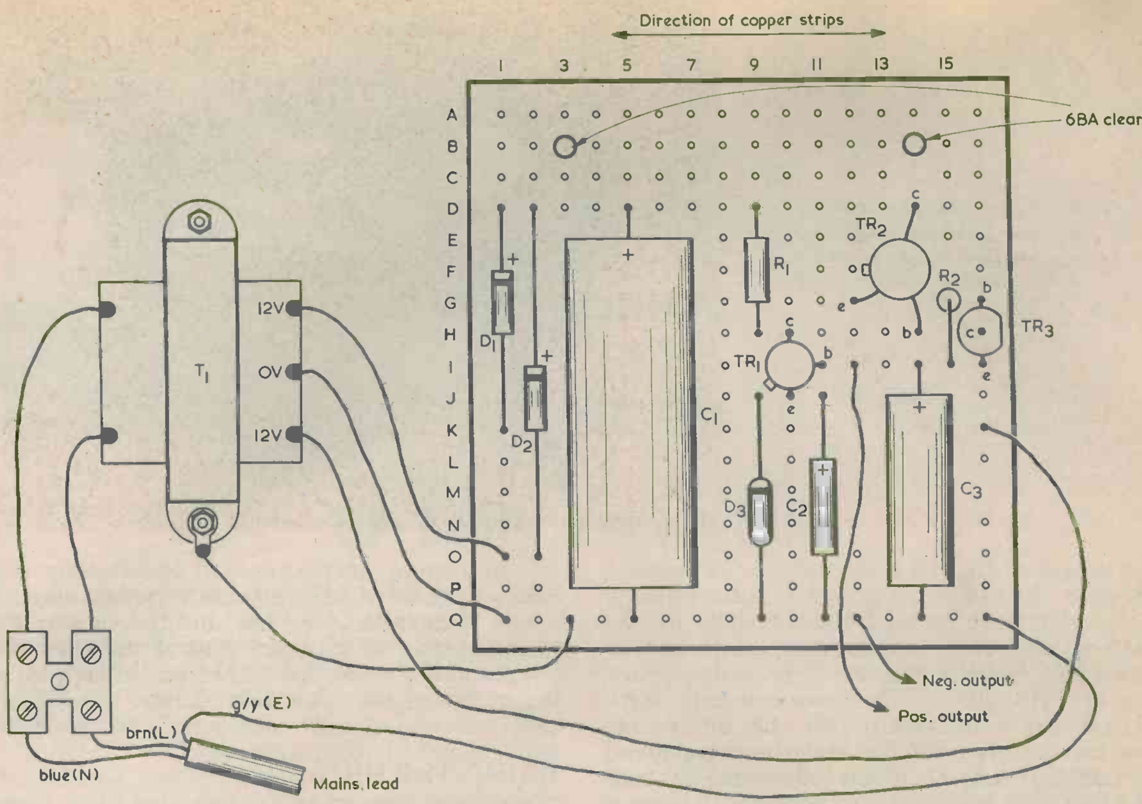


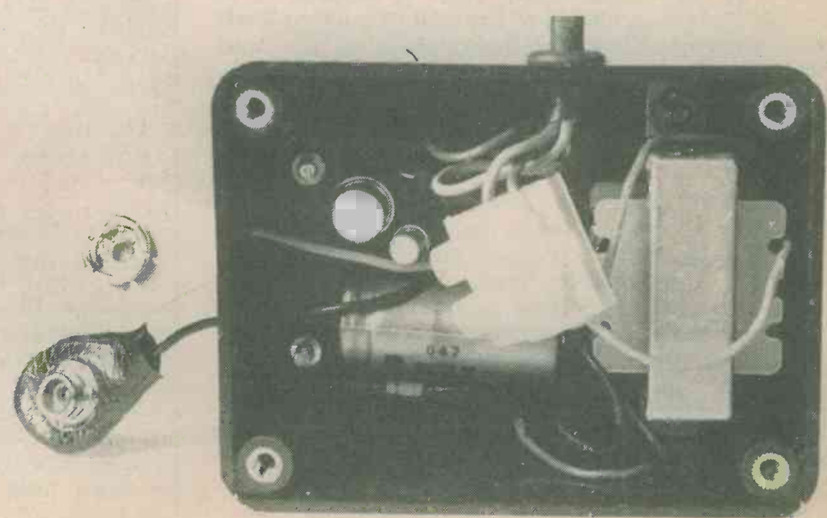
Fig. 2. Wiring up the eliminator unit. All the small components are assembled on a Veroboard module

tably into the battery compartment of the author's Fidelity RAD15 set, for which it was intended. Presumably, the same case should be of a suitable size for installation in other receivers designed to take a PP9 battery.

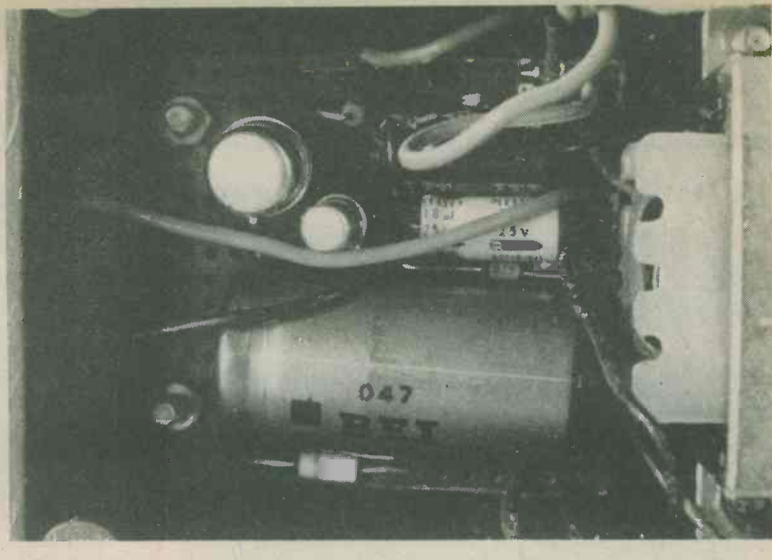
The mains transformer is mounted at one end of the case, being secured by two short 4BA screws and nuts. A solder tag is held under one of the nuts to allow the transformer frame and core to be earthed. It must be mounted as close to the end of the case as possible to allow sufficient space for the component board. An entrance hole for the mains lead is made high up on one of the long sides of the box and is fitted with a grommet. The mains lead should be secured inside the case with a plastic or plastic-faced clip. Two small holes for the output leads are drilled at roughly the centre of the short side of the box adjacent to the component panel.

The component board consists of a piece of 0.1 in. matrix Veroboard having 16 holes by 17 copper strips, as shown in Fig. 2. This diagram gives details of the wiring on the board and also the other wiring in the unit. There are no breaks in the copper strips. The board is mounted in the case by means of two 6BA bolts and nuts, the board being oriented so that these are furthest away from the mains transformer. Spacing washers or several 6BA nuts, are fitted over the bolts between the case and the underside of the board to prevent strain on the latter when the mounting nuts are tightened.

The two connections between the mains lead and the primary of T1 are made via a plastic connector block of the type intended for mains wiring. These are normally sold in 12-way lengths, and it is



Removing the lid of the eliminator case. The 2-way connector block provides connection between the transformer primary and the live and neutral wires of the mains lead



The component board. The larger transistor here is TR2

necessary to cut off a 2-way block with a sharp knife. It is advisable to cover the connector block, after wiring, with two or three layers of insulating tape to ensure that the mains wiring cannot come into contact with any of the other wiring. Alternatively, a panel of s.r.b.p. can be interposed between the connector block and the component board to prevent any accidental electrical contact between the two.

The output of the eliminator is connected to the receiver by way of two PP9 battery connectors. What would normally be a negative connector now becomes the positive eliminator output clip, and what would normally be a positive connector now becomes the negative eliminator output clip. This situation can be readily visualised when the connector clips are compared with the terminals of a PP9 battery. It is necessary to connect the eliminator output to the receiver with correct polarity.

If desired, the output clips could be glued with Araldite to the outside of the short end of the case through which the output leads pass. The clips would then be presented to the receiver in a similar manner to the terminals on a PP9 battery.

As already mentioned, the mains on-off switch is inserted at any convenient point in the mains leads. The author employed a "pressil" switch of the type in which successive pressing of the button closes and then opens the switch. These switches are available from most electrical stores, as well as from Maplin Electronic Supplies. The switch is mounted in a small plastic Verobox type 75-1469-L having dimensions of 71.5 by 49 by 24.5 mm. A hole fitted with a grommet, is drilled at each short side to allow the mains lead to pass through. The mains lead should be suitably clamped inside the box at both ends. If the lead has to be cut to allow access to the live wire, the neutral and earth wires at the cut ends may be connected through by way of a further 2-way connector block.

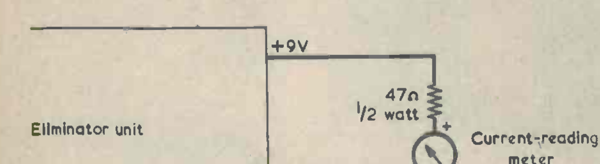


Fig. 3. Checking the current limit operation. The 47 Ω resistor prevents excessive current flow if there is a current limit malfunction

USING THE UNIT

Before connecting the eliminator to the radio, its output voltage should be checked by means of a multimeter switched to a suitable range. The output voltage will probably be slightly less than 9 volts but, since the actual voltage provided by a 9 volt battery varies from about 9.5 volts to less than 8 volts during its working life, this is not of any great practical importance.

It is also a good idea to check that the current limit circuit is functioning correctly. This can be achieved by connecting a multimeter set to a high current range to the output terminals with a 47Ω resistor in series, as shown in Fig. 3. If all is well the meter should give an indication of about 100mA. The resistor limits the current which can flow to a safe level of around 200mA if the current limit circuit is not working. The eliminator should be switched off without delay if the meter reading is well in excess of 100mA.

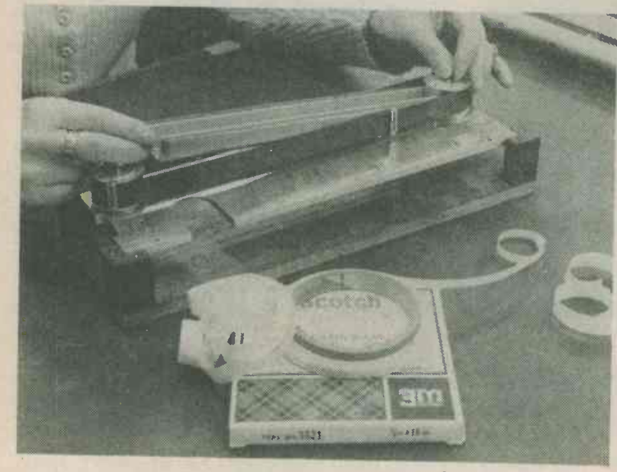
It should not be necessary to carry out any modification to the radio except, perhaps, to make a notch in the battery compartment door to accommodate the mains lead. Some battery compartments have a sliding door, and it will then simply be necessary to have the door not fully closed.

The negative output of the eliminator is at mains earth potential. Quite a few receivers have their chassis and some of the exposed metalwork connected to the positive supply rail, and this point should be borne in mind if the receiver is connected to any equipment, such as a tape recorder, having a chassis which is also at mains earth potential. No problems will arise when the receiver is used on its own.

Finally, it should be noted that the eliminator is only intended for use with items of equipment, such as radio receivers, which have a fairly modest current consumption. It cannot be used to power cassette recorders and similar items requiring a relatively high current. ■

NEWS . . . AND

HIGH DENSITY POLYTHENE TAPE SOLVES FRICTION PROBLEM



A strip of Scotch 5421 high density polythene tape mounted on foam rubber is installed behind the belt on the writing plate assembly of a Mufax document facsimile machine.

Linear movement, such as is found on recording, scanning and tracking devices can cause excessive friction and wear between components, resulting in early failure of equipment if it is not frequently maintained. A simple and effective solution to this problem, in the form of a high density polythene tape, has been adopted by Muirhead Data Communications Limited, manufacturers of document facsimile machines.

The company's Mufax equipment will transmit and receive documents, charts and pictures over a telephone line or radio link, the image being reproduced by means of an electrostatic charge which is applied to the paper through a travelling stylus. This stylus is carried on a rubber belt and traverses the paper up to 600 times a minute.

Stability for the stylus throughout its travel is provided by a ½in wide strip of high density polythene tape mounted on foam rubber and positioned behind the belt. The tape used is Scotch 5421 from 3M, which features an ultra high molecular weight polythene backing. Its low friction properties and resistance to wear make it an ideal bearing surface which gives long, trouble-free performance. Being self-adhesive, it can be applied to almost any material without time-consuming mechanical fixing.

Users of Mufax machines include government departments and the police, so reliable operation is of prime importance. A marine version of the equipment, a weather chart recorder for shipboard applications, is also manufactured by Muirhead at their Beckenham factory.

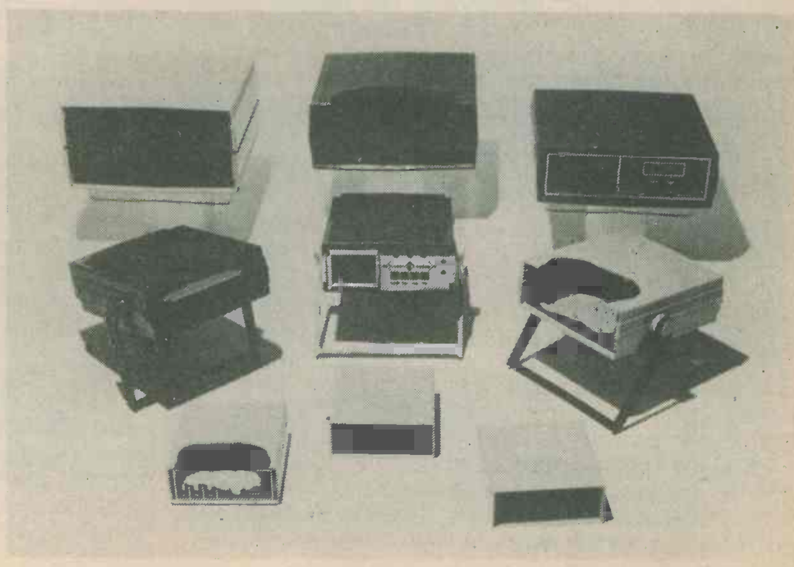
ECONOMICAL ENCLOSURES

The latest range of enclosures from OK Machine & Tool (UK) Ltd., of 48a The Avenue, Southampton, Hants., the 'C' Series, is extremely versatile and has been designed to provide a purpose-built package for electronic instruments while offering substantial savings in assembly cost. This is achieved by building the case up from single components — top, bottom, sides and ends — rather than forming a one-piece unit.

Assemblies are available in over 25 sizes and numerous variations to accommodate printers, terminals, calculators, clocks, indicators, battery packs, timers, receivers, power supplies, radios and many other electronic or electro-mechanical components.

Moulded from tough, durable ABS, 3mm thick, the cases are dust and splashproof when assembled and can be supplied in beige, black or blue textured colours requiring no additional external furnishing. Standard width is 212mm and depth is 232mm with height ranging from 62mm to 88mm in 6mm increments. Inside, vertical circuit board guides are fitted in eleven places. Additionally a Mini Series is offered starting at 37mm high X 130mm wide X 144mm deep.

Options include rail and card slide adaptors, standard and special front and rear panels, RFI/EMI shielding, handles and tilt stands.



. . . COMMENT

AWARD FOR OUTSTANDING WORK ON COMMUNICATIONS BY SATELLITE

In May 1979 The President of the Italian Republic will present the Fifth Marconi International Fellowship worth $25,000 to Dr John R. Pierce, Professor of Engineering at the California Institute of Technology, for his outstanding work in satellite and space technology directed especially towards improving world communications.

Dr Pierce retired in 1971 from the Bell Laboratories where he was Executive Director, Research, of the Communication Sciences Division. His work covered research into radio, electronics, acoustics and vision, mathematics, economic analysis and psychology. Dr Pierce has been granted more than 80 patents for inventions in electron tubes and communication circuits. In 1955, two years before the first satellite, Dr Pierce offered his first concrete proposals for satellite communications.

The Marconi International Fellowship was established in 1974 on the 100th anniversary of the birth of Guglielmo Marconi to commemorate his contributions to science, engineering and technology and is administered by the Aspen Institute for Humanistic Studies, Boulder, Colorado, U.S.A.

EXTENSIONS TO SERVICE

Sigtronic Electronics of 27 Malvern Street, Stapenhill, Burton-on-Trent, Staffs DE15 9DY, have informed us of a new, and rather unique, service which they will be operating from the beginning of May onwards.

They will accept orders by telephone, number 0283-46868, from 6.00pm to 10.30pm every evening from Monday to Friday inclusive, and they are also prepared to advise on the components readers may need without charge. They undertake to depatch orders within 48 hours of receipt of written confirmation, cash to be enclosed. All items are new, and guaranteed for six months, and there is no extra charge for the service.

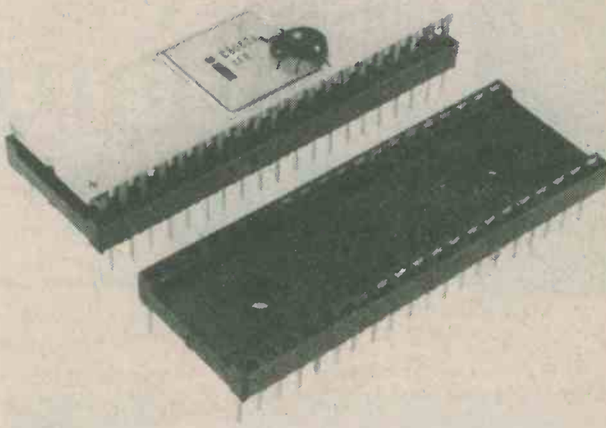
PROPOSED NOVICE LICENCE

There is, of course, considerable controversy in the radio amateur world as to the desirability of a Novice Licence.

The European CW Association, who favour such a licence, suggest one with the following conditions. 1. A simple examination covering regulations and radio theory. 2. A 5wpm morse test. 3. Crystal control only in defined segments of amateur bands (hf and vhf). 4. Maximum power input 10 watts. 5. Holders of an RAE certificate need only to pass the morse test. 6. The licence to be held for 2 years in any 5 year period.

To ascertain support for the proposal would readers in favour send a postcard giving name and address to A. D. Taylor, G8PG, 37 Pickerill Road, Greasby, Merseyside L49 3ND.

NEW I. C. SOCKET RANGE



Winslow Component Systems Limited, the Kent based Semiconductor Accessory Manufacturer, announce the launch of a brand new range of I.C. Sockets.

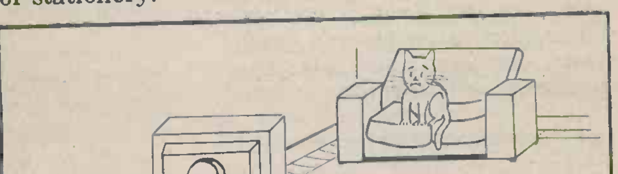
Featuring low profile, glass reinforced polyester bodies — they have been designed to exceed the most stringent criteria demanded by todays high technology microprocessor user and yet are manufactured to be price attractive, even in consumer markets.

Technical Data available from: Winslow Component Systems Limited, Southern House, Edenbridge, Kent.

MODIFICATIONS TO A POPULAR DESIGN

A those of our regular readers who have followed Sir Douglas Hall's receiver designs will be aware, one of the most succesful of these has been the "Spontaflex S. A. 5" medium and long wave radio, which was described in the June 1971 issue. Sir Douglas has had the prototype in constant use since the article appeared and has evolved several worth-while modifications which improve its performance.

Readers who are still using this receiver can obtain details of the modifications direct from Sir Douglas Hall at Barnford, Ringmore, Kingsbridge, Devon, and should send a stamped addressed envelope together with a 7p stamp towards the cost of stationery.



"It's for YOU, the viewer, to decide"

SUGGESTED CIRCUIT

Remote Control Garage Light

by G. A. French

One of the minor irritations of life for the motorist is given when, on a cold night, he drives his car into his garage and then has to fumble around in the dark to find the switch for the garage light. This article describes a device which causes a garage light to be switched on for a timed period, being controlled entirely from within the car. The light is turned on simply by flashing the car headlights on and off, one of the headlights being directed against a photoconductive cell installed permanently in the garage. The timing period commences when the headlamps are turned off and can be extended by flashing them on and off again. The period over which the garage light is turned on is about one and a half minutes, which should be more than adequate to enable the driver to get out of the car and turn on the normal garage light switch.

This idea is not new and the author used it some years ago in the project "Automatic Garage Light", which appeared in ***Radio & Electronics Constructor*** for September 1975. The previous design employed rather a complex approach which necessitated the use of two relays, and the writer decided it would be of advantage to return to the subject with a circuit which had simpler electronics and required one relay only. The present article describes the result of his work.

RELAY OPERATION

An electronic circuit can, in general, control a mains powered lamp by means of a triac or a relay. The triac has the advantage that there are no moving parts to wear out and the disadvantage that, unless some form of isolating device is incorporated, the electronic circuit which controls it has to be connected to one side of the mains supply. The relay has the disadvantage of having moving parts, and the advantage that it enables the electronics to be completely isolated from the mains without any additional isolating components or circuitry. It is for this reason that a relay is employed in the design featured here. An incidental factor is that a very suitable small relay is available from Maplin Electronic Supplies, this being described as a "6 volt Open Relay". The relay has a 410Ω coil, an operate voltage range of 4.8 to 35 volts and changeover contacts rated at 5 amps at a maximum voltage of 240 volts a.c.

The same relay was employed in the previous circuit, which provided a slowly decreasing relay coil voltage near the end of the timing period, the voltage eventually falling below the release voltage level for the relay. Light-weight relays do not, however, always take kindly to slowly reducing coil voltages and tend to suffer from contact chatter. For this reason, a second heavier low voltage relay was included in the earlier design to control, in its turn, the Open Relay.

The present circuit appears in Fig. 1. In this diagram the photoconductive device is an ORP12 cadmium sulphide cell, the resistance of which decreases as the intensity of light falling on it increases. At very high light levels its resistance may be as low as 75 to 300Ω. It couples via R1 to the preset potentiometer VR1, the slider of which connects to the base of TR1.

Under normal ambient light conditions the ORP12 will have a fairly high resistance, and this will fall to a low value when it is brightly illuminated by a car headlamp. The slider of VR1 is adjusted such that, with ambient light, the voltage applied to TR1 base is significantly less than the 1.2 volts needed to cause forward current to flow in the base-emitter junction of TR1 and D1. TR1 is, in consequence, turned off. In this circuit state C1 becomes charged via R3 to as high a voltage as the circuitry around TR2, TR3 and TR4 will allow. When the ORP12 is brightly illuminated by the car headlight the voltage at VR1 slider rises sufficiently to allow a forward bias current to flow in the base-emitter junction of TR1 and in D1. TR1 turns on. Capacitor C1 is rapidly discharged, with the voltage across it falling to around 0.8 volt (given by 0.6 volt across D1 and 0.2 volt across the bottomed TR1). When the car headlight is turned off, PCC1 exhibits its previous high resistance, the voltage at the base of TR1 drops and the transistor turns off. Capacitor C1 commences to charge via R3.

Thus, illuminating the ORP12 with the car headlight causes C1 to quickly discharge. Turning off the headlight allows C1 to slowly charge again.

SCHMITT TRIGGER

To avoid relay chatter it is necessary for its coil voltage to cease abruptly at the end of the timing period rather than reduce slowly, whereupon it is necessary to employ a voltage comparator which has an inherent regenerative action. An excellent choice for the present application is a Schmitt trigger and this is made up of TR3, TR4 and the associated resistors. When TR3

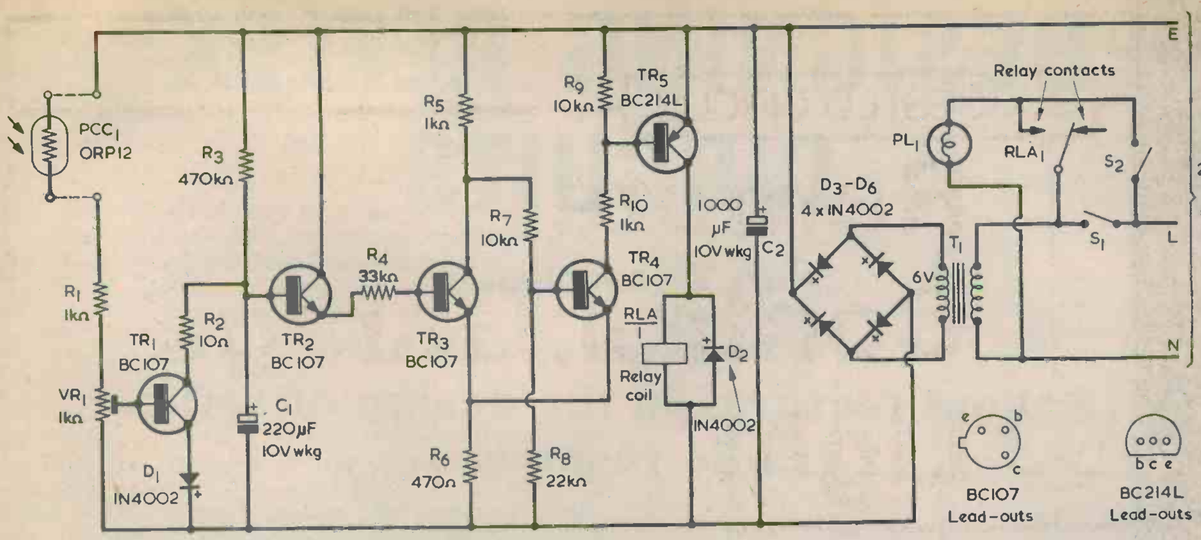


Fig. 1. The circuit of the remote control garage light. Switching on the car headlamps illuminates the photoconductive cell and causes lamp PL1 to be turned on for a period of about one and a half minutes

base is at a low voltage, with respect to the negative supply rail, this transistor is turned off and current flows to the base of TR4 via R5 and R7. TR4 is then turned on. If the base of TR3 is slowly taken positive a level is reached at which the transistor starts to conduct, thereby diverting to itself some of the base current for TR4 which flowed through R5 and causing additional current to pass through R6. The latter effect takes TR4 emitter positive and there is a regenerative action which results in TR3 turning fully on with TR4 cut off. The transistors remain in this state should TR3 base go further positive.

The reverse changeover will occur equally abruptly if the base of TR3 is taken slowly negative but, due to the hysteresis inherent in a Schmitt trigger, will take place at a more negative voltage at TR3 base than that which instigated the first changeover. The hysteresis is of no importance in the present circuit.

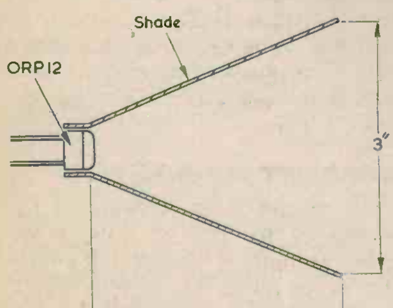


Fig. 2. The intensity of ambient light falling on the photoconductive cell can be reduced by fitting it with a simple shade, as shown here

Under normal conditions, with only ambient light falling on the ORP12, C1 is charged, the positive voltage on its upper terminal being passed via emitter follower TR2 and R4 to the base of TR3. TR3 is, in consequence, turned on and TR4 is turned off. The voltage across C1 is then held at around 3.5 to 4 volts by the current flowing through the base-emitter junctions of TR2 and TR3 and through R4 and R6. Since TR4 is turned off, so also is the p.n.p. transistor, TR5, which is connected in its collector circuit. No current flows through the relay coil and the relay is de-energised. The relay contacts are identified in the circuit as RLA1, and the make pair are open. The lamp, PL1, is therefore extinguished.

When the car headlight is flashed onto the ORP12, capacitor C1 discharges, TR3 turns off and TR4 turns on. So also does TR5, energising the relay and switching on PL1. C1 now commences to charge. Until it approaches the end of the timing period the charging current for C1 is that which flows through R3, because the base-emitter junctions of both TR2 and TR3 are reverse-biased. Near the end of the period current starts to flow into the base of TR2 also, and only a small further positive excursion is needed at TR2 base for the Schmitt trigger to go through its abrupt changeover, with TR3 turning on and TR4 turning off. The relay releases and PL1 is switched off.

If, during the timing period, the car headlight is turned on and off again C1 becomes discharged and the period commences once more. Using the component values shown, the prototype circuit gave a period of almost exactly 90 seconds. Divergencies from this time will be found in other assembled circuits due to component tolerances, particularly in C1 itself, but in general the period should be well in excess of 1 minute and shorter than 2 minutes.

The power supply consists of mains transformer T1, diodes D3 to D6 and smoothing capacitor C2. The rectified supply should be well smoothed, this being achieved by giving C2 the rather large value of 1,000µF. S1 is the on-off switch, whilst S2 is an override switch which can turn on PL1 regardless of the state of the timing circuit.

COMPONENTS

The components are all standard types. All the resistors may be ¼ watt 5% or 10% components. Switch S2 should be a type suitable for switching a mains lamp. The quiescent current drawn by the circuit from the smoothed supply is about 6mA only, this rising to some 14mA when the relay is energised. Despite these low currents it will be preferable to avoid employing a subminiature transformer for T1 and to use instead a transformer whose secondary is rated at at least 100mA, or even quite considerably more. The latter will give good supply voltage regulation, and there is also the fact that many subminiature mains transformers tend to run warm if left switched on for very long periods, as can happen with the present circuit.

The ORP12 may, if desired, be mounted away from the main cir-

Continued on Page 609

DESIGNING REFLEX CIRCUITS

Part 2 (conclusion)

by Sir Douglas Hall, Bt., K.C.M.G.

Salient features in the design of reflex radio receivers

SUPER ALPHA

Fig. 5 shows the author's Super Alpha "Spontaflex" circuit which is far and away the best simple circuit for medium and long waves that he has yet tried. Selectivity is considerably better than that of any of the other circuits described, or that of a ZN414 circuit. It will be seen that, at radio frequencies, TR1 and TR2 operate as a Darlington or Super Alpha pair. Consequently the input impedance at TR1 base is very high indeed. Also, the output impedance at TR1 emitter is so low that a good match is offered to a low impedance detector diode, which has its low impedance made even smaller again by the direct forward current passing through it via TR2 and R5.

After detection, TR2 acts as a common base audio amplifier followed by TR1 as a common emitter amplifier with a fairly high input impedance at its base. The a.f. signal at TR2 collector is routed to TR1 base through R1 and L1. Such back coupling as exists at audio frequency between the collector of TR1 and the base of TR2 is out of phase so that stability is good, though in some cases a resistor of about 10k Ω is required across the r.f. choke to prevent spurious oscillation at the low wavelength end of the tuning range. Input capacitance at TR1 base is very low, which makes for good amplification of the signal in the tuned circuit L1, C2, and this, in turn, can have a very high inductance-capacitance ratio. A coil of 200 turns close-wound of 34 s.w.g. enamelled wire with a $\frac{3}{8}$in. ferrite rod sliding in and out of it will make a satisfactory variable inductance tuner for the medium wave band. C2 has a value of 30pF. An extra capacitor of 560pF switched in parallel with C2 will enable the whole of the long wave band to be received. Alternatively, variable capacitor tuning may be employed, using a coil of 115 turns of 34 s.w.g. enamelled wire and replacing C2 with a variable capacitor of 100pF. The reaction coil, L2, should have 15 turns of 34 s.w.g. enamelled wire if variable inductance tuning is used, or 10 turns with variable capacitor tuning.

A considerable increase in sensitivity at some extra expense may be obtained by changing R3 to 68kΩ and shunting it with the large winding of a crystal microphone transformer, such as the Repanco TT53.

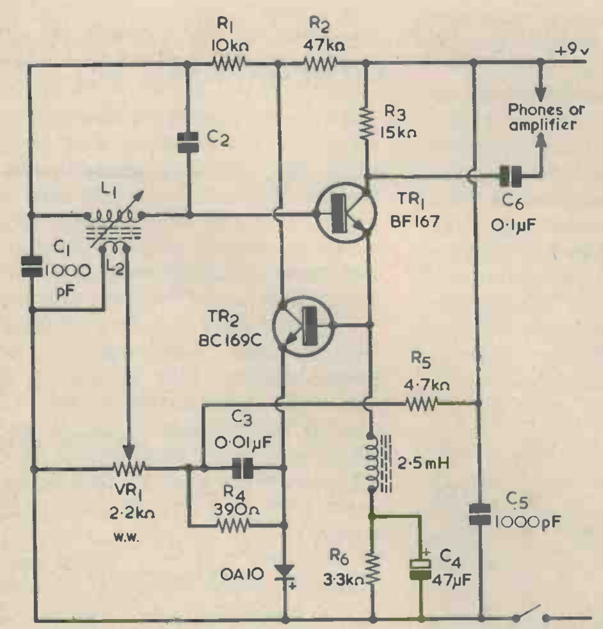


Fig. 5. Described by the author as far and away the best simple reflex circuit for medium and long waves is the design shown here. It exhibits particularly good selectivity

SHORT WAVE CIRCUIT

An excellent short wave double reflex receiver, also employing the author's "Spontaflex" circuit, is shown in Fig. 6 (a). This was first introduced, with germanium transistors, in the magazine issue dated January 1968, under the name of "D.R.C.2", the letters standing for "Double Reflex Colpitts 2-transistor". Its function is very obvious from a study of the circuit. TR1 amplifies, at r.f., as a common base transistor followed by TR2 as a common collector device. Then, after detection, TR2 functions as a common base a.f. amplifier followed by TR1 as a high input impedance common emitter amplifier. Output can be taken by way of a 1k Ω earphone connected across the secondary of the interstage a.f. transformer, or by a crystal earphone connected across the larger primary. Similarly, an a.f. amplifier can be coupled to either of the transformer windings according to the amplifier input impedance.

For short wave listening the reaction control is given by a 100pF variable capacitor connected across the detector diode. This acts as a capacitance tap into the tuned circuit. Variable inductance tuning can be used, if desired. With this

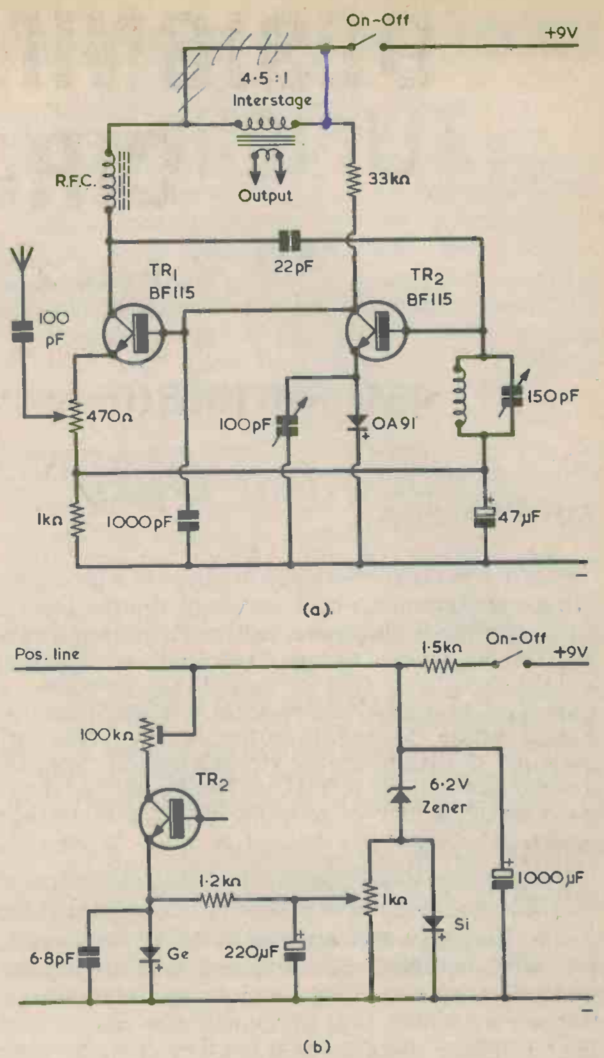


Fig. 6

Fig. 6(a). The "D.R.C.2" short wave reflex circuit. Audio instability problems do not occur at short waves due to the very low impedance at a.f. of the short wave tuning coil

(b). The circuit can be adapted for v.h.f. reception on both a.m. and f.m. A different reaction control circuit, illustrated here, is required at these frequencies

circuit the output at TR2 is in phase with the input of TR1 but, because of the very small a.f. impedance offered by a short wave tuned coil, the base of TR2 is virtually at the potential of the negative rail for audio frequencies. It is thus easier to maintain audio stability with reflexed short wave receivers than it is with medium and long wave receivers.

The circuit can be used for v.h.f., at which frequencies it is highly suitable both for a.m. and f.m. signals. With f.m. signals the synchronous method of detection is employed. The coupling capacitor should be reduced from 22pF to 2.2pF and the tuning capacitor from 150pF to 15pF. A suitable coil for Band II can consist of 6 to 8 turns of 34 s.w.g. wire space-wound on a former consisting of a length of the barrel of a "Bic" ball-point pen, the exact number of turns depending on layout deisgn. Variable capacitor reaction is not suitable for v.h.f. and the circuit shown in Fig. 6(b) is recommended. The 1k Ω potentiometer varies the forward current flowing through the germanium diode and thus its impedance and the consequent damping effect of the tuned circuit. Maximum oscillation occurs with the potentiometer slider at the negative end of its track. The 33kΩ load for TR2 is replaced by a 100kΩ pre-set variable resistor which is adjusted so that the 1kΩ reaction potentiometer gives good control. The silicon diode and the zener diode maintain stable voltages in the circuit as the battery runs down. The two transistors should be changed from BF115 to BF167 or 2N3663.

(Concluded)

Remote Control Garage Light

continued from page 606

cuitry, being coupled to it by a twin lead which should be kept well away from unscreened mains wiring. It is mounted on a wall directly facing one of the car headlamps when the car is parked in its usual position. To reduce illumination by ambient light it can be fitted with a simple shade along the lines indicated in Fig. 2. It is of course extremely unlikely, to say the least, that the ambient illumination at day or night on the ORP12 inside a garage will even approach that offered by a car headlamp positioned a few feet away from it.

The switching part of the circuit may be coupled to the main light switch for the garage, although some constructors may prefer that the circuit switch on its own lamp, the existing garage wiring then being unaltered. ***It is of the utmost importance that the unit be installed in a proper housing which allows no access to circuit points at mains potential and that all external metalwork be reliably connected to the mains earth.*** It will be seen in Fig. 1 that the mains earth connects to the positive rectified supply rail, thereby allowing one of the leads to the ORP12 to be at earth potential. Precautions against shock from the mains must always be fully observed in a garage, which normally has a concrete floor offering a high shock hazard.

When the unit is connected to the mains and is then switched on, C1 will be discharged and the circuit will go through a timing period before it becomes set for use.

After completion and installation, it is necessary for VR1 to be set up. This potentiometer is initially adjusted so that its slider is at the negative end of its track. The car headlamp illuminating the ORP12 is then turned on and the slider of VR1 gradually advanced towards the positive end of the track. A setting will be found at which PL1 lights up and the circuit goes through a timing period. The final position for VR1 slider is just slightly beyond that setting. ■

EXCLUSIVE SERIES

TUNE-IN TO PROGRAMS

Part 5

by Ian Sinclair

Becoming Dszy

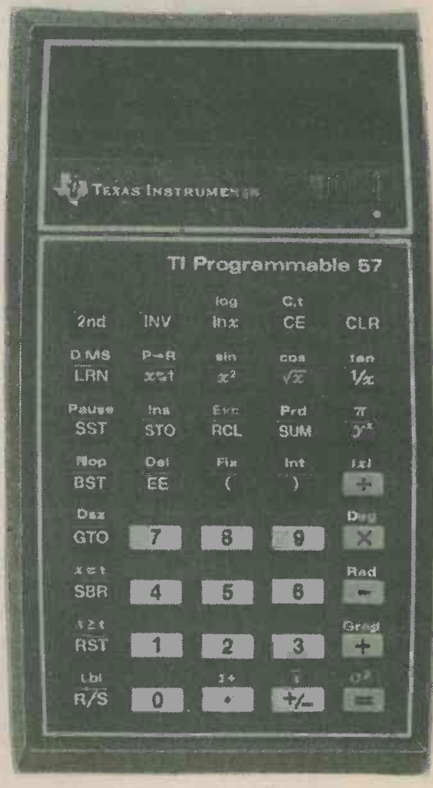
One of the most important features of a programmable calculator is its ability to keep churning round a program loop, displaying results or storing quantities into memories. In Part 4 we noted one method of stopping such a loop by making use of the [x=t] unconditional branch key. This time, we're going to look at another way of limiting the number of times a loop is traced. This involves the [Dsz] key of the TI-57, which is operated by the sequence [2nd] [GTO].

SKIP ON ZERO

The key title [Dsz] comes from the description of what this key does in a program: "Decrement and Skip on Zero". Decrement means count down by 1, and what is being decremented is any number stored in memory 0. If, for example, before running a program we key in [12] [STO] [0], then on the first loop the [Dsz] operation will result in 1 being subtracted from the number in memory 0, leaving 11. On the next loop the [Dsz] operation will subtract 1 again, leaving 10 stored in memory 0, and so on. Eventually, when there is only 1 stored in memory 0, the [Dsz] operation will reduce this to 0, and ***then*** the program will skip one step so that the skip takes the program out of its loop.

This operation could, of course, be done by using the [x=t] operation, but some steps are saved in the program when a straight count-down is needed by the use of the [Dsz] key. We do not, for example, have to program the steps [INV] [SUM] to arrange the decrement, nor the [x=t] for the skip step.

Let's look at an example of this count-down in use. The average value of a wave over a cycle is a quantity which is rather important. If this average value is 0 then the wave is pure a.c., but if there is an average value which is not 0 then there must be more flow in one direction than in the other, so that some d.c. is present. Now this can be calculated by the mathematical process called integral calculus, but the programmable calculator can do the same job in an equivalent way by adding up the amplitudes of a wave at a number of points in the cycle. Suppose we decide to sample a sine wave every 5 degrees. Now, a complete cycle is 360 degrees, so that we will have a total of 72 sample points — a rather tedious business to do using tables or even a conventional calculator.



The keyboard of the Texas Instruments TI-57 programmable calculator. Most keys have a second function, whereupon facilities are nearly double the number of keys provided

In our program we will start by setting the content of memory 0 at 72 and decrement by 1 using [Dsz] on each run through. We could, of course, do this by counting up angles, 0,5,10, and so on. It is easier to use the contents of memory 0 to generate the angle, however. If we start with the number 72 stored in memory 0, then multiplying this by 5 will give 360, which is the first angle to be calculated. If we use the number in memory 0, and multiply it by 5 on each loop, then the result will be the angle we want to use. For example, on the second loop, the number in memory 0 will be 71, and the angle will be 71x5=355 degrees.

The program, shown in Fig. 1, starts by setting the contents of memory 1 at 0, and memory 0 at 72. These steps are ***not*** repeated during the loop because we want to count down the figure in memory 0, and to add up the answers that we get into memory 1. After the [72] [STO] [0] step, then,

Program	Procedure
LRN 0 STO 1 72 STO 0	Fix 2 RST R/S
Lbl 0 RCL 0 X 5 =	After 71 loops the result
sin SUM 1 Dsz GTO 0	(zero) is shown.
RCL 1 R/S LRN	

Fig. 1.

For a calculation of the average value of sin θ X sin (θ+30°), such as might be wanted for calculating power dissipation, the program would read:

Program	Procedure
LRN 0 STO 1 72 STO 0	Fix 2 RST R/S
Lbl 0 RCL 0 X 5 =	After 71 loops the result
STO 2 sin X (RCL 2	(31.17) is displayed. (Note
+ 30) sin = SUM 1	that this program will take
Dsz GTO 0 RCL 1 R/S LRN	about twice as long to run
	as that of Fig. 1.)

Fig. 2.

the program has [Lbl] [0], indicating where the loop starts. Remember that memory 0 and label 0 are quite different. Within the loop the number stored in memory 0 is pulled out and its value multiplied by 5 to give the angle we need for the wave amplitude calculation. The step [sin] now calculates the sine of the angle, and this value is added into memory 1, which stores the sum of the amplitudes of the wave, a sine wave. For other calculations some other expression will replace the [sin] step. as in Fig. 2.

The next step in the program of Fig. 1 is [Dsz] for the count-down, and this is followed by [GTO] [0] so that the loop repeats. When the loop repeats, however, the number stored in memory 0 has been made 1 less by the action of the [Dsz] step, so that the angle whose sine is being calculated is 5 degrees smaller. On the last loop, with figure 1 stored in memory 0, the angle is 5 degrees, and this is the final amplitude calculated. At the [Dsz] step, subtracting 1 gives 0, so that the program skips the [GTO] [0] step and lands on [RCL] [1]. This puts into display the total amount (sum of amplitudes) stored in memory 1, and the [R/S] step then stops the program so that the final figure is visible in the display. Note that the angle 0 degrees is not calculated, because 5 degrees is the last run and the counter skips when the [Dsz] step is used. The value of a sine wave is the same at 360 degrees as it is at 0 degrees, so that we do not have to include the latter in the program. If, in some other program, we had to include the value at 0 degrees (or 0 of whatever quantity we used) we would have to amend the program by starting with a number 1 *higher* in memory 0 (73 in this example) and then subtracting 1 after this number is out of memory. Such a step sequence is shown in Fig. 3.

Program
LRN 0 STO 1 73 STO 0
Lbl 0 (RCL 0 – 1)
X 5 = STO 2
remainder as before

Fig. 3.

INVERTED STEP

Like most of the keys on the TI-57, the action of the [Dsz] key can be inverted by using the sequence [INV] [Dsz]. With this instruction in a program, the sequence that takes place is that 1 is subtracted from the number which is stored in memory 0. Then if the number stored in memory 0 is ***not*** 0 the program skips a step. If the number left in memory is 0, then the next step of the program is used. This 0 facility is nice to have, but we seldom need to use it because it's difficult to think of anything which can be done using [INV] [Dsz] which could not equally easily be done by using [Dsz] by itself.

There are a few points to look out for when we program in the [Dsz] type of instruction. The first and most important point is that we cannot use memory 0 for anything else. In part 8 of this series, we shall be looking at methods of keeping records of programs, but it's not revealing any secrets to say now that we should always keep a note of what each memory is used for when we write or record a program.

Because the [Dsz] instruction counts the number of times round a loop, it doesn't necessarily follow that the number stored in memory 0 must be the number of times that a loop is traced in the course of one program. It's possible to use the [Dsz] instruction in two different loops — counting down in one loop, then reloading another number into memory 0, switching to another loop and using the [Dsz] step all over again. How do we do it? Fig. 4 shows one method but you'll have to wait until we start dealing with subroutines next month for other methods.

Program	Procedure
LRN 4 STO 0 Lbl 0	Load resistor value into
RCL 1 + (RCL 0 X	STO 1.
.05 X RCL 1) =	CLR RST R/S
Pause Pause Dsz GTO 0	Display shows values for
4 +/- STO 0 GTO 0	positive tolerances from
LRN	20% down to 5%, then
	negative tolerance values
	from –20% upwards —
	negative values then
	repeat. To avoid repeats,
	see next month's issue.

Fig. 4.

A few more assorted points on the [Dsz] key are useful to know. One is that a fraction stored in memory 0 is taken for the purposes of the count down as the next whole number up. 0.6 is taken as 1, 5.5 as 6. 14.2 as 15, and so on. This is ocy for the purpose of the "skip-on-zero" step; the number stored in the memory is not rounded up. for example, if we place 4.65 in memory 0 then use the [Dsz] step in a loop, the number will be counted down as 3.65, 2.65, 1.65, 0.65 (which still counts as 1, so that there is no skip yet) and then te next [Dsz] step makes the count 0, ***not*** –0.35. If the number which is placed in memory 0 is a negative number, the [Dsz] operation ***increments*** by 1, so that 1 is ***added*** on each loop. This ensures that the count always ends in 0, causing the skip.

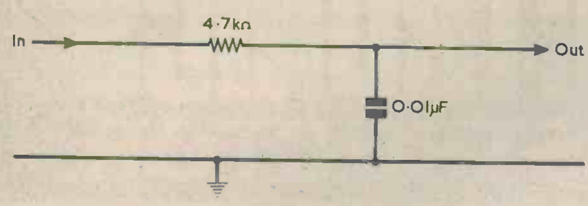


Fig. 5. Simple RC low-pass filter. Gain and phase angles at different frequencies are calculated by the program of Fig. 6. The program will, of course, operate with other values of resistance and capacitance than those shown here

This program calculates the gain (output voltage divided by input voltage) and phase angle (in degrees) for a simple RC low pass filter.

Program
LRN RCL 1 STO 4 RCL 2
Prd 4 RCL 3 Prd 4 Lbl 0
RCL 0 X RCL 4 = STO 5 x^2
+ 1 = √x 1/x Pause Pause
RCL 5 INV tan +/-
Pause Pause Dsz GTO 0 GTO 1
LRN

Procedure
Load value of starting frequency (in kHz) into store 0, value of R (in kΩ) into store 1, value of C (in μF) into store 2
2 X π = STO 3
Fix 2 CLR RST

Pressing [R/S] will give displays of gain, then phase angle for the starting frequency, and then for each 1kHz less until 1kHz. The end of the cycle is signalled by a flashing display caused by the impossible instruction [GTO] [1] (Label 1 is not used).

Fig. 6

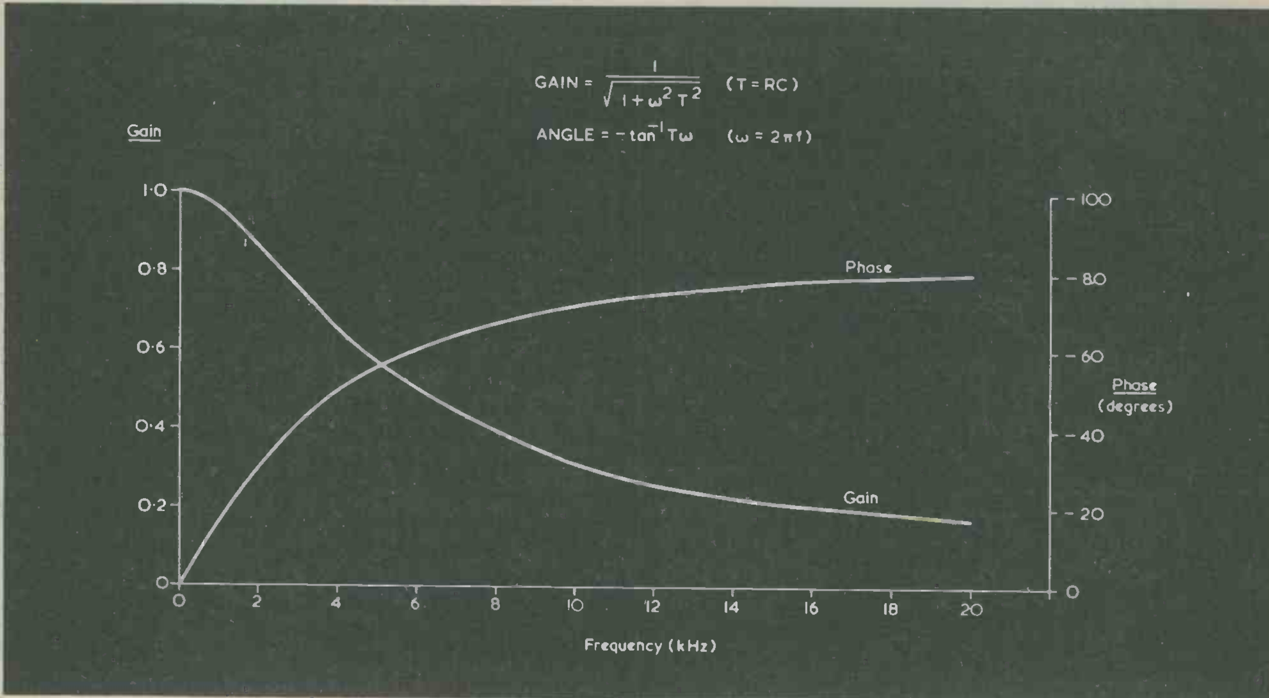


Fig. 7. Graph showing gain and phase angles of the low pass filter of Fig. 5 at a starting frequency of 20kHz. The curves are plotted from the read-out of the Fig. 6 program

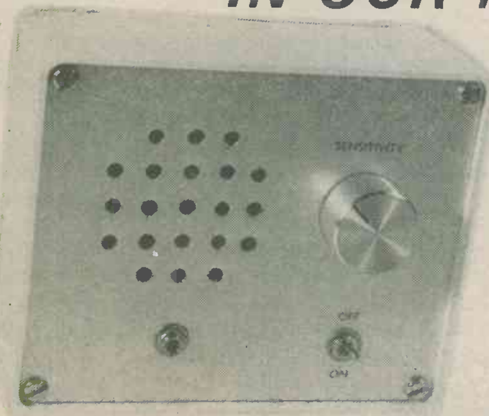
PROGRAM STEPS

Just a short note here while you pause for breath. An important difference between the TI-57 and the PR-100 is the use of what are called merged codes on the TI-57. When, for example, we program [Lbl] [4], [STO] [3], [RCL] [2] on the TI-57, each of these, the instruction and the reference number, counts as just one program step. On the PR-100 each keystroke counts as a program step. Because of this it is difficult to compare the program handling capacity of these two calculators. Another important point which applies to both calculators is that each digit of a number which is entered into a program is counted as a program step. For example if we need the steps [RCL] [2] [X] [15] [÷] [65], then the number steps [15] [÷] [65] amount to 5 program steps. When constants like these have to be used, it's better to calculate the result first (15÷65=0.23) to insert into the program or, even better, to place the full result (0.2307692) in another memory. If we use memory 3 for this result, then the program steps become [RCL] [2] [X] [RCL] [3], which is only 3 steps on the TI-57, 5 on the PR-100.

Next month — subroutines, allowing us to use more program steps then we believed possible. As a tail-piece, though, Fig. 6 shows a program for the gain and phase angle of the low-pass filter of Fig. 5, and Fig. 7 shows the graph produced from the read-out of the TI-57.

RADIO & ELECTRONICS CONSTRUCTOR

IN OUR NEXT ISSUE —



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From 1000 to 1030 on **7300, 9600, 9640, 9720, 9780, 11705, 11740, 11810, 11820, 11835, 11960, 11975, 12055, 15110, 15150, 15305, 15350, 15360, 15440, 15460, 15510, 17700, 17730, 17775, 17825, 17870, 17900, 21615** and on **21645.**

Massive coverage such as the above goes on throughout the day on various channels but it is helpful to remember that from 0400 to 1230 **21645** is in constant use.

Another listening period could be from 2000 to 2030, in which case the channels in use are **5920, 6010, 6020, 6030, 6130, 6200, 7150, 7175, 7300, 7320, 7330, 7440, 9490, 9550, 9630, 9745, 9760, 9785, 9795, 9810, 9845** and on **12050.** The latter frequency is in use throughout the period 2000 to 2300.

AROUND THE DIAL

In which recent loggings, made in the village of Holbrook in the county of Suffolk — the gem of East Anglia — (the county not the village!) are featured.

● SPAIN

Radio Nacional Espana, Madrid, on **11920** at 1534, a round-table discussion on Spanish internal affairs.

RNE Madrid on **11930** at 1530, OM with announcements in Spanish amid recordings of local pops.

● KUWAIT

Radio Kuwait on **21605** at 1050, Arabic music, YL (young lady) with songs in the Domestic Service, scheduled on this channel from 0815 through to 1305.

● MALTA

Duetche Welle, Cologne, with a relay from Cyclops, Malta, on **17825** at 1123, OM (Old Man — male announcer) with the Japanese programme for Asia, scheduled here from 1115 to 1215.

● ISRAEL

Jerusalem on **17630** at 1147, OM with a newscast in Hebrew in a relay of the Domestic Network B to Europe and the Middle East, scheduled here from 0610 to 1740.

Jerusalem on **11655** at 1210, OM with a newscast in the English programme to Europe, Middle East, S & E Asia, N. America, Australia & N. Zealand, scheduled from 1200 to 1230.

● CYPRUS

BBC Limassol on **21660** at 1040, religious service in English to Singapore and Malaysia from the East Mediterranean relay station, the English programme being scheduled from 0900 to 1130.

● USSR

Radio Moscow on **21645** at 1043, YL with the English World Service, featuring at this time some Georgian folk songs and music. Also logged in parallel on **21615.** The recently innovated World Service is entirely in English, see opening paragraph.

● PAKISTAN

Radio Pakistan on a measured **21728.5** at 0735, OM with religious chants, YL with identification in the World Service to South Asia, Middle East and Africa scheduled from 0700 and to the U.K. additionally from 0715. Nominal frequency is **21730.** Also logged in parallel on **21625.**

Radio Pakistan on a measured **11642** at 1805, OM with local songs in the Turkish Service to Europe, scheduled from 1800 to 1900 except for the news in English from 1815 to 1820.

Radio Pakistan on **21625** at 1100, YL with identification and a news bulletin of local affairs read at slow-speed in English in the World Service to Western Europe, scheduled here from 1100 to 1115. Also logged in parallel on **17665.**

● SOUTH KOREA

KBS Seoul on **7550** at 2050, YL with the French programme to Europe, scheduled here from 2030 to 2100 (the English programme is from 2000 to 2030). This channel is probably your best chance to log S. Korea.

● CHINA

Radio Peking on **11445** at 1311, YL with the Laotian programme to Laos, scheduled here from 1300 to 1400.

Radio Peking on **11685** at 1308, YL with the programme for Indonesia, scheduled from 1300 to 1330.

Radio Peking on **15060** at 1320, YL with the programme for Burma, scheduled here from 1300 to 1330.

Radio Peking on **7480** at 2045, Chinese classical music, YL with songs in the Standard Chinese programme intended for Europe and North West Africa, scheduled from 2000 to 2100.

● **CHINA — REGIONAL**

Chinese regional stations broadcast programmes intended for local consumption. Dxing these stations not only provides a lot of interest but also imparts a sense of achievement — providing one logs them!

CPBS Harbin, Heilongjiant, on **4840** at 2215, OM and YL alternate in Chinese. The schedule of this one is from 2040 to 0635 and from 0825 to 1430 and is in parallel on **4924.**

Urumchi (in the new Romanised form Urumqi), Sinjiang, on **4220** at 1543, YL with song in Chinese in a relay of the Peking Home Service. This channel carries the Home Service in Mongolian and also relays Peking (Romanised=Beijing), the schedule being from 2300 to 0555, 1100 and 1730 and also relays the Peking Foreign Service in Russian from 1800 to 2055.

Urumchi, Singjiang, on **4500** at 1540, YL in Chinese in the Home Service, scheduled here from 2300 to 0710, 1000 to 1730 and also relaying the Peking Foreign Service in Russian from 1800 to 2100.

CPBS Peking on **6345** at 1430, Chinese orchestral music in the Domestic Service 2, scheduled here from 2100 to 0030, from 0950 to 1700 Wednesday & Friday, other days from 1033 through to 1700.

CPBS Peking on **11610** at 1115, Chinese music, YL announcer in the Domestic Service 1, scheduled here from 0743 to 1300 and from 2333 to 0300.

CPBS Qinghai on **6260** at 2304, YL in Chinese, choral music, also logged in parallel on **6500.** Schedule unknown.

● **EGYPT**

Cairo on **17920** at 1150, YL with news of local affairs in the Arabic programme for South and South East Asia, scheduled here from 1115 to 1215.

● **SWITZERLAND**

Berne on **21520** at 1055, typical Swiss music in the Entertainment Programme for Africa, scheduled from 1030 to 1100. Also logged in parallel on **21630.**

● **ALBANIA**

Tirana on **7065** at 1530, OM with the Arabic programme to the Near and Middle East, scheduled from 1530 to 1600.

● **BULGARIA**

Sofia on **7670** at 1535, YL announcer with recordings of local-type music in the Serbo-Croat programme for Europe, scheduled from 1530 to 1600.

● **POLAND**

Warsaw on **7125** at 1545, YL and OM with the Danish programme for Europe, scheduled from 1530 to 1600.

Warsaw on **7285** at 1540, YL with a talk in Finnish in the programme for Europe, scheduled from 1530 to 1600.

● **SOUTH AFRICA**

RSA Johannesburg on **21535** at 1335, sports commentary in the English programme for Central and East Africa, Europe and the Middle East, scheduled from 1300 to 1600 (1500 to 1600 Sunday).

● **AUSTRALIA**

Melbourne on **9570** at 0759, YL with frequency details after station identification, 6 pips timecheck at 0800 followed by a newscast in English.

Melbourne on **11740** at 0750, OM with the English programme for Europe (answering listeners letters). The English programme is scheduled here (at the time of writing) from 0700 to 0900.

● **ITALY**

Rome on **7275** at 1548, OM and YL with the German programme for Austria, scheduled from 1535 to 1550.

● **WEST GERMANY**

Deutsche Welle, Cologne, on **21600** at 1047. OM with identification followed by a newscast in the English programme to Central and East Africa, scheduled here from 1045 to 1115.

● **NETHERLANDS**

Hilversum on **9895** at 1335, OM with a talk about the prevailing weather in Holland in the English programme for Europe, scheduled from 1330 to 1420.

● **VATICAN**

Vatican City on a measured **6221.5** at 1050, OM and YL with announcements in English, classical music followed by announcements in various European languages.

● **CLANDESTINE**

Voice of the People of Thailand on a measured **9423** at 1512, local-type music, YL with songs in Thai.

● **NOW HEAR THIS**

Malabo, Equatorial Guinea, on **6250** at 2245, YL announcer, local-style music, songs with female chorus. The clock time quoted is just right for reception of this station, Radio Pyong-Yang is off channel, allowing the signal from Malabo to get through to the U.K. — we hope!

BACK NUMBERS

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

We retain past issues for a period of two years and we can, occasionally, supply copies more than two years old. The cost is 63p, inclusive of postage and packing.

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

BASIC SHORT

By R. A. Pe

Uncomplica
design co
1.2 to 24

Five simple controls, of which one, for aerial attenuation, is only required occasionally, make this neat little short wave receiver easy to operate

For the enthusiast seriously interested in short wave Dx reception (i.e. the reception of distant, rare or otherwise difficult stations) the ideal receiver is, of course, a high quality superhet with good i.f. filters, a b.f.o. and a host of other specialised features. However, even a fairly modest short wave superhet receiver can be quite expensive to buy, whilst the less expensive approach of building one's own receiver is only open to the more experienced constructor.

Fortunately, it is possible to obtain quite good results from considerably simpler equipment, such as the short wave radio which forms the subject of this article. This is a t.r.f. (tuned radio frequency) design, and it differs from a superhet in that it detects the received signal at radio frequency rather than converting it first to an intermediate frequency which is fed to an i.f. amplifier. The t.r.f. receiver cannot have the same sensitivity and selectivity as has the superhet but it employs much simpler and cheaper circuitry, and it requires no complicated alignment after it has been completed. Dx signals may be readily picked up with a t.r.f. set provided that the operator exercises the requisite skill and patience.

THREE TRANSISTORS

The present receiver incorporates three transistors, one of which is a field-effect type. It is powered from its own internal 9 volt battery and has an output which is suitable for high, medium or low impedance headphones. It will also work well with a single crystal earphone, but proper headphones are to be preferred for long periods of comfortable listening.

Three ranges are covered, the frequencies being approximately 1.2 to 4.2MHz in Range 1, 3.5 to 13.5 MHz in Range 2 and 7.0 to 24.0 MHz in Range 3. The set requires an external aerial of the long wire type, but it is still capable of receiving a great many stations with a short indoor aerial if, for any reason, a proper outdoor aerial cannot be provided.

The circuit of the receiver is given in Fig. 1. TR1 and TR2 provide r.f. amplification and detection, and appear in a hybrid cascode configuration which provides high gain and a low noise level at all the frequencies received. TR3 is a straightforward a.f. amplifier which also offers a high degree of gain.

The field-effect transistor, TR1, is used as a common source amplifier with source bias provided by R1 and R2 in series. R1 is adjusted to give optimum bias with the particular f.e.t. employed. The electrolytic capacitor C7 bypasses audio frequencies but, since it is not entirely effective at radio frequencies, the r.f. bypass is provided by the parallel capacitor, C2. The gate of TR1 is biased to the negative rail by the tuned winding of whichever r.f. transformer is switched into circuit by the range switch. There are three r.f. transformers, L1, L2 and L3, these corresponding to the similarly numbered ranges. For simplicity only L2 is shown in Fig. 1, the switch connections to L1 and L3 being identical.

VC1 is the main tuning, or "Bandset" control, whilst the lower value VC2 is the "Bandspread"

WAVE RADIO

Penfold

ated t.r.f. overing 4 MHz.

control. The manner in which these controls are operated is described later. The aerial is coupled to a tap in the r.f. transformer tuned winding by way of S1(b) and VR2. The potentiometer acts as a simple aerial attenuator and may be needed to reduce the input signal strength if the detector becomes overloaded, or if the loading effect of the aerial prevents correct regeneration being obtained.

TR2 is connected in the common base mode, its emitter being driven directly from the drain of TR1. Bias is provided by R4 and R5, with C3 bypassing the base to the negative rail. The choke L4 offers a high impedance at r.f., and a proportion of the r.f. signal at TR2 collector is fed back, via C1, VR1, S1(a) and a coupling winding on the r.f. transformer selected, to the aerial input tuned winding. This feedback is positive and provides regeneration, or reaction, the level of feedback being controlled by VR1. When VR1 is adjusted so that the circuit is just below the threshold of oscillation, or is just beyond it, the effective Q of the tuned circuit is increased very many times, allowing the receiver to exhibit high sensitivity and selectivity. With the present circuit the regeneration also increases the detection efficiency.

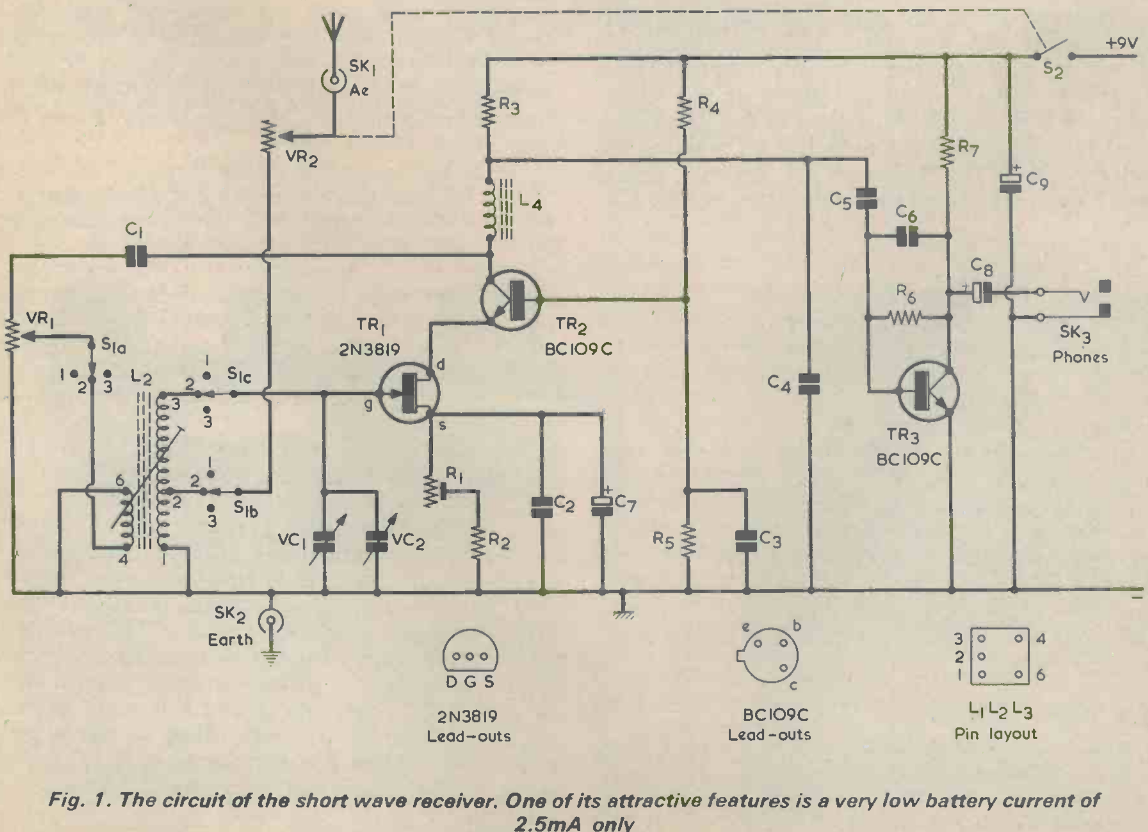


Fig. 1. The circuit of the short wave receiver. One of its attractive features is a very low battery current of 2.5mA only

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)
- R1 2.2kΩ pre-set potentiometer, 0.1 watt, horizontal
- R2 470Ω
- R3 1kΩ
- R4 6.8kΩ
- R5 6.8kΩ
- R6 1.8MΩ
- R7 5.6kΩ
- VR1 1kΩ potentiometer, linear
- VR2 5kΩ potentiometer, log, with switch S2

Capacitors
- C1 100pF ceramic plate
- C2 0.01μF type C280
- C3 0.1μF type C280
- C4 0.015μF type C280
- C5 0.1μF type C280
- C6 270pF ceramic plate
- C7 47μF electrolytic, 10V. Wkg.
- C8 47μF electrolytic, 10V. Wkg.
- C9 100μF electrolytic, 10V. Wkg.
- VC1 365pF variable, type 01 (Jackson)
- VC2 25pF variable, type C804 (Jackson)

Semiconductors
- TR1 2N3819
- TR2 BC109C
- TR3 BC109C

Inductors
- L1 R.F. transformer type KANK 3333R (Toko-Ambit)
- L2 R.F. transformer type KANK 3334R (Toko-Ambit)
- L3 R.F. transformer type KANK 3335R (Toko-Ambit)
- L4 10mH r.f. choke type 8RB 187LY103 (Toko-Ambit)

Switches
- S1 3-pole 4-way rotary with adjustable end stop (see text)
- S2 s.p.s.t. toggle, part of VR2

Sockets
- SK1 insulated wander plug socket, red
- SK2 insulated wander plug socket, black
- SK3 3.5mm. jack socket (see text)

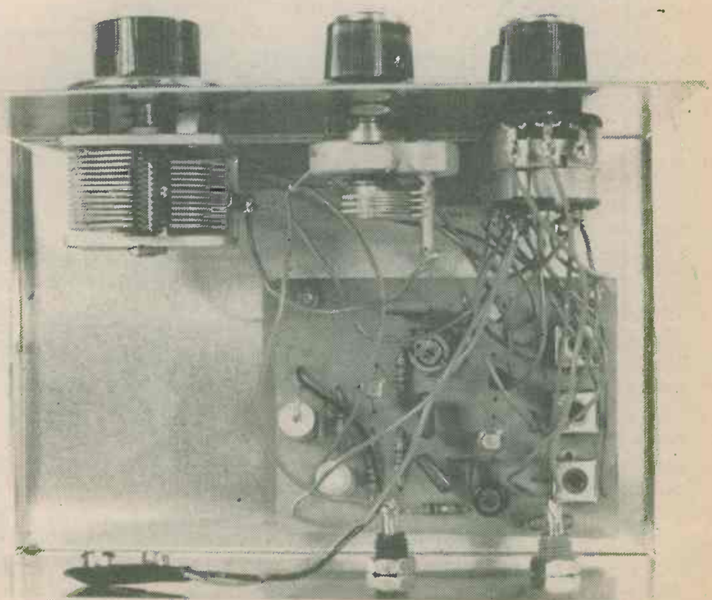
Miscellaneous
- Metal instrument case (see text)
- Headphones with 3.5mm. jack plug (see text)
- 9-volt battery type PP3
- Battery connector
- 1 large control knob
- 4 medium size control knobs
- Materials for printed board
- Nuts, bolts, wire, etc.

Detection is achieved due to non-linearity in TR2. Negative-going half-cycles at its emitter cause TR2 to conduct more heavily, with a consequent increase in current gain. Positive-going half-cycles have the opposite effect. The non-linearity is enhanced by the regeneration and it results in a detected a.f. signal being produced at the upper end of the r.f. choke. R3 functions as the a.f. collector load for TR2, and the detected a.f. signals are passed via C5 to the base of TR3. Any r.f. signal present here is bypassed to the negative rail by C4.

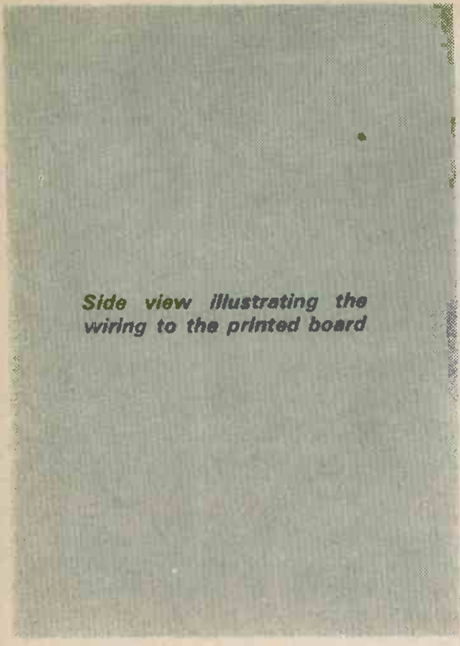
TR3 is a standard common emitter a.f. amplifier, with R7 as its collector load and R6 providing bias. C6 rolls off the higher audio frequencies and gives an improved signal-to-noise ratio. C8 provides d.c. blocking at the output.

C9 is the supply decoupling capacitor whilst S2, which is ganged with VR2, is the on-off switch. The current consumption of the receiver is very low, being about 2.5mA only.

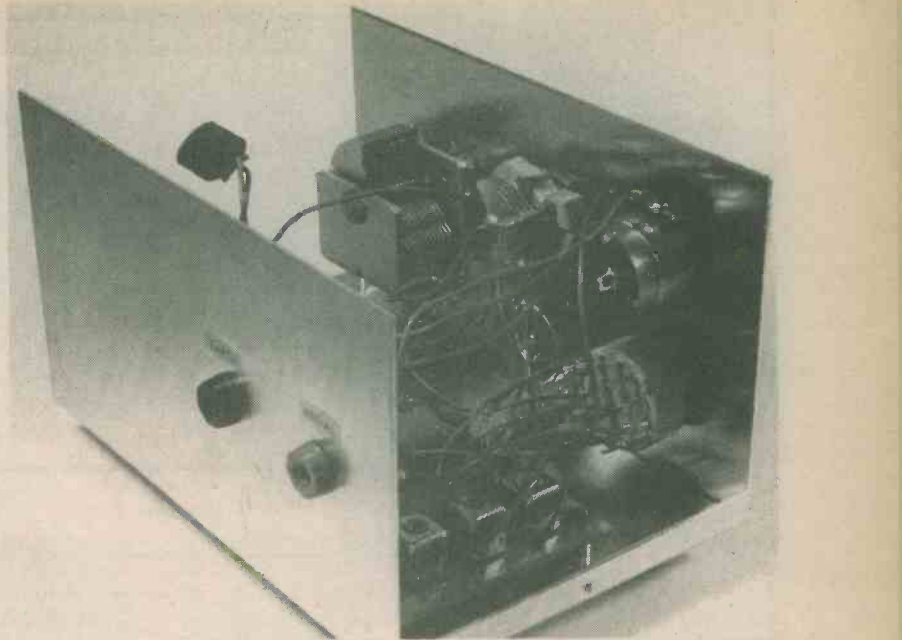
With the exception of the three r.f. transformers, L1 to L3, and the r.f. choke L4, all the components



Most of the components are assembled on a printed board with wire interconnections to the front panel controls



Side view illustrating the wiring to the printed board



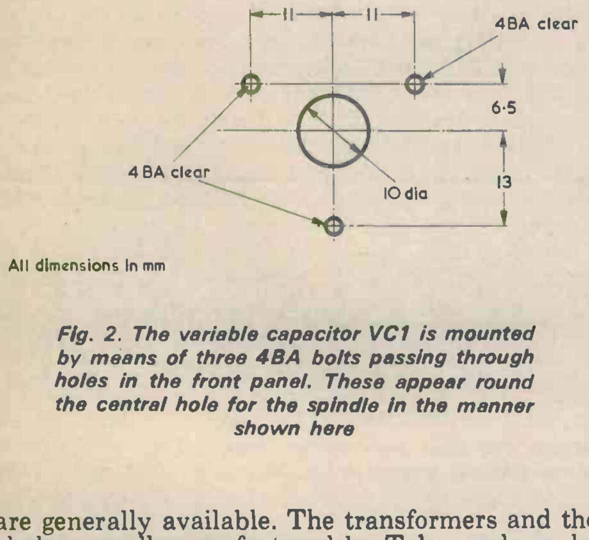


Fig. 2. The variable capacitor VC1 is mounted by means of three 4BA bolts passing through holes in the front panel. These appear round the central hole for the spindle in the manner shown here

are generally available. The transformers and the choke are all manufactured by Toko, and can be obtained from Ambit International. The receiver is housed in a metal instrument case type BC2, available from Harrison Bros., P.O. Box 55, Westcliff-on-Sea, Essex 5SO 7LQ. It has dimensions of 6 by 4 by 3½ ins.

ASSEMBLY

The controls and output socket SK3 are mounted on the front panel, using the layout shown in the photographs. At the upper left is VR2/S2, with VC2 to its right. Below VR2/S2 is S1(a)(b)(c), and below VC2 is VR1. To the right, with the larger knob, is VC1, with SK3 below it. The precise positioning of the front panel components is not important, although the two pairs of controls to the left should be centred on the same horizontal and vertical lines for the sake of appearance. The output jack socket should be of open construction (i.e. not insulated) since it takes up its sleeve connection to chassis from its mounting bush and nut.

VC1 is mounted by three short 4BA countersunk bolts passing through 4BA clear holes laid out in the manner shown in Fig. 2. The bolts fit into tapped 4BA holes in the front plate of the tuning capacitor, and it is important to ensure that the bolt ends do not pass more than marginally past the capacitor front plate as they could then damage the fixed or moving vanes. Spacing washers are fitted over the bolts between the inside surface of the front panel and the capacitor front plate. The capacitor takes up its chassis connection via these mounting bolts. The chassis connection to VC2 is made by way of its mounting bush and nut.

SK1 and SK2 are mounted on the rear panel of the case, with SK1 roughly opposite VR2/S2 and SK2 roughly opposite VC2.

All the smaller components are assembled on a printed circuit board which is reproduced full size in Fig. 3. This is produced and wired up in conventional manner, and it should be noted that the holes for the mounting lugs of L1, L2 and L3 need to be slightly larger than the other component mounting holes. For maximum accuracy, the mounting lug and coil pin holes may be marked out with the aid of the r.f. transformers themselves.

As can be seen from Figs. 3 and 4, there is quite a lot of interwiring between the printed board and the front panel components. The board is finally positioned in the manner shown in the photograph of the receiver interior, with L3 closest to S1(a)(b)(c), and two 6BA clear holes are required in the bottom of the case for securing it in position. The wiring should be as short and direct as possible, including in particular that to VC1, VC2 and S1(a)(b)(c). An unconventional approach, but one which will probably prove easiest for many constructors, is to complete the wiring from the printed board to S1(a)(b)(c), VR1 and VR2/S2 with the board and the controls *outside* the case. Include a lead from the arm of S1(c) for later connection to VC2 fixed vanes. The board and the panel components are then finally mounted in place. Note, incidentally, that S1(a)(b)(c) is a 3-pole 4-way rotary switch with adjustable end stop set for 3-way operation. The underside of the printed board is held clear of the case bottom by short metal spacing washers. A chassis connection to the board is made via the copper print to these washers. There is also a wired chassis connection from one tag of VR1 to the moving vanes tag of VC2.

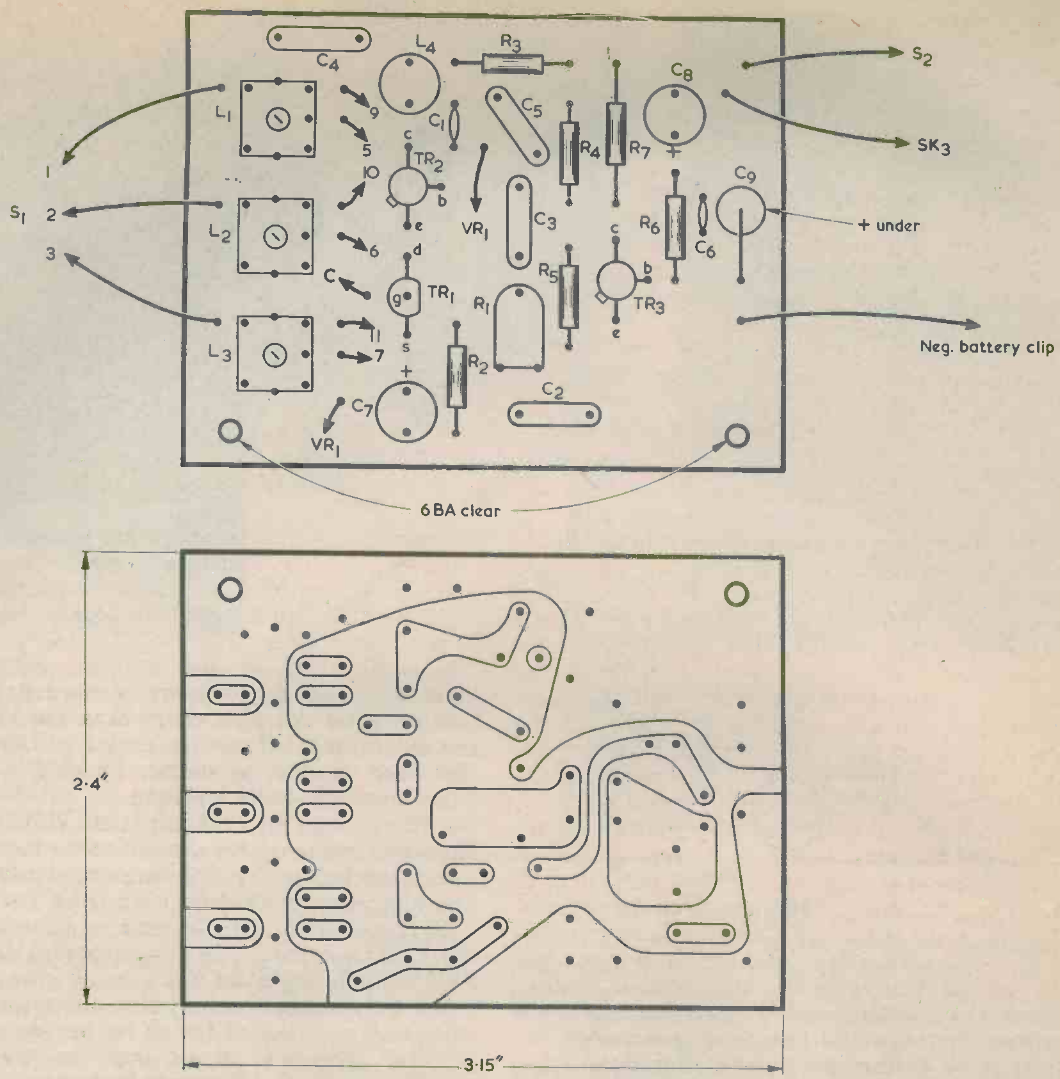


Fig. 3. The printed circuit board, reproduced actual size. The letter and number references indicate connections to the front panel components shown in Fig. 4

Shortening as necessary, the lead from S1(c) arm may be connected to the fixed vanes of VC2, which connect in turn to the fixed vanes of VC1. The lead from the board to SK3 may now also be connected. The only remaining connections should be to SK1 (from VR2 slider) and to SK2 (from the moving vanes tag of VC2).

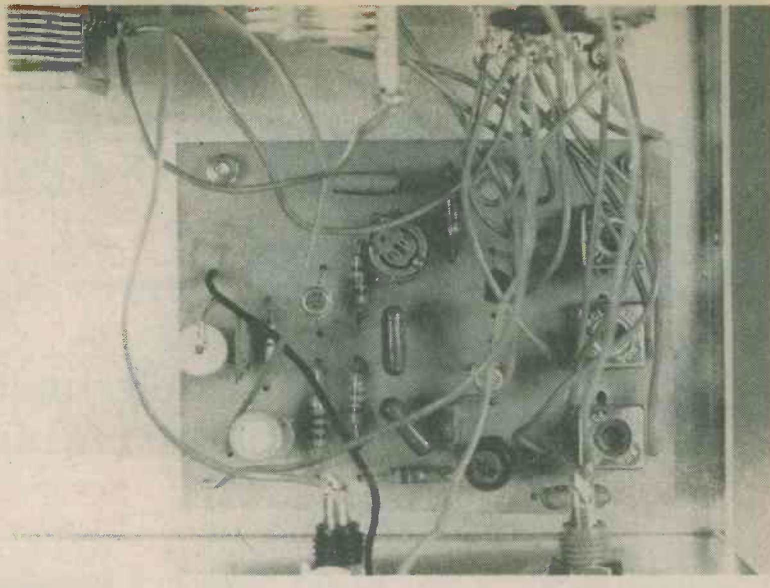
AERIAL AND EARTH

Quite good results can be obtained by simply using a few metres of wire strung around the room as an aerial. With the prototype, even a telescopic aerial little more than a metre long produced good reception of a surprisingly large number of stations. However, as with any short wave receiver, a better aerial system gives improved results. This is especially the case with the lowest frequency Range 1, and here an earth connection will also result in a considerable increase in the number of stations which can be picked up.

An acceptable outside aerial will normally be about 10 to 30 metres in overall length, hung as high as possible and well away from buildings, walls and other earthed objects. The earth connection can consist of a metal spike or pipe pushed into the ground at any convenient point and connected to the receiver by way of a lead which should be as short as possible. Apart from increasing signal strengths at low frequencies, the earth connection will also eliminate the otherwise inevitable hand capacitance effects which may be apparent when tuning in high frequency s.s.b. and c.w. signals.

USING THE SET

The receiver is switched on by rotating VR2/S2 knob clockwise until S2 closes. Normally, the potentiometer need not be advanced clockwise any further than is needed to operate the switch. Advancing the potentiometer further causes the aerial signal to be attenuated, and such attenuation is only needed if the detector is being overloaded by strong signals or if aerial loading effects prevent adequate regeneration from being obtained. Overloading will manifest itself in the form of a high background noise level and an almost total loss of selectivity. Aerial loading effects are only likely to be given with very long aerials and they prevent VR1 from taking the detector to the oscillation point at certain bands of frequencies.



Close-up view of the component board. This is secured to the chassis by two 6BA bolts and nuts, with spacing washers

When initially testing the receiver it is advisable to set S1(a)(b)(c) to Range 2, as there will be a large number of strong transmissions in this range at virtually any time. If VR1 is set fully anti-clockwise it is probable that few, if any, stations will be received. Advancing VR1 clockwise will increase the number of stations received, as well as their strengths, and will also improve the ability of the receiver to pick out just one of several closely spaced transmissions. However, VR1 is a regeneration control and not an a.f. or r.f. gain control, and if it is advanced too far the detector will go into oscillation. This will be heard as a tone of varying pitch as the receiver is tuned across an a.m. station and will make the proper reception of a.m. signals impossible. For optimum a.m. reception, both in terms of sensitivity and selectivity, VR1 should be adjusted so that the detector is just below the threshold of oscillation. The setting of VR1 varies at different frequencies, and it should be readjusted when the tuning control settings are altered significantly.

C.W. (morse) and s.s.b. (single sideband) are the transmission modes which are mainly used on the amateur bands, and these signals can be resolved by adjusting VR1 so that the detector is just beyond the threshold of oscillation. With an s.s.b. signal the tuning must be adjusted to produce an audio signal of the correct pitch and very careful and accurate adjustment is needed in order to achieve this. Strong s.s.b. signals may be rather distorted unless VR1 is advanced a little further to produce stronger oscillation or VR2 is adjusted to decrease the signal strength.

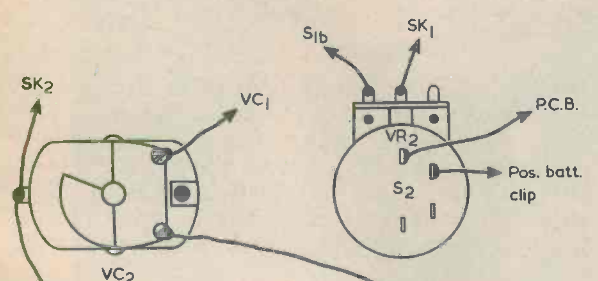


Fig. 4. Connections to VC2, VR2/S2, VR1 and S1(a)(b)(c). Confirm with a continuity tester the outer tags corresponding to the inner tags of S1(a)(b)(c) before wiring to this switch, as relative tag positioning may differ with some components

Tuning will be difficult with VC1, particularly on Ranges 2 and 3, as a small movement of its knob will take the receiver through many stations. This problem is overcome by setting VC1 to the part of the range which is to be searched for stations, and then carrying out the actual tuning by means of VC2. Since the latter has a much lower value than VC1 it covers only a very limited range of frequencies and enables tuning to be far easier.

The required adjustment in pre-set potentiometer R1 will not normally be very critical, and the best setting is found by trial and error. It is necessary to include this potentiometer in the circuit due to variations in bias requirements between different 2N3819 transistors. If R1 is set too high in value (adjusted too far in a clockwise direction) it is likely that there will be a lack of gain and regeneration, with consequently poor results. On the other hand, too low a value may make the set difficult to operate and, with some samples of the 2N3819 in the TR1 position, could even result in the receiver ceasing to operate. It is really just a matter of experimenting with R1 at various settings to find the one which gives the best all-round results.

The r.f. transformers, L1, L2 and L3 are fitted with adjustable tuning cores but, in the absence of a suitable signal generator to set specific frequency coverages, these should be left at the settings they have when the transformers are purchased. The receiver should then cover approximately the frequency ranges stated earlier.

Finally it should be borne in mind that short wave propagation conditions vary throughout the day. In general, the low frequency bands produce the greatest number of stations during the hours of darkness, whereas the high frequency bands provide good long distance reception during daylight hours and tend to fade out completely after dark. There are no hard and fast rules here, however, and propagation can also be affected by seasonal and other variations. ■

WORKSHOP POWER SUPPLY — Part 2

By R. A. Penfold

The concluding article on this high performance multi-option mains power supply

In last month's issue we dealt with the circuit design of this comprehensive power supply and commenced its construction. We now conclude with the remaining constructional details.

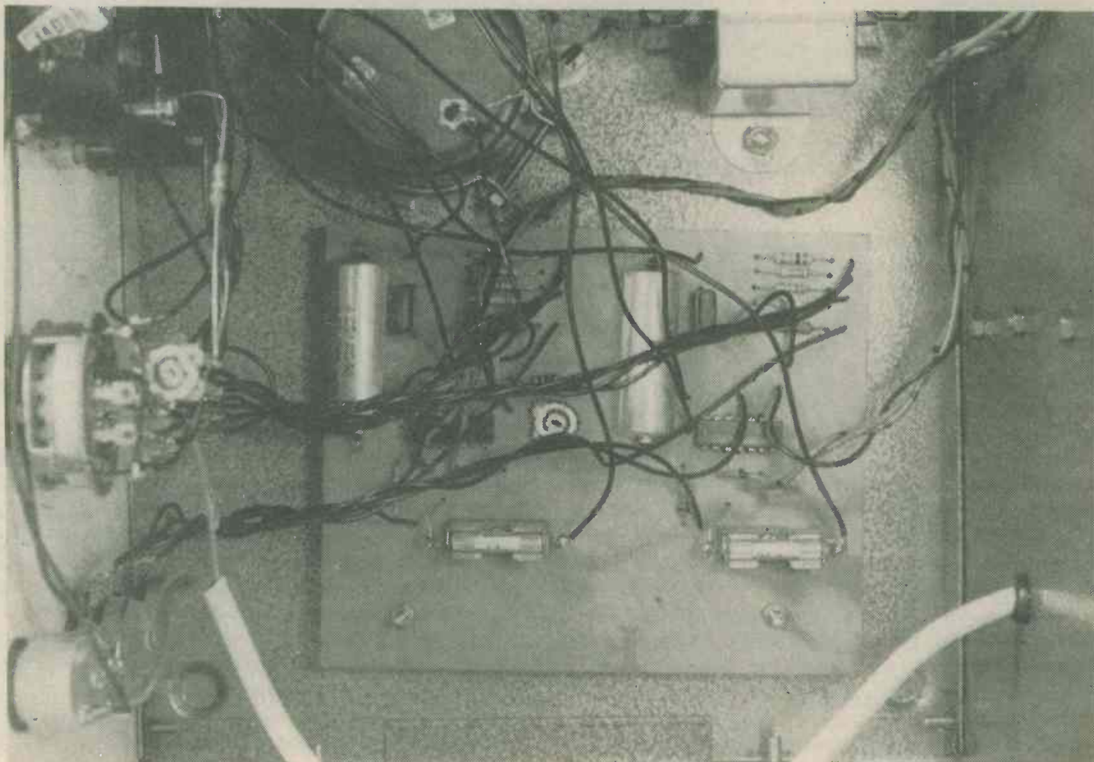
HEATSINK

TR1 and TR2 are mounted on the large heatsink using mica washers and insulating bushes. A solder tag is fitted under one mounting nut for each transistor to provide connection to the collector. Insulated leads about 200mm. long are then connected to the emitter and base and the collector tag of each transistor and these are led through two holes in the rear of the case, the holes being fitted with grommets. The leads should have different colours, which are noted down so that the transistor connections can be correctly identified later. The heatsink is bolted to the rear of the case, near the mains transformer end, in the position shown in the photographs. It may be used as a template for marking out its six mounting holes. Before finishing with this part of the assembly, check with an ohmmeter that the transistor bodies are fully insulated from the heatsink. Confirm also that the connections to the transistor base and emitter pins, and to the collector tag, are well clear of the rear surface of the metal case.

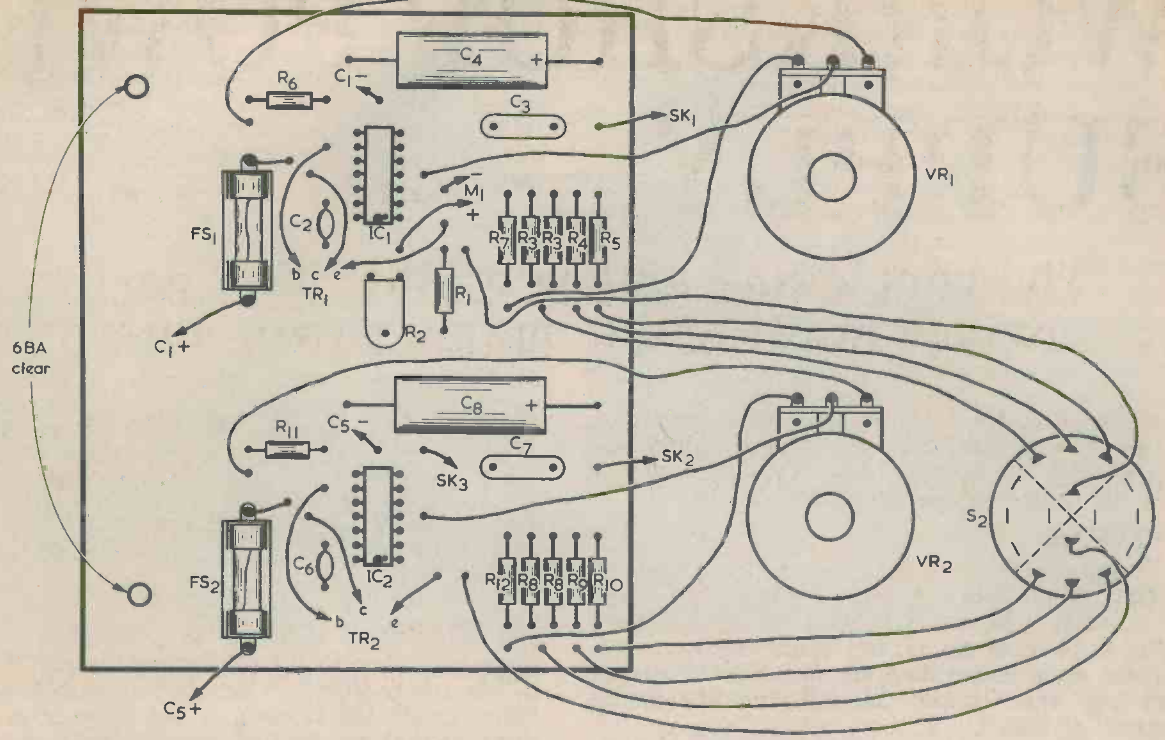
A hole for the mains lead is drilled to the left of the heatsink (as viewed from the rear). This is fitted with a grommet. A plastic or plastic-faced clamp will be required to secure the mains lead on the inside of the case.

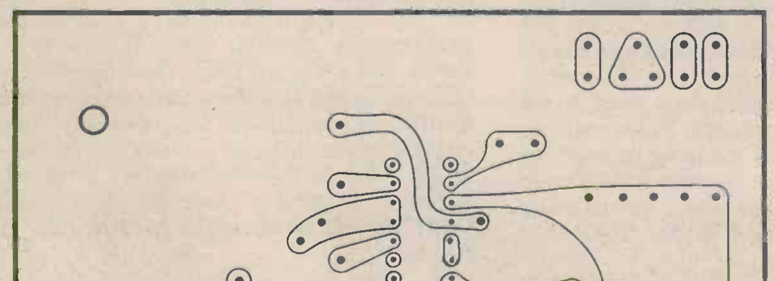
COMPONENT BOARD

Many of the small components are assembled on a printed circuit board which measures 100mm. by 120mm. The copper backing pattern of the board is reproduced actual size in Fig. 5. The two fuseholders are each fixed in position by means of a short 6BA bolt and nut. Mounting holes are not



Many of the small components are assembled on a printed circuit module. This is secured to the base plate of the power supply instrument case





Printed board
100 x120 mm
shown full size

Fig. 5. The printed circuit board for the workshop power supply is shown here actual size. It will be noted that there are two resistors marked R3 and two resistors marked R8. This is because R3 and R8 each consist of two resistors in parallel

shown in Fig. 5 and these should be marked out with the aid of the fuseholders themselves. The fuseholders may have a locating pip on the underside; a second hole is then required for this.

It will be seen that there are two resistors marked "R3", and two resistors marked "R8". This is because R3 and R8 each consist of a 1.2 Ω resistor and a 1.5 Ω resistor in parallel.

The completed component board is mounted on the base of the case behind the controls with C4 at the front. In the prototype, the board was mounted with 6BA screws about 25mm. long, spacing washers about 10mm. long keeping the underside connections clear of the case. It is essential that the board underside be well clear of the case metalwork; longer screws and spacing washers can be used if the constructor wishes to provide a really good clearance here. The board cannot be finally mounted in position until all the external wiring to it has been completed.

OTHER WIRING

The eight rectifiers, D1 to D8, are wired in point-to-point fashion between the transformer secondary tags and C1 and C5, following the circuit diagram of Fig. 2.

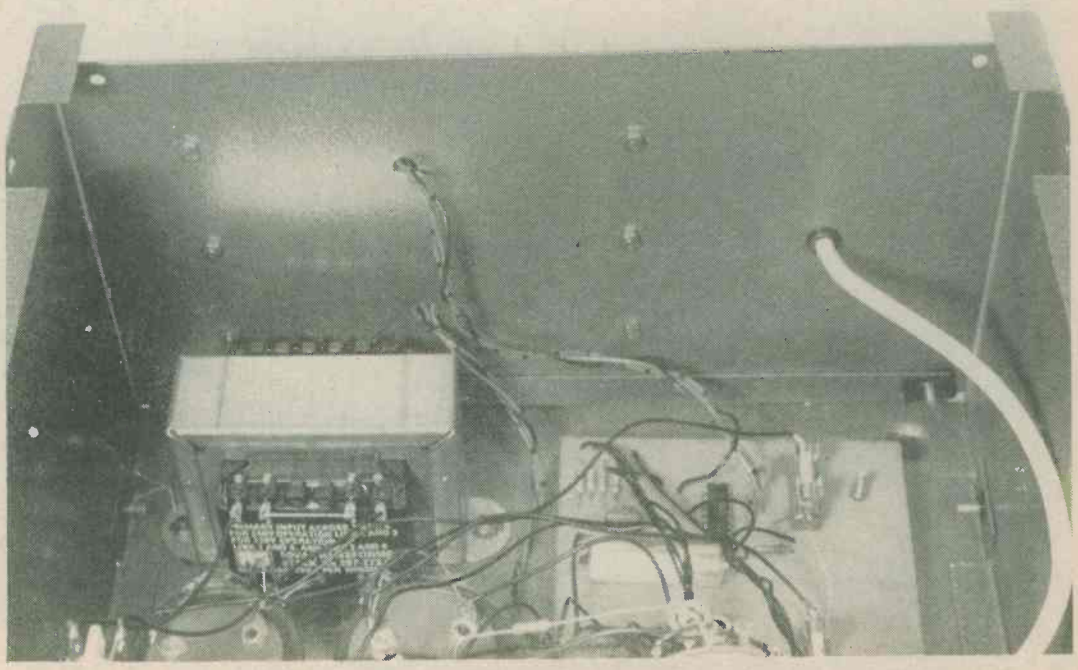
The wiring associated with the front panel components is illustrated in Figs. 5 and 6. When the wiring in Fig. 5 has been completed, the component board may be finally bolted in position. The leads from TR1 and TR2 to the board may need to be shortened in the interests of neatness. Before wiring to the rotary switches, confirm visually or with an ohmmeter the outer tags which correspond to each inner tag. With some switches their positioning with respect to each other may differ from that shown in Figs. 5 and 6.

The wiring in Fig. 6 is point-to-point, with R14 and R13 being soldered to the tags of S4 and meter M2 as indicated. In practice, the slider tag of R14 is soldered direct to the tag of S4, the potentiometer body being horizontal so that it may be easily adjusted. R13 is then positioned laterally between R14 track tag and the positive meter tag. The result is an adequately firm mounting for these two components.

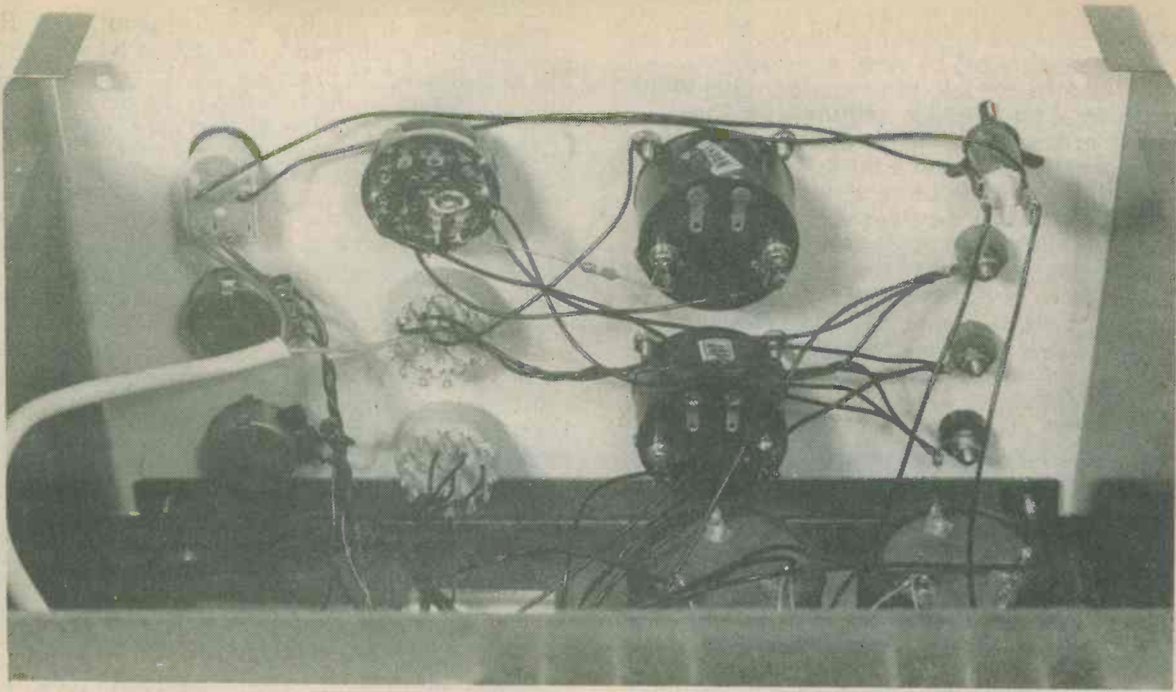
ADJUSTMENT

When the construction has been completed, all the wiring should be carefully checked to make certain that there are no errors. A wiring fault could cause damage to components when the supply is switched on. At this stage the lid of the case will not be fitted, whereupon mains connections are accessible at the on-off switch, the mains transformer primary tags and at the tags of the neon indicator if this is a type which does not have flying leads. Due care must be observed to avoid accidental shock. At this stage R2 and R14 should be adjusted to insert maximum resistance into circuit.

A multimeter switched to a suitable voltage range can be employed for the first tests on the unit. The power supply is switched on and the multimeter connected to each of the outputs in turn, checking that the range of output voltages provided by the appropriate control potentiometer is approximately correct. Next R14 is set up so that meter M2 gives an f.s.d. reading at 25 volts. To do this, S4 is set to select one of the outputs and the multimeter is applied to the output terminals. The control potentiometer is then adjusted for a reading of 20 volts in the multimeter, after which R14 is adjusted to give a corresponding reading in M2. With the original scale calibration, this will be 80μA.



Detail illustrating the mains transformer and the rear of the case. The eight bridge rectifier diodes are wired between the secondary tags on the mains transformer and the tags of C1 and C5



Behind the front panel of the power supply. Point-to-point wiring couples the panel components to the remainder of the circuit

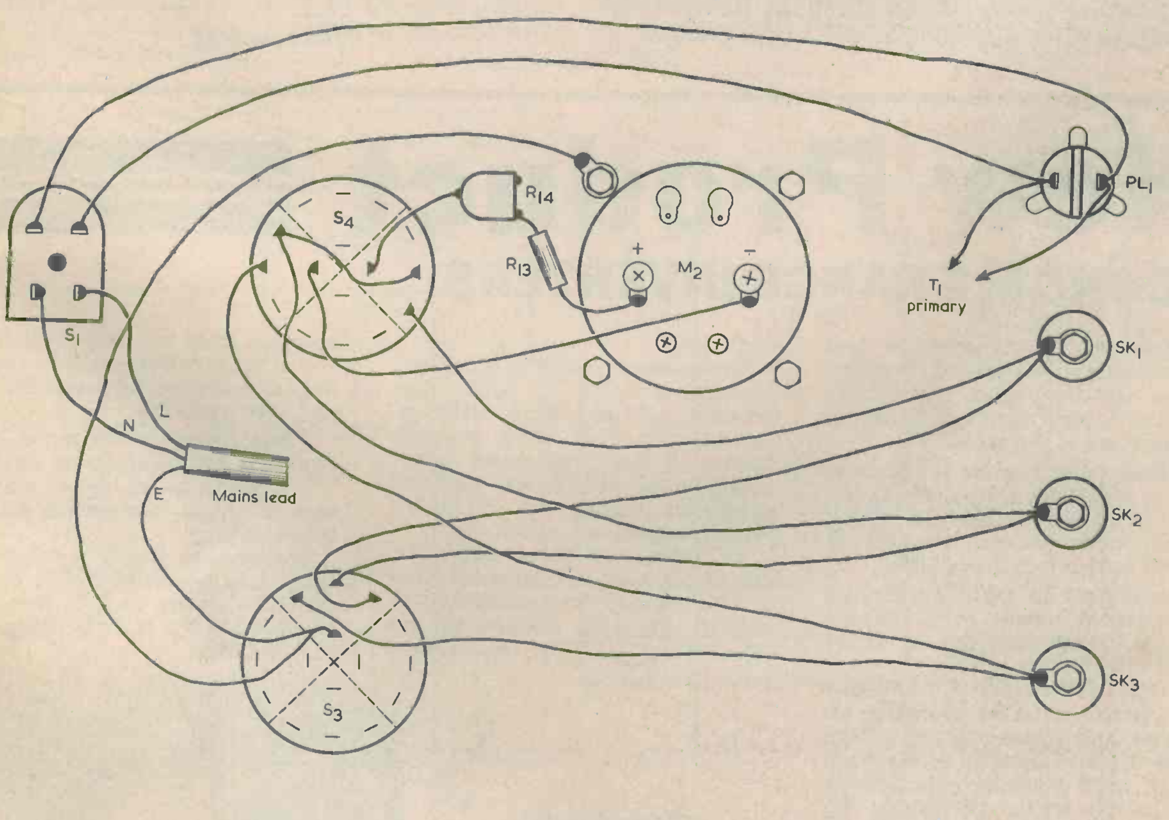


Fig. 6. The remaining wiring behind the front panel. The mains earth wire connects first to the arm of S3 and then to chassis by way of the solder tag secured under one of the mounting nuts of M2

It is next advisable to check that the current limiting circuits are functioning correctly. The two outputs are adjusted to 10 volts, after which each is tested in turn in the following manner. Switch the testmeter to a range which will allow it to give an indication of 1 amp, set S2 to the 1 amp position, and connect the testmeter to the output terminals with a 4.7Ω 5 watt resistor in series. If the current limit circuit is functioning correctly, the testmeter should give a reading of approximately 1 amp. Should there be a fault then the maximum current which can flow in the testmeter is limited to approximately 2 amps. Repeat the procedure with the 100mA limit, but this time inserting a 47Ω 1 watt resistor in series with the testmeter. The latter should indicate about 100mA if all is well. Finally carry out the check at the 10mA limit using a 470Ω ¼ watt resistor in series with the testmeter, whereupon the testmeter should indicate approximately the current limit value. As with the 1 amp test, the series resistors of 47 Ω and 470 Ω limit the current which can flow in the testmeter to about twice the current limit value. These checks must be carried out very carefully to ensure that there is no risk of damage to the testmeter.

When both outputs have been tested in this manner, S2 is set for the 100mA current limit and the testmeter is connected once more to the positive output with the 47Ω 1 watt resistor in series. Once again the testmeter should give an indication of 100mA. R2 is then adjusted so that meter M1 gives the same reading as that given by the testmeter. If the latter should be slightly in excess of 100mA, VR1 is adjusted to reduce the output voltage so that the testmeter reading is just at 100mA. R2 can then be adjusted for a reading of 100 in meter M1.

METER CALIBRATION

Perfectionists may wish to alter the meter scales so that they represent more accurately the currents and voltages that they measure. It is possible to remove the front covers of the meters and unscrew the scale plates for modification, but it must be strongly emphasised that this operation should only be carried out by constructors who have had experience in this type of work and who feel competent to carry out this task. The meters have very delicate mechanical movements which can be easily damaged by careless handling or by the entry of particles of dirt or dust.

In the case of meter M1, the legend "Microamperes" should be removed or covered, being replaced by the term "mA". The 0-100 scale does not need to be altered. With meter M2, the term "Microamperes" is replaced by "Volts". Also its scale is altered from "0-100" to read "0-25". The existing "0" is replaced by a "0" in the new figure type. "20" is changed for "5", "40" for "10", "60" for "15", "80" for "20" and, of course, "100" for "25". The new legends and figures may be cut out from "Panel-Signs" Set No. 4, which is obtainable from the publishers of this magazine.

The unwanted existing letters and figures can be gently scraped off, or they may be covered with thin white paint. Again, it must be reiterated that the process of altering the scales should not be attempted unless the constructor is fully confident that he can carry it out without damaging the meters.

(Concluded)

New Product

ECONOMY RANGE INVERTERS

Messrs. Electrovance are specialising in the sale of inverters. They say they find particularly popular is their range of Economy Transistorised Inverters.

These units convert low voltage d.c. to 200/240v a.c. power simply, and they are suitable for many applications where a domestic mains source is not available.

Assembled in plain aluminium instrument cases with rexine material cover, they use an off the shelf transformer to form the main circuitry. Silicon power transistors are used to form the switching oscillator and instead of using high class branded famous name transistor, these economy inverters use cheaper but similar transistors. The transistors are new, numbered and not rejects.

These inverters are not suitable for absolute continuous use, as the housing cases do not have any ventilation slots and inverters can run fairly warm — all units are d.c. input fused.

Operation is easy to complete, clip onto a normal car battery two polarity coloured leads with attached croc/clips, plug into the rubber 13 amp type mains output socket on the inverter any electrical appliance within the rated inverters wattage and switch on.

DC inputs available are 12v, 24v, 48v, as per models AC output is rated at 240v off load (no equipment connected) dropping on-load to approximately 200/220v AC. These economy units will only keep within 8% of 50Hz when the full wattage output is drawn. Square wave output only available.

These inverters will power most domestic electrical items such as TV's, radios, razors, record players, tape recorders, hair curlers, electric blankets etc.

Electrovance supply a substantial range and enquiries should be addressed to them at P.O. Box 191, London SW6 2LS or by telephone 01-736 0685.

DOUBLE DECCERS

A SPECIAL SERIES FEATURING S-DeCs

No. 7

By Ian Sinclair

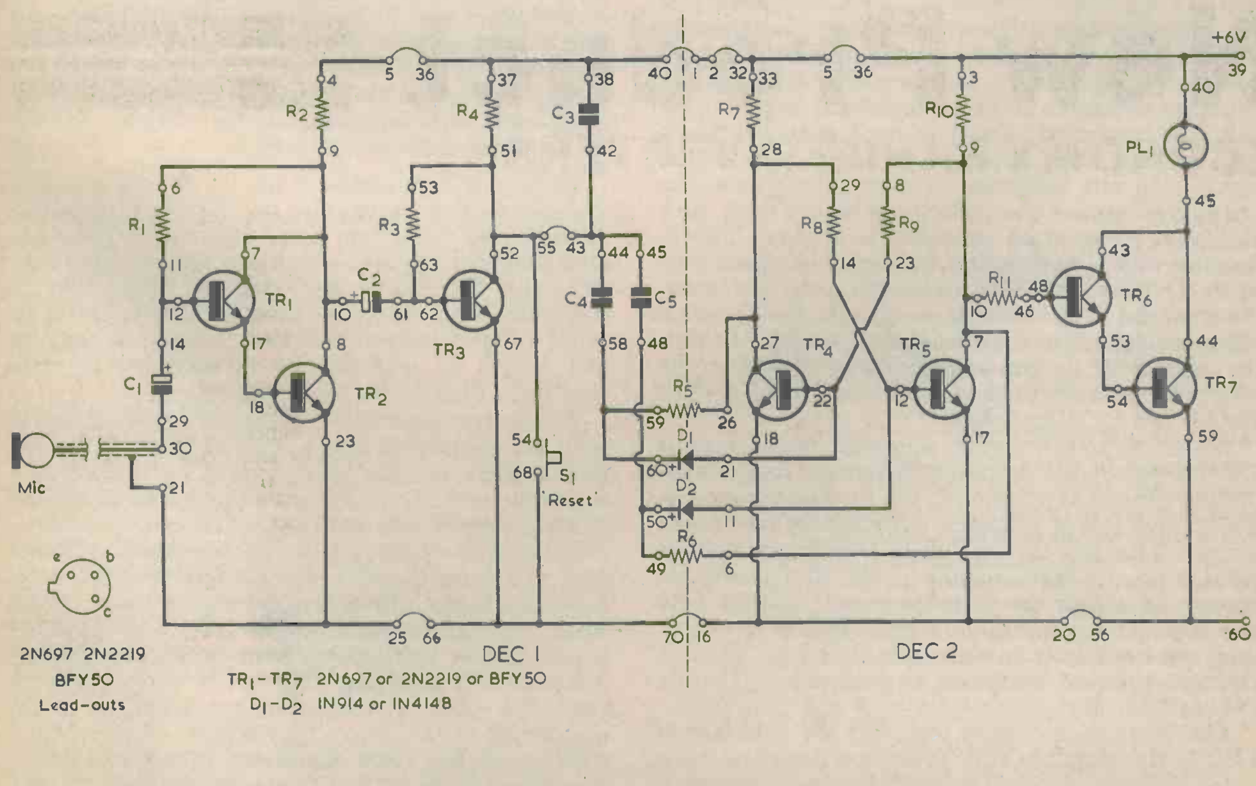
How to control a lamp — or a relay — by successive sound signals.

This is the seventh in the series of articles describing projects which can be built up on two S-DeCs and it deals with a circuit which is activated by sound signals to operate a low voltage light bulb. The circuit is a development of the switching circuit featured last month in "Double Deccer" No. 6. A sharp intense sound such as is obtained from breaking glass or snapping wood will switch the light on, after which another similar sound will switch it off again. Alternatively, the reset switch can be used. The effective range depends very much on the sensitivity of the microphone employed; it is better to place an insensitive microphone near the source of sound than it is to have a sensitive microphone remote from the sound. This is because a sensitive microphone will trigger the circuit too easily on stray sounds. For burglar alarm use (when the lamp would probably be replaced by a relay operating a bell) an insensitive microphone placed near a window or a door is better than a sensitive microphone in the centre of the room being protected.

The circuit can be divided into sound amplifier, pulse former, bistable and lamp driver stages. Since the lamp driving stage has a relatively high current capability, the lamp can be replaced by a relay coil (with parallel protective diode) using the circuit which was shown in "Double Deccer" No. 6.

MICROPHONE

The microphone connects to points 30 and 21 of DeC 1, coupling to the base of TR1 through C1. TR1 and TR2 form a Darlington input circuit with a fairly high input resistance. Bias is provided by R1 which, because of the large current gain in the Darlington pair, has the high value of 1M Ω The voltage gain of the two transistors is no greater than that of a single transistor fed from a low resistance signal source, but the Darlington circuit has the advantage of offering an input resistance which is high enough to avoid excessive losses when a medium impedance or high impedance microphone is used.



The circuit of the sound-operated light switch. The lamp is alternately turned on and off as the microphone picks up consecutive sounds

COMPONENTS

Resistors
(All ¼ watt 5%)

R1 1MΩ	R7 1.8kΩ
R2 12kΩ	R8 22kΩ
R3 150kΩ	R9 22kΩ
R4 22kΩ	R10 1.8kΩ
R5 150kΩ	R11 56kΩ
R6 150kΩ	

Capacitors
C1 10μF electrolytic, 16 V. Wkg.
C2 10μF electrolytic, 16 V. Wkg.
C3 0.001μF polyester or mylar
C4 0.001μF polyester or mylar
C5 0.001μF polyester or mylar

Semiconductors
TR1-TR7 2N697 or 2N2219 or BFY50
D1, D2 1N914 or 1N4148

Lamp
PL1 6V, 60mA, m.e.s.

Switch
S1 push-button, press to make

Miscellaneous
2-off S-DeC
6V battery
Lampholder, m.e.s.
Microphone (see text)
Jack socket (see text)

The second stage, TR3, functions as an amplifier and pulse former. The transistor has a fairly large value collector load resistor, and is deliberately overbiased so that its collector voltage is only just over 1 volt above the negative supply rail. Incidentally, this voltage can only be measured accurately with a high resistance meter, such as a 50kΩ per volt meter switched to a 10 volt range. TR3 operates at full gain, so that the signal applied to its base becomes clipped at its collector. The signal at the collector will have a low voltage limit of about 0.2 volt (the bottomed voltage of the transistor) and a high voltage limit approaching the 6 volts of the supply. In the presence of signal, therefore, the *average* voltage at the collector is higher than the 1 volt level given when no signal is applied. This is another way of saying that the signal has been partially rectified by TR3 (a *linear* amplifier transistor would never bottom or cut off). C3 acts as a reservoir capacitor for this rise in voltage, so that the action of a few sound waves reaching the microphone is to make the voltage at point 42 of DeC 1 rise by a few volts.

When the sound ceases, however, the voltage at TR3 collector will return to its normal level, causing the voltage at point 42 to fall in similar manner. The rate of fall of voltage is governed by the rate at which C3 charges through TR3. The drop in voltage constitutes a negative-going pulse, and it will be enough to trigger the bistable circuit around TR4 and TR5. The operation of a bistable circuit of this type has been fully explained in previous "Double Deccer" articles, including in particular "Double Deccer" No. 3.

The reset push-button connects the collector of TR3 to the negative rail, causing a negative-going pulse to be transmitted through C4 and C5 when it is pressed. This will trigger the bistable so that if the lamp were illuminated it goes out. The bistable is then in the ready condition with TR5 conducting fully and TR4 cut off. A sound pulse from the microphone will, as just described, cause the bistable to switch over, so that TR4 conducts fully and TR5 cuts off. Current now flows through R10 and R11 into the base of TR6, whereupon an amplified emitter current passes into the base of TR7 which turns on and lights the lamp in its collector circuit. Due to the high combined current amplification provided by TR6 and TR7 the lamp can if desired be replaced by a relay coil requiring a considerably higher current.

CONSTRUCTION

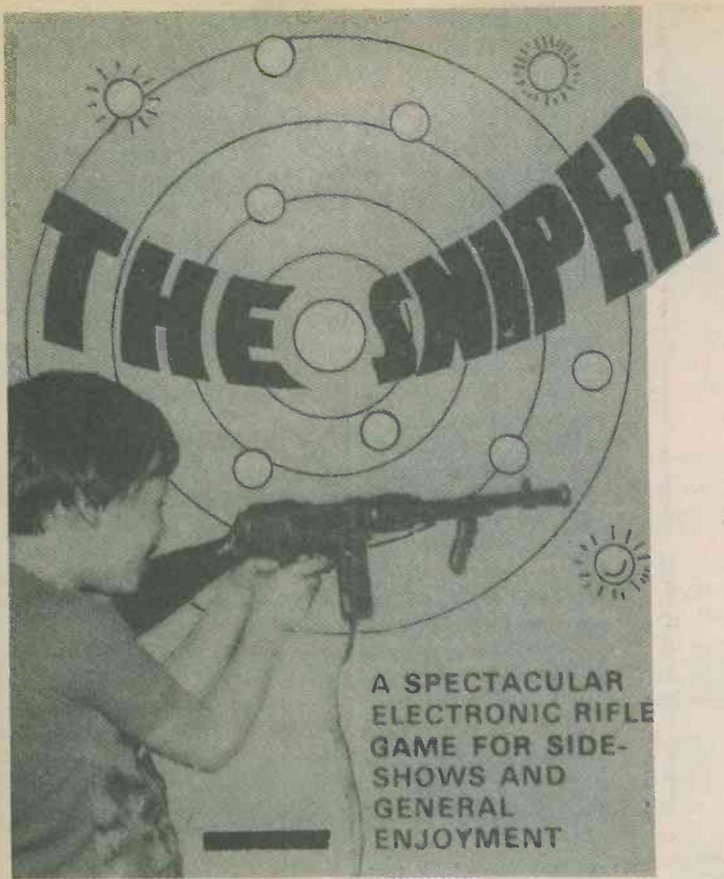
Clip the two S-DeCs together to form one long DeC. A panel may be fitted to DeC 1 to take the reset switch and the lampholder. The microphone can be connected by way of screened cable, the braiding of which connects to the negative rail of the circuit at point 21 of DeC 1. If the microphone is already fitted with a screened cable terminated in a jack plug, the best method of coupling to DeC 1 is to use a matching jack socket with two short lengths of wire soldered to its connection tags and inserted into points 21 and 30 of the DeC. The microphone plug is then fitted into this socket. This approach is preferable to dismantling the jack plug or soldering wires to it. If a new microphone cable is made up, however, remember to solder its ends to short lengths of single strand wire, which will plug much more easily into the S-DeC. Stranded wire should never be inserted into the S-DeC as the strands have a nasty habit of separating and catching in the internal springs.

Connect up the switch and the lamp, using single strand wires, then plug in the eight wire links which bridge the DeCs and the sections of each DeC. At this stage, insert R5, R6, D1 and D2, because these components also bridge the two DeCs. Make certain that the diodes are inserted right way round. The fact that both diode cathodes are on DeC 1 is a good aid for quick checking. The cathode end of the component will be identified by a band, usually white, around the diode body.

Next plug in the capacitors. C1 and C2 are electrolytic, so these must also be connected right way round. The capacitors are followed by the transistors, which are the same n.p.n. silicon types used in all the "Double Deccer" circuits. Check that the transistor lead-outs are fitted correctly; the transistor plug-in points have been chosen so that the full length of lead-out is unnecessary in most positions. Finally fit the resistors.

An electret capacitor microphone was employed with the prototype, and a crystal microphone will give similar results. A dynamic, or moving-coil, microphone with an output impedance of around 50kΩ (as employed with many cassette recorders) could also be employed, but in this case it is important to ensure that C1 is a modern component in good condition, since leakage current here could upset the bias conditions for TR1 and TR2. In practice, any difficulties here can be completely avoided by changing C1 for a 1μF polyester capacitor if a dynamic microphone is to be employed.

When all has been completed it only remains to insert two leads for connection to the battery, and the sound-operated switch is ready to go at the clap of a hand. ■



By E. A. Parr

Concluding article describing this exciting electronic rifle game

GUN CIRCUIT

The internal connections in the gun are shown in Fig. 3.

IC22 is the 15V LAS photo-electric cell. The image of the target light is focused onto the p.e.c. by a lens. The mechanics of setting up the optics will be described later. The sensitivity of the p.e.c. can be adjusted by VR1, but in practice this potentiometer has never had to be moved from its centre setting. The output of the p.e.c. is monitored by LED2 to simplify aligning the optics. This l.e.d. should not. of course, be visible to the budding marksman!

The trigger switch is a simple limit microswitch. LED1 gives the gun fire flashes. In the prototype it was mounted in the breech mechanism. The gun speaker was an ex-transistor radio 75Ω speaker. It was mounted in the gun butt to be just by the marksman's ear.

GUN CONSTRUCTION

The following is a description of how the prototype gun was made. It is intended as a guide, not a rigid set of instructions.

The machine gun was based on a child's toy. The original toy as purchased was made of two plastic pressings joined down the centre line of the gun. These were easily separated with a sharp knife. A small convex (magnifying) lens was obtained from a Christmas cracker (other sources would do, of course!). A bit of experimentation focusing a distant light onto a piece of paper gave the focal length, about 100mm.

The lens was now glued onto one half of the barrel with Araldite (having first checked that the two halves of the gun would fit round the lens). The lens was positioned as near the centre line of the gun as possible, although this is not critical. Next, a proper foresight and backsight were made from the aluminium and attached to the gun. Exact positioning is not important, as the p.e.c. was positioned later to take account of errors.

Now comes the tricky bit. A single light was set up and the half of the gun with the lens in set up in vice at the distance from the light at which the gun would be used (about 3 metres with the prototype). The gun was aimed at the light using the sights. A

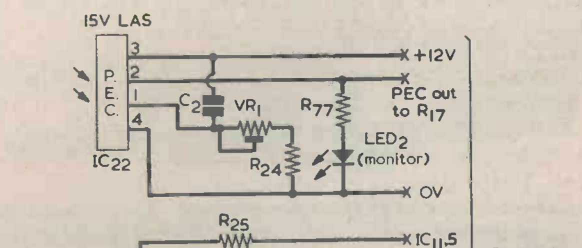


Fig. 3. The internal circuitry in the gun

The gun employed in the rifle game. It connects to the control logic by way of a 12-core cable

piece of paper was then put in the barrel with adhesive tape at the focal distance from the lens, and "spotted" where the light image fell.

The p.e.c. was set up on a small piece of Veroboard with flying leads for connection to R24, C2, etc. The Veroboard was then embedded in Araldite and manoeuvred so that the active area of the p.e.c. lay behind the spot. It is advisable to leave the leads of the p.e.c. long to allow it to be moved by a few millimetres for fine tuning.

When the Araldite had set, R24, VR1, C2, R77 and LED2 were mounted in the gun and connected to the p.e.c. The gun was again set up in the vice and aimed at the fixed light. The supply to the p.e.c. was turned on and the p.e.c. moved on its leads until LED2 came on, checking the aim all the time in case the gun had been moved. Care is essential here if shouts of "cheat" by peeved marksmen are to be avoided later.

By comparison, the mounting of the gun flash l.e.d., LED1, the trigger limit switch and the loudspeaker was simplicity. In mounting the limit switch it is better to have the trigger held back onto the switch by a spring, and the trigger pulling the striker off the switch rather than the trigger pushing a striker onto the limit switch. This prevents an over-strong trigger finger breaking the limit switch mounting, as happened in the development of the prototype.

The gun is connected to the control circuit by a 12 core cable. In the prototype this was about 1.2

The gun can be divided into two halves. The electronics and lens system is fitted into the half which will normmally be held against the right hand side of the marksman's face

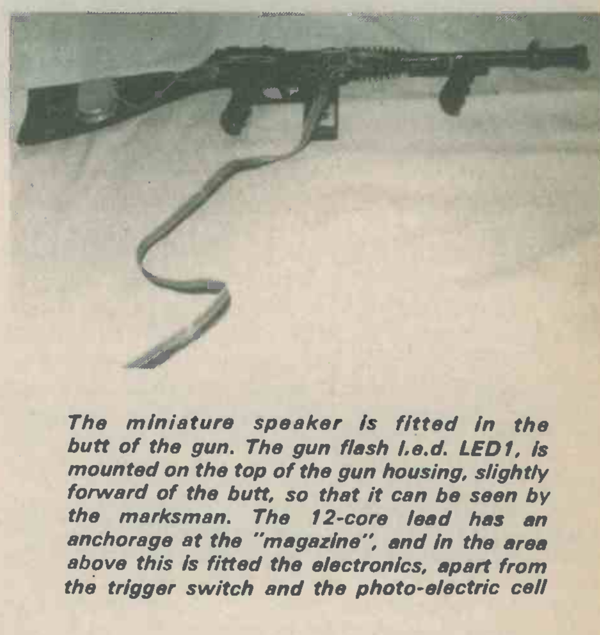
metres long. Note that the OV lines are separated out to prevent noise problems. The cable should be firmly anchored where it enters the gun, for obvious reasons.

When all is correct, the two halves of the gun can be fastened together again. To allow repairs and re-alignment of the optics, the prototype was simply bound with black tape, which was surprisingly effective and neat.

OTHER NOTES

The control circuit was wired up on an RS Components stripboard No. 433-911. No layout is given as the wiring is simply point-to-point. Layout is not critical, although the OV return from TR1 to TR16 was separated from the logic OV. To aid transportation the gun and target cables connect into the control box by way of plugs and sockets.

The power supply uses two transformers. An 8 volt transformer gives the 12 volt supply for the lamps and a 5 volt supply for the logic. A second 6 volt transformer provides the supply for the seven-segment displays. This separate supply was used to reduce the current through the 5 volt regulator. The circuit for the power supply is shown in Fig. 4.



The miniature speaker is fitted in the butt of the gun. The gun flash l.e.d. LED1, is mounted on the top of the gun housing, slightly forward of the butt, so that it can be seen by the marksman. The 12-core lead has an anchorage at the "magazine", and in the area above this is fitted the electronics, apart from the trigger switch and the photo-electric cell

Construction of the target was simple. Ten batten lampholders were fastened to a piece of chipboard, and connected back to the control box by 4 metres of 12 core cable (ten signal, one 12 volts and one spare).

VARIATIONS ON A THEME

In the development of the prototype a few ideas were tried out and rejected. They may be of interest to readers who might like to develop them further.

The first idea was based on a pistol, with IC10(a) and edge-triggered 100mS monostable fired off the bounce removing flip-flop IC9(a)(b). It was found that this was a more skilful game, but people preferred to loose off with a machine

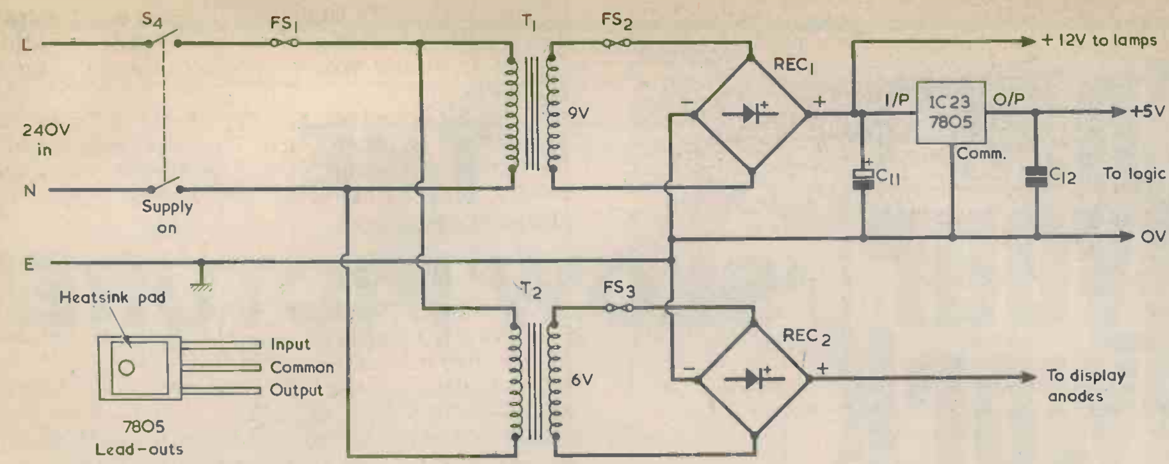


Fig. 4. The power supply. This provides separate outputs for the logic, the lamps and the display anodes

gun. Presumably they are working off their frustrations; there's a PhD thesis subject there for a psychologist!

The second idea was to give the gun a kick. A slot car motor had a lead weight fastened off centre onto the shaft, and the motor mounted at an angle in the gun. A relay was driven off IC9(b), causing the motor to run whenever the trigger was pulled. The effect was startling; the gun kicked worse than the notorious Thompson gun (which was reputed to be more dangerous to your friends than to your enemy). The gun proved impossible to aim and the motorised kick was shelved, although it probably could be made to work with a tamer motor.

Finally, the design proved to have a feature not designed in. With a good marksman it proved possible to "single shot" the gun by lifting off the trigger when a hit was recorded. The record score to date, in fact, is 85 bullets for 80 hits. The game was designed to take 2 minutes at most. With a needle match and a marksman firing single shots the game can take up to ten minutes. This is good fun, but bad for funds in a side show as it slows the income down. It would be easy to overcome the problem, and an obvious method would be a time-out of, say, two minutes. A second method would be a triggerable monostable added to keep the bullets coming for 1 second after the trigger was released.

The convex lens is positioned along the barrel slightly behind the foresight. The photo-electric cell is one focal length behind it and, in the prototype, was just behind the forward grip

This would force the marksman to hurry on and not single shoot. Finally, the bullets counter could be easily changed to a seconds timer, and the result based on hits/time rather than hits/bullets. ■

In your work-shop

THE 'SLOW PICTURE'

The TV with a fault in time

Smithy placed the 12 inch black and white television receiver on his bench and examined it briefly. He recognised it as one of the earlier fully solid-state sets capable of running from the mains or from a 12 volt accumulator. A small label was tied to the carrying handle at the top of its cabinet and, without much expectation, Smithy bent down to look at it. It was rarely that customer descriptions of fault symptoms, even when they were forthcoming, proved to be of any great assistance. This particular fault description was almost frightening in its incomprehensibility.

The label stated: "SLOW PICTURE".

A sudden eldritch vision of a television scene sluggishly trying to keep pace with the transmitter rose in his mind, and he shivered involuntarily. He shook his head irritably and turned to practical matters. After connecting the receiver to the mains, he plugged in an aerial and switched it on. The sound from one of the local channels became audible from the receiver speaker. After a short period the picture appeared, and Smithy examined it carefully. It had excellent brightness and contrast, was locked as firmly as the Rock of Gibraltar to the transmitter sync pulses, and gave no evidence of any serious non-linearity in either the vertical or the horizontal direction. Smithy checked for any conceivable attribute which could merit the adjective "slow", but had to admit himself baffled.

He scratched his sparse locks, then checked reception on the other local channels. Vision and sound continued to be perfect, with no obvious shortcomings in performance whatsoever.

ENTER DICK

"What's up, Smithy?" called out Dick from his bench at the other side of the Workshop. "Got a problem?"

"I certainly have," replied Smithy. "If what the label on this set says is true, it's got the weirdest snag I've ever heard of."

"D'you mean the label which says 'slow picture'?"

"You've seen it, too?"

Dick grinned.

"I always look at any label there is on a set before I take it off the rack for servicing. When I read ***that*** label I decided I'd leave that set for you!"

"Well, thank you very much," replied Smithy caustically. "But what the dickens does 'slow picture' mean? I've tried the set out and it's working perfectly."

"There's nothing in it that's slowing the action, is there? Like people in the picture moving more slowly than they should?"

"Of course there isn't," retorted Smithy shortly. "I suppose the best thing I can do is to leave the set running for a bit and see if anything happens."

On a sudden impulse, Dick rose from his stool and walked over to the filing cabinet. After a little searching, he pulled out a service manual and took it over to the Serviceman's bench.

"These mains-battery sets fascinate me rather," he said. "In the old days a TV set ran off the mains and that was all there was to it."

"The 12 volt battery idea was a logical outcome of receiver development," remarked Smithy. "Or at least it was, so far as simple small monochrome TV's like this one were concerned. When the setmakers started manufacturing receivers with semiconductors in all the stages it became obvious that a complete set could run with a common supply rail of around 11 volts positive. The few high supply voltages which are needed for the picture tube circuits could then be taken from the line output transformer. Hey, is that the service manual for this mysterious set I've got here?"

Dick nodded in agreement, whereupon Smithy took the manual from him and opened it at the circuit diagram. He stabbed his finger at the power supply section of the circuit. (Fig. 1).

"There you are," he remarked. "Now, to continue my argument, here's a set in which all the stages work basically from a stabilized supply rail of around 11 volts. After a suitable mains supply has been provided, only a little extra circuitry is needed to make the set capable of working from a battery as well. It can, for instance, run from a 12 volt car battery."

'Blimey," protested Dick, "that's

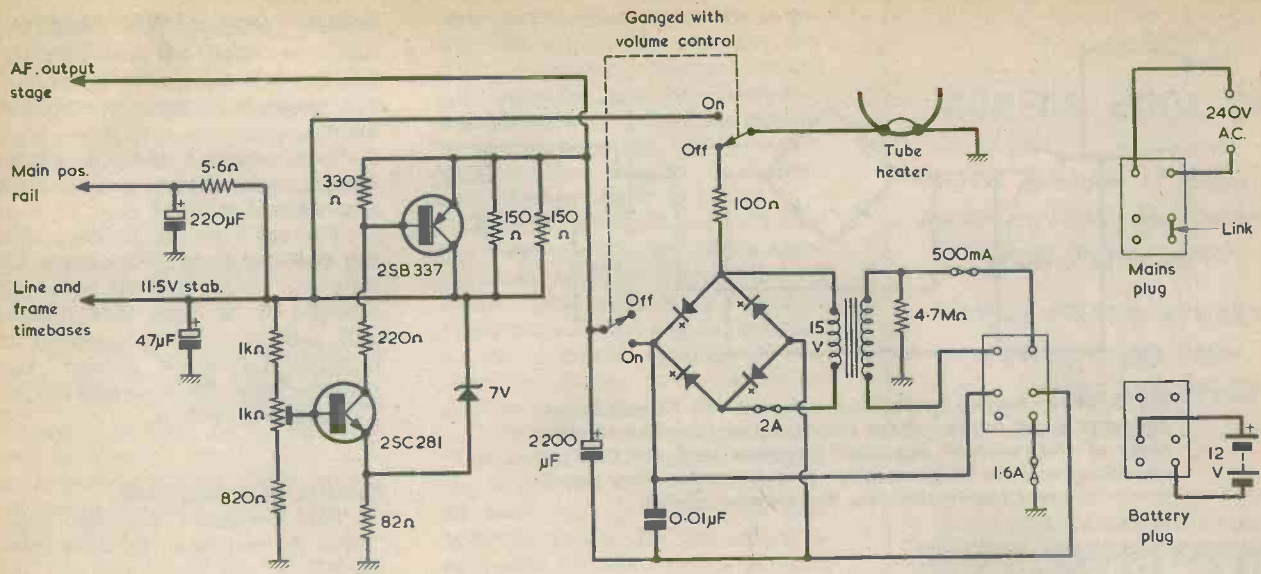


Fig. 1. A mains-battery power supply for a monochrome television receiver. Mains or battery operation is selected by inserting the appropriate plug. This is a slightly simplified version of the power supply section of the I.T.T. "Featherlight 12"

asking rather a lot, isn't it? Car battery voltages vary all over the place according to the state of charge they have."

"That's true," agreed Smithy. "In fact, you can expect a nominal 12 volt car battery in good condition to offer anything between say, 12 and 17 volts or so. But all that means is that there has to be a voltage stabilizing circuit in the power supply of the receiver which can handle these changes in voltage. Since a voltage stabilizing circuit is very desirable just for ordinary mains running, there's no serious extra expense incurred in using the same stabilizing circuit for battery operation."

MAINS-BATTERY SELECTION

"How do you select mains or battery supply?"

"Different manufacturers have different ideas here," said Smithy. "With this present set, the selection is done by having the power input plug wired up differently for mains and battery operation. Let's look at mains operation first. As you can see, the a.c. mains input goes to the top two pins of the 6-way power plug." (Fig. 2.)

"There's a shorting link," put in Dick quickly, "between the middle and bottom right hand pins of that plug."

"There is, indeed. Now the top two pins of the plug go to the mains transformer primary via a fuse. Although the set has got a mains isolating transformer, a 4.7M Ω resistor couples one side of the mains to chassis. This is to prevent the chassis from assuming an excesively high static voltage, which it could do if it were completely floating. The 15 volt secondary of the transformer connects by way of another fuse to a standard bridge rectifier. An unusual aspect of the design is that one section of the receiver on-off switch appears ***after*** the rectifier. When the switch section closes, it connects the positive side of the rectifier output to the 2,200 µF reservoir electrolytic. The negative electrolytic terminal connects to the negative output of the bridge rectifier, and these two circuit points then go to chassis through the link in the power input plug and another fuse. Got it?"

"Yes, it's all quite easy if you take the circuit one step at a time. Where does the positive voltage on the reservoir capacitor go?"

"To the voltage stabilizer."

"Right. Let's do battery operation next."

"Fair enough," said Smithy, pointing to the battery plug in the diagram (Fig: 3).

He paused to collect his thoughts.

"Well now," he continued, "the 12 volt battery connects to two different points in the power plug, and this time there are no links between any of the pins. So, when the battery plug is fitted there is, first, no mains going to the transformer primary and, second, no connection to chassis for the negative bridge rectifier output

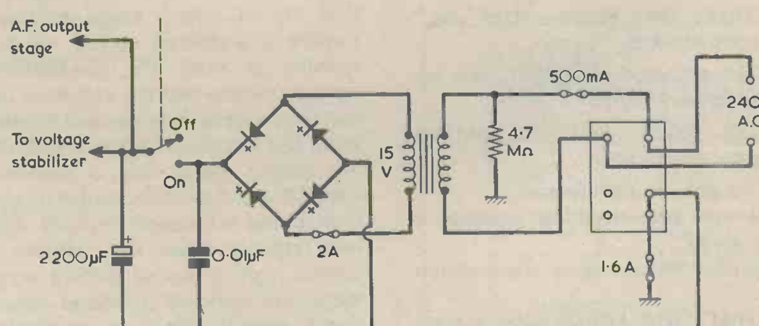


Fig. 2. Power supply circuit conditions for mains operation

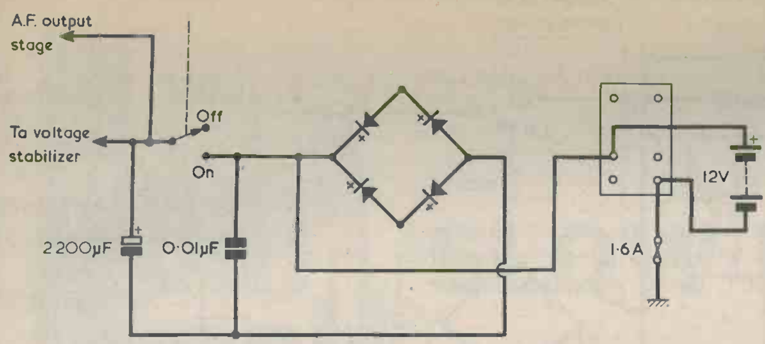


Fig. 3. When battery operation is selected, the 12 volt battery connects direct to the voltage stabilizing section. The negative sides of the reservolr capacitor (together with the 0.01 µ F capacitor) and the bridge rectifier do not now have any significant connection into the receiver circuit

point or the negative side of the 2,200µF electrolytic. You don't need the reservoir capacitor when the power is obtained from a low impedance source such as a car battery, and there's no point in having the bridge rectifier fully in circuit. What happens now is that the negative battery input goes to chassis through the same fuse which was in the rectifier output circuit, whilst the positive battery input goes to the same on-off switch section as did the positive output of the bridge rectifier."

"And from there it goes to the voltage stabilizer?"

"It goes to the voltage stabilizer."

"Just a minute," remarked Dick suddenly. "Didn't you say that all the stages in the receiver work basically from the stabilized voltage rail?"

"I did."

"Well in this circuit, one doesn't." returned Dick triumphantly. "The audio output stage runs from the unstabilized positive supply both with mains and battery operation."

Smithy looked down at the circuit, then turned to his assistant.

"That's very observant of you," he commended.

Dick polished his finger nails on an imaginary lapel.

"I'm pretty good at spotting things, you know."

"As you so rightly say . . ."

"I can see anything unusual a mile away."

'Well, this supply connection to . . ."

"That's why I'm so good at servicing. I've got this talent for . . ."

"Will you flaming well belt up?" roared Smithy. 'Darn it all, I've only got to give you a bit of praise and you spend the rest of the day playing it up. Come to think of it, why on earth *am* I giving you all this gen when I'm supposed to be working?"

"Well, you aren't doing any work while you're waiting for something to happen with this 'slow picture' TV."

Smithy looked down at the television receiver, which continued to reproduce an excellent picture. He reached over to its volume control and turned its knob anticlockwise whereupon, with a click, the receiver became switched off. The sound ceased and the picture collapsed.

"I'll turn it on again after a while," he remarked. "Perhaps the fault will come on if the set is switched on and off a few times in a short period."

"Why," asked Dick, "does the a.f. output stage take its supply from the unstabilized positive voltage?"

Smithy sighed. When Dick was in search of information any hopes of peace were impossible until his curiousity was fully satisfied.

"There are two reasons for this," replied Smithy. "A minor reason is that the a.f. output stage does not require a stabilized supply so that running it from the unstabilized voltage means that the stabilizer circuit has a little less current to deal with. But the main reason is that the a.f. output stage has a standard Class B configuration which draws high peaks of supply current with loud signals when the volume is turned high. If the a.f. output stage were run from the stabilized supply these current peaks could slightly modulate the stabilized supply voltage, giving picture judder and things like that. One answer to this problem would be to have an extremely efficient and fast-acting stabilizer circuit, but a much easier solution is to simply run the a.f. output stage from the non-stabilized supply."

"But wouldn't the a.f. output current peaks tend to modulate the unstabilized voltage?"

"Oh yes," agreed Smithy. "But the stabilizer circuit deals more efficiently with sudden voltage changes at its input than it does with sudden current changes at its output. To some extent, the stabilizer pass transistor acts also as a decoupling resistor."

STABILIZER SECTION

"Pass transistor," repeated Dick. "What do you mean by pass transistor?"

"A voltage stabilizer circuit incorporating one or more transistors normally has one transistor which passes all the supply current," explained Smithy. "That's the pass transistor. If you look at the stabilizer section of this power supply, you'll see that there is a p.n.p. transistor which functions as the pass transistor." (Fig. 4.)

Dick looked at the part of the circuit at which Smithy was pointing, and groaned.

"Blow me," he complained, 'the transistors here are those fiendish '2SB' and '2SC' types."

"They're no problem," retorted Smithy, reaching up to the shelf over his bench for a book. "What do you think we've got ***Tower's*** in here for?"

Smithy handed the Workshop copy of ***Tower's International Transistor Selector*** to his assistant, who proceeded to turn the pages quickly.

"Here we are," he said, running his finger down the columns in the ***Selector.*** "Now, the 2SB337 is a germanium p.n.p. power transistor in a TO3 case, and it's got a maximum collector current rating of 7 amps. Let's have a look next for the 2SC281."

He turned a few more pages.

"And the 2SC281," he went on, "is an n.p.n. silicon transistor in a TO1 case. This is quite a small job, with a maximum collector current of 100mA. Well, that's got the transistors sorted out. Let's now have a look at that stabilizing circuit."

He concentrated on the circuit and then started to frown in puzzlement.

"What's up?" asked Smithy.

"There's something queer here," stated Dick. "For a start, the base of the small n.p.n. transistor goes to a potential divider across the stabilized supply. Right?"

"Right."

"Which means that if, for any reason, the stabilized supply rail goes negative, so also does the base of the transistor. This in turn will mean that it passes less collector current, with the result that less base current is available for the base of the p.n.p. pass transistor. But that's crazy!"

"Why?"

"Because that pass transistor is supposed to pass ***more*** current when the stabilized voltage goes negative, to bring the voltage back to its proper level. With this arrangement the stabilized voltage is actually ***encouraged*** to go negative!"

"You haven't got the full picture," remonstrated Smithy. "You're forgetting the 7 volt zener diode between the stabilized supply rail and the emitter of the n.p.n. transistor. Now, there's a good fat current flowing through that zener diode and the 82Ω resistor going down to chassis below it. Judging from the resistor value and the voltages concerned, the current in the 82 Ω resistor will be around 50mA, part of which will flow through the zener diode and part of which will flow through the n.p.n. transistor. For the sake of argument, let's say that the pre-set pot is adjusted so that half the stabilized voltage appears at the base of the p.n.p. transistor. Let's also say that, for some reason, the stabilized voltage goes negative by a small voltage. Half that negative excursion will be applied to the base of the n.p.n. transistor, whilst the ***whole*** of the excursion will be applied to its emitter because of the zener diode. Since its emitter is going more negative than its base, the n.p.n. transistor collector current will increase, and not decrease, thereby increasing the base current of the pass transistor. The pass transistor will then bring up the stabilized voltage to its correct level."

"Gosh," breathed Dick, "I can see it all now. The base of the n.p.n. transistor goes negative, but the emitter goes even more negative. You'll get a similar stabilizing effect in the opposite direction if the stabilized voltage attempted to go positive, won't you?"

"You will," confirmed Smithy. "The emitter of the n.p.n. transistor would be taken more positive than its base and it would pass less collector current. The pre-set pot is adjusted so that the stabilized voltage is just at the right level. Incidentally, you should never adjust the pre-set potentiometer in any TV stabilized supply without following the instructions in its service manual ***exactly***. With some sets, too high a stabilized supply voltage can result in disproportionately increased voltages in the line output stage, and these could increase the possibility of component breakdown in the long term."

He consulted the service manual.

"I see that, with this set," he continued, "the pot should be set up for 11.5 volts at the collector of the pass transistor. This 11.5 volts goes direct to the line and frame timebases, and via a 5.6 Ω decoupling resistor to all the remaining receiver stages."

"Except the a.f. output stage."

"Except," repeated a mildly exasperated Smithy, "the a.f. output stage."

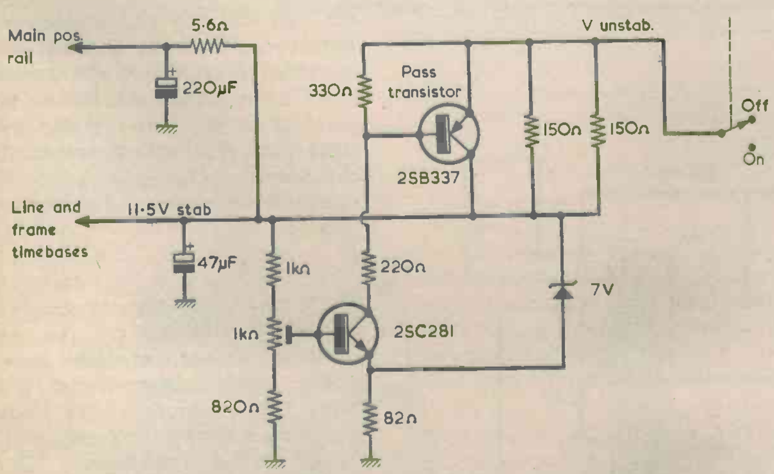


Fig. 4. The voltage stabilizing section of the power supply. The 1kΩ pre-set potentiometer is adjusted for a voltage of 11.5 volts at the collector of the pass transistor under operating conditions specified in the receiver service manual

MYSTERY UNCOVERED

He reached out and turned the volume control knob on the television receiver in order to switch it on. Once more the sound channel was heard from the speaker. After a period the irritatingly faultless picture appeared on the screen. Smithy watched it abstractedly and then glanced down at the service manual circuit. Suddenly his eyes narrowed as he surveyed the power supply section more closely.

"Eureka!"

"Hey?"

"Eureka!"

"Blimey," complained Dick, "what's got into you? And why on earth are you raving on about resistance wire?"

"I've just realised what this 'slow picture' business is all about," replied Smithy. "Seeing that you've wished yourself onto me for the moment you might as well make yourself useful. Get the back off that set, dig out the power supply section and locate the 100Ω resistor which connects between the bridge rectifier and the second part of the receiver on-off switch. This is the one."

Smithy pointed to the resistor in question. (Fig.5.)

Puzzled, Dick unplugged the receiver from the mains, removed the aerial and took off the cabinet back. After some minutes' work he was able to locate the 100Ω resistor.

"Right," said Smithy briskly, "put the set switch to the 'on' position, so as to break any external circuit to that resistor. Then measure its value."

Dick took up Smithy's testmeter and proceeded to carry out his instructions. The needle of the testmeter, switched to an ohms range, was hardly deflected from its left-hand end stop as Dick applied the test prods to the resistor.

"Stap me, Smithy," he said admiringly. "That was an inspired guess. This resistor's completely open-circuit."

"Good," grinned Smithy. "I was lucky; it could have been a bad contact in the on-off switch or a wire come adrift or something fiddling like that. Anyway, put in a new 100Ω resistor and then we'll see how this set performs."

After a trip to the spares cupboard Dick soon had a new 100Ω resistor soldered into circuit. He returned the power supply section to its correct place on the receiver chassis, put the receiver switch to the "off" position and looked expectantly at the Serviceman.

"Plug that set back into the mains again," said Smithy, "pop in an aerial and switch it on."

Obediently, Dick did as he was told. Once again, there was an immediate appearance of the sound at switching on with, after a delay, the production of a picture. Smithy beamed at the set cheerfully.

"I don't see what you're looking so pleased about," commented Dick. "The set's working just the same as it did before."

But Smithy's obvious mood of euphoria could not be shaken. He gazed happily at the picture on the TV screen for another minute or so then leaned over and turned the set off at the volume control switch.

"What the heck," asked Dick, "happens now?"

"Nothing," replied Smithy airily. "We just sit and wait for a few minutes."

Smithy looked at his watch and, despite Dick's growing impatience, sat impassively on his stool. Much to Dick's irritation, he refused to answer any further queries but merely kept glancing at his watch.

"Now," he remarked suddenly, "that set has been turned off for all of five minutes. Let's find out what it does when I switch it on again."

He once more operated the volume control switch and, yet again, the local sound channel was heard from the speaker.

But, this time, it was accompanied by the virtually immediate appearance of the picture on the screen.

"I'm beginning," said Dick thoughtfully, "to see what you're driving at now."

"We've cured the 'slow picture' fault," chortled Smithy. "This set is wired up so that, when it operates from the mains, the picture appears almost immediately at switch-on. When the set is turned on by means of its own on-off switch the picture tube heater is powered by the stabilized 11.5 volt supply. Putting the receiver switch to the 'off' position connects the tube heater via that 100Ω resistor you changed to the bridge rectifier, whereupon the heater continues to run at reduced power, ready to give a picture again when the set is next switched on. Now, the set-owner had got used to the picture coming on straightaway at switch-on so that when, after that 100Ω resistor had gone open-circuit, the picture took some time to appear he considered that he had a 'slow picture'. A very good customer diagnosis, that!"

"Come off it, Smithy," snorted Dick, "it had you baffled all along."

"Well, it did for a bit," confessed Smithy. "Anyway, to round things off, let's just see what power does actually get to the tube heater in the switched off condition. The only rectifier in the bridge which can then conduct is the one in the lower right-hand arm, with the result that the heater is being supplied with rectified alternate half-cycles." (Fig.6.)

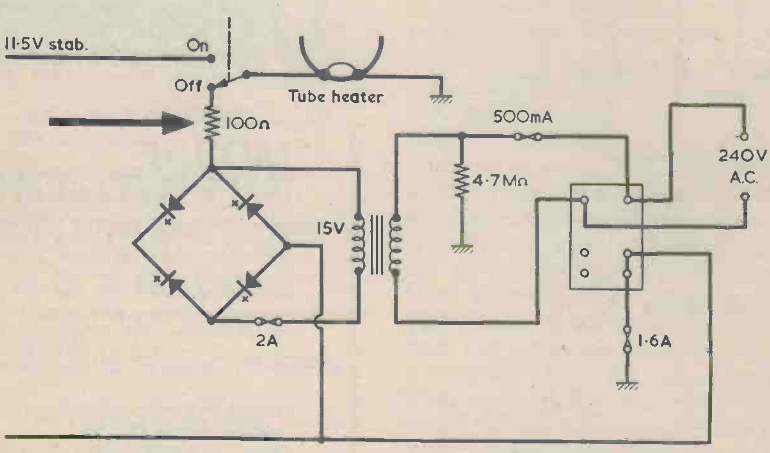


Fig. 5. Tube heater switching circuit. The arrow points at the 100Ω resistor which Smithy asked Dick to check

CLOSING LINES

"This has certainly been an unusual fault," commented Dick. "Hey, just a minute; I think I could make up a little rhyme about it!"

"Oh no," groaned Smithy. "Don't say you're back at your old game of dreaming up limericks."

But Dick was not to be forestalled, and he held up a finger for silence.

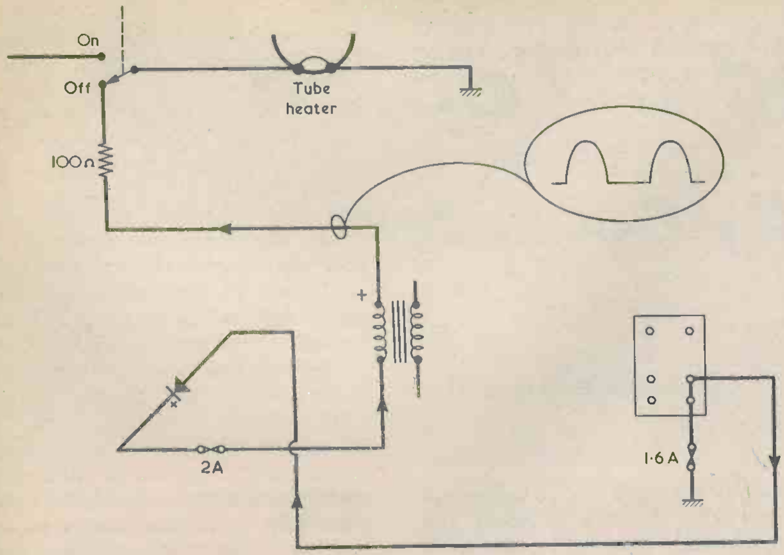


Fig. 6. When the receiver is switched off, alternate half-cycles from the transformer secondary pass through the tube heater, following the circuit path shown here. The current (assumed to flow from positive to negative) appears when the upper end of the secondary is positive

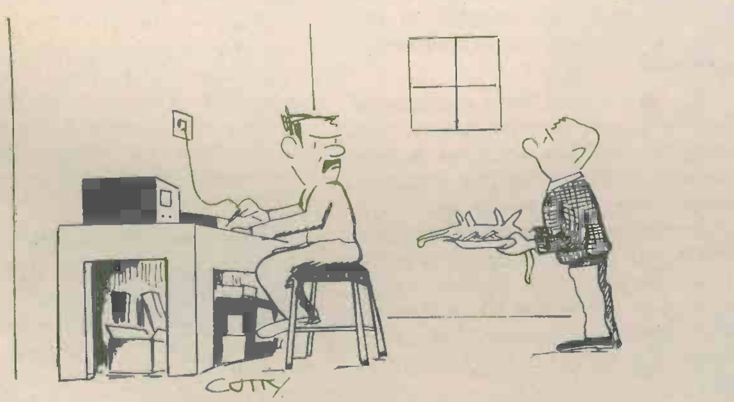
"A slow picture is no real disaster,

And it's easy to make it come faster.

Don't change a transistor

But just a resistor,

And you'll get an immediate raster!"



"No, No, I said get me some crocodile clips — not crocodile and chips"

Radio Topics

By Recorder

****

Resistance in ohms is equal to voltage divided by current in amps. So runs the Law of the good Georg Simon Ohm, who lived over the years 1787 to 1854. One hundred and twenty-five years later we can still put Ohm's Law to good use in the constructional design work that we carry out.

To start off with, let's indulge in a little algebraic re-shuffling so that we can express the Law in its other two forms: voltage is current multiplied by resistance and, perhaps the most useful form of all, current is voltage divided by resistance.

EASIER UNITS

Since we don't frequently bump into amps in much of the electronics we deal with, it is usually easier for us to think of Ohm's Law in terms of milliamps, whereupon we can say that current, in milliamps, is equal to voltage divided by resistance in kilohms. If we find that 1 volt is dropped across a 1k·Ω resistor, then the current flowing through that resistor is 1mA. Should there be 2 volts across the 1kΩ resistor, then the current is 2mA. Similarly, 1 volt across a 200 Ω resistor denotes a current of 5mA in the resistor, and so on.

When we want to find the current flowing in a resistor it is normally much simpler to check the voltage across it than it is to measure the actual current itself. This is because we can easily obtain a voltage reading by applying our testmeter prods across the resistor. To measure current we would in most instances have to break the circuit in which the current flows and insert the current-reading meter in series. Determining current by measuring voltage is particularly of advantage in checking circuits such as transistor amplifier stages. These often have series emitter or collector resistors whose values are of the order of 500;Ω to 20kΩ. The mathematics involved in determing the current in these resistors from the voltages dropped across them is, in consequence, not too difficult at all.

OUTPUT POWER

Power, in watts, is equal to voltage multiplied by current in amps. Since, from Ohm's Law, current is voltage divided by resistance we can reach the conclusion that the power dissipated in a resistor is equal to voltage squared divided by the resistance. One useful application for this equation is in determining, roughly, the maximum r.m.s. output power which can be obtained from an audio amplifier in the mid-fi category. Nearly all a.f. amplifiers these days have an output voltage which, under no-signal conditions, sits at approximately half the supply voltage. When handling a signal the output voltage can then swing very nearly to the positive rail on positive audio half-cycle peaks and very nearly to the negative rail on the negative half-cycle peaks. The output of the amplifier normally couples to the speaker via a high value electrolytic capacitor.

To take a nice easy example of how to assess amplifier power, let's imagine that the amplifier supply voltage is 20 volts. The amplifier output can then swing up to 10 volts positive and negative and, as a result, has a peak value of 10 volts. This corresponds to an r.m.s. voltage of 0.7 times 10, or 7 volts. And when we square that r.m.s. value of 7 volts we get a figure of 49.

If we couple the amplifier to a speaker having an impedance of 50Ω (which we will treat as a resistance of that value) then the maximum r.m.s. audio power we will get from the amplifier and speaker combination is 49 divided by 50 (voltage squared divided by resistance). This is just under 1 watt. With a 15Ω speaker the audio power is 49 divided by 15, or, near as dammit, 3.3 watts. An 8Ω speaker will give 49 divided by 8, which is 6.1 watts. And a 5Ω speaker produces a maximum r.m.s. output power of 49 divided by 5, or nearly 10 watts.

All these figures are very approximate because, in practice, the amplifier output swing won't be right up to the supply rails and the impedance offered by the speaker is pretty nominal anyway. But they give us a good guideline as to what can be expected from a particular amplifier and speaker. To be practical, it would be prudent to assume that the actual maximum r.m.s. output power is, say, some 70% to 80% of the calculated figure.

With a given amplifier, as speaker impedance goes down output power goes up. So also, unfortunately, does the amplifier output current. There will be a limit to the output current which the amplifier can produce, this being expressed normally in terms of the minimum speaker impedance which may be connected to its output. Connecting a speaker of lower impedance could then cause damage to the amplifier if it does not have automatic overload protection.

COMPONENT ANALYSER

For many years H. W. Sullivan Limited have been well known in the precision measurement field as manufacturers of bridges, potentiometers, detectors and measurement standards. The company now announces a completely new automatic instrument, the AC5555 Automatic Component Analyser, designed and manufactured at their premises at Archcliffe Road, Dover, Kent, CT17 9EN. This instrument is suitable for production and goods inwards inspection as well as for laboratory applications. What is more, it has some almost spectacular capabilities, as the following description shows.

The Sullivan AC5555 accepts a wide range of components, whether they be resistors, capacitors or inductors. It automatically selects the range ***and function,*** and displays the value and unit on two digital displays. When the instrument is switched on, it is in the fully automatic mode and no setting-up procedure is required. This is the normal mode of operation and to test a component it is only necessary to connect it to the instrument, whereupon the value is displayed irrespective of the component type. The method of operation is thus so simple that it is virtually impossible to make mistakes. The auto-function facility makes the instrument particularly useful for the identification of unknown components in laboratory or production areas.

With some applications, such as the testing of a batch of components which have nominally the same value, the operator can if required lock the instrument into a particular range. This manual mode of operation gives a shorter display response time than is given with the automatic mode.

The mains operated fourteen-range AC5555 measures the parallel capacitance and conductance or the series inductance and resistance of the test component at a frequency of 1kHz. The maximum reading on each display is 19999, and the instrument measures capacitance up to 200μF with an ultimate resolution of 0.01pF, while inductance may be measured up to 200 henrys with a resolution of 10 nanohenrys. Resistors can be measured either as resistance up to 2M Ω or as conductance. With the resistance and conductance ranges, resistance values of 100 millionths of an ohms to 10,000M Ω may be discriminated.

Five terminals are provided on the front panel for connection to the component under test. With such a sophisticated piece of measurement equipment, a simple robust connection system is essential. H. W. Sullivan have designed a special Test Jig, the AC5556, and a lead set, both available as optional extras for use with the AC5555. The Test Jig is extremely easy to use and accepts discrete components with axial or radial leads and having a body length up to 95mm. For other applications, such as the testing of transformers or printed circuit boards, the screened test lead is used.

The AC5555 is suitable for rack mounting and has dimensions of 430 by 195 by 275mm, and you can obtain an idea of its appearance from the accompanying photograph.

BREAKDOWN TESTER

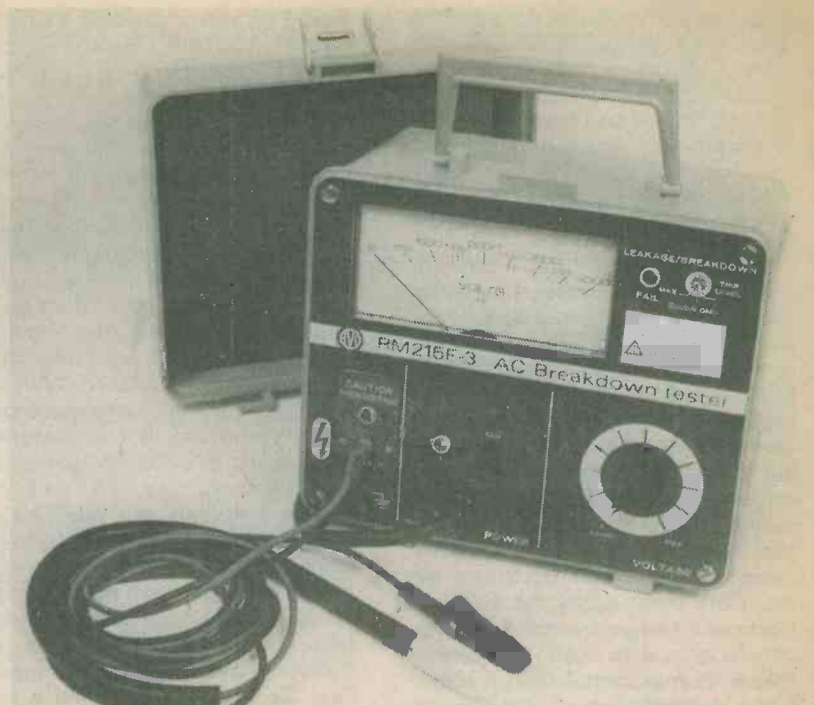
The second photograph illustrates another comprehensive item of test equipment, this originating from Avo Limited, also of Archcliffe Road, Dover, Kent. This new instrument is a Leakage and Breakdown Tester and has the type number RM215-F/3. It performs a particularly important role in factory applications, especially now that the Health and Safety at Work Act lays down rigid requirements for the safety of electrical installations.

The RM215-F/3 is portable and compact, and can be used for general flash testing work as well as the measurement of breakdown voltage. It will also detect leakage current in the testing of electrical components and systems.

The instrument operates from a standard supply voltage of 120 or 240 volts at 50Hz and will provide a continuously variable a.c. test voltage between the limits of 50 volts and 4 kilovolts. It is sensitive to current passed by a component under test and can be adjusted to operate in either leakage or breakdown operational mode.

A failure interlock ensures that when a component fails under test the test voltage is automatically switched off. The design of the instrument ensures that the output current is limited to a safe value, even with the test leads short-circuited together. The tester has a low internal resistance, a very important requirement when testing

Apply any component to the H. W. Sullivan AC5555 Analyser and it will automatically determine whether it is a resistor, a capacitor or an inductor, and then display its value! It is shown here in use with the AC5556 Test Jig



New Leakage and Breakdown Tester, introduced by Avo Limited. This provides an alternating test voltage which is continuously variable from 50 volts to 4 kilovolts

components possessing high capacitance.

The instrument is housed in a durable plastic case with a detachable lid containing a compartment into which the test leads and the power supply cable can be stored when these are not in use. It is available through Avo distributors in the U.K. and in other countries throughout the world.

RADIO CONTROL

Radio controlled model aircraft buffs have much to occupy themselves at present with the extremely sophisticated transmitting and receiving equipment which is currently available to them. I am sure that their mouths will water, nevertheless, at the thought of the remote-piloted helicopter employing the "Supervisor" system which has been successfully developed by Marconi Avionics in association with Westland Helicopters.

The purpose of the Supervisor system is to enable a remote-piloted helicopter to be controlled from the ground so that a battlefield commander can keep the forward edge of a battlefield under constant surveillance.

The "Wideye" helicopter employed in the Supervisor system is manufactured by Westland Helicopters Limited of Yeovil, whilst its very advanced electronic control payload, as well as the ground control vehicle, is provided by Marconi Avionics Electro-Optical Surveillance Division at Basildon. The helicopter, with its twin coaxial rotors, stands about as high as an average man, and its payload comprises a small stabilized camera sensor and 2-way radio link to convey command data from the ground to the helicopter and video data from the aircraft to the ground vehicle. The latter is fitted with tracking antennas, data processors, video monitors and a control console.

This is yet another achievement for Marconi Avionics Limited, a company which is very energetic in the field of airborne electronic equipment.

A BOOK FOR THE RADIO AMATEUR

TELEVISION INTERFERENCE MANUAL, 2nd Edition. By B. Priestley, B.Sc., C.Eng., M.I.E.R.E. 80 pages, 210 x 145mm. ($8\frac{1}{4}$ x $5\frac{1}{2}$in.) Published by the Radio Society of Great Britain. Price £1.35.

This book is primarily intended for the amateur radio transmitter who seeks to avoid neighbourly friction and annoyance by ensuring that his signals do not break through on nearby television receivers. In crowded localities the problems of TVI can be difficult to solve, especially as the breakthrough may be due to shortcomings in design or operation of the television receiver itself.

"Television Interference Manual" covers the whole field of TVI, and the information and advice it gives can be assumed to be virtually the entirety available at the time of its publication. Also dealt with are break-through problems with audio equipment. Audio break-through has become much more difficult to solve owing to the current widespread use of expensive solid-state audio systems which are more prone to interference than earlier cross-modulation-free valve equipments.

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WORLD RADIO TV HANDBOOK 1979 £9.15

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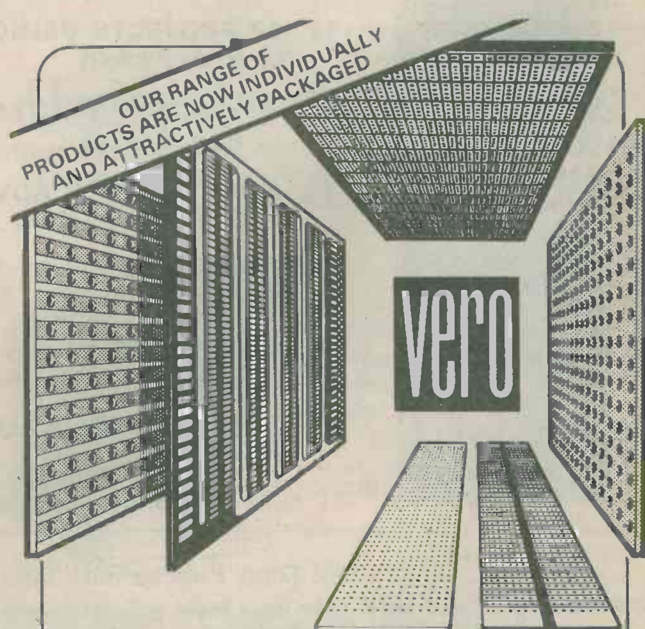

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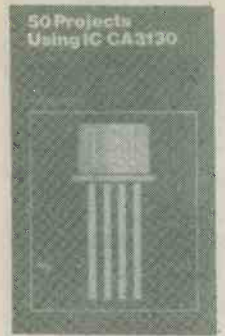

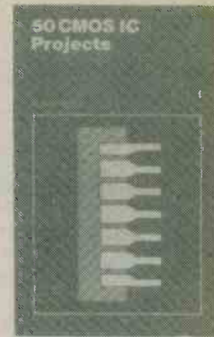

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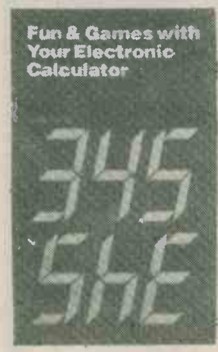

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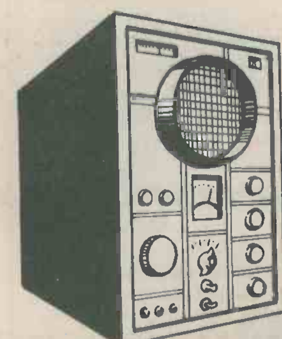

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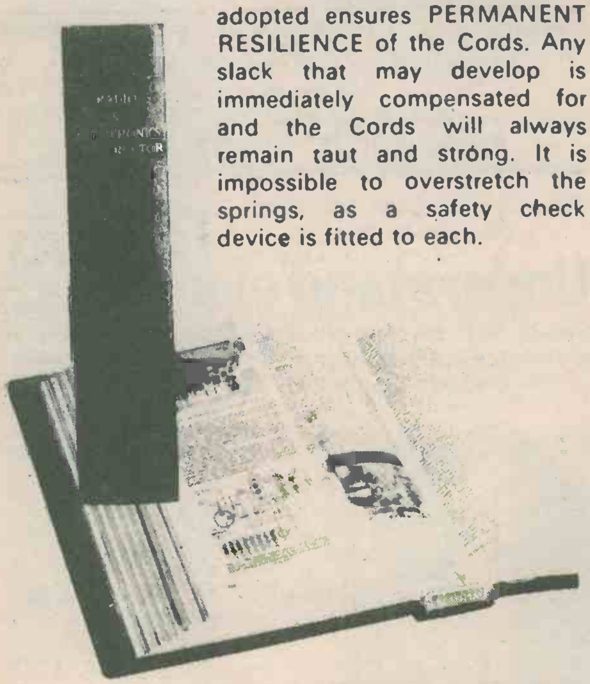

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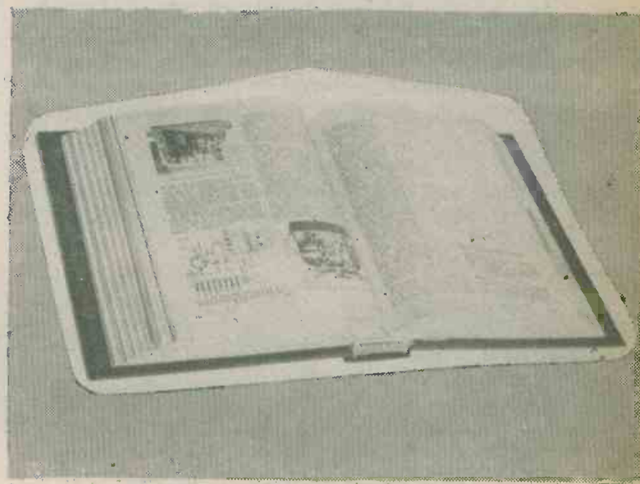

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