THE

RADIO CONSTRUCTOR

Vol. 24 No. 8 MARCH 1971 17½p (3/6)

MODIFYING THE 'TRIO' 9R-59DE Rx
(PART ONE)

DIRECT CONVERSION RECEIVERS
TIMER WITHOUT ELECTROLYTICS

Special IN THIS ISSUE

Eight Constructional Projects
Many other features

Type	£/Np
AC107	37
AC126	25
AC127	25
AC128	20
AC176	25
AC187	30
AC188	30
ACY17	29
ACY18	20
ACY19	20
ACY20	19
ACY21	19
ACY22	19
ACY40	15
ACY41	15
AD140	55
AD149	57
AD161	37
AD162	37
AF114	25
AF115	25
AF116	25
AF117	25
AF118	44
AF124	25
AF126	17
AF139	37
AF186	40
AF239	37
ASY26	25
ASY27	30
ASY28	22
ASY29	30
ASZ21	37
AUY10	1.50
BA115	8
BC107	12
BC108	12
BC109	12
BC147	15
BC148	15
BC149	15
BC158	17
BC169C	12
BC182	12
BC182L	10
BC183	9
BC183L	9
BC184	15
BC184L	15
BC186	40
BC212	17
BC212L	12
BCY30	25
BCY31	48
BCY32	50
BCY33	20
BCY34	25
BCY38	30
BCY70	19
BCY71	37
BCY72	16
BD121	1.10
BD123	1.10
BD124	1.03
BDY20	1.05
BF115	25
BF163	40
BF167	25
BF173	30
BF178	52
BF180	37
BF181	37
BF184	25
BF185	25
BF194	17
BF195	15
BF196	15
BF200	35
BFX13	25
BFX29	31
BFX84	26
BFX85	34
BFX86	25
BFX87	30
BFX88	25
BFY50	23
BFX51	19
BFY52	20
BFY53	16
BFY90	67
BSX19	16
BSX20	16
BSX21	37
BSY27	20

Type	£/Np
BSY29	25
BSY95A	15
BY100	20
BYX10	15
BYZ10	40
BYZ12	30
BYZ13	20
BZY88 Series 3.3V to 30V	15
D13T1	45
MJE520	75
MJ480	97
MJ481	1.25
MJ490	1.00
MJ491	1.35
MPF102	43
MPF103	37
MPF104	37
MPF105	40
NKT124	30
NKT125	40
NKT126	37
NKT128	25
NKT135	26
NKT137	32
NKT210	25
NKT211	25
NKT212	25
NKT213	25
NKT214	23
NKT215	21
NKT216	46
NKT217	50
NKT218	25
NKT219	25
NKT223	27
NKT224	25
NKT225	21
NKT229	29
NKT237	31
NKT238	19
NKT239	23
NKT240	20
NKT241	21
NKT242	15
NKT243	56
NKT244	17
NKT245	17
NKT261	21
NKT262	19
NKT264	21
NKT271	18
NKT272	17
NKT274	18
NKT275	23
NKT279A	12
NKT281	29
NKT302	87
NKT304	79
NKT351	75
NKT401	71
NKT402	77
NKT403	65
NKT404	60
NKT405	79
NKT406	62
NKT420	1.83
NKT451	58
NKT452	54
NKT453	50
NKT603F	30
NKT613F	30
NKT674F	30
NKT676F	30
NKT677F	28
NKT713	29
NKT717	44
NKT734	26
NKT736	32
NKT773	25
NKT781	29
NKT10339	25
NKT10419	19
NKT10439	27
NKT10519	22
NKT20329/0013	31
NKT80111	67
NKT80112	83
NKT80113	1.00
NKT80211	75
NKT80212	75
NKT80213	75

Type	£/Np
NKT80214	75
NKT80215	75
NKT80216	75
OA5	20
OA10	25
OA47	8
OA70	8
OA73	8
OA79	8
OA81	8
OA85	8
OA90	8
OA91	8
OA95	8
OA200	10
OA202	10
OC19	37
OC20	97
OC22	47
OC23	60
OC24	60
OC25	37
OC26	33
OC28	60
OC29	75
OC35	50
OC36	63
OC41	25
OC42	30
OC44	15
OC45	15
OC71	15
OC72	23
OC75	23
OC76	25
OC77	40
OC81	23
OC81D	20
OC81Z	55
OC82	25
OC82D	15
OC83	23
OC84	25
OC139	25
OC140	35
OC170	25
OC171	30
OC200	37
OC201	47
OC202	63
OC203	37
OC204	40
OC205	65
OC206	75
OC207	75
OCP71/M	47
ORP12	50
ORP60	60
ORP61	40
P346A	19
ST140	15
ST141	20
TD716	60
TIP31A	62
TIP32A	74
V405A	46
ZTX108	11
ZTX300	13
ZTX302	18
ZTX303	18
ZTX304	27
ZTX314	11
ZTX320	30
ZTX330	18
ZTX500	16
ZTX501	16
ZTX502	20
ZTX503	17
ZTX504	40
1N34A	20
1N60	20
1N64	20
IN82A	47
1N87A	23
1N914	7
1N4001	7
1N4002	7
1N4003	10
1N4004	10
1N4005	12
1N4006	15
1N4007	20
1N4148	7

Type	£/Np
2G302	19
2G371	15
2G374	25
2N174	80
2N385A/2N388A	75
2N404	23
2N696	15
2N697	17
2N698	30
2N706	10
2N706A	12
2N708	16
2N711	37
2N711A	37
2N911	50
2N914	20
2N918	42
2N1090	30
2N1091	33
2N1131	30
2N1132	30
2N1302	20
2N1303	20
2N1304	25
2N1305	25
2N1306	30
2N1307	30
2N1308	34
2N1309	31
2N1507	23
2N1613	22
2N1711	25
2N2147	82
2N2148	63
2N2160	62
2N2368	17
2N2369	17
2N2369A	20
2N2646	50
2N2904	44
2N2904A	49
2N2905	65
2N2905A	75
2N2906	44
2N2906A	54
2N2926, all colours	10
2N3053	25
2N3054	63
2N3055	75
2N3702	11
2N3703	10
2N3704	11
2N3705	10
2N3706	9
2N3707	11
2N3708	7
2N3709	9
2N3710	9
2N3711	9
2N3819	35
2N3820	60
2N3826	30
2N4058	17
2N4060	20
2N4061	20
2N4062	20
2N4284	15
2N4287	15
2N4289	15
2N4871	40
3N84	1.30
3N128	69
3N140	76
3N141	73
3N152	86
40250	55
40309	33
40310	45
40312	48
40320	36
40360	43
40361	48
40362	58
40406	56
40407	39
40408	51
40409	54
40468A	35
40600	58
40601	55
40602	40
40603	49

TERMS: Cash with order please. Postage & packing – 10Np Inland, 25Np Europe, 60Np elsewhere. All goods guaranteed. ALL ORDERS DESPATCHED WITHIN ONE WORKING DAY OF RECEIPT. 1971 Retail Catalogue now available: 5Np stamp for postage appreciated.

Components

RESISTORS
Carbon Film ¼ & ½ Watt 5%. 2 Np each
Packs of 10 (of one value/wattage) 15 Np per pack.

PRESETS
P.C. Type 0.3 Watt
Standard size 7 Np
Sub-miniature 5 Np
(Available vertical or horizontal mounting). Usual values 100 ohms to 5 Meg.

POTENTIOMETERS
Log or Lin Less switch – 17 Np
Log or Lin DP switch – 27 Np
Log or Lin Stereo L/S – 50 Np
Values: 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1 Meg, 2 Meg.

CAPACITORS
Mullard Miniature Electrolytic – C426 Series

Mfd.	Volt.Wkg.	
2.5	16	8 Np
10	16	6 Np
20	16	6 Np
40	16	6 Np
80	16	6 Np
1.6	25	8 Np
6.4	25	6 Np
12.5	25	6 Np
25	25	6 Np
50	25	6 Np
80	25	6 Np
1	40	8 Np
4	40	6 Np
8	40	6 Np
16	40	6 Np
32	40	6 Np
50	40	6 Np

Mullard Metallised Polyester 250v

Mfd		Mfd	
.01	3 Np	.22	5 Np
.015	3 Np	.33	7 Np
.022	3 Np	.47	8 Np
.033	3 Np	.68	11 Np
.047	4 Np	1.0	14 Np
.068	4 Np	1.5	20 Np
.1	4 Np	2.2	24 Np
.15	5 Np		

Mullard Electrolytic – C437 Series

Mfd	Volt Wkg.	
250	16	9 Np
400	16	12 Np
640	16	15 Np
1000	16	18 Np
160	25	9 Np
250	25	12 Np
400	25	15 Np
640	25	18 Np
100	40	9 Np
160	40	12 Np
250	40	15 Np
400	40	18 Np

Mullard Sub-Miniature Ceramic Plate – C333 Series
63 volt working. Range 1.8pf to 220pf (usual pref. values)
Packs of 6 (any values) – 30 Np

NEONS
Miniature neon bulbs: 0.6mA 65vac 90vdc. Pack of 5 for 30 Np
Panel neon indicators, mains voltage. Red lenses – round, square or arrow-shaped faces Each 20 Np

VEROBOARD

2.5" × 17" × .15"	57 Np
2.5" × 5" × .15"	23 Np
2.5" × 3.75" × .15"	19 Np
3.75" × 17" × .15"	79 Np
3.75" × 5" × .15"	30 Np
3.75" × 3.75" × .15"	22 Np
2.5" × 5" × .1"	25 Np
2.5" × 3.75" × .1"	23 Np
Spot face cutters –	38 Np
Veropins: pack of 50 for	21 Np

Bargain Pack. 36 square inches of various sizes. .15" &/or .1" 50Np

HEATSINKS
T0-5 (Clip-on) pack of 4 for 15 Np
FINNED type for 2 × TO-3 ready drilled at 43 Np
FINNED type undrilled for plastic power at 34 Np

BOOKS

G.E. Transistor Manual	£1.47
R.C.A. Transistor Manual	£1.40
Designers' Guide to British Transistors (data book)	£1.25
R.C.A. Hobby Circuits Manual	£1.40
110 Semiconductor Projects (Marston)	£1.25
Zener Diode Handbook	84 Np
Photocell & Solarcell Handbook	84 Np
Thyristor (S.C.R.) Handbook	£1.00

NEW ! SN74N SERIES TTL LOGIC

NOW FROM L.S.T. – FULL SPECIFICATION TEXAS INDUSTRIAL INTEGRATED CIRCUITS AT ECONOMY PRICES

		1–49	50–99	100+
SN7400N SN7401N SN7402N	Quad 2-input NAND gate Quad 2-input NAND gate open collector Quad 2-input NOR gate	32	27	22
SN7403N	Quad 2-input NOR gate open collector	35	30	25
SN7404N SN7410N	Hex Inverter Triple 3-input NAND gate	32	27	22
SN7413N	Schmidt Trigger	45	40	35
SN7420N SN7430N SN7440N	Dual 4-input NAND gate 8-input NAND gate Dual 4-input NAND Buffer	32	27	22
SN7442N	BCD to decimal decoder TTL output	£1.12	£1.00	88
SN7450N SN7453N SN7460N	Expandable Dual 2-wide 2-input AND–OR–INVERT gate Expandable 4-wide 2-input AND–OR–INVERT gate Dual 4-input expander	32	27	22
SN7470N SN7472N	J-K Flip-flop J-K Master-Slave Flip-flop	45	40	35
SN7473N SN7474N	Dual J–K Master-Slave Flip-flop Dual D-type Edge-Triggered Flip-flop	50	45	43
SN7475N	Quadruple Bistable Latch	65	60	55
SN7476N	Dual J–K Master-Slave Flip-flop with Preset & Clear	55	50	47
SN7483N	Four-bit Binary Full-Adder	£1.30	£1.20	£1.10
SN7490N SN7492N SN7493N	Decade Counter Divide-by-12 Counter Four-bit Binary Counter	£1.12	£1.00	87
SN74141N	BCD to decimal Decoder/Driver (Replaces the obsolete SN7441AN)	£1.45	£1.30	£1.15

MIX PRICES: Devices may be mixed to qualify for quantity price
Larger quantities – prices on application.

LINEAR AND DIGITAL I/C's

R.C.A.

CA3004	£1.80
CA3005	£1.20
CA3011	75
CA3013	£1.05
CA3014	£1.25
CA3018	85
CA3020	£1.30
CA3028A	75
CA3035	£1.25
CA3043	£1.40
CA3044	£1.20
CA3046	75
CA3047	£1.40
CA3048	£2.05
CA3049	£1.60
CA3052	£1.65

BARGAIN OP-AMPS !!
LM709C – 60 Np (DIL high gain op-amp)
LM741CN 95 Np (equiv. SN72741P)

PC1006/1 Multimeter Sensitiser packaged circuit KIT includes all accessories £7.55

FAIRCHILD

	1–11	12–24	25+
μL900	40 Np	35 Np	32 Np
μL914	40 Np	35 Np	32 Np
μL923	53 Np	50 Np	47 Np

Devices may be mixed to qualify for quantity price.

G.E. (USA)

PA230	Pre-amp	£1.10
PA234	1 Watt Amp	£1.00
PA237	2 Watt Amp	£1.87
PA246	5 Watt Amp	£2.63
PA424	Zero Volt Switch	£2.45

MISCELLANEOUS

TH9013P	Toshiba 20 Watt Hybrid IC Amp	£4.47
IC10	Sinclair	£2.75
SL403A	Plessey New Design	£2.12

MULLARD

TAA263	Linear Amp	75 Np
TAA293	General Purpose Amp	£1.00
TAA310	Record/Playback Amp	£1.50
TAA320	MOS LF Amp	65 Np
TAD100	IC Receiver	£1.97
TAD110	AM/FM Receiver	£1.97

ULTRASONIC TRANSDUCERS

Operate at 40kc/s. Can be used for remote control systems without cables or electronic links. Type 1404 transducers can transmit and receive. **FREE:** With each pair our complete transmitter and receiver circuit. PRICE £5.90 Pair
(Sold only in pairs)

IOR

DD119	Heat sink compound – Silicone grease	30 Np
DD170	Bargain pack of five 1 Watt Zener diodes	97 Np
DD175	4 pieces 100 PRV Rectifiers 500mA	50 Np
DD176	2 pieces 200 PRV Rectifiers 500mA	30 Np
DD177	2 pieces 400 PRV Rectifiers 500mA	50 Np
DD180	Bargain Transistor pack 2 AF + RF	57 Np
DD184	Assortment of RF, audio & power transistor solar cell & diode	£1.67
DD190	Pack of 4 assorted solar cells	50 Np
EP50A	Solar motor (operates from 54M)	£1.97
51M	Silicon Solar cell 10–16mA	95 Np
54M	Silicon Solar cell 25–40mA	£1.67
B2M	Low cost Selenium solar cell	63 Np
B3M	Selenium cell in protective case	75 Np
CS120	Cadmium Sulphide photoconductive cell	98 Np

Only part of the International Rectifier "Diamond Line" range are listed
Send for free catalogue or ask your local component stockist.

TRIACS

2N5756	2.5A (RMS) 400 PIV TO-5 Mod.	95 Np
40486	6 Amp (RMS) 400 PIV TO-5 Mod	£1.20
40430	6 Amp (RMS) 400 PIV TO-66	£1.01
40432	6 Amp (RMS @ 75° Amb.) 400 PIV*	£1.50
40512	2.2 Amp (RMS @ 25° Amb.) 400 PIV*	£1.45

*These types have integral triggering.

40576	15A (RMS) 400 PIV TO-66	£1.70
SC146B	10 Amp 200 PIV Plastic Flat-pack	£1.25
SC146D	10 Amp 400 PIV Plastic Flat-pack	£1.75
ST2	Bi-lateral avalanche trigger diode	47 Np

ZENER DIODES

400mW 10% GLASS CASE TEXAS Mfr.

1S2036	3.6 volt	1S2082	8.2 volt
1S2039	3.9 volt	1S2100	10 volt
1S2043	4.3 volt	1S2110	11 volt
1S2047	4.7 volt	1S2120	12 volt
1S2056	5.6 volt	1S2160	16 volt
1S2062	6.2 volt	1S2180	18 volt
1S2068	6.8 volt	1S2270	27 volt
1S2075	7.5 volt	1S2300	30 volt

Prices: 1-24 **15Np** 25-99 **11Np** 100+ **9Np**

THYRISTORS

CR1/051C	1 Amp 50 PIV TO-5	40 Np
CR1/401C	1 Amp 400 PIV TO-5	50 Np
2N3525	5 Amp 400 PIV TO-66	£1.09
40739	10 Amp 400 PIV Stud Mtg.	£1.65

ENCAPSULATED BRIDGES

Type No	Current	Rms.Volts	
W005	1 Amp	50	50Np
W06	1 Amp	600	65Np

LST ELECTRONIC COMPONENTS **LTD**
MAIL ORDER DEPT. (RC)
7 COPTFOLD ROAD
BRENTWOOD, ESSEX

Visitors welcome at our new retail shop – same address.

REVERBERATION UNIT KIT

A new, all silicon version of our self-contained, 6 transistor, reverberation chamber to which microphones, instruments, tuners or tape recorders may be connected for added dimensional effect. The output is suitable for most amplifiers and the unit is especially suitable for use with electronic organs. A ready-built spring and transducer assembly is used (£2.95 (59/-) if bought separately).

Complete easy-to-build kit, with constructional notes and circuits **£7.50** (£7.10.0) Pre-drilled and printed case **£1.70** (34/-) All parts available separately. Send **5p** (1/-) for circuit and construction details.

WAH-WAH PEDAL KIT

SELECTIVE AMPLIFIER MODULE. The basis of the Wah-Wah pedal. Kit contains all the components to build a 2-transistor circuit module, also the sockets, control, etc., required for the constructor to assemble his own design. **£1.75** (35/-). Assembled and tested module **£2.12** (42/5).

FOOT VOLUME CONTROL PEDAL. Foot pedal unit in very strong fawn plastic. Fitted with output lead and plug for connection to guitar amplifier. May be used for volume control or converted to Wah-Wah by adding the module.
Pedal unit now only **£5.12** (£5.2.5).
Complete kit for Wah-Wah pedal now only **£6.50** (£6.10.0).

I.C. STEREO AMPLIFIER KIT

A new kit from Wilsic to build a hi-fi integrated circuit stereo amplifier 3 watts per channel with full tone controls and attractive veneered cabinet, or may be built into plinth unit. Complete amp kit with stabilised power pack **£21.45** (£21.9.0) with economy power pack **£18.50** (£18.10.0). Cabinet kit: teak **73½p** (14/8) mahogany **66p** (13/2). Full plans and detailed prices **10p** (2/-).

New catalogue **15p** (3/-) with special discount order form.

WILSIC ELECTRONICS LIMITED
6 COPLEY ROAD, DONCASTER, YORKSHIRE

LASKYS EXCLUSIVE DIGITAL CLOCK

- 12 hour alarm
- Mains operation
- Auto sleep switch
- Built-in alarm buzzer
- Shock and vibration proof
- Hours, mins. and secs. read-off
- Silent operation synchronous motor
- Forward and backward time adjustment
- Made especially for Laskys by famous maker

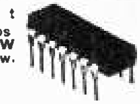
HUNDREDS OF APPLICATIONS

This unique DIGITAL CLOCK is now available EXCLUSIVELY FROM LASKY'S in chassis form for you to mount in any housing that you choose. All settings are achieved by two dual concentric controls at the front, including: ON/OFF & AUTO ALARM, 'sleep' switch, 10-minute division 'click' set alarm (up to 12 hour delay), time adjustment. Ultra simple mechanism and high quality manufacture guarantee reliable operation and long life. The sleep switch will automatically turn off any appliance – radio, TV, light, etc., at any pre-set time up to 60 mins. and in conjunction with the AUTO setting will switch on the appliance again next morning. The clock measures 4¾(W)x1¾(H)x3¾(D) (overall from front of drum to back of switch). SPEC. 210/240V AC, 50Hz operation; switch rating 250V, 3A, complete with instructions.

LASKYS PRICE **£6.95** Post 18p

LASKY'S RADIO LTD (Dept RC)
3-15 Cavell Street London E1 2BN
33 TOTTENHAM COURT ROAD, LONDON W1P 9RB
42–45 TOTTENHAM COURT ROAD, LONDON W1P 9RD
109 FLEET STREET, LONDON EC4
152/3 FLEET STREET, LONDON EC4
207 EDGWARE ROAD, LONDON W.2

BI-PAK=LOW COST IC'S



BI-PAK Semiconductors now offer you the largest and mos popular range of I.C's available at these **EXCLUSIVE LOW PRICES.** TTL Digital 74N Series fully coded, brand new. Dual In-line plastic 14 and 16 pin packages.

BI-PAK Order No.		Description	Price and qty. prices 1–24	25–99	100 up
BP00	7400N	Quad 2-Input NAND GATE	33p	27p	23p
BP01	7401N	Quad 2-Input NAND GATE—OPEN COLLECTOR	33p	27p	23p
BP04	7404N	HEX INVERTER	33p	27p	23p
BP10	7410N	Triple 3-Input NAND GATE ..	33p	27p	23p
BP20	7420N	Dual 4-Input NAND GATE	33p	27p	23p
BP30	7430N	Single 8-Input NAND GATE ..	33p	27p	23p
BP40	7440N	Dual 4-Input BUFFER GATE ..	33p	27p	23p
BP41	7441N	BCD to decimal decoder and N.I.T. Driver	£1·13	£1	87p
BP42	7442N	BCD to decimal decode (TTL O/P)	£1·13	£1	87p
BP50	7450N	Dual 2-Input AND/OR/NOT GATE —expandable	33p	27p	23p
BP53	7453N	Single 8-Input AND/OR/NOT GATE —expandable	33p	27p	23p
BP60	7460N	Dual 4-Input—expandable	33p	27p	23p
BP70	7470N	Single JK Flip-Flop—edge triggered	45p	40p	35p
BP72	7472N	Single Master Slave JK Flip-Flop ..	45p	40p	35p
BP73	7473N	Dual Master Slave JK Flip-Flop ..	50p	45p	43p
BP74	7474N	Dual D Flip-Flop	50p	45p	43p
BP75	7475N	Quad Bistable Latch	55p	50p	47p
BP76	7476N	Dual Master Slave Flip-Flop with preset and clear	55p	50p	47p
BP83	7483N	Four Bit Binary Adder	£1·30	£1·13	£1
BP90	7490N	BCD Decade Counter	£1·13	£1	87p
BP92	7492N	Divide by 12 4 Bit binary counter ..	£1·13	£1	87p
BP93	7493N	Divide by 16 4 Bit binary counter ..	£1·13	£1	87p
BP94	7494N	Dual Entry 4 Bit Shift Register ..	£1·13	£1	87p
BP95	7495N	4 Bit Up-Down Shift Register ..	£1·13	£1	87p
BP96	7496N	5 Bit Shift Register	£1·20	£1·05	93p

Data is available for the above Series of I.C's in booklet form, price 13p each.

LINEAR I.C's

Type No.	Case	Leads	Description	Price 1–24	25–99	100
BP 201C – SL201C	TO-5	8	G.P. Amp	63p	53p	45p
BP 701C – SL701C	TO-5	8	OP. Amp	63p	50p	45p
BP 702C – SL702C	TO-5	8	OP. Amp Direct O/P	63p	50p	45p
BP 702 – 72702	D.I.L.	14	G.P. OP. Amp (Wide Board)	53p	45p	40p
BP 709 – 72709	D.I.L.	14	High OP. Amp ..	53p	45p	40p
BP 709P – uA709C	TO-5	8	High Gain OP. Amp ..	53p	45p	40p
BP 741 – 72741	D.I.L.	14	High Gain OP. Amp (Protected)	75p	60p	50p
uA 703C – uA703C	TO-5	6	R.F. IF Amp	43p	35p	27p
TAA 263	TO-72	4	A.F. Amp	70p	60p	55p
TAA 293	TO-74	10	G.P. Amp	90p	75p	70p

TTL INTEGRATED CIRCUITS

Manufacturers' "Fall outs"—out of spec. devices including functional units and part functional but classed as out of spec. from the manufacturers' very rigid specifications. Ideal for learning about I.C's and experimental work, on testing, some will be found perfect.

PAK No.				PAK No.			
UIC00	5	7400N	50p	UIC73	5	7473N	50p
UIC01	5	7401N	50p	UIC74	5	7474N	50p
UIC02	5	7402N	50p	UIC75	5	7475N	50p
UIC03	5	7403N	50p	UIC76	5	7476N	50p
UIC04	5	7404N	50p	UIC80	5	7480N	50p
UIC05	5	7405N	50p	UIC82	5	7482N	50p
UIC10	5	7410N	50p	UIC83	5	7483N	50p
UIC20	5	7420N	50p	UIC86	5	7486N	50p
UIC40	5	7440N	50p	UIC90	5	7490N	50p
UIC41	5	7441AN ..	50p	UIC92	5	7492N	50p
UIC42	5	7442N	50p	UIC93	5	7493N	50p
UIC50	5	7450N	50p	UIC94	5	7494N	50p
UIC51	5	7451N	50p	UIC95	5	7495N	50p
UIC60	5	7460N	50p	UIC96	5	7496N	50p
UIC70	5	7470N	50p	UICX1	20	ASST'D 74's	£1·50
UIC72	5	7472N	50p				

Packs cannot be split but 20 assorted pieces (our mix) is available as PAK UICX1. Every PAK carries our BI-PAK Satisfaction or money back GUARANTEE.

DUAL-IN-LINE LOW PROFILE SOCKETS

14 and 16 lead sockets for use with Dual-In-Line Integrated Circuits.

Order No.	Price each 1–24	25–99	100 up
TSO14—14 pin type	33p	27p	25p
TSO16—16 pin type	43p	37p	35p

RTL FAIRCHILD (U.S.A.) I.C's

RTL Micrologic Circuits
Epoxy case To-5 temp. range 15°C to 55°C

	Qty. prices each 1–11	12–24	25–99	100 +
µL 900 Buffer	40p	35p	33p	27p
µL 914 Dual two-input GATE	40p	35p	33p	27p
µL 923 J-K Flip-Flop	53p	50p	47p	45p

Full data and circuits for I.C's in booklet form, price 7p each.

DTL DIGITAL I.C's

DTL dual in-line package.

	Price
Type MC844P expandable dual 4-Input NAND Power Gate	50p each
Type MC845P Clocked Flip-Flop	75p each

FULL DATA SUPPLIED WITH UNITS

ALL PRICES QUOTED IN NEW PENCE
Please send all orders direct to our warehouse and despatch department.

BI-PAK SEMICONDUCTORS
P.O. BOX 6, WARE, HERTS.

Postage and packing add 5p. Overseas add extra for Airmail. Minimum order 50p. Cash with order please. Giro No. 388-7006.

VALUE ALL THE WAY

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

PIV	1A TO5	3A TO66	7A TO66	10A	16A TO48	30A TO48
50	23p	25p	47p	50p	53p	£1·15
100	25p	33p	53p	58p	63p	£1·40
200	35p	37p	57p	61p	75p	£1·60
400	43p	47p	67p	75p	93p	£1·75
600	53p	57p	77p	97p	£1·25	—
800	63p	70p	90p	£1·20	£1·50	£4

SILICON RECTIFIERS - TESTED

PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	4p	5p	5p	7p	14p	21p	47p
100	4p	6p	5p	13p	16p	23p	75p
200	5p	9p	6p	14p	20p	24p	£1
400	6p	13p	7p	20p	27p	37p	£1·25
600	7p	16p	10p	23p	34p	45p	£1·86
800	10p	17p	13p	25p	37p	55p	£2
1000	11p	25p	15p	30p	46p	63p	£2·50
1200	—	33p	—	33p	57p	75p	—

SILICON HIGH VOLTAGE RECTIFIERS
10-Amp 3-K.V. (3000 P.I.V.) Stud Type with Flying Leads, 80p each.

DIACS
For Use with Triacs BR100 .. .. 37p each

2A POTTED BRIDGE RECTIFIERS. 200V. 50p

UNIJUNCTION
UT46. Eqvt. 2N2646, Eqvt. TIS43. BEN3000. 27p each, 25-99 25p, 100 UP 20p.

NPN SILICON PLANAR
BC107/8/9, 10p each; 50–99, 9p; 100 up, 8p each; 1,000 off, 7p each. Fully tested and coded TO-18 case.

FREE
One 50p Pack of your own choice free with orders valued £4 or over.

AF239 PNP GERM. SIEMENS VHF TRANSISTORS. RF MIXER & OSC. UP TO 900 MHZ. USE AS REPLACEMENT FOR AF139-AF186 & 100's OF OTHER USES IN VHF. OUR SPECIAL LOW PRICE:- 1-24 37p each, 25-99 34p each, 100 + 30p each.

FET'S

2N 3819	35p
2N 3820	93p
MPF105	40p

CADMIUM CELLS
ORP12 43p
ORP60, ORP61 40p each

PHOTO TRANS.
OCP71 Type 43p

EX-EQUIPMENT MULLARD
AF117 transistors. Large can 4 lead type. Leads cut short but still usable. Real value at 15 for 50p.

SIL. G.P. DIODES

300mW	30	50p
40PIV(Min.)	100	£1·50
Sub-Min.	500	£5
Full Tested	1,000	£9

Ideal for Organ Builders.

D13D1 Silicon Unilateral switch 50p each.
A Silicon Planar, monolithic integrated circuit having thyristor electrical characteristics, but with an anode gate and a built-in "Zener" diode between gate and cathode. Full data and application circuits available on request.

TRIACS

VBOM	2A (TO-1)	6A (TO-66)	10A (TO-88)
100	50p	63p	£1
200	70p	90p	£1·25
400	90p	£1	£1·60

VBOM + Blocking voltage in either direction.

AD161 AD162
NPN PNP
MATCHED COMPLEMENTARY PAIRS OF GERM. POWER TRANSISTORS.
For mains driven output stages of Amplifiers and Radio Receivers.
OUR LOWEST PRICE OF 63p *PER PAIR.*

HIGH POWER SILICON PLANAR TRANSISTORS. TO-3.
Ferranti ZT1487 NPN
VCB60 1c 6A fT. 1M/cs
VCE 40 Ptot. 75W
VEB8 hFE 15-45
Price 30p each.

2N3055 115W. SIL. POWER NPN
OUR PRICE 63p each

FULL RANGE OF ZENER DIODES VOLT. RANGE 2-33V
400mW (DO-7 Case) 13p
1-5W (Top-Hat) .. 17p
10W (SO-10 Stud) .. 25p
All fully tested 5% tol. and marked. State voltage required.

BRAND NEW TEXAS GERM TRANSISTORS
Coded and Guaranteed

Pak No.		EQVT.
T1	8 2G371A	OC71
T2	8 2G374	OC75
T3	8 2G3744A	OC81D
T4	8 2G381A	OC81
T5	8 2G382T	OC82
T6	8 2G344A	OC44
T7	8 2G345A	OC45
T8	8 2G378	OC78
T9	8 2G399A	2N1302
T10	8 2G417	AF117

All 50p each pack

2N2060 NPN SIL. DUAL TRANS. CODE D1699 OUR PRICE 25p each.

120 VCB NIXIE DRIVER TRANSISTOR Sim. BSX21 & C407. 2N1893 FULLY TESTED AND CODED ND120. 1-24 17p each. TO-5 NPN 25 up 15p each.

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 5p each. Any Qty.

KING OF THE PAKS Unequalled Value and Quality

SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.		
U1	120 Glass Sub-min. General Purpose Germanium Diodes ..	50p
U2	60 Mixed Germanium Transistors AF/RF ..	50p
U3	75 Germanium Gold Bonded Diodes sim. OA5, OA47 ..	50p
U4	40 Germanium Transistors like OC81, AC128 ..	50p
U5	60 200mA Sub-min. Sil. Diodes ..	50p
U6	30 Silicon Planar Transistors NPN sim. BSY95A, 2N706 ..	50p
U7	16 Silicon Rectifiers Top-Hat 750mA up to 1,000V ..	50p
U8	50 Sil. Planar Diodes 250mA OA/200/202 ..	50p
U9	20 Mixed Volts 1 watt Zener Diodes ..	50p
U11	30 PNP Silicon Planar Transistors TO-5 sim. 2N1132 ..	50p
U13	30 PNP-NPN Sil. Transistors OC200 & 2S104 ..	50p
U14	150 Mixed Silicon and Germanium Diodes ..	50p
U15	25 NPN Silicon Planar Transistors TO-5 sim. 2N697 ..	50p
U16	10 3-Amp Silicon Rectifiers Stud Type up to 1000 PIV ..	50p
U17	30 Germanium PNP AF Transistors TO-5 like ACY 17-22 ..	50p
U18	8 6-Amp Silicon Rectifiers BYZ13 Type up to 600 PIV ..	50p
U19	25 Silicon NPN Transistors like BC108 ..	50p
U20	12 1·5-amp Silicon Rectifiers Top-Hat up to 1,000 PIV ..	50p
U21	30 A.F. Germanium alloy Transistors 2G300 Series & OC71 ..	50p
U23	30 Madt's like MAT Series PNP Transistors ..	50p
U24	20 Germanium 1-amp Rectifiers GJM up to 300 PIV ..	50p
U25	25 300 Mc/s NPN Silicon Transistors 2N708, BSY27 ..	50p
U26	30 Fast Switching Silicon Diodes like IN914 Micro-min ..	50p
U28	Experimenters' Assortment of Integrated Circuits, untested. Gates, Flip-Flops, Registers, etc., 8 Assorted Pieces ..	£1
U29	10 1-amp SCR's TO-5 can up to 600 PIV CRS1/25-600 ..	£1
U31	20 Sil. Planar NPN trans. low noise Amp 2N3707 ..	50p
U32	25 Zener diodes 400mW D07 case mixed Volts, 3-18 ..	50p
U33	15 Plastic case 1 amp Silicon Rectifiers IN4000 series ..	50p
U34	30 Sil. PNP alloy trans. TO-5 BCY26, 2S302/4 ..	50p
U35	25 Sil. Planar trans. PNP TO-18 2N2906 ..	50p
U36	25 Sil. Planar NPN trans. TO-5 BFY50/51/52 ..	50p
U37	30 Sil. alloy trans. SO-2 PNP, OC200 2S322 ..	50p
U38	20 Fast Switching Sil. trans. NPN 400Mc/s 2N3011 ..	50p
U39	30 RF Germ. PNP trans. 2N1303/5 TO-5 ..	50p
U40	10 Dual trans. 6 lead TO-5 2N2060 ..	50p
U41	25 RF Germ. trans. TO-1 OC45 NKT72 ..	50p
U42	10 VHF Germ. PNP trans. TO-1 NKT667 AF117 ..	50p

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

NEW QUALITY TESTED PACKS

Pak	Description	Price
Q1	20 Red spot Trans. P.N.P. ..	50p
Q2	16 White Spot R.F. Trans. P.N.P.	50p
Q3	4 OC 77 Type Trans.	50p
Q4	6 Matched trans. OC44/45/81/810	50p
Q5	4 OC 75 Transistors	50p
Q6	4 OC 72 Transistors	50p
Q7	4 AC 128 Trans. P.N.P. High Gain	50p
Q8	4 AC 126 Trans. P.N.P.	50p
Q9	7 OC 81 Type trans.	50p
Q10	7 OC 71 Type trans.	50p
Q11	2 AC 127/128 Comp. pairs PNP/NPN ..	50p
Q12	3 AF 116 Type Trans.	50p
Q13	3 AF 117 Type Trans.	50p
Q14	3 OC 171 H.F. Type trans. ..	50p
Q15	5 2N2926 Sil. Epoxy Trans. ..	50p
Q16	2 GET880 low noise Germ. trans.	50p
Q17	3 NPN 1 ST141 & 2 ST140 ..	50p
Q18	4 Madt's 2 MAT 100 & 2MAT 120	50p
Q19	3 Madt's 2 MAT 101 & 1MAT 121	50p
Q20	4 OC 44 Germ. trans. A.F. ..	50p
Q21	3 AC 127 NPN Germ. trans. ..	50p
Q22	20 NKT trans. A.F. R.F. coded ..	50p
Q23	10 OA202 Sil. diodes sub-min ..	50p
Q24	8 OA 81 diodes	50p
Q25	6 IN914 Sil. diodes 75PIV 75ma ..	50p
Q26	8 OA95 Germ. diodes sub-min IN69 ..	50p
Q27	2 10A 600PIV Sil. Rects. IS45R ..	50p
Q28	2 Sil. power Rects. BYZ 13 ..	50p
Q29	4 Sil. trans. 2 x 2N696, 1 x 2N697, 1 x 2N698 ..	50p
Q30	7 Sil. switch trans. 2N706 NPN ..	50p
Q31	6 Sil. switch trans. 2N708 NPN ..	50p
Q32	3 PNP Sil. trans. 2 x 2N1131, 1 x 2N1132 ..	50p
Q33	3 Sil. NPN trans. 2N1711	50p
Q34	7 Sil. NPN trans. 2N2369, 500MH2	50p
Q35	3 Sil. PNP TO-5 2 x 2N2904 & 1 x 2905 ..	50p
Q36	7 2N3646 TO-18 plastic 300MH2 N.P.N. ..	50p
Q37	3 2N3053 NPN Sil. trans... ..	50p
Q38	7 PNP trans. 4 x 2N3703, 3 x 2N3702	50p
Q39	7 NPN trans. 4 x 2N3704, 3 x 2N3705	50p
Q40	7 NPN amp 4 x 2N3707, 3 x 2N3708	50p
Q41	3 plastic NPN TO-18 2N3904 ..	50p
Q42	6 NPN trans. 2N5172	50p
Q43	7 BC 107 NPN trans.	50p
Q44	7 NPN trans. 4 x BC108, 3 x BC109	50p
Q45	3 BC 113 NPN TO-18 trans. ..	50p
Q46	3 BC 115 NPN TO-5 trans. ..	50p
Q47	6 NPN high gain 3 x BC167, 3 x BC168 ..	50p
Q48	4 BCY 70 PNP trans. TO-18 ..	50p
Q49	4 NPN trans. 2 x BFY51, 2 x BFY52	50p
Q50	7 BSY 28 NPN switch TO-18 ..	50p
Q51	7 BSY 95A NPN trans. 300MH2 ..	50p
Q52	8 BY100 type Sil. rect.	£1
Q53	25 Sil. & germ. trans. mixed all marked new	£1·50

GENERAL PURPOSE GERM., PNP POWER TRANSISTORS

Coded GP100. BRAND NEW To-3 CASE. POSS. REPLACEMENTS FOR:—
OC25-28-29-30-35-36. NKT401-403-404-405-406-450-451-452-453. TI3027-3028.
2N250A, 2N456A-457A-458A, 2N511-511 A & B. 2G220-222. ETC.
SPECIFICATION.
VCBC 80V VCEO 50V IC 10A PT 30 WATTS HFE 30-170

PRICE	1–24	25–99	100 up
	43p each	40p each	36p each

GENERAL PURPOSE SILICON NPN POWER TRANSISTORS

Coded GP300. BRAND NEW To-3 CASE. POSSIBLE REPLACEMENT FOR:—
2N3055. BDY20. BDY11.
SPECIFICATION.
VCBO 100V. VCEO 60V. IC 15AMPS. PT. 115 WATTS. Hfe 20-100. PTI MHZ.

PRICE	1–24	25–99	100 +
	55p each	50p each	47p each

GENERAL PURPOSE NPN SILICON SWITCHING TRANS.

TO-18 Sim. to 2N706/8, BSY27/28/95A. All usable devices, no open or short circuits. ALSO AVAILABLE in PNP Sim. to 2N2906, BCY70. When ordering please state preference NPN or PNP.

20 for ..	50p	500 for	£7·50
50 for ..	£1	1000 for	£13
100 for	£1·75		

SURPLUS A.E.I. 40A GERM. JUNCTION RECTS.

FOR POWER APPLICATIONS.

Type			
	GP6C20	400PIV	40p each
	GP6C30	600PIV	50p each

PRINTED CIRCUITS EX-COMPUTER
Packed with semiconductors and components, 10 boards give a guaranteed 30 trans and 30 diodes. Our price 10 boards 50p. Plus 10p P. & P. 100 boards £3. P. & P. 30p.

TRANSISTOR EQUIVALENTS BOOK. A complete cross reference and equivalent book for European, American and Japanese Transistors. Exclusive to BI-PAK. 75p each.

GERM. POWER TRANS.

Type	Price each
OC20	50p
OC22	30p
OC23	33p
OC25	25p
OC26	25p
OC28	40p
OC29	40p
OC35	33p
OC36	40p
AD140	40p
AD142	40p
AD149	43p

OUR STOCKS of Individual devices are now too numerous to mention in this Advertisement. Send S.A.E. for our listing of over 1,000 SEMICONDUCTORS. All available EX-STOCK at very competitive prices.

ALL PRICES QUOTED IN NEW PENCE

GIRO No. 388-7006

Please send all orders direct to our warehouse and despatch department.

BI-PAK SEMICONDUCTORS
P.O. BOX 6, WARE, HERTS.

Postage and packing add 5p. Overseas add extra for Airmail. Minimum order 50p Cash with order please.

KING OF THE PAKS BI-PAK GUARANTEE SATISFACTION OR MONEY BACK

BI-PRE-PAK LIMITED

FULLY TESTED AND MARKED

AC107	.15	OC140	.17
AC126	.13	OC170	.23
AC127	.17	OC171	.23
AC128	.13	OC200	.25
AC176	.25	OC201	.25
ACY17	.15	2G301	.13
AF139	.13	2G303	.13
AF186	.37	2N711	.50
AF239	.37	2N1302-3	.20
BC154	.25	2N1304-5	.25
BC171		2N1306-7	.30
= BC107	.13	2N1308-9	.35
BC172		2N3819FE	.45
= BC108	.13	Power	
BF194	.15	Transistors	
BF274	.15	OC20	.50
BFY50	.20	OC23	.30
BSY25	.37	OC25	.25
BSY26	.13	OC26	.25
BSY27	.13	OC28	.30
BSY28	.13	OC35	.25
BSY29	.13	OC36	.37
BSY95A	.13	AD149	.30
OC41	.13	AUY10	1.25
OC44	.13	2N3055	.63
OC45	.13	2S034	.25
OC71	.13	Diodes	
OC72	.13	AAY42	.10
OC73	.17	OA95	.09
OC81	.13	OA79	.09
OC81D	.13	OA81	.09
OC139	.13	IN914	.09

FREE! Packs of your own choice up to the value of .50 with orders over £4.

CLEARANCE LINES

DON'T MISS THIS LAST CHANCE – ONLY A FEW LEFT.

UHF/VHF T.V. TUNER UNITS.

TU.2. Containing 2 AF186's & 2 AF178's Price .50 P & P .13 each unit

All the units have many other components, e.g. Capacitors. Resistors, Coils and tuning condensors, etc. Although these are manufacturers' rejects they are not beyond repair as has been proven by many of our customers.

ALL TUNER UNITS ARE SUPPLIED WITH CONNECTION DATA.

COLOUR T.V. LINE OUTPUT TRANSFORMERS

Designed to give 25KV when used with PL509 & PY500 valves. As removed from colour receivers at the factory.

ONLY £1 each. Post and Packing .23

SPECIAL LINE

1 AMP Bridge Rectifiers – ½" Square.
100 PIV – .25 400 PIV – .33 800 PIV – .40

PAK F.3 COMPLEMENTARY SET. NPN/PNP GERM. TRANS. **.13** PAIR

BUMPER BUNDLES

These parcels contain all types of surplus electronic components, printed panels, switches, potentiometers, transistors and diodes, etc.

WEIGHT 2 LBS. COSTS £1

POST & PACKING .23

NEW TESTED & GUARANTEED PAKS

B2	4	Photo Cells, Sun Batteries. .3 to .5V, .5 to 2mA.	.50
B77	2	AD161–AD162 NPN/PNP Trans. Comp. output. Pair	.50
B81	10	Reed Switches. Mixed types large and small.	.50
B89	2	5SP5 Light Sensitive Cells. Light res. 400Ω. Dark 1MΩ.	.50
B91	8	NKT163/164 PNP Germ. to –5. Equiv. to OC44, OC45.	.50
B92	4	NPN Sil. Trans. A06=BSX20, 2N2369, 500 MHz, 360 mW.	.50
B93	5	ACY17-21 PNP Germ. GET113 Trans. equivalent to	.50
B98	10	XB112 & XB102 equiv. to AC126, AC156, OC81/2, OC71/2, NKT271. etc.	.50
B99	200	Mixed Capacitors. P & P .13 Approx. qty., weight counted.	.50
H4	250	Mixed Resistors. P & P .10 Approx. qty., weight counted.	.50
H7	40	Wirewound resistors. Mixed values. Postage .07	.50
H8	4	BY127 Sil. Recs. 1000 PIV, 1 amp. Plastic.	.50
H9	2	OCP71 Light sensitive phototransistors.	.50

Return of the unbeatable P.1 Pak. Now greater value than ever.

Full of short lead semiconductors and electronic components, approx. 170. We guarantee at least 30 really high quality factory marked Transistors PNP and NPN, and a host of diodes and rectifiers. Mounted on printed circuit panels. Identification chart supplied to give some information on the transistors.

P.1 PLEASE ASK FOR PAK P.1 ONLY **.50**
.10 P & P on this Pak.

OUR VERY POPULAR 3p TRANSISTORS

FULLY TESTED & GUARANTEED.

TYPE "A" PNP Silicon alloy, metal TO-5 can. 2S300 type, direct replacement for the OC200/203 range.

TYPE "B" PNP Silicon, plastic encapsulation, low voltage but good gain, these are of the 2N3702/3 and 2N4059/62 range.

TYPE "E" PNP Germanium AF or RF – please state on order. Fully marked and tested.

TYPE "F" NPN Silicon, plastic encapsulation, low noise amplifier, of the 2N3707/8, 9, 10, 11 range.

ANNOUNCING THE OPENING OF OUR ENTIRELY NEW CASH & CARRY DEPARTMENT. ON-THE-SPOT SALES OF ALL CATALOGUED ITEMS, PLUS MANY OTHER LINES OF INTEREST.

Reductions for bulk buying.

Manufacturers welcomed.

These are but a few examples:
OC44, OC45, OC81, OC139, 1N4007 – all at **8p**
1N4001 at **4p**,
1N4004 at **5p**,
1N4006 at **6p**.
Minimum quantity 500.

SEMICONDUCTOR SUPERMARKET OF THE SOUTH EAST

NEW UNMARKED UNTESTED PAKS

B80	8	Dual Trans. Matched O/P pairs NPN, Sil. in TO-5 can.	.50
B83	200	Trans. Makers rejects. NPN/PNP. Sil. & Germ.	.50
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202.	.50
B86	50	Sil. Diodes sub. min. IN914 & IN916 types.	.50
B88	50	Sil. Trans. NPN, PNP. equivalent to OC200/1, 2N706A, BSY95A, etc.	.50
B60	10	7 Watt Zener Diodes. Mixed voltages.	.50
H6	40	250mW. Zener Diodes DO-7 min. Glass Type.	.50
H10	25	Mixed volts 1½ watt Zeners. Top Hat type.	.50
B66	150	High quality Germ. Diodes. Min. glass type	.50
H15	30	Top Hat Silicon Rectifiers. 750mA. Mixed volts.	.50
H16	8	Experimenters' Pak of Integrated Circuits. Data suppd.	.50
H20	20	BY126/7 type Silicon Rectifiers. 1A. plastic to 1,000v.	.50

MAKE A REV. COUNTER for your Car. The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a perfectly linear and accurate rev. counter for any car. **£1 each**

FREE CATALOGUE AND LISTS for:–

ZENER DIODES
TRANSISTORS, RECTIFIERS
FULL PRE-PAK LISTS
& SUBSTITUTION CHART

MINIMUM ORDER .50 CASH WITH ORDER PLEASE. Add .05 post and packing per order. OVERSEAS ADD EXTRA FOR POSTAGE.

P.O. RELAYS **8 FOR £1**

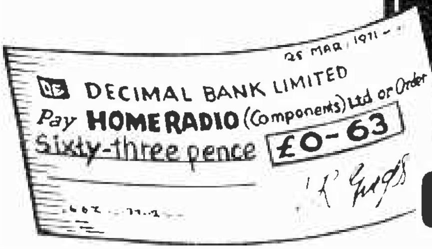
Various Contacts and Coil Resistances. No individual selection. Post and Packing .25

FREE! A WRITTEN GUARANTEE WITH ALL OUR TESTED SEMICONDUCTORS

BI-PRE-PAK LTD DEPT. C, 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX
TELEPHONE: SOUTHEND (0702) 46344

HOME RADIO (Components) LTD., Dept. RC, 234-240 London Road, Mitcham CR4 3HD. Telephone : 01-648 8422

It costs ONLY 63p post paid



for today's MOST USEFUL COMPONENTS CATALOGUE

Many radio and electronic enthusiasts say that our catalogue is "priceless"! Be that as it may, we charge you only 63 pence. What is more, the catalogue contains 6 vouchers, each worth 5 pence when used as indicated. And for good measure, we throw in a useful Bookmark giving electronic abbreviations and a 30-page Price Supplement. *Why are you waiting?*

By the way, if it suits you to call at our shop you save yourself another 20 pence – the post and packing costs.

Ordering components is easier and quicker with our

Credit Account Service

Just a phone call away

Our aim in life at Home Radio (Components) Ltd. is to make *your* life less complicated! To this end we introduced our Credit Account Service, one advantage of which is that you can order components by telephone *any time, any day*. If you phone out of shop hours a recording machine takes your message for us to deal with when we open shop next day.

There are *other* advantages to the Service – if you want to order by post we provide Order Forms and *Prepaid* Envelopes. You settle your account just once per month. Of course for ordering your components you first need our Catalogue, and after you have been in the Service 12 months we regularly send you an up-to-date catalogue – FREE!

For full details of our Credit Account service just drop us a line or phone 01-648 8422.

The price of 63p applies only to catalogues purchased by customers in the U.K. and to BFPO addresses.

POST THIS COUPON NOW
with your Cheque or P.O. for 63p

Please write your Name and Address in block capitals

Name ______________________

Address ______________________

____

____

HOME RADIO (COMPONENTS) LTD., Dept. RC,
234-240 London Road, Mitcham, Surrey CR4 3HD.

THE Radio Constructor

Incorporating THE RADIO AMATEUR

MARCH 1971

Vol. 24 No. 8

Published Monthly (1st of Month)
First Published 1947

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9 1SN

Telephone 01-286 6141

Telegrams Databux, London

Annual Subscription: £2.40 (U.S.A. and Canada $6) including postage. Remittances should be made payable to "Data Publications Ltd." Overseas readers please pay by cheque or International Money Order.

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. Queries must be submitted in writing and accompanied by a stamped addressed envelope for reply.

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

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

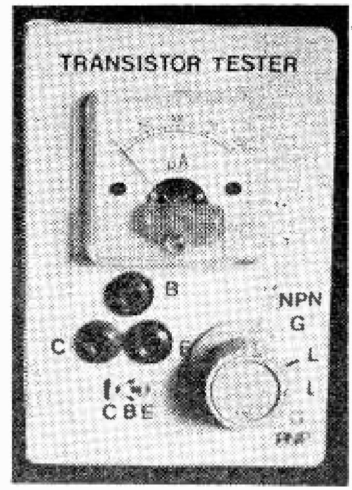
Production.—Letterpress.

CONTENTS

Published in Great Britain by the Proprietors and Publishers, Data Publications Ltd, 57 Maida Vale, London, W9 1SN.
The *Radio Constructor* is printed by Kent Paper Company Ltd, London and Ashford, Kent.

APRIL ISSUE WILL BE PUBLISHED ON APRIL 1st

TRANSISTOR TESTER



by

H. WILLIAMS

This simple little item of test gear carries out leakage and gain checks with both p.n.p. and n.p.n. transistors

MOST MEMBERS OF THE electronic construction fraternity will own fairly large numbers of transistors that have been aquired from time to time. It is often necessary to test and sort these and the unit described here was designed with that aim in mind. Another useful function of the Transistor Tester is to check the very cheap surplus transistors that are now available for as little as 6d each. Many of these transistors will prove to be useless. Nevertheless, even after rejecting the duds one is usually left with a whole mass of perfectly usable devices, each costing less than a resistor.

The Transistor Tester measures leakage and gives the comparative gain of a transistor, thus enabling matching and other forms of selection from branded types. Its principle is very simple and it can be built in a couple of hours, yet it should prove invaluable to the serious constructor.

CIRCUIT THEORY

Fig. 1 shows the theory of operation. When the switch is in the 'Leakage' position the battery is connected across the emitter and collector of the transistor, and the resultant current is monitored by the meter.

When the switch is set to 'Gain' a resistor is connected from the collector to the base and the resultant current is again monitored.

In practice the sensitivity of the meter needs to be changed for these various readings and in the full circuit, shown in Fig. 2, it will be seen that the meter is shunted to give three different sensitivities by means of S1(b).

To simplify the switching it is assumed that p.n.p. transistors are usually germanium and n.p.n. devices are usually silicon. Certainly there are plenty of exceptions to this general rule but the assumption has been made here to give the simplest circuit. It only applies to the leakage test, the meter being shunted to give a lower sensitivity when checking p.n.p. leakage. This does not, of course, invalidate silicon p.n.p. leakage readings, but it shows them in a much more compressed part of the scale. Germanium n.p.n. power transistors, which may have a relatively high leakage, can be checked as for p.n.p. leakage with the emitter and collector connections reversed.

OPERATION

With the switch, S1, in the N.P.N. Leakage position the battery is applied with the correct polarity across the transistor under test and meter, unshunted, is at its maximum sensitivity of 200μA.

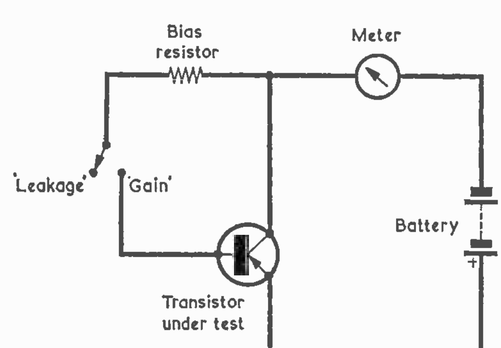
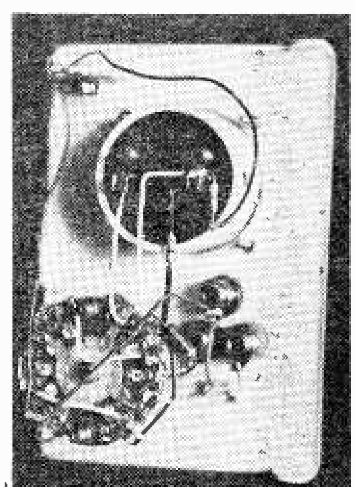


Fig. 1. Simplified circuit, illustrating the basic testing operation



Rear view of the prototype, without battery. The solder tag of Fig. 3 was not fitted when this photograph was taken

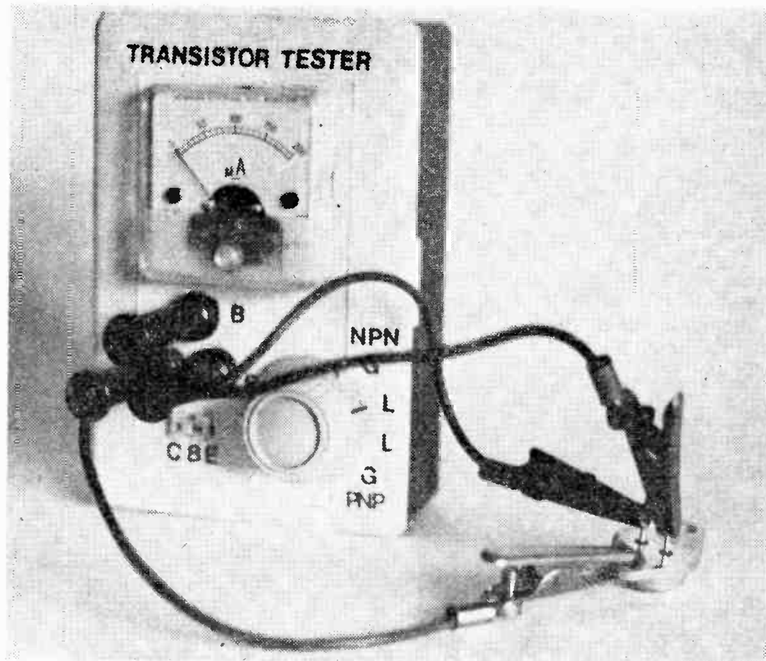
When the switch is set to 'N.P.N. Gain' a 220Ω resistor is switched between the base and collector by means of S1(a), whilst S1(b) shunts the meter to read 2.5mA f.s.d. by connecting a 75Ω resistor across it.

In the 'P.N.P. Leakage' position the 200μA sensitivity is too high for some germanium types – especially power transistors – and so S1 (b) sets the sensitivity of the meter to about 1.2mA.

In the 'P.N.P. Gain' position the meter is again shunted to read 2.5mA f.s.d., and S1(b) connects the 220kΩ resistor between base and collector.

S1(c) and S1(d) serve only to change the battery polarity for n.p.n and p.n.p. types. R4, a 3.6kΩ resistor, acts as a limiter and prevents the meter being overloaded in the case of a short-circuit transistor. It limits the current through the meter to about 2.5mA. It is important to note that the unit must always be initially switched to either 'N.P.N. Gain' or 'P.N.P. Gain' when testing an unknown transistor. This protects the meter if the transistor should happen to be short-circuit, since the maximum current that can then flow is 2.5mA and the meter is shunted to read this current. The leakage test is carried out after the gain test has indicated that the transistor is not short-circuit.

The meter chosen was on of the Japanese SEW types, widely available at a reasonable price. It has an internal resistance of 900Ω and it is from this figure that the values of the shunt resistors are calculated. Their actual value is not too important as readings are largely of a



The Tester in use, checking a power transistor

comparative nature. Resistors with a tolerance of 5% will be adequate.

CONSTRUCTION

Any suitable housing may be employed for the Transistor Tester, since layout is not important. The writer's unit was built into a plastic case measuring 4½ by 3 by 1¼in., and with a hinged lid that could be removed.

Two sets of transistor connections are required. Three sockets into which wander plugs are fitted are wired in parallel with a conventional transistor socket. Extension wires fitted with crocodile clips can be run from the wander plug sockets for testing power transistors or those wired into a circuit.

Switch S1 is a 4-pole 4-way rotary type and is wired as shown in Fig. 3. If a switch having a

COMPONENTS

Resistors
(All resistors ½ watt)
R1 220kΩ 10%
R2 75Ω 5%
R3 180Ω 5%
R4 3.6kΩ 5%

Switch
S1(a)(b)(c)(d) 4-pole 4-way rotary

Meter
M1 0–200μA meter, type MR38P (SEW)

Battery
B1 9-volt battery, type PP3 (Ever Ready)

Miscellaneous
Transistor socket
3 wander plugs and sockets
3 crocodile clips
Battery connector
Pointer knob
Solder tag
Plastic case, or similar housing

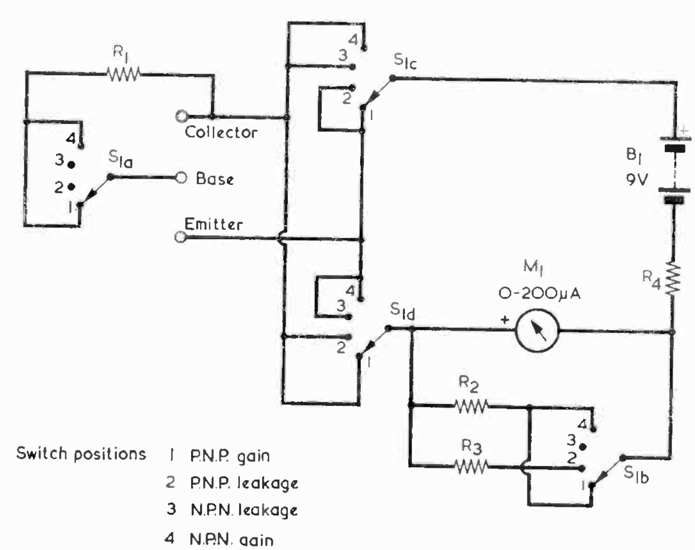


Fig. 2. The complete circuit of the Transistor Tester

different construction is employed. wiring should follow the circuit diagram of Fig. 2. The switch must have break-before-make contacts.

OPERATION

When the Transistor Tester has been built, carefully check all wiring for errors. Set S1 to either position I or IV and quickly short-circuit the collector and emitter sockets. The meter should read near full-scale deflection.

Calibration, if required, is best carried out with transistors which are known to be good; one will quickly get to know what the correct or acceptable readings are and a note can be made on a table affixed to the case of the unit. Short-circuit transistors will, as already stated, show f.s.d., and open-circuit devices will show no reading at all.

An interesting exercise is to measure some of the surplus 'equivalent' transistors against the 'real McCoy'. Frequently the differences will become apparent, but the author has come across several instances where differences failed to show up on the tester. Also, the transistors, when in circuit, offered identical performances. ■

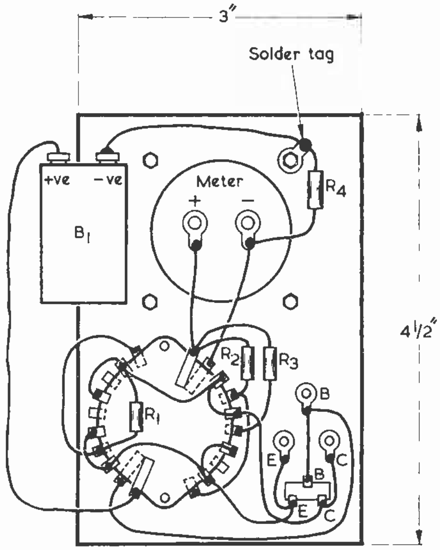


Fig. 3. Construction and wiring diagram when a double bank single wafer switch is used. The contacts shown in broken line are below the wafer. Use a continuity tester to identify individual contacts if any doubt exists. The components should be mounted on a plastic case lid, as in the prototype, or on a front panel made of Paxolin or similar insulating material

NEW LOGIC PROBE

A versatile 5-volt logic probe, designed for testing DTL and TTL circuitry, has been introduced by EMI Electronics' Radar and Equipment Division, Hayes, Middlesex. Designated 'LP500/1', the new probe can identify seven different categories of logic signal including the important open circuit condition. These capabilities allow rapid checking of logic circuits thereby minimising the need for expensive test equipment such as oscilloscopes.

The 18cm (7in.) long, 1.9 cm (0.75in.) diameter probe distinguishes between logic 1, logic 0, open circuit, +ve going pulses, −ve going pulses, square waves below 1MHz (approx.) and pulse trains (including square waves) with a p.r.f. above 1MHz (approx.). It can be run from the power supply of the equipment under test, from a 4.5 Volt battery or a standard bench power supply.

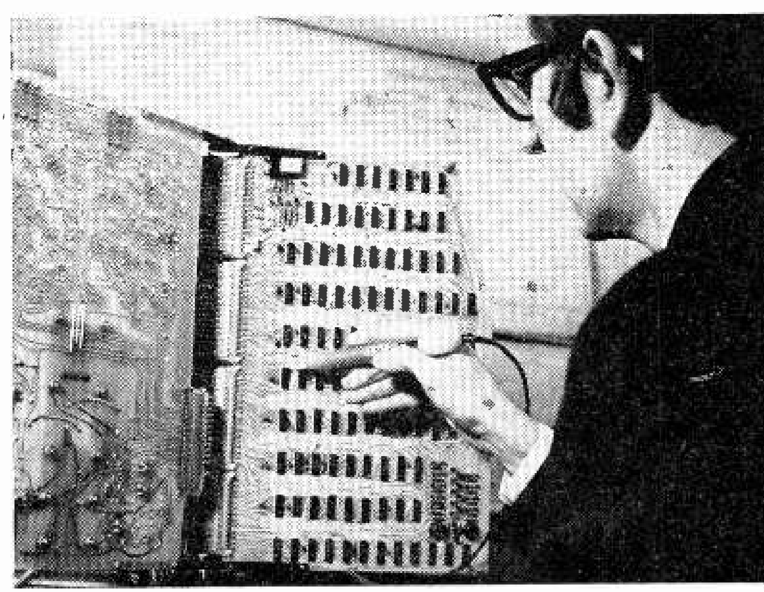
Connection to the supply is effected by a 120cm (4ft.) cable terminated in 4mm banana plugs which afford simple connection to many standard bench supplies. Insulated plug-on crocodile clips provide easy alternative connection.

LOGIC PROBE - METHOD OF OPERATION

The probe operates in one of two modes selected by a thumb-operated microswitch. With the switch depressed, the a.c. mode is indicated by a steady light under open circuit conditions. When the switch is released, the d.c. mode is indicated by a flashing light in the open circuit condition.

In the d.c. mode, the probe senses the input and gives an 'off', 'on' or flashing indication according to whether the input level is below, above or between two voltage thresholds; V1: 0.625V±0.125V or V2: 2.4V±0.4V. If any waveform is present it is integrated over 100mS and the mean level sensed.

In the a.c. mode the probe responds to positive going edges faster than 0.5 μs, each edge causing the lamp to extinguish and then re-light after 100mS. Single pulses as narrow as 50nS and pulse trains having p.r.f.'s up to 1 MHz (approx.) are detected in this manner. Pulses at p.r.f.'s greater than 1 MHz (approx.) are indicated by an 'off' condition.



Timer Without Electrolytics

by

J. PHILIPS

In order to obtain sufficiently long timing periods the current trend in electronic timers is to employ an electrolytic component as the timing capacitor. This article describes a timing circuit which, by taking advantage of a pulsed transistor, enables a paper or plastic foil capacitor to be used instead

A NUMBER OF CIRCUITS FOR ELECTRONIC TIMERS have appeared in this and other journals over recent years, all of the published designs taking advantage of a standard technique in which the voltage across a charging or discharging capacitor triggers a switching circuit when it reaches a predetermined level. To obtain reasonably long timing periods with this technique it is necessary to employ capacitors having large values, whereupon the inevitable choice has consisted of electrolytic components. Unfortunately, timer designs of this nature can never be looked upon as providing the ultimate in accuracy. This is due to the well-known shortcomings of electrolytic capacitors, these consisting of variations in capacitance with age and applied voltage, and variations in leakage resistance due to age, applied voltage and temperature.

This article describes a different and unusual approach to the design of the electronic timer, and the circuit to be discussed enables long timing periods to be achieved with a timing capacitor having a relatively low value. There is no necessity to use an electrolytic component, and the timing capacitor can be a standard paper or plastic foil type instead. In consequence, the resultant design is completely free from the inherant unreliability that is given when an electrolytic timing capacitor is employed.

DISCHARGING CIRCUIT

Before examining the overall circuit of the timer it will be of advantage to initially discuss the reason why it allows a low value timing capacitor to be employed.

A conventional basic approach to timer design appears in Fig. 1 (a). Here we have a capacitor which is initially maintained in a charged condition by means of switch S1. The timing period is commenced by setting S1 to the 'Trip' position, whereupon the capacitor discharges via the resistor in parallel with it. At the same time a second set of contacts on S1 (not shown in Fig. 1) completes the external controlled circuit which is being timed. When the voltage across the capacitor falls to a predetermined value the switching circuit triggers and breaks the external controlled circuit, thereby bringing the timing period to an end. The length of the period depends upon the values of the capacitor and resistor and may be adjusted by altering either of these.

As already mentioned, this simple system requires a high value in the capacitor if reasonably long timing periods are to be obtained. The situation is worsened by the fact that the resistor has to have a relatively low value, or it will otherwise become comparable with the leakage resistance of the capacitor when the latter is electrolytic, and the unreliability due to varying leakage resistance would then become

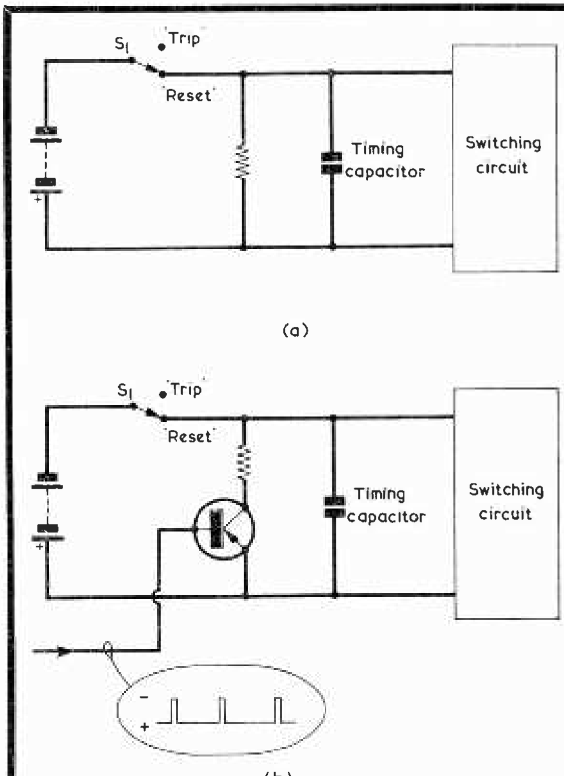


Fig. 1(a). A basic electronic timing circuit. Separate contacts on S1 (not shown) in combination with the switching circuit control the external circuit being timed
(b). The length of the timing period may be increased by inserting a pulsed transistor in series with the discharge resistor

more evident. A low value in the resistor necessitates, again, a correspondingly high value in the capacitor.

The solution proposed in the author's design is shown diagrammatically in Fig. 1 (b). This circuit is operated in the same manner as that of Fig. 1(a), but a transistor is now inserted in series at the lower end of the resistor. A series of pulses is fed to the base of the transistor, with the result that it only passes current during the presence of each pulse, and is cut-off between pulses. If the capacitor and resistor have the same values as they have in Fig. 1(a), the capacitor discharges more slowly because the discharge current now only flows during pulses. Should the pulses be of much shorter duration than the intervals between pulses, the discharge period of the capacitor will be considerably extended. Alternatively, the value of the capacitor can be made very much smaller for the same discharge period.

If, for reasonably long discharge periods the value of the capacitor is sufficiently low to enable a non-electrolytic component to be economically employed, a further advantage accrues. A good quality non-electrolytic capacitor (i.e. a paper or plastic foil component) can have an extremely high leakage resistance, this being particularly true of the plastic types. A typical specification for polycarbonate capacitors, for instance, quotes insulation resistance in megohms multiplied by microfarads as being greater than 20,000. With insulation resistances as high as this it becomes possible to use larger values of discharge resistor in the timing circuit, whereupon the value required in the capacitor becomes lower again.

Both these techniques – the use of a pulsed transistor in series with the discharge resistor and a high value discharge resistor across a paper or plastic foil capacitor – are employed in the timing circuit now to be described.

THE CIRCUIT

The complete circuit of the electronic timer appears in Fig. 2. In this diagram, the timing capacitor is C3 and the pulsed transistor is TR3, this being a p.n.p. silicon junction transistor type OC204. It is pulsed by inserting its base-emitter junction in series with the emitter of TR2 which, with TR1, is in a multivibrator circuit. When TR2 is turned on during the multivibrator cycle so also is TR3, which then draws current from C3 via R6 and R7. R7 provides a control of timing period which, with the author's circuit, ranges from 2 to 110 seconds.

In the multivibrator, the period during which TR2 is turned off is controlled by R3 and C2, whilst the period when TR1 is turned off is controlled by R2 and C1. The product of the values of R3 and C2 is 50 times the product of the values of R2 and C1, whereupon it would appear at first sight that the period of turn-off in TR2 during each cycle will be 50 times greater than the period of turn-off in TR1. For the present application we are more interested

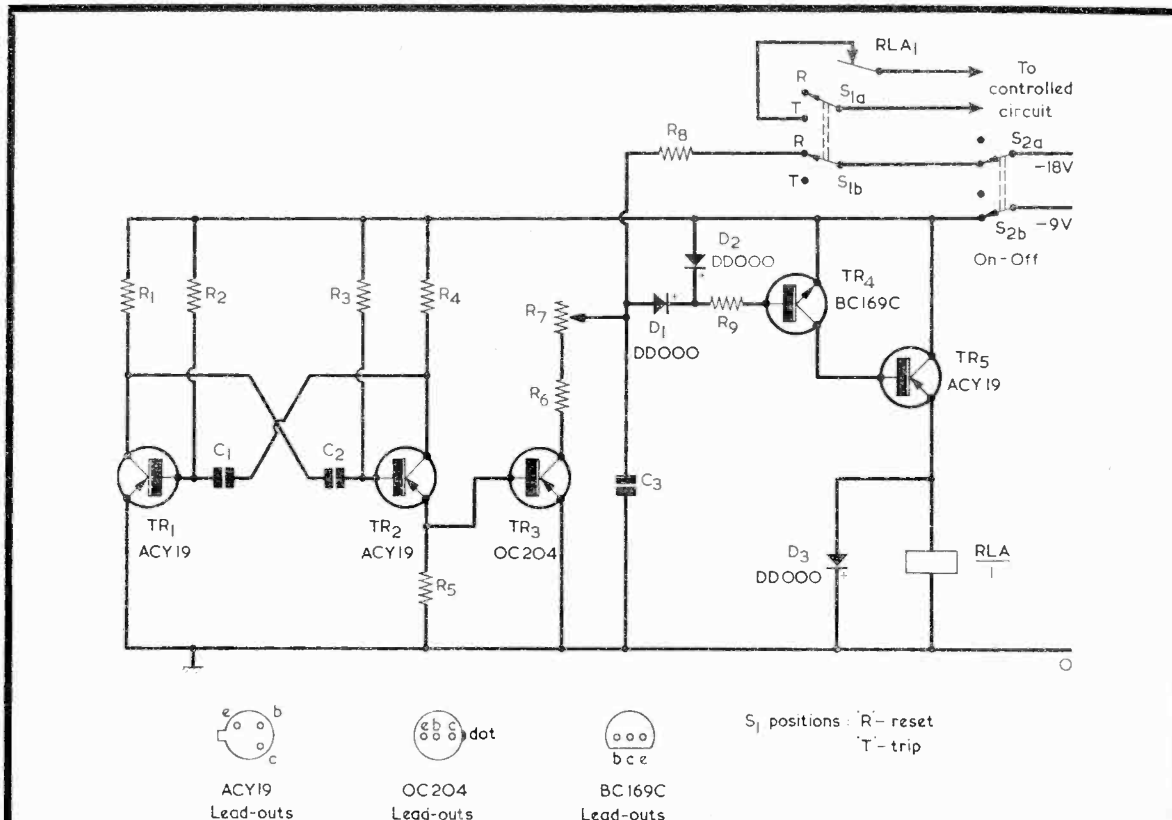


Fig. 2. The complete circuit of the electronic timer. The timing capacitor, C3, is paper or plastic foil, and is not electrolytic

in the length of time when TR2, and hence TR3, is turned *on*, and our first-sight appreciation would indicate that TR2 and TR3 are turned on for only one fifty-first fraction of each multivibrator cycle. In practice, unfortunately, it is rather difficult to obtain a high on-off time ratio from a simple 2-transistor multivibrator. In the present circuit, for example, TR2 commences to pass current for a short period *before* the transition which turns it fully on, this being due to the slow increase in potential at its base resulting from the large values in C2 and R3. Thus, TR2 is already passing a small but significant current by the time that the positive excursion at its collector becomes sufficiently swift to initiate the changeover by way of the relatively low value capacitor C1. Because of this effect, the period during which the pulsed transistor. TR3, is at least partly conductive becomes longer than one fifty-first of the multivibrator cycle. Measurements taken with the author's unit showed an average current flow in R6, with R7 slider at the lower end of its track, which was about one-twentieth of the current which flowed if the collector of TR3 was short-circuited to its emitter. With R7 slider at the upper end of its track the fraction was approximately one-fifteenth, the variation being presumably due to the lower current which was then drawn through TR3. The result is that the pulsed transistor circuit enables the timing capacitor to have one-fifteenth to one-twentieth the value it would otherwise require. This is still a considerable advantage and well justifies the use of the multivibrator and pulsed transistor.

It is appreciated that a more complex multivibrator circuit would provide a cleaner rectangular wave for application to the pulsed transistor. However, the very simple circuit, as shown, gave excellent practical results and was quite reliable from the point of view of repeatability of timing periods. In consequence, there seemed to be little point in adding further components and devices to it when it was already functioning adequately.

Before leaving this section of the circuit, brief mention should be made of resistor R5. This component is included merely to ensure that leakage current in TR2 when it is turned off does not cause the base of TR3 to rise above its 0.6 volt turn-on potential. It was found that the average collector current in TR3 reduced slightly when R5 was added. The presence of R5 has negligible effect on the pulsing function, in which TR2 commences to draw current before it turns fully on. Indeed, the average current in TR3 collector circuit remained unaltered for experimental variations in R5 from 1 to 3.9kΩ.

SWITCHING CIRCUIT

We have, up to now, concentrated solely on the multivibrator and pulsed transistor section of the timing circuit since this represents the novel variation on standard timer design which provides the main reason for this article. We can next examine the rest of the circuit, armed with the knowledge that C3 is the paper or plastic foil timing capacitor and that its rate of discharge, and hence the length of the timing period, is controlled by R7.

In the remainder of the circuit, switch S1 is normally kept in the 'Reset' position, whereupon its contacts S1(b) connect the upper plate of C3 to the negative 18 volt line via limiter resistor R8. Under these circumstances, C3 is charged to 18 volts. Since the upper plate of C3 is negative of the 9 volt supply line, silicon diode D1 is reverse-biased and no current can flow through it to the relay switching transistors TR4 and TR5. Relay RLA/1 is, in consequence, de-energised. At the same time, the connections to the controlled circuit are kept open by contacts S1(a) of switch S1.

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)

R1	2.2kΩ
R2	47kΩ
R3	100kΩ
R4	2.2kΩ
R5	2.2kΩ
R6	10kΩ
R7	2MΩ potentiometer, linear
R8	10Ω
R9	4.7kΩ

Capacitors

C1	0.01μF, paper or plastic foil
C2	0.25μF, paper or plastic foil
C3	8μF, paper or plastic foil

Semiconductors

TR1	ACY19
TR2	ACY19
TR3	OC204
TR4	BC169C
TR5	ACY19
D1	DD000
D2	DD000
D3	DD000

Switches

S1	d.p.d.t., toggle
S2	d.p.d.t., toggle or rotary

Relay
RLA1 See text

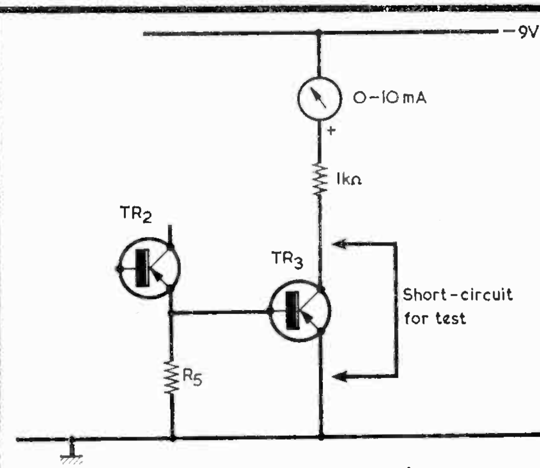


Fig. 3. A simple test circuit for checking the multivibrator and pulsing circuits

To initiate a timing period, S1 is set to the 'Trip' position, whereupon its contacts S1(a) complete the external controlled circuit. Also, its contacts S1(b) break the 18 volt supply to the upper plate of C3, which now begins to discharge via R7, R6 and pulsed transistor TR3. After a period, the potential on the upper plate of C3 falls below that on the 9 volt supply line, whereupon diode D1 conducts and allows current to flow via limiter resistor R9 to the base of TR4. TR4 and TR5 form a direct-coupled pair having extremely high current gain, and represent a çombination which has been used recently in several of the 'Suggested Circuit' articles by G. A. French. They function very well in the present circuit, their gain being such that a base current in TR4 of the order of 2μA is all that is required to cause the relay in the emitter circuit of TR5 to become energised. When the relay energises, its break contacts RLA1 open and interrupt the external controlled circuit.

The timing period is now complete. A further period may be initiated by putting S1 to 'Reset', whereupon C3 becomes charged again and the relay releases, and then setting it once more to 'Trip'.

Two components which have not so far been mentioned are silicon diodes D2 and D3. The function of D2 is to ensure that leakage current in D1 cannot cause the reverse emitter-base voltage in TR4 to exceed about 0.6 volts when the upper plate of C3 is negative of the 9 volt supply line. The maximum reverse base-emitter voltage quoted for the transistor specified for TR4 is 5 volts only. Silicon diode D3 is the usual component which is connected across transistor-driven relay coils, and it prevents the appearance of high back-e.m.f. voltages when the relay de-energises.

COMPONENTS

The transistors specified are all readily obtainable types. The BC169C in the TR4 position is available from Amatronix Ltd. Diodes D1 to D3 are not critical and any silicon diode can be employed instead of the Lucas DD000 type indicated in the Components List.

S1 is a d.p.d.t. toggle switch. A rotary type is not advised here. On the other hand, S2 can be any type of d.p.d.t. switch.

Relay RLA1 is any relay whose coil resistance is 400Ω or greater, and which energises reliably at 9 volts. The writer employed a P.O.3000 relay with a 600Ω coil in the protoype circuit. It requires a single break contact set only, and suitable relays are available from a number of suppliers. In addition, P.O.3000 relays, made up to customers' requirements can be obtained from L. Wilkinson (Croydon) Ltd., Longley House, Longley Road, West Cryodon, Surrey.

If the constructor wishes to employ a larger non-electrolytic capacitor in the C3 position this is, of course, perfectly in order. The values of R7 and R6 could then be scaled down accordingly. Thus, if C3 is made 16μF, R7 and R6 can be 1MΩ and 5kΩ respectively. The larger capacitor will enable a possibly slightly more robust potentiometer to be used in the R7 position, but should otherwise offer no particular advantage. As stated earlier, the timing range obtained with the author's unit was 2 to 110 seconds, but there may be variations from these figures with other units built up to the circuit. If necessary, a little extra at the longer end of the range can be obtained by slightly increasing the value of C3. Resistor R7 should be fitted with a pointer knob and a scale calibrated in the timing periods it provides. Four or five measured calibration points will need to be taken when drawing up this scale, as it will be somewhat non-linear.

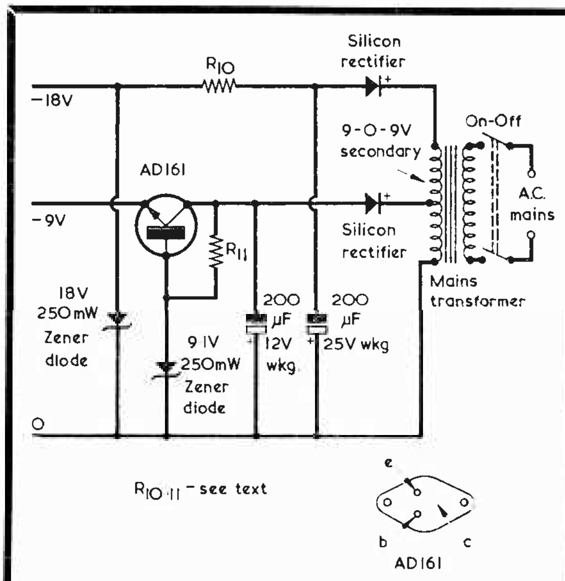


Fig. 4. A suggested power supply circuit for the timer. The AD161 transistor need not be mounted on a heat sink

Probably the only part of the circuit where the constructor could possibly encounter trouble is in the multivibrator incorporating TR1 and TR2. High-gain transistors are essential here. The author checked a number of ACY19's in this part of the circuit and all worked correctly, but there is still a very slight risk that a pair of particularly low gain devices may not oscillate. Should this occur, the only solution is to reduce the value of R3 and/or C2 until oscillation commences, thereby sacrificing a little of the pulse ratio advantage offered by the multivibrator. Indeed, a good constructional approach consists of getting the multivibrator and TR3 in working order before attending to the rest of the circuit. The operation of TR3 can be checked by connecting a 1kΩ resistor between its collector and the 9 volt supply line with a current-reading meter in series, as in Fig. 3. The current should be about 9mA when the collector of TR3 is short-circuited to its emitter. If the current drops by a considerable amount but does not cease altogether when the short-circuit is taken off, then the multivibrator is working and the circuit is pulsing. After this test, the 1kΩ resistor may be removed, R6 and R7 connected to the collector of TR3 and the remainder of the timer made up.

Whilst dealing with the components an interesting final point is that, at the end of the timing period, capacitor C3 also acts as an integrating device which enables the relay to energise. If, during tests, an attempt is made to energise the relay without C3 in circuit all that happens is that amplified pulses are applied to the relay coil. The relay does not then energise because the coil presents a high inductive reactance to these pulses!

POWER SUPPLY

The current taken from its power supply by the timer is low, and the author's unit drew 6mA from the 9 volt negative line with the relay de-energised and 23mA when the relay operated. The current drawn from the 18 volt line is negligibly low, consisting merely of that required to charge capacitor C3.

The writer employed bench stabilised supplies to provide the two voltages, and it is assumed that a constructor who intends to make up the unit will have sufficient technical knowledge to be able to design a simple power supply. A suggested supply circuit, which has not been checked by the author in practice, is given in Fig. 4. The operation of this supply is self-explanatory, and doubtless readers will be able to make up alternative supplies which offer the same performance and which employ components that are already to hand.

So far as voltage regulation is concerned it should be noted that the 9 volt supply need only be well-regulated for the circuit condition in which the relay is de-energised. It does not matter if the supply voltage falls slightly when the relay energises. The 18 volt supply will be adequately regulated by a simple zener diode circuit. If the circuit of Fig. 4 is made up, both R10 and R11 should have values which cause zener diode current, as measured by a meter temporarily inserted in series with each diode, to be of the order of 10mA. Also, S2 of Fig. 2 is not required since the timer can be switched on and off by the switch in Fig. 4. ■

TRUE R.M.S. VOLTMETER

The VX408A true r.m.s. voltmeter, which is now available from ITT Components Group Europe, can display accurately the average voltage or the true r.m.s. voltage of circuits under test as required. This facility is particularly important when studying transitory signals.

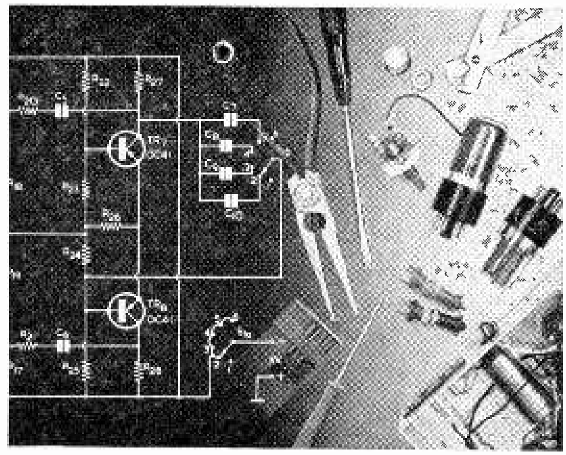
Main features of the VX408A are the high input impedance, and low noise factor preamplifier with attenuator. A high gain amplifier allowing wide excursion of the output signal amplitude provides a large peak factor range when measuring r.m.s voltages.

Made by ITT Metrix, the VX408A has an input impedance of 10 megohm with voltage range up to 300mV and 300V. Band widths are 10Hz to 10MHz for average voltages and 50Hz to 10MHz for r.m.s. voltages.

For further information contact ITT Electronic Services, Edinburgh Way, Harlow, Essex – telephone: Harlow (02796) 26811, ext. 790; telex: 81146.

Visual Bell Indicator

by G. A. FRENCH



THE VISUAL BELL INDICATOR circuit described in this month's article is the result of a request from a reader, who asked for a transistor circuit which would cause a bulb to light up whenever an electric bell was rung. A further requirement was that the bulb should remain illuminated for some four or five seconds after the bell ceased ringing.

Since there are quite a number of applications for a device of this nature, it was considered that the circuitry involved would make a worthwhile subject for the 'Suggested Circuit' series. An obvious application that springs to mind is the installation of the bulb in the living-room, so that the family, whilst watching television, can be warned that the front door bell is ringing or has just been rung. Again, since the system can be adapted for more than one bell-push, it becomes possible to fit a number of bulbs on an indicator board, each bulb corresponding to an individual bell-push. The bulbs will then indicate which bell-push has been pressed, the associated bulb remaining illuminated even after the bell has stopped ringing.

CIRCUIT OPERATION

The circuit which was evolved is shown in Fig. 1, this diagram applying to the situation where there is one bell-push only. The system is powered by a standard bell transformer having an eight volt secondary. The primary of this transformer connects permanently to the mains supply, and the eight volts appearing on its secondary is rectified by D2, causing a d.c. voltage to be continually available across C3.

When the bell-push is pressed, it completes a circuit from the bell transformer secondary to the bell via resistor R1, whereupon a small alternating voltage is dropped across this resistor. The voltage is rectified by diode D1, with the result that capacitor C1 charges up to a voltage lying between 1 and 1.5 volts. Due to the voltage across C1, base current flows in transistor TR1 which, with TR2, forms a Darlington pair. TR2 bottoms and pilot lamp PL1 becomes illuminated, the current flowing through it being obtained from the rectified supply across C3.

As soon as the bell-push is released no further current is drawn through R1, and the voltage across this resistor drops to zero. Capacitor C1 is still charged, and it now commences to discharge via R2 into R3 and into the base-emitter junctions of TR1 and TR2. No discharge current flows via D1, which is now reversed-biased. The base current in TR1 slowly decreases. However, the amplified current in the base-emitter junction of TR2 is still sufficient to maintain this transistor in the bottomed condition for approximately three seconds. After this period, the collector current in

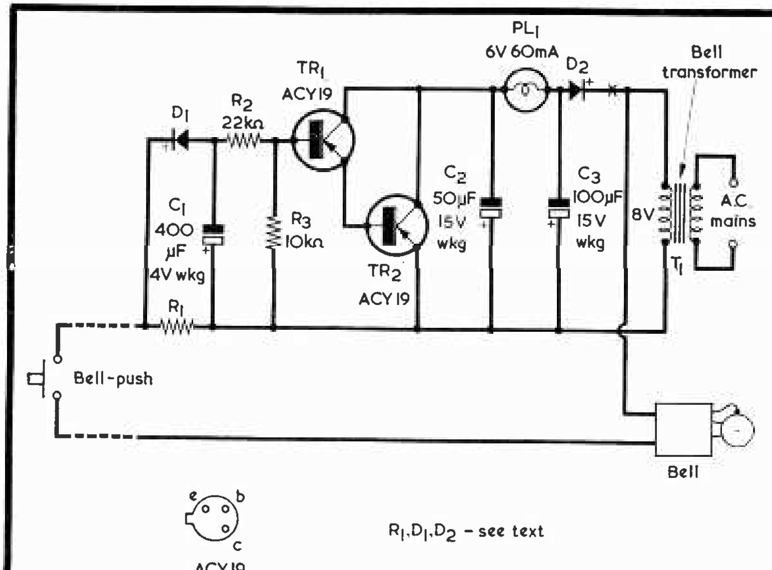


Fig. 1. Circuit of the visual bell indicator. The bulb continues to glow for a short period after the bell-push has been released

TR2 commences to fall and the pilot lamp illumination drops until it becomes completely extinguished. The lamp will then light up again when the bell-push is pressed once more, and will similarly remain illuminated for a short period after the bell-push has been released.

FURTHER DETAILS

There are a number of points in the circuit which have not been covered by the explanation of circuit operation just given. To begin with, both TR1 and TR2 need to be germanium types, as specified, because silicon transistors would exhibit a higher base-emitter forward voltage drop, with the consequence that it would be necessary to drop a much higher voltage across R1 to cause TR2 to bottom. The higher voltage dropped across this resistor might then adversely affect bell operation, this being particularly true if there are long wiring runs to the bell-push. Since TR1 and TR2 are germanium devices, their use in the Darlington configuration causes a small, but significant, leakage current to appear in TR2 when the bell-push is not pressed. This continual leakage current prohibits the use of a battery for powering the light circuit, because the battery would become exhausted too rapidly. At the same time, the light circuit cannot be powered by unrectified a.c. (say, from a second bell transformer) because, although TR2 could pass sufficient current on alternate half-cycles to illuminate the lamp, the collector-base junction of TR1 would conduct on half-cycles when the collector was positive and cause a partial discharge in C1. C1 would not, then, remain charged for a sufficiently long period after the bell-push had been released.

All these factors point to the use of a rectified voltage from the bell transformer which supplies the bell itself. In this case, precautions have to be taken to protect the transistors from the voltage 'spikes' which can appear in an electric bell circuit. A small level of protection is given by C3 but the main protection is provided by C2. In company with the resistance offered by PL1, this component provides a decoupling circuit for any 'spikes' which may be present across C3. The base-emitter junctions of TR1 and TR2 are auto-

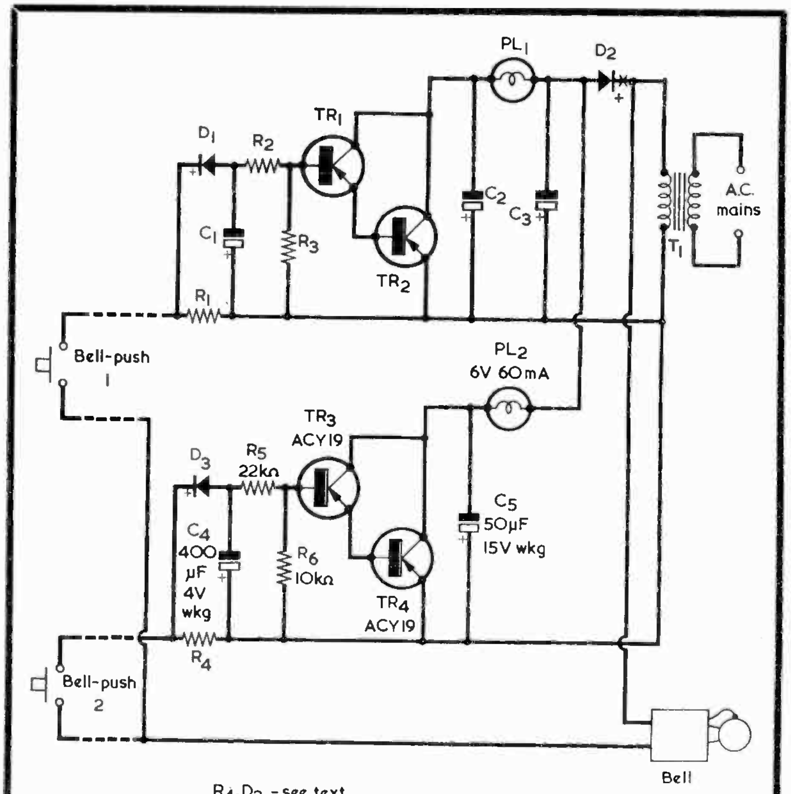


Fig. 2. The circuit can be employed to indicate which of a number of bell-pushes has been pressed, and this diagram shows a system having two bell-pushes and two indicator bulbs. The components in the upper section have the same values as in Fig. 1

matically protected by C1 and R2.

Rectifier D1 can be any silicon rectifier in the Lucas DD000 category. It would be advisable to use a high voltage rectifier for D2. The reverse voltages applied to this component during bell operation may, in some instances, be quite high and a suitable component would be a BY100. In practice the reverse voltages will very probably be considerably lower than those at which this rectifier is rated but, since the BY100 is a low-cost component in any case, and since it functions as well, at low voltages, as a low voltage rectifier, its choice would be justified.

The only remaining component which has not been mentioned is R3. The purpose of this resistor is to reduce leakage current in the Darlington pair of transistors when the bell-push is not pressed, and it has a value which causes the filament of the pilot lamp to be just below glowing level.

If there are more than one bell-push, the circuit to the left of diode D2 can be duplicated. A system with two bell-pushes, intended for operation with a single bell transformer and bell, is given in Fig. 2. The section which includes the second bell-push, D3, TR3, TR4, R4 to R6, C4, C5 and PL2 is identical with that having the similar components in Fig. 1. R4 has the same value as R1, and D3 is the same type as D1.

When Bell-Push 2 is pressed, a voltage is dropped across R4, whereupon C4 becomes charged in the same way as did C1 of Fig. 1. Transistors TR3 and TR4 then cause PL2 to light up, and remain illuminated for a short period after Bell-Push 2 has been released, in a similar manner as did TR1 and TR2.

If further bell-pushes are incorporated in the system further sections may be added, these running from the single bell transformer, and from the single rectified voltage provided by D2.

COMPONENTS

The components employed in the circuit are standard types, and the diodes have already been dealt with. Resistors R2 and R3 (and R5 and R6 in Fig. 2) are 10% ¼ watt components. The 6-volt 60mA bulb (or bulbs) is available from Home Radio under Cat. No. PL7. It is desirable that the transistors specified be employed. Alternatives of similar gain can be used, but they must have equal, or higher, voltage and current ratings.

The bell transformer employed by the author was an inexpensive component retailed by Woolworth's stores, and it has a 5-volt tap in its 8-volt secondary winding. Bell transformers offering less than eight volts will not be satisfactory in the circuit. If the bell transformer offers more than eight volts, resistance should be inserted in series with D2 at the point marked with a cross in Figs. 1 and 2. The resistance should be of the order of 16Ω for every volt in excess of eight volts. In Figs. 1 and 2, the terminal of the bell which does not connect to the bell-push is wired to the upper end of T1 secondary. It will not upset operation of the transistor circuitry if this terminal of the bell is connected to a tap in the secondary instead, since the bell current will still flow through R1 (or R4). It may be found that some low-cost bells function better at a lower supply voltage.

The value of R1 is found experimentally, and should be that which causes a rectified voltage of 1 to 1.5 volts to appear across C1 when the bell-push is pressed. The value will probably be of the order of 3 to 5Ω. Take care not to fit too high a value of resistor initially, or the rectified voltage across C1 may exceed its working voltage rating. The resistor finally employed should be rated at one watt.

If a good quality bell is employed, the circuit should operate reliably as described, but some difficulty may be experienced with inexpensive electric bells which draw a heavy operating current. In most instances it will be found helpful to run such bells from a low voltage tapping, as already described. Alternatively, a small-value resistor may be inserted directly in series with the bell to reduce its current consumption. If the bell draws a heavy current, the indicating bulb will run at reduced brilliance when the bell-push is pressed, and will then brighten when the bell-push is released.

The components in the circuit may be assembled in a small unit near the bell transformer. Capacitor C2 (and C5 in Fig. 2) should be mounted close to TR2 (or TR4 in Fig. 2). If it is found that the bulb continually glows at low level when the associated bell-push is not pressed, the value of R3 (or R6 in Fig. 2) should be reduced until the effect clears. ■

EXPANSION OF ITA UHF SERVICE

The Independent Television Authority announces the award to the Marconi Company of a contract worth more than £1-million. This contract is for the supply of television transmitters needed for the expansion of the ITA network of UHF main stations.

The contract covers the supply of 15 sets of transmitters for installation in different regions of the United Kingdom from 1972 onwards. All these equipments, each rated at up to 12kW output, will be installed at main ITA stations to be built as part of the second phase of the UHF Network of transmitters being constructed to provide a duplicated UHF 625-line combined colour and black-and-white service.

The award of this contract to the Marconi Company follows detailed assessment of tenders from a number of British and overseas firms. It is the usual practice of the ITA to standardise whenever possible on a single manufacturer for a complete series of stations: 26 of the 27 main transmitting stations now in operation or being built in the first phase of this Network are from Pye of Cambridge. The ITA has paid tribute to the equipment supplied by Pye, and their success in meeting the stringent delivery dates under the terms of a contract worth more than £2-million placed with the company in 1967.

Among the technical features of the second phase stations now being investigated by the Marconi Company is the use of five-cavity klystrons of the type pioneered in Europe by the ITA since 1969. All the transmitters will be operated at unattended stations by means of automatic or remote-control.

Each station will have three klystron amplifiers: in normal operation, the vision and sound outputs will be derived from separate amplifiers; the third klystron will form a reduced-power, standby unit. providing combined vision and sound output. Should a fault occur in the main units, the standby unit will be brought rapidly into operation, either automatically or by remote control from one of the 14 ITA regional colour control centres. This will enable the service to be maintained at a power of only 6dB below normal level.

The sites at which these transmitters are to be installed will be announced later. They will extend the coverage in a number of regions in which one or more main transmitting stations have already been included in the first phase of the ITA UHF network building programme.

Sequential Latching Relay Circuit

by

R. A. BUTTERWORTH, G8BI

A simple combination of three relays enables circuits to be switched on, then off, by sequential closures of a push-button

A READY MADE SEQUENTIAL LATCHING RELAY IS expensive and is limited in the number of free contacts available for the operation of external circuits. For those who have never come across such a relay it is like an ordinary relay but energising power does not have to be applied continuously. When operated, circuits are made or broken as the case may be and the power is then removed; when power is again applied all circuits return to their original condition. The sequential operation is achieved by an ingenious mechanism which latches the contacts on and off.

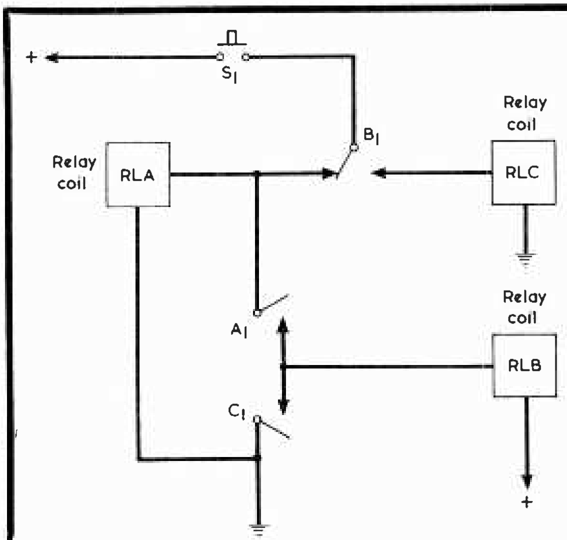
In a suitable circuit, ordinary relays can be made to latch equally as well and possibly more reliably. A minimum of three relays is required, but these can still be cheaper than the proper latching relay. The attraction with using ordinary relays is that more contacts are available. If a very large number of contacts are required a further relay can be added to the system.

OPERATION OF THE SYSTEM

The accompanying diagram gives the basic circuit. Only the contacts required for the operation of the latching system are shown. The two positive supply points are common and, in practice, connect together.

When push-button S1 is pressed, relay RLA is energised and contacts A1 close. RLB cannot operate because it has the positive potential applied to its coil. Immediately S1 is released RLB does operate, since the positive potential at its coil causes a current to flow to earth (negative) through this coil, contacts A1 and RLA coil. This current keeps RLA and RLB energised. Also, contacts B1 change over. Relay RLC does not energise, however, because S1 is open.

When S1 is next pressed, RLC energises and contacts C1 short-circuit the coil of RLA. This releases and contacts A1 open. When switch S1 is released, relay RLC de-energises. Its contacts C1 open and RLB de-energises also. The circuit is then in its original condition, ready for the start of another cycle of operation.



The sequential latching relay circuit. Both RLA and RLB energise when S1 is first actuated, then release when it is next actuated. External circuits may be controlled by additional contact sets on either of these two relays

The author uses this arrangement to switch eight external circuits which bring a stand-by rig into operation if the main transmitter fails. Two microphone, two audio, three operational lines and an indicator lamp are involved, the function of the lamp being to show that the stand-by is in use. The large number of contacts required are provided by three spare contact sets on RLA, three spare contact sets on RLB and two contact sets on a fourth relay whose coil is inserted in series with that of RLA.

Coil resistances and operating voltage are not critical, and the constructor who has sufficient experience with relays to contemplate the construction of a circuit of this nature will be able to employ suitable components that are already on hand or which may be purchased at low cost. ■

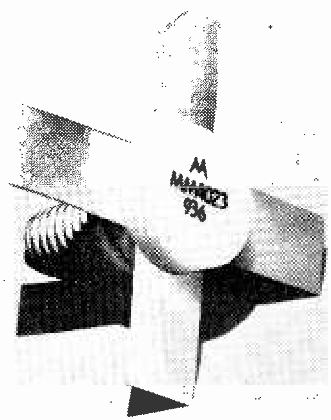
NEW CRT CATALOGUE

Characteristics of more than 80 current GEC cathode ray tubes are contained in a new catalogue 'Professional Cathode Ray Tubes' published by The M-O Valve Co. Ltd.

Types for instrumentation, radar, alpha-numeric display and T.V. studio service are included together with a complete equivalents list, phosphor guide and translation of terms into French, German, Italian and Spanish.

NEWS . . . AND .

SILICON P.N.P. R.F. POWER TRANSISTORS



A further four devices have now been added to Motorola Semiconductors' already established range of silicon p.n.p. r.f. power transistors.

These four transistors, types MM 4020 to MM 4023, have been designed primarily for operation from 12.5V d.c. supplies in v.h.f. large-signal amplifiers in military and industrial equipment operating at frequencies of up to 250 MHz. At a frequency of 175 MHz, the devices exhibit maximum output powers and minimum power gains of 3.5W and 11.5dB, respectively, to 40W and 4.5dB, respectively.

Each of the transistors is of balanced multi-emitter construction with thin-film michrome resistors in series with each emitter to distribute power evenly throughout the chip.

An isothermal design of the device and its case ensures the even generation and flow of heat in and from the chip, rendering each transistor highly stable in varying temperature conditions – the output power typically decreases by less than 10% as the case temperature increases from 25 to 100°C.

All four devices are fitted with strip-line terminal leads which introduce very low series inductance. Combined with the inherently high input impedance of p.n.p. transistors, this low inductance simplifies inter-stage impedance matching and enables wide bandwidths to be obtained in the systems employing these devices.

The transistors are priced at, for quantities of 100 to 499 £3.33 to £20.36 each.

"CENTRALAB" WAFER SWITCHES

Ultra Electronics (Components) Limited, who are marketing the established range of 'Centralab' wafer switches, announce immediate delivery of popular switches in this series. Illustrated are four typical switches: the PA 2019, the PA 2011, the PA 2045 and the PS 109.

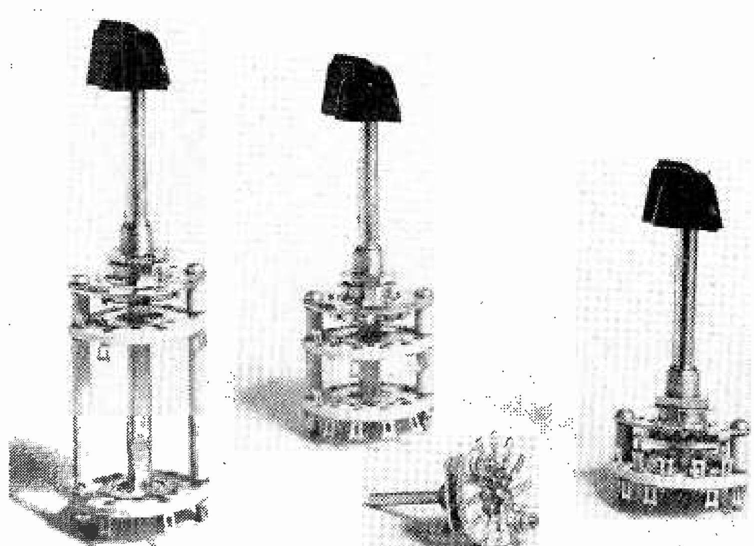
The PA range is a series of ceramic insulated switches offering a wide range of switching combinations, and featuring high-Q low loss design. They are particularly suited for complex switching circuits in modern transistor and thermionic circuits for both commercial and industrial applications. These switches are rated at 110mA/250V a.c. (5.5A/6V d.c.), with a breakdown voltage of 1500V a.c. between critical parts. The PA 2011 and the PA 2045 are four and two pole switches respectively, with 2–6 positions. The PA 2019 is a six pole two position switch. Other switches in the PA 2000 range are available with 1–18 poles and 2–12 positions.

The PS 109 is a sub-miniature deluxe ceramic switch from the PS 100 series, designed for high density electronic equipment and aircraft systems where the size/weight ratio is at a premium. Applications are portable equipments, guided missiles and test instruments. These switches are rated at 75mA/240V a.c. (2A/6V d.c.) with breakdown voltages of 750V r.m.s. The PS 109 is three pole, three positions and other switches in the range are available from 1–12 poles with 2–11 positions.

All switches are single hole bush mounted. Delivery is ex-stock and there is a rapid prototype service.

Full details of the complete range of wafer switches and switchkits (for customer assembly of prototypes) are provided on the new 'Centralab' wall chart available from Ultra Electronic (Components) Ltd., Fassetts Road, Loudwater, Bucks.

'Centralab' is a registered trade mark of Globe Union Inc.; registered user Ultra Electronics (Components) Limited.



'Centralab' wafer switches, left to right, PA2045, PA2011 and PA2019 (general purpose miniature switches). Foreground, PS109 (subminiature ceramic switch)

. . . COMMENT

BBC's SOUND FACTORY

If you pass through West London and have exceptional hearing, you may distinguish above the traffic noise a variety of strange, weird and unreal sounds. If you do, they are most likely to be emanating from the BBC's Radiophonic Workshop. Here can be found a fascinating 'sound' factory which was set up in 1958 to develop techniques for producing electronically, incidental music and special sound effects required for radio and television programmes.

The first of its kind in Britain, the Radiophonic Workshop has built up an international reputation as a creative unit specialising in constructing imaginative sound aids which now play such a vital part in both the visual and aural enjoyment and understanding of programmes. The sound and music is produced by the electronic manipulation on tape of all sources of sound, including natural sounds and the sounds derived from electronic generators.

The Workshop's organiser, Desmond Briscoe, and his small team of highly-skilled assistants who produce original sounds and music or interpret the work of other composers, work in the strange world of sine waves and square waves, of electronic filters, feedback, superimposition and artificial reverberation. It is a world where raw elemental sounds are manipulated, intricately cut and shaped and synchronised to produce sounds musical, comical, fantastic, beautiful or fearful – but all of them new and unusual.

Organiser Desmond Briscoe and his senior assistant, Delia Derbyshire, at work in the BBC Radiophonic Workshop

USELESS HOBBY?

We trust that your wife or girl friend does not look upon your radio activities as a useless hobby. Although, as we mentioned some years ago, some enthusiasts seem to be like the owner of a lathe we once heard of – who just used the lathe to make tools for use with the lathe!

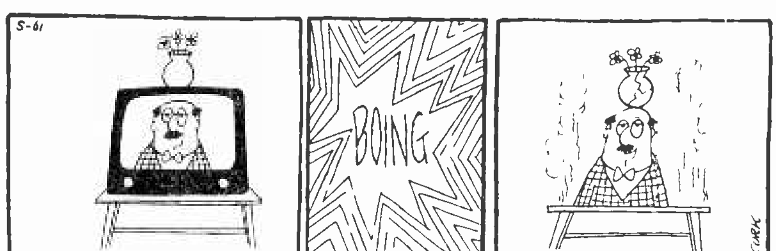
Tim Matthews, in a BBC Woman's Hour talk, claimed that a fantastic interest in useless hobbies is one of the ingredients of the British character. He gave his prize to a gentleman who collected and carefully analysed sink noises. His recording of a basin in a top floor bedroom of a leading Bristol hotel was described: "Starting off in fine control, the final climax and deep-throated gurgle is typical of fifth-floor plumbing, with long drop-down pipe".

RECORDED MUSIC IN CHURCHES

The history of recorded music played in churches and cathedrals goes back quite a long way, with Salisbury Cathedral before the war, St. Sepulchres, Holborn, London, continuing, we believe, an unbroken series extending back to the war years, and Southwark Cathedral starting about 1948.

Those early recitals no doubt sounded very poor in quality judged by today's standards, but a high one has always been set at the recitals given at the Woodford Green United Free Church, regularly announced in this magazine.

We congratulate the organiser, Don Steven, on the completion of 21 years of regular winter monthly recitals. Much pleasure has been given to many by the use of his outstanding equipment in a large and beautiful church.



WRONG BAND

IT WAS ALL VERY WELL TO HEAR OUR FIRST AMATEUR QSO; what we now needed was to get into the QSL card racket.

We had read all about these in the current radio press, although we could only afford to purchase one such weekly journal every now and again. At the time, we gazed longingly at the, to us, complex designs of Scott Taggart and wished we had the necessary resources with which to emulate the circuits featured in the well-thumbed pages of the magazines. However, we set about printing our own QSL cards – at least this was one project we could afford!

With a supply of blank postcards and the printing set previously purchased for the then sole purpose of Sunday School evasion, we arrived at what we fondly imagined was a presentable design.

Within the established pecking order, I occupied the secretarial perch which was, needless to add, the lowest form of life in our particular coop. The 'Chief Operator' being the eldest and the next in line being the 'Chief Engineer', it only left one other to fill the comparatively lowly post of 'Scribe'.

Our QSL card was duly posted to the G6— we had logged when trying out what we thought was our 40 metre band coil. Each coil had to be soldered into circuit – band changing was quite a job! Had the G6— known what was about to descend upon himself, no doubt he would have thought long and hard before mentioning his address to three budding listeners hopefully venturing to burst forth upon the short wave world!

By now our time spent in the shack was somewhat limited, being mainly during some weekday evenings and Saturdays.

It seemed that the utter lack of Sunday morning Church attendances and Sunday School appearances had been duly noted by one of our direst enemies, of which be it noted, we had several. This particular little sneak was still smarting over a defeat we had inflicted upon him in retaliation for a previous misdemeanour directed against us. Performing the greatest of schoolboy crimes, he 'told on us' to the Sunday School authorities who, in turn, informed our respective parents. The ensuing punishments I leave to your imagination. After all, we had done quite well out of stamping the attendance books of other miscreants!

Ruefully done out of our illicit Sunday afternoon sessions in the shack, we awaited the arrival of the QSL card from our victim. It duly arrived. With great excitement we gazed at our very first card, the sense of achievement has never since been forgotten. But what was this? A short note accompanied the card. In rather cryptic terms we were brusquely told that he, the G6—, had been having that particular QSO on the 20 metre band and added "If you really *did* hear me, I suggest you re-calibrate your receiver".

Slowly the inescapable truth dawned upon us; somehow or other we had got it all wrong – what we thought was the 40 metre band was in fact the 20 metre band. Oh well, we had to learn by our mistakes I suppose! C.W. ■

NOW HEAR THESE

Times = GMT *Frequencies = kHz*

● **EL SALVADOR**
YSS Radio Nacional del Salvador has been noted with an English newscast of five minutes duration at around 0350 on **5980** (5kW) and on **9555** (5kW).

● **PAPUA & NEW GUINEA**
Radio Wewak (VL9CD) has been heard on **3335** (10kW) with songs and music at 2018, light music at 2022. Signals faded out by 2026. QRM from adjacent teletype transmitter. BADX (British Association of Dx'ers) also report this station with chimes at 2015 then into Pidgin English, also reported with announcements in Pidgin, chimes and time check identification at 2030.

Radio Rabaul on **3385** (VL9BR), also 10kW, is reported by BADX being heard at 2040 with local music.

Port Moresby (VLK3) has been logged on **3925** (10kW) at 2037 with a talk in English interspersed with music till 2051 fade-out. Reported by BADX from 2025 to 2035 fade-out and at 1959 with music, 'pips', identification and news in English. The channel suffers QRM from JOZ Tokyo (50kW).

Port Moresby (VLK4) is reported by BADX on **4890** (10kW) at 1345 with light music and announcements in English.

● **SOLOMON ISLANDS**
The Solomon Islands Broadcasting Service on **7235** (VQO7) has been logged with news in English at 1100. Also reported by BADX in 'Bandscan' – the broadcast bands survey feature of their journal 'Bandspread' – being heard at 1045 with light music and news at 1100.

● **PAKISTAN**
Quetta may be heard on **3915** (10kW) with Asian-type music at around 1600.

● **MALAWI**
Blantyre can be heard on **3380** (10/100kW) at 1945 with a record request programme – complete with telephone conversations with local listeners making the requests.

● **JORDAN**
Radio Amman can be logged on **9560** (100kW) at 1615 with the English programme.

● **INDIA**
VUD Delhi may be heard on **3905** (20kW) with local music and songs at 1530.

● **MOZAMBIQUE**
Radio Clube de Mozambique, Lourenco Marques, has been logged on **3338** (10kW) at 2000 when closing with National Anthem.

● **TURKEY**
BADX reports reception of the Turkish Police Radio on **6339** (ex-**6442**) from 1445 with local music, announcements and short talks in Turkish. Identification at 1600 sign-off as "Turkiye Polis Radyo".

Acknowledgements:- BADX, Our Listening Post, SCDX ■

QSX

by

FRANK A. BALDWIN

(All Times GMT)

● AMATEUR BANDS

Activities on these bands have been restricted and spasmodic as far as the writer is concerned, this state of affairs being occasioned by the lack of time and the fact that 14MHz has tended to fade-out during the late evenings – a favoured listening time. However, several forays on 'Top Band' during both evening and early morning periods, has produced some real Dx of note. The early morning sessions were held on Sundays during the recent Trans-Atlantic Test series.

On one notable occasion, 'twenty' did produce some results during a CW listening period and a recent late morning period on 21MHz showed that the Far East stations were getting through at good strengths.

Of all the amateur bands covered there is no doubt at all that 'Top Band' produced, at least for the writer, most of the 'goods'.

1.8MHz
EUROPEAN

CW: DL9KRA, EI9J, EI9ON, GM3YCB, GM3YOR, GW3VPL, GW3WRE, GW3XJC, GW3YLZ, HB9NL, OH3XZ, OK1ATP, OK1AUT, OK1DKR, OK1HAS, OK1JAX, OK1JMP, OK1KRS, OK1MDX, OK2ADX, OK2BOB, OK2FPN, OK2PEW, OK2VX, OK3YCF, OL7AOF, OL8NL, PAØPN.

TRANS-ATLANTIC

CW: K1PBW, K3MBF, K8RRH, KV4FZ, VE3DDR, VE7HZ (**1802** at 0547), W1BB, W1HGT, W2FJ, W4QCW/4, W8AH, W8ANO, W8GDQ.

14MHz

CW: FPØCA, JK1MIN, OX3AX, PY8RC, VP2AAP, ZE1CU, ZS3AW.
SSB: FYØNA, PZ5RK, VP9MI, ZE2KV, ZS6AI, ZS6AM, 5Z4DW.

FYØNA provided the information that the Ø series was being issued to non-residents in French Guiana.

21MHz

CW: JAØCUV, JA1NLZ, JA1YFL, JA3BJA, JA3IBY, JA4HIX, ZS6SS.

● BROADCAST BANDS

The Asian Dx 'season' is now declining, the results so far having been well down on last year. During most afternoon listening sessions on the low frequency bands, short skip conditions have prevailed with semi-local utility stations completely covering the wanted transmissions. During the 'season' however there have been a few occasions on which Dx stations have been logged, although the signal strengths have been weaker than in recent years.

The Latin American 'season' will soon be upon us – perhaps we shall all have better luck with these exotic transmissions than we have had with those from Asia and the Far East.

● ASIAN STATIONS

3335kHz 2018 Wewak, Papua/New Guinea, songs and light music heard till fade-out at 2026. Teletype QRM from station 2kHz lower.

3905kHz 1555 VUD Delhi with programme of Indian music.

3915kHz 1559 Quetta, Pakistan, Asian-style songs and music.

3945kHz 1540 Peshawar, Pakistan, talk in dialect. Peshawar is in West Pakistan on the railway to the Khyber Pass, commanding the route Afghanistan–India.

4723kHz 1414 XZK2 Rangoon, Burma, with Asian-type music and songs. Rangoon is the capital city of Burma and is situated on the eastern arm of the Irrawaddy delta.

4890kHz 1400 VLK Port Moresby, Papua, logged from **1318** with a programme of song and music records. VLK is managed by the Australian Broadcasting Commission. The power is 10kW. Schedule is as follows: 2000–2200 (Sundays from 2030), 2215–0700 and 0715–1401.

4927kHz 1600 Djambi, Indonesia, with closing announcements, identification and closing melody, 'Love Ambon'.

5084kHz 1443 Medan, Indonesia, programme of songs and music in the Asian-style. Medan is the capital of East Sumatra.

6045kHz 1500 YDF Djakarta, Indonesia, with local news in Indonesian, mentioning Bandung several times. At **1515** there was an orchestral item consisting of a slow melody on deep-toned chimes and gongs.

7235kHz 1100 VQO7 Solomon Islands, news in English. Weak signal, fading to barely audible at times.

7245kHz 1315 Saigon, Vietnam, radiating a talk in Vietnamese, followed by Asian-type music and songs at **1325**.

7255kHz 1415 VOA (Voice of America) Okinawa, with a talk in an Asian dialect and songs in local-style with announcements.

7270kHz 1356 RRI (Radio Republik Indonesia) YDB3 Djakarta, heard with songs in Arabic-like manner and announcements in Indonesian at **1358.** The power is 50kW.

7310kHz 1455 Pathet Lao, talk in Asian dialect. Martial music at **1500** followed by announcements and a talk in French. Pathet Lao is the guerilla organisation in Laos; a number of clandestine transmitters are operated by them on several channels.

● LATIN AMERICAN STATIONS

The Latin American 'season' is generally reckoned to commence in June, but the writer has found, in practice, that it often starts towards the end of March. There are, however, several South American stations that can be heard all year round, notably the Venezuelians.

4709kHz 0203 HCAV3 Radio Luz y Vida, Ecuador, typical S. American songs and music. Listed on **4712kHz.**

4860kHz 0227 YVQE Maracaibo, Venezuela, with a sports commentary in Spanish.

4890kHz 0215 YVKB Caracas, Venezuela, Latin American-style music and station identification.

4905kHz 0230 ZYZ20 Rio de Janeiro, Brazil, songs and music in local-style and station identification.

4910kHz 0235 YVPN San Fernando de Apure, Venezuela, typical Latin American music programme.

4960kHz 0252 YVQA Cumana, Venezuela, songs, music, interspersed with many announcements.

5045kHz 0305 CP38 La Paz, Bolivia, talk in Spanish and identification, "La Voz del Altiplano".

● BEGINNERS CORNER

For those beginners who wish to 'have-a-go' at some South American stations, the following are listed. They are comparatively easy to receive in terms of LA reception, the main requirement being the ability to get out of that warm bed so early in the morning!

4800kHz 0300 YVMO Barquisimeto, Venezuela, the power is 10kW. This station puts a fairly reliable signal into this country throughout the year. YVMO closes down at 0400 with the National Anthem; listen for the station identification, "Radio Lara".

4900kHz 0330 YVNK Barquisimeto, Venezuela, the power is 10kW. This one also closes at 0400. Listen for the identification, "Radio Juventud". ■

NOTES ON SEMICONDUCTORS

by

P. WILLIAMS

"Begin at the beginning," the King said gravely, "and go on till you come to the end; then stop." ***(Alice In Wonderland.)*** **This article does, indeed, begin at the beginning, and it is the first in a series of short notes, each of which deals with a specific feature of transistor operation**

The complexity of electronic circuits and systems seems to increase without limit. We may have reached the stage where newcomers to the subject are overwhelmed by the quantity of information, and these notes aim to show what can be done with the fewest components. In each brief note some basic property of transistors will be described, and a practical circuit based on it will be given. Many of the circuits will have appeared before, but there will be many novelties, and it is hoped that some characteristics of transistors that are not as widely appreciated as they deserve will be revealed.

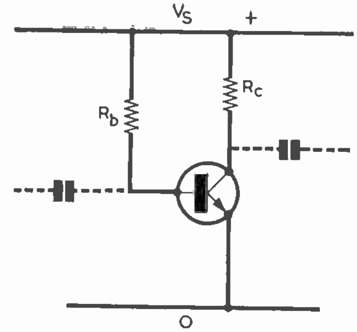
TABLE

Component values for a range of popular transistors at various supply voltages.

Transistor	Collector Current (mA)	Typical h_{FE}	Vs (volts)	Vc (volts)	Rb	Rc
2N3707	0.1	250	6	3	15MΩ	33kΩ
BC108	2	250	12	8	1.5MΩ	2.2kΩ
2N2926	2	80	6	4	220kΩ	1kΩ
2N706	10	40	10	4	39kΩ	560Ω
BFY50	150	50	9	4.5	3.3kΩ	33Ω

SIMPLE BIASING

Turning the clock back 20 years, let us look at the first transistors and the circuits in which they were used. We can then trace the evolution of present-day designs and, perhaps, gain some clues to the future. The accompanying diagram shows the simplest and most familiar form of biasing from those early days. To most experimenters it will be second-nature to choose the correct values of resistors, but a brief explanation may not be out of place for beginners.



The simplest and most familiar form of biasing. For p.n.p. transistors the supply voltage needs to be reversed

The voltage swing and current needed by the load or following stage must be known. Often the collector potential is about half the supply voltage – partly to obtain maximum undistorted voltage swing, but also to give the widest tolerance in component parameters. The collector current should be greater than the required peak load current, and may be, say, twice as much. If IL is the peak load current then

$$Rc \approx \frac{Vs/2}{2I_L}$$

$$\approx \frac{Vs}{4I_L}$$

The base current is then found be dividing the collector current by the d.c. current gain in common emitter, h_{FE} (where the capital letters in the subscript indicate a d.c. parameter, the 'F' means forward current gain and the 'E' that the emitter is the electrode common to input and output).

Thus

$$Ib = Ic/h_{FE} \quad \text{and}$$

$$Rb = Vs/Ib$$

$$= h_{FE}\, Vs/Ic.$$

Comparing this with Rc=2Ic, obtained as above by assuming half the supply voltage across Rc, we have

$$Rb \approx 2h_{FE} Rc.$$

Old hands may by now be scoffing at the naivety of all this and muttering about leakage current, gain spreads, base-emitter drops and the like. Can I beg them to be patient till next time, when we may get a bit closer to reality? The Table gives a selection of suggested component values for some popular transistors at various currents. In all cases near preferred values have been chosen. ■

Direct Conversion Receivers

Part 1

by

PAUL DEWHURST

The synchrodyne – sometimes described as "the superhet with an i.f. of zero kHz" – has long been a source of fascination to the amateur experimenter. In this first article of a 2-part series our contributor discusses the principle of synchrodyne reception, and then introduces some very simple receivers which employ this principle. In next month's issue a complete 3-valve design for the 80 metre band is described

BOTH THE T.R.F. RECEIVER AND THE SUPERHETERODYNE receiver depend for their selectivity upon highly selective tuned circuits at some radio frequency before the required signal is turned into audio, or demodulated, and the difference between them lies essentially in the fact that in the superhet system the selectivity is achieved at a fixed frequency, to which frequency the required signal is converted, whereas in the t.r.f., or "straight" set, the selectivity is achieved entirely at the frequency of the required signal. In both systems pre-detector gain – i.f. gain in the case of the superhet, and r.f. gain (often obtained by means of reaction) in the t.r.f. – is used. This pre-detector gain, and the selectivity obtained at the same time, is necessary because of the detector used, which is nearly always of that type known as an "envelope" detector. Into this category fall the commonly used diode detectors and most of the other detectors that are encountered, such as grid detectors, anode bend detectors, infinite impedance detectors, and the various transistor detectors. All these detectors, or "demodulators", work by a process of rectification, analogous to the ordinary mains rectifier which turns 50Hz a.c. into d.c. for radio sets and other appliances.

This type of detection depends on a non-linearity which tends to turn an alternating current into a pulsating direct one, and any alternating current applied to the device will be treated in this way. Thus, the envelope detector is not frequency conscious; neither, unfortunately, is it very sensitive. For these reasons the pre-detector gain and selectivity mentioned before, and encountered in all normal receiving methods, is essential in a receiver which is to be of any practical use at all. Even the humble, but still very usable, crystal set must have pre-detector selectivity unless one can be certain that only one station is transmitting – and even then a tuned circuit will help as it gives some pre-detector gain. This pre-detector gain can lead to problems, such as instability and cross-modulation, and the pre-detector selectivity causes the complicated alignment procedures necessary with a modern highly selective superhet. Cross-modulation in particular can be a difficult problem to eliminate, for wherever there is more than one strong signal at the grid of an amplifying valve that valve can be driven into its non-linear region and cross-modulation will result, as many who have mistakenly hotted up their old S.640's and R.1155's with "little glass valves" have found out. One can get round this nowadays to some extent by lumping all or most of the selectivity after the first frequency changer in the form of a mechanical filter or multi-crystal filter, but this is relatively expensive and the complicated superhet principle is still involved, which the author has always somehow felt to be rather like cracking a nut with a sledgehammer.

It is interesting to note that, although most Amateur transmission is nowadays either c.w. or s.s.b., the envelope detector cannot by itself produce intelligible audio from these types of signal, and a beat frequency oscillator or carrier insertion oscillator has to be used to heterodyne, or "translate", the received signal into the audio range.

THE SYNCHRODYNE

Shortly after Hitler's War a different system of reception was developed in England by D. G. Tucker, who in 1954 compiled a most interesting account of the development of the system[1]. His homodyne, or synchrodyne, was a method of reception for amplitude modulated signals in the Broadcast band. The principle is quite simple. The receiver has a local oscillator which is synchronised to the carrier of the required signal. This local oscillation is then allowed to modulate the incoming signal, so

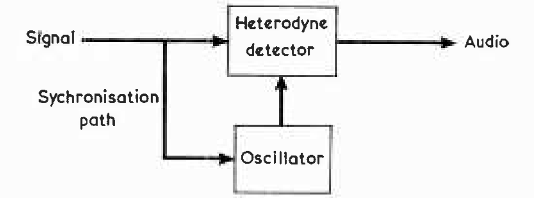


Fig. 1. Basic synchrodyne system

that the wanted signal is obtained immediately as audio, whereas unwanted signals are heterodyned to the difference frequency between their original carrier and that of the required signal. There is thus no detection of unwanted signals (in other words, no audio is produced by them) unless their frequency differs from that of the wanted signal by a frequency within the audible range, and the supersonic heterodynes of the unwanted signals can be rejected by a low pass filter immediately after the heterodyning process. One can regard the system either as a superhet with an i.f. of zero kHz or as a straight receiver with a linear heterodyne detector (the old oscillating detector which is still sometimes used for c.w. and s.s.b. reception and the diode with b.f.o. are, of course, non-linear heterodyne detectors). It is in fact the simplest form of phase-locked receiver.

Fig. 1 shows the essential synchrodyne system. As can be seen, it is basically very simple. Nevertheless, it has never really caught on, most likely because synchronisation and phase-locking are not always easy to achieve without relatively complicated circuitry, and almost certainly partly because by the time it was developed the design of a.m. broadcast valve receivers was well established as the 4 + 1 superheterodyne. It can be seen that the receiver needs no high selectivity before the detector, and r.f. amplification should not be necessary if the heterodyne mixer noise is not too high. The selectivity of the system is determined by the bandwidth of the audio amplifier, as will be explained later on, and this is certainly a simpler way of obtaining selectivity than by using chains of i.f. transformers, or crystal filters.

DIRECT CONVERSION

The idea of the synchrodyne had appealed to the author for some time, although no attempt was made to get one to work, even though circuits are available (see Ref. 1 for circuits and bibliography). But it occurred to him that if one looked at the type of receiver depicted in Fig. 1, and took away the synchronisation path, then one was left with what is now known as a product detector, which of course is nothing more than a heterodyne detector or common-or-garden frequency changer – or frequency translator, as s.s.b. men are now prone to say. The product detector is now commonly found in receivers intended for s.s.b. and c.w. reception, and gives similar results to the diode with b.f.o. over a much larger range of input signal voltage.

Although, as has been stated, the heterodyne detector is an inherently selective device, this selectivity in the case of the usual product detector comes too late in the amplification chain to be of any use, and in general it is true to say that adding a product detector to an older receiver is only of any real benefit from a selectivity point of view when the i.f. passband is greater than the audio passband; this is not a very commonly encountered set of conditions. If the i.f. passband is less than the audio passband, or about the same, then the only point in adding a product detector is to increase the dynamic

DIRECT CONVERSION RECEIVERS

A new approach to amateur band reception

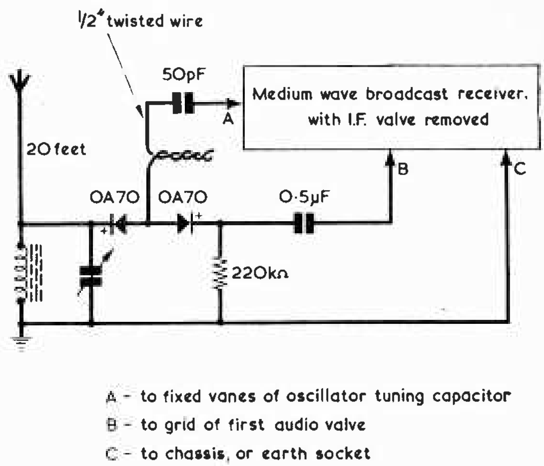
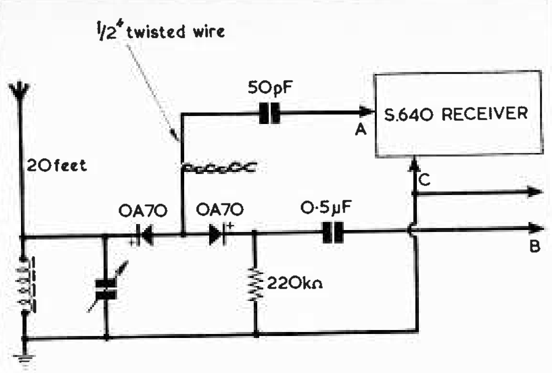


Fig. 2. Simple direct conversion experimental receiver

range of the detector, which was formerly limited by weak b.f.o. injection; a diode with b.f.o. does not sound any different than a product detector.

One could regard the original synchrodyne idea as a phase-locked product detector, but reception of a.m. is possible with a product detector without phase-locking, either by removing the carrier and using one sideband (by means of a highly selective i.f. strip before the detector) which is in effect turning the a.m. signal into an s.s.b. signal, or by using a highly stable local oscillator with a very low tuning rate, which makes it possible to retain the correct tuning position with ease (rather like tuning an oscillating detector to zero-beat, whereupon the modulation becomes audible). This second method, known sometimes as "exalted carrier" reception[2], is not suitable for broadcast reception, because synchronism cannot be maintained accurately enough, and when it is lost distortion occurs. This distortion, however, is not enough to impair intelligibility of speech to any great extent, and the system is quite satisfactory for Amateur a.m. phone reception. It is odd that the R.S.G.B. Handbook (third edition, page 93; fourth edition, page 420) should say that it is unusable or unsuitable for reception; and of course the product detector is ideal for s.s.b. or c.w.

It further occurred to the author that since the product detector in the Amateur superhet was "translating" an r.f. (i.f. actually, but r.f. in effect) signal into audio, then one might be able to do away with the i.f. strip before it and have a product detector working on the actual frequency to be received. After all, if a product detector will turn a 465kHz s.s.b. signal into audio, why should it not also turn a 3.8MHz s.s.b. signal into audio just as well? It seemed theoretically possible, but it also seemed too easy. Again, there was the question which eternally confronts the amateur experimenter when it appears he has had an original idea: "Why, if it is so simple, has it not been done before?" The crux of the matter in this case was whether the heterodyne detector followed by an audio amplifier could in fact provide the sort of selectivity required in today's Amateur bands.



A - to fixed vanes of oscillator tuning capacitor

B - to input of A.F. amplifier

C - to chassis of S.640 receiver and of amplifier

Fig. 3. Improved simple direct conversion experimental receiver

Some simple maths will show that this "direct conversion" system can in fact rival anything but the most selective superheterodyne at a fraction of the cost. Consider the following example, assuming an a.m. signal and a heterodyne detector: if the input carrier has a frequency of 1.0MHz and is modulated with an audio signal of 5kHz, then the received signal consists of the carrier plus two sidebands, one of 995,000Hz and the other of 1,005,000Hz. If then the local oscillator has a frequency of 1.0MHz, the same as the signal carrier, the two will combine in the heterodyne detector and give rise to the following frequencies: sum of local oscillator and carrier, 2.0MHz; difference of local oscillator and carrier, zero Hz; sum of local oscillator and lower sideband, 1.995MHz; difference of local oscillator and lower sideband, 5kHz; sum of local oscillator and upper sideband, 2.005MHz; difference of local oscillator and upper sideband, 5kHz. Thus, only the original modulation is heard and the other components are easily rejected by a low pass filter, being well out of the audio range. It is also quite obvious from this example that any signal differing in frequency from that of the required one by more than that of the assumed audio passband (5kHz) will not be heard, as it will be dealt with by the low pass filter. One could only achieve greater selectivity by restricting the audio response; the same thing, however, applies to the superhet as well, for if one restricts the i.f. response one also restricts the audio response. Thus the direct conversion receiver can rival the superhet from the selectivity angle.

Let us now consider the arrangement from the point of view of c.w. reception, and s.s.b. as well, for an s.s.b. signal is in reality nothing more than a lot of c.w. signals of different frequencies bobbing up and down. Suppose that the input signal is one of 1.0MHz and that the local oscillator is on a frequency of 1.005MHz. These two will mix to produce two beats, one of 2.005MHz, which will be dealt with by the low pass filter, and another one of 5kHz, which will be heard as an audio tone. The snag (there is nearly always one of these) is, of course, [illegible] with superhets using a low frequency i.f. and that is second channel interference, more correctly termed "audio image" in this case. In the example given the image signal will be 5kHz on the other side of the local oscillator, or 10kHz away from the wanted signal, at 1.01MHz. This is, admittedly, a defect in the simple direct conversion receiver – but in practice one can usually manage to avoid the interfering signal by retuning slightly, so that the two signals then give different beat notes relative to one another. The required signal could then be selected by a tunable selective audio filter, which is much easier and cheaper to build than an i.f. filter; or, at the very simplest level, one can tune the receiver so that the beat note corresponds to, say, the resonance in the headphones.

Again, one could use a device such as the "Selectoject"[3], which would give one completely variable selectivity and choice of beat-note frequency, and in practice this would eliminate a lot of the trouble due to the inherent lack of single signal response characteristic of the simple direct conversion receiver.

With s.s.b. the "second channel" signal will be on the wrong side of the oscillator to be intelligible, and will be heard as meaningless sound, through which it has been found in practice one can perfectly well hear and read the required signals. It takes a little practice, but anyone can do it with patience.

In any case, while this "audio image" is admitted to be a nuisance, the simple direct conversion receiver should still out-perform many of the superhets of the older type which are still around. Suppose, for instance, that the audio response of the amplifier is cut off at 2.5kHz (a not unreasonable figure for Amateur communication – indeed a highly desirable one, since anyone radiating a signal with modulation on it of more than 2.5kHz is using more than his fair share of the band), then the total passband of the receiving system is 5kHz, which is not as bad as it may sound, since there are plenty of superhets still around with i.f. bandwidths greater than this. One could make a single signal direct conversion receiver by using the phasing technique, the exact reverse in fact of the phasing method of s.s.b. generation, and such a receiver ought to be able to out-perform the best superhet, given a selective audio system. As soon as the author gets hold of a pair of 7360 beam-deflection valves (and some time!) he intends to experiment along these lines, but meanwhile the results of his experiments with direct conversion so far may be of interest.

RESULTS WITH SIMPLE RECEIVERS

Having decided that the principle was worth investigating, a very simple receiver was made up, which is shown in Fig. 2. This arrangement may cause some raised eyebrows and even some disbelief, but the author can assure readers that it does work, and furthermore only takes ten minutes at the most to get going. An aerial of about 20 feet was used in the original as it was felt that anything longer might give rise to a greater amount of radiation from the local oscillator than would be tolerable. The aerial tuned circuit was first made to resonate between 1.5 and 2.0MHz, since the local oscillator of the usual medium wave superhet with an i.f. of 465kHz or thereabouts oscillates up to about 2.0MHz, thus covering the Amateur "top band" on 160 metres. The back-to-back diodes form the simplest product detector the author has come across, and can be used in superhets in the usual way with good results. The arrangement is not so proof against a.m. signals as a valve product detector, although it could probably be improved by matching the diodes; it is good enough, however, for the present purpose.

The local oscillator in Fig. 1 is the oscillator of the medium wave radio set used for the experiment, which should employ valves in the usual frequency-changer, i.f. amplifier, double-diode-triode and output pentode line-up. This receiver *must* be an a.c.-only type of set with an isolating mains transformer. The author used a crocodile clip to connect the 50pF capacitor to the fixed vanes of the oscillator section of the receiver tuning capacitor; it clipped quite easily onto the solder tag. The ½in. length of twisted insulated wires forms a small capacitor which helps to reduce the oscillator amplitude to a reasonable level, and also helps to reduce "pulling" or interaction between the input tuned circuit and that of the oscillator. If desired, a variable trimmer, preferably of the concentric type, could be used here. Also, the 50pF capacitor may be left out if the distance between the two circuits is not greater than a few inches. The capacitance employed should be the smallest found to give reasonable results. Too little oscillator injection will give high noise level and weak signals, whereas too much injection will give a high noise level and spurious signals due to harmonics of the oscillator. The i.f. valve in the receiver is removed from its socket so that no signals will be heard by way of the normal signal path, and the audio side of the set is used to amplify the tiny audio signals from the product detector.

The arrangement was tried on 160 metres but pulling of the oscillator by the aerial input circuit was so great that the system was unusable. So the input circuit was made to tune to 80 metres (with the tuning capacitor very nearly open, for low C and greater sensitivity) in the hope that the second harmonic of the local oscillator on 1.5–2.0MHz (giving an injection signal of 3.0–4.0MHz) would be strong enough to make the system work. Results were immediately obtained, several s.s.b. Amateur stations being heard quite clearly (though not very loudly, of course, since the only amplification in the system is a two stage audio amplifier – triode and output pentode – in the radio set used.

For those wishing to try out the arrangement the tuning procedure is as follows. First, tune the radio set to 200 metres, at which setting its oscillator will be operating round about 2.0MHz, giving a harmonic of 4.0MHz. Make sure that the wavechange switch is set to the medium wave position. Then tune the input circuit till the noise peaks. About twenty turns of wire on an average ferrite rod will tune to 4.0MHz with a 500pF tuning capacitor; if it does not, remove the ferrite rod slowly until it does or, if this fails, add more turns. Signals should now be heared and can be tuned in by means of the tuning knob of the radio set, thus altering the oscillator frequency. There should be little pulling between the two circuits. The input tuning is fairly flat, and hardly needs altering from one end of the 80 metre band to the other (3.5–3.8MHz). You will not be blown out of your seat by the loudness of reception, and the arrangement is not offered as a receiver for serious use, but those trying it out will almost certainly be amazed by the selectivity of the system and the ease with which s.s.b. signals tune in. More will be heard, of course, if high resistance headphones are used, one lead to chassis and the other via a 0.01μF capacitor to the anode of the output valve in the radio set.

If signals are too weak to be readable, try a longer aerial, connected via a small capacitor (about 15–25pF) if it is very long. However, something should be heard with the short aerial, especially after dark or on Sunday mornings, when there are some quite hefty signals about. Using this extremely simple set-up the author has heard Amateur s.s.b. stations from Germany, the Netherlands, France, and of course plenty of British stations. C.W. reception is also very good, and for the occasional foray onto a.m. just tune to zero beat and try to keep it there. The arrangement sounds and tunes just like a superhet with the b.f.o. on, and if anyone can think of a simpler way of receiving s.s.b. or c.w. with

CAN ANYONE HELP?

Requests for information are inserted in this feature free of charge, subject to space being available. Users of this service undertake to acknowledge all letters, etc., received and to reimburse all reasonable expenses incurred by correspondents. Circuits, manuals, service sheets, etc., lent by readers must be returned in good condition within a reasonable period of time.

Fi-Cord 1A Portable Tape Recorder. — M. A. Amstell, 37 Basing Hill, Wembley Park, Middx – circuit diagram, manual, or any information.

Harverson F. M. Tuner Kit. — W. E. Wood, 13 Tillbridge Lane, Sturton-by-Stow, Lincoln. – circuit of this unit, using ECC85 tuning head.

Grundig Radiogram/Tape Recorder.—F. A. Howes, 38 Manor Road, Banbury, Oxon – service sheet or circuit of this equipment (No.8090 WFE/3D).

'Dinsdale' Amplifier. — R. G. Haseler, 30 Acheson Road, Birmingham 28, B28 OTJ - circuit diagram or any other details.

Receiver Type 78. — D. L. Roberts, 7 Oundle Road, Moreton, Wirral, Cheshire – circuit diagram and any other details of this ex-WD set.

AVO Universal Bridge. — G. M. Keenan, 15 Tudor Drive, Cregagh, Belfast, BT6 9LS – circuit or service manual for AVO Universal Bridge No. 408-151. Also for 'Radar' CRT Tube Tester-Reactivator.

good selectivity, the author would like to hear about it! It is in fact a completely usable receiving system for 80 metres if one uses headphones and is prepared to listen mainly to fairly strong stations, since the sensitivity is naturally limited. The author used it for several weeks instead of his usual Eddystone S.640 receiver, and no particular lack of signals was noticed. Naturally, one would not use such a simple system to try and hear stations from the Antipodes.

ADDING BANDSPREAD

After several weeks' experience it was decided that tuning would be much easier if bandspread was provided, and that more audio amplification would be a good thing. Accordingly, the arrangement shown in Fig. 3 was devised. As can be seen, this is merely a more sophisticated version of the previous circuit. Now, the S.640 receiver is brought into use, its oscillator working on half-frequency to avoid pulling, with the result that bandspread is good and tuning much easier. The audio amplifier consisted of an ECC83 and an EL84, but no details are given of the circuit as almost any sensitive amplifier should do just as well. For really high gain a tape recorder amplifier would probably be ideal, and there is no reason why a transistor amplifier should not be used, as long as some attempt is made to match the high output impedance of the product detector to the low input impedance of the amplifier. The main requirement of the amplifier is that it should have high gain and a low noise figure, which is why a tape recorder amplifier should be effective, since the requirements of such an amplifier are precisely the same.

The author found that the ECC83–EL84 arrangement gave good results, and the gain was enough to make mains hum pick-up a problem at the maximum gain setting. The setting of the tuning capacitor of the S.640 (or of any other set with bandspread which one cares to use) has to be worked out by taking away the i.f. frequency from the required signal frequency divided by 2. So, if one wants to receive signals on 7MHz, then one requires an oscillator frequency of 3.5MHz, and when the oscillator is tuned to this frequency when using the S.640 or any other receiver with an i.f. of 1.6MHz then the dial pointer will show 3.5 minus 1.6MHz, i.e. 1.9 MHz.

The S.640 did not permit operation on 80 metres because it does not tune to a low enough frequency for the second harmonic of the oscillator to fall in the band, but with the arrangement shown in Fig. 3 good results were obtained on 40 metres and on 20 metres. A few s.s.b. signals even came through on 15 metres, although at the higher frequencies it was apparent that a lower-noise mixer was necessary. It was also found that better results were obtained by removing the EL84 and using high resistance headphones, one lead connecting to the chassis of the amplifier and the other to the grid pin of the EL84 socket, thus using the ECC83 only as an amplifier.

(To be concluded)

REFERENCES

1. D. G. Tucker, "The history of the homodyne and synchrodyne", Journal of the British Institution of Radio Engineers, 1954, April, p. 143.
2. M. G. Crosby, W2CSY, "Product detectors". 'Single Sideband for the Radio Amateur', p. 34 ARRL publication.
3. "The Selectojet", 'The Radio Amateur's Handbook', 1965, p. 131. ARRL publication.

CURRENT SCHEDULES

Times = GMT *Frequencies = kHz*

★ SPAIN

RNE Madrid, broadcasts to North America and Canada from 0100 to 0345 on **6140** and **11925.** RNE broadcasts to Europe in German at 2000, French at 2100 and in English at 2200 on **11710.**

★ KUWAIT

Programmes in English are now radiated from 0400 to 0900 and from 1600 to 2100 on **4967.5,** from 1600 to 1800 to Asia on **9640** and to Europe on **11825,** from 1830 to 2000 to Europe on **9640.**

★ MALI

Radio Mali is on the air weekdays from 0600 to 0800 on **4783, 5995,** and **7110.** Also from 1800 to 2330 on the same frequencies. **7110** channel is also used from 1200 to 1430. On the air Sundays from 0800 to 1730 on **7110** and from 1830 to 2300 on **4783, 5995** and **7110.**

★ PAKISTAN

The English Service to North America from 0015 to 0100 is on **9640** and **11672.** Radio Pakistan can also be heard on **7095** and **9460,** in parallel, around 2000.

★ ECUADOR

HCJB, Voice of the Andes, has replaced the **21460** channel with that of **11780** for the European evening transmissions to Europe. **17900** channel has been replaced by **17755** for the same transmission (1845 to 2000 in English).

★ MALAYSIA

Radio Malaysia may be heard with a programme in English from around 1030, with newscast at 1100, on **7280** and on **9660** in parallel.

★ NEW ZEALAND

Radio New Zealand now broadcasts to Australia from 0900 to 1145 on **9520** and **11705,** the latter channel replacing that of **11820.** Radio New Zealand may also be heard at 1655 when signing on to the Pacific Islands on **11780.**

★ UNITED ARAB REPUBLIC

The European Service from Cairo can be heard from 1830 to 2300 on **9805,** this replacing the previously used **9675** channel.

★ USA

KGEI, The Voice of Friendship, San Francisco, can now be heard from 2330 to 0200 on **15280** and from 0200 to 0500 on **9695.** The latter outlet is covered by RSA (Johannesburg) until 0320. KGEI has been heard from 2330 to 2400 on **15280** with programmes in both English and Spanish.

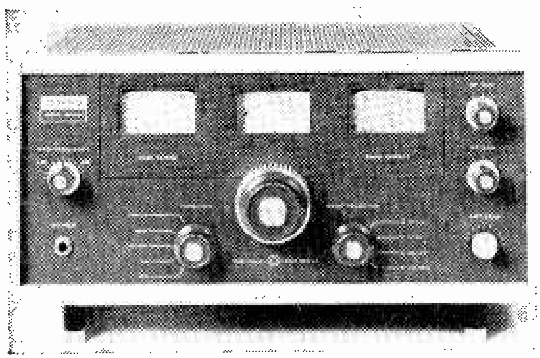
★ VENEZUELA

YVXJ Radio Barquisimeto may be heard from around 2100 to 2200 on **9510** (10kW). At 2200 the channel is used by BBC Atlantic Relay (Ascension Island). YVMQ Radio Barquisimeto may be heard on Sundays from 0245 to 0400 on **4990** (15kW).

★ CENTRAL AFRICAN REPUBLIC

Bangui may be heard from 2045 to 2130 sign-off on **5035** (30kW) with news in English at 2030.

Acknowledgements:- Our Listening Post, SCDX ■



MODIFYING TI
COMMUNICA
(P

The 'Trio' 9R-59DE communicatioı with short wave listeners both in priced, the receiver represents e› expenditure of a little time and n

THE ADVENT OF THE 'TRIO' 9R-59DE COMMUNICATIONS receiver has enabled many short wave listeners not having the proverbial long pocket to obtain a design which is excellent in its class and price range, and which can be further improved by a few modifications. These alterations do not necessarily have to be carried out at one and the same time, and they may be spread out over a period as the available time and spare cash permits.

In this short series, the modifications to be described are divided into two sections. Those discussed here are simple to carry out whilst those described in Part 2 (to be published next month) are more complex.

Throughout the series it is assumed that the modifications described by C. M. Lindars in the October 1970 issue of this magazine have been carried out.[1]

The manufacturer's specification is shown in Table I and the circuit block diagram in Fig. 1. From this it will be seen that the receiver is a single-conversion superhet having an r.f. stage, a mixer with separate oscillator, two i.f. stages with 455kHz mechanical filters, a germanium diode a.m. detector, product detector and b.f.o., audio and power amplifiers, half wave voltage doubler a.g.c. rectifier, noise limiter, S-meter, and h.t. rectifier. A total of seven solid-state devices are incorporated in the circuit, D1 – the S-meter rectifier – not being shown in the block diagram of Fig. 1.

WARNING

Before commencing any of the modifications to be described, all connections to the receiver should be removed. It is particularly important that the mains plug be disconnected from the a.c. mains socket.

At the rear of the chassis, on the back apron, is fitted a slide switch immediately under the fuse-holder. This switch must at all times (in the U.K.) be in the 230V position and *not* in the 150V position. If the receiver is rested on the bench such that the front panel is uppermost, ensure that this switch is clear of the bench top by resting the chassis on two small piles of books. It will be necessary to place the receiver in this position during the lining-up process to be described in Part 2.

1 Copies of the October 1970 issue may be obtained direct from the publisher at 20p post paid.

After any modification, and prior to reconnection of the a.c. mains and switching on the receiver, always ensure that the 230V/150V switch is in the 230V position. If the switch is incorrectly positioned, the fuse will blow (provided the correctly rated 2A fuse is fitted).

During modifications, always stand the receiver on the bench such that the mains transformer is nearest the bench top.

MODIFICATION 1

To completely eradicate any unwanted r.f. couplings along the heater line, three 5,000pF ceramic capacitors are used to bypass the heater line to chassis. The first is connected from pin 4 of V1 (6BA6) to chassis – see Fig. 2(b); the second from pin 4 of V2 (6BE6) to chassis and the third from pin 5 of V3 (a) (6AQ8) to chassis.

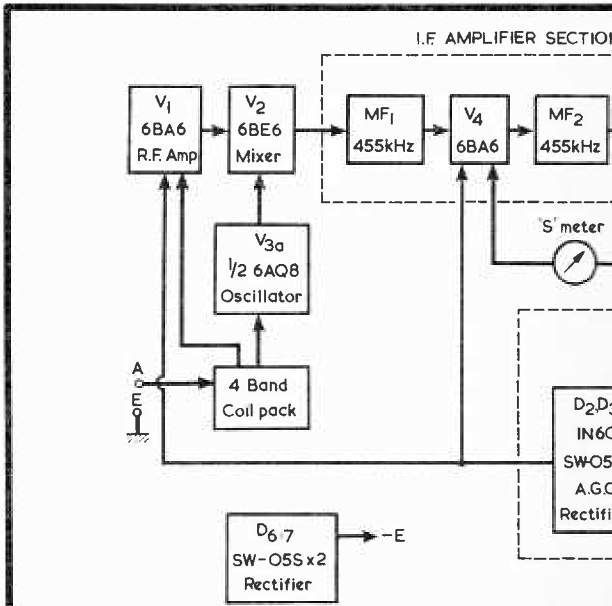


Fig. 1. Block diagram of the

E 'TRIO' 9R-59DE
IONS RECEIVER
RT 1)

Cover Feature

receiver has proved to be very popular
s country and abroad. Very reasonably
llent value, and it is possible with the
ney to further improve its performance

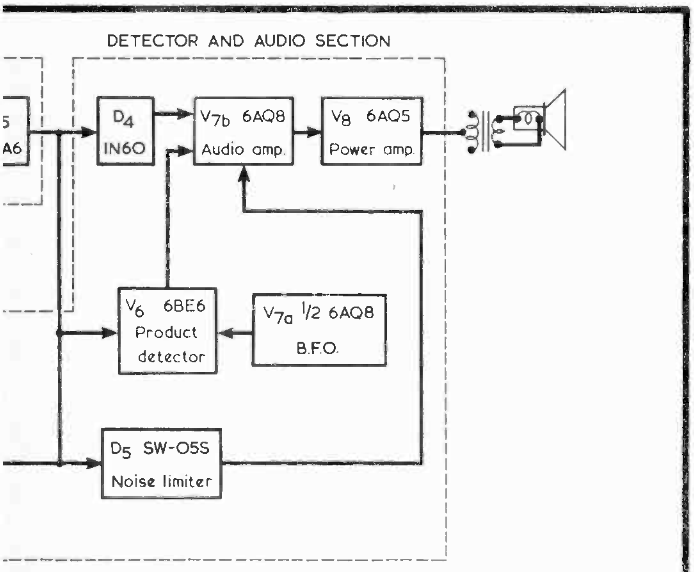
These capacitors also assist in the eradication of a.c. mains hum – of which more later.

MODIFICATION 2

Fig. 2(a) shows the r.f. stage which has been previously modified (as described in the October 1970 issue) to include its own gain control and a 68Ω resistor in the R3 position.[2]

Fig. 2(b) shows the r.f. stage after further modification. From this it will be seen that the a.g.c. components C1 (150pF) and R2 (1MΩ) have been removed. Additionally, the grid resistor R1 (47Ω) has been taken out. A short length of p.v.c. covered wire should now be connected from pin 1 of V1 to the r.f. coil tag from which C1 was disconnected.

2 All R and C designations in this series conform to those of the receiver Operating Manual.



' R9-59DE communications receiver

TABLE I

'Trio' 9R-59DE
Manufacturer's Specification

Frequency ranges
550—1,600kHz
1.6–4.8MHz
4.8–14.5MHz
10.5–30MHz

Bandspread
(Direct Reading on Amateur Bands)
3.5MHz 80m
7MHz 40m
14MHz 20m
21MHz 15m
28MHz 10m

Sensitivity
A, B, C, BANDS–Less than 6dB
(for 10dB S/N ratio)
D, BAND–13MHz; Less than 18dB
(for 10dB S/N ratio)
28MHz; Less than 10dB
(for 10dB S/N ratio)

Selectivity
±5kHz at – 50dB

Audio power output
1.5 watts

Power supply
AC 115/230V, 50/60Hz

Power consumption
45 watts

Valves and Diodes
6BA6 RF Amplifier
6BE6 Mixer
6AQ8 Oscillator
6BA6 I.F. Amplifier
1N60 Detector
SW–05S ANL
SW–05S 1N60 AGC
½6AQ8 BFO
½6AQ8 Audio Amplifier
6AQ5 Audio Power Output
SW–05 × 2 Rectifier
1N60 S Meter

Recommended speaker type
4 or 8 ohm moving-coil speaker

Dimensions
7in. H, 15in. W, 10in. D.

Weight
18.8 lbs.

The 10kΩ potentiometer in the cathode line should be replaced by a 5kΩ potentiometer.

In practice, it has been found that this modification causes the receiver to have enhanced sensitivity. Provided the r.f. gain control is used intelligently, the circuit will not be subject to cross-modulation effects.

The foregoing modification represents the simplest that can be made to the existing r.f. stage, and it is capable of being carried out by comparative beginners. In Part 2, to be published next month, a more complex modification to this stage – the substitution of the higher gain type EF183 for the 6BA6 – will be described. With the high amplification then available, the components which have just been removed from the grid circuit of the 6BA6 will require to be replaced; they should therefore be retained by those wishing to carry out this further modification.

most of it had been induced between the two adjacent transformers.

Unsolder all the output transformer wires, to both primary and secondary connections, then remove the transformer from the top of the chassis deck and re-locate it on the rear apron of the coil pack. When unsoldering the connections from the output transformer, it is necessary to make notes of the wire colour codes and their correct connections. This precaution makes the re-wiring process an easy matter.

The output transformer can be secured to the coil-pack rear apron with the aid of a 6BA nut and bolt fitted with a shakeproof washer. This is fitted through an existing hole located between the r.f. coils for Bands B and C. The necessary second securing bolt is that which already holds the r.f. coil for Band A

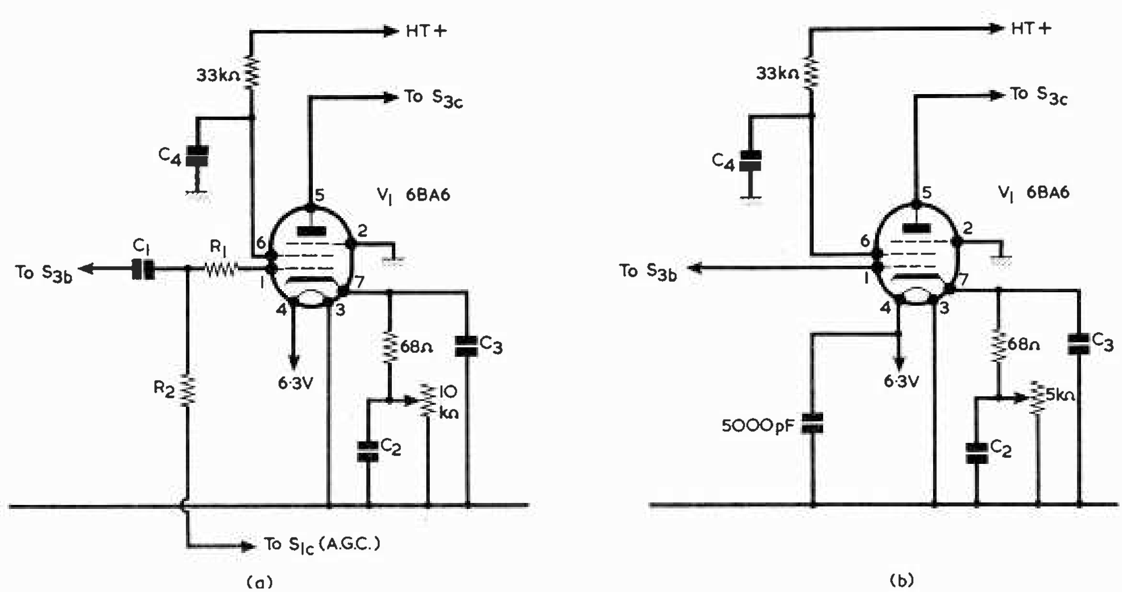


Fig. 2(a). Circuit of the r.f. stage prior to modification. It is assumed that the modifications described in the October 1970 issue have been carried out
(b). Circuit of the r.f. stage after the modifications described here

MODIFICATION 3

The two basic shortcomings of the receiver are (a) excessive 50Hz a.c. mains hum – particularly noticeable when using 8Ω headphones – and (b) oscillator instability above 15MHz.

The first of these will disappear once the following modification has been carried out. The second shortcoming will be dealt with next month.

The first cure for excessive hum tried out was to fit an additional smoothing circuit in the main h.t. line but this proved to be ineffective, only a small improvement being gained at the expense of a reduced supply voltage.

The a.c. mains 50Hz hum was found to be almost entirely due to the siting of the output transformer on the chassis deck right alongside the mains transformer. Upon re-siting the output transformer under the chassis the hum virtually vanished, proving that (this being the largest r.f. coil at the rear right-hand edge of the pack). Rewire the output transformer into circuit.

It will be found, after this modification, that hum has almost completely vanished, even when using headphones. The remaining very small amount of residual hum is that to be expected from most mains operated equipment.

MODIFICATION 4

This modification entails the fitting of a separate 6.3V supply for the Bandspread and Bandset dial lamps, thereby removing some of the load from the hard working mains transformer, and in addition providing a dial lamp for the S-Meter.

For this modification the following items must be obtained: a heater transformer having a rating of 6.3V at 1.5A (H. L. Smith & Co. Ltd., type LT1), an MES bracket (Home Radio Ltd., Cat. No. PLH2) and a round MES pilot lamp rated at 6.3V 0.3A.

The heater transformer is mounted on the chassis deck centrally between the Bandset and Bandspread tuning capacitors. The tags of the transformer should point towards the front panel. Secure the transformer to the chassis deck by means of two 4PK self-tapping screws. When drilling through the chassis deck, take great care to ensure that the drill does not cause damage to any of the coils, coil wiring or switch wafers.

To the input side of the transformer (clearly marked on the component) connect two lengths of p.v.c. covered wire – clear plastic-covered lighting flex is ideal – and feed the free ends down below the chassis through the Bandset dial chassis cut-out. Solder the end of one length to the tag of the on/off switch to which a yellow p.v.c. covered wire is already attached, and solder the end of the remaining length to the fuseholder tag to which a brown a.c. mains input lead is connected. Ensure that the Bandset dial rotates freely and that the a.c. mains input wires to the heater transformer do not chafe against the circular drum drive.

Disconnect the existing heater leads from the mains transformer to the dial lights. These are blue and black p.v.c. leads connected to the mains transformer tags nearest the capacitor C45 associated with the fuseholder. These lengths of wire can now be used when wiring up the S-Meter lamp.

Looking from the front panel, from the left-hand panel lamp assembly connect the blue and black leads to the heater transformer secondary (6.3V) tags. These are clearly marked on the component.

Obtain the MES bracket and secure this to the metal screening panel associated with the Bandspread capacitors. Use the existing bolt at the top of the screen nearest the front panel. Do not tighten this bolt as yet.

Screw home the new pilot lamp, carefully bend the two 'legs' of the MES bracket through 45° and adjust it such that the lamp is near (but not touching) the S-Meter dial edge in a position between the S-Meter and the Bandspread dial assembly. Secure the bolt holding the MES bracket.

Connect two p.v.c. covered wires from the added dial lamp tags to the secondary 6.3V tags of the heater transformer.

NEXT MONTH

In the following issue we shall be dealing with the four steps necessary to achieve oscillator stability above 15MHz, a tape recording facility, the addition of a double-tuned i.f. stage and full frequency alignment.

NEW SPECIAL DUTY BATTERY

A new 12 volt primary battery has been introduced by Crompton Parkinson Ltd., a Hawker Siddeley Electric company, for use where good storage properties are required along with low quiescent current drains and only sporadic high current requirements.

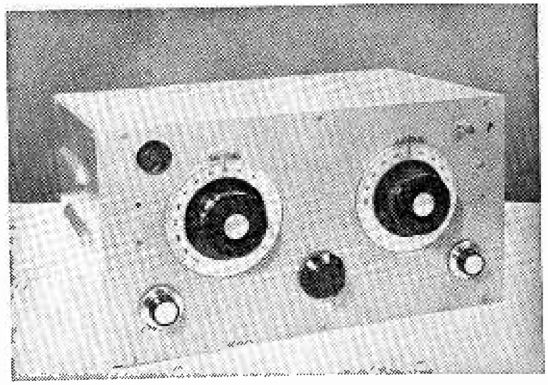
The battery, type G1470, has two 4BA screwed brass terminals soldered to the inner cell assembly. The cell is protected by a plastic wrap to prevent any deterioration leading to a shortening of its life when operating in a damp environment.

THE 'CRUSADER' SIMPLE SUPERHET

(Part 3)

by

F. A. BALDWIN



In this concluding article, the author describes the testing and alignment of the receiver

On completion of the wiring a careful check should be made for dry joints and incorrect connections. If in doubt, always refer back to the circuit diagram given in Fig. 1 published last month. Remove any blobs of solder which may have fallen into the chassis. Check for h.t. short-circuits by testing between the positive plate of C26 (the yellow tag of the dual electrolytic capacitor) and chassis. If an ohmmeter is used for this test, its needle will give an 'initial' kick' due to charging currents in the electrolytic capacitors.

Fit the valves and connect a loudspeaker, and an aerial and earth, to the appropriate sockets. Plug into the a.c. mains and switch on. Pilot lamp PL1 should light immediately and, after several moments, there should be a visible glow from the valve heaters. When the valves have warmed up a hiss will be evident from the speaker as R13 is turned towards maximum. Check reception over the four wavebands. The i.f. transformer cores will not be in their final aligned positions but it should still be possible to receive a number of signals on all four bands.

The accompanying Table lists test voltages obtained with the prototype receiver with no signal applied. These are intended as a guide only, and the usual tolerances apply.

The i.f. transformers may next be aligned. This process should not be carried out until the receiver has had at least ten minutes' warming-up time.

If a signal generator is available disconnect the aerial, select the medium wave band, apply the signal generator output between chassis and the fixed vanes of C1 or C2, and set it to 465kHz. Adjust R13 to its maximum setting and attenuate the signal generator until its output is just audible from the loudspeaker. If an interfering signal causes a heterodyne beat, readjust C1, C10 until the interference clears. Then, using an insulated tool, *slowly* and *carefully* adjust the cores of IFT1 and IFT2 for maximum output from the loudspeaker, increasing signal generator attenuation as required to keep the output just above audible level. None of the cores should require a great deal of adjustment, and it is preferable to align them in sequence, starting at IFT2 and working back to IFT1. The sequence should be repeated, after which the signal generator can be removed. No further i.f. alignment is then required.

Should a signal generator not be available, the i.f. transformer cores are adjusted on a received signal. The procedure is much the same, the main thing to bear in mind being that alignment should always be carried out on a *weak* signal. Switch to medium waves and tune in a fairly weak signal which shows no sign of fading. Attenuate the signal by using a very short aerial, such as a piece of wire several feet long laid on the bench, and carefully tune the receiver for maximum signal strength. After this, leave the receiver tuning undisturbed and adjust the i.f. transformer cores in the same way as for the signal generator. The signal input can be reduced as required by shortening the aerial or, even, by using no aerial at all. (Direct signal pick-up on the coilpack coils and wiring can occur when the receiver is not mounted in its metal case.)

Any adjustment made to the coilpack alignment should be carried out on the aerial circuits only and not in the oscillator section. The trimmers are adjusted at the high frequency end of each band, and the dust cores at the low frequency end. The positions of trimmers and cores are shown in Fig. 10. Each trimmer should be adjusted with C3 set to mid-capacitance. If, however, it is found that a trimmer, even at minimum capacitance, only approaches the signal peak and cannot pass through it, reduce the capacitance inserted by C3 and leave the coilpack trimmer at minimum capacitance. It is possible that second-channel signals may be received at the high frequency end of the SW2 band, the effect being that the same signal appears at two fairly close settings of C1, C10. Should this occur, set C1, C10

TABLE

Circuit Position	*Volts*
Pin 6 V1	150
Pin 8 V1	66
Pin 6 V2	88
Pin 5 V2	130
Pin 7 V3	68
Pin 7 V4	170
Pin 8 V4	180

to the setting where it has lower capacitance and trim to this. It may be necessary to 'rock' C2, C11 back and forth through the signal when trimming at the high frequency end of the SW2 band, due to slight oscillator 'pulling'.

After i.f. and r.f. tests have been completed, the coilpack should be switched to the 'Gram' position. V3 and V4 should then amplify any a.f. signal applied to the a.f. input sockets.

When the best possible results have been obtained, the receiver may be finally installed inside its metal cabinet, whereupon it is ready for use. It is important to note that the receiver must, on no account, be operated without a loudspeaker connected. If the secondary of output transformer T1 is not suitably loaded it is possible for high audio voltages to appear in its primary circuit, with consequent risk of damage.

The author's prototype performs extremely well over its entire frequency range and has provided many hours of pleasurable listening. The *'Crusader'* design offers a very useful introduction to the construction and operation of a superhet receiver. ■

Transistor Power from Valve Amplifiers

by

C. P. FINN

Obtaining power for transistor circuits from the cathode of an a.f. output valve

MANY READERS WILL KNOW THAT A POWER source for a transistor pre-amplifier can be 'borrowed' by tapping off voltage from the cathode of a single-ended a.f. output valve. Usually an adjustment is made to the cathode bias resistor, and if the transistor unit is disconnected a dummy load is substituted.

An improvement is given by connecting a zener diode in the cathode circuit: this eliminates the need for a dummy load and guarantees the stability of the voltage.

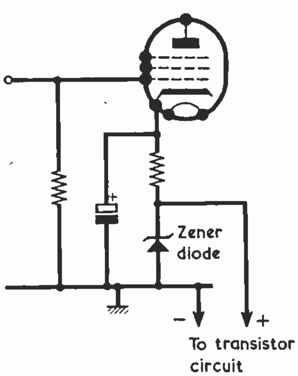


Fig. 1. Obtaining a supply for a transistor pre-amplifier from an a.f. output valve when cathode bias voltage is greater than the required supply voltage

CONNECTING THE DIODE

The zener diode should be wired in place of the cathode bias resistor. If the valve bias is greater than the required transistor supply voltage (and hence the zener voltage) then a smaller value additional bias resistor should be wired between the zener diode and the cathode, as in Fig. 1.

To find the value required for the additional resistor, first subtract the zener voltage from the cathode voltage to obtain the voltage that is to appear across it. Then divide this figure by the cathode current of the valve. Thus, if the zener voltage is 10, the cathode voltage 12 and the cathode current 50mA (= 0.05A), the value of the additional resistor is 2/0.05, or 40Ω. In practice a 39Ω resistor would be used.

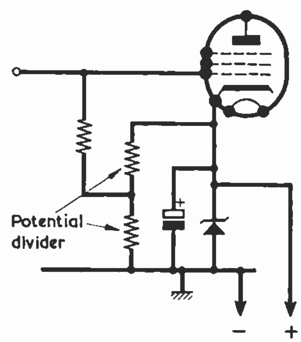


Fig. 2. An alternative circuit, which enables supply voltage to be greater than cathode bias voltage

If the bias is less than the zener voltage the zener diode is still connected in the cathode circuit, and the grid resistor is connected, not to chassis, but to the tap in a potential divider across the zener diode. This arrangement is shown in Fig. 2. The total value of the two resistors forming the potential divider can be anywhere between 10kΩ and 100kΩ, and the ratio between their values should be such that the bias voltage appears across the upper. To give another example, say that zener voltage is 15 and grid bias voltage is 11. Suitable values for the upper and lower resistors in the potential divider would then be 11kΩ and 4kΩ respectively. The latter would, in practice, be 3.9kΩ. ■

RECENT PUBLICATIONS

SINGLE SIDEBAND FOR THE RADIO AMATEUR. Published by American Radio Relay League.

254 pages, $6\frac{1}{2}$ x $9\frac{1}{2}$in. Price £1.85 (37/-) post paid.

The technique of SSB transmission and reception must be comprehended by all present-day and future radio amateurs. It is a complex subject, the understanding of which is greatly helped by suitable instructional literature. This book is eminently suitable for this purpose.

The Foreword to the new edition of this well-known manual states:– "The pages of *QST* have carried the complete story of this transition from AM to SSB, covering the whole field of amateur SSB technique in the process. Building a book around the significant articles published in *QST* has been, and continues to be, a logical way to present the constantly changing SSB picture. This new edition continues the plan of selecting major articles describing principles, practice, and current circuit methods . . . "

"In this edition, special emphasis has been placed on those principles and methods that an amateur *must* observe in adjusting and using his transmitter in order to avoid causing unnecessary interference. In addition, there is a large selection of well-tried equipment designs which the experimentally inclined constructor can modify, combine and select from to his heart's content."

There is, indeed, a goodly selection of equipment designs. The chapter dealing with Exciters includes a Phasing-Type Sidebander, also a Filter-Type 100 Watt Output Sidebander. There is an excellent section on Transceivers; a Solid-State SSB Transceiver, a 50 Watt PEP Output Transceiver for 75, a 7MHz Mobile SSB Transceiver, a Transistorised Transceiver (Almost), a Transceiving Converter for 160 and a 21/28MHz Transverter for 3.5MHz. Transceivers are fully described with considerable constructional information and detail.

Linear Amplifiers and their construction are fully covered, as well as their adjustment and testing. The section on Receivers covers solid-state product detectors and gives a variety of designs for up-to-date SSB receiving equipment.

The book concludes with sections on SSB VHF Techniques, Accessories, Appendices on Valve Ratings, Regulations, etc. A most comprehensive book which can be recommended.

LOW COST PROPORTIONAL. By W. P. Holland. Published by Radio Control Publishing Co. Ltd.

118 pages, $5\frac{3}{4}$ x 8in. Price £1.05 (21/-).

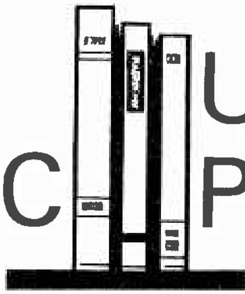
This excellent book is published by the proprietors of the monthly magazine *Radio Modeller*. In the foreword it is stated they receive many enquiries from owners of single channel radio control equipment who wish to progress to a system of control giving smoother results. Upon being advised to "go multi-proportional", these readers find that multi-proportional costs more than they can afford, with the price of a suitable transmitter and receiver being at the £100 mark.

This well-illustrated book explains how to go "multi" for much less than the figure quoted, provided one is prepared to construct the equipment. The publication covers the subject fully, from the simplest pulsed rudder, through proportional rudder, plus sequential, selective and progressive elevator and engine control, to full dual proportional rudder and elevator, with progressive or sequential engine control. The subject matter is dealt with in a logical and concise manner. The earlier chapters cover the theory of the systems adequately and lucidly, the emphasis being on the practical applications of theory rather than theory itself.

In the constructional sections of the book, instructions are set out clearly and fully; in some cases almost as much detail is provided as can be found in a kit manual. It is of interest to note that full details are given for making up printed circuit boards – information which is taken for granted and not provided often enough in constructional articles. There is also a description of a simple transistor tester and some hints on batteries.

A very useful book which can be recommended to radio control model enthusiasts, whether they be beginners or more experienced ■

BASIC UNDERSTANDING PRINCIPLES —



by W. G. Morley

This is the first of a short series written specifically for the beginner

FROM TIME TO TIME WE RECEIVE requests from newcomers to the hobby of radio construction for articles which explain the basic technical principles involved. To meet these requirements in the past, we published the series 'Understanding Radio', this dealing with the main aspects of the subject in some detail. However, 'Understanding Radio' was a long series; it commenced in the August 1961 issue and ended in the March 1970 issue. Since the more elementary points were dealt with early in that series and since newcomers are always joining the ranks of radio enthusiasts, it was considered that a short series giving succinct details on basic principles would be very welcome at the present time. This article forms the first of the series.

ELECTRICITY

An understanding of radio cannot be achieved without an initial appreciation of the fundamentals of electricity. In consequence, we turn first to a consideration of atoms, which are the smallest parts of matter capable of entering into chemical combination.

An atom consists basically of a nucleus around which one or more particles called *electrons* travel in orbit. These electrons carry a negative charge of electricity. The nucleus contains one or more *protons*, each having a positive charge of electricity equal to the negative charge of an electron. The number of protons varies according to the material of which the atom forms a part, but each atom is so constituted that, in the absence of outside influence, the number of electrons in orbit normally equals the number of protons in the nucleus. Thus the total electrical charge presented by the atom is zero, because the opposite charges held by the protons and electrons cancel out.

The manner in which electrons orbit round the nucleus is reminiscent of that in which man-made satellites travel round the Earth. The satellites are held in orbit by the gravitational attraction which exists between the two bodies. Electrons, however, are maintained in orbit due to an electrical attraction to the nucleus, this resulting from the fact that unlike electrical charges attract each other. Similar charges, on the other hand, repel each other.

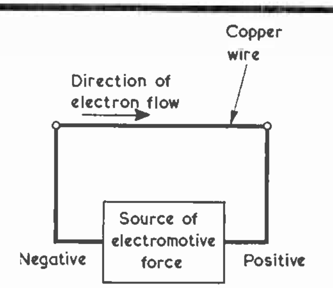


Fig. 1. Illustrating the manner in which an electric current flows in a conductor

In the atoms of some materials, including in particular the metals, some of the electrons are not held very securely to the nucleus. In consequence, an electron may leave the nucleus of one atom and pass into orbit around the nucleus of a neighbouring atom. Since the neighbouring atom then has one electron too many, it may similarly lose an electron to another neighbouring atom, and so on. At the same time, the original atom which lost the first electron now has an electron too few, and is therefore ready to accept a wandering electron from another atom. The overall result is that there is a continual random flow of *free electrons* throughout the atoms of the material, their movement from atom to atom being completely haphazard. It should be noted at this stage that when an atom loses or gains an electron it is described as an *ion*. If the atom has an electron too many it becomes a *negative ion*, because its overall charge is equal to that of the electron; and if it has an electron too few it becomes a *positive ion*, because its overall charge is equal to that of the proton which is not now cancelled by a corresponding electron.

Materials which have free electrons moving from atom to atom are capable of functioning as *conductors* of electricity, the most important of these in electrical work being the metals. All metals, such as copper, zinc, aluminium, etc., are conductors. Fig. 1 shows a copper wire to whose ends are connected a source of *electromotive force* (or *e.m.f.*) which may in practice consist of a battery. The positive terminal of the source of electromotive force connects to the right-hand end of the wire and the negative terminal connects to the left-hand end of the wire. Free electrons at the right-hand end of the wire are attracted towards the positive terminal of the source of electromotive force and leave their parent atoms. These, becoming positive ions, attract electrons from atoms to their left which, in turn, attract electrons from further atoms to the left. The overall result is that there is now a general flow of electrons along the wire from left to right instead of the previous random movement. This flow of electrons in one direction constitutes an *electric current.*

When visualising the flow of the electrons which make up the electric current, it must be remembered that, although the current appears immediately after the source of electromotive force is connected, the actual speed of each individual electron from left to right is relatively very slow. Individual electrons merely pass from one atom to the next, the general *trend* of movement along the wire being from left to right. Another way of looking at the situation is to consider that the copper wire always has the same quantity of electrons in it. When the source of electromotive force is connected to it, electrons flow out of the wire into the positive terminal of the source of electromotive force and an equal number of electrons flow into the wire from the negative terminal of the source of electromotive force.

Fig. 1 also introduces the concept of a *circuit*, since it illustrates a situation where a flow of electrons, and hence an electric current, continually circulates around the combination of the wire and the source of electromotive force.

We have seen that metals are conductors and allow the easy passage of electric current. There are other materials which have very few free electrons amongst their atoms, and these do not readily allow the passage of an electric current. Such materials are known as *insulators.*

ELECTRICAL UNITS

The practical unit of electromotive force is the volt. This may be abbreviated to the single letter V. Subdivisions of the volt are the millivolt (mV), which is one-thousandth of a volt, and the microvolt (μV), which is one-millionth of a volt. A multiple of the volt is the kilovolt (kV), which is one thousand volts. In normal radio work it is very common for the term 'voltage' to be employed instead of 'electromotive force'.

The unit of electric current is the *ampere*, frequently abbreviated to *amp* or the single letter A. Subdivisions of the ampere are the milliampere or milliamp (mA), which is one-thousandth of an ampere, and the microampere or microamp (μA), which is one-millionth of an ampere.

It should be mentioned at this stage that a further electrical unit which can be briefly introduced following our examination of Fig. 1 is the *coulomb*. The coulomb defines the quantity of electricity (virtually, the number of electrons) which flows past a given point in a circuit. A current of one ampere results in the flow of one coulomb per second. The coulomb is not encountered very frequently in simple radio work.

CELLS AND BATTERIES

A common source of electromotive force is the electric cell. One version of the cell is very familiar due to its use in electric torches, and it has the appearance shown in Fig. 2(a). There is a zinc outside container which provides the negative terminal and a brass cap (connecting to a carbon rod inside) which provides the positive terminal. the e.m.f. of a cell of this nature is approximately 1.5 volts when the cell is new.

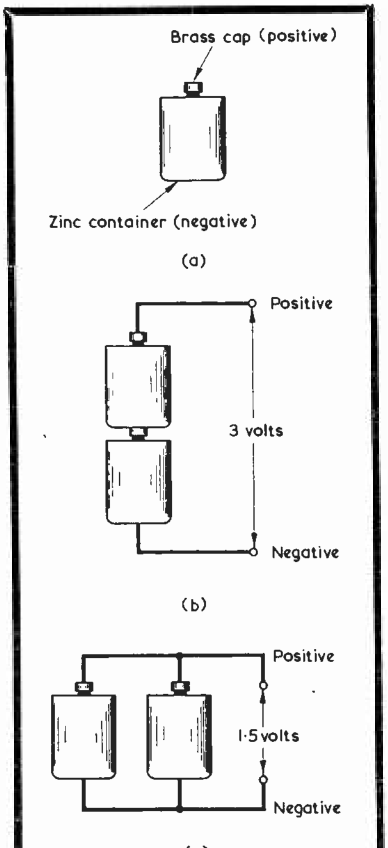


Fig. 2(a). A familiar 1.5 volt cell of the type employed in electric torches
(b). Two cells connected in series form a 3 volt battery
(c). Two cells in parallel provide the same e.m.f. as a single cell

Fig. 2(b) shows two cells connected *in series*. This is achieved by connecting the positive terminal of the lower cell to the negative terminal of the upper cell. The e.m.f.'s of the cells now add, and the e.m.f. available between the bottom and top terminals is approximately 3 volts. If the cells are connected *in parallel*, as in Fig. 2(c), the available e.m.f. remains unchanged at about 1.5 volt, but the combination is capable (provided both cells are identical) of providing twice the useful current that a single cell can produce.

When two or more cells are connected in series, the combination is referred to as a *battery*. Usually, a single cell does not produce a sufficiently high e.m.f. for radio work, whereupon it is customary to employ manufactured batteries which are made up of single cells connected in series.

Other types of cell and battery are commonly encountered. Typical examples are given by 6-volt and 12-volt car batteries. These consist of the requisite quantity of single cells connected in series. In car batteries the single cells offer an e.m.f. of about 2 volts.

The electrical symbol for a single cell appears in Fig. 3(a). The symbol for a battery comprising two cells is shown in Fig. 3(b) and that for one comprising three cells is shown in Fig. 3(c). If the battery to be depicted by the symbol has three cells or more, a very common approach is to draw in the outside cells only, joining these together by a broken line, as in Fig. 3(d). The outermost short thick line in the symbols of Fig. 3 corresponds to the negative terminal, whilst the outermost long thin line corresponds to the positive terminal. These polarities ('polarity' in electricity applies to whether a point has negative or positive charge) are indicated by a minus sign for negative and a plus sign for positive. A useful mnemonic for remembering which of the lines in the battery symbol is positive is to bear in mind that a plus sign has a longer 'length of line' than a minus sign, as also has the positive line in the battery symbol itself.

RESISTANCE

In Fig. 1 we applied a source of electromotive force to a length of copper wire which acted as a conductor of electricity.

It is obvious that there can be no such thing as a 'perfect conductor', because this would infer than an infinite number of electrons could flow through it. In consequence we encounter the situation where any conductor, however 'good' (i.e. however readily it allows the flow of electrons) must still, to some extent, limit the magnitude of the current which passes through it. This limiting effect is referred to as the *resistance* of the conductor, and it is measured in units known as *ohms*. The resistance of any conductor can be directly calculated

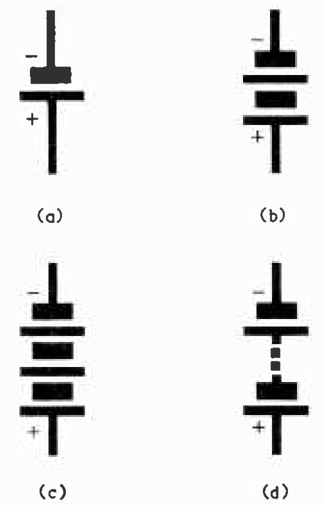


Fig. 3. Circuit symbols for (a) a single cell, (b) a two-cell battery, (c) a three-cell battery, and (d) a battery having three or more cells

from the voltage and current figures which appear in its circuit, the calculation being carried out with the aid of the equation:

$$R = \frac{E}{I}$$

In this equation, R represents resistance in ohms, E represents electromotive force in volts and I represents current in amps. To take an example, let us assume that an electromotive force of 10 volts is applied across a conductor, whereupon a current of 2 amps flows in that conductor. Its resistance, from the equation, then becomes equal to 10 divided by 2, or 5 ohms.

By means of simple algebraic repositioning, the equation may be alternatively written in the forms:

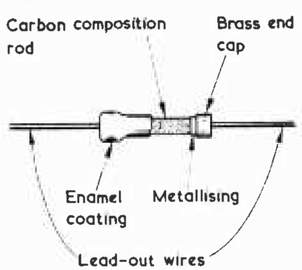


Fig. 4. A typical carbon composition resistor, with part of the protective enamel coating removed to show the internal construction. The metallising at the end of the rod ensures good contact to the brass end cap

$$I = \frac{E}{R} \text{ and}$$

$$E = IR.$$

These alternative versions of the equation are useful because, in practice, we often know the resistance of a conductor together with the voltage across it, or the current which flows through it. We can then determine the unknown quantity (current or voltage respectively) by use of the appropriate equation.

The term 'ohm' is represented by the symbol Ω. Multiples of the ohm are the *kilohm* (kΩ) which is equal to one thousand ohms, and the *megohm* (MΩ) which is equal to one million ohms.

In radio work, special components are manufactured which offer fixed values of resistance. These are known as *resistors* and may have values as high as 20 megohms or even more. They are made in a number of different ways. Carbon composition resistors, having the general construction shown in Fig. 4, consist of a moulded rod which, before polymerisation (i.e. 'setting' of its integral plastic) consisted of a mix of unpolymerised phenolic plastic (Bakelite), carbon particles, and fillers of an inert insulating material. Different resistance values are obtained in production by varying the proportion between the carbon particles and the other ingredients in the initial mix. Another version of the resistor employs a deposit of crystalline carbon or other metal deposited on the outside of a rod of ceramic material. This type of resistor maintains its resistance value more accurately with age than does the carbon composition resistor, and is in consequence referred to as a *high-stability resistor*. A further type of resistor, the *wirewound resistor*, comprises a length of 'resistance wire' (i.e. wire made from a special alloy which offers a relatively high resistance per unit length) wound on a ceramic tube, or 'former' as in Fig. 5(a). The whole is then covered with a protective varnish or cement coating through which metal tags or wires, to which external connections can be made, protrude. Some wirewound resistors have taps along part of their length, as shown in Fig. 5(b), these enabling different values of resistance to be selected. Wirewound resistors are not commonly made for values higher than about 100kΩ because such values require a large number of turns of very thin resistance wire, and are difficult to manufacture economically.

The types of resistor we have just discussed are intended to provide a fixed and unchanging resistance value when they are employed in a circuit. They are then described as *fixed resistors* when it is neces-

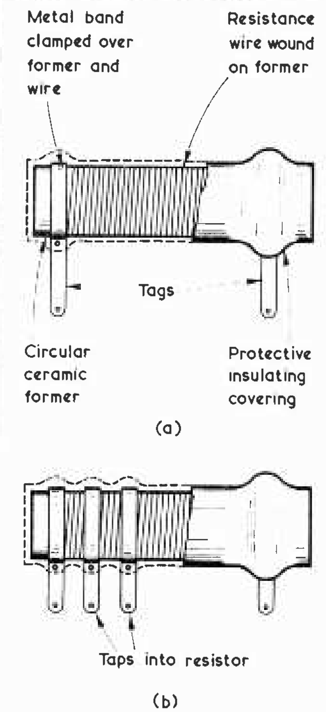


Fig. 5(a). A wirewound resistor (b). Some wirewound resistors have taps to enable different values of resistance to be selected

sary to differentiate them from an alternative type of resistor which is known as the *variable resistor*, or *potentiometer*. In the most commonly encountered form of the variable resistor, the material offering resistance appears in the form of a circular *track*, along whose surface a *slider* or *wiper* can travel, as in Fig. 6(a), thereby enabling any desired resistance within the range of the component to appear between the slider tag and the two tags which connect to the ends of the track. The slider is coupled to a shaft on which is fitted a control knob. Variable resistors may have carbon composition tracks or, in the lower values, wirewound tracks. Some variable resistors are designed to be adjusted for a specific value of resistance, after which they are left alone. These are known as *pre-set variable resistors* or *pre-set potentiometers*, and normally have a screwdriver slot for adjustment of the slider instead of a shaft and control knob. An alternative construction for a pre-set variable resistor is illustrated in Fig. 6(b). Here, the track is provided in the form of a long flat bar along which the slider can be moved.

The terms 'variable resistor' and 'potentiometer' are often confused. To be precise, the component is a variable resistor when connection is made to the slider and to one end of the track, since it then inserts a variable quantity of resistance into the circuit to which it is connected. The component is a potentiometer when a source of e.m.f. is connected across the two ends of the track, and an output, which represents a fraction of the e.m.f., is taken off between the slider and one end of the track.

The circuit symbol for a fixed resistor is shown in Fig. 7(a), and that for a variable resistor or potentiometer in Fig. 7(b), where the arrow represents the slider. An alternative symbol, employed when the component is used as a variable resistor only, is given in Fig. 7(c). The circuit symbol for a pre-set variable resistor or potentiometer appears in Fig. 7(d), with an alternative version, for the pre-set variable resistor only, in Fig. 7(e). Note that the qualification 'variable' can be inferred by adding a sloping arrow, as in Fig. 7(c), and that the qualification 'pre-set' can be inferred by adding a sloping T-shaped sign, as in Fig. 7(e). These additions appear on the circuit symbols of other radio components if they are in the variable or pre-set category.

POWER

When an electric current flows in a conductor it causes the temperature of the conductor to increase. Work has in consequence been done, since electrical energy has been converted into heat. Power defines the rate of doing work and, for electricity, is measured in *watts*. The quantity of watts in a circuit can be calculated from the equation:

$$P = EI$$

where P is power in watts, E is e.m.f. in volts and I is current in amps. Thus, if an e.m.f. of 10 volts is applied to a conductor and a current of 2 amps flows, the power dissipated in the conductor in the form of heat is 10 times 2, or 20 watts.

The term 'watt' may be abbreviated to the single letter W. A thousandth of a watt is a milliwatt (mW), whilst a thousand watts constitute a kilowatt (kW).

Examples of electrical power dissipation in the form of heat are very common in everyday life. A familiar instance is the electric fire, which may employ, typically, one or two 1-kilowatt elements. If a 1-kilowatt element is fed from 240 volts mains, the equation just given tells us that the current consumption in amps is 1,000 divided by 240, which is a little in excess of 4 amps. Electrical power may be converted into forms other than heat. In an electric motor, for instance, it is converted into rotary

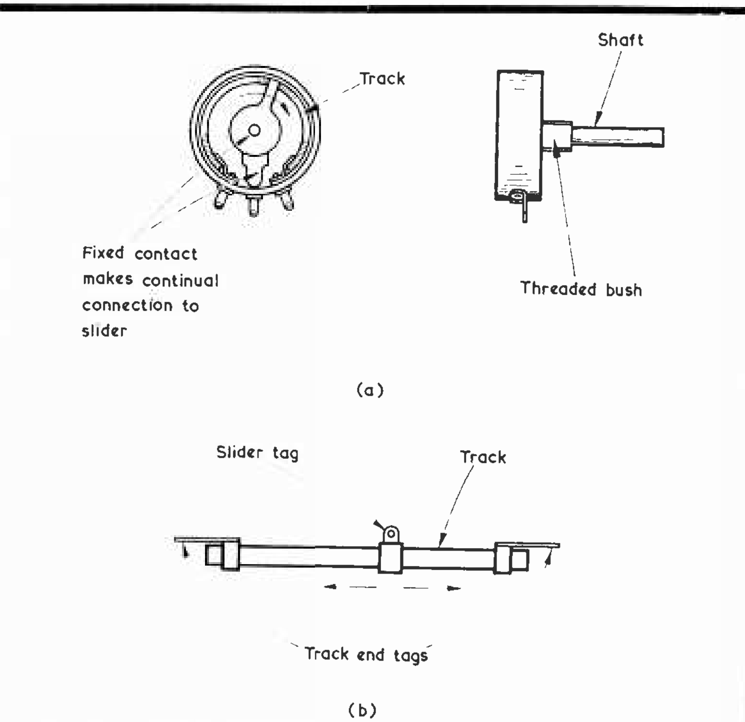


Fig. 6(a). Rear and side views of a variable resistor or potentiometer (b). An alternative construction, employed with some pre-set potentiometers. Connection to the slider is made by way of a flexible wire motion. It is interesting to note that some of the power in the electric motor will still be converted into heat due to the inevitable resistance of the conductors employed in its construction. The object of efficient design, in this case, will consist of keeping the power wasted in the form of heat to as low a level as possible.

Returning to the fixed resistors used in radio equipment, it is evident that, since these are intentionally manufactured to present resistance, they will in many circuits be called upon to dissipate significant amounts of heat. Because of this, resistors are manufactured in a number of different physical sizes, each size being given a wattage rating to indicate the maximum heat which the resistor may safely dissipate before its temperature rise becomes too great for it to continue reliable operation. As is to be expected, the physical size increases as wattage rating becomes greater. Typical wattage rating figures for radio resistors are 1/10 watt, 1/8 watt, $\frac{1}{4}$ watt, $\frac{1}{2}$ watt, 1 watt, 2 watts and 3 watts. In many radio circuits, and particularly in those incorporating transistors instead of valves, wattage dissipation requirements are so small that a large proportion of the resistors employed may safely be as low as 1/10 watt in rating.

The home-constructor should note here that any one size of carbon resistor can be given more than one wattage rating according to different industry specifications. It is possible for resistors to be offered for sale to him at the rating that corresponds to the least stringent specification, and which therefore enables the highest wattage figure to be quoted. Since the home-constructor does not have access to the appropriate technical specifications he is advised to employ carbon resistors at less than half the specified rating at which they are sold. Thus, a nominal $\frac{1}{2}$ watt resistor should not be called upon to dissipate more than $\frac{1}{4}$ watt, and so on. The practice ensures that an adequate safety margin is always kept in hand.

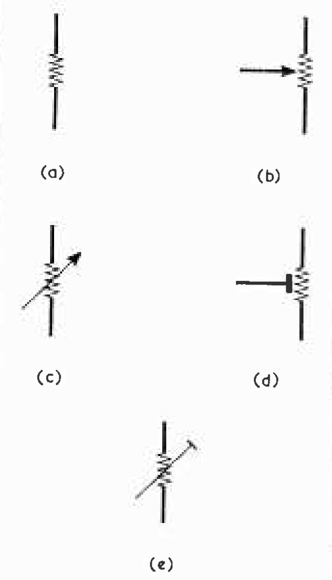


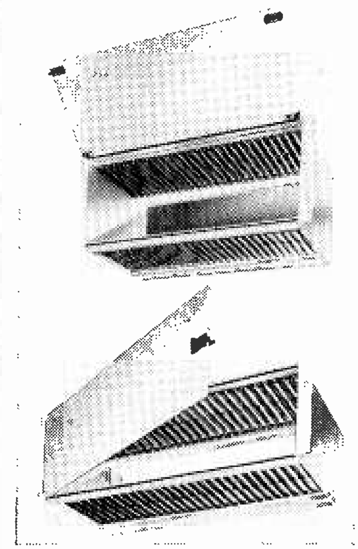
Fig. 7. Circuit symbols for (a) a fixed resistor, (b) a variable resistor or potentiometer, (c) a variable resistor, (d) a pre-set variable resistor or potentiometer, and (e) a pre-set variable resistor

NEXT MONTH

In next month's issue we shall carry on to examine capacitance, inductance and alternating current.

VERO CARD FRAMES

A new feature on their Series 3 Card Frames has now been introduced by Vero Electronics Ltd., of Chandler's Ford, Hampshire. This involves two styles of hinged front panels. On Series 3A the frames have front panels hinged at the side to improve appearance and still retain the adjustable card width features essential for development work. Production frames can be tailor-made to exact requirements. Full card frame apertures are available as all fixings are attached to the panel and not to the frame.



On the Series 3C card frames the front panels are hinged at the bottom and are capable of full 180° movement. This also gives an improved appearance and the panels can easily be removed for servicing. As with the Series 3A full card frame apertures are available as all fixings are attached to the panel and not to the frame.

RECENT PUBLICATION

ITV 1971. Edited by Eric Croston. 240 pages, 9 x 7$\frac{3}{4}$in. Published by Independent Television Authority. Price 75p.

This lively, attractive and colourful book covers virtually every aspect of the ITV system at the start of 1971, ranging from programme policy, through the "Dustbinmen" to questions and answers on colour reception. This exceptionally wide field is dealt with in a series of individual sections which will appeal to anyone interested in television, including the non-technical layman who merely views the transmitted pictures.

Included in the many subjects dealt with are details of individual programmes, finance (and it may be noted here that the Exchequer has benefitted by well over £300 million from Independent Television since 1954), advertising control, technical notes on receiver installation, coverage maps for individual transmitters, and background information on each of the programme companies. There is also a very extensive bibliography listing such diverse titles as "Television And The Child", "One Hundred Years of Georgian London" and the Data Publications' "Understanding Television".

"ITV 1971" contains many photographs and diagrams, a large number being in colour. It is on sale at bookstands and bookstalls and is distributed by Independent Television Publications Limited, 247 Tottenham Court Road, London, W1P 0AU.

TRANSISTOR DATA MANUAL

Avo (Thorn Group) announce the publication of an up-to-date edition of the well-known Avo International Transistor Data Manual.

An alphabetical/numerical index provides instant reference to the complete characteristic data which is given for each transistor in a single line entry across some twenty columns. The lists of alternatives for CV and other types is retained, together with a complete section of outline drawings providing full details of the relevant connections.

Price is £4.40 (including UK postage and packing) and copies are immediately available from Avo Limited, Avocet House, Dover, Kent.

AMATEUR RADIO SCIENTIFIC STUDIES

A VERY INTERESTING PAPER BY GEOFF STONE, G3FZL, appears in the current issue of *Region I News*, the journal of the International Amateur Radio Union, Region I Division, which gives a very good idea of the amount of genuine scientific work which has been accomplished in recent years by radio amateurs working through the Radio Society of Great Britain Scientific Studies activities.

The present phase of RSGB Scientific Activity stems from the International Geophysical Year of 1957, since when scientific programmes started for IGY have been continued. G3FZL reminds his readers that these programmes owe much to Dr. R. L. Smith-Rose who is a Past President of the RSGB and who has spent much of his life as a professional radio engineer, latterly as Director of the Radio and Space Research Station.

During the IGY, emphasis was on radio propagation phenomena associated with sunspot maximum, such as radio wave reflection and scattering from the aurora borealis. New information on VHF propagation by this mode was obtained, which has progressed to closely related fields such as ionospheric sporadic E propagation in the 50 to 70MHz region.

Another subject investigated was that of tropospheric propagation, the original object being to find means of predicting unusual propagation conditions, suitable for use by the average radio amateur equipped only with the more usual, readily available, meteorological instruments. The fact that this project showed an unsuccessful correlation, does not detract from its value, as useful conclusions could be drawn from the results obtained. For instance, it was apparent that a barometer, coupled with a knowledge of the mechanics of tropospheric wave propagation, and a study of current weather maps, would enable quite good predictions to be made.

The Society's interest in tropospheric propagation resulted in it being asked by the CCIR to participate in obtaining data on VHF-UHF propagation across land-sea paths of domestic TV frequencies, in an effort to help the prevention of mutual interference between TV stations. To this end, the Society set up a 432MHz beacon, GE3GEC, in London and invited PE1PL in the Hague to set up an automatic receiving station. As a result, data was obtained which helped in the revision of the CCIR VHF propagation curves used by broadcast engineers for planning purposes. As Geoff Stone comments:- "This is an excellent example of international cooperation and of the work of radio amateurs harnessed to professional requirements."

An interesting observation from the IGY was that amateur radio reports derived much of their value from the fact that there were many of them from widely dispersed locations. Moreover their value was greatly enchanced if they were quantitive rather than qualitative and disciplined rather than haphazard. This factor encouraged the Society to increase its beacon programme, a beacon having the virtue of giving a continuous signal source of known strength and thus encouraging a small group of observers to report regularly.

Geoff Stone concludes his most informative and interesting paper by outlining the Society's current scientific programme. Work on auroral and E layer propagation continues, particularly in relation to 70MHz, with the establishment of beacons in Gibraltar, Rhodesia and Iceland. More intensive investigations into microwave propagation are being planned, with the setting up of 1296MHz beacons in London and on the East Coast of England. The Society is also cooperating in the World Amateur Beacon Project on 28MHz. As the author states:- "Completely new fields remain to be explained and much consolidation in known fields remain to be done. Amateur space communication opens a vast new field which will prove of great interest in the next decade. It can confidently be said that the radio amateur still has much to contribute in scientific projects and it is the responsibility of national societies to stimulate and co-ordinate such activities".

A.C.G.

CASSETTE TAPE HEAD CLEANING

The Bib Division of Multicore Solders Limited, Hemel Hempstead, Hertfordshire, announce the introduction of their new Cassette Tape Head Cleaning Tape, suitable for all compact cassette type recorders and car player units.

The unit comprises a cassette tape container in which high quality cleaning tape has been incorporated to clean tape heads, capstan and pinch wheel. It is very simple to use, in the same manner as a tape cassette it is placed in the machine and operated in the playback position.

A plastic container is provided for the cleaning tape cassette. This handy new accessory retails at 10s 7d. / 53p including p.t.

LOW-COST TV AERIAL

by

T. WHITE

This simple indoor television aerial can be made up in half an hour. In many cases, it will give a better performance than is provided by manufactured indoor aerials of the 'rabbit's ears' variety

MANY READERS MAY RECALL THAT FAMOUS TV sketch in which the late Tony Hancock spent some five minutes or so vainly trying to find the best position for his 'rabbit's ears' indoor TV aerial. Those who have similarly tried to position aerials of this type will probably have encountered the same sort of situation. The average living-room, with its metal fittings, wiring and adjacent plumbing, is virtually saturated with reflected TV signals, these having an almost infinite variety of amplitude and phase differences. Moving an indoor aerial through a foot or so can sometimes make all the difference between a perfectly acceptable picture and one that will not even lock.

REMOVING GUESSWORK

The aerial to be described here does not overcome the positioning problem, but it takes much of the guesswork out of the process. Also, since the conductors used are much thicker than the telescopic rods of many 'rabbit's ears' aerials, signal pick-up is significantly greater. A further advantage is that the feeder to the receiver is well matched at the aerial end, whereupon standing waves on the feeder itself are much less evident. With 'rabbit's ears' aerials it sometimes happens that the positioning of the feeder is nearly as important as the positioning of the aerial itself.

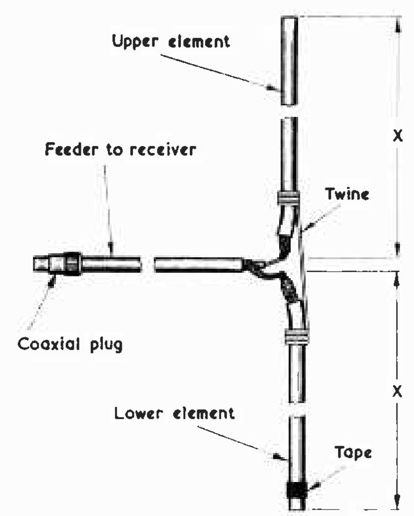
Before carrying on to details of the assembly of the aerial it must be emphasised that, considering the unpredictable nature of the TV field strength pattern inside a house, success in all cases cannot be guaranteed. Also, the performance cannot, of course, be equal to that given by a proper outdoor aerial mounted up in the air above the roof. However, the writer has used aerials of the type to be described on several occasions, with results superior to those given by 'rabbits ears' aerials. In one instance where the aerial was used, the local Band I signal could be received at good strength and good quality where previously it could not be resolved at all. It should be pointed out that, in any event, the cost of the aerial is very small, since it consists merely of lengths of coaxial cable, plus insulating tape and string!

The aerial is intended for use on Bands I and III only. U.H.F. signals can only be reliably picked up with the correct aerial made for the job and, preferably, mounted outside.

ASSEMBLY

The assembly of the indoor aerial is illustrated by the accompanying diagram. It consists of a feeder of ordinary 75Ω coaxial cable which couples to two vertical pieces of similar cable positioned as shown. These two pieces of cable form the upper and lower elements of a conventional half-wave dipole.

In making up the aerial, first select a suitable length of 75Ω coaxial cable for the feeder. About four yards should be adequate for the average installation. Fit a coaxial plug at one end; this will eventually be plugged into the aerial input socket of the receiver. Cut back the outside insulation at the other end by about 1¼in., then tease out the strands of the outer braiding so that they can be twisted up into a pigtail which leaves the cable just after the end of the outer insulation. Strip back the insulation from the inner conductor of the cable for about ½in.



Illustrating the method of assembly of the aerial. In practice, the connection between the centre conductor of the feeder and the upper element is taped up before the twine is fitted

Cut two further lengths of 75Ω coaxial cable to the dimension 'X' (which will be discussed shortly). Strip back the outer insulation of one length by about ¾in. Without teasing out the strands, push back the outer braiding, leaving the inner conductor and its insulation protruding. Cut the inner conductor and its insulation at a point ¼in. from the end of the outer insulation. Pull the braiding back out again, twisting its strands up into a pigtail. Note that no connection is made to the inner conductor of this cable; connection is made to the outer braiding only. Repeat the process with the second length of coaxial cable which was cut to length 'X'.

Solder the centre conductor of the feeder section to the pigtail of braiding from one of the two equal-length pieces of cable. This piece of cable now becomes the upper element of the dipole aerial. Solder the pigtail of braiding from the feeder section to the pigtail of braiding from the second equal-length piece of cable. This second piece of cable is now the lower element of the dipole. Using ordinary electrician's black insulating tape, completely cover the centre conductor from the feeder section and the pigtail of braiding from the upper element so that all metal is covered. Wrap a short length of the tape round the lower element of the dipole near the bottom to act as a marker. This is done because it is difficult to differentiate between the upper and lower elements after assembly has been completed.

Take a short length of thin twine and secure it to both the upper and lower elements in the manner shown in the diagram. The twine is passed around the lengths of cable about 1 to 1½in. away from the termination of the outer insulation. The purpose of the twine is to take the strain from the solder joints when the aerial is suspended by its upper end. Ex-Boy Scouts and Master Mariners will be able to make a neat job of whipping the twine to the cable, but a high degree of skill and neatness is not really required here. The tension on the twine will be low only.

Finally cover all the exposed conductor and the twine with insulating tape to form a neat T-junction. The indoor aerial is then complete.

ELEMENT LENGTH

The length, 'X', of the two dipole elements depends upon the channel to be received. Calculated values for the channels in Bands I and III are given in the Table. In all the cases encountered by the writer, it has been found adequate to cut the elements for reception of the local Band I channel. Reception on the local Band III channel has then been good. This may, of course, have been a matter of luck, and in some localities it may be found better to cut the elements for reception of the local Band III signal, after which it may be found that the resultant aerial copes adequately at Band I. It may even be necessary to use separate Band I and Band III aerials. As was stated at the beginning of this article, success cannot be completely guaranteed in a situation as unpredictable as that of indoor aerial TV reception. In the worse cases some experiment is inevitable.

TABLE

Values of dimension 'X' for television channels in Bands I and III.

Channel	'X'	Channel	'X'
1	5ft. 3in.	8	1ft. 3in.
2	4ft. 7in.	9	1ft. 2½in.
3	4ft. 4in.	10	1ft. 2in.
4	3ft. 10in.	11	1ft. 1½in.
5	3ft. 7in.	12	1ft. 1in.
6	1ft. 4in.	13	1ft. 0¾in.
7	1ft. 3½in.		

After the aerial has been completed, try to find the best position for it in the room. Ideally, both upper and lower sections should be vertical but, if this cannot be achieved, it is in order to have part of the lower section horizontal. If the constructor is fortunate, he may be able to conceal much of the aerial behind furniture. Also, the aerial can be made up using white, instead of brown, coaxial cable, if this matches in better with room decoration.

As a final point it is, in general, better to have the dipole elements some distance away from the TV receiver. This reduces interaction with the receiver r.f. and i.f. circuits and obviates the picture 'noise' that some otherwise serviceable line output stages tend to radiate. ■

ELECTRONIC COMPONENTS BOARD CONFERENCE

A wide-ranging conference on electronic components, to be held at the Royal Garden Hotel, Kensington, London from May 18th to 21st, will invite component manufacturers and users to argue on a no-holds-barred basis. One debate, for instance, covers the theme 'The components industry – dead or alive?'

The conference has been organised by the Electronic Components Board and will be held in conjunction with the International London Electronic Component Show at Olympia, London.

Title of the conference is 'Forward into the 70's.' It will be opened by Dr. I. Maddock, Controller, Industrial Technology at the Department of Trade and Industry.

The discussions will be far from the normal style at technical meetings. As well as the 'Dead or alive?' debate, which will be on the lines of the 'Your Witness' TV feature, there will be a brains trust for a frank discussion of customers requirements and problems.

The conference covers a lot of ground. One morning is devoted to dealing with the B.S.9000 scheme, the series of British Standards effecting assessed quality components. The scheme is now in course of introduction and is of vital interest to manufacturers and users, and will have international impact.

Government and British Standards Institution experts will explain the implications and scope of the scheme while manufacturers and users will comment on operating experience and customer reactions.

During part of the conference, discussions will be divided so that those interested either in passive or active components can both be fully served. Throughout there will be late afternoon sessions organised by specialist groups of the Electronic Components Board.

A number of technical 'state of the art' papers will include probes into the future developments likely in the industry.

General interest in the conference is underlined by the fact that the 55 papers required were 'over-subscribed' by more than 250 per cent. ■

In your work-shop

In this episode, Dick encounters the situation where the repair of a faulty TV line output stage causes the reappearance of the sound signal! Under Smithy's guidance, he also takes a brief look into some aspects of hybrid TV receivers, which incorporate both valves and transistors, and finally turns his attention to the design of current quarter-wave u.h.f. tuners

DICK LOOKED AT THE CHASSIS of the 20 inch monochrome single-standard 625 line television receiver with profound distrust.

Once again he turned up the brilliance. But there was no raster. Once again he turned up the volume. But, apart from a slight background hiss, there was no sound. Once again he looked at the half-dozen or so valves that the set boasted. But all he could see was that their heaters continued to glow merrily away at normal level. And, once again, he applied his testmeter prods between chassis and the h.t. positive line. But only to obtain the expected supply reading of 225 volts.

With an expression of despair he placed his testmeter prods back on the bench, after which he cupped his chin in his hands and glowered at the receiver. He next turned his eyes in the direction of its service manual, which was open at the circuit diagram, and glowered at this instead. The circuit diagram showed that the r.f. and i.f. stages of the receiver employed transistors, as opposed to valves in the remainder of the set. After several unprofitable minutes of gloomy preoccupation, Dick suddenly sat up straight in the unequivocal manner of one who has arrived at a decision.

HYBRID TV RECEIVER

"Smithy!"

The Serviceman, busy at his bench at the opposite side of the Workshop, sighed. Resignedly, he placed his soldering iron on its stand then turned round to face his assistant.

"Am I never," he complained wearily, "to get any peace this morning? This is the fourth time you've pestered me up to now. What's more, you always manage to disturb me when I'm in the middle of a fiddling job. What's the trouble this time?"

"It's this set."

"What's wrong with it?"

"It's got no raster and it seems to be dead both on vision and on sound. And yet the valves are still lighting up and there's stacks of h.t. voltage. I just don't know where to *start*."

Smithy threw a cursory glance at the receiver.

"I should commence by checking the line oscillator and line output stage," he advised. "You'd better see, first of all, whether you're getting drive to the line output valve grid. Set your testmeter to read 200 volts f.s.d., connect its positive prod to chassis and its negative prod to the line output grid."

Dick checked the appropriate valve pin number from the service manual, then made the test connections suggested by Smithy. (Fig. 1(a)).

"I'm getting a reading," he announced, "of about 90 volts."

"Then," pronounced Smithy, "there's plenty of drive going to that line output stage. The line oscillator should be all right or, at least good enough to provide *some* sort of e.h.t. voltage and scan."

"Why do you get the negative voltage?"

"Because the feed to the line output valve is, basically, by way of a capacitor and grid leak, and the grid goes negative just as occurs in a leaky-grid detector," replied Smithy. "I should imagine that the next thing you'd better do is check if there's any h.t. voltage on the line output screen-grid."

Dick applied his testmeter prods to chassis and the screen-grid pin and glanced at his meter. (Fig. 1(b)).

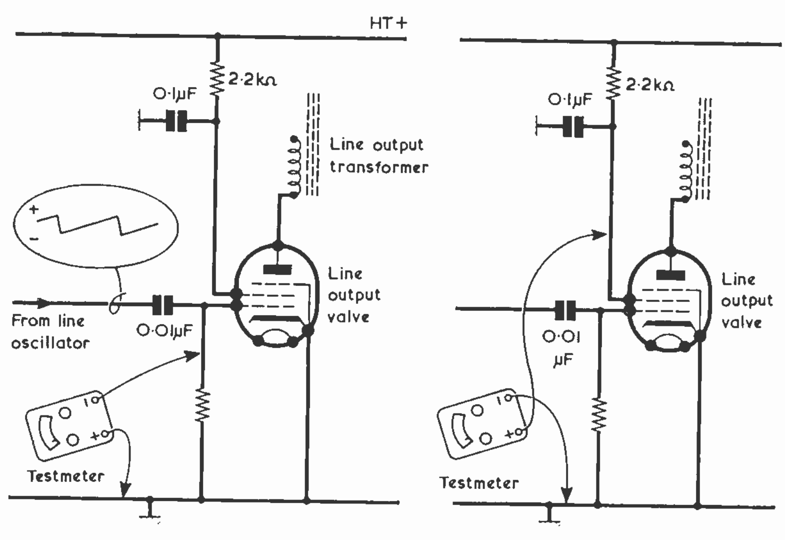


Fig. 1(a). A simple method of checking for drive to a line output valve consists of checking the voltage on its control grid, which should be highly negative of chassis. The testmeter, switched to read volts, should present a resistance of 10,000 ohms per volt or more
(b). Checking the h.t. voltage on the screen-grid of the line output valve

"Hello," he remarked. "We seem to have struck gold first go! There's no voltage on this screen-grid."

"No voltage at all?"

"Nary a sausage."

Despite his irritation at having been interrupted, Smithy looked pleased at the outcome of his suggestion. Forgetting his own work for the moment he wandered over, looked at the chassis on Dick's bench and then at his assistant's testmeter. Dick had been right: there was no voltage whatsoever on the screen-grid of the line output valve.

Smithy reached over and switched off the receiver.

"Check the resistance," he said, "between that screen-grid and chassis."

Dick busied himself with the setting up of his testmeter, then once more touched its prods to the screen-grid pin and chassis.

"There is," he remarked, "a dead short here."

"That will be your fault then," stated Smithy. "The short *could* be in the line output valve so you'd better remove it from its socket to make certain, but it will much more likely be in the 0.1μF bypass capacitor which ties that screen-grid down to deck."

As Smithy watched, Dick quickly checked the valve, which proved to be blameless so far as internal short-circuits were concerned. He next examined the printed circuit around the line output valve to make certain that no accidental bridging had occurred between the foil connecting to the screen-grid pin and that connecting to chassis. Finally, he cut one lead of the suspect screen-grid bypass capacitor. He next applied his testmeter, still switched to read resistance, across this component. (Fig. 2).

"That's it," he called triumphantly. "This capacitor's short-circuit."

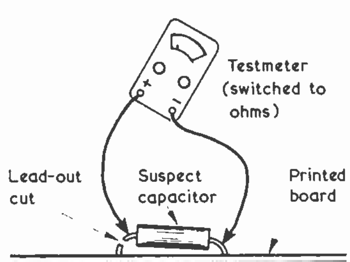


Fig. 2. In some instances the only decisive way of finally ascertaining that a capacitor is short-circuited consists of cutting one lead-out to isolate it from the circuit in which it connects. The lead should be cut such that the capacitor may be resoldered into circuit if it is found to be serviceable

"Very good," commented Smithy. "I'll just hang on here whilst you replace it, to see what happens afterwards. I'm beginning to get interested in this set."

As Dick walked over to the spares cupboard to get a replacement capacitor, Smithy brought his stool over and settled himself comfortably. Dick returned and picked up his side-cutters.

"There are, of course," remarked Smithy chattily, as Dick worked on the repair, "quite a few other ways in which we could have determined that the line output stage wasn't working properly. For instance, although 625 line output transformers are a lot quieter, partly because they run at a higher frequency than the old 405 line output trannies used to be, you can still often hear them singing away when the line output stage is working properly. In our case we were fortunate in being able to find the fault as easily as we did."

"The new capacitor's in now," interrupted Dick. "Shall I switch the set on?"

"By all means."

Dick turned on the receiver. After a short while the booster diode cathode rose to emitting temperature, allowing h.t. current to flow to the line output valve anode. At once, a modulated raster showing the morning test pattern became visible on the screen. Much to Dick's surprise, the accompanying test music also appeared, this being reproduced by the loudspeaker with good volume and excellent clarity.

TRANSISTOR SUPPLY

"Hell's teeth," exclaimed Dick, "this set must be haunted! I've just fixed a line output stage fault and, lo and behold, the sound circuits come into operation as well!"

"There's an easy explanation for that," said Smithy. "And seeing that you've got the service manual for the set open on your bench I'm surprised you haven't spotted it yourself. Just look at this bit."

Smithy pointed to the circuitry around one of the windings on the line output transformer. (Fig. 3). Dick looked at the manual a little uncertainly.

"That winding," he ventured doubtfully, "goes to the line deflector coils, doesn't it?"

"Of course it does," returned Smithy irritably, "but if you look again, you'll see there's a tap in it which connects to a rectifier and then to a reservoir and smoothing circuit. The rectifier circuit provides about 18 volts positive of chassis, and supplies all the transistor circuits of the receiver."

"Blimey," said Dick, taken aback at this unexpected evidence of the fiendish cunning of TV receiver designers," so it does. Do you know, Smithy, I've fixed quite a few sets of this type before, and I've never even noticed that the transistors get their supply from the line output stage."

"It's a fairly common practice," said Smithy. "There are plenty of advantages to the scheme, the first of these being its simplicity and low cost. It's only necessary to add a winding to the line output transformer of the receiver, or to tap into a winding that's already there, whereupon a low voltage supply for the transistor stages becomes available with nothing other than a simple rectifier circuit. Secondly, the line output stage will very probably incorporate stabilised width control to take up variations in mains voltage, with the result that the transistor supply will be reasonably well stabilised as well. A third feature is that the transistor stages don't come on until after the line output stage is running. This avoids one of the design problems that occur with gated a.g.c. circuits. If the r.f. and i.f. stages become operative *before* the booster diode warms up after switching the set on from cold, you can, unless suitable precautions against the effect are provided, have the situation where there is no a.g.c. voltage because of the absence of gating pulses from the line output transformer. With the present system this particular problem doesn't even arise."

"I see," said Dick, examining the circuit of the receiver more closely. "Incidentally, I notice that in this set the stages using transistors are those in the vision and sound i.f. strip, the a.g.c. circuit and the tuner unit."

"That's right," confirmed Smithy. "And since this is a single-standard 625 line receiver, it only has a u.h.f. tuner. There's no tuner unit for Bands I and III at all. I must say, incidentally, that I fully approved of these transistor u.h.f. tuners when they first appeared. The old valve u.h.f. tuners didn't give too much trouble, I know, but my experience has been that the present run of transistorised tuners knocks spots off them so far as freedom from electrical faults is concerned. I assume you've noticed, by the way, that the tuner in this set uses quarter-wave resonant lines."

Dick looked uncertainly at the tuner unit circuit diagram in the service manual.

"Does it?" he queried blankly.

"As opposed," continued Smithy, warming to his theme, "to half-wave resonant lines."

"Ah yes, now," said Dick. "The old half-wave resonant lines, there."

"It's always obvious from the

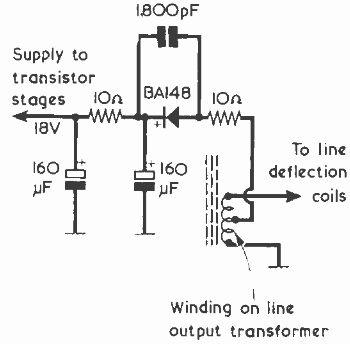


Fig. 3. A typical transistor supply circuit, as employed in hybrid television receivers. The BA148 is a silicon rectifier, and has a p.i.v. of 350 volts and an average maximum forward current of 0.3 amp

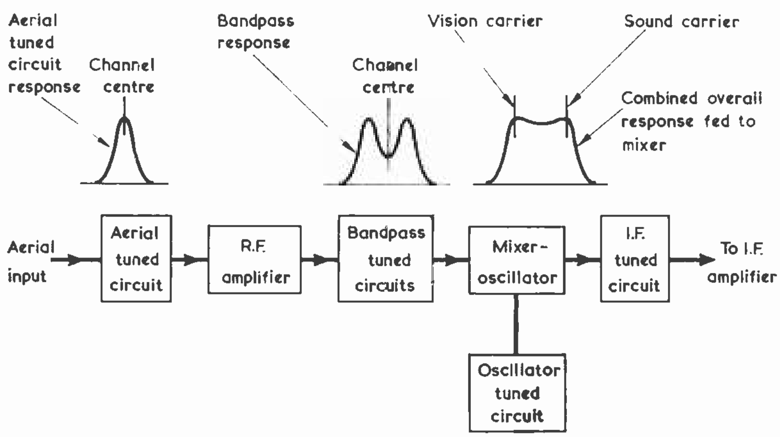


Fig. 4. General television tuner design employs the stage layout shown here. The responses are idealised and are applicable in particular to v.h.f. tuners. U.H.F. tuners may not exhibit so marked a bandpass response

circuit diagram when a u.h.f. tuner has quarter-wave lines."

"Now you put it that way," said Dick, "the obviousness is remarkable even."

"Quarter-wave lines have one end connected to chassis."

"True," said Dick, "very true."

"Whereas half-wave lines are floating and have tuning capacitance to chassis at both ends."

"At both ends," repeated Dick.

Smithy turned a wary eye on his assistant.

"Have you," he asked suspiciously, "any idea of what I'm talking about?"

"I haven't," grinned Dick, "the faintest clue. I got lost immediately after the freedom from electrical faults bit!"

U.H.F. TUNERS

Smithy chuckled.

"Oh well," he said, "I suppose I can't blame you. It's a very long time since we last had a session on u.h.f. tuners and, seeing that we've got an actual tuner to look at as well as the circuit diagram in front of us, it won't do any harm to have a short discussion on them now. I'll have to sketch out a few diagrams, so perhaps you can lend me your note-pad."

"Certainly," said Dick magnanimously, as he reached over for the pad.

He picked this up, shaking off a random surface coating of odd nuts, bolts and small items of hardware, tapped its side smartly on the bench surface to dislodge the dust it had collected, then passed it over to Smithy. That worthy looked distastefully at the yellowing top sheet.

'When," he asked, "was the last time you used this pad?"

"I can't remember," replied Dick airily. "In any case I don't bother to make notes these days. I keep things in my head instead."

"Well," retorted Smithy witheringly, "considering its great size and its vast emptiness there should be plenty of space for them."

Holding the paper disdainfully between thumb and finger tips, the Serviceman tore off the top sheet and consigned it to Dick's rubbish bin. The sheet underneath, yellowed at the edges only, appeared to be just worthy of Smithy's approval. He took out his pen and proceeded to scribble out his first sketch. (Fig. 4).

"U.H.F. tuners," he resumed, "have pretty well the same basic stage line-up as have almost all TV tuners, ever since the first v.h.f. turret types came into use. There is a tuned aerial input stage offering a single peak at the centre of the channel being received, this being followed by an r.f. amplifier which feeds into a bandpass pair of tuned circuits. Ideally, the bandpass pair provides a double-humped curve which is also centred on the channel being received. The output of the bandpass pair is fed to the mixer or frequency-changer and the overall response, from aerial to mixer, is a combination of the aerial input tuned circuit peak and the double-humped response of the bandpass pair. This combination should be a relatively flat response with sound and vision carriers sitting on the edges of the flat part. In practice, it may be a little difficult to get a response as good as the one I've just drawn on all channels with a multi-channel tuner, but small discrepancies in amplitude between sound and vision carriers up to some 3dB overall are permissable and won't cause much trouble."

The Serviceman paused for a moment.

"Getting back to the tuner stages themselves," he went on, "we now have a signal which has passed through the aerial tuned circuit, r.f. amplifier and bandpass tuned circuits, and which is then applied to the mixer. In u.h.f. tuners the mixer also acts as oscillator, the oscillator frequency being above signal fre-

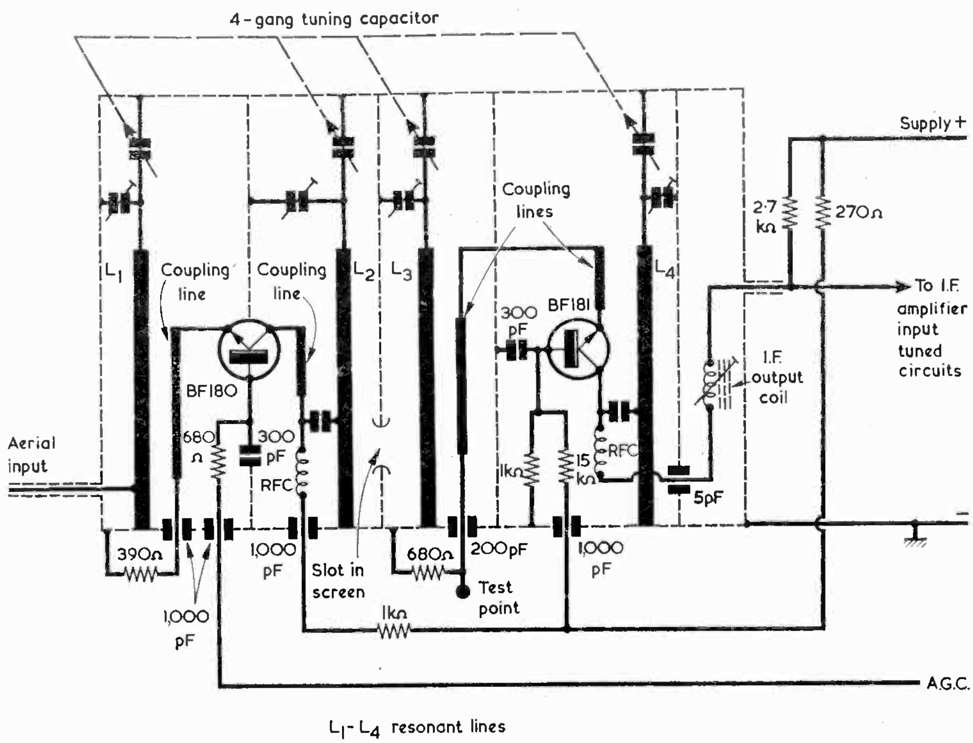


Fig. 5. Typical quarter-wave u.h.f. tuner circuit, shown in slightly simplified form. The component values are representative of current practice

quency. The output of the u.h.f. mixer consists of i.f. vision carrier at 39.5 MHz and i.f. sound carrier at 33.5 MHz, and this band of frequencies is passed through an i.f. tuned coil in the tuner and then fed to the i.f. amplifier. Okay?"

"Yes," said Dick contentedly. "This is all standard TV tuner stuff."

"Good," returned Smithy. "Well now, that's the stage line-up for most u.h.f. tuners. There are exceptions, though, in so far that some u.h.f. tuners omit the aerial input tuned circuit and relay on the band-pass pair only for r.f. selectivity. The aerial input to the r.f. amplifier in these tuners is aperiodic. However, you can forget about the aperiodic types for the time being and concentrate on tuners like the one in the receiver we have here. This is one of the types that does have an aerial tuned circuit."

Smithy indicated the circuit diagram of the tuner unit. (Fig. 5).

TUNED LINES

"The next thing you have to remember," he continued, "is that u.h.f. frequencies require tuned circuits in which the inductive part is much too small in value to be provided by the usual type of wound coil. Because of this the tuned circuits employ 'lecher lines', which are usually referred to just as 'lines'. To understand how these lines work, it's necessary to take an initial gander at elementary aerial theory."

Smithy drew a further sketch on Dick's note-pad. (Fig. 6(a)).

"Here," he said, "is an electrical conductor. If this were employed as a half-wave dipole aerial at the requisite frequency, what would be the voltage and current distribution along its length?"

Smithy handed Dick his pen. After a little thought, Dick added two lines. (Fig. 6(b)).

"Would it be like this?"

"You've got it right," confirmed Smithy, pleased. "An important point is that the voltage is of opposite polarity and is at maximum amplitude at the ends, so that the conductor, at the frequency at which it is a half wavelength long, acts in the same way as a parallel tuned circuit. In half-wave u.h.f. tuners the lecher lines consist of strips of metal somewhat less than half a wavelength long. This shortening reduces the inductance presented by the lines so that, on their own and acting as a dipole, they would resonate at too high a frequency. They are then brought down to the desired frequency by adding capacitance to earth at both ends, whereupon the lines plus the capacitance provide the tuned circuits for the tuner. (Fig. 7(a)). The 'earth' in this case is the actual

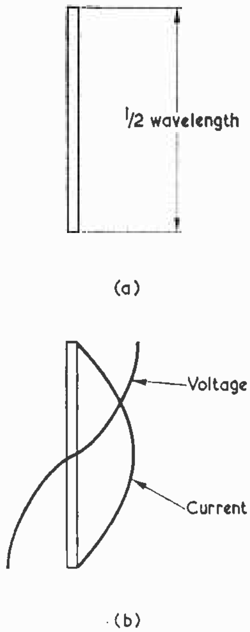


Fig. 6(a). A conductor whose length is equal to a half wavelength at a specific frequency (b). The voltage and current distribution in the conductor if this is energised as a dipole aerial

tuner chassis which can be assumed to possess very low inductance in itself. As you may imagine, if the capacitances at each end of a half-wave line are equal, then the centre of the line has zero r.f. voltage with respect to earth."

"What about the quarter-wave tuners?"

"The quarter-wave tuners were a logical development from the half-wave types," replied Smithy. "It was realised that, since there could be zero r.f. voltage at the centre of a resonant half-wave line relative to earth, that centre could be connected directly to earth without upsetting the operation of the line and the associated circuit. The further reasoning was that, since the centre of the line could be connected directly to earth, there was no point in continuing the line after that earth connection!"

"Hey?"

"It's quite true," said Smithy. "And that's where the term 'quarter-wave' comes in, since the line which terminates at earth is half of a half-wave line. In the quarter-wave tuner, the line terminates at a flat earth plate, which is actually one side of the tuner chassis. (Fig. 7(b)). The quarter-wave line then works in exactly the same manner as if it had another quarter-wave section, with an equal-value capacitor to earth, sticking out beyond the earth plate. (Fig. 7(c)). However, the extra quarter-wave bit is screened from the remainder of the circuit by the earth plate, and so it isn't really needed."

"I seem to remember something similar with half-wave and quarter-wave aerials," said Dick, frowning. "But I can't quite put a finger on it."

"What you're probably thinking about," said Smithy, "is the quarter-wave aerial which is mounted perpendicular to a flat earth plane. The assumption is made that the earth plane reflects an image of the upper quarter-wave section, so that the aerial behaves in a similar manner to a half-wave dipole. You could say that the earth plate in the u.h.f. tuner 'reflects' the upper quarter-wave line in the same way, so that the quarter-wave line works effectively as a half-wave line. The analogy isn't perfectly true, but it's near enough to rely on if you find it helpful in understanding how the tuner unit quarter-waves lines operate. The quarter-wave lines in a u.h.f. tuner are shorter than an actual quarter-wave, which means that they can be brought down in frequency by adding capacitance between the hot ends and earth. Obviously, this capacitance needs to be added at the non-earthy end of each line only, with the result that each line requires only one set of tuning capacitance instead of, as with the half-wave lines, two sets of capacitance. There is, thus, an economy in components in addition to the economy in space resulting from the use of shorter lines. In a u.h.f. tuner the capacitance for each line is provided by a trimmer plus one gang of a 4-gang variable capacitor which provides tuning through all the channels."

CIRCUIT OPERATION

"Ah yes," responded Dick, pointing at the circuit of the complete tuner. "That 4-gang capacitor will be the one shown here. The tuner is divided into sections by means of screens, and one gang of the tuning capacitor appears in each of the first four sections."

"You've got the idea," confirmed Smithy. "The total coverage provided by the 4-gang capacitor is from Channel 21 in Band IV to Channel 68 in Band V. In other words, from about 470MHz to 855MHz. The mechanical structure of the tuner closely resembles its circuit diagram, being divided into individual compartments, with a tuned line in each of the first four compartments. (Fig. 8). The resonant lines consist of silver-plated metal strips which are made with precise lengths and widths. They are each soldered to the chassis side at one end. The next point to take up is that, if one line runs parallel to another line, there is an inductive coupling between them. An inductive coupling to a line can also be obtained by running a piece of wire alongside it."

"Fair enough," remarked Dick. "It seems as though you can have direct connections, too. For instance, the aerial input in the circuit of the complete tuner couples directly to line L1 at a point near its earthy end. This is, I suppose, equivalent to tapping into a point near the earthy end of a coil."

Smithy nodded in assent.

"I see that line L1," continued Dick, encouraged, "then couples to the emitter of the first transistor by way of a coupling line which runs alongside L1. Correct?"

"Correct," confirmed Smithy. "The collector of TR1 has a mixture of inductive and capacitive coupling to L2, this being provided by a coupling line and a small-value capacitor. The positive feed for TR1 collector is obtained via an r.f. choke. This will normally be a small air-cored self-supporting choke having about a dozen turns or so."

"The base of TR1 goes down to deck via a bypass capacitor," remarked Dick. "That means that it's operating as a grounded base transistor, doesn't it?"

"That's right," replied Smithy. "The grounded base configuration enables the transistor to amplify at much higher frequencies than it can do when it's in grounded emitter. In the present circuit, forward a.g.c. is applied to the base of TR1 via the 680Ω resistor."

"Forward a.g.c.?"

"Forward a.g.c.," repeated Smithy firmly. "There are two ways of applying a.g.c. to the base of a transistor so as to reduce its gain. One method consists of reducing the base current, and this is known as 'reverse a.g.c.'. Reverse a.g.c. is what is normally employed in transistor portable radios. The other consists of reducing its gain by *increasing* its base current, and this is 'forward a.g.c.'. It works because the increasing base current reduces the impedance in the base-emitter junction. If you assume that the base material presents a fixed resistance between its input terminal and its actual junction with the emitter, a reduced impedance in the junction itself means that less signal voltage appears across that junction."

"What's the advantage of forward a.g.c.?"

"It allows the transistor to pass a relatively high collector current when it is biased to give low gain," replied Smithy. "The result is that it cannot then be overloaded by a strong signal, as can occur if it were heavily biased back in a reverse a.g.c. system. In consequence, a transistor in a forward a.g.c. system does not introduce cross-modulation when handling strong signals."

"Oh I see," said Dick brightly. "I wonder why forward a.g.c. isn't used in portable radios."

"Partly because of the increase of battery current consumption which would result when receiving strong signals," said Smithy, "but mainly because cross-modulation isn't too troublesome with such radios, anyway. With these, it's usually possible to tune out strong signals which are liable to cause cross-modulation."

"Can you use forward a.g.c. with *any* transistor?"

"Only with types which are specially designed for it," said Smithy.

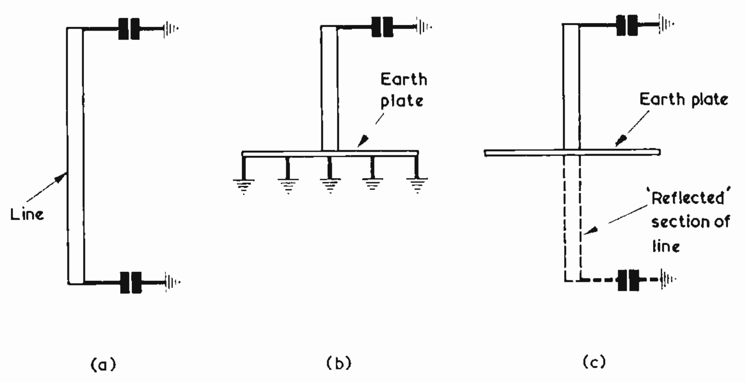


Fig. 7(a). The frequency at which a line is resonant can be reduced below the half-wave frequency by adding capacitance to earth at both ends

(b). If both capacitances in (a) are equal the line has zero r.f. voltage to earth at its centre and may be terminated at that point by an earth plate

(c). It may prove helpful to assume that the upper section of the line and its capacitor re-appear below the earth plate as a 'reflected' image

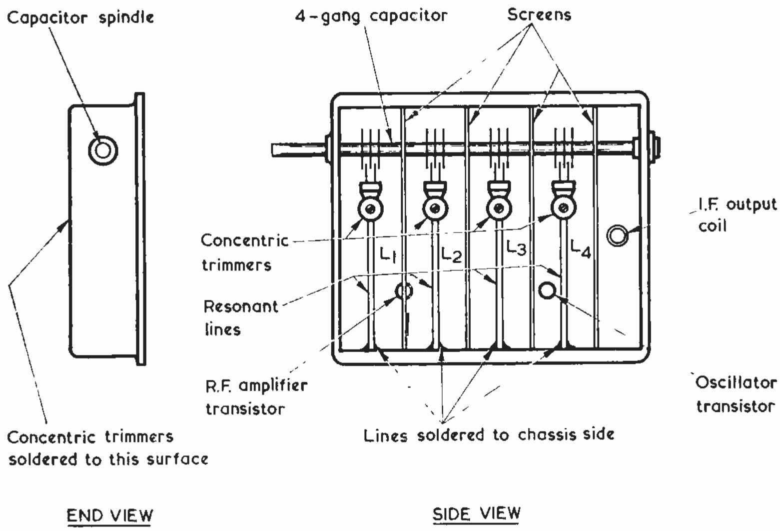


Fig. 8. Typical basic construction of a quarter-wave u.h.f. tuner. The resonant lines are numbered to agree with those in Fig. 5. In the end view, the tuning capacitor spindle projects towards the reader

"A typical example being the BF180 silicon planar transistor which is employed here. Right, now! Having successfully got past that little diversion let's return to the circuit of that tuner. The resonant line L2 appears in the first section of the bandpass pair of the tuner, whilst L3 appears in the second section."

"L3," objected Dick, "is screened from L2."

"No, it isn't," retorted Smithy. In practice a means of coupling is provided by way of a small rectangular slot cut in the screen between the two lines. L3 couples via a coupling line to the emitter of the second transistor. This is the mixer-oscillator and, with the oscillator line L4, is housed in the fourth compartment. The oscillator feedback is provided by a short coupling line in the emitter circuit which runs parallel to L4. The i.f. output at the collector of TR2 passes through an r.f. choke and a 5pF feed-through capacitor, these components removing most of the u.h.f. and oscillator signal, and then passes on to a series i.f. output coil. This couples via coaxial cable to the first i.f. tuned circuits of the set, and enters into a pi filter resonant at around the middle of the i.f. band."

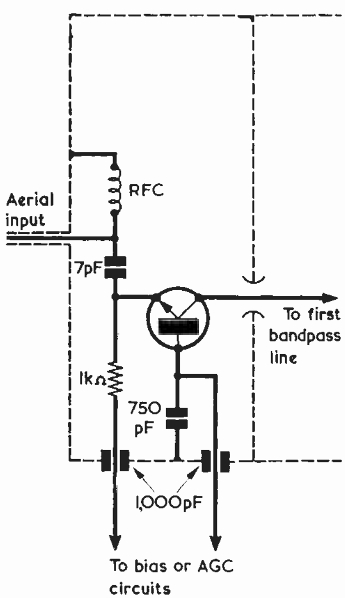


Fig. 9. Typical r.f. amplifier stage, with representative component values, of a u.h.f. tuner having aperiodic input

"Well, that's fair enough," commented Dick. "And, of course, all the four lines are tuned by the sections of the 4-gang capacitor, whilst each line has its own trimmer. I must say that these quarter-wave u.h.f. tuners are darned simple, Smithy!"

"They are," agreed Smithy. "In fact, when you look inside them there seems to be hardly any components at all – just hardware! The test point in that tuner, incidentally, provides a point for the injection of i.f. for the alignment of the tuner i.f. coil and the i.f. tuned circuits which immediately follow it."

APERIODIC INPUT

"*Very* neat," commented Dick appreciatively. "Didn't you say something earlier on about u.h.f. tuners with aperiodic input circuits?"

"Yes, I did," confirmed Smithy, returning to Dick's note-pad. "With these the aerial input goes straight to the emitter of the r.f. amplifier. Like this."

Smithy sketched out the aperiodic aerial input circuit. (Fig. 9).

"As you can see," continued Smithy, "the first transistor is in grounded base. Its collector couples to the quarter-wave line which appears in the first section of the bandpass pair. After that the tuner circuit is similar to the one we've just examined. When the tuner has an aperiodic input stage, all the selectivity has to be provided by the bandpass pair on their own."

"I certainly," remarked Dick, "know a darned sight more about u.h.f. tuners now than I did before. *And* about transistor supplies which are obtained from the line output stage. I won't be caught by that one again!"

"Good show," said Smithy. "Then I'll now be getting back to my own bench. Unless, of course, there's anything else that's troubling you."

But even Dick had to admit that there was nothing further on which he required assistance or which was needed to satisfy his curiosity. Gratefully, Smithy returned to his own work, whilst Dick tidied up and finished off the single-standard hybrid TV set.

And, thus, we leave the pair in peace: Dick to enter into fresh fields of confusion and bewilderment; Smithy to muse over victories past and conquests yet to come. And us? What better can we do now than to turn elsewhere, and sample, say, the heady pleasures of 'Understanding Basic Principles' or even, surrender ourselves to the scintillating seductions of G.A. French's latest "Suggested Circuit"? ■

EDITOR'S NOTE

The transistor supply circuit shown in Fig. 3 is that employed in the G.E.C. model 2047 and allied receivers. The remaining diagrams apply to general television receiver principles and not to any specific receiver.

DECIMAL CURRENCY

Will readers sending remittances please ensure that cheques are written in decimal currency.

We would remind readers also that postage rates are now 2½p second class, 3p first class up to 4 ozs.

Radio Topics

By Recorder

A BROWSE THROUGH THE PAGES of component suppliers catalogues can sometimes produce very useful constructional ideas. I've just been examining the latest catalogue of Home Radio (Components) Ltd., and I've encountered some particularly useful gadgets here which should help me out a great deal with future projects.

PRINTED CIRCUITS

The first items I bumped into are two ready-made printed circuit panels which are supplied complete with a 'universal' printed circuit pattern. Both panels are 6in. long by 2in. wide, and the pattern on each terminates at one end in eight copper strips on an 0.15in. matrix. Either board can be plugged into an 8-way edge connector (Home Radio Cat. No. BTS41) whose contacts mate with the eight strips I've just mentioned.

One panel (Cat. No. BTS36) is drilled to take two B9A valveholders, whilst the other (Cat. No. BTS37) can accommodate eight transistors. The valve board has three long strips along its length to take supply rails and other services, these strips being perforated at intervals for connections. Also provided are a large number of small isolated sections of copper, each being perforated to take 2, 3 or more connections each. Thus, the valve panel is capable of carrying a very wide range of different circuits. The transistor board is of a similar nature, and has base, collector and emitter points marked.

The boards represent most carefully thought-out design work, and should be just the job for those circuits which have left the experimental stage and require to be assembled in neat and permanent fashion.

Another little find has been the Lektrokit Relay Mounting Plate No. 1, which appears under Cat. No. LK-1011. The Relay Mounting Plate has holes which are designed for the mounting of three P.O. 3000 type relays, and it is primarily intended for mounting between two Lektrokit chassis rails in the same way as are the more familiar Lektrokit perforated chassis plates. To my mind, the Relay Mounting Plates provide a useful means of mounting P.O. 3000 relays on *any* chassis layout, whether this be Lektrokit-based or not, since they offer the considerable advantage of eliminating the drilling of those fiddling and close-spaced holes which P.O. 3000 relays normally require.

UNSOLDERING MICROCIRCUITS

Unsoldering i.f. transformers and valveholders from printed circuit boards can be tiresome enough, but have you ever considered the problems involved in the unsoldering of multi-terminal integrated circuits? Computer boards are not 100 per cent reliable after assembly, and the tracing of a fault on such a board may necessitate that serviceable integrated circuits be removed and replaced quite a few times.

The Marconi Company Ltd. (of Marconi House, Chelmsford, Essex) has now produced what is stated to be the world's first portable unsoldering tool for facilitating the damage-free removal of integrated circuits and other multi-terminal devices. Developed by Marconi's Research Division, the unit consists of an electrically heated pot of molten solder with a metal piston floating in it. A vertical hole through the piston is fitted with one of a number of 'nozzles' shaped to accommodate different packages, such as dual in-line packs, T05 cans, hybrid solid logic devices, relays and even discrete component assemblies.

The component to be unsoldered from the board is held in a spring-loaded remover and set over the appropriate nozzle while the piston is depressed. Molten solder wells up through the hole and contacts the pins on the underside of the board before draining back into the pot. The spring-loaded remover comes into operation immediately the pins are freed, so that removal is practically instantaneous and there is no excessive transfer of heat to damage the component or the board. The oxide layer which invariably forms on molten solder is trapped on its passage up through the piston, so that only fresh clean solder actually touches the joints.

The accompanying photograph illustrates the unsoldering tool in action, a dual in-line i.c. having just been removed from the board shown. The unsoldering tool has its own integral heating element, and power consumption is only 300 watts from a 240-volt supply.

Already arousing considerable interest, the tool may well become as familiar in servicing departments as the ubitiquous soldering iron. One company, the Hexacon Electric Company of New Jersey, has concluded a royalty agreement with Marconi to market the tool on a non-exclusive licence through the world. Forming part of the Hexacon range of soldering equipment, the unsoldering tool will sell for under two hundred dollars (£80), complete with a sprung component remover and a range of fittings for different component packages.

MANUAL RESILIENCE

I feel that it is thought-provoking, to say the least, to reflect on the fact that quite a few of the mechanical devices we handle these days might well not operate properly were it not for the natural resilience of the flesh which appears between our finger and thumb bones and the controlling parts of such devices. I am prompted to make this observation after having re-encountered one of those inexpensive petrol cigarette lighters which made their first appearance during World War II and which have been in continual production with slight modifications ever since. You will very probably know the design I am referring to when I tell you that the wick of this particular model projects from a large cylindrical barrel which is pulled bodily out of the lighter when it needs to be refilled. The flint

The new Marconi portable unsoldering tool in action. This is designed to facilitate the damage-free removal from a printed board of integrated circuits and similar multi-terminal components striking mechanism of these lighters could hardly be simpler. One puts one's thumb on a corrugated surface at the top of the lighter and presses down, whereupon the item with the corrugated surface moves through 90°, taking the flint wheel with it by way of a ratchet. As soon as it starts turning, the flint wheel has sufficient rotational force to provide an adequate spark, despite the fact that the assembly boasts no mechanical spring toggle whatsoever.

What occurs, of course, is that the bone in the thumb applies a constant pressure which initially causes the flesh bearing on the corrugated surface to become compressed. At a certain level the compression becomes sufficient to overcome the friction between flint wheel and flint, and the wheel then revolves rapidly. The toggle action is really provided by the flesh of the thumb. If the lighter were operated by an all-metal robot it probably wouldn't function.

Rather the same sort of thing occurs with rotary switches having heavy indent springs; and you may recall, in this respect, that some of the earlier 12-channel TV turret tuners had indent springs which seemed to have been originally designed for the rear axle of a London Transport bus. Quite an exceptional amount of force was required to rotate the selection knob, and once it came anywhere near the required channel the indent spring took over and carried the turret to the final position, very often against the natural resilience of the flesh of the hand.

Present-day a.c. mains electric light switches, which do not have a mechanical toggle action and merely rely on a simple cam pressing one contact against another, also to some extent rely on flesh resilience. When the flesh bearing against the switch lever becomes sufficiently compressed, the cam suddenly moves round to the fully on or off position allowing a fairly quick break or make (which is all that is required for resistive a.c. circuits) to be achieved. The reliance on flesh resilience can be readily checked here, and it is quite easy to operate a switch of this nature very slowly so that its contacts 'sizzle' at the instant when the contact is being broken. Such 'sizzling' would be impossible with a switch incorporating a true mechanical toggle; however slowly the latter was operated there would always be a point at which it abruptly changed from off to on, and another where it just as abruptly changed from on to off.

Notice that, in all these cases, there is virtually no dependence on the human servo-mechanisms which automatically tell us (albeit with a slight delay due to reflex time) when we have moved a lever or a knob sufficiently far. They all work on the simple principle that flesh can be looked upon as being a compressive spring.

There is, I suppose, no particular moral to be drawn from all this, and I can only conclude by congratulating the designers of devices which operate by reason of the effect for their ingenuity in taking advantage of it. At the same time, if anyone suggests that those miniature transistor radio volume controls which incorporate an integral cam-operated switch be henceforth referred to as 'flesh-pots', I shall ask him to kindly leave the stage.

MAKESHIFT HEAT SINKS

One of these days I really must go out and buy myself a good supply of ready-made transistor heat sinks. This omission on my part was highlighted recently when I found myself repeatedly requiring temporary heat sinks for transistors of the OC35 and AD162 categories. These transistors are employed in some rather urgent experimental work I have been carrying out, in which they are required to dissipate only a relatively low amount of power and would not normally require heat sinks. Even so, they have sometimes been getting a little warmer than they should.

Looking hurriedly through a box of odds and ends of hardware to see whether I could find any pieces of metal to which I could temporarily bolt the transistors, I stumbled on an idea which has solved the problem quite happily. The solution is given by small brass hinges, as used in carpentry. The type I am now employing measure ½in. by 1½in. when closed and have three holes on each side. If one of these hinges is closed over one end of the transistor a bolt can be passed through the centre hinge holes and the transistor hole, causing the end of the transistor case to be sandwiched between the two sections of the hinge. A nut is then fitted to the bolt and this, when tightened, causes the inside hinge surfaces to conform to the contour of the transistor case, thereby making a reasonably efficient heat-conducting joint. Two of these hinges, one at each end of the transistor, raise the power it can dissipate by at least a watt or two. Also, it is easy to make a collector connection by soldering to the brass of one of the hinges.

I must admit that the combination of a power transistor and two brass hinges looks pretty incongruous, to say the least, and it is certainly not the sort of thing I would fit into a permanent and properly finished item of equipment. Also, the heat taken away from the transistor by the hinges is by no means as great as is given by a correctly designed heat sink against which the whole surface of the transistor is bolted. Nevertheless, these little brass hinges offer an ideal solution if you're in a hurry, haven't time to cut and drill out a proper heat sink and only want to dissipate a little extra power anyway. ■

"Look it up in the Bible and tell me what it means!"

THIN-FILM VIDEO AMPLIFIER

A thin-film video amplifier designed by the BBC Engineering Department is being manufactured and marketed by ITT Components Group Europe. The circuit was developed to meet the need for a miniature video and pulse output stage capable of driving a 75 ohm load with a 1V peak-to-peak, a feature beyond the range of present monolithic circuits.

With high input impedance (greater than 15 kilohm) and low output impedance (less than 100 milliohm), the 131 BCR amplifier can be matched to a wide range of loads. External feedback connections determine the gain of the amplifier, the maximum output current is 100 mA.

For applications where a particular d.c. output is required, external biasing resistors are used. If a very high input impedance is required, bootstrap feedback can be employed. The packaging of the amplifier meets British DEF 5011 environmental specifications.

For further information contact ITT Components Group Europe, Capacitor Product Division, Brixham Road, Paignton, Devon.

LATE NEWS

Times = GMT *Frequencies - kHz*

★ AMATEUR BANDS

● TOP BAND

At the time of writing, Trans-Atlantic signals continue to be heard on this band mainly on Sunday mornings from around 0430 to 0730. CW signals from across the 'pond' heard in mid-January included W1BB (**1804** at 0625), W1BHQ (**1806** at 0658), W1HGT (**1804** at 0515), W1PL (**1802** at 0650) and W9UCW (**1808** at 0200). – See Last Look Round.

● IRAN

EP2BQ has been heard on **3795** SSB at 1830 and EP2DX using SSB at 1920 on the same frequency.

● SENEGAL REPUBLIC

6W8DY has been heard using **3793** SSB at 0728, **3799** SSB at 2045 and using **7081** SSB at 2110. 6W8GE is reported QRV often on **21025** and **21040** from 1800 to 1900 and from 2000 to 2100.

● LESOTHO

7P8AB heard on **21020** at 1935 using CW, on **21314** SSB at 1807 and also on **28600** SSB at 0959. 7P8AZ heard on **21212** SSB at 1601 and also on **21270** SSB at 1824.

● FRENCH GUIANA

FY7YR has been heard on **14110** SSB at 2030; FY7AE on **14173** SSB at 0607 and on **28609** SSB at 1119 and 1355; FY∅Z0 on **21315** SSB at 1203; and FY∅NA on **28545** SSB at 1406.

● BRITISH HONDURAS

VP1JF heard on **28620** SSB at 1330 and VP1ST on **14225** SSB at 0010.

★ BROADCAST BANDS

● BRAZIL

ZYZ43 Radio Em. Paranaense, Curitba, has moved to the new channel of **9660** (7.5kW) from **9545**. Schedule is from 0800 to 2100.

PRK9 Radio Inconfidencia, Belo Horizonte, may be heard around 2015 on **15190** (5kW). Schedule is from 0900 to 0300.

PRA8 Radio Clube Pernambuco, can often be logged on **11865** (7.5kW). Schedule is from 0900 to 0300, listen around 2030.

On the l.f. bands, listen for ZYZ20 Rio de Janeiro on **4905** (5kW). Announces as "Radio Relogio" and may often be heard at good signal strength from around 0100 onwards. Schedule is 24 hours. Listen also for ZYX2 Radio Brazil Central, Goiania, on **4995** (5kW) around 0100 or so. Schedule is from 0800 to 0400.

● CHAD

Fort Lamy may be heard on **4904** (30kW) around 2000 with programmes of colourful local music and songs. Languages used are French, Arabic and various local dialects. Station identification is in French.

● EQUATORIAL GUINEA

Santa Isabel, Fernando Po (also spelt Poo) may be heard around 2015 or so on **6250** (10kW). Languages used are Spanish and various local dialects, the schedule being from 0500 to 2300. Often heard with songs and music in the Spanish style.

● SENEGAL

Dakar may often be logged on the **4890** (25kW) channel around 2000. Programme languages are French, Portuguese and local dialects. Schedule is from 0600 to 1000 and from 1800 to 2400 on this frequency.

Acknowledgements:- Our Listening Post, SCDX, ISWL.

WORLD RADIO–TV HANDBOOK

The 1971 edition of this well-known handbook was published and released in January. With a format of 6 by 9 inches and comprising some 372 pages, the 1971 edition (25th) represents better value than ever at the £2.10 selling price.

The Handbook updates all the information that is currently available on Radio and TV stations throughout the world.

In addition to the frequency lists and station information, the Handbook also features many articles containing much information of interest to all who operate over the short waves. Such items as Broadcasts in English, Dx Programmes, News in English, World Time Charts, Time Tables and many useful maps of various areas of the world.

The 1971 WRTH may be obtained from Modern Book Co., 19 Praed Street, London W.2, at £2.19 post paid.

LAST LOOK ROUND

TOP BAND TOPICS

For several years now interest in Dx working on this band has grown apace. Apart from G-Dx and Eu-Dx which attracts many to the band, there are those stalwarts who continue to get – or attempt to get – their CW signals across the Atlantic; this applying mainly to amateurs in the UK, Eire, W. Germany, Czechoslovakia and the USA. In addition to these countries however, signals have been heard from Canada, Venezuala, US Virgin Islands and Bermuda.

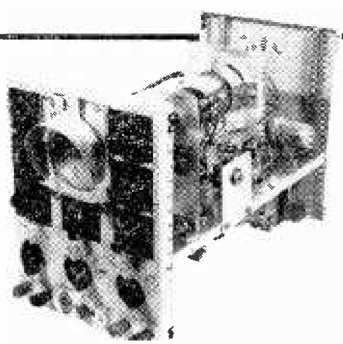
During the last 'season' for intercontinental working (the 'season' is approximately from mid-October to late February) activity has been greater than ever although conditions did not approach those of the previous 'season'. In the main, signals from across the Atlantic tended to be just above the noise level although on occasions some were coming in at good signal strengths – 'regulars' such as W1BB, W1HGT and K1PBW, but more of all this in a later issue.

EXTRA

in April issue of PRACTICAL WIRELESS

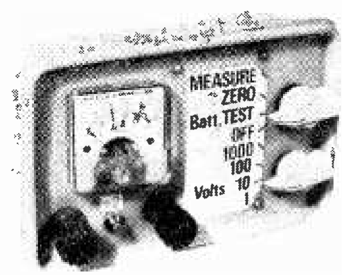
8-PAGE GUIDE TO TEST INSTRUMENTS

This illustrated eight-page supplement is a survey of current test gear for servicing radio and audio equipment. Though complete in itself, it will also provide a useful introduction to an important new series on servicing by H. W. Hellyer and Gordon J. King, which starts in the following month's issue.



WORKSHOP OSCILLOSCOPE

This *Practical Wireless* design enables you to see what is going on inside a circuit, including the examination of waveforms, distortion and pulses. You can make this versatile test instrument—readily available c.r.t. and other components. Even the case is a stock item. Read all about it in the April issue.



HIGH IMPEDANCE VOLTMETER

Winner of the *Practical Wireless* Project Autumn Trophy. With ranges of 1-10-100-1000V and input impedance of at least 3MΩ. The cost is small, a 50μA meter and three 2N2926 transistors forming the basis of operation of this ingenious project. Full constructional details in the April *Practical Wireless.*

Plus other constructional features

PRACTICAL WIRELESS

April issue on sale Friday 5 March — 17½p

SMALL ADVERTISEMENTS

Rate: 4p (9d.) per word   Minimum charge 60p (12/-)

Box No. 10p (2/-) extra.

Advertisements must be prepaid and all copy must be received by the 4th of the month for insertion in the following month's issue. The Publishers cannot be held liable in any way for printing errors or omissions, nor can they accept responsibility for the *bona fides* of advertisers. (Replies to Box Numbers should be addressed to: Box No. ——, *The Radio Constructor*, 57 Maida Vale, London, W9 1SN.

SERVICE SHEETS (1925-1970) for Radios, Televisions, Transistors, Tape Recorders, Record Players, etc., with fault finding guide. Over 8,000 models available. S.A.E. list/enquiries. Hamilton Radio, 54 London Road, Bexhill, Sussex.

CONSTRUCTORS USED COMPONENTS. Parcels at 50p each, including postage, 50 assorted resistors. 50 assorted capacitors. 10 electrolytic capacitors. 10 assorted knobs. 5 assorted potentiometers. 20 assorted valve bases. Please state which parcel required. Broadcast type twin gang variable capacitors at 18p each Speakers at 50p each. 7 inch, 5 inch, 5½ x 3½ inch elliptical. P & P. 18p. Box No. G142.

NEW CATALOGUE NO. 18, containing credit vouchers value 50p. now available. Manufacturers new and surplus electronic and mechanical components, price 23p post free. Arthur Sallis Radio Control Ltd., 28 Gardner Street, Brighton, Sussex.

VALVES. All at 13p postage paid. EB91, 6AG5, EL91, EL92, DK91, EF40, 3ML, 1S5, 141TH, U142, UBC41, UY41, 171DDP, 10F9, N142, U404,VR91, HL41DD, TH41, PEN45, X65, U14, TDD4, 6B4G, 41MP, 801-A, VT136, VP41, HP4106, VT62. Box No. G143.

BUILD IT in a DEWBOX robust quality plastic cabinet 2in. x 2½in. x any length. S.A.E. for details. D.E.W. Ltd., 254 Ringwood Road, Ferndown. Dorset. Write now – right now.

MINI MAINS PACK KIT. Safe double-wound transformer, Si.rects, 1000μF and instructions for 9V, 120mA eliminator. Can be built to size of PP6 battery. UK 95p, post paid. S.A.E. list. Amatronix Ltd., 396 Selsdon Road, South Croydon, Surrey, CR2 ODE.

FOR SALE: Txing type variable capacitor, 50-110pF, ¼in. spacing £1. Ditto, 75 +75pF, ¼in. spacing, 50p Tannoy P.A. Mic, £1.50. 1.5 - 3MHz Command receiver, £2. Motor generator, 12V 4A in, 400V .05A out, £1.50. Eddystone 6 pin plug-in coil formers, Cat. 538, 13p. Type 3 T/P ink rollers, 25p bottle. 200ft. Super-8 cine reels, 25p. Box No. G144.

CONFIDENTIAL PRINTING/DEVELOPING. Free printing. Developing from 40p S.A.E. details. Mr. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

"MEDIUM WAVE NEWS" Monthly during Dx season —Details from: K. Brownless, 7 The Avenue, Clifton, York.

(Continued on page 513)

RADIO OPERATORS

There will be a number of vacancies in the Composite Signals Organisation for experienced Radio Operators in 1971 and subsequent years.

Specialist training courses lasting approximately eight months are held at intervals. Applications are now invited for the course starting in September 1971.

Salary Scales

During training with free accommodation provided at the Training School:-

Age 21	£848	per annum
22	£906	,, ,,
23	£943	,, ,,
24	£981	,, ,,
25 and over	£1,023	,, ,,

On successful completion of course:-

Age 21	£1,073	per annum
22	£1,140	,, ,,
23	£1,207	,, ,,
24	£1,274	,, ,,
25 (highest age point)	£1,351	,, ,,

then by six annual increments to a maximum of £1,835 per annum.

Excellent conditions and good prospects of promotion. Opportunities for service abroad.

Applicants must be United Kingdom residents, normally under 35 years of age at start of training course, and must have at least two years operating experience, or PMG qualifications. Preference given to those who also have GCE 'O' level or similar qualifications. Exceptionally well qualified candidates aged from 36-40 may also be considered.

Interviews will be arranged throughout 1971.

Application forms and further particulars from:-

Recruitment Officer (TRO 63)
Government Communications Headquarters,
Oakley,
Priors Road,
CHELTENHAM,
Glos., GL52 5AJ.
Tel: Cheltenham 21491. Ext. 2270.

If you're a telecommunications man and match up to the qualifications below **cut yourself into a slice of Britain's future**

Become a

Radio Technician

in the fast-growing world of Air Traffic Control

Please send me an application form and details of how I can join the fascinating world of Air Traffic Control Telecommunications

Name ....

Address ....

RCT/E4

....

Not applicable to residents outside the United Kingdom

To: A J Edwards, C Eng, MIEE,
The Adelphi, Room 705, John Adam Street,
London WC2N 6BQ,
marking your envelope 'Recruitment'

Sending this coupon could be your first step to a job that's growing in importance every year.

The National Air Traffic Control Service needs Radio Technicians to install and maintain the vital electronic aids that help control Britain's ever-increasing air traffic.

This is the kind of work that requires not only highly specialised technical skills but also a well developed sense of responsibility, and candidates must be prepared to undergo a rigorous selection process. Those who succeed are assured a steadily developing career of unusual interest and challenge. Starting salary varies from £1044 (at 19) to £1373 (at 25 or over): scale maximum £1590 (higher rates at Heathrow). There is a good annual leave allowance and a non-contributory pension for established staff.

You must be 19 or over, with at least one year's practical experience in telecommunications, ('ONC' or 'C and G' qualifications preferred).

NATCS

National Air Traffic Control Service

SMALL ADVERTISEMENTS

(Continued from page 511)

TOP TRANSISTORS: ACY22, BC108, BC109, BC168, BFY51, BFY52, BSY27, OC45, OC71, OC72, OC200, OC201, OC202, ZTX300, 2N706, 2N2926, 2N3702, 2N3703, 2N3705, 2N3706, 2N3708. Brand new, unmarked, fully tested. Only 9p each or 16 for £1. Money back gurantee. P. & P. 5p. J. M. King, (M), 17 Buckridge, Portpool Lane, London E.C.1.

JOIN THE INTERNATIONAL S.W. LEAGUE. Free services to members including Q.S.L. Bureau, Amateur and Broadcast Translation, Technical and Identification Dept.—both Broadcast and Fixed Stations, DX Certificates, contests and activities for the SWL and transmitting members. Monthly magazine, *Monitor,* containing articles of general interest to Broadcast and Amateur SWLs, Transmitter Section had League affairs, etc. League supplies such as badges, headed notepaper and envelopes, QSL cards, etc., are available at reasonable cost. Send for League particulars. Membership including monthly magazines, etc., £1.75 per annum. Secretary ISWL, 1 Grove Road, Lydney, Glos., GL15 5JE.

FOR SALE: Keilcraft model patrol boat. 40in., with Taplin Twin engine. Twin rudders with steering motor fitted. Throttle control for R/C also fitted. Superstructure requires completing and R/C gear installing. With Raven R/C four channel reed Tx and Rx. £60 o.n.o. Also P.A.C. kit for 57in. span Tiger Moth, £12. Box No. G146.

POSTAL ADVERTISING? This is the Holborn Service. Mailing lists, addressing, enclosing, wrappering, facsimile letters, automatic typing, copy service, campaign planning, design and artwork, printing and stationery. Please ask for price list.—The Holborn Direct Mail Company, Capacity House, 2-6 Rothsay Street, Tower Bridge Road, London, S.E.1. Telephone: 01-407-1495

FOR SALE: Cossor 1045 double beam scope, Mk II. Surplus to requirements. In daily use. Complete with instruction service manual. £18. Box No. G147.

WANTED: *Radio Constructor* magazines. Any dates (not bound). Reasonable prices. All letters acknowledged. Box No. G148.

WORLD DX CLUB covers all aspects of SWLing on Amateur and Broadcast Bands through its monthly bulletin *"Contact".* Membership costs £1.38 a year Enquiries to Secretary, WDXC, 11 Wesley Grove, Portsmouth, Hants., PO3 5ER.

FOR SALE: *International Encyclopedia of Stamps,* published by IPC Magazines Ltd. Vol. 1, parts 1 to 14. Vol. 2, parts 1 to 13. Cover price 23p each part. Will sell at £2 per volume. Box. No. G149.

TO CLEAR; *Life World Library and Life Sunday Times World Library.* All at 50p post paid. South-East Asia, Israel, Scandinavia, Tropical Africa, Greece, Mexico, Russia, Italy, Britain, Japan, Brazil. France, India & Germany. Box No. G150.

FREQUENCY LIST TRANSFERS. We have a limited supply of sheets of Dial Frequency Transfers in black. Short Wave frequencies 1.8Mc/s to 32Mc/s and 144Mc/s to 146Mc/s. Includes amateur band marker frequencies at 100kc/s points and other short wave frequencies from 2 to 32Mc/s at every 500kc/s points. Each frequency is repeated. Two sheets for 5p, five sheets for 10p, postage 2½p. Data Publications Ltd., 57 Maida Vale, London W9 1SN.

(Continued on page 515)

SMALL ADVERTISEMENTS

(Continued from page 513)

FOR SALE: Specialist stamp collection. Space, Railway Centenary, ITU, IGY, etc. issues. Catalogue value approx. £150. Offers? S.A.E. for details. Another collection of early Space issues £25 o.n.o. Small general collection at £5. Box No. G151.

FREE GIFT when you request our quality stamps, supplied on approval. Generous discounts. Details from: Watson's Philatelic Service, 6 Beech Avenue Brentwood, Essex.

WANTED; Marine type sextant. Details & price to Box No. G152.

ARE YOU A MOTORING ENTHUSIAST? The Seven-Fifty Motor Club caters for all types of motor sport–racing, rallies, hill climbs, etc. Monthly Bulletin free to members. For full details write to: The General Secretary, Colin Peck, "Dancer's End", St. Winifred's Road, Biggin Hill, Kent.

FOR SALE: Pye Ranger 2M Tx. Needs converting. With valves and power supply. £6 plus carriage. Box No. G153.

IF YOU HAVE ENJOYED A HOLIDAY on the Norfolk Broads, why not help to preserve these beautiful waterways. Join the Broads Society and play your part in determining Broadlands future. Further details from:—The Hon. Membership Secretary, The Broads Society, "Icknield", Hilly Plantation, Thorpe St. Andrew, Norwich, NOR 85S.

HOLIDAY ACCOMMODATION. Burwood Lodge Hotel, Dawlish Road, Teignmouth, S. Devon. Especially for parents with young children. Facing south, on the cliffs, direct access by private path to sea. Mothers' kitchen, automatic washing machines, baby listening service. Licensed lounge. Ample free parking.

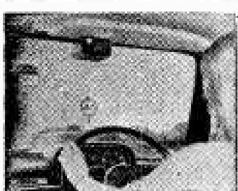
CRYSTALS. Marine frequencies. 2381, 2089, 2306, 2182, in holders with ¾in. pin spacing £2 each. Box No. G154.

RECITALS OF RECORDED MUSIC. The second Saturday evening of each winter month. Next recital: Saturday, March 13th, 1971, 8 p.m. Woodford Green United Free Church, Woodford Green, Essex. Bus routes 20, 20A, 179 and 275 – alight at "The Castle" stop.

RELAYS. Sigma type 72AOZ, octal base, £1.50; Carpenter, polarised, £1; D164816, £1.50. Box No. G155.

MUSICAL MIRACLES

WAA-WAA PEDAL. Complete kit of all parts, robust cabinet, mechanism & instructions. Huge sales, well proven design. **ONLY £2.45** complete. Or built & tested **£4.75** post free. **RHYTHM BOX.** Build your own from our pre-built electronic circuit modules, e.g. box giving waltz, foxtrot, etc. costs under **£17. ORGAN PERCUSSION** units **£14.** Bass pedal and other fascinating effects, fuzz, tremolo, etc. Send s.a.e. for list.
D.E.W. LTD. 254 Ringwood Road, **FERNDOWN,** Dorset



RADAR SPOTTER

Prevention is best – YOU know it makes sense!

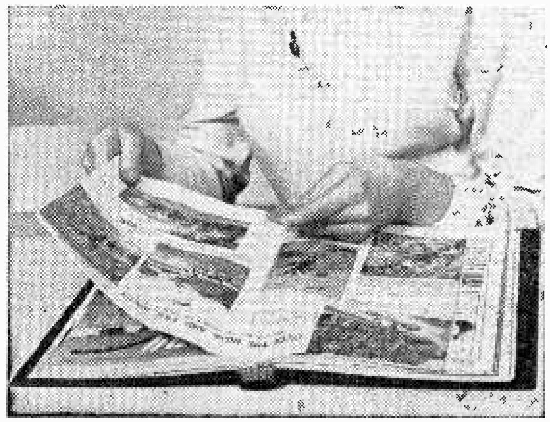
Use our unique non-radiating legal radar receiver. Gives early warning of Radar Speed Traps up to 1½ miles on motorways. Completely self contained (no wiring). Compact, clips on to sun visor. Weighs only 10½ ozs.

BE SAFE, NOT SORRY — ORDER NOW. £13.75 C.O.D. 30p extra. BELDING & BENNETT LTD. (Box 38) 45 Green Lane, Purley, Surrey. For full details Tel: 01-688 3255 or 01-660 2896 or send 4p in stamps. Callers welcome by appointment.

PLAIN-BACKED NEW STYLE SELF-BINDERS

for your other magazines

(max. format 7½" x 9½")



The "CORDEX" Patent Self-Binding Case will keep your copies in mint condition. Issues can be inserted or removed with the greatest of ease. Specially constructed Binding cords are made from Super Linen of great strength, very hard twisted and twice doubled. They are attached to strong RUSTLESS Springs under tension, and the method adopted ensures PERMANENT RESILIENCE of the Cords. Any slack that may develop is immediately compensated for, and the Cords will always remain taut and strong. It is impossible to overstretch the springs, as a safety check-device is fitted to each.

COLOURS: MAROON OR GREEN

(If choice not stated, colour available will be sent)

PRICE 70p Postage 10½p

Available only from:–

Data Publications Ltd.
57 Maida Vale London W9 1SN

CHASSIS and CASES by

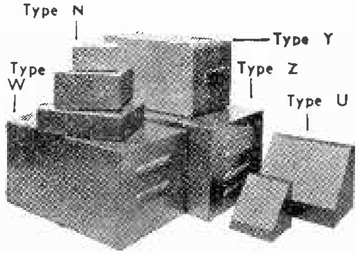
Smith's of EDGWARE ROAD

H. L. SMITH & CO. LTD.
287/9 Edgware Road
London W2 IBE
TEL: 01-723 5891

CASES ALUMINIUM, SILVER HAMMERED FINISH

Type	Size	Price	Type	Size	Price
N	8x6x2"	£1.05	W	12x7x7"	£2.00
N	6x6x3"	£1.00	W	15x9x8"	£2.70
N	4x4x2"	65p	Y	8x6x6"	£1.65
U	4x4x4"	65p	Y	12x7x7"	£2.60
U	5½x4½x4½"	£1.00	Y	13x7x9"	£2.90
U	8x6x6"	£1.30	Y	15x9x7"	£3.00
U	9¼x7½x3½	£1.40	Z	17x10x9"	£4.15
U	15x9x9"	£2.80	Z	19x10x8½"	£4.50
W	8x6x6"	£1.30			*Height

Type N has removable bottom. Type U removable bottom or back. Type W removable front. Type Y all screwed construction. Type Z removable back and front. Plus p. & p.



BLANK CHASSIS

FOUR-SIDED 16 SWG ALUMINIUM

Size	Price	Base	Size	Price	Base
6x4x2"	34p	17p	10x8x2½"	66p	30p
7x4x1½"	33p	18p	12x7x2½"	66p	33p
7x5x2"	40p	19p	12x9x2½"	76p	38p
8x4x2"	38p	19p	13x8x2½"	76p	38p
8½x5½x2"	44p	21p	14x7x3"	80p	36p
9x7x2"	50p	26p	14x10x2½	88p	47p
10x4x2½"	50p	21p	15x10x2½	92p	50p
12x4x2½"	55p	22p	17x10x3"	£1.10	55p
12x5x3"	66p	26p			

TO FIT OUR CASES

Size	Price	Base	Size	Price	Base
7x5¾x1½"	38p	21p	12x6¾x2"	60p	33p
7x5¾x2"	43p	21p	14x8¾x2"	74p	44p
11x6¾x1½"	55p	30p	15¾x9¾x2½"	94p	52p
11x6¾x2"	55p	30p	17¾x9¾x2½"	£1.05	59p

Plus post & packing

PANELS: Any size up to 3ft. at **36p** sq. ft. 16 s.w.g. (18 s.w.g. **32p**). *plus postage and packing*

YUKAN SELF-SPRAY SO PROFESSIONAL THE YUKAN AEROSOL WAY–

Get these NOW! air drying **GREY HAMMER OR BLACK WRINKLE (CRACKLE) finishes**

Yukan Aerosol spraykit contains 453g fine quality, durable easy instant spray. No stove baking required. Hammers available in grey and blue, 90p carr. pd. Modern Eggshell Black Wrinkle (Crackle) producing a 3D textured finish. 90p carr. pd. all at 85p per push-button self-spray can at our counter. Also durable, heat and water resistant Black Matt finish (339g self-spray cans only) 75p carr. pd.
SPECIAL OFFER. One can plus optional transferable snap-on trigger handle (value 25p) for 96p carr. pd. Choice of 13 self-spray plain colours and primer (motor car quality) also available.
Please enclose cheque or crossed P.O. for total amount direct to:

Other Yukan Air Drying Aerosols, 453g at 90p carr. pd. include Zinc Chromate Clear Lacquer Metallics Grey Blue

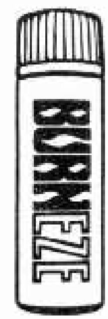
DEPT: N/2 YUKAN, 307a EDGWARE ROAD, LONDON W21BN

We supply many Government Departments, Municipal Authorities, Institutes and Leading Industrial Organisations—We can supply you too.
Open all day Saturday. Closed Thursday afternoons.

Now British—even better

Fingers

The more 'fiddly' the job, the more you depend on your finger-tips. Make sure minor burns and blisters don't rob them of their skill.
Apply BURNEZE, pronto!
This unique scientific aerosol cools the heat out of a burn in just 8 seconds, anaesthetizes pain, reduces swelling.
BURNEZE – the clever tip for burnt finger-tips.
From chemists.



Potter & Clarke Ltd Croydon CR9 3LP

DATA BOOK SERIES

DB5 TV FAULT FINDING
124 pages. Price **50p,** postage 5½p.

DB16 RADIO CONTROL FOR MODELS
192 pages. Price **75p,** postage 7½p.

DB17 UNDERSTANDING TELEVISION
512 pages. Price **£1.88,** postage 20p.

DB18 AUDIO AMPLIFIERS
128 pages. Price **53p,** postage 5½p.

DB19 SIMPLE SHORT WAVE RECEIVERS
140 pages. Price **80p,** postage 5½p.

I enclose Postal Order/Cheque for .... in payment for ....

NAME ....

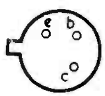
ADDRESS ....

....

(Please use Block Capitals for both name and address)
Postal Orders should be crossed and made payable to Data Publications Ltd.
Overseas customers please pay by International Money Order.
All publications are obtainable from your local bookseller.
Data Publications Ltd., 57 Maida Vale, London W9 1SN

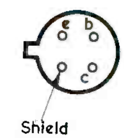
Please mention **THE RADIO CONSTRUCTOR** when writing to advertisers

P.N.P./N.P.N. Transistor Lead-outs



'A'

The Table lists commonly encountered transistors having lead-out layout as shown in Diagrams 'A' and 'B'. Those for Diagram 'A' conclude the list commenced in Data Sheet No. 47. Transistors corresponding to Diagram 'B' are in T0-12, T0-17 or T0-72 encapsulations.



'B'

N.P.N. Diagram 'A'				P.N.P. Diagram 'B'		N.P.N. Diagram 'B'	
2N2222 (S)	2N2570 (S)	2N3831 (S)	2S101 (S)	AF139 (G)	2N3282 (G)	BF161 (S)	2N3293 (S)
2N2222A (S)	2N2883 (S)	2N3866 (S)	2S102 (S)	AF178 (G)	2N3283 (G)	BF180 (S)	2N3294 (S)
2N2236 (S)	2N2884 (S)	2N3924 (S)	2S103 (S)	AF179 (G)	2N3284 (G)	BF181 (S)	2N3570 (S)
2N2237 (S)	2N3010 (S)	2N4000 (S)	2S104 (S)	AF180 (G)	2N3285 (G)	BF182 (S)	2N3571 (S)
2N2243 (S)	2N3011 (S)	2N4001 (S)	2S131 (S)	AF181 (G)	2N3286 (G)	BF183 (S)	2N3572 (S)
2N2243A (S)	2N3036 (S)	2N4300 (S)	2S501 (S)	AF239 (G)	2N3307 (S)	BF222 (S)	2N3839 (S)
2N2297 (S)	2N3053 (S)	2N4427 (S)	2S502 (S)	ASY67 (G)	2N3308 (S)	BFW30 (S)	
2N2368 (S)	2N3108 (S)	2N5413 (S)	2S503 (S)	MF3304 (S)	2N3783 (G)	BFX89 (S)	
2N2369 (S)	2N3303 (S)	2N5414 (S)	2S512 (S)	MM1139 (G)	2N3784 (G)	BFY90 (S)	
2N2369A (S)	2N3418 (S)	2S001 (S)	2S701 (S)	MM5000 (G)	2N3785 (G)	TIS56 (S)	
2N2410 (S)	2N3419 (S)	2S002 (S)	2S702 (S)	MM5001 (G)	2N4260 (S)	TIS57 (S)	
2N2432 (S)	2N3420 (S)	2S003 (S)	2S703 (S)	MM5002 (G)	2N4261 (S)	2N918 (S)	
2N2432A (S)	2N3421 (S)	2S004 (S)	2S711 (S)	2N700 (G)	2N4411 (S)	2N2708 (S)	
2N2483 (S)	2N3553 (S)	2S005 (S)	2S712 (S)	2N700A (G)	2N4957 (S)	2N2857 (S)	
2N2484 (S)	2N3724 (S)	2S014 (S)	2S731 (S)	2N2415 (G)	2N4958 (S)	2N3287 (S)	
2N2537 (S)	2N3724A (S)	2S017 (S)	2S732 (S)	2N2416 (G)	2N4959 (S)	2N3288 (S)	
2N2538 (S)	2N3725 (S)	2S018 (S)	2S733 (S)	2N3127 (G)		2N3289 (S)	
2N2539 (S)	2N3725A (S)	2S019 (S)	40361 (S)	2N3279 (G)		2N3290 (S)	
2N2540 (S)	2N3830 (S)	2S020 (S)		2N3280 (G)		2N3291 (S)	
2N2569 (S)		2S95A (S)		2N3281 (G)		2N3292 (S)	