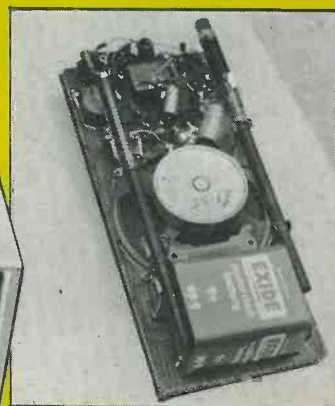
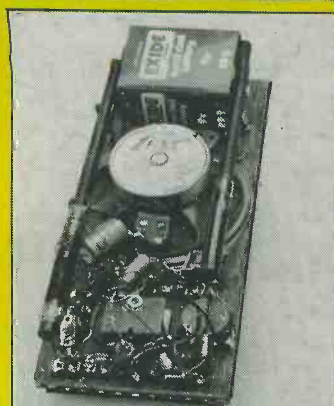
RADIO & ELECTRONICS CONSTRUCTOR

FEBRUARY 1978

45p

THE "CASCODE"

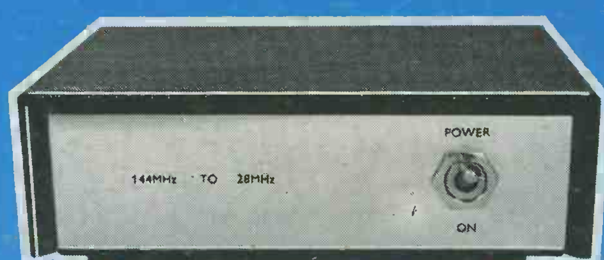




MEDIUM & LONG WAVE PORTABLE

PART ONE (2 PARTS)

TWO METRE



CONVERTER

ALSO FEATURED

ELECTRONIC DICE

N-STAGE SEQUENCER

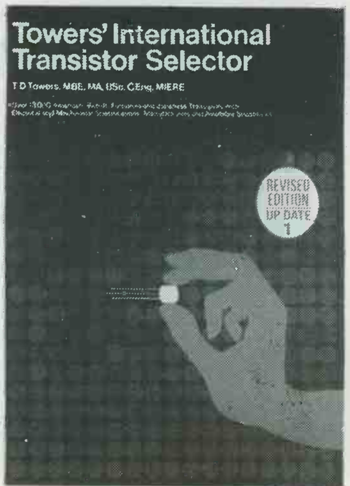
HIGH RATIO VARICAP DIODES

Full-Wave Rectifier Ratings (Electronics Data No.30)

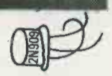
DIRECT SUPPLY SERVICE TO READERS

TOWERS INTERNATIONAL TRANSISTOR SELECTOR

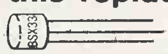
(NEW REVISED EDITION)



This is dead!



Would this replace it?



If it takes you longer than 1 minute to find out all about these transistors then you need a copy of TOWER'S INTERNATIONAL TRANSISTOR SELECTOR. Its one of the most useful working books you will be offered this year. And probably the cheapest!

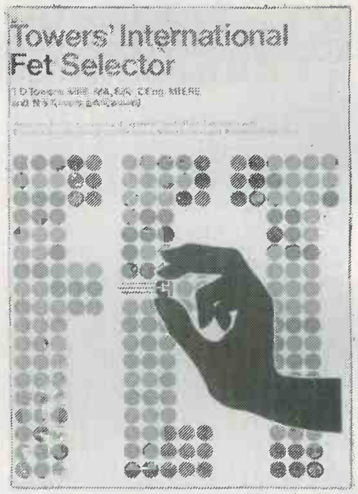
In it you will find a really international selection of 13,000 transistor types — British, Continental European, American and Japanese. And we think that they will solve 90% of your transistor enquiries.

Current and widely used obsolete types were carefully selected and arranged in Numero-Alphabetical order by an author who was uniquely qualified to do the job. With his compendium, all you need to know is the type number and you can learn all about a transistor's specification; who made it and where to contact them; or what to use to replace it.

Price **£5.00** inc P&P

TOWERS INTERNATIONAL FET SELECTOR

(JUST PUBLISHED)



If you deal with field effect transistors, or fet's — whether as a student, a hobbyist, a circuit engineer, a buyer, a teacher or a serviceman — you often want data on a specific fet of which you know only the type number.

Specifications apart, you may be even more interested in where you can get the device in question. And perhaps more important still (particularly with obsolete devices), you may want guidance on a readily available possible substitute.

This fet compendium, a comprehensive tabulation of basic specification, offers information on:

1. Ratings
2. Characteristics
3. Case details
4. Terminal identifications
5. Applications use
6. Manufacturers
7. Substitution equivalents (both European and American)

The many fet's covered in this compendium are most of the more common current and widely-used obsolete types.

It is international in scope and covers fet's not only from the USA and Continental Europe, but also from the United Kingdom and the Far East (Japan).

Price **£4.00** inc P&P

(Please allow 21 days for delivery)

Tower's International Transistor Selector

by T. D. Towers
MBE, MA, BSc, C Eng, MIERE
£5.00
inc. post and packing

To:—DATA PUBLICATIONS LTD.
57 MAIDA VALE
LONDON W9 1SN

Please send me .... copy/copies to the address shown below

NAME ....

ADDRESS ....

....

....

....(Block capitals)

Tower's International FET Selector

by T. D. TOWERS
MBE, MA, BSc, C Eng, MIERE
£4.00
inc. post and packing

To:—DATA PUBLICATIONS LTD.
57 MAIDA VALE
LONDON W9 1SN

Please send me .... copy/copies to the address shown below

NAME ....

ADDRESS ....

....

....

....(Block capitals)

RADIO & ELECTRONICS CONSTRUCTOR

FEBRUARY 1978
Volume 31 No. 6

Published Monthly (1st of Month)
First Published 1947

Incorporating The Radio Amateur

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9 1SN

Telephone 01-286 6141

Telegrams Databux, London

Annual Subscription: £6.50 (U.S.A. and Canada $12.00) including postage. Remittances should be made payable to "Data Publications Ltd". Overseas readers please pay by cheque or International Money Order.

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

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

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

Production.—Web Offset.

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

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

THE MARCH ISSUE WILL BE PUBLISHED ON 2nd FEBRUARY

BI-PAK GREAT SPACE-

WE NEED THE SPACE —

AUDIO MODULES—ALL REDUCED! TRANSISTOR PRICES SLASHED! MANY PAKS 33⅓% OFF

THYRISTORS

No THY1A/50	1Amp	50 volt	TO5	18p
No THY1A/400	1Amp	400 volt	TO5	32p
No THY3A/50	3Amp	50 volt	TO64	25p
No THY3A/200	3Amp	200 volt	TO64	32p
No THY3A/400	3Amp	400 volt	TO64	40p
No THY5A/50	5Amp	50 volt	TO66	25p
No THY5A/400	5Amp	400 volt	TO66	40p
No THY5A/600	5Amp	600 volt	TO66	50p
No C106/4	6Amp	400 volt	TO220	42p

TRIAC

S84 8Amp 400 volt TO220 Plastic (Non Isolated Tab) 80p

DIACS

BR100 15p
D32 15p

SWITCHES

No 16178 5 x Mains Slide Switches 40p'
No S17 5 x Miniature Slide Switches 40p'
No S18 4 x Standard Slide Switches 40p'
No S19 4 x Miniature Push to Make single hole mounting 40p'
No S20 3 x Miniature Push to Break single hole mounting 40p'
No S21 Push-button Switch Pak 4 x Assorted types multi bank and singles Latching and non-latching £1.00'

CAPACITOR PAKS

16201 18 Electolytics 4.7µF-10µF
16202 18 Electrolytics 10µF-100µF
16203 18 Electrolytics 100µF-680µF
ALL 3 at Special Price of £1.20
16160 24 Ceramic Caps 22pF-82pF
16161 24 Ceramic Caps 100pF-390pF
16162 24 Ceramic Caps 470pF-3300pF
16163 21 Ceramic Caps 4700pF-0.047µF
ALL 4 at Special Price of £1.60

RESISTOR PAKS

Order No		
16213	60 ¼W	100 ohm-820 ohm
16214	60 ¼W	1K-8.2K
16215	60 ¼W	10K-82K
16216	60 ¼W	100K-820K

ALL 4 AT SPECIAL PRICE OF £1.60

16217	40 ½W	100 ohm 820 ohm
16218	40 ½W	1K-8.2K
16219	40 ½W	10K-82K
16220	40 ½W	100K-820K

ALL 4 AT SPECIAL PRICE OF £1.60'

TRANSISTOR *FALL-OUT* PACK GERM, SILOCON, POWER, NPN, PNP ALL MIXED, YOURS TO SORT AND TEST

Approx. 500 pieces
Order No. S23. **£1.25 per pack**

VOLTAGE REGULATORS

Positive
No MVR7805 µA7805 TO220 85p
No MVR7812 µA7812 TO220 85p
No MVR7815 µA7815 TO220 85p
No MVR7818 µA7818 TO220 85p
No MVR7824 µA7824 TO220 85p

Negative
No MVR7905 µA7905 TO220 £1.10
No MVR7912 µA7912 TO220 £1.10
No MVR7915 µA7915 TO220 £1.10
No MVR7918 µA7918 TO220 £1.10
No MVR7924 µA7924 TO220 £1.10

µA723C TO99 38p   72723 14 pin Dil 38p
LM309K TO3 £1.20

MICROPHONES

DYNAMIC DUAL IMPEDANCE UNI DIRECTIONAL CARDIOID MICROPHONE
Impedance 600ohms and 50K Response 50-14 000 Hz
Sensitivity 54dB at 50K Size 1½" Dia x 6½" Long
Order No 1328 £7.50'

DYNAMIC CASSETTE MIC

Fitted with On Off switch 1 metre of tough lead with floating 2 5 and 3 5 mm plugs
Impedance 200 ohms Sensitivity 90dB Frequency 90-10 000 Hz Size 20mm Diameter x 120mm long
Order No 1326 £1.15'

LOGIC PROBE

A pocket size instrument capable of detecting T T L D T L Flip Flop and other pulse circuits It is easy to use and operates from the 5V D C supply of the circuit under test The logic levels are indicated by 2 red L E D s one for High and the other for Low There is also a green L E D for the Pulse Mode of the unit
No S59 **Our Special Price £15.95**

TRANSISTORS

BRAND NEW — FULLY GUARANTEED

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC107	25p	BC177	12p	BF194	9p'	TIP32C	36p	2N1893	28p
AC126	14p	BC178	12p	BF195	9p'	TIP41A	34p	2N2218	15p
AC127	16p	BC179	12p	BF196	12p'	TIP41B	35p	2N2218A	18p
AC128	16p	BC182	9p'	BF197	12p'	TIP41C	36p	2N2219	15p
AC128K	24p	BC182L	9p'	BF200	25p	TIP42A	36p	2N2219A	18p
AC176	16p	BC183	9p'	BFX29	22p	TIP42B	37p	2N2221	15p
AC176K	24p	BC183L	9p'	BFX84	18p	TIP42C	38p	2N2221A	16p
AC187	16p	BC184	9p'	BFY50	12p	TIP2955	65p	2N2222	15p
AC187K	26p	BC184L	9p'	BFY51	12p	TIP3055	42p	2N2222A	16p
AC188	16p	BC212	10p'	BFY52	12p	ZTX107	6p'	2N2369	10p
AC188K	26p	BC212L	10p'	MPSA05	22p'	ZTX108	6p'	2N2904	14p
AD161		BC213	10p'	MPSA06	22p'	ZTX109	7p'	2N2904A	15p
162MP	80p	BC213L	10p'	MPSA55	22p'	ZTX300	7p'	2N2905	14p
AF139	30p	BC214	10p'	MPSA56	22p'	ZTX301	7p'	2N2905A	15p
AF239	30p	BC214L	10p'	OC44	12p	ZTX302	9p'	2N2906	12p
BC107	6p	BC251	10p'	OC45	12p	ZTX500	8p'	2N2906A	14p
BC108	6p	BCY70	12p	OC71	9p	ZTX501	10p'	2N2907	12p
BC109	6p	BCY71	12p	OC72	12p	ZTX502	12p'	2N2007A	13p
BC118	10p'	BCY72	12p	OC75	10p	2N696	10p	2N2926G	8p'
BC147	8p'	BD115	40p	OC81	14p	2N697	10p	2N2926Y	7p'
BC148	8p'	BD131	35p'	TIP29A	35p	2N706	7p	2N3053	12p
BC149	8p'	BD132	37p'	TIP29B	36p	2N706A	8p	2N3055	35p
BC154	16p'	BF115	17p	TIP29C	38p	2N708	8p	2N3702	7p'
BC157	9p'	BF167	19p	TIP30A	36p	2N1302	12p	2N3703	7p'
BC158	9p'	BF173	20p	TIP30B	37p	2N1303	15p	2N3704	6p'
BC159	9p'	BF180	25p	TIP30C	38p	2N1304	15p	2N3903	11p'
BC169C	10p'	BF181	25p	TIP31A	32p	2N1307	18p	2N3904	11p'
BC170	6p	BF182	25p	TIP31B	33p	2N1308	22p	2N3905	11p'
BC171	6p'	BF183	25p	TIP31C	34p	2N1309	22p	2N3906	11p'
BC172	6p'	BF184	25p	TIP32A	34p	2N1613	15p		
BC173	7p	BF185	25p	TIP32B	35p	2N1711	15p		

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA119	5p	BAX16/		BYZ17	28p	OA91	7p	IN5401	11p
AAZ13	4p	OA202	5p	BYZ18	28p	OA95	7p	IN5402	12p
BA100	6p	BY100	15p	BYZ19	28p	IN34	5p	IN5404	13p
BA115	5p	BY127	10p'	OA47	5p	IN60	6p	IN5406	16p
BA144	5p	BYZ10	32p	OA70	5p	IN914	4p	IN5407	17p
BA148	10p	BYZ11	32p	OA79	7p	IN4148	4p	IN5408	19p
BA173	10p	BYZ12	32p	OA81	7p	1S44	3p		
BAX13		BYZ13	30p	OA85	7p	IN5400	10p		
OA200	5p	BYZ16	30p	OA90	6p				

LINEAR I.C.s

TBA800	12 pin QIL	75p'	UA711C	TO99	25p	UA748	TO99	28p
TBA810	12 pin QIL	£1.00'	UA703	TO99 (Plastic)	20p	72558	(Dual 748) TO99	45p
TBA820	14 pin QIL	80p'	741P	8 pin DIL	18p	MC1310P	14 pin DIL	£1.25'
LM380	14 pin DIL	80p'	72741	14 pin DIL	20p	76115	14 pin QIL	£1.25'
LM381	14 pin DIL	£1.35'	UA741C	TO99	20p	NE555	8 pin DIL	32p
72709	14 pin DIL	28p	72747	14 pin DIL	55p	NE556	14 pin DIL	60p
UA709	TO99	28p	748P	8 pin DIL	28p	SL414A	10 pin	£1.80'

New Consignment ZN414 Radio Chip **75p***

OPTOELECTRONICS

DISPLAYS
No 1510 707 LED Display 70p each
No 1511 747 LED Display £1.50 each
No S53 DL33 Triple 7 segment LED Display Character height 0 11" Common cathode 12 pin DIL 30p each

LEDs
No S51 Red TIL209 (5 x 125") 50p
No S52 Red FLV117 (5 x 2") 50p
No 1502 Green 125" 18p each
No 1505 Green 2" 18p each
No 1503 Yellow 125" 18p each
No 1506 Yellow 2" 18p each
No S82 0 2" (clear illuminating Red) 12p each

2nd QUALITY LED PAK
1507 10 x LEDS Assorted 75p

LED CLIPS
1508 125 125 5 for 12p
1508 2 2 5 for 15p

SPECIAL REDUCTIONS
1514 NORP 12 45p each
S76 OCP71 5 for £1.00
S83 5 NIXIE Tubes ITT 5870 ST (including Data) £2.00
S77 Neon Indicator Lamps 230 V AC State Colour (Red Amber and Green) 25p each

D.I.Y. PRINTED CIRCUIT KIT

Contains 6 pieces of copper laminate board, box of etchant powder, measure, tweezers, marker pen, high quality pump drill, Stanley knife and blades and 6 in metal rule
Full easy to follow instructions.
Order No S64 **Sale price £5.50**

MAMMOTH I.C. PAK

Approx 200 Pieces
Assorted fall-out integrated circuits, including Logic, 74 series, Linear, Audio and D T L Many coded devices, but some unmarked — you to identify
Order No 16223 **£1.00**

P.C.B. BOARDS

S61 8 pieces 8" x 3¼" (Approx) Single sided paper 50p
S62 4 pieces 8" x 3¼" (Approx) single sided fibreglass 50p
S63 3 pieces 7" x 3¼" (Approx) double sided fibreglass 50p

POWER SUPPLY STABILIZER BOARD

Unused ex-equipment stabilizer board, input 30 V D C output 20 V complete with circuit diagram
Order No S81 **£1.25**

P.O. RELAYS

S85 2 Off Post Office relays 40p

ETCH RESIST PENS

Order No 1609 50p each

BATTERY HOLDERS

to take 6 x HP7's
Order No 202 10p each

SOLDER

5 m of 18 sw Multi-core Solder
Order No. S60 50p

EX G.P.O. MICROSWITCHES

Order No. S84 **4 for 50p**

I.C. INSERTION/ EXTRACTION TOOL

Order No 2015 30p

CABLE CLIPS

S65—50 2 5 mm round single pin fixing 30p

SPECIAL OFFER!

UNTESTED SEMICONDUCTOR PAKS

Code Nos shown below are given as a guide to the type of device The devices themselves are normally unmarked.

No 16130 100 Germ. Gold bonded diodes like OA47 40p
No 16131 150 Germ Point contact diodes like DA70&81 40p.
No 16132 100 200mA Sil diodes like OA200 40p
No 16133 150 75mA Sil Fast switching diode like IN4148 40p
No 16134 50 750mA Sil top hat Rects. 40p
No 16135 20 3 amp Sil stud Rect 40p
No 16136 50 400mw Zeners D O.7 case 40p
No 16137 30 NPN Plastic trans like BC107 8 40p'
No 16138 30 PNP Plastic trans like BC177 8 40p'
No 16139 25 NPN Trans like 2N697/2N1711 TO39 40p
No 16140 25 PNP Trans like 2N2905 TO39 40p
No 16141 30 NPN Trans like 2N706 TO18 40p
No 16143 30 NPN Plastic trans like 2N3906 40p'
No 16144 30 PNP Plastic trans like 2N3905 40p'
No 16145 30 PNP Germ trans like OC71 40p
No 16147 10 NPN To3 Power trans like 2N3055 80p

I.C. SOCKET PAKS

No S66 11 x 8 pin D I L Sockets £1.00
No S67 10 x 14 pin D I L Sockets £1.00
No S68 9 x 16 pin D I L Sockets £1.00
No S69 4 x 24 pin D I L Sockets £1.00
No S70 3 x 28 pin D I.L. Sockets £1.00

TRANSISTOR SOCKETS

No S71 15 x TO18 Sockets £1.00
No S72 10 x TO5 Sockets £1.00

MOUNTING PADS

No S73 50 Mixed Transistor Pads TO18 and TO5 40p

TRANSISTOR HEATSINK PAK

20 Assorted types TO1 TO5 TO18, TO92
Our Mix
Order No S75 60p

TRANSISTOR INSULATING KITS

Mica washers and bushes assorted types, i e TO220 TO66, TO3, etc
Approx 100 pieces (approx 40 sets)
Order No S74 50p per pak

DARLINGTON POWER TRANS

70 watt 8 amp NPN and PNP in plastic case 199
High Voltage (Typ 80V) High gain
10 pieces 5NPN and 5 PNP
Data Sheet supplied
Order No S78 **£1.00 per Pak**

MATCHED PAIRS OF GERMANIUM PNP MED. POWER TRANS

2 amp 750 mW

	VCE	VCB	HFE	
NKT301	40	60	30-100	35p per pair
NKT302	40	60	50-150	35p per pair
NKT303	20	30	30-100	25p per pair
NKT304	20	30	50-150	25p per pair

ZENER PAKS

No S55 20 mixed values 400mW Zener diodes 3-10V £1.00
No S56 20 mixed values 400mW Zener diodes 11-33V £1.00
No S57 10 mixed values 1W Zener diodes 3-10V £1.00
No S58 10 mixed values 1W Zener diodes 11-33V £1.00

UNIJUNCTION TRANSISTORS

U146 – TIS43 20p

FET'S

2N3819 15p   2N5458 18p

2 AMP. BRIDGE RECTIFIERS

Metal Stud Mounting
No S45 50 V (KBS005) 28p
No S46 100 V (KBS 01) 30p
No S47 200 V (KBS 02) 34p

10 Amp. BRIDGE RECTIFIERS 200 V ON HEATSINK — SPECIAL CLEARANCE Order No. S22 .... £1.00

SILICON RECTIFIERS G.E 1 Amp
Similar IN4000 Series
No S41 25 Like IN4001 (1A 50 V) 60p
No S42 20 Like IN4002 (1A 100V) 60p
No S43 18 Like IN4003 1A 200V) 60p
No S44 15 Like IN4004 1A 400V) 60p

SILICON RECTIFIERS — ½ Amp G.E.
S48 40 x 50 V 60p
S49 30 x 200 V 60p
S50 20 x 700V 60p

G.E. HIGH VOLTAGE SILICON RECTIFIERS
GR559 10 mA 14 KV (14 000 V) 20p each
GA432 1 AMP 2 KV (2.000 V) 20p each
FD2 5 2 5 KV Voltage Doubler 20p each

DON'T MISS OUR SPECIAL CASSETTE OFFER! LOOK AT OUR BOOKS

SAVING SALE BI-PAK

YOU MAKE THE SAVING!

POTENTIOMETERS

Slider 40 MM. Travel

Order No		
16191	6 x 470 Ohm LIN Single	40p*
S24	6 x 1K LIN Single	40p*
S25	6 x 5K LIN Single	40p*
16192	6 x 10K LIN Single	40p*
S26	6 x 10K LOG Single	40p*
16193	6 x 22K LIN Single	40p*
16195	6 x 47K LOG Single	40p*
16194	6 x 47K LIN Single	40p*
S27	6 x 100K LIN Single	40p*
S28	6 x 100K LOG Single	40p*
S29	6 x 500K LOG Single	40p*

Slider 60 mm. Travel

S30	6 x 2 5K LOG Single	40p*
S31	6 x 10K LIN Single	40p*
S32	6 x 50K LIN Single	40p*
S33	6 x 250K LOG Single	40p*
S34	4 x 5K LOG Dual	40p*
S35	4 x 10K LIN Dual	40p*
S36	4 x 100K LOG Dual	40p*
S37	4 x 1 3 MEG LOG Dual	40p*

S38 MIXER SLIDER POTS. VARIOUS VALUES & SIZES OUR MIX £1.00*

S39 6 x CHROME SLIDER KNOBS 40p*

WIREWOUND

A range of wirewound single gang pots. with linear tracks of 1 watt rating.

Order No.	Value	Order No.	Value
1891	10 ohms	1896	470 ohms
1893	47 ohms	1897	1K
1894	100 ohms	1898	2K2
1895	220 ohms	1899	4K7

NOW ONLY 35p Each

15 Rotary Potentiometers Assorted values and types 40p*

16186 25 Pre-sets Assorted Values and types .. 40p*

SALE PRICE 40p

MULTI-TURN PRE-SETS

S40 3 x 100K LIN .... **ONLY 50p**

AUDIO PLUG AND SOCKET PAKS

Order No.		
S1	5 x 3.5mm. Plastic Jack Plugs	40p*
S2	5 x 2.5mm. Plastic Jack Plugs	40p*
S3	4 x Std. Plastic Jack Plugs	50p*
S4	2 x Stereo Jack Plugs	30p*
S5	5 x 5-pin 180° Din Plugs	50p*
S6	8 x 2-pin Loudspeaker Plugs	50p*
S7	6 x Phono Plugs Plastic	50p*
S8	5 x 3.5mm. Chassis Sockets (Switched)	25p*
S9	5 x 2.5mm. Chassis Sockets (Switched)	25p*
S10	4 x Metal Std. Chassis Switched Jack Sockets	50p*
S11	2 x Stereo Jack Sockets with instruction leaflet for Headphone connection	50p*
S12	5 x 5-pin 180° Din Chassis Sockets	40p*
S13	8 x 2-pin Din Chassis Sockets	50p*
S14	6 x Single Phono Sockets	40p*

AUDIO LEADS

Order No.		
117	A.C. Mains connecting lead for cassette recorders and radios. Telefunken type	45p*
118	5-pin Din Headphone Plug to stereo socket	78p*
119	2 x 2-pin Plug to inline stereo socket for headphones	60p*
123	20ft. of coiled guitar lead	£1.15*
124	3-pin to 3-pin Din Plug	50p*
125	Audio Lead 5-pin Plug to 5-pin Din Plug	50p*
126	Audio Lead 5-pin Din plug to tinned open ends	50p*
127	Audio Lead 5-pin Din plug to 4 phono plugs	90p*
129	Audio Lead 5-pin Plug to 5-pin Din Plug — mirror image	70p*
130	5 Meter Lead 2-pin Din plug to 2-pin Din inline socket	45p*
132	10 Meter Lead 2-pin Din plug	65p*

HEAVY GAUGE BLACK PLASTIC BOX

With aluminium lid and fixing screws

Size: 6¼" x 3¾" x 2"

Order No. S16 **Only 75p**

74 SERIES TTL ICs

TYPE	QUANTITY 1 £p	100 £p	TYPE	QUANTITY 1 £p	100 £p	TYPE	QUANTITY 1 £p	100 £p
7400	0.09	0.08	7448	0.70	0.68	74122	0.45	0.42
7401	0.11	0.10	7450	0.12	0.10	74123	0.65	0.62
7402	0.11	0.10	7451	0.12	0.10	74141	0.68	0.65
7403	0.11	0.10	7453	0.12	0.10	74145	0.75	0.72
7404	0.11	0.10	7454	0.12	0.10	74150	1.10	1.05
7405	0.11	0.10	7460	0.12	0.10	74151	0.65	0.60
7406	0.28	0.25	7470	0.24	0.23	74153	0.70	0.68
7407	0.28	0.25	7472	0.20	0.19	74154	1.20	1.10
7408	0.12	0.11	7473	0.26	0.22	74155	0.70	0.68
7409	0.12	0.11	7474	0.24	0.23	74156	0.70	0.68
7410	0.09	0.08	7475	0.44	0.40	74157	0.70	0.68
7411	0.22	0.20	7476	0.26	0.25	74160	0.95	0.85
7412	0.22	0.20	7480	0.45	0.42	74161	0.95	0.85
7413	0.26	0.25	7481	0.90	0.88	74162	0.95	0.85
7416	0.28	0.25	7482	0.75	0.73	74163	0.95	0.85
7417	0.26	0.25	7483	0.88	0.82	74164	1.20	1.10
7420	0.11	0.10	7484	0.85	0.80	74165	1.20	1.10
7422	0.19	0.18	7485	1.10	1.00	74166	1.20	1.10
7423	0.21	0.20	7486	0.28	0.26	74174	1.10	1.00
7425	0.25	0.23	7489	2.70	2.50	74175	0.85	0.82
7426	0.25	0.23	7490	0.38	0.32	74176	1.10	1.00
7427	0.25	0.23	7491	0.65	0.62	74177	1.10	1.00
7428	0.36	0.34	7492	0.43	0.35	74180	1.10	1.00
7430	0.12	0.10	7493	0.38	0.35	74181	1.90	1.80
7432	0.20	0.19	7494	0.70	0.68	74182	0.80	0.78
7433	0.38	0.36	7495	0.60	0.58	74184	1.50	1.40
7437	0.26	0.25	7496	0.70	0.68	74190	1.40	1.30
7438	0.26	0.25	74100	0.95	0.90	74191	1.40	1.30
7440	0.12	0.10	74104	0.40	0.35	74192	1.10	1.00
7441	0.60	0.57	74105	0.30	0.25	74193	1.05	1.00
7442	0.80	0.70	74107	0.30	0.25	74194	1.05	1.00
7443	0.95	0.90	74110	0.48	0.45	74195	0.80	0.75
7444	0.95	0.90	74111	0.75	0.72	74196	0.90	0.85
7445	0.80	0.75	74118	0.85	0.82	74197	0.90	0.85
7446	0.80	0.75	74119	1.30	1.20	74198	1.90	1.80
7447	0.70	0.68	74121	0.28	0.26	74199	1.80	1.70

Devices may be mixed to qualify for quantity price. Data is available for the above series of ICs in booklet form **price 35p**

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.14	CD4018	£0.85	CD4035	£1.40	CD4056	£1.15
CD4001	£0.16	CD4019	£0.45	CD4037	£0.78	CD4069	£0.32
CD4002	£0.16	CD4020	£0.95	CD4040	£0.78	CD4070	£0.32
CD4006	£0.80	CD4021	£0.85	CD4041	£0.68	CD4071	£0.20
CD4007	£0.17	CD4022	£0.80	CD4042	£0.68	CD4072	£0.20
CD4008	£0.80	CD4023	£0.18	CD4043	£0.78	CD4081	£0.20
CD4009	£0.50	CD4024	£0.64	CD4044	£0.78	CD4082	£0.20
CD4010	£0.50	CD4025	£0.18	CD4045	£1.15	CD4510	£1.10
CD4011	£0.18	CD4026	£1.85	CD4046	£0.95	CD4511	£1.25
CD4012	£0.17	CD4027	£0.48	CD4047	£0.75	CD4516	£1.10
CD4013	£0.42	CD4028	£0.80	CD4049	£0.46	CD4518	£1.10
CD4015	£0.80	CD4029	£0.95	CD4050	£0.46	CD4520	£1.10
CD4016	£0.42	CD4030	£0.46	CD4054	£0.95		
CD4017	£0.80	CD4031	£1.80	CD4055	£1.60		

AUDIO MODULE SALE

Type	Description	Normal Price	Sale Price
AL30A	10W RMS Power AMP	~~£3.65~~	£2.95*
AL60	25W RMS Power AMP	~~£4.35~~	£3.55*
AL80	35W RMS Power AMP	~~£6.95~~	£5.95
AL250	125W RMS Power AMP	~~£15.95~~	£14.45
SPM80	35V Power Supply	~~£3.75~~	£3.10*
PS12	20-30V Power Supply for AL30A	~~£1.30~~	£1.15*
PA12	Stereo Pre-Amp for AL30A	~~£6.70~~	£5.95*
PA100	Stereo Pre-Amp for AL60/AL80	~~£13.75~~	£12.45*
S450	Stereo F.M. Tuner	~~£20.45~~	£18.65*
MPA30	Magnetic-Ceramic Pre-Amp	~~£2.85~~	£2.55*
Stereo 30	Complete Audio Chassis 7W + 7W RMS	~~£16.25~~	£14.95

LOOK & LISTEN!

GE 100 NINE CHANNEL MONO-GRAPHIC EQUALIZER MODULE £19.50

The GE100 has nine 1 octave adjustments using integrated circuit active filters. Boost and Cut limits are ± 12dB. Max. Voltage handling 2 V RMS. T.H.D. 0.05%. input impedence 100 K. Output impedence less than 10 K. Frequency response 20 Hz-20 KHz (3dB). The nine gain controls are centred at 50, 100, 200, 400, 800, 1,600, 3,200, 6,400 and 12,800 Hz. The suggested gain controls are 10 K LIN sliders (not supplied with the module) See Paks S31 and 16192

SG30 POWER SUPPLY BOARD FOR GE100 15-0-15 VOLT **£4.50**

SEND S.A.E. FOR TECHNICAL DATA ON ALL AUDIO MODULES

SPECIAL OFFER!

COMPONENT PAKS

Order No	Quantity	
16164	200 approx. Resistors mixed values (Count by weight)	40p*
16165	150 approx. Capacitors mixed values (Count by weight)	40p*
16167	80 ⅛W Resistors mixed values	40p*
16168	5 pieces Assorted Ferrite rods	40p*
16169	2 pieces Tuning gangs MW/LW	40p*
16170	50 metres Single strand wire assorted wire	40p
16171	10 Reed switches	40p*
16172	3 Micro switches	40p*
16176	20 Assorted electrolytics Trans types	40p*
16177	1 pack Assorted hardware nuts/bolts, etc.	40p
16179	20 Assorted tag strips and panels	40p
16180	15 Assorted control knobs	40p*
16184	15 Assorted Fuses 100mA-5 amp	40p
16188	60 ½W Resistors mixed values	40p*
16187	30 metres stranded wire assorted colours	40p

½ PRICE BARGAIN!

£4 worth (min. Value)

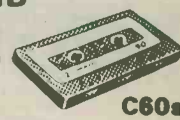
Electronic Project Books, Technical, Semiconductor Data and Equivs. — Books of Assorted Titles

Our Clearance Price —

£2 per bundle†

Order No. S80

SUPER SOUND SAVING



C60 METROSOUND LOW NOISE CASSETTES

Order No. S53 **10 for £2.50***

BIB GROOVE CLEAN

Model 60 Chrome Finish Plastic

Order No. 829 £1.40*

HOT OFFER

ANTEX SOLDERING IRONS

Order No.

1931 X25 25watt. LOW LEAKAGE
Usually ~~£3.40~~ **Sale Price £2.95**
PLUS FREE Heatshunt

1948 Model C 15watt GENERAL PURPOSE
Usually ~~£3.40~~ **Sale Price £2.95**
PLUS FREE Heatshunt

1939 ST3 Soldering Iron Stand, suitable for either Iron **£1.20**

NEW Siren Alarm Module

American Police screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer breakdown and other security purposes. Order No. S15 **Only £3.50**

AVDEL BOND

Cyanocrylate adhesive Bonds — plastic, rubber, Transistors. Components in Seconds.

Order No. 143 **55p per 2 gm. phial**

ORDERING

Please word your orders exactly as printed, not forgetting to include our part number.

VAT

Add 12½% to prices marked *
Add 8% to others excepting those marked †. These are zero.

OPT FOR OPTOELECTRONICS! PRINTED CIRCUIT KITS. BOARDS & PENS.

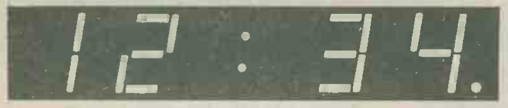
BI-PAK

Dept. ETI.2, P.O. Box 6, Ware, Herts

COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.

FOR RELIABLE JOINTS—ANTEX IRONS!

WIRELESS TIME :



approx. ¾ full size digits shown here

National's MA1012 LED digital clock module is a complete clock & alarm unit, operating from 50 or 60 Hz mains, and offering all the features you would expect: Hours-minutes display in bright 0.5" leds with optional seconds, sleep and snooze alarms, fast and slow setting, AM/PM indicator, switched alarm outputs - but best of all *no RFI.* Thus the MA1012 is suitable for use in any radio/tuner applications, and requires just 1.75 x 3.75 x 0.7" total. (Ex. transformer).
£9.45 per module, isolating mains transformer £1.50 each. (*8% vat)
Two modules, and two transformers for £20.00 (+8% vat)

In the latest Ambit catalogue: more TOKO coils, chokes, filters etc., data on the short wave coil sets, a revised price list, micro-microphone inserts, special offer lines etc.

DETECKNOWLEDGEY

Metal locator principles and practise, including some of the facts and information manufacturers of £100+ detectors would rather you didn't know. £1.00 each.

The Bionic Ferret 4000 - a VCO metal locator based on the PW seekit, including all parts, plasticwork, ready wound coil etc. Inc. free copy of detecknowledgey. £34.26 in pp and VAT at 8%.

Special announcement. The Bionic Radiometer metal locator is at last to be released. A full VLF discriminator, with simultaneous display of ferrous, non-ferrous and foil objects. With a little practise, you can actually find objects obscured by junk. Outperforms units costing £150+. Digital control. Demo available at Brentwood, on sale soon for less than £75.SAE info:

COMPONENTS

Herewith the list of first quality parts and modules for wireless, inc. Europe's largest range of signal coils and inductors. ½m in stock !

CA3089E	FM IF	1.94
KB4402	FM IF	1.94
HA1137W	FM IF	2.20
TBA120	FM IF	0.75
TBA120S	FM IF	1.00
sn76660n	FM IF	0.75
ua720	AM rad	1.40
CA3123E	AM rad	1.40
HA1197	AM rad	1.40
TBA651	AM rad	1.81
MC1350	agc gain	1.00
ua753	fm gain	1.80
LM1496	Bal mix	1.25
MC1310P	mpx dec	2.20
KB4400	as above	2.20
ca3090aq	mpx dec	4.35
HA1196	mpx dec	4.20
LM380	2w AF	1.00
LM381	preamp	1.81
tda2020	15w AF	2.99
tca940E	10w AF	1.80
tba810as	7w AF	1.08
LM301an	op amp	0.39*
ua741	op amp	0.34*
LM3900	op amp	0.68*
7805uc	5v/1amp	1.55*
tda1412	12v/½A	0.95*
78M20	20v/½A	1.20*
78M24	24v/½A	1.20*
ua723cn	variable	0.80*
NE550a	as above	0.80*
taa550b	32v ref	0.50*
icl8038cc	sig gen	4.50*
NE555v	timer	0.70*
NE566v	vco	2.50*
NE567v	tone dc	2.50*
NE560B	hf pll	3.50*
NE561B	hf pll	3.50*
NE565K	lf pll	2.50*
MC1312	quad	1.50
11C90	650mhz	14.00*
ZTX107	50v/.3w	0.14
ZTX108	30v/.3w	0.14
ZTX109	30v/.3w	0.14

BC413	lo noise	0.18
40238	shld RF	0.25*
BF224	.6ghz RF	0.22
BF274	.7ghz RF	0.18
ZTX212	50v/.3w	0.17
ZTX213	30v/.3w	0.16
ZTX214	30v/.3w	0.17
ZTX451	60v/1w	0.18
ZTX551	60v/1w	0.18
BD515	45v/10w	0.27
BD516	45v/10w	0.30
BD535	60v/50w	0.52
BD536	60v/50w	0.53
BD609	80v/90w	0.70
BD610	80v/90w	1.20
BF256	1ghz fet	0.34
E176	p ch swt	0.38
MEM614	(40822)	0.38*
MEM616	(40673)	0.67*
MEM680	lo noise	0.75*
BA102	vhf varic	0.30
BA121	vhf varic	0.30
BB104	dual var.	0.45
BB105	uhf varic	0.40
mvam2	dual AM	1.48
mvam115	15v/AM	1.05
mvam125	25v/AM	0.90

TOKO Coils & Filters

10mm & 7mm (rad cont)

AM IFts with cap		0.30
FM IFts with cap		0.33
eg		
YHCS11098AC2		0.30
YHCS12374AC2		0.30
YHCS11100AC2		0.30
KALS4520A		0.33
KACSK586HM		0.33
LLC238	7mm	0.33
LLC4827	7mm	0.33
LLC4828	7mm	0.33
CFS10.7	ceramic	0.50
BLR3107N	mpx	1.90
BBR3132	6pole fm	2.25

MFL 2.4 kHz ssb mech. filter for ssb gen/IF 455kHz with matching transf's. 9.95
MFH series 4/5/7kHz bandwidth @ 455kHz 1.95
MFK series 7/9kHz bw 1.65

Modules/tunerheads etc.

EC3302 3cct v/cap fm	7.50
EF5600 5cct v/cap fm	12.95
EF5800 6cct v/cap fm	15.25
EF5801 (5800+osc op)	17.45
8319 4 v/c, mos mixer	11.45
7252 complete fm mono tunerset.afc,agc,mute	26.50
7253 complete fm stereo tunerset. afc, agc, mute	26.50
7020 10.7MHz fm if	6.95
7030 linear phase fm if	10.95
93090 ca3090aq dec	8.36
92310 1310 decoder	6.95
91196 ha1196 decoder	12.99
91197 mw/lw v/cap tun.	11.35
7122 3 v/c mw (OR lw) tuner KIT 15v tuning	9.00
810k 7w af kit comp.	£3
940k 10w af kit	3.95
tda2020k pr. tda2020 ics, pcb, heatsinks for pa	9.35

All mpx decoders feature TOKO pilot tone filters.

Tuners: complete

Larsholt signalmaster Mk 8
Best fm tuner kit under £100
Looks as good as it sounds.
Full instructions 86.95
Audiomaster amp. Matching 25+25w rms amp. 79.00
carriage on above £3 extra ea.

Misc.

FX1115 beads	10/0.25
MW/LW ferrite rod ant	0.90
min. foil trimmers (see pl)	
22t 100k pots for tuning	.45
RFchokes: 1uH to 120mH	

VAT is extra at 12½%, except where otherwise shown (*8%). PP now 25p per order. Catalogue 45p (inc). Pse send A5 or larger SAE with enquiries. Price lists free with an SAE. Full range of components etc available to callers at our new easy-to-get-to premises.

ambit INTERNATIONAL

Number 2, Gresham Road, Brentwood, Essex. CM14 4HN
telephone (0277) 216029
Our new premises are only 200 yards from Brentwood station - with parking facilities outside the door !! *

NOW AVAILABLE . . .

LATEST BOUND VOLUME No. 30 of "Radio & Electronics Constructor"

AUGUST 1976 to JULY 1977

Comprising 776 pages inc. index

PRICE £3.70 P&P 90p

BOUND VOLUME No. 27
(August 1973 to July 1974)
Price £2.60 P&P 90p

BOUND VOLUME No. 28
(August 1974 to July 1975)
Price £3.00 P&P 90p

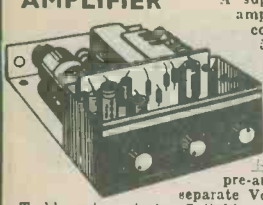
BOUND VOLUME No. 29
(August 1975 to July 1976)
Price £3.30 P&P 90p

Limited number of these volumes still available.

We regret all earlier volumes are now completely sold out.

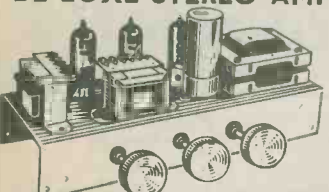
Available only from
DATA PUBLICATIONS LTD.,
57 MAIDA VALE, LONDON, W9 1SN

SUPERSOUND 13 HI-FI MONO AMPLIFIER



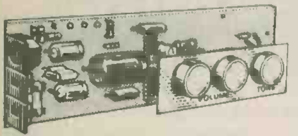
A superb solid state audio amplifier. Brand new components throughout. 5 Silicon transistors plus 2 power out-put transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz. 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £15.00. P. & P. £1.20.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line-up:-2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built and tested to a high standard. £12·40. P. & P. £1·30.

HARVERSONIC STEREO 44



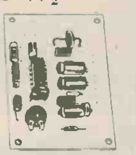
A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets and 5 pin din tape rec./play socket are mounted on the printed circuit panel, size approx. 9½" × 2½" × 1" max. depth. Supplied brand new and tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically), at only £9·00 plus 50p P. & P. Mains transformer with an output of 17V a/c at 500 m/a can be supplied at £1·50 plus 40p P. & P. if required. Full connection details supplied.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240v. Secondary combinations 0-5-10-15-20-25-30-35-40-60v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price £3.00 P. & P. £1.20.

MAINS TRANSFORMER. For power supplies.
Pri. 200/240v. Sec. 9-0-9 at 500 mA. £1.60 P. & P. 65p.
Pri. 200/240v. Sec. 12-0-12 at 1 amp. £1.85 P. & P. 65p.
Pri. 200/240v. Sec. 10-0-10 at 2 amp. £2.50 P. & P. 90p.
Pri. 200/240v. Sec. 23v. at 1·5 amp, 6v at ·6 amp, 8v. at 50 mA. £2.65 + 65p P. & P.

ALL PURPOSE POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3½" × 2½". Ready built and tested. Price £6.75. P. & P. 95p

STEREO-DECODER SIZE 2" × 3" × ½"



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

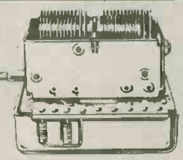
QUALITY RECORD PLAYER AMPLIFIER MK. II A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in wide × 3in deep × 6in high. Ready built and tested. PRICE £7·00. P. & P. £1.25
ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE £8·00. P. & P. £1.30.

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

200/240V Mains operated Solid State A/M F/M Stereo Tuner. Covering M.W. A.M. 540-1605 KHZ, VHF/FM 88-108 MHZ. Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built-in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600 m/v RMS into 20K. Simulated teak finish cabinet. Will match almost any amplifier. Size 8½" w. 4" h. × 9½" d. approx. LIMITED NUMBER ONLY at £28 + £1.50 P. & P.

SPECIAL OFFERS

Mullard LP1159 RF-IF Double Tuned Amplifier Module for nominal 470kHz. Size approx. 2¾" × 1¼" × ¾" 7·6V + earth. Brand new pre-aligned. Full specification and connection details supplied. £2·25 + P. & P. 20p.



Pye VHF/FM Tuner Head covering 88-108M/Hz. 10·7M/Hz IF output 7-8V + earth. Supplied pre-aligned, with full circuit diagram. Connection details supplied. Beautifully made with precision-geared FM Gang and 323 Pf + 323 Pf AM Tuning Gang only £3·15 + P. & P. 35p.

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

HI-FI LOUDSPEAKER SYSTEM MkII

Beautifully made simulated teak finish enclosure now with most attractive slatted front. Size 16½" high × 10¼" wide × 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. AVAILABLE IN NOMINAL 4 ohm, 8 ohm or 16 ohm impedance (state which). Handling power 10 watts R.M.S.

OUR PRICE £14.00 each. Carr. £3

Cabinet Available Separately £8.00 each. Carr. £2.00
Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter £12.50 each. Carr. £3.00

LOUDSPEAKER BARGAINS
5in. 3 ohm £2·00, P. & P. 35p. 7 × 4in. 3 ohm £2·35, P. & P. 48p. 10 × 6in. 3 or 15 ohm £3·20. P. & P. 75p. 8 × 5in. 3 ohm with high flux magnet £3·00, P. & P. 60p. Tweeter. Approx. 3½". Available 3 or 8 or 15 ohms, £2.00 + 30p P. & P.

2" PLASTIC CONE HF TWEETER 4 ohm, £3·50 per matched pair + 50p P. & P.

HIGH POWER HI-FI 8 ohm Dome Tweeter. 1" voice coil. Magnet size 3" dia. Suitable for use in up to 50 watt systems. £4·50 each + 60p P. & P.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £2.00 yd. length. P. & P. 50p per yd. (min. 1 yd.). S.A.E. for samples.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾" × 14¾" × 1⅞" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz–20kHz. Can be mounted on ceilings, walls, etc. and used with or without baffle. Send S.A.E. for details. Only £8·40 each. P. & P. 90p for one, £1.10 for two.

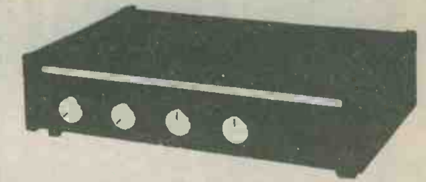
Now also available 8"-8 ohm. 10 watts r.m.s. 20 watt peak 40 Hz-20,000 Hz. Overall depth 1". Ideal for Hi-Fi or for use in cars £5.25 + P. & P. (one 65p, two 75p).

SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE. T/O stylus Diamond Stereo LP and Sapphire 78. ONLY £2.50 P. & P. 20p. Also available fitted with twin Diamond T/O stylus for Stereo LP. £3.00 P. & P. 20p.

LATEST CRYSTAL T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo 78. £2.00 P. & P. 20p

LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only £2.00 P. & P. 20p

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



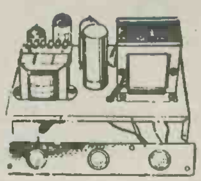
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specifications: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ± 3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ± 3dB 12–15,000 Hz. Bass, boost approx. to ± 12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2½"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT	£13·50	P. & P. 80p
(Magnetic input components 33p extra)		
POWER PACK KIT	£5·50	P. & P. 95p
CABINET	£5·50	P. & P. 95p

Special offer—only £23.75 if all 3 units ordered at one time plus £1.25 P. & P.

Full after sales service
Also available ready built and tested £31·25. P. & P. £1.50.

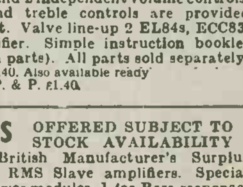
3-VALVE AUDIO AMPLIFIER HA34 MK II.



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4½"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £8.50. P. & P. £1.40.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. £8.00. P. & P. £1.40.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p × SAE (Free with parts). All parts sold separately. ONLY £13.50. P. & P. £1.40. Also available ready built and tested £18.00. P. & P. £1.40.

SPECIAL LINES OFFERED SUBJECT TO STOCK AVAILABILITY

Limited number of British Manufacturer's Surplus professional 100 watt RMS Slave amplifiers. Special features: 2 separate power modules, 1 for Bass response, and 1 for mid. range/tweeter. 5 stage LED display for power o/p indication. A/c mains i/p switchable for 110 or 240V. Can easily be converted to stereo.

AVAILABLE TO PERSONAL CALLERS ONLY—PLEASE PHONE TO CONFIRM AVAILABILITY.
Brand new and tested only £33·75.

OUR PRICES INCLUDE VAT AT CURRENT RATES

Open 9.30-5.30 Monday to Friday. 9.30-5 Saturday
Closed Wednesday.
Prices and specifications correct at time of press. Subject to alteration without notice

HARVERSON SURPLUS CO. LTD.

(Dept. REC) 170 HIGH ST., MERTON, LONDON, SW.19. Tel: 01-540 3985
A few minutes from South Wimbledon Tube Station
SEND SAE WITH ALL ENQUIRIES. FOR PERSONAL CALLERS ONLY: WE CAN NOW OFFER A FULL REPAIR SERVICE ON ALL HI-FI EQUIPMENT, DISCO, CASSETTES, CAR RADIO, ETC.

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

Lamp control panels with 5A mains triac, heat sink, 2 Multi-turn trimpots, cermet pot, 4 x 1A diodes, 9 x 1N914 neon indicator, 11 popular transistors, Hi-stab resistors, capacitors, etc. £1.00 p&p 45p

ZN414 Radio Chip £1.20

Mullard 12-0-12V, 1.4A stabilized, regulated, power supply. Approx. 8½" x 4¾" x 3½" with handbook. £15.00 p&p £1.30

Greenpar 50 ohm BNC line plug, round or flanged chassis socket or t.n.c. or u.h.f. plug, all 50p each

POSTAL ORDERS means quicker service — unless a fee is paid for special clearance it is 8 days to ensure cheques are not returned 'unpaid'. Postal order poundage charge is offset by it now costing up to 16p bank charges on every cheque written out.

250Ω 50 watt + Resistor 30p

SEMICONDUCTORS

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

AC128/176	15p	BCY40	50p	BFW30	£1
ACY28	19p	BCY70/1/2	12p	BFW57/58	17p
AF116	16½p	BCZ11	28p	BFX12/29/30	20p
AF124/6/7	25p	BD113	50p	BFX84/88/89	17p
AF139	20p	BD115/6	31p	BFY52	13p
AF178/80/81	30p	BD131/2/3	35p	BFY90	50p
AF239	30p	BD135/6/7/8/9	30p	BR101	30p
ASY27/73	30p	BD140/142	30p	BRY39/56	26p
BC107/8/9 + A/B/C	6p	BD201/2/3/4	80p	BSV64	30p
BC147/8/9 + A/B/C/S	6p	BD232/4/5/8	49p	BSV79/80 F.E.T.s	80p
BC157/8/9 + A/B/C	6p	BDX77	£1	BSV81 Mosfet	90p
BC178A/B, 179B	12p	BD437	50p	BSX20/21	14p
BC184C/LC	9p	BF115/167/173	15p	BSY40	27p
BC186/7	20p	BF178/9	20p	BSY95A	12p
BC213L/214B	10p	BF180/1/2/3/4/5	15p	BU204+Mount Kit	£1.60
BC261B	8p	BF194/5/6/7	6p	CV7042 (OC41/44 ASY63)	5p
BC327/8, 337/8	8p	BF194A, 195C	6p	GET111	40p
BC547/7B/8/8A/8C	10p	BF200, 258, 324	20p	ON222	20p
BC556/7/7B/8/9	9p	BF202/3	30p	TIP30/3055	45p
BCX32/36	12p	BF336	27p	TIS88A F.E.T.	23p
BCY31	80p	BFS28 Dual Mosfet	£1	ZTX300/341	7p
		BFW10/11 F.E.T.	40p	2N393 (MA393)	30p

BRIDGE RECTIFIERS

Amp	Volt		
1	1,600	BYX10	30p
1	140	OSH01-200	26p
1 4	42	BY164	40p
0.6	110	EC433	6p
5	400	Texas	90p
2½	100	I.R.	40p

2N456A	50p
2N706A	15p
2N929	14p
2N987	40p
2N1507/2219	15p
2N2401	30p
2N2412	70p

2N2483	23p
2N2904/5/6/7/7A	15p
2N3053	14p
2N3055 R.C.A.	50p
2N3704	8p
2N3133	20p
2N3553	50p
2N4037	34p
2N5036 (Plastic 2N3055)	30p
2N5484 FET	34p
2SA141/2/360	31p
2SB135/6/457	20p
40250 (2N3054)	30p

NEW B.V.A. VALVES

EB91	34p
ECL80	34p
PCC84	34p
6SN7	50p
6AT6	50p
EZ81	40p

TRANSFORMER

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

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

OTHER DIODES

1N916	6p
1N4148	3p
BA145	14p
Centercel	24p
BZY61/BA148	10p
BB103/110 Varicap	20p
BB113 Triple Varicap	37p
BA182	13p
OA5/7/10	15p
BZY88 Up to 33 volt	8p
BZX61 11 volt	15p
BR100 Diac.	15p
BZY96C 10V	30p
BZY95C 33V	30p

INTEGRATED CIRCUITS

TBA920	£3.00
TAA700	£2.00
TBA800	£1.00
741 8 pin d.i.l. op.	24p
SN76013N	£1.20
TAD100 AMRF	£1.00
CA3001 R.F. Amp	50p
CD4013 CMOS	36p
TAA300 1wt Amp	£1.00
TAA550 Y or G	22p
TAA263 Amp	65p
7400/7401	14p
7402/4/10/20/30	14p
7414	56p
7438/74/86	24p
7414	56p
7483	69p
LM300, 2-20 volt	69p
LM1303N	£1.00
74154	90p
TBA5500	£1.50

RECTIFIERS

	Amp	Volt	
IN4004/5/6	1	4/6/800	5p
IN4007/BYX94	1	1250	5p
BY103	1	1,500	18½p
SR100	1.5	100	7p
SR400	1.5	400	8p
REC53A	1.5	1,250	14p
LT102	2	30	10p
BYX22-200	1½	300	20p
BYX38-300R	2.5	300	40p
BYX38-600	2.5	600	45p
BYX38-900	2.5	900	50p
BYX38-1200	2.5	1,200	55p
BYX48-300R	2.5	300	26p
BYX49-600	3	600	35p
BYX49-900	3	900	40p
BYX49-1200	3	1,200	52p
BYX48-300R	6	300	40p
BYX48-600	6	600	50p
BYX48-900	6	900	60p
BYX48-1200R	6	1,200	80p
BYX72-150R	10	150	35p
BYX72-300R	10	300	45p
BYX72-500R	10	500	55p
BYX42-300	10	300	30p
BYX42-600	10	600	65p
BYX42-900	10	900	80p
BYX42-1200	10	1,200	95p
BYX46-300R*	15	300	£1.00
BYX46-400R*	15	400	£1.50
BYX46-500R*	15	500	£1.75
BYX46-600*	15	600	£2.00
BYX20-200	25	200	60p
BYX52-300	40	300	£1.75
BYX52-1200	40	1,200	£2.50
RAS310AF*	1.25	1,250	40p

*Avalanche type

TRIACS

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

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

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

DLI Pal Delayline . . 50p

Relay Socket 15p
Take miniature 2PCO relay

B9A valve can . . 5p

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

Mullard Semiconductor, Valve & Component Data Book 1976-8 40p

OPTO ELECTRONICS

Diodes		Photo transistor	
TIL209 Red	12p	BPX29	80p
BPX40	50p	OCP71	45p
BPX42	80p		
BPY10 (VOLTIAC)	80p		
BPY68 / BPY69 / BPY77	80p		

BIG L.E.D. 0.2" 2v 50m/A max.
RED 14p
Wire end neons 7p

PHOTO SILICON CONTROLLED SWITCH BPX66 PNPN 10 amp £1.00

THYRISTORS

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

.3" red 7 segment L.E.D. 14 D.I.L. 0-9+D.P. display 1.9v 10m/a segment, common anode 75p
RS 0.6in green £2.00
Minitron 0.3in 3015F filament £1.10

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

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

PAPER BLOCK CONDENSER

0.25MFD	800 volt	60p
1MFD	250 volt	30p
1MFD	400 volt	40p

I.C. extraction and insertion tool 42p

CHASSIS SOCKETS

Car Aerial **9p**, Coax **6p**, 5 pin 180° **9p**, 5 or 6 pin 240° din **6p**, speaker din switched **10p**, 3.5 mm switched **5p**, stereo ¼" jack enclosed **15p**.

RS *Irravin* high temperature wire, 19/0-16, minus 55° to 105°C, 600V, 3A, white, black or red. Half trade price at 30p 10M coil.
Lasso 10M x 15mm grey p.v.c. insulating tape 20p

ENAM. COPPER WIRE

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

GARRARD

GCS23T Crystal Stereo Cartridge 95p
Mono (Stereo compatible), Ceramic or crystal 75p

HANDLES

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

Belling Lee white plastic surface coax outlet box 20p

Miniature Axial Lead Ferrite Choke formers 2p

RS 10 Turn Pot 1% 250, 500 Ω, 1K, 50K £1.50

Copper coated board 10" x 9" approx 35p

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

KLIPPON 25A 440v TERMINAL BLOCKS professional leaf spring clamp, twin with clip-over cover 7p

Strip of 4 440A, 440V 12p

Philips Iron Thermostat . . . 15p
McMurdo PP108 8 way edge plug 10p
Multicore Solder ½kg. 16 or 18 or 20 s.w.g. £4.00 p&p 65p

New unmarked, or marked ample lead ex new equipment

ACY17-20	8p	TIC44	24p
ASZ20	8p	2G240	£1
ASZ21	30p	2G302	5p
BC186	11p	2G401	5p
BCY30-34	20p	2N711	25p
BCY70/1/2	8p	2N2926	4p
BY126/7	4p	2N598/9	6p
HG1005	10p	2N1091	8p
HG5009	3p	2N1302	8p
HG5079	3p	2N1907	£1
L78/9	3p	Germ. diode	1p
M3	10p	2N3055 Motorola	30p
OA81	3p	GET120 (AC128 in 1" sq. heat sink	15p
OA47	3p		
OA200-2	3p		
OC23	20p	GET872	12p
OC200-5	20p	2S3230	30p

BARGAIN CAPS

2500 mfd.	40v	30p
.1 mfd.	350/500v	1½p
.1 mfd.	1500v	2p
10000 mfd.	15v	12p
6800 mfd.	10v	6p
32+32 mfd.	275v	8p
16+32 mfd.	350v	12p
8+8 mfd.	350v	8p
1 mfd. non-polar	350v	3p
25000 mfd.	25v	20p
12000 mfd.	12v	12p

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

NICAD Rechargeable Batteries, 12v ex equip. Type A 1" dia. x 2½". 10 hours at 150mA. £3.00
Type B Storno Flat Pack. 500m/A 5" x 2" x ½" £1.20

KLAXON 12-24v 2-tone transistorized Alarm Sounder. Note, pitch and duration variable. Weatherproof alloy case. £10.00 p&p £1.30

TIE CLIPS

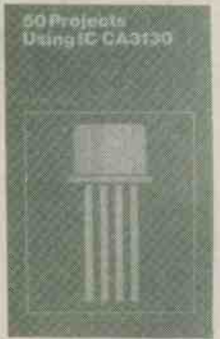
Nylon self locking, 3½" 2p

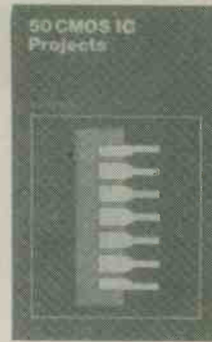
SMALL ORDERS, ENCLOSE SUITABLE STAMPED ADDRESSED ENVELOPE LARGE ORDERS, ADD SUFFICIENT FOR POSTAGE, PACKING, INSURANCE, ETC. TOTAL GOODS PLUS CARRIAGE. ADD V.A.T.

MAIL ORDER CUSTOMERS ONLY ADD 8% VAT-I PAY BALANCE ON 12½% ITEMS
ALL ENQUIRIES, ETC., MUST BE ACCOMPANIED BY A STAMPED ADDRESSED ENVELOPE

DIRECT READER SERVICE

RADIO & ELECTRONICS BOOKS





1. **50 PROJECTS USING RELAYS, SCR's & TRIACS** by F. G. Rayer — **£1.25**
2. **FUN & GAMES WITH YOUR ELECTRONIC CALCULATOR** by J. Vine — **87p**
3. **50 (FET) FIELD EFFECT TRANSISTOR PROJECTS** by F. G. Rayer — **£1.40**
4. **DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS** by Adrian Michaels — **£2.70**
5. **50 SIMPLE L.E.D. CIRCUITS** by R. N. Soar — **87p**
6. **MODERN TAPE RECORDING HANDBOOK** by B. B. Babani — **87p**
7. **THE COMPLETE CAR RADIO MANUAL** by F. C. Palmer — **87p**
8. **SOLID STATE NOVELTY PROJECTS** by M. H. Babani — **97p**
9. **28 TESTED TRANSISTOR PROJECTS** by R. Torrens — **£1.07**
10. **SOLID STATE SHORT WAVE RECEIVERS FOR BEGINNERS** by R. A. Penfold — **£1.07**
11. **50 PROJECTS USING IC CA3130** by R. A. Penfold — **£1.07**
12. **50 CMOS IC PROJECTS** by R. A. Penfold — **£1.07**
13. **HOW TO BUILD ADVANCED SHORT WAVE RECEIVERS** by R. A. Penfold — **£1.35**
14. **BEGINNERS GUIDE TO BUILDING ELECTRONIC PROJECTS** by R. A. Penfold — **£1.40**
15. **50 CIRCUITS USING GERMANIUM SILICON & ZENER DIODES** by R. N. Soar — **87p**

all prices include postage & packing

To: Data Publications Ltd., 57 Maida Vale, London W9 1SN

Please send me within 21 days .... copy/copies of

....

....No. ....

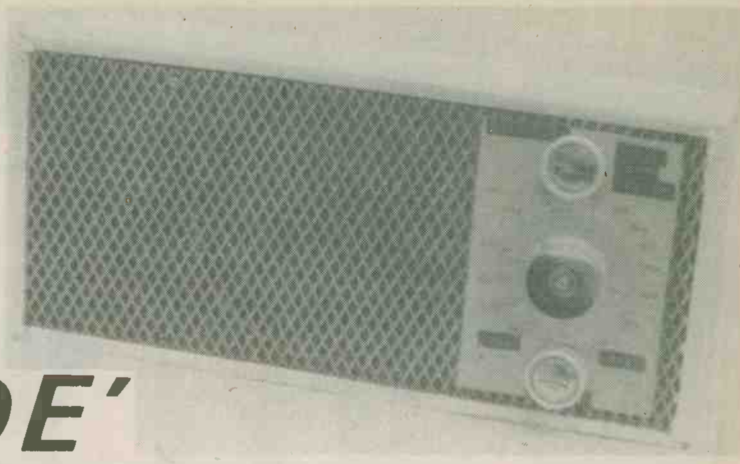
I enclose Postal Order/Cheque for £..........

Name ....

Address ....

(Block Letters Please)

(We regret this offer is only available to readers in the U.K.)



THE 'CASCODE' MEDIUM AND LONG WAVE PORTABLE

by Sir Douglas Hall, K.C.M.G. Part 1 (2 parts)

★ Three transistors give a five-stage performance

★ An unusual and ingenious design

As many readers know, there are areas where medium and long wave reception with a very simple receiver having a single tuned circuit, such as can be made around the ZN414 or two doubly reflexed bipolar transistors, is very difficult because of the presence of a powerful local transmitter. If this is in line with other required transmissions satisfactory use cannot be made of the ferrite aerial directional properties and, so far as t.r.f. designs are concerned, special circuits such as those employed in the author's Super Alpha receivers, described in earlier issues, have to be used to obtain the necessary station separation.

NEW CIRCUIT

The receiver to be described incorporates a new double reflex circuit with which r.f. amplification increases with wavelength. In many, but not of course all cases, the swamping station will be at the higher frequency end of the medium wave band and here, with less amplification offered, greater selectivity can be obtained. The author does not claim for this design the selectivity offered by his Super Alpha circuit, particularly the versions using variable inductance tuning, but the present receiver is less prone to swamping by a local station than is a single tuned circuit ZN414 receiver, especially if the interfering station is not in the lower frequency half of the medium wave band. The receiver, also, offers a high level of gain on the long wave band.

The cascode configuration will be familiar to many readers of this magazine and, with bipolar transistors, can be described as a common emitter amplifier feeding directly into the emitter of a common base amplifier. The appellation is not strictly accurate with the present design, but is appropriate enough: what happens is that a two stage r.f. amplifier, with both transistors in the common emitter configuration, is followed by a diode detector which feeds its audio output into a two-stage a.f. amplifier using the same two transistors as before. At a.f. the first transistor amplifies in the common base mode and the second functions as an emitter follower.

The first of the two transistors is biased so as to pass a very small current on medium waves and even less — only a few microamps — on long waves. Because the efficiency of a common emitter amplifier falls as frequency rises, and because this effect is more noticeable at very low collector currents, the result is a drop in amplification to a small figure at around 200 metres, although high efficiency is maintained at, say, 1,500 metres. The second transistor of the pair passes some 600uA and gives fair amplification at all wavelengths in the medium and long wave bands.

In Fig. 1 switch S1 is shown set to medium

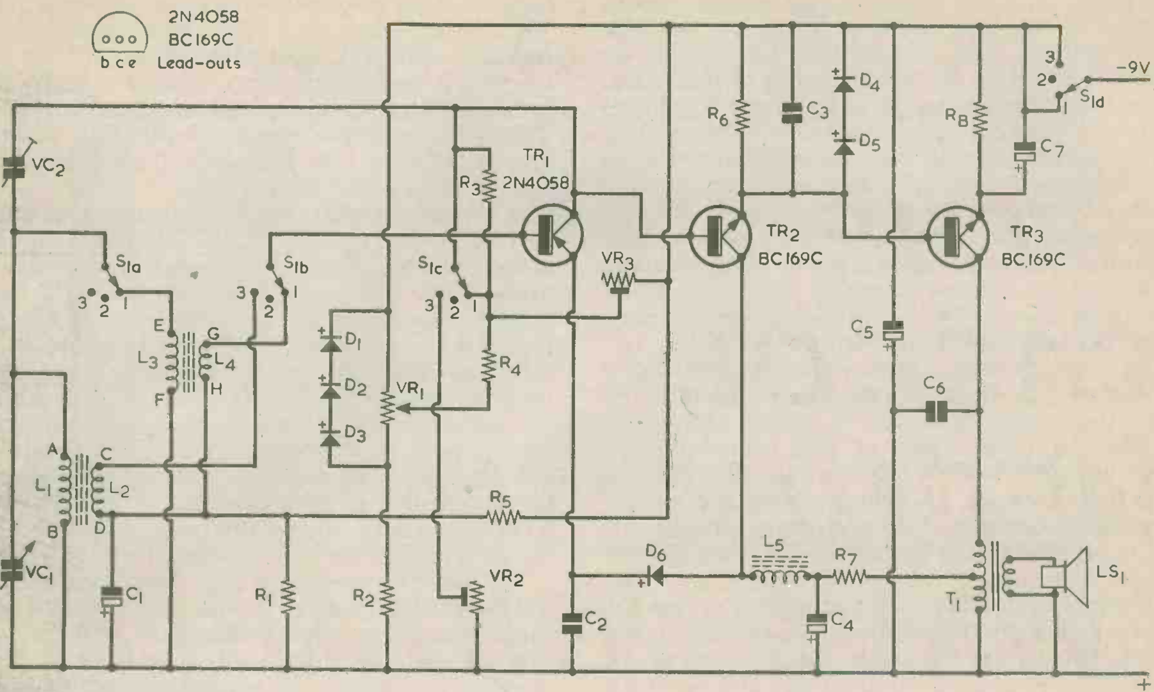


Fig. 1. The circuit of the "Cascode" medium and long wave portable

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)
R1 4.7kΩ
R2 6.8kΩ
R3 120kΩ
R4 27kΩ
R5 6.8kΩ
R6 1.5kΩ
R7 3.9kΩ
R8 33Ω
VR1 2.2kΩ potentiometer, wire-wound (see text)
VR2 10MΩ pre-set potentiometer, skeleton (see text)
VR3 1MΩ pre-set potentiometer, miniature skeleton, horizontal

Capacitors
C1 100μF electrolytic, 6V. Wkg.
C2 0.1μF polyester
C3 0.1μF polyester
C4 1,000μF electrolytic, 6V. Wkg.
C5 1,000μF electrolytic, 10V. Wkg.
C6 0.047μF polyester
C7 100μF electrolytic, 6V. Wkg.
VC1 365pF variable, type 01 (Jackson)
VC2 40pF trimmer, mica

Inductors
L1-L4 see text
L5 10mH r.f. choke type CH4 (Repanco or equivalent)
T1 Output transformer type LT700 (Eagle)

Semiconductors
TR1 2N4058
TR2 BC169C
TR3 BC169C
D1-D5 1S44
D6 OA70, OA71, OA80 or OA81

Switch
S1 4-pole 3-way rotary, miniature (see text)

Speaker
LS1 3Ω or 4Ω speaker, 5in. (see text)

Battery
9-volt battery type PP9

Miscellaneous
3 knobs
2 ferrite rods, 8in. by ⅜in. diameter
4 Lektrokit clips, part no. LK2721 (see text)
Battery connectors
18-way tagboard
38 s.w.g. enamelled copper wire (for L1 and L2)
24 s.w.g. enamelled copper wire (for L3 and L4)
Materials for panel and case (see text)
Nuts, bolts, wire etc.

waves. The medium wave coils, L3 and L4, are wound on a ferrite rod, with L3 being tuned by VC1. L4 is a small coupling coil giving correct matching to the base input of TR1. L1, the long wave tuned coil, is in parallel with L3, but has no significant effect on the performance of the latter. This method of wavechange switching is employed because if L1 were simply switched out of circuit on medium waves it could become resonant with its own self-capacitance at a frequency at the low wavelength end of the medium wave band, with undesirable absorption effects. As TR1 passes a small current its input impedance is not as low as is usual with a common emitter amplifier and a step-down ratio, from L3 to L4, of 6:1 gives satisfactory results. On long waves the step-down ratio is 7:1. With a conventional common emitter transistor stage the step-down ratio would be of the order of 12:1, with a consequent loss of voltage amplification. The amplified signal at TR1 collector feeds directly into the base of TR2, whose r.f. collector load is the r.f. choke, L5. The signal is also passed to the diode detector, D6, and the resultant a.f. signal is applied to the emitter of TR1, which now acts as a common base a.f. amplifier. The amplified a.f. signal is developed mainly across R4 and, at a relatively high impedance, couples to the base of TR2, this transistor functioning as an emitter follower at audio frequencies and having a similarly high input impedance. The emitter load for TR2 is R6 and the signal now passes directly to the base of TR3, a straightforward high gain common emitter output transistor. The primary of output transformer T1 is in the collector circuit of TR3 and its secondary is connected to a 3Ω or 4Ω speaker.

REACTION

Reaction is obtained by feeding back a small proportion of the r.f. signal at TR1 collector back to its base via VC2 and coils L3 and L4, phasing being in the correct sense for positive feedback. (For simplicity of circuit presentation, coils L4 and L2 are shown, in Fig. 1, with the opposite phasing to that which they have in practice). Reaction control is given by VR1, which determines the current flowing through TR1. D.C. negative feedback, with a.f. bypassed by C4, is obtained from the collector of TR2 to the emitter of TR1 via D6. Further negative feedback of direct current, with a.f. again bypassed by C4, is given by returning R7 to a centre tap in the output transformer primary instead of direct to the lower positive line. These d.c. feedback loops help to maintain voltage stabilization in the circuit.

The three silicon diodes, D1, D2 and D3, keep the direct voltage across VR1 to a constant figure of about 1.65 volts irrespective of the state of the battery. This gives constant reaction performance. VR3 is adjusted such that zero volume is just reached with VR1 at its zero setting. If VR3 offers too much resistance, zero volume will be given before VR1 is set at zero and, also, current through TR3 will rise unnecessarily. Should VR3 insert too low a resistance, zero volume with a powerful signal will be impossible to obtain.

A separate ferrite rod, on which are wound L1 and L2, is used on long waves. Otherwise, operation is the same as on medium waves with several small differences. The reaction feedback to TR2 base is now, of course, via the coupling winding L2. R3 is inserted in series with R4 to reduce the current through TR1, and pre-set potentiometer VR2 is brought into circuit. This potentiometer is adjusted for satisfactory volume control operation and it functions in an opposite way to VR3. If VR2 has too high a resistance, zero volume will be unobtainable with a powerful station. If it offers too low a resistance zero volume will be given before VR1 is set at zero and current through TR3 will rise.

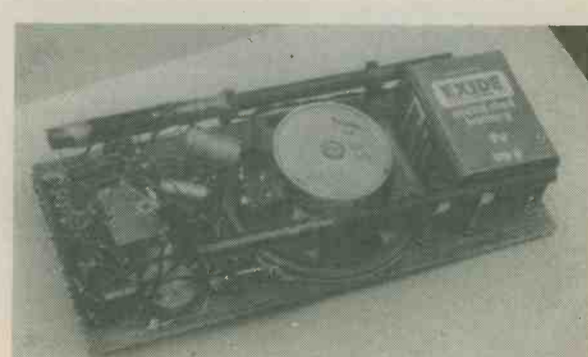
D4 and D5 prevent a high surge of current in TR3 when the receiver is first switched on and the capacitors in the circuit charge up, and they limit the voltage across R6 to about 1.1 volts. Under working conditions, the voltage across this resistor is approximately 0.8 volts.

COMPONENTS

Some comments need to be made next concerning components. Switch S1 is a miniature 4-pole 3-way rotary component. Its body diameter is 1.1in, or less. VR1 is a small wire-wound potentiometer and that employed by the author was a type CLR1106/11S, obtainable from Electrovalue. This has a body diameter of 0.94in. Although specified as 2.2kΩ, any value from 2kΩ to 3kΩ will be satisfactory. VR2 has the high value, for a pre-set potentiometer, of 10MΩ, and this is also available from Electrovalue as type PR15. The speaker is specified as a 5in. component, working to the fact that most present-day nominal "5in." speakers have an actual diameter of 4½in. Also, it should not be more than 1⅞in. deep. If the speaker obtained should happen to exceed these dimensions it is merely necessary to modify the front panel and case dimensions accordingly.

Four ⅜in. Lektrokit spring clips, part no. LK2721, are used for mounting the two ferrite aerial rods. These are available, in packets of 10, from Home Radio. Two tagstrips are employed in the construction, these being cut from an 18-way tagboard.

All the components are mounted on the rear of the front panel. There are two ferrite rod aerials, one for medium waves and one for long waves



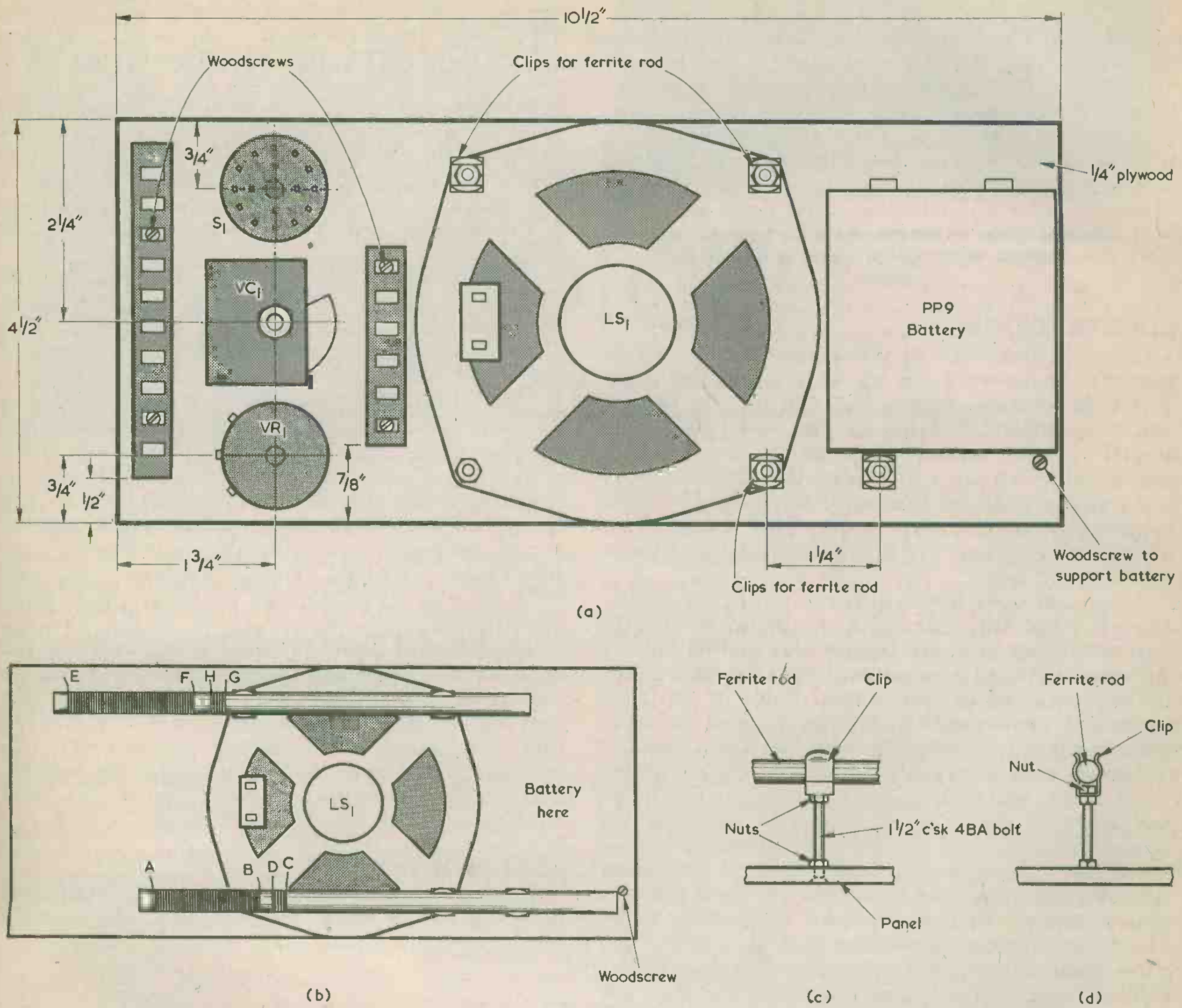


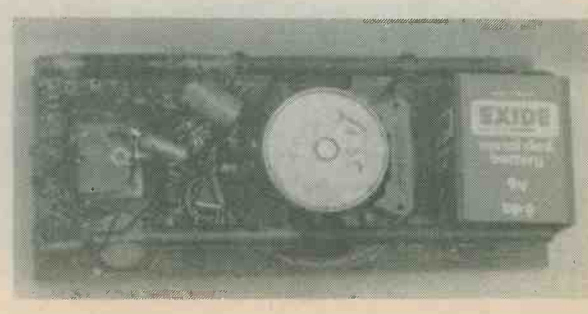
Fig. 2(a). The dimensions of the front panel and the layout of the components which are mounted directly onto it

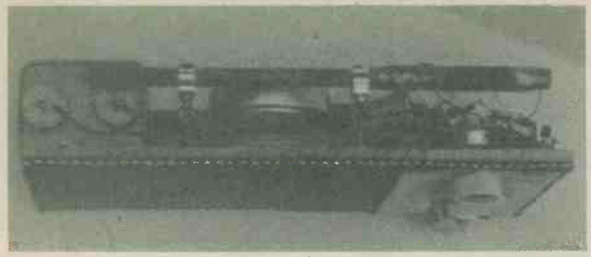
(b). The positions taken up by the two ferrite rod aerials when, later, these are fitted into their clips. The letters "A" to "H" identify the leads from the aerial windings

(c). Side view showing how the spring clips are secured at the ends of the $1\frac{1}{2}$in. 4BA bolts

(d). End view of the bolt and clip assembly

Another view of the components assembled on the rear of the front panel





Looking down on the top of the receiver. Here, the medium wave ferrite aerial is nearer the reader

CONSTRUCTION

Construction starts by cutting out a piece of ¼in. plywood to measure 10½ by 4½in., as in Fig. 2(a). These dimensions assume that the speaker has an actual diameter of 4½in., as has just been mentioned. If the actual diameter of the speaker employed is 5in. or a little less, the dimensions of the panel should be increased to 11 by 5in. The other dimensions shown in Fig. 2(a) need not be altered, except that the 2¼in. dimension to VC1 is increased to 2½in.

A speaker aperture is next cut out in the panel, after which 4 BA clear holes are drilled out for its four mounting bolts. Holes are also drilled for S1, VC1 and VR1. VC1 requires three 4BA clear holes for screws passing into tapped holes in its front plate, and their positions can be marked out with the aid of a paper template. This has a ⅜in. hole cut out in its centre and is held against the capacitor front plate, whereupon the positions of the holes are marked on it in pencil. The capacitor is mounted, later, with three short countersunk 4BA bolts, and spacing washers may be fitted over these between the panel and the capacitor front plate to give clearance for the protrusion around the spindle. It is important to ensure that the ends of the three bolts do not pass more than fractionally inside the front plate of the capacitor when they are finally tightened up as they may then damage the fixed or moving vanes. It is for this reason that short bolts are required.

Two tagstrips, one 10-way and one 6-way, are cut out from the 18-way tagboard. Two lengths of p.v.c. insulating tape are stuck to the plywood at the positions the tagstrips will take up, and the tagstrips are then screwed to the board by means of four small woodscrews passing through the holes in the centres of the appropriate tags. The positioning of the tagstrips and the woodscrews is shown in Fig. 2(a).

The speaker is secured with four countersunk 4BA bolts, one of which is ½in. long whilst the remainder are 1½in. long. The Lektrokit spring clips for the ferrite rods are secured to the ends of the longer bolts, as shown in Figs. 2(b), (c) and (d). A fourth 1½in. 4BA countersunk bolt is mounted on its own, 1¼in. to the right of the lower right-hand speaker mounting bolt, and this is similarly fitted with a clip. It may be necessary to slightly enlarge the holes in the clips to allow the 4BA bolts to pass through. Fig. 2(b) illustrates the positions that the ferrite rods and coils will take up when they are fitted later. To avoid damage, the ferrite rods and coils are not mounted until all other components are in place.

The panel of Fig. 2 (a) will be vertical when the receiver is in use. The PP9 battery then rests on the clip at the end of the bottom right hand 1½in. 4BA bolt and on a woodscrew which is partly screwed into the panel. The correct position for this woodscrew can be found with the aid of the battery, and the woodscrew may then be fitted. S1, VC1 and VR1 can also be fitted at this stage.

NEXT MONTH

In next month's concluding article, details will be given of the aerial coil windings, the receiver wiring and the setting up procedure.

(To be concluded)

BOOK REVIEW

OSCAR — Amateur Radio Satellites

192 pages 205 x 148mm. (8 x 5¾in.) By Stratis Caramanolis

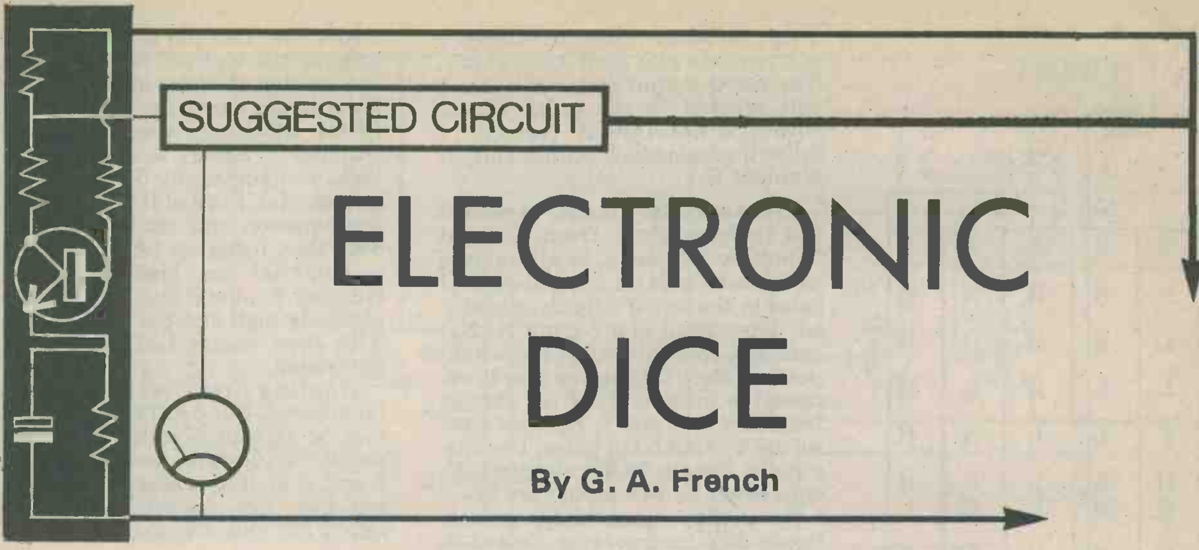
Distributed by the Radio Society of Great Britain
Price £4.20 including postage

Already a best-seller in its original German edition, with over 7,000 copies sold, this first-ever book on Amateur radio satellites has now been translated into English and updated.

It fills a need which is becoming ever more apparent as more and more radio amateurs turn their attention to space communication. There are so many aspects of science not familiar to most radio amateurs involved in "Communication via OSCAR," but in this volume all the essential information for an appreciation of the techniques involved for a proper understanding of Orbital Satellites Carrying Amateur Radio is contained.

The first half of the book discusses the background to the subject, including orbital geometry, satellite anatomy, communications principles and telemetry. These chapters help greatly to give the reader a clear understanding of the principles involved in satellite communication. The book then goes on to describe the satellites of the OSCAR series and how they have been used for communication, education and experimentation. The use of published orbital predictions and the somewhat confusing subject of plotting orbits are both well explained.

For those who wish to obtain a comprehensive understanding of OSCAR techniques, this book is essential reading.



ELECTRONIC DICE

By G. A. French

The CD4018AE presettable divide by "N" counter is one of the more interesting CMOS digital i.c.'s currently available to the home constructor. The device is capable of dividing by 2, 4, 6, 8 or 10 according to the external connections made to it, and it has five not-Q outputs. The full type number is CD4018A, with the suffix E added to indicate a plastic d.i.l. package.

PIN FUNCTIONS

The pin functions of the i.c. are illustrated in Fig. 1. The positive supply is connected to pin 16 and the negative supply to pin 8. The device is advanced one step by each positive-going pulse applied to the clock input.

If it is desired to divide by 2 the not-Q1 output is connected to the data input. Division by 4, 6, 8 or 10 is achieved by connecting the not-Q2, not-Q3, not -Q4 or not -Q5 output respectively to the data input, and the divided output can then be taken from the not-Q output which is so connected. A feature of which advantage is not normally taken is that, in all the dividing functions apart from that for divide by 2, the unused not-Q outputs follow a distinctive sequence which is repeated once for each division cycle. This pattern can be employed, with the aid of simple NAND or NOR gates, to set up a sequence generator.

In the article "CD4018 Truth Tables", which appeared in the June 1977 issue of this journal, the author presented tables showing all the not-Q output states for each clock count. These demonstrated that, after several initial counting steps, the outputs followed a fixed pattern of high or low states. The article "4-step CMOS Sequence Switch", in the July 1977 issue, gave an example of a 4-step switch consisting of a CD4018 and a CD4011 quad 2-input NAND gate. In this present article the author returns to the CD4018 and uses it, in its divide by 6 function, to provide a 6-step switch. The switch comprises a CD4018, a CD4011 and a CD4001 quad 2-input NOR gate, and its outputs drive six l.e.d.'s in sequence. The CD4018 has a relatively high frequency clock pulse input which can be interrupted by pressing a push-button, whereupon the circuit performs as an electronic dice having a fully random performance.

The accompanying Table 1 shows the states of the not-Q outputs of a CD4018 when it is con-

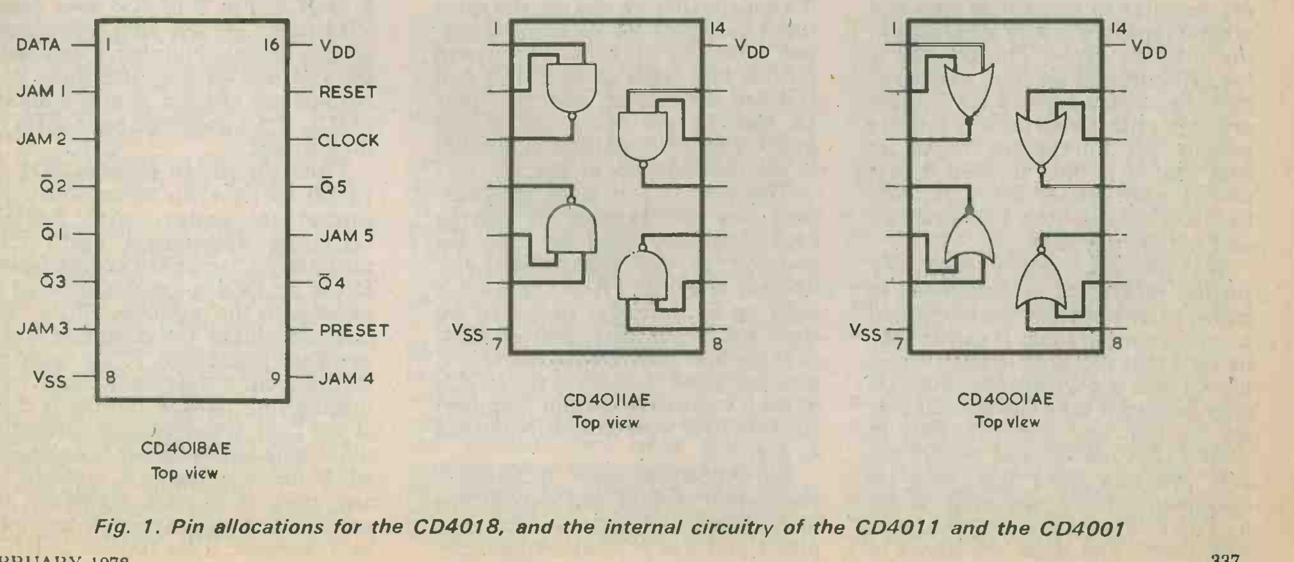


Fig. 1. Pin allocations for the CD4018, and the internal circuitry of the CD4011 and the CD4001

TABLE 1

Not-Q3 to Data input

Step	Not-Q outputs				
	1	2	3	4	5
1	H	H	H	H	H
2	L	H	H	H	H
3	L	L	H	H	H
4	L	L	L	H	H
5	H	L	L	L	H
6	H	H	L	L	L
7	H	H	H	L	L
8	L	H	H	H	L
9	L	L	H	H	H

nected as a divide by 6 device with its not-Q3 output connected to the data input, and is repeated from the June 1977 article. At switch-on (or after resetting) all the not-Q outputs are high. The first clock pulse takes the i.c. to Step 2 in the Table, with the not-Q1 output going low. The successive states of the not-Q outputs for subsequent clock pulses show the distribution of high and low states throughout the outputs, and it is found that these take up a steady pattern after Step 3. Step 9 is the same as Step 3, Step 10 will be the same as Step 4, and so on. As a result, Steps 3 to 8 inclusive will repeat for as long as the CD4018 circuit is switched on and positive-going pulses are fed to its clock input.

We can obtain six separate outputs from Steps 3 to 8 by finding high and low combinations which are peculiar to any single step and are not repeated in any other step in the division cycle. The process is not difficult and we find, at Step 3, that the not-Q3 and not-Q5 outputs are high at this step only. Similarly looking for unrepeated highs we find that it is only in Step 5 that not-Q1 and not-Q5 are high, and that it is only in Step 7 that not-Q1 and not-Q3 are high.

We do not readily find any further individual combinations of highs, so we next look for individual combinations of lows. It can at once be seen that it is only in Step 4 that not-Q1 and not-Q3 are low, that it is only in Step 6 that not-Q3 and not-Q5 are low, and that it is only in Step 8 that not-Q1 and not-Q5 are low. We now have the basic requirements for a sequence of six output steps, or "Output Numbers", and these are shown in Table 2, where Output Number 1 corresponds with Step 3 of Table 1. The not-Q output states in Table 2 will proceed in the order shown, with another Output Number 1 following immediately after Output Number 6.

It is a very easy matter to extract the information from Output Numbers 1, 3 and 5, as all we have to do is to connect 2-input NAND gates to the not-Q outputs concerned. The output of a 2-input NAND gate goes low only when its two inputs are high. It is just as easy to extract the information from Output Numbers 2, 4 and 6, but this time we use 2-input NOR gates. The output of a 2-input NOR gate goes high only when its two inputs are low.

As already mentioned, the electronic dice incorporates a quad 2-input NAND gate i.c. type CD4011 and a quad 2-input NOR gate type CD4001. To assist in following the circuit operation of the electronic dice, the internal connections in these two i.c.'s are also shown in Fig. 1.

ELECTRONIC DICE

The complete circuit of the dice is given in Fig. 2. IC1 is a 555 connected in a standard multivibrator circuit, and it feeds a train of positive-going pulses via S1 to the clock input of the CD4018, IC2. Pressing S1 stops the pulses passing into the clock input whereupon (assuming a perfect switch) the CD4018 stays in the last state it held at the instant of opening the switch.

All the "jam" inputs of the CD4018, as well as the preset and reset inputs, are taken to the negative rail. For the present application we do not require the not-Q2 and not-Q4 outputs, and no connections are made to their pins. The not-Q3 output is connected to the data input in order to give division by 6. The not-Q1, not-Q3 and not-Q5 outputs are taken to the CD4011 and the CD4001 i.c.'s and it happens that we can use the same input gate pins for each not-Q output from the CD4018. The fourth NAND and NOR gates in IC3 and IC4 are not needed, and their pins 12 and 13 are taken up to the positive rail. No connection is made to the gate outputs at pin 11.

The NAND and NOR gate outputs are not capable of driving l.e.d.'s directly, and so they are coupled to the transistor l.e.d. drivers, TR1 to TR6. The l.e.d.'s light up in the order indicated by their suffix numbers, and we shall next see how the CD4018 not-Q outputs are gated through to the l.e.d.'s at each successive Output Number, starting first with Output Numbers 1, 3 and 5.

On Output Number 1, Table 2 shows that not-Q3 and not-Q5 are high. These high outputs pass into pins 1 and 2 of IC3, whereupon pin 3 goes low. This pin connects to the base of the emitter follower TR1, the emitter of which similarly goes low, causing current to flow through LED1. LED1 lights up. At Output Number 3, not-Q1 and not-Q5 are high, whereupon pins 5 and 6 of IC3 go high also. Pin 4 of IC3 goes low in consequence, and emitter follower TR3 then lights up LED3. Not-Q1 and not-Q3 are high at Output Number 5, pins 8 and 9 of IC3 are similarly high and pin 10 goes low. TR5 then causes LED5 to be illuminated.

Dealing next with Output Numbers 2, 4 and 6, Table 2 tells us that at Output Number 2 not-Q1 and not-Q3 are low. So also are pins 8 and 9 of IC4, whereupon pin 10 goes high. Base current flows via R6 into TR2, this transistor turns on and LED2 lights up. At Output Number 4, not-Q3 and not-Q5 are low, these connecting to pins 1 and 2 of IC4. Pin 3 of IC4 goes high, TR4 turns on and LED4 becomes alight. Output Number 6 has not-Q1 and not-Q5 low, and these low outputs are applied to pins 5 and 6 of IC4. Pin 4 goes high and LED6 is illuminated.

Thus, the circuit causes LED1 to LED6 to light up successively in numerical order, with LED1 becoming illuminated again immediately after LED6 extinguishes. If the six l.e.d.'s are mounted on a panel with the numbers "1" to "6" alongside them, the circuit behaves as an electronic dice. IC1 is made to oscillate at a relatively high frequency and the dice number is that of the l.e.d. which remains steadily illuminated after S1 has been pressed. Since only one l.e.d. is alight at any time it is only necessary to provide one series resistor to limit l.e.d. current. This resistor is R7.

TABLE 2

Activating not-Q states

Output Number	Not-Q states
1	3 and 5H
2	1 and 3L
3	1 and 5H
4	3 and 5L
5	1 and 3H
6	1 and 5L

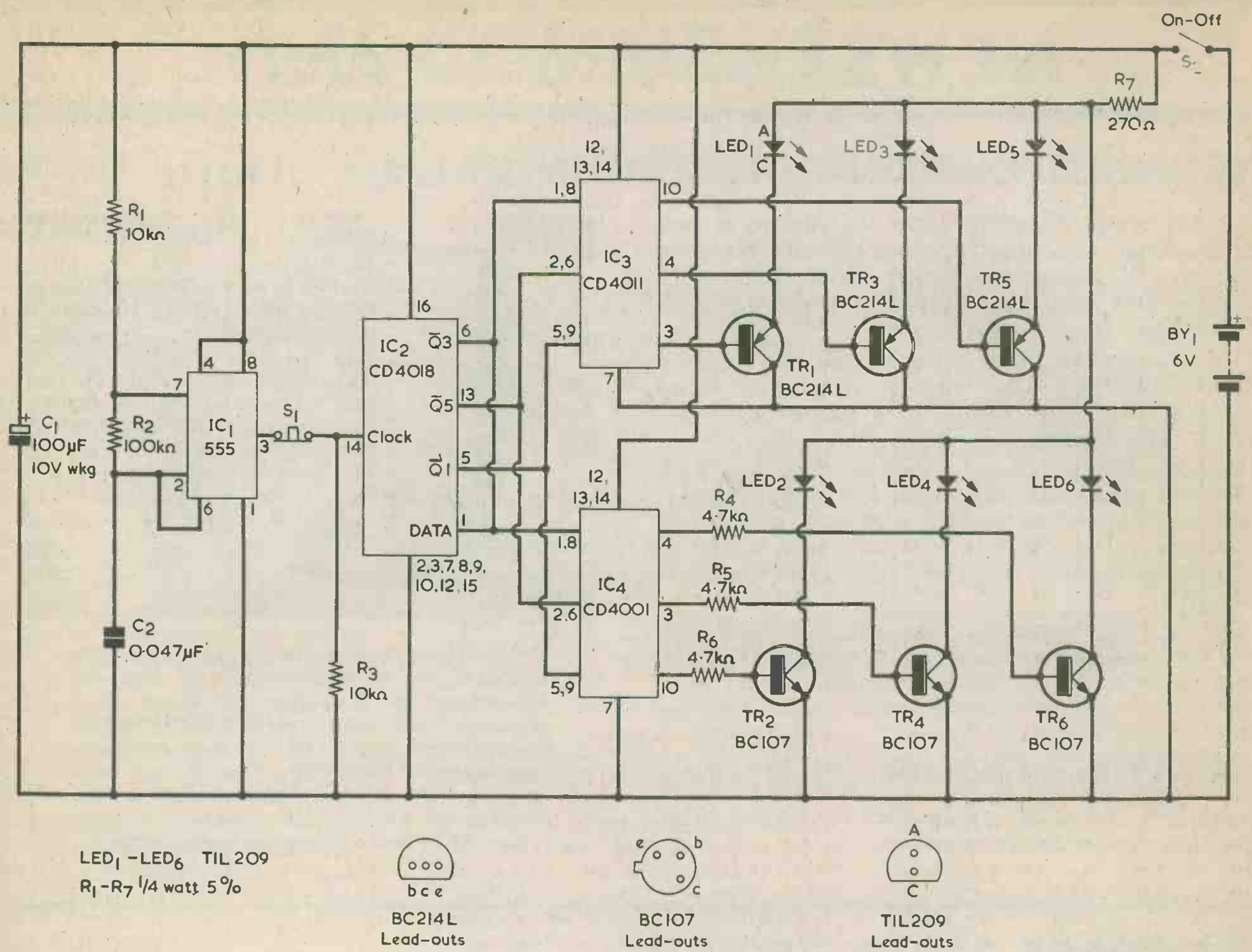


Fig. 2. Full circuit diagram of the electronic dice. The light-emitting diodes turn on successively at high speed, and one of these will remain steadily illuminated when switch S1 is pressed

PRACTICAL POINTS

The circuit can be assembled in a small plastic case with the l.e.d.'s and the two switches on the front panel. Current consumption from the 6 volt battery is approximately 15mA both with S1 closed and open.

The frequency at which the 555 runs is approximately 150Hz, and this causes a very noticeable flicker in the l.e.d.'s when S1 is closed. If desired the 555 frequency can be increased by reducing C2 to 0.01μF, and this value removes the flicker from the l.e.d.'s, which all light up at a reduced level before S1 is pressed. The author feels that the flickering with C2 at 0.047μF, is, however, more impressive.

Circuit operation can be checked if the 555 is slowed down to about 1 cycle in 3 seconds by connecting a 20μF electrolytic capacitor across C2. Obviously, the capacitor negative lead should connect to the negative supply rail.

Following switch-on at this low speed, LED1, LED3 and LED5 will light up, after which LED1 will be lit on its own. This corresponds to Steps 1 and 2 in Table 1. At Step 3, LED1 will still be alight but the circuit will now have started the cycle of Table 2.

If S1 is pressed when the output of the 555 is low, the circuit will remain in the state it had when the switch was opened. Should S1 be pressed when the 555 output is high the circuit may pass quickly through one or more steps. This will be caused by the fact that the switch does not break the circuit cleanly and is giving an effect similar to that given by contact bounce. The circuit is almost certain to pass quickly through several steps if S1 is released when the 555 output is high, and this will be due to conventional contact bounce. Both effects are quite random and do not detract in any way from the overall random character of the output indications given. Similar effects can occur when the 555 is running at its proper speed but the 555 frequency will then be too high for them to be observed.

Since IC2, IC3 and IC4 are CMOS devices, their pins should be protected from high static voltages and they should be soldered into circuit with a soldering iron whose bit is reliably earthed. A good approach consists of using i.c. holders, the i.c.'s being fitted to these after all wiring has been completed. ■

NEWS . . . AND .

NEW PROFESSIONAL RECORDING TAPE

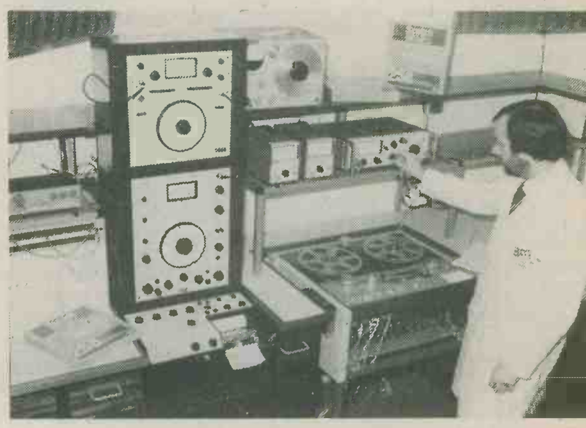
3M United Kingdom have introduced a new professional recording tape, specifically designed for the UK/European market which demands a quality tape with high output and low signal-to-print ratio.

In addition to these features, the new tape — Scotch 256 — also enjoys improved wind characteristics, the results of a newly developed black back coating.

Scotch 256 has been evolved to provide a high dynamic range, low distortion, low signal-to-print ratio and high wind quality. The tape has a print-through level of –59dB, a bias noise level of –67dB and signal-to-noise value of 77dB (DIN measurements).

Scotch 256 comes in ¼in., ½in., 1in. and 2in. widths and is suitable for open-hub type applications. It has been developed in the well-established 3M laboratories and manufacturing plant in Gorseinon, S. Wales.

3M claims that this tape sets new high, professional standards, and expects the Scotch 256 to achieve immediate acceptance for its low print through characteristic alone.



Dave Skinner seen testing Scotch Type 256 professional recording tape at the 3M laboratories in Gorseinon, S. Wales. Test equipment includes a Bruel & Kjaer 3rd octave spectrometer type 2114 and Beat frequency oscillator type 1022 with a Bruel & Kjaer level recorder type 2305; a Telefunken M15 tape deck; a Hewlett-Packard distortion analyser type 333A and a Quantech wave analyser

IBA SPACE STUDY BEGINS

By tuning-in to an Italian space satellite, IBA engineers at Crawley Court, Winchester have begun the study of 12 GHz radio propagation which was delayed when the Thor-Delta launcher of a European communications satellite failed last September.

In readiness for the launch of the Orbital Test Satellite (OTS) of the European Space Agency, a special 12 GHz satellite receiving terminal was designed and built last summer at a cost of about £75,000. This station, with a 3-metre dish aerial, is located in front of the IBA's Engineering Centre at Crawley Court, Winchester, and is connected to measuring equipment in the engineering research laboratories.

The study programme, jointly planned with the Post Office and European broadcasters, is aimed at establishing a Eurovision satellite distribution network in the 1980s and, in the long term, opening the way for direct broadcasting to homes from satellites.

The 11-12 GHz Super High Frequency (SHF) propagation experiments include the careful monitoring and measuring of the strength and polarisation of the signals received from the beacon transmitter. Frequencies between 11.7 and 12.5 GHz will be used for space broadcasting in Europe, and signals on such frequencies are known to be more affected by rain, hail and water vapour than the lower frequencies currently used for space communications. It is therefore important to accumulate detailed knowledge of the range of variations and anomalous effects likely to be encountered in operational systems.

When the first OTS launching failed it was known that it would be some months before a back-up satellite could be in orbit, and it appeared that the study programme would inevitably be delayed.

However, an experimental Italian synchronous communications satellite 'SIRIO', designed for radio propagation and telecommunications experiments above 10 GHz, was successfully launched last August on behalf of the Italian National Council for Research (CNR), and this carries a beacon transmitter radiating continuously on a frequency of 11.596 GHz (less than 200 MHz from the intended beacon frequency of OTS).

By re-orientating the Crawley aerial dish, IBA engineers have found no difficulty in picking up, identifying and using the signals from SIRIO, which is located 22,300 miles above the Equator at a longitude of 15° West.

The Italians have co-operated and agreed to this unanticipated use of their satellite. The sensitivity of the IBA terminal will be increased shortly by means of a parametric amplifier in readiness for the reception of television signals through the OTS satellite, but initially this low-noise amplifier will be used to improve reception of the SIRIO beacon.

The Crawley Court satellite receiving terminal has been designed by IBA engineers and built to an IBA specification by a number of contractors including Marconi Space & Defence Ltd., Continental Microwave Ltd., Ferranti Ltd. and The Marconi Research Laboratories.

. . . **COMMENT**

BACKGROUND TO BBC WAVELENGTH CHANGES IN NOVEMBER 1978

As promised last month we set out below the wavelength changes which the BBC will be making in November, together with background information explaining the reasons for the changes.

The changes that will take place are:

Radio 1 moves to 1089kHz/275m and 1053kHz/285m;

Radio 2, at present on long wave moves to medium: 693kHz/433m and 909kHz/330m;

Radio 3 moves to 1215kHz/247m;

Radio 4, at present on several medium waves, moves to two long waves: 200kHz/1500m and in Central Scotland 227kHz/1322m.

The frequencies which are used for broadcasting in this country have to be carefully co-ordinated with those of other countries in Europe, and from time to time an international frequency plan is drawn up to ensure, as far as possible, that countries can develop their broadcasting service, and keep mutual interference between stations to a minimum.

On the long and medium wave bands there is only a limited number of channels, and to accommodate all the stations in the European area it is necessary for each channel to be used by several stations in different countries. This sharing of channels presents most problems during the hours of darkness, when stations can be received at much greater distances, because of reflections in the ionosphere, and as a result interference occurs between stations using the same channels. This has been an unfortunate feature of radio broadcasting for many years.

During the last 20 years broadcasting on vhf has been started in many countries, including the United Kingdom. Vhf has many advantages, one being that because the signals do not carry so far, stations in many parts of Europe can use the same channels without mutual interference.

However, the medium and long wave bands are still most widely used and the BBC must therefore endeavour to provide the best possible coverage on these bands.

During 1974 and 1975 an international conference was held to replan the medium and long wave broadcasting bands in Europe, Africa, Asia and Australasia. As a result a new plan was drawn up and this will come into effect on 23 November 1978.

At present in the European area there are some 1450 transmitters on the two bands, with a combined power of about 82 Megawatts. The new plan provides for 2700 transmitters in the same area, with a combined power of 214 Megawatts. As the number of channels has not increased appreciably, the overcrowding will increase and night time interference will become even worse than it is already. The deterioration on some channels will be greater than on others, and having examined the implications of the new plan it soon became clear to the BBC that it would not be satisfactory to continue to transmit all of the programmes, on their existing frequencies. At the same time the BBC was anxious to make certain changes which would have been desirable even without a new frequency plan.

It was decided that Radio 4, as a main news and information channel, should be available complete throughout the United Kingdom and not only in England as at present, and that it was desirable to improve the mf coverage of Radio 1.

Radio 2 to be transmitted on two good medium frequency channels, with coverage so far as possible of the whole United Kingdom.

The present Radio 3 frequency (647kHz/464m) will suffer increased interference at night time, and to continue with it would have meant that the night time service of Radio 3 would be severely limited, so a different frequency had to be found.

As a result of the changes, most listeners will have to accustom themselves to new places on the dial for the programmes they need, but the changes are considered to be essential if the best possible coverage is to be maintained.

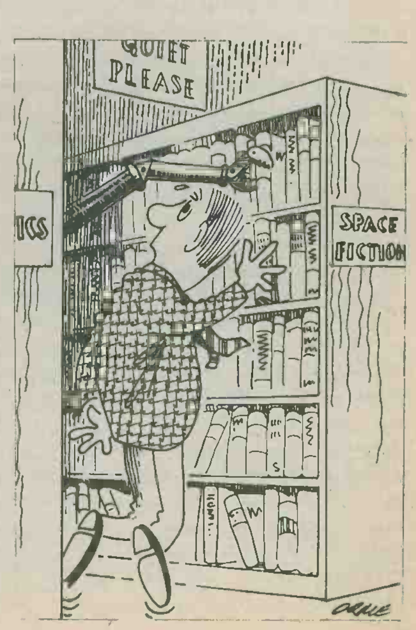
NOTE: the vhf positions of all BBC Radio services on radio sets will remain the same.

'R.& E.C.' BINDERS

Binders to accommodate our new format will be available within the next three weeks. They will be of the previous high standard and the cost is only £1.60, including V.A.T., plus postage 30p.

There are a few binders of the old size available and orders for them should be placed without delay — see out advertisement pages.

Plain binders are only available in the new format, price £1.50, plus postage 30p.



6th NATIONAL AMATEUR RADIO EXHIBITION

The Amateur Radio Retailers Association's Jubilee Year Exhibition held at the Granby Halls, Leicester, in October was as well attended as ever.

Amongst the 'new' features which caught one's eye was a well set out demonstration of microprocessor gear and its applications and several examples of Visual Display teleprinter systems. There was an increasing amount of gear for the higher frequencies and some microwave components to be found on some of the stalls. As usual the component stalls were popular, offering an opportunity to acquire those 'hard to get' bits and pieces. Altogether a very worthwhile show.

SPECIAL SERIES **Blob-a-job**

No. 8

COUNTDOWN!

by I. R. Sinclair

The fascination of t.t.l. operation combines with Blob Board ease of construction to make our last Blob-A-Job project the ultimate in the series.

This circuit will display the number 9 on a readout when a push-button is pressed, and will then count down to zero when the button is released. At zero the count stops. A stop output can be taken from the circuit to start or stop other apparatus provided that the current and voltage limits of the t.t.l. integrated circuit providing the stop signal are not exceeded.

CIRCUIT OPERATION

In the circuit, shown in Fig. 1, IC1(a) is part of a quad 2-input positive NAND Schmitt gate, and it functions as an oscillator running at approximately 1Hz. Its output drives the countdown input of a 74192 reversible decade counter. The 74192 i.c. may seem expensive at around £1.25 (at the time of writing), but it saves the use of a number of other i.c.'s and also enables us to make up the circuit on a single ZB-4-IC Blob Board. In addition, the 74192 is a very versatile and useful counter i.c., being capable of counting up or down according to which terminal the clock pulses are connected.

There are four data inputs, labelled D, C, B and A, which enable the counter to be set to whichever digits are wanted. These inputs, each at 0 or 1 as required, are entered into the counter when the "load" input at pin 11 is taken to logic 0. The number 9 is represented in binary as 1001, so that we can have D at 1, C at 0, B at 0 and A at 1 for our data inputs. We can earth inputs B and C, leaving inputs A and D floating (or connected to the 5 volt positive supply rail), and the counter will be loaded when pin 11 is temporarily earthed by pressing the push-button S1. When clock pulses are applied to the countdown terminal, the countdown will start. The count will continue to zero, at which outputs QD, QC, QB and QA will all be 0, and the next clock pulse is gated internally to the "borrow" output at pin 13, used normally when a chain of counters is being operated. Pin 13 goes low and, in our circuit, operates a latch consisting of IC1(b) and IC1(c) which gates off the clock pulses and keeps the output of the counter at zero by taking the "clear" input at pin 14 high. This latch is reset by S1 at the same time as the loading operation is carried out for the next countdown sequence.

The counter outputs at QD, QC, QB and QA are taken to the D, C, B and A inputs of the 7447 decoder, which then provides the correct outputs on seven lines to feed the display. Current limiting

COMPONENTS

Resistors
(All 10%)
R1 560Ω $\frac{1}{4}$ watt
R2-R8 470Ω 1/8 or 1/10 watt (see text)

Capacitor
C1 680μF electrolytic, 10V. Wkg.

Semiconductors
IC1 74132
IC2 74192
IC3 7447

Display
DY1 BDL747

Switch
S1 miniature push button, press to close

Blob Board
Blob Board type ZB-4-IC

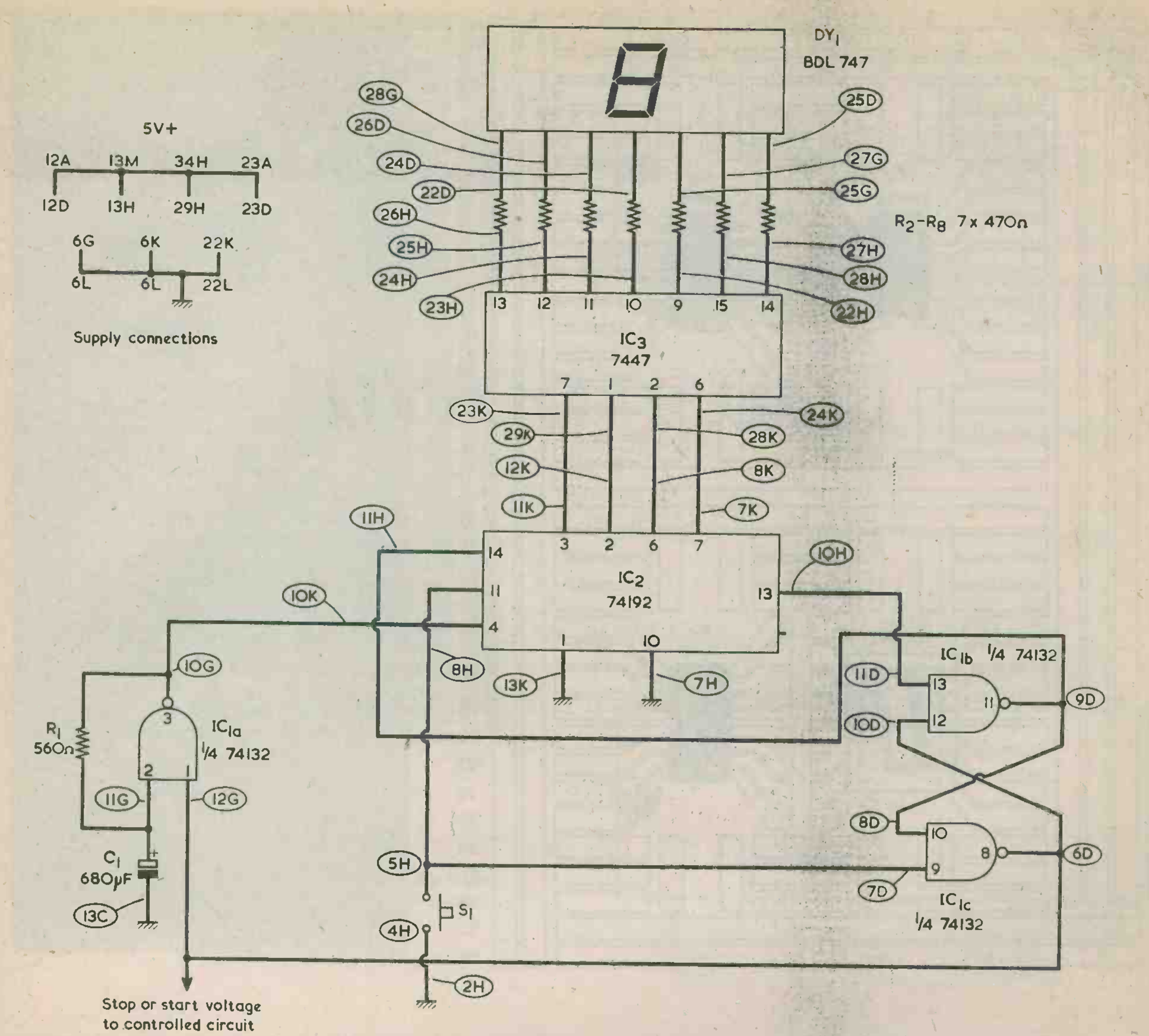


Fig. 1. The circuit of the Countdown device. When S1 is pressed the display indicates a 9, then counts down to 0 when the switch is released. Circled number and letter references apply to Blob Board connection locations

resistors must be used between the decoder and the display to prevent excessive current from flowing in the display and decoder. The display suggested for this counter is the common anode BDL747 ("Jumbo") type, this being a large display that is visible across a room. The display brightness depends on the value of the limiting resistors; 470Ω is suggested as a reasonable compromise between brightness and current consumption. The BDL 747 is available from Bi-Pak.

CONSTRUCTION

The circuit is constructed on a ZB-4-IC Blob Board, the suggested layout of the i.c.'s being shown in Fig. 2. Note that the BDL747, though it has nominally 18 pins, will (just) fit on a 16-pad Blob Board position, because several pins are omitted. See the pinout diagram in Fig. 3. The missing pins also help to define the pin numbering. The decimal point is not used in this application, so that no connection is made to its terminal pin. The i.c.'s should be mounted with their index marks towards the bottom of the board. Note that the 74192 and 7447 i.c.'s are 16-pin types whilst the 74132 is a 14-pin device. There are, in consequence, two Blob Board pads unused at the 74132 position, so that pin 1 of the i.c. is on pad 12G and pin 8 on pad 6D.

Start construction by tinning the pin-ends of the i.c.'s in the usual way. Then mount the i.c.'s on the board, checking carefully that each pin is on the correct pad. Start soldering in, always soldering pin 1 first, checking for correct position, then soldering the diagonally opposite pin (8 or 9) and then rechecking the positioning, before soldering on the rest of the pins.

Wiring can now commence, as illustrated in Fig. 7. The first step is to wire in the 470Ω resistors between the seven outputs of the 7447 and the seven cathodes of the display. The seven outputs of the 7447 are in a line on one side of the i.c., but appear in the order, starting at pin 9, of e, d, c, b, a,

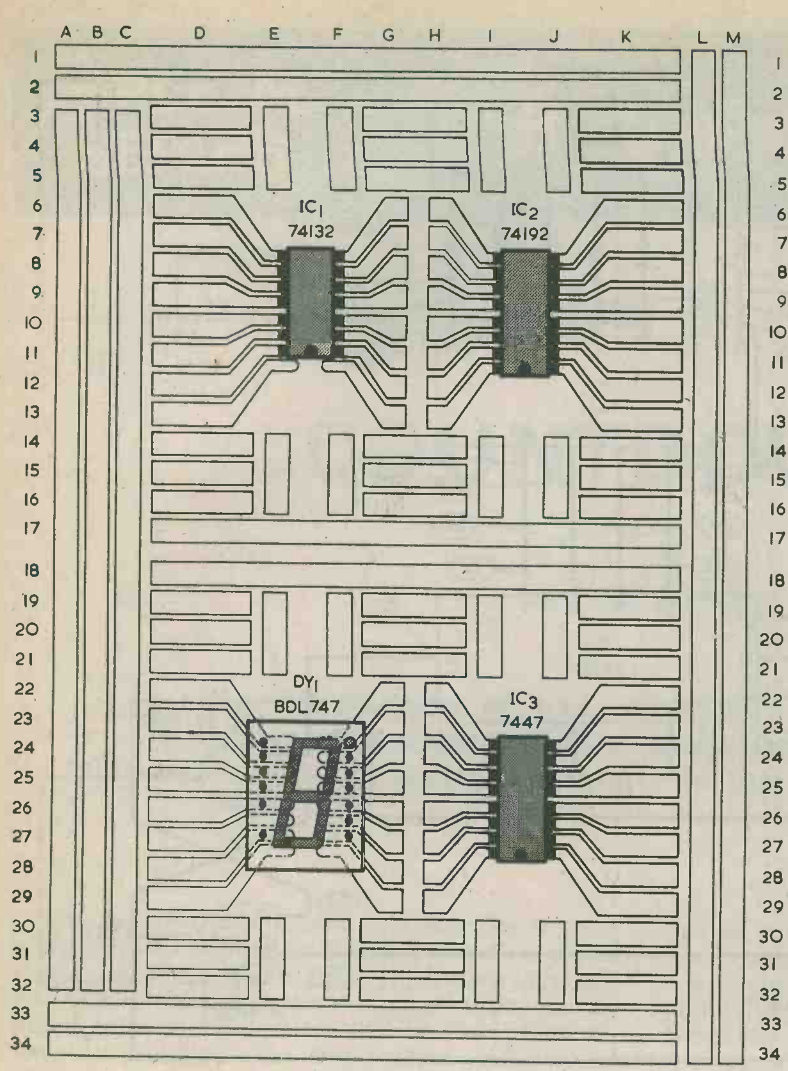
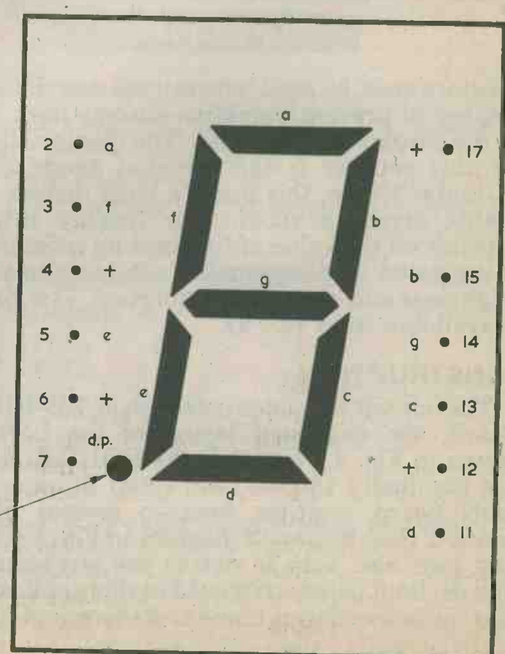
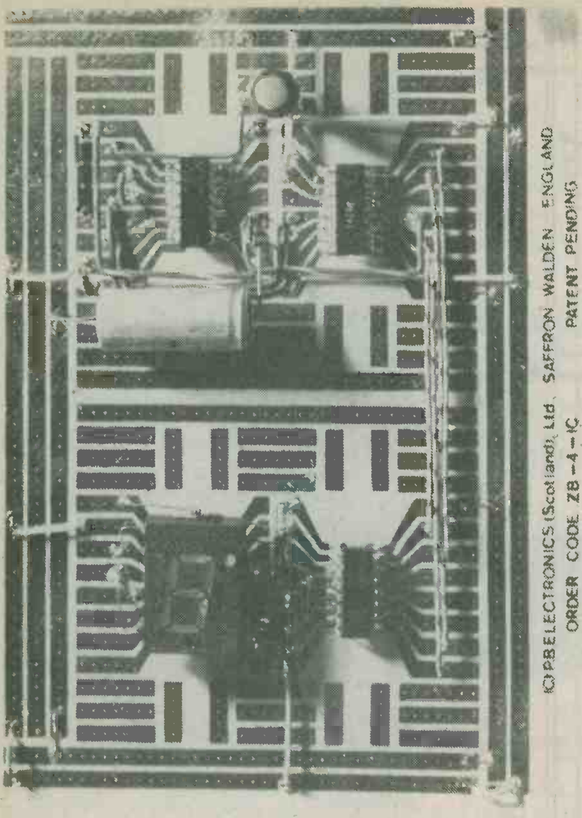


Fig. 2. Fitting the three integrated circuits and the display to the Blob Board. The orientation of the display is shown by the position of the decimal point and by the missing pin 16

Fig. 3. Pin functions of the display, viewed with the pins away from the reader. This is nominally an 18 pin device with pins 1, 8, 9, 10, 16 and 18 omitted. The positive signs indicate common anode pins





The assembled Countdown circuit forms a very neat assembly on the ZB-4-IC Blob Board

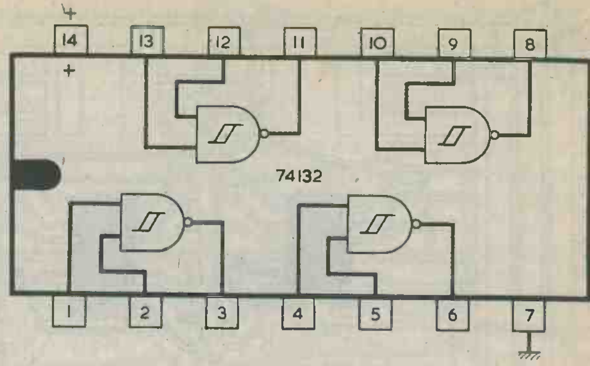


Fig. 4. The pinning of the 74132 quad 2-input Schmitt trigger

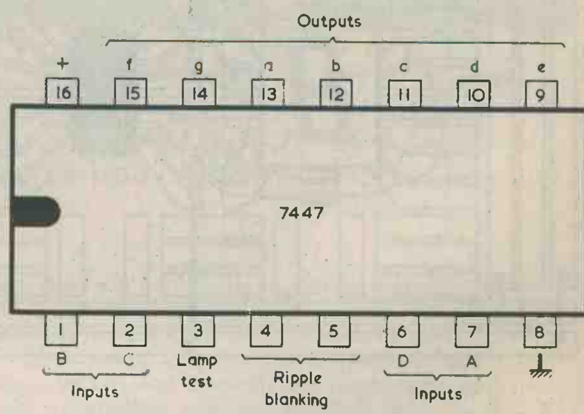


Fig. 5. The 7447 decoder has the pin functions shown here

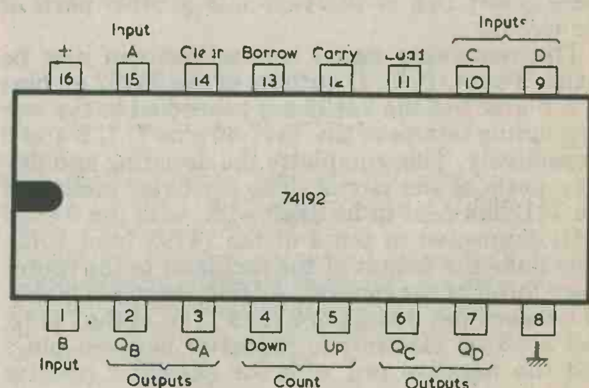


Fig. 6. The pin functions of the 74192 up/down counter

g, f. The cathode pins of the BDL 747 are not similarly arranged, so that the resistors will have to cross over each other. Some of the resistors can pass under the body of the display rather than take the longer route round it, and such a process is easier if the resistors used are 1/8 or 1/10 watt types with very small bodies so that a piece of sleeving can be passed over the resistor body and most of its lead-outs. Whatever method of routing the resistors is employed, sleeving must be passed over their lead-outs wherever there is a possibility of short-circuit to another lead-out, to a Blob Board pad or to the display terminal pins. The wiring is between corresponding letters, with output "a" on the 7447 connecting via a 470Ω resistor to cathode "a" in the display, and so on.

SUPPLY CONNECTIONS

The supply connections may next be made. The 5 volt positive input is connected to strip M and the negative input to strip L. Link wires near the board corners then route these supplies around the outer strips of the board, as shown in Fig. 7. The BDL 747 has several common anode pins, and only one needs to be connected to the positive supply. This is pin 12 at pad 23D. There is no negative supply connection to the display, as the cathodes of the l.e.d.'s are coupled to the negative rail through the 7447

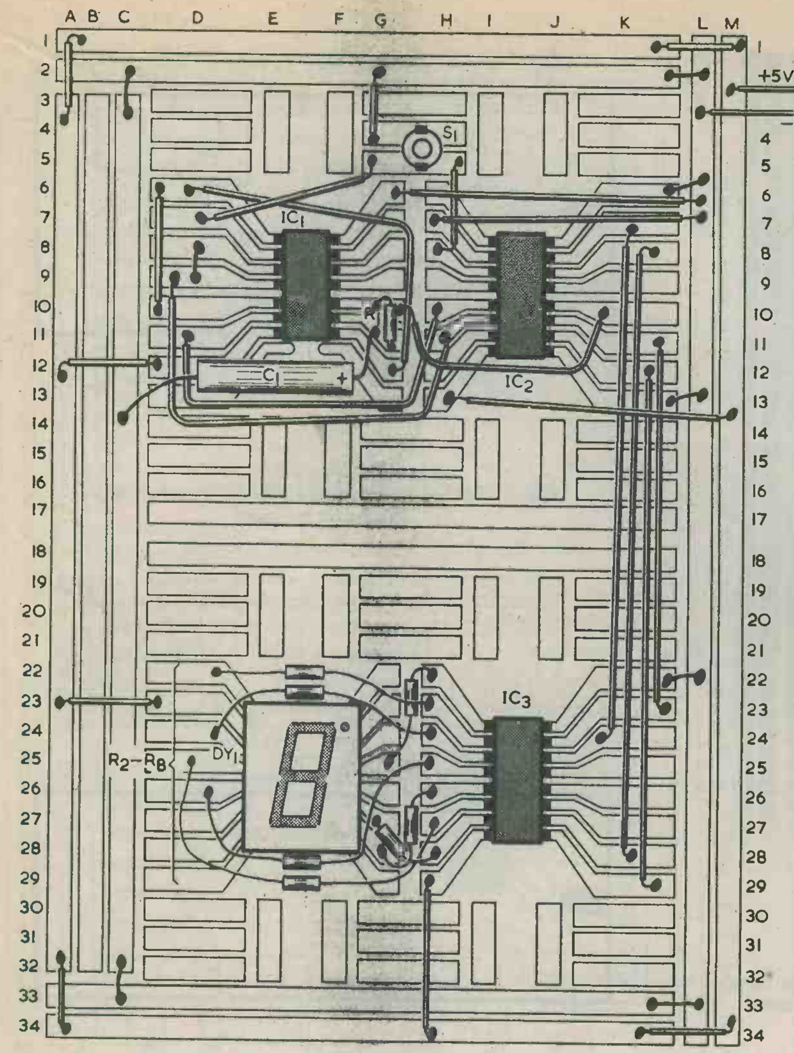


Fig. 7. Final steps in wiring of the Blob Board. The positioning of resistors R2 to R8 can be carried out as described in the text

decoder. With the 7447, pin 8 (pad 22K) is taken to the negative rail and pin 16 (pad 29H) to the positive rail. With the 74192, pin 8 (pad 6K) is the negative supply connection and pin 16 (pad 13H) the positive connection. Pin 7 (pad 6G) of the 74132 connects to negative and pin 14 (pad 12D) to the positive rail. Use insulated wire for these connections and for all subsequent connections where there is any risk of short-circuits to other parts of the circuit.

The remaining signal connections can now be made. The A, B, C, D outputs of the 74192 on pins 3, 2, 6 and 7 of the 74192 are connected to the corresponding inputs of the 7447 at pins 7, 1, 2 and 6 respectively. This completes the decoding and display parts of the circuit. The oscillator section of the 74132 is next to be dealt with, with pin 3 (pad 10G) connected to pin 4 of the 74192 (pad 10K). This links the output of the oscillator to the countdown input of the counter. A 560Ω resistor is blobbed between pin 3 and pin 2 (pad 11G) of the 74132, and a 680μF electrolytic capacitor between pin 2 and the negative rail with the capacitor positive lead connecting to pin 2.

There are now no further resistors or capacitors to mount. Pin 10 (pad 8D) of the 74132 is connected to pin 11 (pad 9D), and pin 8 (pad 6D) is connected to pin 12 (pad 10D), completing the latch inter-wiring. Pin 8 is connected to pin 1 (pad 12G) and this completes the wiring around the 74132. A few connections between the 74132 and the 74192 have next to be made. Pin 11 of the 74132 (pad 9D) is connected to pin 14 of the 74192 (pad 11H), and pin 9 of the 74132 (pad 7D) is connected to pin 11 of the 74192 (pad 8H) and also to one terminal of the push-button switch on pad 5H. The other terminal of the switch is soldered to pad 4H, which is then coupled to the adjacent negative rail track. Pin 13 of the 74132 (pad 11D) is next connected to pin 13 of the 74192 (pad 10H). Finally, pins 1 and 10 of the 74192 (pads 13K and 7H) are connected to the negative supply rail. If required, an output lead can be connected to pad 6D.

This completes the wiring on the board. It will be noted that one of the four gates in the 74132 is not used, and no connections are made to its pins. A number of other i.c. pins are left unconnected also; this is intentional as it is required that the pins concerned be left floating.

An output is available on the lead connected to pad 6D. The voltage on this lead is low before the countdown starts. It goes high during the countdown and then goes low again when the countdown is complete.

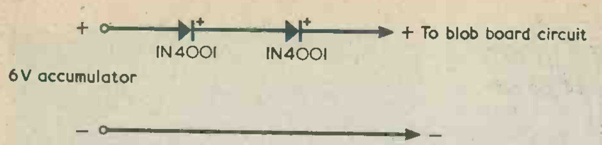


Fig. 8. The circuit may be powered by a 6 volt accumulator if two forward connected silicon diodes are inserted in series to drop the voltage

TESTING

The circuit draws a relatively high supply current of about 200mA and a mains power supply offering a regulated 5 volt output is the best source of power. A 5 volt stabilizing circuit was described in the first Blob-a-Job article in this series, this appearing in the June 1977 issue. A mains supply should not be used if the voltage can rise above 5.5 volts off load. A 6 volt accumulator may also be employed with two silicon rectifiers in series, as in Fig. 8, to drop the voltage to a safer level. The rectifiers also protect against accidental reversal of supply polarity, which can damage the integrated circuits. An accumulator which is on charge must not be employed. Dry batteries will not have a long life operating this display, although a fresh 4.5 volt battery could be used for a quick demonstration.

The title of this article "Countdown!", is symbolic since it is the last of the Blob-a-Job series, which is therefore similarly counted down. The projects which have been described in the series are useful and instructive, and they all demonstrate the ease and speed with which quite complex circuits can be readily assembled on Blob Boards.■

RECENT PUBLICATIONS

RADIO DATA REFERENCE BOOK, Fourth Edition. By T. G. Giles, B.Sc., G4CDY and G. R. Jessop, C.Eng., M.I.E.R.E., G6JP. 200 pages, 225 x 140mm. ($9\frac{3}{4}$ x $15\frac{1}{2}$in.) Published by Radio Society of Great Britain. Price £3.00.

This is another R.S.G.B. publication, also appearing in a new and enlarged edition. Indeed, the text has been completely revised for the fourth edition and much new material added, including sections on transistors, heat sinks and modern filter design. The book has also been rearranged into nine subject areas for greater ease of reference. These areas are: units and symbols, basic calculations, resonant circuits and filters, circuit design, aerials and transmission lines, radio and television services, maps and meteorological data, materials and engineering data, and mathematical tables.

The purpose of the book is to provide as much reference data as is possible without taking up space with unnecessary details on basic theory. The book can be consulted for such diverse information as metric thread dimensions, great circle calculations, transistor y-parameters, RTTY standards, TV channel frequencies and, even, the Beaufort wind scale. This is a useful reference work for anyone who deals at design level with modern radio communication equipment.

MODERN ELECTRONICS MADE SIMPLE. By George H. Olsen, B.Sc., C.Eng., M.I.E.R.E., M.Inst.P. 318 pages, 215 x 125mm. ($8\frac{1}{2}$ x 5in.) Published by W. H. Allen & Co. Ltd. Price £2.95 (cloth), £1.75 (paper).

Appearing in the W. H. Allen "Made Simple" series, this book starts, very nearly from scratch, to take the reader into the basics of advanced present-day electronic devices and principles. All that the reader needs is a knowledge of elementary electricity.

The text is concise and, so far as is possible, mathematics are avoided. There is a considerable amount of useful information in the volume, certainly very much more than is encountered in some books which ostensibly set out to introduce beginners to the science of electronics.

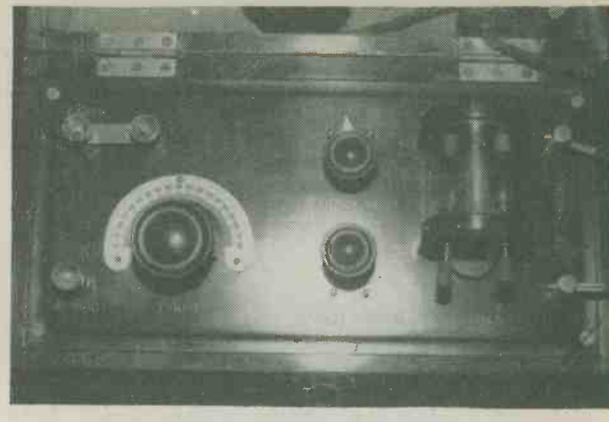
Commencing with basic electron theory and the general functioning of electronic systems the book progresses rapidly, but not excessively so, to semiconductors, amplifiers, integrated circuits, power supplies, oscillators, radio transmission and reception, the oscilloscope, television and high fidelity reproduction. There then follows an introduction to digital circuits, a chapter on photoelectric devices and a final chapter describing simple projects which may be built.

As an example of the depth with which subjects are dealt, the chapter on power supplies includes diacs and triacs, and the chapter on digital circuits gives a description of the operation of a liquid crystal display. This is definitely a helpful book for the newcomer to electronics.

WITH SPARE DETECTOR

By Ron Ham

A receiver from the 1920's which incorporated two crystal detectors.



The front panel of the BTH Radiola receiver. The tuning control, with scale, is to the left, and the dual crystal and cat's whisker unit is at the right. The top central control is a condenser selection switch and the lower central control switches in either of the two crystals

Occasionally an early set in good condition appears in a second-hand shop and through the vigilance of David Rudram of Worthing the British Thomson-Houston crystal receiver seen in the photographs was rescued for posterity.

DOUBLE CAT'S WHISKER

Two features of this set are the double cat's whisker and crystal unit mounted on the right of the ebonite front panel and the use of a variometer for tuning. The polished wooden cabinet with its lid closed measures 11¼in. by 5¼in. by 8½in. high. After a good clean up both the BTH insignia, under the carrying handle, and the BBC approval label were found intact. The letters "BBC" are encircled by the usual words "Type Approved By Postmaster General", and another outer circle is inscribed "G.P.O. REG. No. 106".

Overall view of the receiver, complete with headphones. The "Instructions For Using" are mounted inside the receiver case lid

As can be seen in the second photograph, the instruction card is mounted inside the lid. It is dated January 1925 and is followed by the words "Form 1996-A Fourth Edition" which, coupled with the extra circle surrounding the approvals label, made both the owner and the writer conclude that this was a special purpose set. However, a dig in the writer's early radio magazines revealed an advertisement in *Wireless Weekly* for October 22nd, 1924, which identified the set as "The Radiola Model A" and described it in the following manner.

"This set is provided with two crystals, and if one ceases to function, the other can be instantly switched into circuit. The normal range for telephony is 30 miles, but a greater range is possible under favourable conditions. The tuning is simple and selective."

The price was quoted as £3. 10s. A pair of "B.T.H. 4000 ohm Head Telephones" could be obtained for £1. 5s. extra.

SELECTIVITY

Like all enthusiasts, David has tried the set out, and its selectivity between BBC Radios 1 and 4 in his area is surprisingly good. He found also that one crystal is slightly more sensitive than the other.

During the magazine research, another advertisement for BTH receivers was found in *Wireless World* dated December 24th, 1924, which showed an almost identical set, but with a larger cabinet and a valve built in. This was the "Radiola 1 (Valve Crystal) Receiver" and the advertisement stated: "This is the ideal set for Head Telephone reception up to 100 miles. Two crystals, with change-over switch, are provided."

The price, "with enclosed H.T. battery and B.5 valve", was £9. 15s. Again, BTH 4000 ohm headphones could be bought for £1. 5s. extra.

Should any readers have comments to make about these sets the writer would be pleased to hear from them. ■

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT *Frequencies* = kHz

We commence this month by giving the Broadcast Bands a rest and delve into the 'goings-on' taking place at the CW ends of some of the Amateur Bands. No doubt CW (Morse Code — or more correctly Continuous Wave using the Morse Code) is not everybody's cup of tea but at least the results show just what may be heard using this mode of operation.

1.8 — 2.0 MHz (Top Band)
DL10V, F8VJ, G13PDN, GM3XOQ, GW3 XJC, OL9CHZ and PAHIP. Noise levels on the band have been quite high of late and results obtained are far below those achieved last year.

7.0 — 7.1 MHz (Forty Metres)
CO2SM, CO5PN, CO7ET, FM7AZ, HI8MOG, JA7UI/PZ, J28AY, LU9FEG, PY1EIZ, UD6DLL, UI8OU, UL7RAS, W4WE, 9K2DR. Undoubtedly the best time for listening on this band is the early mornings — and I mean early — around 0100 to 0400!

14.00 — 14.35 MHz (Twenty Metres)
AP2TN, CX4LO, EL2AZ, EP2IK, FY7YE, HC2TI, KL7HCC, KP4DDO, KV4AA, OA4AHO, OD5LX, UF6FDI, UJ8AC, UW8AT, VE7CML, VK4PB, VU2YK, ZL2AYJ, ZL3BK, ZS1PH, ZS5BO, 4J6AM. Which leaves this band still occupying the position of the best DX producer of them all.

As for the remaining Amateur Bands — I couldn't find the time to cover them!

CURRENT SCHEDULES

● SOCIETY ISLANDS (FRENCH)
"Radio Tahiti" has a schedule in which programmes in French, Tahitian and English are radiated from 1600 to 1800 on **6135, 9750, 11825** and on **15170**. Of these channels, the first two are 4kW and therefore unlikely to be heard here in the U.K. and the latter two are of 20kW. The English programme is from 1900 to 1915 (not Sundays) but the best chance of logging Tahiti is around 0530 to 0600 on **15170**. A Tahitian programme is presented from 0300 to 0600 and a French transmission is made from 0600 until sign-off at 0800.

● LAOS
An External Service in various languages from Vientiane is on the air from 0400 to 0630 and from 1100 to 1430 on **7145**. The English programmes are from 0600 to 0630 and from 1330 to 1400.

● MONGOLIA
Ulan Bator has an External Service in which English programmes intended for South East Asia and the Far East are radiated from Monday to Saturday from 1220 to 1250 on **9575** and **11860** and from 1715 to 1745 on **8890**.

● KENYA
"The Voice of Kenya", Nairobi, operates a Domestic Service in which programmes in Swahili are broadcast from 0630 to 1330 on **7240** and on **4885** from 0300 to 0630 (Sundays 0330 to 0630); from 1330 to 2010 (Saturdays 1330 to 2110). This is the National Service.

The General Service from Nairobi has an all-English programme content and may be heard from 0900 to 1100 Monday to Friday and from 0620 to 1330 on Saturday and Sunday on **7125**. From 0300 to 0620 (0330 to 0620 on Sunday) and from 1300 to 2010 (1300 to 2110 on Saturday) on **4804**.

Vernacular Service from Nairobi is from 1500 to 1900 on **4950** and from 0900 to 1045 on 7150. This service is not broadcast on Sundays or public holidays.

Programmes from the Mombasa station (vernaculars) are on **4915** from 0330 to 0500 and from 1400 to 2005 and on **7140** from 0800 to 1100.

● NIGERIA
The "Voice of Nigeria" Lagos, presents programmes in English as follows — from 0555 to 0835 on **7275** and on **15120** to West and East Africa, the Middle East and Europe; from 1800 to 1930 on **7275, 11770** and on **15120** to West, Central and Southern Africa, Europe and the Middle East.

Programmes in English may also be heard from 1530 to 1700 on **7275** and on 11770 when being directed to West, Central, East and Southern Africa and the Middle East.

● CHINA
Broadcasts to Taiwan in the External Service of Radio Peking in Standard Chinese, Amoy and Hakka are scheduled as follows — from 1439 to 1900 on **4770**; 2000 to 2314 and from 1430 to 1900 on **5125**; from 1226 to 1900 and from 2000 to 0014 on **6790**; from 0830 to 1900 and from 2000 to 0610 (Sunday to 0705) on **9170**; from 0830 to 1438 and from 2000 to 0610 (Sunday to 0705) on **11100**;

from 0830 to 1429 and from 2315 to 0610 (Sunday to 0705) on **15710**; 0830 to 1225 and from 0015 to 0610 (Sunday to 0705) on **15880**.

The Domestic 1st Programme in Standard Chinese is now as follows — from 1303 to 1735 and from 2000 to 2300 on **3220;** from 2000 to 2300 on **3450;** from 1133 to 1735 and from 2000 to 2200 on **4905;** from 0848 to 1735 and from 2000 to 2400 on **5320;** from 1018 to 1735 and from 2000 to 2330 on **7935;** from 2000 to 1735 on **9080;** from 1100 to 1735 and from 2303 to 0100 on **10245;** from 2303 to 1300 on **11330;** from 0733 to 1130 and from 2203 to 0430 on **12420;** from 0103 to 0845 on **15550** and from 2333 to 1015 on **15590.**

The Domestic 2nd Programme in Standard Chinese is announced as from 1403 to 1700 and from 2100 to 2240 on **3290;** from 1118 to 1700 and from 2100 to 0030 on **4250;** from 1203 to 1700 and from 2100 to 2400 on **4850;** from 1033 to 1700 and from 2100 to 2400 on **5163;** from 1203 to 1700 and from 2100 to 0001 on **6345;** from 0033 to 1115 on **7190;** from 0800 to 1700 and from 2100 to 0220 on **7770;** from 0700 to 1030 **9670;** from 0700 to 1200 on **9745;** from 2243 to 1400 on **10260;** from 0003 to 1200 on **11040;** from 0133 to 1000 on **12200** and from 0001 to 1100 on **15030.**

AROUND THE DIAL

● TANZANIA

Dares Salaam on **5050** at 1931, local songs and music in typical local style in the Commercial Service (in Swahili). The schedule is from 1300 to 2015 whilst the National Service is radiated on this channel from 0300 to 0500. The power is 10kw.

● MOZAMBIQUE

Radio Mozambique, Beira, on **4895** at 0353, interval signal of drums and orchestra repeated. identification in English, Portuguese and vernaculars repeated ("This is Radio Mozambique, Beira").

● EGYPT

Cairo on **9805** at 1831, OM in Italian to Europe, the schedule of this programme being from 1830 to 1930.

Cairo on **9850** at 1835, OM in Arabic in the Domestic Service, the Schedule of which is from 1800 to 2355 on this channel.

● INDIA

AIR Delhi on **9912** at 1840, a programme of Arabic music in a broadcast to the Arab world, scheduled from 1730 to 1930.

Hyderabad on **4800** at 1533, YL with a newscast in English. The schedule is from 1200 to 1830, all programmes in Arabic except English news bulletins at 1232 and 1530. The power is 10kW.

Kurseong on **3355** at 1543, YL with the news in English. The schedule is from 1130 to 1800 (East Regional Service in vernaculars except for the English newscast at 1530). The power is 20kW.

● SINGAPORE

Radio Singapore on a measured **5052** at 1540, OM with a ballad in English. The schedule is from 2230 to 1630 (Sunday to 1700) and the power is 20kW.

● CZECHOSLOVAKIA

Prague on **9605** at 1810, YL with a talk in the English programme directed to Africa, scheduled from 1730 to 1830.

● NETHERLANDS

Hilversum on **9895** at 1818, YL in Dutch to the Middle East, Africa and Europe, identification, National Anthem and off at 1820. The schedule of this programme is from 1700 to 1820.

● ECUADOR

Radio Popular, Cuenca, on **4800** at 0417, YL with songs in Spanish. This one is audible after Radio Lara signs off at 0400. The schedule of Radio Popular is around the clock, the power is 2kW and it sometimes identifies as "Amiga Popular de Cuenca".

Radio Nacional Progreso, Loja, on **5060** at 0406, local-style dance music, songs in Spanish. The schedule is from 1030 to 0415 (sign-off is variable) and the power is 5kW.

Radio Rio Amazonas, Macuma, on **4870** at 0347, OM with identification in Spanish, National Anthem and off — which is not in conformity with the schedule, this being from 1130 to 0300. However, since it has also been reported closing as early as 0140 the sign-off time is not surprising. The power is 10kW and the programme language is mainly local vernaculars.

● COLOMBIA

Ecos del Atrato, Quibdo, on **5020** at 0357, YL with songs in Spanish, OM with announcements, National Anthem and off at 0401. The schedule is from 1100 to 0400 and the power is 1kW.

NOW HEAR THIS

La Voz de Galapagos, Isla San Cristobal, on **4810** at 0357, identification in Spanish, announcements and off after full National Anthem at 0401 — but who touched the record and temporarily slowed it down?

HOBBIES EXHIBITION — EXMOUTH, 13th to 16th MARCH 1978

The Exeter Amateur Radio Society will be exhibiting at the above exhibition to be held in the Pavilion, Exmouth, South Devon.

On their stand there will be HF TX/RX, VHF/UHF and Amateur TV stations, plus **a fully equipped SWL station.** In addition to the foregoing there will be an Electronics Section.

The Society's monthly meetings are held in the Community Centre, St. David's Hill, Exeter at 1930 hours on the second Monday in the month.

2 METRE CONVERTER

By A. P. Roberts

This crystal controlled unit converts the 2 metre amateur band to a range of 28 to 30MHz, thereby permitting 2 metre reception on a standard short wave receiver.

There seems to be a continuing increase in interest in the v.h.f. and u.h.f. amateur bands, and in particular in the 2 metre band. For anyone who already has a good short wave receiver the obvious way to get started on v.h.f. amateur band reception is to use a converter ahead of the existing receiver. Provided the receiver has good sensitivity, such an arrangement can produce excellent results for a relatively small monetary outlay.

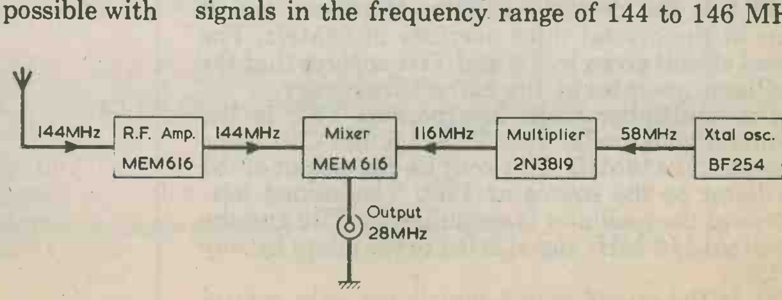
The converter which forms the subject of this article is crystal controlled, and uses four transistors including two dual gate MOSFET's and a Jugfet. It is of the type where the s.w. receiver is used as a tuneable i.f. strip, and in this case the i.f. is 28 to 30MHz. The prototype is used in conjunction with a Trio QR-666 receiver, and good reception of stations up to about 25 miles away is possible with only a telescopic aerial. Of course, by using a more sophisticated aerial, and possibly also adding a high gain low noise aerial amplifier, a far greater range could be attained.

It should perhaps be pointed out that although the circuit is fairly simple, this is not a project which is really suitable for anyone of limited experience. Alignment, for instance, is more difficult than is the process of aligning, say, a medium wave superhet receiver. Ideally, both a multimeter and a v.h.f. signal generator should be available, although it is possible to manage without either of these.

OPERATING PRINCIPLE

A block diagram of the converter is shown in Fig. 1. the heterodyne principle is used to convert aerial signals in the frequency range of 144 to 146 MHz

Fig. 1. Block diagram illustrating the operation of the 2 metre converter. This requires only one doubler stage to bring the crystal frequency up to the desired heterodyne value



(the limits of the 2 metre band) to a range of 28 to 30MHz so that they fall within the coverage of a short wave receiver.

The aerial input signal is amplified by an r.f. stage before being fed into the mixer stage. Both these stages use dual gate MOSFET's, which provide a low noise level. The crystal oscillator operates at a frequency of 58MHz, and its output is doubled in frequency by a Jugfet multiplier stage prior to being fed to the second input of the mixer.

If, for example, an aerial signal of 144MHz is received, this will be heterodyned with the 116MHz signal from the multiplier stage to produce a difference frequency of 28MHz (144 minus 116 equals 28). The two input signals, plus the 260MHz sum frequency, will also appear at the output of the mixer, but these will lie well outside the tuning response of the short wave receiver and can be ignored. Obviously, a 145MHz aerial signal will produce a mixer output at 29MHz and a 146MHz signal an output of 30MHz. Thus, by coupling the converter output to a receiver having a coverage of 28 to 30MHz it is possible to tune over the entire 2 metre band. Furthermore, the receiver tuning dial calibration can be used to determine the reception frequency since it is merely necessary to add 116MHz to the indicated dial frequency.

THE CIRCUIT

The complete circuit of the 2 metre converter appears in Fig. 2. The aerial signal is coupled to a tap in L1 which, together with TC1, forms the input tuned circuit, resonant at 145MHz. This connects direct to the gate 1 of the r.f. amplifier transistor, TR1. The gate 2 is biased a few volts positive by the potential divider consisting of R1 and R2, and this bias produces maximum gain from the device. The drain load for TR1 is choke L2. R3 is the source bias resistor, and this is bypassed by C3. C1, C2 and R4 provide decoupling for the r.f. stage.

The output from TR1 is coupled via C4 to a tap in coil L3, which connects to the gate 1 of the mixer transistor, TR2. L3 and TC2 form a second tuned circuit resonant at 145MHz. Both the aerial and mixer tuned circuits have pre-set tuning. Variable tuning would serve no purpose as the bandwidth of both tuned circuits is greater than 2MHz.

TR2 is a conventional dual gate MOSFET mixer, with its output being developed across the tuned circuit consisting of L4 and C5. Again, pre-set tuning is employed and the iron-dust core of L4 is adjusted so that the circuit is resonant at the centre output frequency of 29MHz. The output signal is taken from a tap in L4 and is coupled to the output socket, SK2, by way of the d.c. blocking capacitor, C6. The tap in L4 is closer to the drain end of the coil than the earthy end, it being found that this provides optimum signal coupling into the short wave receiver used with the converter.

TR4 is the crystal oscillator transistor and it runs at the crystal third overtone of 58MHz. The tuned circuit given by L6 and TC4 ensures that the oscillator operates at the correct frequency.

The multiplier stage incorporates TR3 in the common gate mode, with TC3, L5 and C10 being resonant at 116MHz. C11 couples the output of the oscillator to the source of TR3. The second harmonic of the oscillator is amplified by TR3 and the resultant 116 MHz signal is fed to the mixer by way of C9.

S1 is the on-off switch and is the only control which is fitted to the converter. Power is obtained from a 9 volt battery type PP6, which has quite a long operating life since the current consumption of the converter is only about 10mA. This is much less than the current required by most converters, and is achieved by the use of a relatively high frequency oscillator, which requires only one multiplier stage instead of the more usual two or three.

COMPONENTS

Most of the components employed in the design are standard readily available items, but inevitably a few parts are of a more specialised nature. The 58MHz third overtone crystal can be obtained from Doram Electronics and possibly from other firms who specialise in crystals. The crystal lead-outs were soldered directly to the printed circuit board in the prototype but readers who prefer to do so may alternatively use a crystal holder, soldering this to the board and then plugging in the crystal. The holder should be an HC-25/u type. The four ceramic trimmers are Doram Type A components. Other trimmers having a similar capacitance swing would probably be satisfactory, but it would almost certainly be necessary to alter the printed circuit board to accommodate them physically.

The MEM616 transistors specified for TR1 and TR2 are available from Ambit International, whilst the BF254 used for TR4 is listed by Electrovalue. L4 is wound on a 10mm. diameter coil former type 450, available from Maplin Electronic Supplies, and is fitted with an 8mm. iron-dust core type 8, also supplied by Maplin. L2 is wound on a

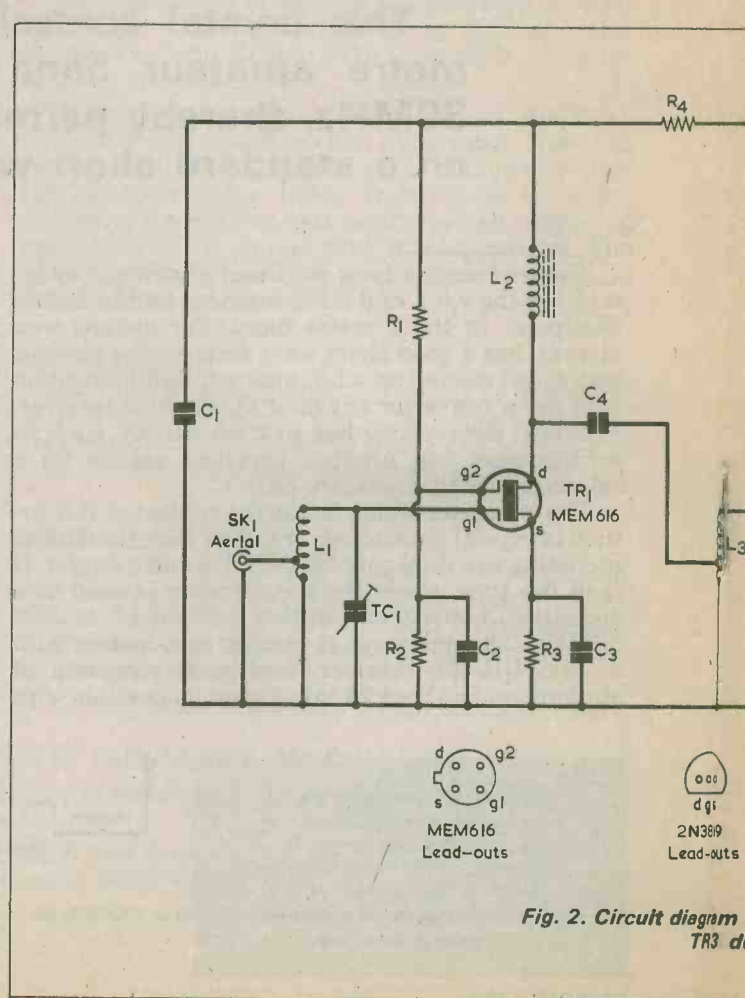


Fig. 2. Circuit diagram

ange of 28 to
overage of a

d by an r.f.
stage. Both
ET's, which
al oscillator
its output is
tiplier stage
f the mixer.
144MHz is
the 116MHz
produce a
minus 116
the 260MHz
utput of the
the tuning
d can be ig-
signal will
d a 146MHz
coupling the
coverage of
the entire 2
tuning dial
he reception
ary to add
cy.

re converter
coupled to a
orms the in-
z. This con-
plifier tran-
olts positive
R1 and R2,
in from the
ke L2. R3 is
assed by C3.
he r.f. stage.
C4 to a tap
of the mixer
econd tuned
e aerial and
ng. Variable
andwidth of
1Hz.
SFET mixer,
s the tuned
pre-set tun-
of L4 is ad-
t the centre
put signal is
d to the out-
ocking capa-
drain end of
found that
ng into the
nverter.
istor and it
58MHz. The
ures that the
uency.
TR3 in the
d C10 being
utput of the
second har-
TR3 and the
nixer by way

only control

which is fitted to the converter. Power is obtained from a 9 volt battery type PP6, which has quite a long operating life since the current consumption of the converter is only about 10mA. This is much less than the current required by most converters, and is achieved by the use of a relatively high frequency oscillator, which requires only one multiplier stage instead of the more usual two or three.

COMPONENTS

Most of the components employed in the design are standard readily available items, but inevitably a few parts are of a more specialised nature. The 58MHz third overtone crystal can be obtained from Doram Electronics and possibly from other firms who specialise in crystals. The crystal lead-outs were soldered directly to the printed circuit board in the prototype but readers who prefer to do so may alternatively use a crystal holder, soldering this to the board and then plugging in the crystal. The holder should be an HC-25/u type. The four ceramic trimmers are Doram Type A components. Other trimmers having a similar capacitance swing would probably be satisfactory, but it would almost certainly be necessary to alter the printed circuit board to accommodate them physically.

The MEM616 transistors specified for TR1 and TR2 are available from Ambit International, whilst the BF254 used for TR4 is listed by Electrovalue. L4 is wound on a 10mm. diameter coil former type 450, available from Maplin Electronic Supplies, and is fitted with an 8mm. iron-dust core type 8, also supplied by Maplin. L2 is wound on a

COMPONENTS

Resistors
(All ¼ watt 5%)
R1 10kΩ
R2 8.2kΩ
R3 470Ω
R4 1kΩ
R5 2.2kΩ
R6 120kΩ
R7 1kΩ
R8 150kΩ

Capacitors
C1 0.015μF or 0.022μF ceram
C2 0.0022μF ceramic
C3 0.0047μF ceramic
C4 10pF ceramic
C5 47pF polystyrene (see text
C6 47pF polystyrene
C7 0.0047μF ceramic
C8 0.1μF type C280 (Mullard
C9 10pF polystyrene or ceram
C10 39pF polystyrene or cera
C11 8.2pF ceramic
C12 0.015μF or 0.022μF ceran
TC1 4-20pF trimmer, ceramic

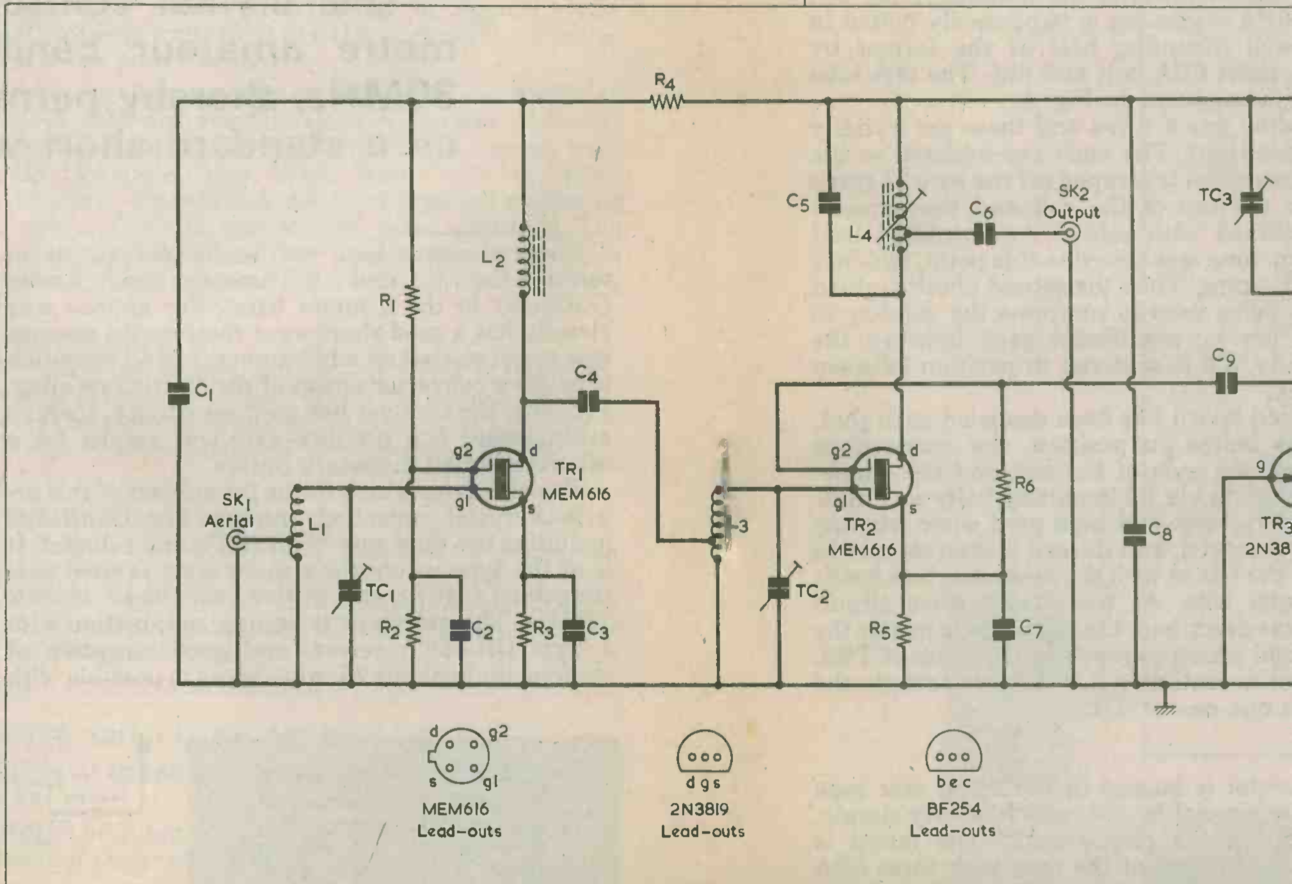


Fig. 2. Circuit diagram of the converter. TR1 is the aerial signal amplifier an
TR3 doubles the crystal frequency and mixing is carried

COMPONENTS

Resistors
(All ¼ watt 5%)
R1 10kΩ
R2 8.2kΩ
R3 470 Ω
R4 1kΩ
R5 2.2kΩ
R6 120kΩ
R7 1kΩ
R8 150kΩ

Capacitors
C1 0.015μF or 0.022μF ceramic
C2 0.0022μF ceramic
C3 0.0047μF ceramic
C4 10pF ceramic
C5 47pF polystyrene (see text)
C6 47pF polystyrene
C7 0.0047μF ceramic
C8 0.1μF type C280 (Mullard)
C9 10pF polystyrene or ceramic
C10 39pF polystyrene or ceramic
C11 8.2pF ceramic
C12 0.015μF or 0.022μF ceramic
TC1 4-20pF trimmer, ceramic
TC2 4-20pF trimmer, ceramic
TC3 3-10pF trimmer, ceramic
TC4 10-60pF trimmer, ceramic

Inductors
L1-L6 see text

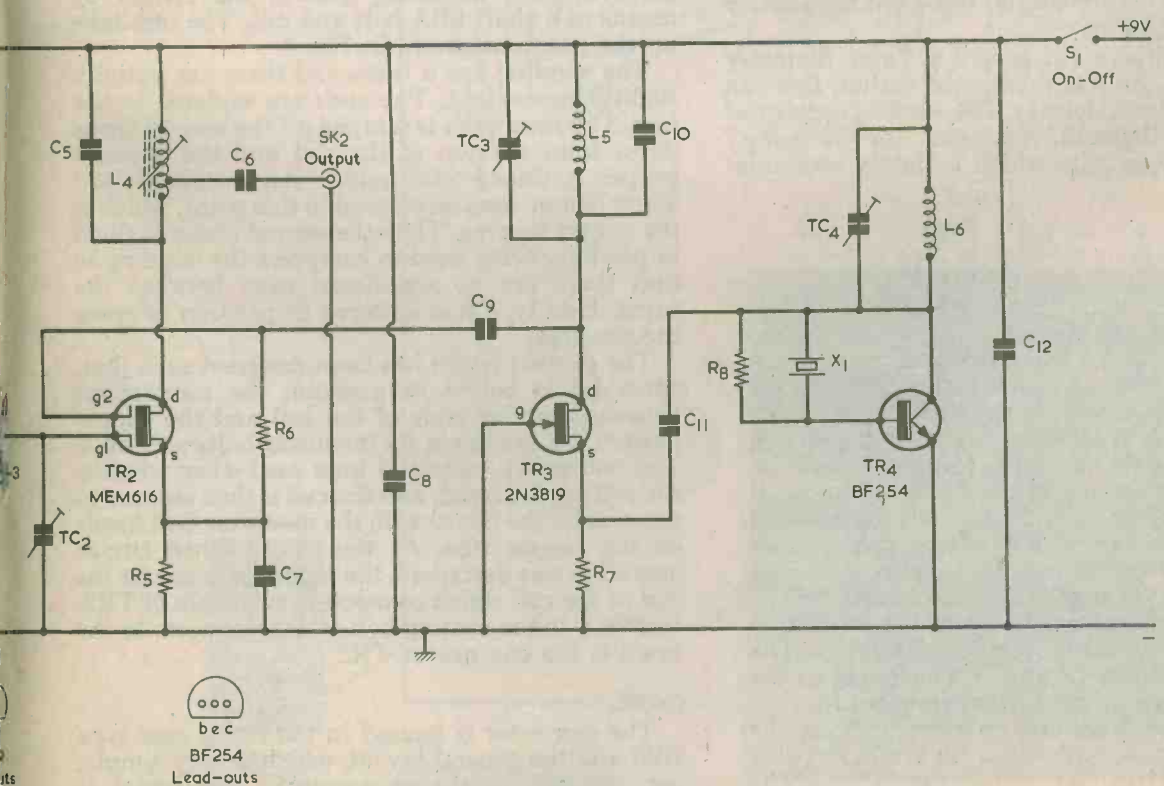
Transistors
TR1 MEM616
TR2 MEM616
TR3 2N3819
TR4 BF254

Crystal
X1 58MHz third overtone, HC-25/u

Switch
S1 s.p.s.t. toggle

Sockets
SK1 coaxial socket
SK2 coaxial socket

Miscellaneous
Instrument case type BV3
9 volt battery type PP6 (Ever Ready)
Battery connector
Materials for coils (see text)
Printed circuit board
HC-25/u crystal holder (see text)
Nuts, bolts, wire etc.



m of the converter. TR1 is the aerial signal amplifier and TR4 the crystal oscillator. doubles the crystal frequency and mixing is carried out by TR2

7mm. former fitted with an iron-dust core. A suitable former can be cut from a former type 351/8BA, this being fitted with an iron-dust core type 6. These two items can, again, be obtained from Maplin Electronic Supplies.

The converter is housed in a case type BV3, this being supplied by Bi-Pak Semiconductors.

PRINTED BOARD

Virtually all the circuitry is assembled on a printed board which is reproduced, full-size, in Fig. 3. For greatest accuracy and least risk of strain on the component the two holes for the crystal pins should be marked out accurately with the aid of the crystal itself. The hole positioning may differ, and the copper pattern may need to be slightly amended, if a crystal holder is used. The other holes will cater for the components specified without difficulty. The three board mounting holes, and the two mounting holes for L4 former, are drilled out 6BA clear.

All the coils are home constructed. L1 and L3 are identical, and they each consist of exactly 4 turns of 0.9mm. diameter (or 20 s.w.g.) enamelled copper wire. They are self-supporting and are wound around a temporary $\frac{5}{16}$in. diameter former, such as the shank of a $\frac{5}{16}$in. twist drill. With each coil the enamel insulation is removed at a point $1\frac{1}{2}$ turns from one end (the earthy end) and the exposed copper is tinned with solder. This is the tapping point on the coil. The coil turns are spaced evenly so that each coil is 0.5in. long, and the lead-out sections which pass through the board are very short. The lead-out sections also, of course, have the enamel scraped away and are then tinned.

L5 is virtually identical with L1 and L3, the only difference being that it does not have a tapping point. L6 is very similar to L5 but has exactly 5 instead of 4 turns.

L2 is wound on a $\frac{1}{2}$in. length of 7mm. diameter plastic tubing. As was mentioned earlier, this can be cut from a 7mm. former. The winding consists of 20 turns of 0.28mm. diameter (or 32 s.w.g.) enamelled copper wire which is tightly scramble-

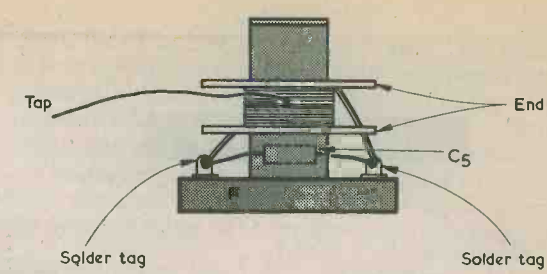


Fig. 4. Detail illustrating the manner in which L4 is wound

wound around the middle of the former. The two coil ends are twisted together close to the winding so that there is no possibility of the coil springing apart. The iron-dust core referred to earlier is fitted centrally in the former. It does not require any later adjustment as L2 is merely an r.f. choke.

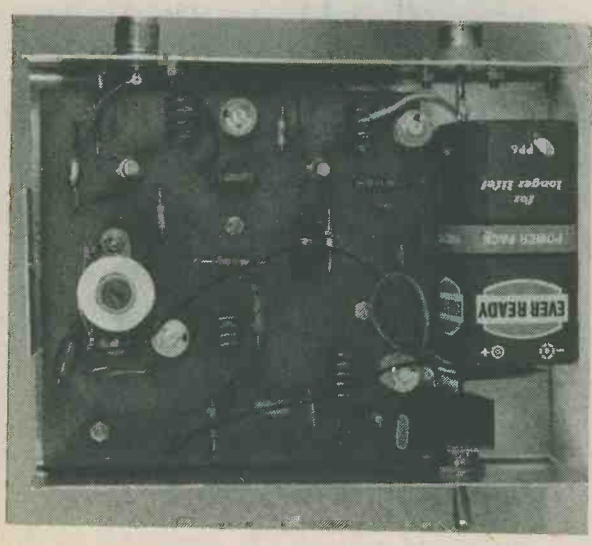
L4 is wound on the Maplin former type 450 using 0.9mm. (or 20 s.w.g.) enamelled copper wire. The coil is illustrated in Fig. 4. The two end cheeks are made from small circular pieces of plastic or s.r.b.p. with a diameter of around 20mm. and a 10mm. diameter hole in the centre. The author used a couple of pieces of plastic which were removed from an old case by means of a $\frac{3}{4}$in. chassis punch. Initially, one of the end cheeks is glued in position towards the bottom of the coil former. A 6BA solder tag is temporarily bolted in place at each mounting hole of the former by means of a short 6BA bolt and nut. The tags take up the positions shown in Fig. 3.

The winding has 6 turns and these are initially slightly spaced out. The ends are soldered to the tags. The insulation is scraped off the wire $1\frac{1}{2}$ turns down from the top of the coil and the exposed copper is tinned with solder. An insulated lead about 35mm. long is soldered to this point, which is the output tapping. Then the second cheek is glued in position, being used to compress the winding so that there are no significant gaps between the turns. Finally, C5 is soldered in position between the two tags.

The printed board has been designed such that, when L4 is bolted in position, the connections between the two ends of the coil and the copper pattern are made via its mounting bolts and nuts. The temporary bolts and nuts used when winding the coil are removed, and the coil is then secured in position on the board with the mounting bolt heads on the copper side. As was stated when circuit operation was described, the tap in L4 is nearer the end of the coil which connects to the drain of TR2. In Fig. 3 the mounting bolt which connects to the drain is the one nearer TR2.

CASE

The converter is housed in the metal case type BV3 and the general layout, which is very simple, can be seen in the photographs. The board is secured to the bottom of the case with three 6BA bolts and nuts, short metal spacing washers being fitted between the case bottom and board underside to prevent short-circuits to the case surface.



The printed circuit board fits comfortably into the ready-made metal case, leaving adequate room for the battery

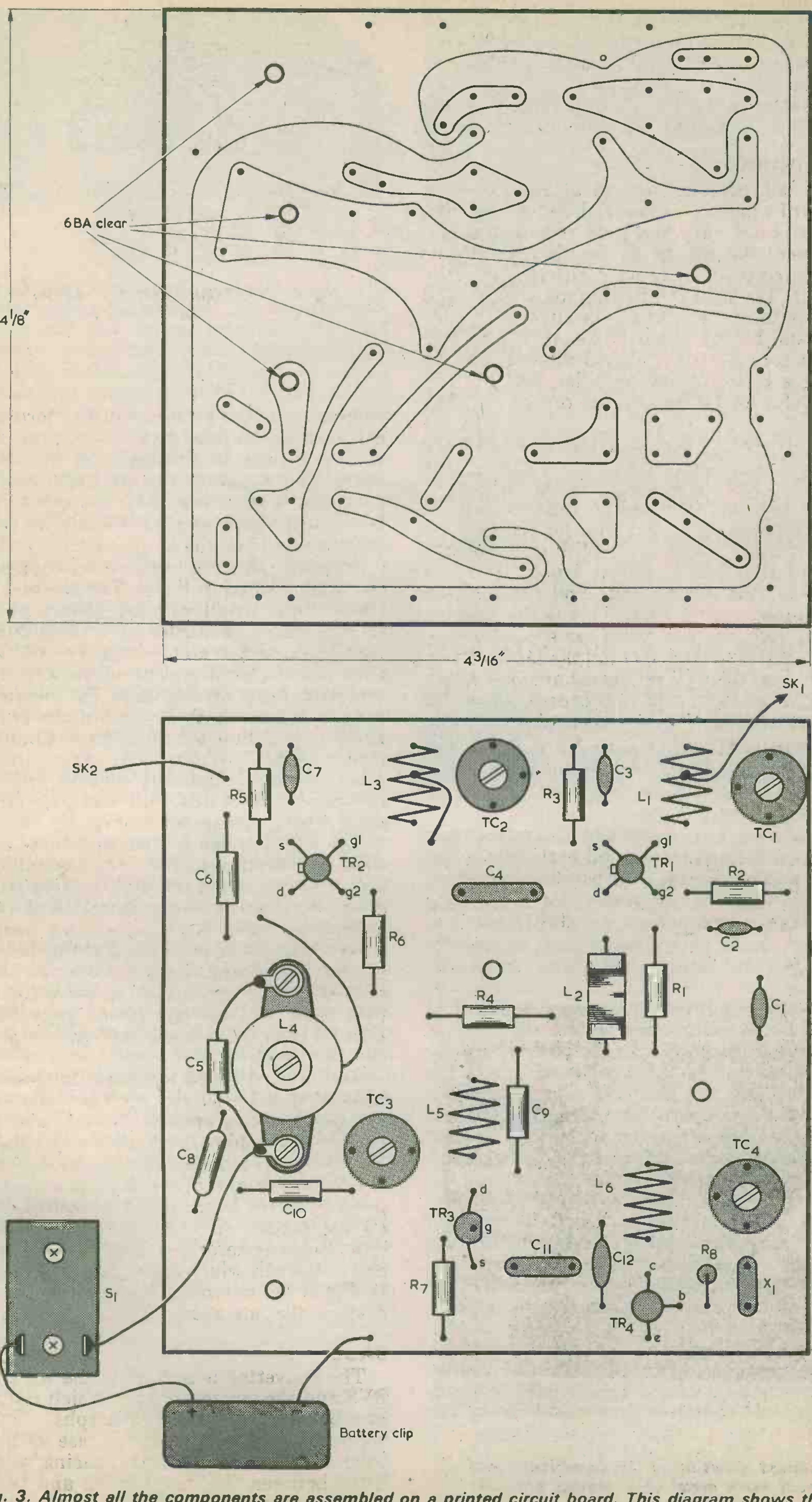


Fig. 3. Almost all the components are assembled on a printed circuit board. This diagram shows the copper and component sides of the board, and is reproduced full size for tracing

The input and output coaxial sockets are mounted on the rear panel

The chassis connection to the board is made via one of these spacers. The board is oriented such that the crystal is to the front near the on-off switch. SK1 and SK2 are coaxial sockets mounted symmetrically on the rear panel. SK1 is positioned near TC1 and SK2 near C7. The connection to the outer contact of each is via the chassis and its mounting bolts and nuts. The battery may be held in place when the case lid is screwed on by a piece of foam plastic fitted between its upper surface and the lid underside. Alternatively, a simple clamp can be devised.

A metal case is necessary to ensure that all the circuitry is screened, thereby minimising breakthrough in the 28 to 30MHz range.

ADJUSTMENT

Any normal type of v.h.f. aerial can be connected to SK1, and for local reception a simple telescopic or dipole aerial is quite suitable. A 2 metre dipole has an overall length of 38½in., and the elements are each 19in. long. It is preferable for the aerial to be mounted fairly high up, and it is connected to the converter via a length of 75Ω coaxial feeder. The feeder is terminated at an ordinary TV aerial type of coaxial plug, which is fitted into SK1.

The converter is connected to the receiver by a short length of 75Ω coaxial cable, and the outer braiding of this is connected to the chassis of both the converter and the receiver. This must be a screened cable in order to minimise i.f. breakthrough, and it should be as short as possible to reduce losses and detuning effects due to its self-capacitance.

Initial setting up involves the measurement of battery current. A multimeter set to a high current range is inserted in series with the positive supply lead. The converter is then switched on. If the meter reading indicates that it is safe to do so the converter is switched off, the multimeter set to a current range which allows clear readings around 10mA, and the converter is then turned on again. A reading of approximately 10mA should now be given.

Adjusting TC4 should result in some variation of the reading, with there being a range of settings where there is a reduction in the current consumption. This is where the oscillator circuit is operating, and TC4 should be set towards the centre of this range.

If a suitable signal generator is available this can be used to feed a signal in the 144 to 146MHz range into the aerial circuit of the converter. The resultant heterodyned signal is then tuned in on the receiver after which L4 core, TC1 and finally TC2 are adjusted to peak the signal. TC3 can also be set to a peak level, but this will not be its final setting.

It will be found that the test signal can be received at two settings of the receiver dial, these being spaced equally on either side of 29MHz. One signal is produced by the desired combination of the 116MHz oscillator signal and the aerial signal, whilst the other is the combination of the third harmonic of the 58MHz oscillator and the aerial signal. The 174MHz harmonic produces spurious responses with aerial signals of 146MHz to 144MHz as the receiver is tuned from 28MHz to 30MHz. There is obviously no way of reducing these spurious responses by improving the front end selectivity, since they are generated by the same range of frequencies which offer the required responses.

However, the responses can be minimised by adjusting TC3 to null the crystal third harmonic. The receiver is tuned to a spurious response from the test signal after which TC3 is adjusted to the null point. This point is very well defined and is just slightly off tune from the point where TC3 peaks the spurious response. Provided the adjustment is carried out correctly, the spurious response should be some 40dB or more down on the main one.

It should be found that the gain of the converter can be improved by adjusting TC4 towards the point where oscillation ceases. Be careful not to adjust TC4 too close to this point though, since this could cause the oscillator to be unreliable and it may not start when the unit is switched on. If the setting of TC4 is altered, then TC3 will need some slight readjustment.

Should a suitable signal generator and a multimeter not be available then the initial adjustments become largely a matter of trial and error, with the trimmers being tried at various settings and the band being searched for a transmission to act as the test signal. TC4 should be adjusted for almost maximum capacitance, whereupon the oscillator should then operate. The core of L4 can be peaked for maximum noise output from the receiver at first. When a suitable transmission has been located, the unit is adjusted in the manner just described.

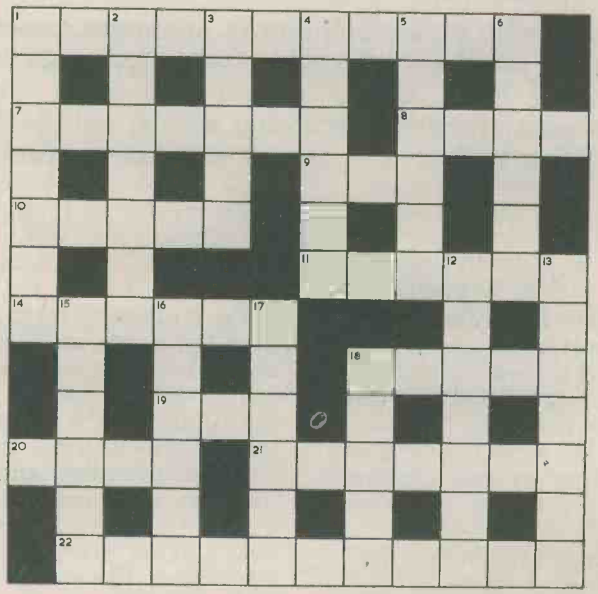
If a comparatively long cable is used between the converter and the receiver it may be found that the core of L4 has to be almost fully unscrewed in order to peak sensitivity. This condition can be corrected by reducing the value of C5 to 39pF.

■

Editor's Note. Since this article was prepared for the printer it has been found that difficulty may be experienced in obtaining the HC-25/u crystal specified. An alternative is available, in HC-18/u, from P. M. Electronic Services, 7A Arrow Park Road, Upton, Wirral, Merseyside L49 0UB. The HC-18/u crystal has lead-out wires which may be soldered directly to the printed board.

CONSTRUCTOR'S CROSSWORD

Compiled by J. R. Davies



CLUES ACROSS

1. Rubicon sham reveals frequency division. (11)
7. Burnt-out component defeated. (7)
8. Connector once known as a puff. (4)
9. Employ in humorous effect. (3)
10. Applies to ancillary extra. (3-2)
11. Enlist with the short wave enthusiasts. (6)
14. Too many of these can form hum loops. (6)
18. Light diffractive device. (5)
19. Prefix, a muddled one, indicating newness. (3)
20. Ordered set of binary digits. (4)
21. It revolves, yet is the same both ways. (7)
22. We are all subject to this pressure. (11)

CLUES DOWN

1. This battery actually accumulates electricity. (7)
2. Little 'orror of a discharge device. (7)
3. Chassis edge tied up with strings? (5)
4. Booklet descriptive of organ key-board tuning? (6)
5. Natural logs of voltage ratios. (6)
6. A pair in connection. (6)
12. Con-artist in the crystal microphone. (7)
13. Pertaining to figures. (7)
15. Visual static display of north-seeking polarity. (6).
16. Double-cycle effect given by two stages in cascade. (6)
17. Pants which can cause sudden surges. (6)
18. Musical frequency. (5)

(Solution on page 376)

HIGH RATIO VARICAP DIODES

By W. Poel

Part 1 (2 parts)

Varicap diodes with high maximum to minimum capacitance ratios can control tuned circuits over a wide frequency range, including the full medium wave band. Our contributor discusses present performance and, in next month's concluding article, will describe an a.m. tuner incorporating a single i.c. and having full varicap tuning.

It is still a little known fact that relatively low cost varicap diodes for tuning the lower frequency bands have been on the market now for some two years. This is surprising bearing in mind the large number of advantages accruing from the use of such devices, as opposed to the more conventional mechanical counterparts. One or two constructional features employing the diodes have been published, but really nothing too elaborate.

Varicap diodes present a high capacitance at low reverse voltages and low capacitance at high reverse voltages. Historically, the early high capacitance ratio diodes — those having a ratio of high to low capacitance in excess of 15:1 — were costly to manufacture, highly individual in characteristics and certainly very expensive. £7 per diode was about average. However, Motorola's ion implantation technique as applied to the MVAM capacitance diode series has revolutionised production, producing high volumes of closely matched diodes at a price which is now competitive with any of the mechanical means of achieving three-gang tuning of radio frequency circuits.

VARICAP PRINCIPLE

The basis of operation is quite easy to grasp. The varicap diode junction is reverse biased so that no current flows, and there is a depletion layer at the junction between mobile charges. Increasing the reverse voltage increases the thickness of the depletion layer. Since capacitance can be demonstrated to increase by bringing two conductors closer together then it is simple to extend the idea to include the diode conducting areas on either side of the depletion layer. The diode capacitance increases when the depletion layer reduces in width, and it becomes smaller when the depletion layer increases in width. Here is our basis for the tuning of radio frequency circuits by means of a d.c. potential.

Fig. 1 demonstrates a typical design for a v.h.f. tunerhead, an application where varicap diode tuning has been known for some five or six years. A tuning voltage ranging from 2 to 16 volts controls the tuning of the signal tuned circuits as well as that of the oscillator tuned circuit.

A much smaller capacitance change is needed to tune the v.h.f. band than is necessary for tuning the medium wave band, and technology has been well able to provide suitable varicap diodes for some time. The spread of the f.m. Band II is only 88 to 108 MHz, or 20 MHz. The ratio of the band (20MHz) to the highest frequency (108MHz) is only 0.18.

On medium waves the band extends from 525kHz to 1,605kHz. This gives a spread of 1,080kHz and a ratio of 0.67. The range of the necessary tuning capacitor swing is consequently far greater.

Typical U.K. standards for the medium wave band are 366pF tuning capacitors combined with 160μH oscillator coils, and an intermediate frequency of 470kHz. The oscillator range is consequently set to be 525 plus 470kHz to 1,605 plus 470kHz, which equals 995 to 2,075kHz.

From

$$C=\frac{1}{(2\pi f)^2L}$$

we find that at 995kHz the capacitance total needs to be 160pF and at 2,075kHz it needs to be 36pF.

At signal frequencies an inductance of around 330μH is employed, leading to a tuning capacitance at 525kHz of about 300pF and at 1,605kHz one of 30pF. Thus with the 366pF gang, and taking into account residual capacitance of about 12 to 20pF for an average design, the medium wave band is covered with a substantial margin of overlap. Obviously it is possible to tune the band with a smaller capacitance swing, but

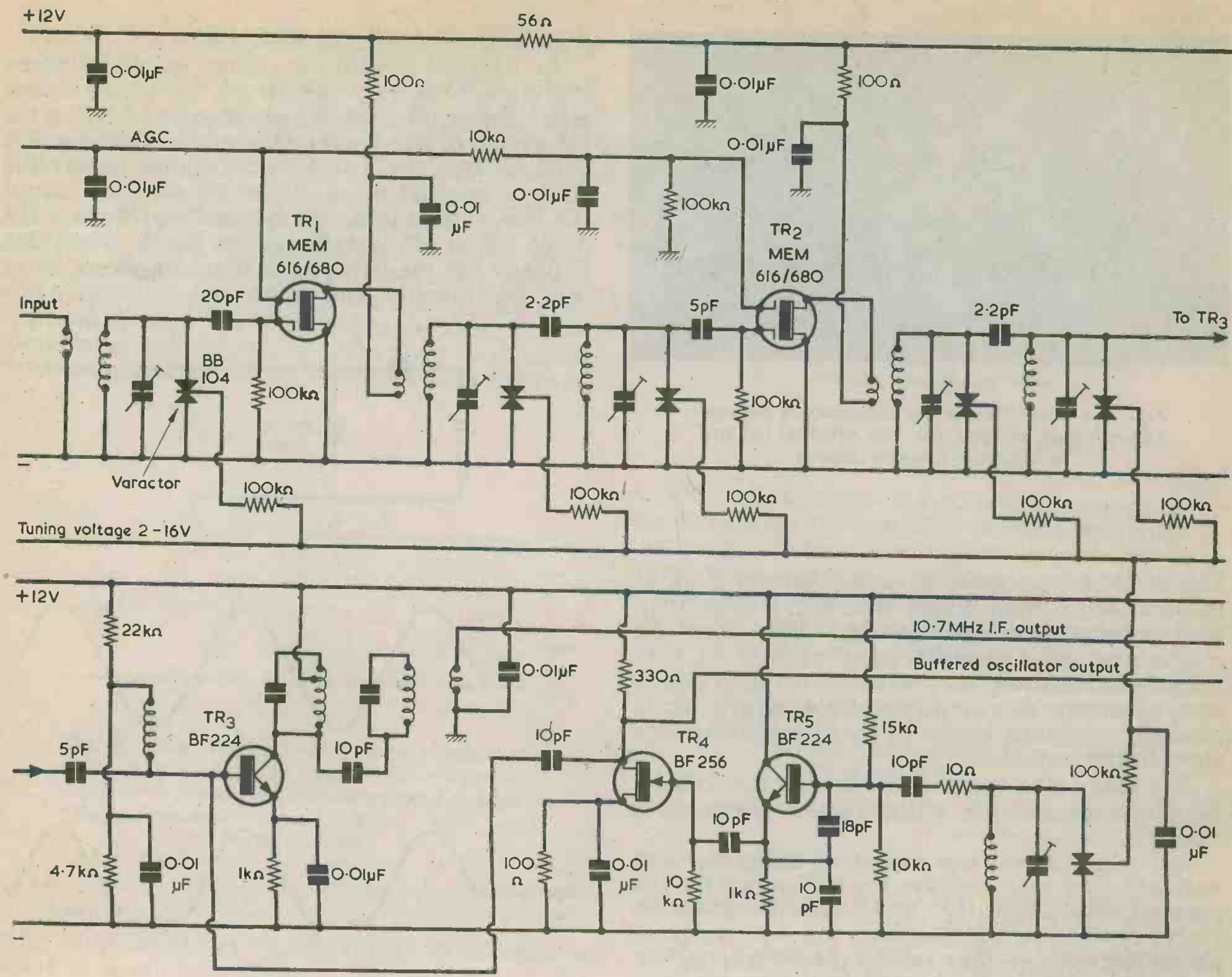


Fig. 1. A comprehensive v.h.f. tunerhead for Band II f.m. reception. TR1 and TR2 are r.f. amplifiers, with TR3 as mixer. The oscillator is TR5, with TR4 functioning as a buffer amplifier. All resonant circuits are tuned by varicap diodes

then stray capacitance can become the limiting factor, restricting the coverage of the higher frequency end of the band. Since the oscillator capacitance swing is so much less than the signal frequency capacitance swing, a series padding capacitor of about 270pF can be used to reduce the oscillator tuning range so that it tracks with the signal frequency range. Trimmers are obligatory in the circuits to "take up the slack" and ensure accurate tracking. The basic signal frequency and oscillator tuned circuits are shown in Fig. 2.

The same approach and formula can be used to determine L and C values anywhere in the r.f. spectrum, and the widespread availability of scientific calculators should make life a lot easier for the would-be tuned circuit designer.

DESIGNING WITH VARICAPS

The wide range varicaps used for tuning the medium wave band are available in two basic forms, both with a similar capacitance range, but the MVAM115 uses a 15 volt maximum tuning bias as opposed to the 25 volts of the MVAM125. The curve of capacitance versus voltage is shown in

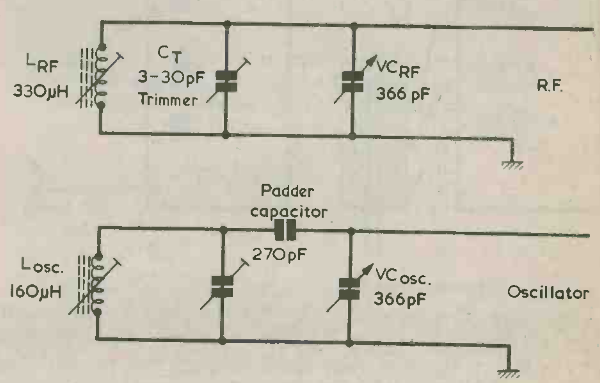


Fig. 2. Basic medium wave tuning circuits for r.f., or signal frequency, and oscillator frequency. The padder capacitor enables the oscillator circuit to track with the r.f. circuit.

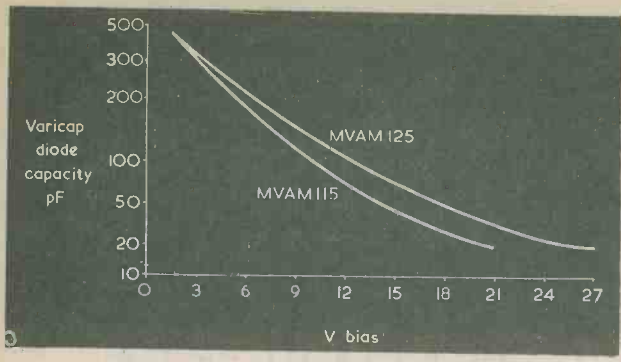


Fig. 3. Curves illustrating capacitance change against bias voltage for the MVAM115 and MVAM125 varactor diodes

Fig. 3. There is a residual capacitance of 20pF at the maximum bias, which is rather greater than with most mechanical systems. But since the mechanical gang capacitor may need to be connected via relatively long wires to the tuned inductors, a considerable saving on circuit strays can be made by designing layout so that the varicaps are close to the inductors.

The long leads can then be on the d.c. control bias lines instead. Fig. 4 illustrates a comparative example.

It is the convenience aspect of designing with varicaps that really makes the difference for the amateur constructor. R.F. and oscillator circuits no longer need to be painstakingly set out alongside the tuning gang — they can be placed where they are most conveniently located in the layout, and fed from d.c. bias that is independent of the layout considerations that afflict r.f. circuits.

The electrical considerations of the circuit are broadly the same as for the previously worked example. Just remember the higher residual capacitance, and use a value of oscillator coil that will permit latitude of adjustment.

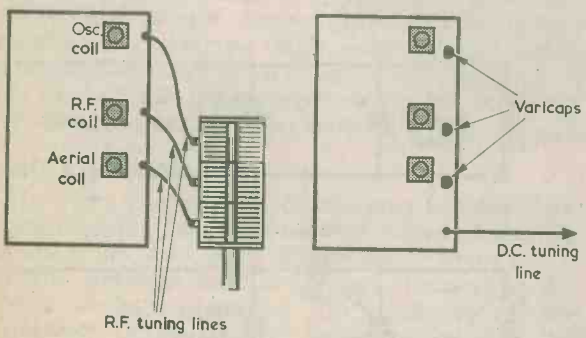


Fig. 4. With conventional mechanical tuning, as on the left, relatively long wires are needed to connect the coils to the tuning capacitor. Varactor diodes can be mounted close to the coils they tune, and the d.c. tuning line can have any length

SHORTCOMINGS OF VARICAPS

As with all good things, there are some shortcomings. However, none are so drastic as to outweigh the advantages. The primary problem is the behaviour of the diodes at low bias voltages of 2 volts or less. In an oscillator tuned circuit the chances are that the oscillator voltage may exceed the bias voltage and thus become rectified by the diode action of the varicap. See Fig. 5. When this happens the oscillator may stop altogether, or at least become distorted and noisy.

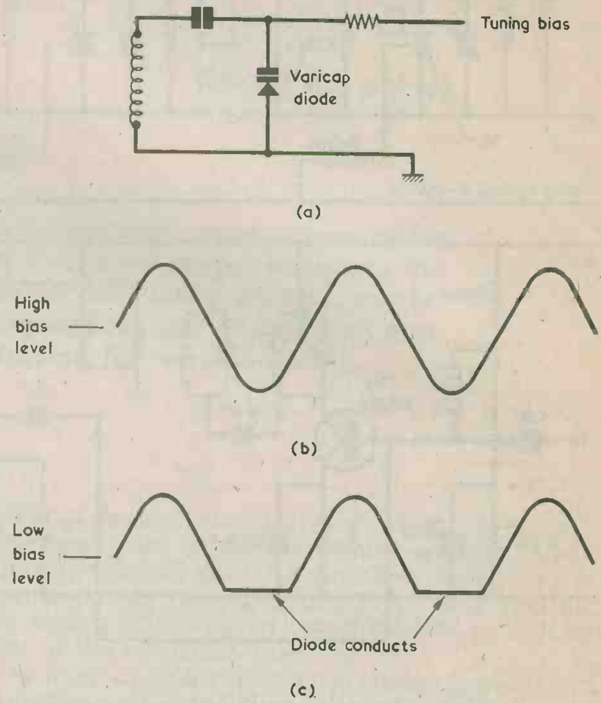


Fig. 5(a). A varicap diode is coupled to the coil it tunes by way of a d.c. blocking capacitor, and the tuning bias voltage can be supplied via a resistor. (The varicap diode symbol is an alternative to that shown in Fig. 1.)

(b). A relatively high signal amplitude, as may appear in an oscillator circuit, can be dealt with satisfactorily by the varactor diode when the tuning bias voltage is high

(c). Too low a bias voltage can result in the diode becoming conductive (as a normal silicon diode) over part of each cycle. The result is heavy distortion of the waveform

If this rectification takes place due to high levels of signal in the signal frequency amplification chain then cross-modulation may result, causing the receiver in which the diode is fitted to become unusable under certain circumstances. However, provided the minimum bias voltage is kept to about 2 to 3 volts these problems will not cause serious troubles.

Contrary to popular belief, varicaps do not suffer excessive thermal drift. In fact, the thermal stability of the varicap circuit is quite satisfactory — provided obvious aspects of design, like keeping the oscillator away from sources of heat such as power regulator stages — are taken into consideration.

An important point to watch for is tuning voltage stability. Up to frequencies of about 4MHz a very small ripple on the tuning voltage will be unnoticed, but circuit requirements become more stringent at the higher frequencies. The span of 15 volts given with the MVAM115 could for instance tune a range of 16MHz in the 14 to 30MHz band. With a channel spacing of some 4 to 6kHz this represents about 3,200 discrete channels. Such conditions call for absolutely stable tuning voltages and a high degree of resolution in the tuning potentiometer system. A ten or twenty turn potentiometer is obligatory and, even then, a separate fine tuning control is a useful idea. This is shown in Fig. 6.

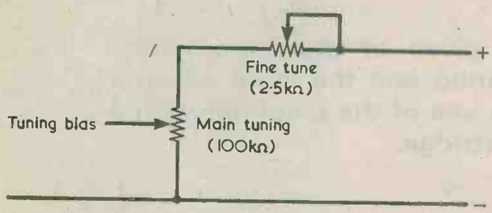


Fig. 6. When tuning over a large number of channels it is helpful to have a fine tune potentiometer in series with the main tuning control. The component values shown here are representative

At high frequency tuning ranges it is perhaps wiser to employ the 25 volt bias versions of the varicaps, since any ripple on the tuning voltage has proportionately less effect in terms of capacitance variation. Remember, too, that large values of decoupling capacitance may not be employed after the tuning potentiometer since these will slug the tuning rate, and the consequent slow change in tuning voltages will make the unit impossible to tune with any degree of accuracy. In Fig. 7 there is

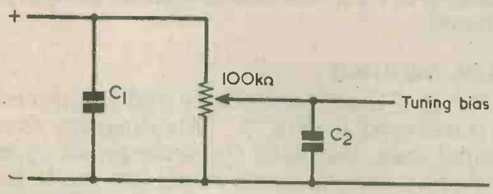


Fig. 7. In this tuning control circuit C2 must not have too high a value or control will be sluggish

no limit on the value of C1 but the maximum value for C2 is 0.1μF. But then, the high impedance on the tuning voltage line also makes it susceptible to the pick-up of hum and noise, much as with a high impedance audio line. In other words there is a slight dilemma, which can be resolved by using an emitter follower to lower the impedance, as in Fig.

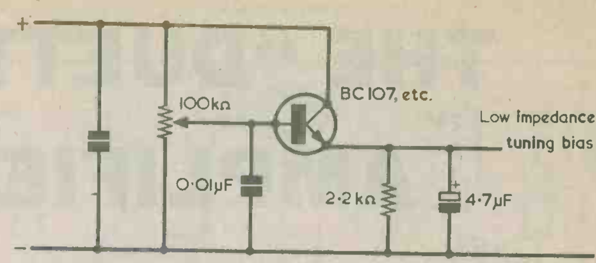


Fig. 8. An emitter follower after the tuning control permits the use of larger bypass capacitors on the tuning bias line

8. This will increase the current consumption of the circuit slightly but the lowered impedance of the tuning voltage line nevertheless makes it a worth-while addition. The thermal characteristics of the emitter follower lead to drift in the tuning unless care is taken to isolate the device as far away from heat as is possible.

And so, the arrangement we finally arrive at as being the ideal for tuning varicap diodes is that shown in Fig. 9.

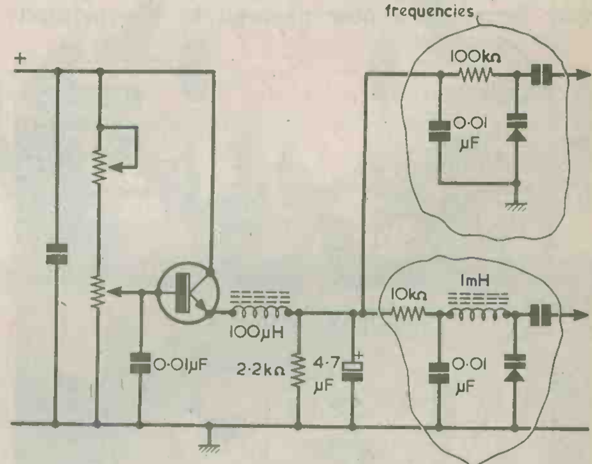


Fig. 9. A very good arrangement for controlling varicap diodes, showing alternative circuits at the diodes themselves for high and low frequencies. The 100μH choke cuts out h.f. noise

Readers familiar with the various techniques employed in optimizing r.f. circuitry will probably have thought up one or two other ideas, such as decoupling the feed resistor with 100pF to help cut out v.h.f. "spurii". But the number of such minor details is endless, and so the theory must stop here for the time being. Next month we shall move on to the application and consider a practical unit incorporating high capacitance ratio varicap diodes.

(To be concluded)

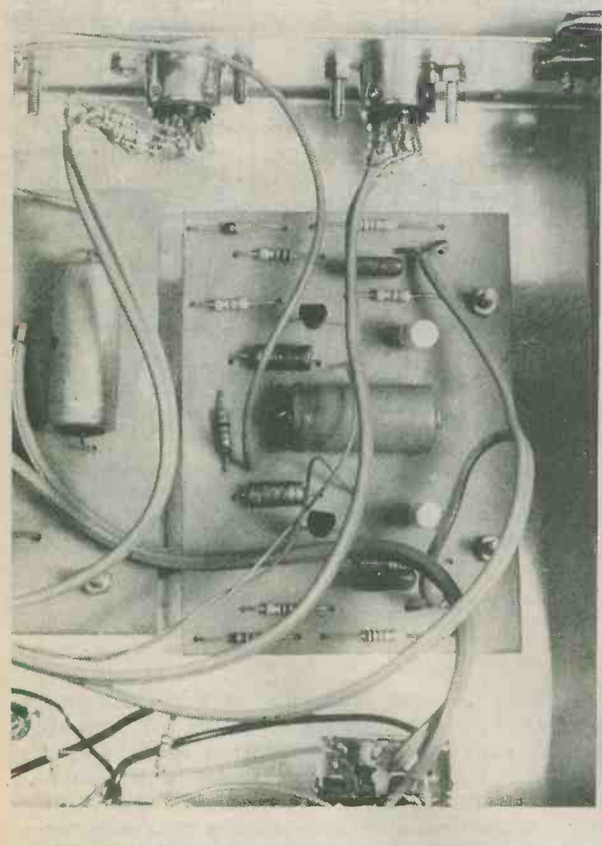
THE "DUETTE" STEREO AMPLIFIER

Part 2 (conclusion)

By R. A. Penfold

In this concluding article details are given of the pre-amplifier printed circuit board, the tone control wiring and the input selector switch connections. Also discussed is the use of the amplifier with a high output gram cartridge.

In Part 1, published last month, the circuit functioning of the stereo amplifier was described, followed by constructional details for the case, the power amplifier printed board and the power supply board. We now proceed to the printed board on which the pre-amplifier circuitry is assembled.



The pre-amplifier board. This has two identical channels, each incorporating an f.e.t. amplifier

PRE-AMPLIFIER BOARD

The pre-amplifier board is illustrated full size in Fig. 8, which shows both the copper pattern and the component layout. This printed board assembly is constructed in the usual way. It is mounted in the same manner as the previous two boards, using ½in. metal spacers on the mounting bolts. However, it cannot be finally fitted in position until it has been connected to the rest of the amplifier. It is oriented such that its two mounting holes are furthest away from the power amplifier.

A twin stereo screened cable connects the pre-amplifier panel to S1, and the braiding of its leads is earthed at the board only. Although the channels on the pre-amplifier board are identical it will be found helpful to assume that the components with the suffix "(a)" are in the left hand channel. The wires passing to C13-R15 and to C13(a)-R15(a) are not screened.

CONTROL WIRING

The wiring of the tone, balance and volume controls is illustrated in Fig. 9. This diagram shows one channel only, but both channels are of course the same. The chassis connections are made to a 6BA solder tag which is mounted on the base of the chassis between, and just to the rear of VR1 and VR4. A 6BA clear hole has to be drilled for the 6BA bolt and nut which secure this tag.

Construction of this part of the unit will be found easier if the front sections of the dual gang potentiometers are wired up first. Try to keep the wiring reasonably short and direct. The tags of the potentiometers and the ends of component lead-out wires should be well tinned with solder prior to making a connection. To maintain the channel routing, the front sections of the dual gang potentiometers can be made the right hand channel and the rear sections the left hand channel. Reference to the circuit diagrams of Figs. 1 and 2, which were published last month, will assist when wiring up the components around the balance control.

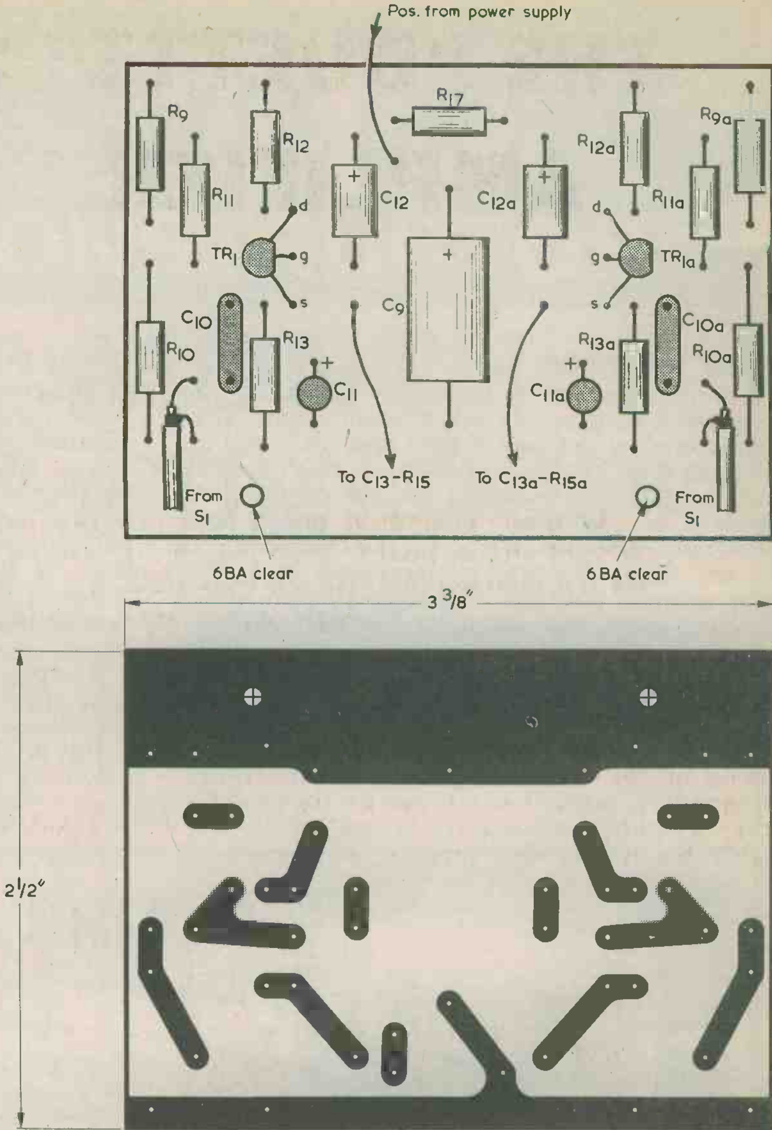


Fig. 8. The pre-amplifier board, reproduced full size for tracing. As will be noted, the board holds two identical channels

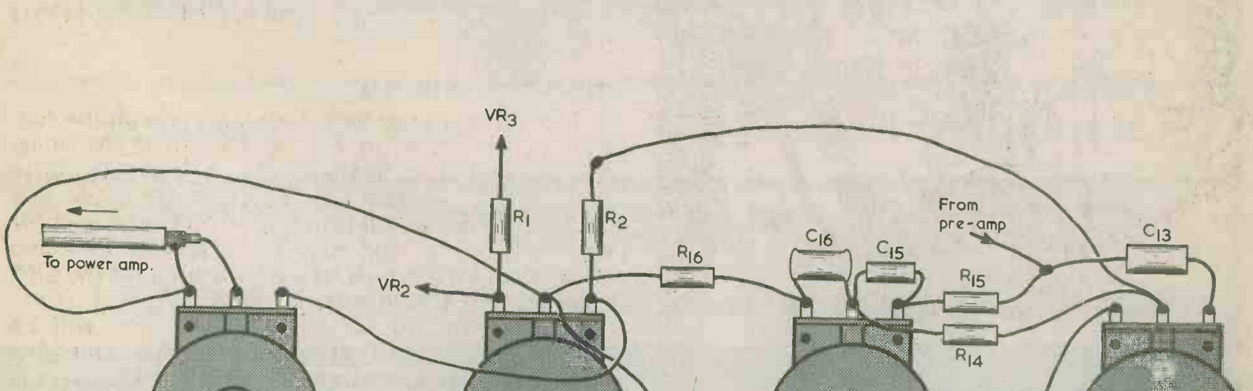


Fig. 9. Wiring up the volume, balance and tone controls. These are shown for one channel only

Another view of the completed stereo amplifier. The legends on the front panel are taken from Panel-Signs. Set No. 4

INPUT SELECTOR

The input wiring is illustrated in Fig. 10. The resistors making up the four attenuators are wired up directly on the tags of SK4 and SK5, and the lead-out wires of these resistors must be cut fairly short so that this wiring is reasonably rigid and there is no significant pick-up of mains hum. Although not shown in Fig. 10, the connections to S1 are made by way of screened wire. The attenuators at SK5 are connected via twin stereo screened cable, the attenuators at SK4 are connected via a second stereo screened cable, and SK3 is connected via a third stereo screened cable. The braiding of each cable is earthed at the appropriate input socket.

GRAM INPUT

The gram input has quite a high sensitivity, but some crystal and ceramic cartridges provide a nominal output level of only about 50 to 100mV r.m.s., and so these have to be catered for. If, however, the amplifier is to be used with a medium or high output cartridge it would be advisable to add an attenuator at the gram input, as otherwise there is the likelihood that the signal will be clipped at the output of the pre-amplifier, with the reproduced signal quality being extremely poor in consequence.

An attenuator for each gram channel could easily be wired up on SK3, in exactly the same manner that the existing input attenuators are wired up on

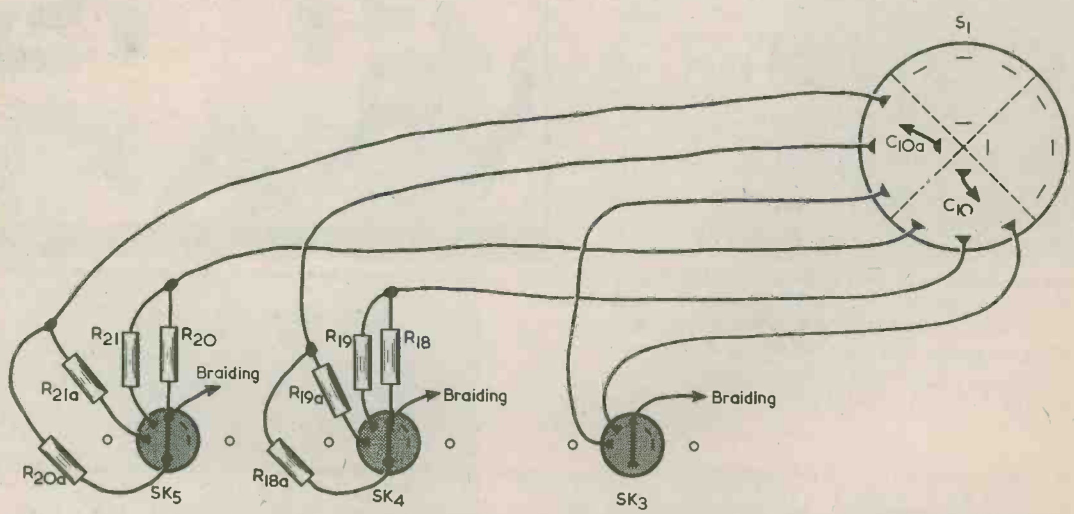


Fig. 10. The input selector wiring. Before connecting to S1 confirm the three outer tags which correspond to each centre switch arm tag; their relative positioning may differ with some switches

As a final detail a couple of bands of insulating tape can be used to hold together some of the many connecting cables, so that a neater interior finish is obtained. These bands of tape can be seen in the photograph of the interior which appeared in last month's issue.

The completed amplifier requires no adjustment whatsoever and so, once the unit has been completed and thoroughly checked for errors, it is ready for a practical test.

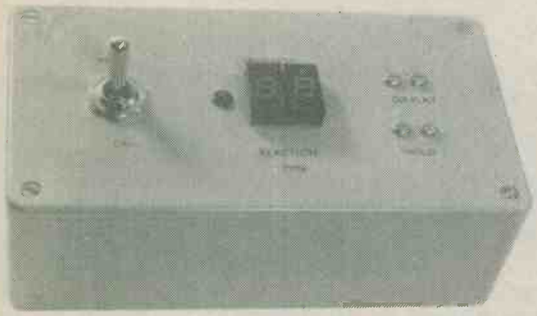
SK4 and SK5. Suitable resistor values would be 820kΩ for the series input resistors, and 270kΩ for the following shunt resistors. This would leave the input impedance at its previous level of about 1MΩ but would reduce the input sensitivity to approximately 200mV r.m.s. for 2 watts output. About 1.6 volts r.m.s. would then be needed in order to seriously overload the pre-amplifier, and it is unlikely that any cartridge would supply such a signal.

(Concluded)

RADIO & ELECTRONICS CONSTRUCTOR

NEXT MONTH

DIGITAL REACTION TIMER



- ☆ 2 DIGIT DISPLAY READING UP TO 0.99 SECONDS
- ☆ SIMPLE CIRCUIT ONLY 5 ACTIVE DEVICES
- ☆ POWERED BY A 9 VOLT BATTERY!

C. W. FILTER UNIT

NEEDLE-SHARP c.w. tuning can be achieved with this selective a.f. filter design.

A high Q pot core coil assembly is employed, and two filter frequencies are available.

STOP THE SHOPLIFTER!

An inexpensive alarm unit which, by causing a bell or buzzer to sound, protects items on display whether in a shop or in the home.

PARALLEL — R BOX

NOVEL A.F. OSCILLATOR

MANY OTHER ARTICLES

ON SALE 2nd FEBRUARY **Avoid disappointment. ORDER NOW**

BACK NUMBERS

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

We retain past issues for a period of two years and we can, occasionally, supply copies more than two years old. The cost is 58p, inclusive of postage and packing.

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

'NOTES FOR NEWCOMERS'

Chassis, Earth and Ground

By D. F. Thomas

If you make a connection to the metalwork of a piece of equipment, does that connection go to "chassis," "earth" or "ground"?

An aspect of electronics which can confuse the beginner is the apparently indiscriminate usage of the terms "chassis," "earth" and "ground." Sometimes they appear to refer to the same thing and sometimes they seem to refer to quite different things.

In one text you may find that all the connections to the metalwork of a piece of equipment are described as being "connected to chassis," and in another you may find that they are "connected to earth." Then in a third text you may encounter the statement that an equipment "chassis is not earthed"!

There is, in addition, the mysterious "ground" which quite often crops up in technical literature. Things are described as being "connected to ground" or as being "grounded."

"EARTH" AND "GROUND"

We can clear up the terms "earth" and "ground" without delay, since they both mean exactly the same thing. "Earth" is the term mainly employed in Britain whilst "ground" is almost invariably used in the U.S.A. Nowadays, the word "ground" is being used more and more in the U.K., partly because we have employed a lot of American designed devices, such as integrated circuits, for which the technical references include the word "ground." But, to reiterate, there is no difference in meaning between the two terms. If this article were to appear in an American magazine all the remaining section of it would use the word "ground" instead of "earth," simply because American readers are more used to the term.

Dealing next with symbols, Fig. 1(a) shows the circuit symbol for "earth" and Fig. 1(b) that for "chassis." Often, and particularly in service manuals, the chassis symbol consists of a broad horizontal line, as in Fig. 1(c).

We now come to "chassis" and "earth" and here we do encounter conflicts of meaning. In general, virtually all electrical and electronic systems have a metal framework which provides a common reference or connection point for all the stages and sections of the system. We frequently refer to this as the "earth" of the system, even when it is not actually connected to earth. A common example is encountered in car electrics, where the metal frame of a car is referred to as "earth," despite the fact that the framework is well and truly insulated from the actual earth by four rubber tyres.

In early domestic radio receivers in the U.K. the same thing applied. Many of these sets were built like battleships with heavy metal chassis, and the chassis provided the "earth" of the receiver. A connection to the chassis was a connection to "earth." In practice the chassis was frequently connected by a wire to the actual earth itself by way of, say, a length of copper tubing driven into the soil.

Fig. 1(a). The circuit symbol for earth

(b). A common symbol for chassis

(c). An alternative chassis symbol, frequently encountered in service manuals

(a) (b) (c)

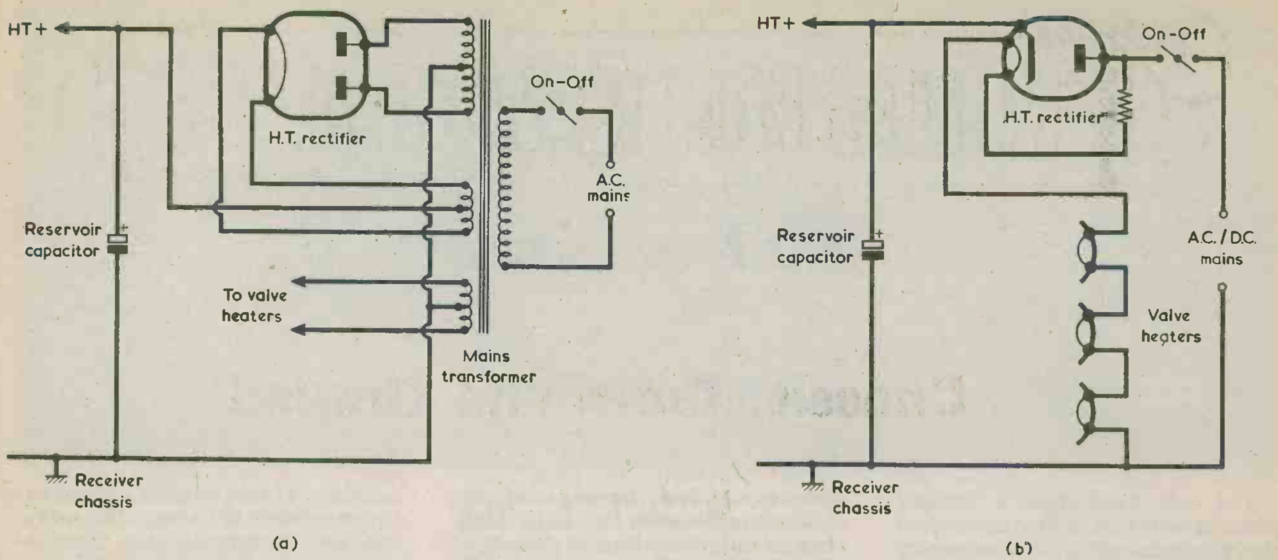


Fig. 2(a). An example of a valve receiver a.c. mains supply incorporating a mains transformer

(b). A power supply without a transformer. This early circuit could operate from d.c. as well as a.c. mains supplies, and there is a direct connection between the receiver chassis and one side of the mains

MAINS-DRIVEN RADIOS

The first a.c. mains-driven radios had mains transformers with separate h.t. and heater secondaries, as shown in Fig. 2(a), and again the receiver chassis could be directly connected to earth. Then along came "transformerless" receivers in which, to reduce costs, the mains transformer was omitted and the chassis was connected directly to one side of the mains, as in Fig. 2(b). The chassis was housed in a wooden or plastic cabinet and was completely enclosed to prevent its being touched and thereby imparting a shock. Usually, the mains supply lead had two wires only, so that it was just as likely that the receiver chassis could connect to the live side of the mains as to the neutral side. This practice continued with television receivers, with the result that nearly all domestic mains-driven receivers in the U.K. had chassis which could connect to either the live or the neutral side of the mains. These receivers were largely responsible for the replacement of the term "earth" by "chassis" for the common connection point.

Now, there is nothing wrong with referring to the chassis of a motor car as "earth," because it is merely insulated from earth and is not connected to anything else. But it is quite another thing to refer to a receiver chassis as "earth" when that chassis can connect to a voltage which is actually *lethal* with respect to earth! This is when the use of the word "chassis" started in earnest, and was applied to connections to the chassis of receivers of this type.

Those old mains valve radios are now almost a thing of the past, although there are still very many "live chassis" TV sets around. And so the term "earth" is creeping back again, at least so far as connections to a radio receiver chassis are concerned. Indeed, some of the smaller items of equipment don't have a metal chassis at all, consisting as they do of a printed board fitted in a plastic case. If these are battery operated, the "chassis," or "earth," may simply be the negative supply rail or the positive supply rail.

And that, in general, sums up the situation. If a piece of equipment has a chassis or metalwork which is actually connected to earth, connections to it can be described as connections to "earth" or connections to "chassis." A similar situation arises when the chassis is not connected to earth but is also not connected to anything else. But when the equipment chassis connects to one side of the mains the use of the term "chassis" instead of "earth" is almost obligatory, because the chassis is in this instance quite dangerously removed from earth potential. ■

"Mum I've done it. It works!"

Radio Topics

By Recorder

★★★★★★★★★★

Did you know that a straight piece of wire has inductance? And that this inductance increases as the wire gets thinner?

These are just two of the many little facts concerning inductance that one bumps into when working in radio and electronics. In general, we tend to accept inductance without question but it is an electrical quantity that can play quite a few tricks on us if we don't take appropriate precautions. When it starts to reveal what are usually hidden effects, inductance can be much more mischievous than the other two foundation stones of electronics — capacitance and resistance.

INDUCTANCE

The electrical properties of inductance are just the opposite to those of capacitance. After settling down following the initial connection, an inductance acts, at d.c., as a length of wire (actually, the wire with which it is wound) whilst a capacitor acts as an open-circuit. At a.c. the reactance (very roughly "a.c. resistance") of an inductance increases as frequency increases whilst the reactance of a capacitance decreases with increase in frequency.

A capacitor tends to oppose a change of voltage across its plates, and an inductor, or coil, tends to oppose a change in the current flowing through it. When a sinusoidal alternating voltage is applied to a capacitor the resultant current leads the voltage by 90 degrees (one quarter of a cycle), but in an inductor the current lags by 90 degrees on the voltage. This is fairly easy to visualise: if you connect a battery via a series resistor to a capacitor the initial current is high and then reduces as the voltage across the capacitor increases; change the capacitor for an inductor and the initial current flow is low, rising as the voltage across the inductor increases.

It is not difficult to make a capacitor which is very close to being an "ideal capacitor", i.e. a capacitor without resistance or inductance and having infinite resistance between its plates. Making an inductor which is close to an "ideal inductor" is much harder. To start off with, the inductor has to be wound with wire, which has an inevitable resistance, and there are bound to be stray capacitances between turns. Additional factors accrue if the inductor has a ferrite or iron-dust core, or has a laminated core as has a mains transformer. The permeability of all these cores varies according to the current which flows in the inductor and therefore changes the inductance. This effect is, fortunately, much too small to be of any significance with coils having ferrite or iron-dust cores which are used in the r.f. and i.f. stages of radio and television receivers, because the currents flowing in such coils are very low. On the other hand it is of considerable importance when high currents flow in the inductor, as occur with ferrite cored tape recorder erase heads and ferrite cored TV line output transformers. Changes in permeability with the laminated cores of mains transformers and the like can be very high, and these have to be taken into account in the design of the transformer.

WIRE INDUCTANCE

And now let us turn to the fact that a straight piece of wire has inductance. At low frequencies this inductance is normally too small to raise any problems but it can become quite a serious matter at v.h.f. frequencies above 50MHz or so. Band III television tuners covering Channels 6 to 13 (175 to 220MHz) use coils in the aerial, oscillator and mixer tuned circuits. If one of these is tuned to Channel 12, inserting half an inch of wire in series can easily make it tune down to the lower frequency Channel 11! Band III coils usually have only three or four turns of wire in them and, with a standard turret tuner, these have to connect to two tags on the turret. It may happen that Channels 6 to 9 can be covered by coils having four turns of wire. Since there has to be a discrete number of turns on each coil so that it can connect to its tags, the reducing inductance as the Channel numbers go up can be provided by increasing the spacing between turns and by using thicker gauges of wire for the coils. If the coils for Channel 10 cannot be wound with four turns, the windings switch for this Channel to three relatively closely spaced turns of thin wire. The large drop in inductance given by going from four to three turns is partly compensated for by the extra inductance of the thin wire. Turret tuners are now, of course, largely obsolescent since current TV manufacture is for the u.h.f. Bands IV and V, which extend from 470 to 855MHz. At these frequencies all attempts at using coils in the aerial, oscillator and mixer tuned circuits are abandoned. The u.h.f. tuned circuits consist of straight Lecher lines and variable capacitors or varicap diodes.

Whilst the inductance of a straight piece of wire is, in general, too low to be very troublesome at frequencies below some 50MHz or so it is still necessary to follow common-sense rules so far as the wiring up of tuned circuits is concerned. It is always very desirable to have short connecting wires between the capacitor and inductor of any r.f. tuned circuit, and the need for such short leads increases with frequency. A long connecting wire may not alter the resonant frequency to any appreciable extent, but it will certainly introduce losses and lower the Q of the tuned circuit. There *has* to be wire in the inductor and it is preferable that there be as little extra wire in the tuned circuit as is reasonably possible.

Another little item to add to the list which qualifies the behaviour of inductors is "skin effect". When a radio frequency current is caused to flow through a wire it sets up magnetic fields in the wire which in turn induce secondary currents which oppose the primary current. The result is that the r.f. current has to flow mainly on the outer surface of the wire, with the result that the r.f. resistance of the wire is quite a lot higher than its d.c. resistance. This skin effect becomes worse as frequency increases, which is one reason why short wave tuned coils are wound with quite thick wire having a large surface area. In the early days of domestic radio Litzendraht multi-stranded wire was introduced to reduce skin effect. This wire, commonly known as Litz wire, has a number of strands of thin enamelled wire woven together in such a manner that each strand comes out to the surface in turn, with the result that all the strands carry the same amount of r.f. current. The theory is that it is then possible to force more r.f. current through the Litz wire than can be passed by a solid wire of the same overall diameter. The Litz wire also reduces discrepancies in current-carrying capabilities along the length of a coil. The theory works very well in practice over a rather limited range of frequencies, and coils wound with Litz wire have a higher Q than coils wound with single wires of comparable diameter. Nowadays, much of the Litz wire employed in electronics is the cheaper "bunched Litz", which does not have the careful weaving pattern of the original Litz formulation but which nevertheless functions very nearly as well.

LIMITED FREQUENCIES

The only snag with Litz wire is that it is only really effective at frequencies from around 200kHz to 3MHz. You will therefore find it mainly in i.f. transformers resonant at around 460kHz and in medium and long wave aerial and oscillator tuned circuits.

The individual strands of Litz wire are insulated from each other except at the ends where they are all soldered together at the coil connection points. If you ever have to resolder a broken Litz wire, you don't need to despair at the thought of cleaning the enamel off all the individual strands before you can solder to them. This *was* necessary in the old days when the wire enamel was oil-based (similar to that employed on most of the enamelled wires sold on the home-constructor market). With present-day Litz wires the strands are covered with "solder-through" enamel, whereupon you merely apply a reasonably hot soldering iron and resin cored solder to the Litz wire ending and all the enamel on the wire strands dissipates into the solder and flux, allowing a satisfactory joint to be made to the copper underneath.

I have only just covered the surface of inductance in these notes, but you will see that it presents quite a complex subject in its own right. Fortunately, the home-constructor can either buy his inductors ready-made or can successfully wind basic coils himself. But it is always a good thing to have an idea of what goes on, even in such simple assemblies as these.

T.T.L. STICKIES

One problem in trouble-shooting or breadboarding t.t.l. circuits is that, unless you're fully conversant with the pin allocations of the i.c.'s, you have to keep referring back to the data books to find which pin does this and which pin does that. A very neat idea to overcome this problem is illustrated in the accompanying photograph. Affixed to the top of the i.c. is an adhesive printed label which indicates at a glance all the pin functions of the i.c. concerned.

These labels are "STICKIES", and are made by Concept Electronics. They have the same size as the i.c. to which they are applied and are available to show pin-outs for the 61 most popular 14 and 16 pin t.t.l. packages. They can be used for constructing and debugging prototypes, fault-finding on production circuits, and even for designing printed circuit layouts. They are also a valuable teaching aid.

Available in sets of 450, "STICKIES" are packed in reusable plastic folders complete with comprehensive instructions. The instructions also give a list of logical equivalents which can be used to extend the range to cover 86 i.c.'s. Further details can be obtained from Concept Electronics, 8 Bayham Road, Sevenoaks, Kent.

JUMPING THE GUN

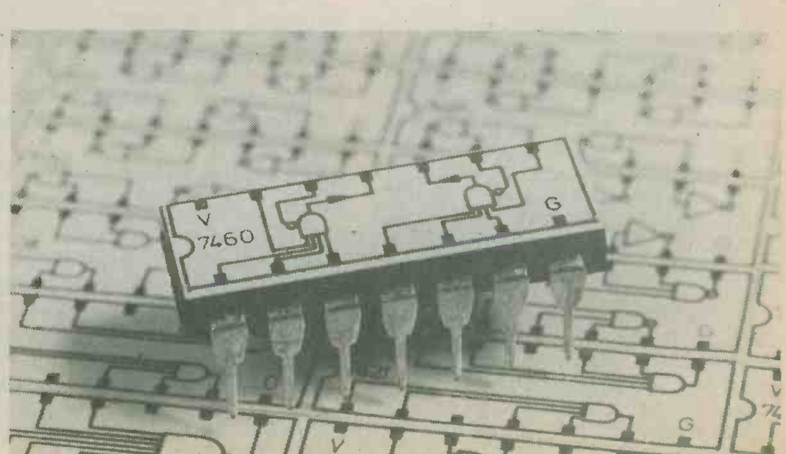
One of the problems of producing a constructional journal is that long articles describing the more ambitious projects have usually to be spread out over two issues. This is of course unavoidable and we ease things by giving as much information as possible on the components that are required in the first part of the article. Such an approach enables the constructor to have all the relevant information on the parts in a single issue.

One of our regular contributors has raised another point concerning articles which appear in two parts. Where setting-up instructions are given it is obvious that these will normally appear in the second part since, by then, all the constructional and wiring details will have been given. There is the possibility that someone, working to the circuit diagram and what constructional details are given in the first part, may build the project and then be unable to set it up correctly. This doesn't seem to be the cause of much trouble in practice, but it might be worth mentioning that it is always best to wait until setting-up instructions appear and are followed before making the assumption that a project can be considered complete.

WATER EARTH

Since 240 volts a.c. can cause a lot of unhappiness if it turns up in the wrong places, I'm rather a fanatic so far as checking the earthing of domestic mains appliances is concerned. Recently, a member of the Recorder family acquired a second-hand electric kettle at a local jumble sale and I decided to test it for safety before anyone put it to use. The 3-core lead and the connector plugging into the side of the kettle seemed to be

How to tell, at a glance, the pin functions of a t.t.l. integrated circuit. Concept Electronics have introduced stick-on printed labels which can be applied to the 61 most popular logic i.c.'s. By taking advantage of equivalents the range can be extended to cover 86 packages



perfectly satisfactory and the kettle looked, indeed, as though it had not seen a great deal of use. Out came the multimeter, to reveal a satisfactory low resistance reading between live and neutral leads and virtually infinity between either of these leads and the earth lead.

I next checked between the earth lead and the metal shell of the kettle. An open-circuit! Complimenting myself on having discovered a possible shock hazard I examined the side of the kettle to see if any connection had come adrift, to find that there simply was no connection to the metal of the kettle.

And then the penny dropped. A check between the earth lead and the metal cover of the heating element inside the kettle revealed zero ohms. The kettle was manufactured such that the metal shell was floating but was earthed, when the kettle was filled, by way of the water in the kettle itself.

I suppose this is a reasonable approach. But what is the situation, I wonder, if we should happen to use the kettle to boil distilled water? ■

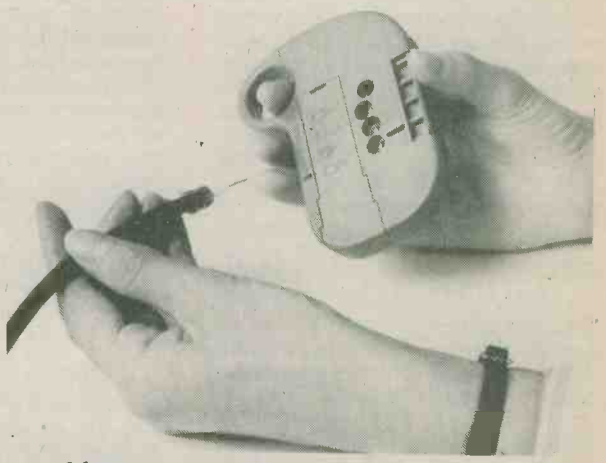
Trade News . . .

AUTOMATED HAND TOOL FOR ACCURATE COAX CABLE STRIPPING

A new hand operated coaxial cable stripper has been introduced by AB Engineering Company under the model number COAX-1. Simple hand pressure ensures fast and accurate stripping of television, telecommunication and other coaxial cables up to 7.5 mm diameter. The tool incorporates four apertures offset to a common cutting blade which when automatically adjusted by means of two screws provides the necessary variation in the depth of cut to:

Aperture one — strips the outer insulation; Aperture two — cuts through the screen and strips the insulation leaving a 7 mm or 12 mm length; Aperture three — strips the dialectric; Aperture four — cuts through the cable.

In use the spring loaded cutting blade is opened by pressure on the handle, the cable inserted and the tool is then spun round and the spring loaded blade pressure is sufficient to complete the cutting and stripping operations.



For economy in use the cutting blade may be adjusted when it becomes blunt. Each blade is guaranteed for a minimum of 150 operations and spare blades are available in packs of ten.

The AB Engineering Coax-1 is ideal for service engineers, small volume workshop levels and production rectification work. Further details may be obtained from AB Engineering Company, Apem Works, St. Albans Road, Watford, Herts.

THE SINCLAIR ENTERPRISE CALCULATOR

What sort of calculator does the British public want? Dual-purpose for desk top or hand-held use; a readable display in any light; long battery life; a full memory, percentage key and, to Sinclair's surprise, a square root facility.

Those were the answers Sinclair received from a nationwide research programme into the non-specialist calculator user market, which the company values at £20 million plus.

The result? A combination of all these requirements — the new Sinclair Enterprise — an all-purpose calculator now available at £9.95 plus VAT. The Enterprise is slimly built for portability; has a big, clear, bright display; well spaced keys and a battery life averaging one year from a standard, readily obtainable, transistor radio battery.

The Enterprise measures 5ins. x 2ins., is ¾in. deep (max) and weighs 4oz. Power is provided by a simple to fit PP3 type battery, with mains power as an option. Features a 'king size' eight digit red display with wide-angle vision under all light conditions.

With a durable satin silver finish, special rubber non-slip feet for desk-top use, the Enterprise has the standard Sinclair 12 month 'repair or replace' guarantee. It is presented in a unique flip-up display box with a detailed instruction book and its own carrying case.

The Sinclair calculator range now comprises the Enterprise, the Cambridge Memory, Universal, Scientific and Programmable hand-held units, the desk-top Oxford Universal and Scientific, and the prestige Sovereigns, available in solid gold, gold and silver plate, chrome and matt black.

In your work-shop

N-STAGE SEQUENCER

Smithy describes a fully electronic sequencer which simply causes a succession of relays to energise, one after the other, with a predetermined time interval between the energising of one relay and the energising of the one which follows.

"My Auntie Eff," said Dick chattily, "had rather an unpleasant accident with her Christmas dinner."

"Did she?" queried Smithy. "What happened?"

"Well, she decided to have a duck this time instead of the usual turkey, and one of her cats, a real mangy old thing, ate a great chunk out of it just after she'd cooked it."

"Dear me," remarked Smithy mildly. "That must have raised a problem for her."

"It did," grinned Dick. "It left her with a duck-filled tatty puss!"

Smithy winced.

"I should have known better," he sighed morosely. "I was hoping you'd be giving up those terrible gags of yours for 1978."

The Serviceman looked around him. This was the first morning of work after the New Year holiday and all signs of the frantic rush before Christmas and the fairly busy subsequent period leading up to New Year's Eve had now completely disappeared. The "For Repair" rack was empty, awaiting the first servicing jobs of 1978, and the Workshop was pervaded with an unstrained and unwonted atmosphere of serenity.

"It seems peculiar," mused Dick, "to think that we are already in 1978. All we do is go trundling through time at a breakneck speed, and the years fall away behind us like leaves in Autumn."

"Blimey, you're getting a bit poetic, aren't you?" remarked Smithy, cocking an eyebrow at his assistant. "So far as I'm concerned I take time as it comes. Life is just a series of sequences following each other."

"Sequences," repeated Dick slowly. "It's funny you should refer to sequences. Over the holiday I heard about a guy who's assembled a whacking great model train layout. When he wants to run it he puts all the trains and signals and points and things through a set of programmed sequences. The idea of the whole thing has stuck in the back of my mind ever since I was told about it."

Smithy's interest was aroused.

"How," he asked, "does he programme the sequences ?"

"Apparently he's made up a tape and plays this through a tape recorder. When something on the model train installation is due to happen there's a short a.f. tone from the tape and this goes through filters and activates the appropriate relay controlling the action required."

"That's one way of running a sequence of operations," said Smithy thoughtfully. "But there's an alternative idea which comes to my mind straightaway. This could consist of a fully electronic sequencer which simply causes a succession of relays to energise one after the other, with a predetermined time interval between the energising of one relay and the energising of the one which follows it."

"How many different steps could you incorporate in a sequencer like that ?"

"As many as you liked," replied Smithy. "There would have to be a starting stage and this would then be followed by a series of identical sequencer stages, each one triggering off the next after a pre-set time delay. At the end would be a finishing stage which, when operated, would turn the whole lot off again!"

"Stap me," said Dick, impressed, "this sequencer scheme you're talking about seems to be very versatile."

"It is," confirmed Smithy. "Apart from the fact that it can have as many stages as you like the timing period for each stage in the sequence can be pre-set to any length from about 2 seconds to longer than 2 minutes. The completed sequencer could control steps in a model train layout or in virtually any other electrical system in which operations are carried out in a predetermined order."

"You said just now," stated Dick, "that each stage in the sequencer would use an identical circuit. What would that circuit be like, Smithy?"

The Serviceman pulled his notepad towards him.

"Come over here," he called out as he started to sketch a circuit on the pad, "and I'll show you."

Eagerly, Dick carried his stool over to Smithy's bench and perched himself alongside the Serviceman. With a flourish, that worthy drew in the last line of his circuit diagram and then placed his pen on his bench. (Fig.1.)

"There you are," he remarked. "Now, this sequencer stage is very simple and it works entirely from basic first principles. It is preceded by a stage having precisely the same circuit and whose output is coupled to R2 in my diagram. As you can see, the stage employs a 555 timer. The output from the previous stage is at a high voltage before it is activated and this causes current to flow into the base of TR1 via R2. In consequence, TR1 turns hard on and ensures that C1 is fully discharged. R3 is merely a current limiting resistor which prevents excessive collector current in the transistor when, at a much later stage in the proceedings, the transistor

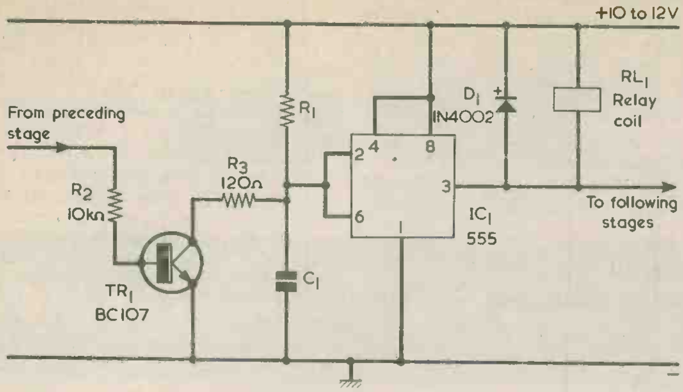


Fig. 1. One of the intermediate stages in Smithy's N-Stage Sequencer. Combined with suitable starting and finishing stages, there can be any number of these intermediate stages, each following a previous one. The timing period of the stage is controlled by the values of R1 and C1.

causes C1 to be discharged from the charged condition. The 555 comparator inputs, at pins 2 and 6, are very close to the potential of the negative rail, and under this condition the 555 output, at pin 3, is high. This means that relay RL1 does not energise."

"Will there be a similar relay coil in the previous stage ?"

"There will," stated Smithy. "Now, at a pre-ordained moment in the overall sequencer cycle, the preceding stage will turn on, and the output at pin 3 of *its* 555 will go low, energising *its* relay. When the preceding stage output goes low, the voltage at the left hand end of R2 in my diagram falls nearly to the negative rail and TR1 turns off. C1 is now able to charge via R1. When the voltage across C1 reaches two-thirds of that on the positive rail the 555 suddenly changes state and its output, at pin 3, goes low. C1 continues to charge after this, but it has no further effect on circuit operation. Relay RL1 now energises and its contacts switch on the appropriate controlled circuit in the sequence. At the same time, the low voltage output at pin 3 passes to the next stage, which has a similar resistor to R2 at its input."

ROBUST OPERATION

"Blow me," said Dick, "you couldn't have things much easier than that. I assume that the time taken for the relay to energise after the preceding stage has operated is controlled by R1 and C1."

"That's right," confirmed Smithy. "And it will be approximately equal to the time constant of these two components. The time constant of R1 and C1 is the time needed for the voltage across the capacitor to reach 63 per cent of the supply voltage after TR1 turns off. This is very nearly the same as the two-thirds of supply voltage which is needed to trigger the 555, and so the calculations needed to find the values of R1 and C1 for a specific time delay are quite easy to carry out. Another useful aspect of the circuit is that it is very robust. The only sensitive points which are likely to respond to unwanted voltage spikes or pulses are the i.c. comparator inputs at pins 2 and 6, but in this circuit they are held at a low impedance to the negative rail by C1. In practice, this capacitor will have a value of at least 10μF."

"I see what you mean," remarked Dick, as he gazed at the circuit. "Well, that shows one of the stages in your sequencer. How about adding another stage and also the starting and finishing stages?"

"All right," said Smithy obligingly. "The starting and finishing stages need a little more thought to work out than did the stage I've just drawn, so I'll have to check out some ideas here."

Smithy bent over his note-pad and proceeded to draw out several experimental circuits, mentally checking their operation as he did so. After some minutes he gave a grunt of satisfaction.

"Ah yes," he said cheerfully, "I've got my ideas sorted out now. Hang on a bit and I'll draw the full circuit."

He tore off the top sheet of his note-pad, then proceeded to sketch a new circuit. This was much larger than the previous one and it was quite some time before Smithy had it completed. Dick watched in fascination as the circuit took shape. (Fig.2.)

N-STAGE SEQUENCER

"Now how about this ?" Smithy put his pen down again and rubbed his hands together briskly. "One complete sequencer which can offer you all the steps you require. I think I'll call it my 'N-Stage Sequencer'!"

"It certainly looks impressive," commented Dick. "How do you get it started ?"

"First of all," said Smithy, "you switch on the power at S2 with S1 in the 'Stop' position. All the C1 capacitors throughout the sequencer are discharged, whereupon all the 555 pin 3 outputs are high and all the relays are de-energised. The high 555 outputs also mean that all the transistors from TR1B to TR1N are turned hard on and all the capacitors from C1B to C1N are maintained discharged."

"What about TR1A?"

"That's turned hard on, too, and it keeps C1A discharged. However, TR1A doesn't get its base current from a preceding 555; instead it gets it via the coil of relay RL2. The coil resistance of RL2 will be much lower than the value of R2A, which means that TR1A will get nearly as much base current as the other transistors. At the same time the current in the coil of RL2 will be too low for that relay to energise."

"There's a relay contact set in the negative supply to the relay coil. What relay does that belong to ?"

"It belongs to the last relay in the sequencer, which is relay RL1N," explained Smithy. "And the circuit shows the contact sets in the de-energised position."

"Right! Let's get this sequencer started, Smithy!"

"Okay," replied Smithy equably. "We kick off by moving S1 from the 'Stop' to the 'Start' position. This completes a circuit, via the de-energised contacts of RL1N, from the negative supply rail to the coil of RL2, and this relay energises. Its contacts close, to start off the first step of the sequencer. Since the lower side of the relay coil is now connected to the negative rail there is no base bias current for TR1A, and this transistor turns off. C1A commences to charge and, when it has reached two-thirds of supply potential, IC1A changes over and relay RL1A energises. Its contacts actuate the second step of the sequence. TR1B is now turned off and capacitor C1B commences to charge. And so the sequence proceeds, with each relay in the system becoming energised in turn."

"What happens when the sequence advances to TR1N and IC1N? That i.c. circuit looks a little different to the others."

"That's because it's in the finishing stage," stated Smithy. "When the sequence reaches C1N this begins to charge just like the previous capacitors did, and IC1N changes state when the capacitor voltage reaches two-thirds of the supply voltage. IC1N output at pin 3 then goes low and relay RL1N energises by way of D3. As a result the contacts of RL1N, over at the left hand end of the diagram,

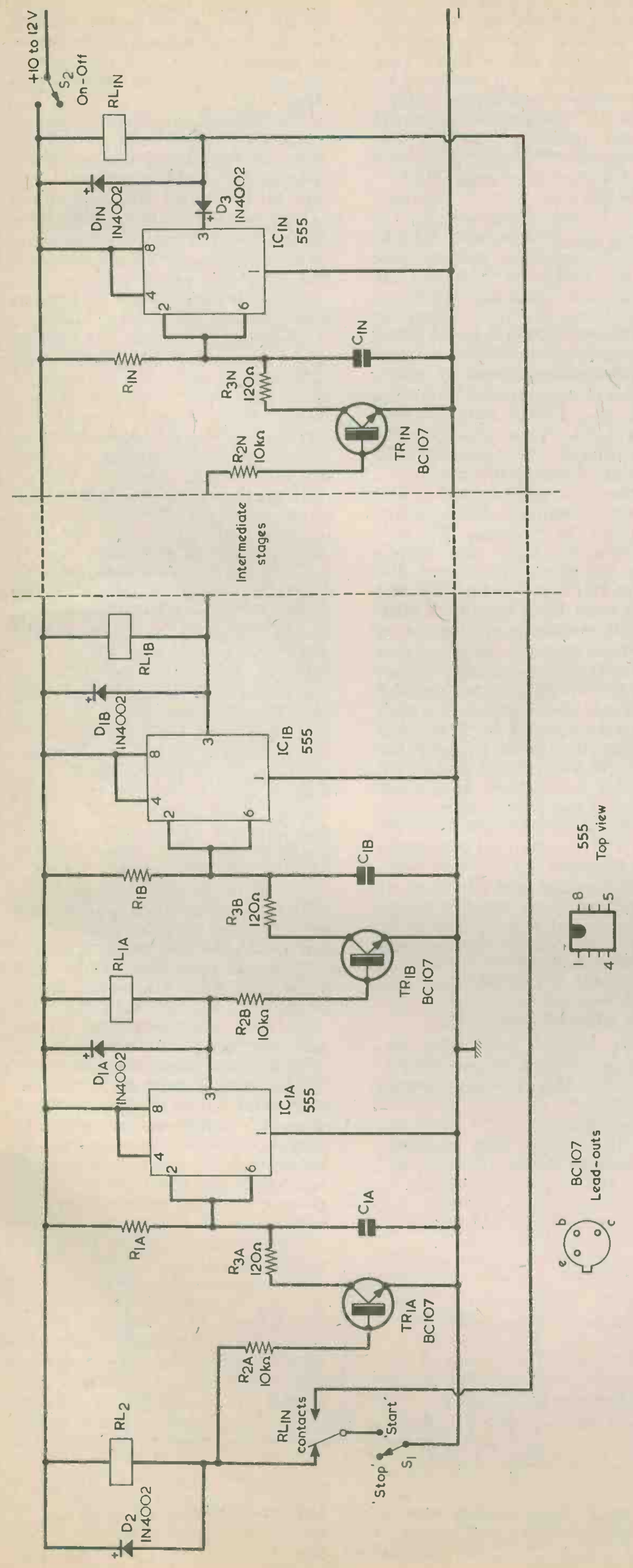


Fig. 2. The complete circuit of the Sequencer. The intermediate stages all have the circuit of Fig. 1. Resistors R2 and R3 are $\frac{1}{4}$ watt 10%

change to the energised state, and complete a circuit, via S1 in the 'Start' position, from the negative rail to the lower side of RL1N coil. So RL1N is now held energised by its own contacts and not by IC1N."

"If RL1N contacts change to the energised position," said Dick, frowning, "there'll be no energising circuit for the coil of relay RL2."

"There won't be," agreed Smithy. "As soon as RL1N energises, its contacts cause RL2 to release. A base bias current now flows into TR1A via R2A and the relay coil, and TR1A turns hard on, rapidly discharging C1A. When the voltage across C1A falls to one-third of the supply voltage TC1A changes state and its output goes high, causing RL1A to release and TR1B to be turned on. TR1B quickly discharges C1B. This process runs rapidly through the sequencer with each relay releasing in turn."

"Blimey," breathed Dick. "It's like a row of dominoes falling down! What about the last relay, RL1N?"

"That's the only one which remains energised. In its turn, the output of IC1N will go high but this merely causes D3 to be reverse biased. RL1N remains energised via its own contact set, as I explained just now. So RL1N has caused the sequence to be completed with all the other relays de-energised. To start the sequence again, S1 is first put to 'Stop'. This breaks the circuit to the coil of RL1N, which releases, whereupon its contacts at the left hand end of the circuit change over to the de-energised state. The sequence will now start all over again if S1 is returned to the 'Start' position. Incidentally, you can shut off the sequence at any point in its cycle if you wish to do so by putting S1 to 'Stop'. This causes all energised relays to release."

RELAY LOGIC

"Hell's teeth," said Dick appreciatively, "this is no end of a circuit, Smithy! Hey, I've just thought of something!"

"What's that?"

"All the relays stay energised after they've been turned on," stated Dick. "That means that all the controlled sequence steps will stay on after they've been turned on in the sequence. Shouldn't each one be turned off after the appropriate step?"

"Ah," said Smithy. "This is where we apply a little relay logic. Now, in virtually all the controlled systems I can think of, each step can be controlled by applying a supply voltage to the circuit concerned. So what we do is connect the relay contacts in an arrangement like this."

Again Smithy picked up his pen and drew out a circuit. (Fig. 3.).

"What happens here," he went on as he completed his diagram, "is that, at the start, the contacts of RL2 close and cause the supply voltage to be passed to controlled circuit A. When RL1A energises its contacts break the supply to circuit A and pass it to circuit B. The sequence proceeds in this manner until we reach the relay for the stage immediately before the last one. The contacts of this relay merely pass the supply current direct to the controlled circuit, which is circuit N. When relay RL1N energises it causes relay RL2 to release, and the supply voltage is cut off by RL2 contacts. You should note that it is the release of RL2 which finally ends the sequence. Since RL2 contacts open first, the contacts of subsequent relays cannot pass momentary supplies of current to the controlled circuits before they, too, release. This assumes, of course, that relay RL2 is the same type as the other relays or, at least, has the same or a quicker release action."

"What do you do," asked Dick, "if you want to have a controlled circuit turned on after another circuit has started and before it ends?"

"You use relay logic again," said Smithy. "Look, I'll give you an example."

He drew another circuit on his pad. (Fig. 4.).

"Here's the idea," he continued. "In this circuit contacts C close at some point during the sequence and cause the supply to be passed to controlled circuit C via contacts F. After a period, contacts D operate

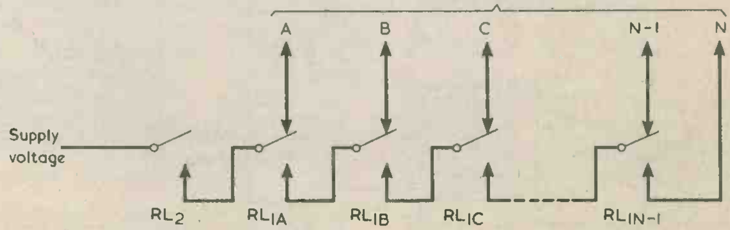


Fig. 3. Relay contact logic allows each controlled circuit to be switched on and off in turn. All the contacts are shown in the de-energised state.

and pass the supply voltage to controlled circuit D. This connection breaks when contacts E operate, and some time later contacts F operate and break the supply to circuit C. So we have managed to insert circuit D into the middle of circuit C. Got it?"

"Blimey, yes. Incidentally, what sort of relays should be used in the sequence?"

"Whatever, within reason, you can lay your hands on. There is for instance a very nice and suitable relay with a 410Ω coil which is available from Maplin Electronic Supplies and this has a changeover contact set which will switch a.c. mains voltages up to 45 amps, or low voltages at d.c. up to 5 amps. Whatever relays are used it is preferable that they have reasonably high resistance coils, say 300Ω or more, as this eases supply current demands. Also, if a relay coil draws too much current, the output at pin 3 of the associated 555 i.c. may not go sufficiently below 0.6 volt to turn off the following transistor. Theoretically, this can happen when the current drawn through the relay coil is in excess of around 30mA or so, although in practice the 555's I have handled seem to be able to draw down much higher currents than that without the output voltage being above 0.6 volt. If it should happen that any 555 output does not go sufficiently low to turn off the following transistor, it is merely necessary to add another 10kΩ resistor between the transistor base and the negative rail or, in really bad cases, to insert a silicon diode in series with the base circuit as well. But, as I say, it's unlikely that you'll need to do either of these things in practice." (Fig. 5(a) and (b).).

POWER SUPPLY

"You mentioned power supply demands just now," said Dick. "What sort of power supply would you recommend?"

"Pretty well anything that will supply the current required at some 10 to 12 volts," replied Smithy. "Each 555 will draw something like 8mA all the time and you have to add to that current drawn by the relay coils as they become energised. The relay current continually increases as the sequence proceeds, reaching its maximum just as RL1N energises, but this should still be well within the capabilities of a simple unregulated mains supply using a bridge rectifier. The mains transformer secondary can have a voltage of around 8 to 9 volts and, if it is rated at a current well in excess of the maximum consumed by the sequencer, regulation should be quite adequate. The power supply voltage must not exceed 16 volts, incidentally, which is the maximum rated voltage for the 555." (Fig. 6.)

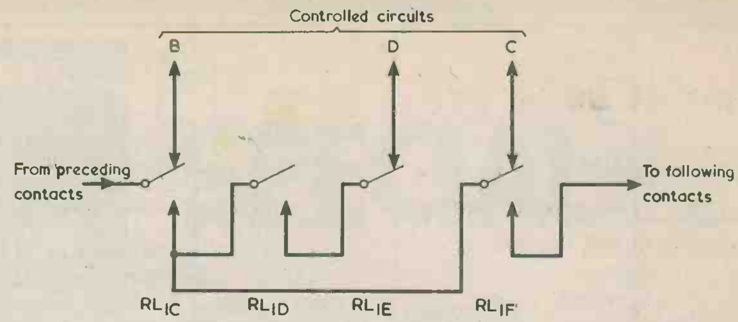


Fig. 4. A further example of relay logic, in which circuit D is turned on and off during the period when circuit C is on. The contacts of the following relay, RL1G, will then control circuit E.

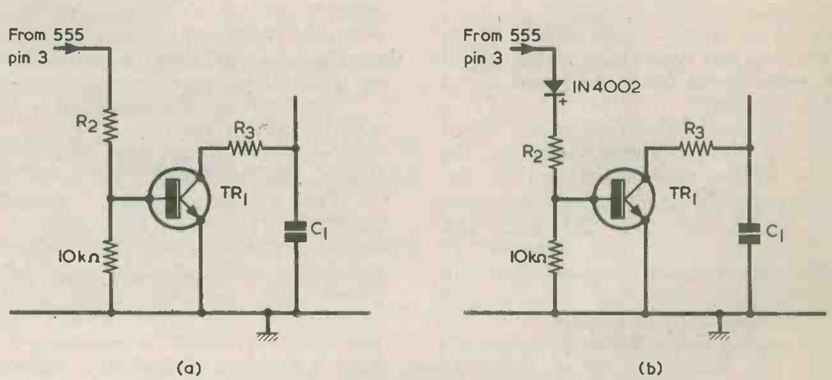


Fig. 5. (a). If a relay coil draws a high current the output of a 555 may not fall to a sufficiently low voltage to turn off the following transistor. The situation can be cleared by adding a 10kΩ resistor between the transistor base and chassis.
(b). In severe cases a forward biased silicon diode may be inserted in series with R2.

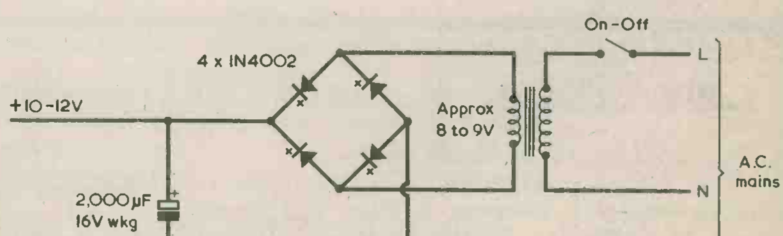


Fig. 6. A simple mains supply such as that shown here is quite adequate to power the sequencer. As there is now a mains on-off switch, S2 of Fig. 2 can be dispensed with

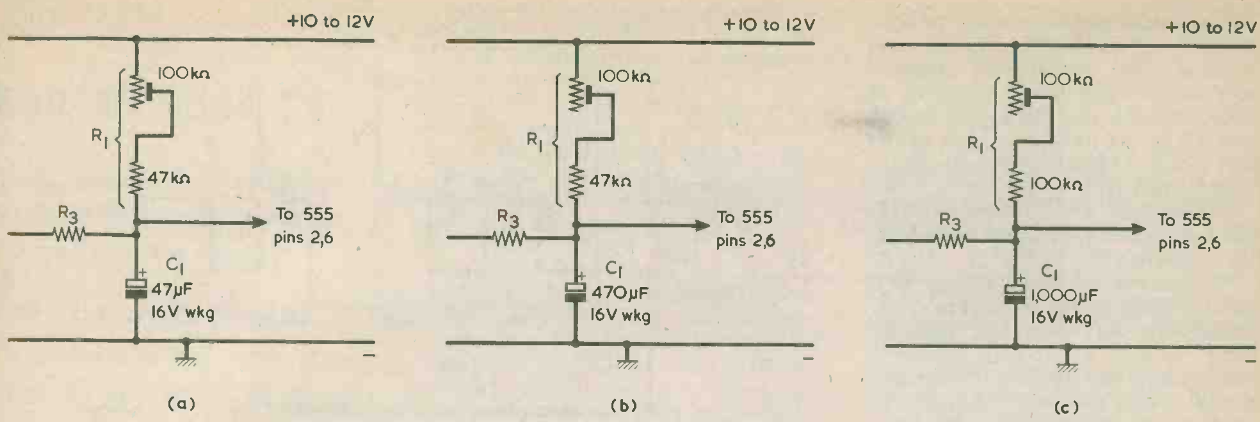


Fig. 7(a). In practice C1 has to be an electrolytic component, whereupon R1 must be partly variable. The component values shown here allow the circuit to be set up for 5 seconds
(b). A timing circuit suitable for 50 seconds
(c). These components can be adjusted for a timing period of 2 minutes

Smithy looked expectantly at his assistant. "Fair enough?"

"Yes, sure," said Dick. "No, there's just one other thing. What about the values for R1 and C1 in each stage?"

"Blimey, I'd forgotten all about them! Well, as I said earlier on, the period for each stage will be approximately equal to the time constant of the resistor and the capacitor. The time constant in seconds is equal to the resistance in megohms multiplied by the capacitance in microfarads. It will be preferable to keep the resistance in the range of some 20kΩ to 500kΩ, which means that the capacitors will all have to be electrolytic types with their well known wide tolerance on value. In turn, this means that the resistance will have to be partly variable so that it can be set up accurately to the required period."

"What value of R1 and C1 would you want for a period of 5 seconds?"

"A good combination here," said Smithy thoughtfully, "would be 50µF and 100kΩ. In practice the 100kΩ could be given by a 100kΩ pre-set pot in series with a 47kΩ fixed resistor. This would give you more than sufficient range to be able to set up a 5 second period. Also, the capacitor could in practice be 47µF." (Fig. 7(a).)

"And 50 seconds?"

"Just increase the capacitance to 470µF." (Fig. 7(b).)

"All right, then, what about a period of 2 minutes?"

"That's 120 seconds," stated Smithy. "1,000µF and 120kΩ would be a satisfactory combination here. You could still use a 100kΩ pre-set pot, and the series fixed resistance this time would be 100kΩ, too. It would be necessary to have a number of trial runs before you had the pot adjusted for the correct time period and a good way of doing this would be to set S1 to 'Stop' and temporarily short-circuit the base of the appropriate discharge transistor to the negative rail. This procedure allows any stage to be set up on its own. The process will be a little time-consuming, but then that's life." (Fig.7(c).)

TIME AGAIN

"As you say," said Dick philosophically, "that's life. Just like your sequencer we go through a series of episodes all the time. Like the steps we've gone through this morning in your explanation of the way the sequencer works."

"Haven't you any more questions on it?"

"Nope," said Dick in a satisfied tone. "I have none at all. I am now fully clued-up on this sequencer design of yours."

He glanced around at the empty Workshop.

"To change the subject," he remarked chattily, "I can't remember whether I told you that my Auntie Eff had rather an unpleasant accident with her Christmas dinner."

Smithy drew breath to deliver the irate retort that Dick had indeed told him . . .

(But, just for the hell of it, let us turn our own sequencer switch to 'Stop' and then back to 'Start' again)

"Did she?" queried Smithy. "What happened?"

"Well, she decided to have a duck this time instead of the usual turkey, and one of her cats, a real mangy old thing . . ."

CONSTRUCTOR'S CROSSWORD — SOLUTION

ACROSS

1, Subharmonic. 7, Overrun. 8, Plug. 9, Use. 10, Add-on. 11, Listen. 14, Earths. 18, Prism. 19, Neo. 20, Word. 21, Rotator. 22, Atmospheric.

DOWN

1, Storage. 2, Bleeder. 3, Apron. 4, Manual. 5, Nepers. 6, Couple. 12, Twister. 13, Numeric. 15, Aurora. 16, Tandem. 17, Shorts. 18, Pitch.

Notes on the answers. A bleeder resistor is connected across a smoothing capacitor in a high voltage power supply, usually to discharge it when the supply is switched off. Nepers are akin to decibels as units, but are based on Naperian, or natural, logarithms. The piezoelectric slices in a crystal microphone are referred to as "benders" or "twisters" according to the type of stress they undergo when the microphone diaphragm moves.

SPECIAL OFFER

For a limited period

By arrangement with Messrs. MacMillan we are able to offer the above book at a special low price to readers of RADIO & ELECTRONICS CONSTRUCTOR.

Normal Price £4.35

SPECIAL OFFER PRICE......£3.50

Saving 85p

Both prices include postage and packing

In this introduction to semiconductor devices, the author provides a comprehensive survey of modern active and non-active semiconductor technology. Without leaning too heavily on device physics, he explains device functions and then illustrates their use with typical circuits and applications.

Following a summary of the physical basis of semiconductor elements — in non-mathematical terms — a study of bipolar and field-effect transistors leads to considerations of monolithic integrated circuits. More advanced charge-coupled devices, semiconductor memories and optoelectronic devices are studied in some detail.

CONTENTS

To: Data Publications Ltd., 57 Maida Vale, London W9 1SN
Please send me within 21 days .... copy/copies of
SEMICONDUCTOR DEVICES

I enclose Postal Order/Cheque for £..............

Name ....

Address ....

(Block Letters Please)

(We regret this offer is only available to readers in the U.K.)

THE MODERN BOOK CO

RADIO DATA REFERENCE BOOK

by T. G. Giles **Price £4.00**

AUDIO AMPLIFIERS FOR THE HOME CONSTRUCTOR
by I. R. Sinclair PRICE: £2.50

DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS
by A. Michaels PRICE: £2.75

PRINCIPLES OF TRANSISTOR CIRCUITS
by S. W. Amos PRICE: £4.55

IC OP-AMP COOKBOOK
by W. G. Jung PRICE: £9.75

ACTIVE FILTER COOKBOOK
by D. Lancaster PRICE: £10.80

TV TYPEWRITER COOKBOOK
by D. Lancaster PRICE: £7.30

IC TIMER COOKBOOK
by W. G. Jung PRICE: £7.40

TTL COOKBOOK
by D. Lancaster PRICE: £6.60

ELECTRONICS AND RADIO
by N. Nelkon PRICE: £3.00

TRANSISTOR ELECTRONIC ORGANS FOR THE AMATEUR
by A. Douglas PRICE: £4.80

MASTER TRANSISTOR/IC SUBSTITUTION HANDBOOK
by Tab Books No. 970 PRICE: £5.50

GETTING THE MOST OUT OF YOUR ELECTRONIC CALCULATOR
by W. L. Hunter PRICE: £3.60

OP-AMP CIRCUIT DESIGN AND APPLICATIONS
by J. Carr PRICE: £3.90

BUILD YOUR OWN WORKING ROBOT
by D. L. Heiserman PRICE: £3.50

ELECTRONICS AND PHOTOGRAPHY
by R. M. Brown PRICE: £2.20

MICROELECTRONICS
by C. L. Hallmark PRICE: £4.80

125 ONE TRANSISTOR PROJECTS
by R. P. Turner PRICE: £2.10

HOW TO BUILD SPEAKER ENCLOSURES
by A. Badmaieff PRICE: £3.65

110 SEMICONDUCTOR PROJECTS FOR THE HOME CONSTRUCTOR
by R. M. Marston PRICE: £2.70

110 THYRISTOR PROJECTS USING SCRs AND TRIACS
by R. M. Marston PRICE: £2.70

110 OPERATIONAL AMPLIFIER PROJECTS FOR THE HOME CONSTRUCTOR
by R. M. Marston PRICE: £2.70

50 PHOTOELECTRIC CIRCUITS & SYSTEMS
by P. S. Smith PRICE: £2.00

BEGINNER'S GUIDE TO RADIO
by G. K. King PRICE: £3.00

BEGINNER'S GUIDE TO COLOUR TELEVISION
by G. J. King PRICE: £2.50

BEGINNER'S GUIDE TO ELECTRIC WIRING
by F. Guillou PRICE: £2.50

BEGINNER'S GUIDE TO AUDIO
by I. R. Sinclair PRICE: £3.00

BEGINNER'S GUIDE TO INTEGRATED CIRCUITS
by I. R. Sinclair PRICE: £3.00

RADIO SERVICING POCKET BOOK
by V. Capel PRICE: £3.10

TELEVISION ENGINEERS' POCKET BOOK
by P. J. McGoldrick PRICE: £5.10

ELECTRONICS POCKET BOOK
by P. J. McGoldrick PRICE: £4.25

COLOUR T.V. WITH PART. REF. TO THE PAL SYSTEM
by G. N. Patchett PRICE: £5.50

COLOUR T.V. PICTURE FAULTS
by K. J. Bohlman PRICE: £2.75

RECEIVING PAL COLOUR T.V.
by A. G. Priestley PRICE: £5.50

PRICES INCLUDE POSTAGE

We have the Finest Selection of English and American Radio Books in the Country

19-21 PRAED STREET (Dept RC) LONDON W2 INP

Telephone 01-723 4185

AVAILABLE MID-JANUARY . . .

NEW FORMAT SELF-BINDER

for "Radio & Electronics Constructor"

The "CORDEX" Patent Self-Binding Case will keep your issues in mint condition. Copies can be inserted or removed with the greatest of ease. Rich maroon finish, gold lettering on spine.

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.

PRICE £1.60 including V.A.T. P. & P. 30p

SMALLER SIZE ($7\frac{1}{2}$" x $9\frac{1}{2}$") BINDERS
Limited number of these titled Binders still available **Price £1.20 P. & P. 30p**

Available only from:—

Data Publications Ltd. **57 Maida Vale London W9 1SN**

SMALL ADVERTISEMENTS

Rate: 10p per word. Minimum charge £1.50
Box No. 25p 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. — ***Radio and Electronics Constructor,*** 57 Maida Vale, London, W9 1SN.

TREASURE HUNTERS! Construct 11-transistor metal detector giving £300 performance. 10 page illustrated plans, send £1. C. H. Lucas, 241 Upminster Road South, Rainham, Essex.

BOOKS TO CLEAR: *Introductory Radio — Theory and Servicing,* 1948 (With Teacher's manual) by H. J. Hicks, £1.50. *Klystron Tubes,* by A. E. Harrison, 1947, £1.50. *An Approach to Audio Frequency Amplifier Design,* 1957, G.E.C. Publication, £1.25. *Television Engineers' Pocket Book,* 1954, by Molloy & Hawker, 50p. All prices include postage. — Box No. G329.

TV REPAIRS SIMPLIFIED. Full repair instructions individual British sets £4.50; request free circuit diagram. Stamp brings details of unique TV publications. Auserec, 76 Churches, Larkhall, Lanarkshire.

OUTSTANDING 2200 HI-FI FM TUNER. Full coverage 88-102mHz; Varicap tuning. Latest silicon superhet design. Ideal for push button/manual tuning. Only £9.95. UNIQUE 3300 STEREO CLASS A AMPLIFIER. Power 32 watts peak. Complete stereo pre-amplifier/2 power amplifiers. All inputs accepted. Only £10.95. 5500 TUNER AMPLIFIER. Specification as above 2. Only £19.95. All equipment built, tested and guaranteed with full instructions (P. & P. 50p). GREGG ELECTRONICS, 86-88 Parchmore Road, Thornton Heath, Surrey.

GAMMA ENTERPRISES for all constructors! Transistors, resistors, capacitors, I.C.'s, hardware, etc. Large S.A.E. for catalogue. Dept. RE, 18 Landale Road, Peterhead, Aberdeenshire, AB4 6QP.

SILICON SOLAR CELLS: Booklet 75p. — Data on cells in stock 20p or s.a.e. for current price list. Edencombe Limited, 16 Prince's Avenue, London NW9 9JB.

WANTED: Desk-FAX machine, complete or spare parts, with literature, manuals, etc., in the series TR100/1 and TR102/1, made by Creed & Co. Ltd. Details to Box No. G335.

WANTED: Large and small quantities of transistors, I.C.'s, displays, etc., etc., Call any Saturday to: 306 St. Paul's Road, London N.1. Telephone: 01-359 4224.

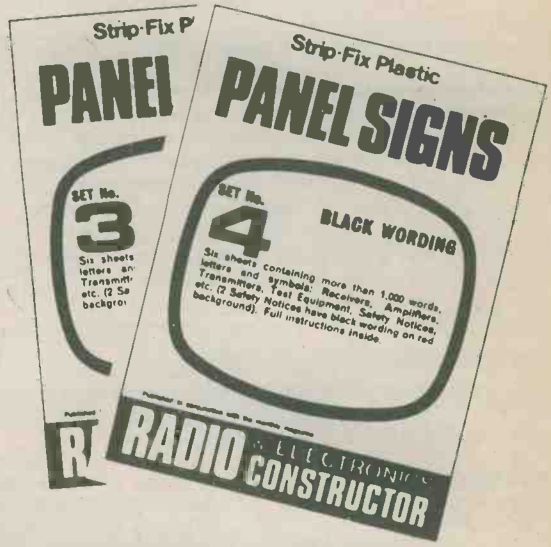
FOR SALE: Complete 9.5mm cine "Wide screen" outfit — Cameras, projector, screen, etc. S.A.E. for details. Box No. G336.

WANTED: Single or double beam oscilloscope in working or repairable condition. Reasonably priced. Telephone 01-397 3228.

FOR SALE: Copies of *"Hi-Fi News"* January 1975 to October 1975 inclusive, plus December 1975 and January 1976. Mint condition. Offers? Box No. G338.

(Continued on page 381)

Use Strip-fix Plastic PANEL SIGNS



6 SHEETS IN EACH SET

★ SET 3 - Wording - WHITE

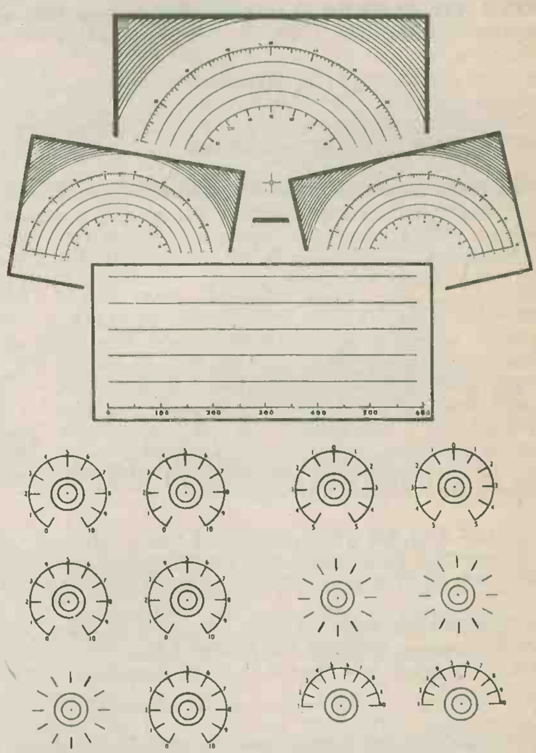
★ SET 4 - Wording - BLACK

Over 1,000 words and symbols, covering more than 300 terms, in each set

Illustration of actual size = RADIO

★ SET 5 - DIALS

6 sheets containing one Large and two Medium scales, Large Horizontal Tuning scale, Frequencies, 12 Control Panels



SET 3: 75p
SET 4: £1.00
SET 5: 38p

ALL PRICES INCLUDE V.A.T.

P. & P. 8p per set

- Easy to fix
- Stapled in booklet form
- Designed to hang above workbench
- Pocket for loose cuttings
- Professional finish

To Data Publications Ltd., 57 Maida Vale, London, W.9 1SN

Please supply Panel Signs as follows: Set 3 ..... Set 4 ..... Set 5 .....

I enclose cheque / crossed postal order for .... (Tick which set is required)

NAME ....

ADDRESS ....

....

(BLOCK LETTERS PLEASE)

SMALL ADVERTISEMENTS

(Continued from page 379)

WHAT'S THE SECRET OF MAKING MONEY? The knowledge and ability that very few people possess, to undertake work in a specialised field that is crammed with opportunities. We are supplying a MANUAL that will enable you, in your own home, WITH NO PREVIOUS EXPERIENCE, to repair Vacuum Cleaners, Drills and Portable Tools, by showing in easy, step by step stages, how to diagnose faults, rewind armatures and fields and make up Test equipment. 13 chapters covering Test procedures, apparatus required, test charts, where to obtain materials and where to find work. Packed with diagrams and information. Get your copy now. Only £4 plus 30p P. & P. C.W.O. Copper Supplies, Dept. REC1, 102 Parrswood Road, Withington, Manchester 20.

THE RADIO AMATEUR INVALID & BEDFAST CLUB is a well established Society providing facilities for the physically handicapped to enjoy the hobby of Amateur Radio. Please become a supporter of this worthy cause. Details from the Hon. Secretary, Mrs. Rita Shepherd, 59 Paintain Road, Loughborough, Leics., LE11 3LZ.

BOOKS TO CLEAR: *The Radio Constructor* Vol. 15 August 1961 to July 1962, Bound, £2.30. *Short Wave Magazine*, Bound, Volume VIII, March 1950 to February 1951, £2.00. All prices include postage. Box No. G340.

INTERESTED IN OSCAR? Then join AMSAT-UK. Newsletters, OSCAR NEWS Journal, prediction charts, etc. Details of membership from: James Keeler, G4EZN, Church Farm Cottage, Banningham Road, Aylesham, Norfolk, NR11 6LS.

MAGAZINE COLLECTORS. Disposing of very early issues of *Radio Constructor*. Various odd issues dating from 1950 to 1975 at 25p each. S.A.E. for list. Prices include postage. Box No. G341.

STAMP FOR LISTS of new and used components. Box No. G343.

RESISTORS: E12, 5% 1/3 W — 1p. Diodes 4148 — 3p, 4004 — 5p, LM555CN — 38p. VAT inclusive. 15p postage. Cleveland Supplies, P.O. Box 20, Redcar, Cleveland.

FOR SALE: Small electrolytics 10μF-220μF. £2/100, £15/1000. Same unmarked £1/100, £8/1000. J. Bruere, 17 Heald Close, Shawclough, Rochdale, Lancs.

FOR SALE: Chess playing computer game. Stamp for details. Box No. G346.

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 and 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., £3.75 per annum. (U.K. and British Commonwealth), overseas $10.00 or £4.00. Secretary ISWL, 1 Grove Road, Lydney, Glos., GL15 5JE.

(Continued on page 382)

BRAND NEW COMPONENTS

Semiconductors

AC126/7/8	14p	BCY70/71/2	13p	MPF102	33p	2N2646	50p	**Integrated circuits**	
AD161/2	40p	BD131/2	40p	1N916	5p	2N2904/5	15p	709 DIL	24p
BC107/8/9	8p	BD139	40p	1N4001/2	4p	2N2926(R)	7p	741 DIL	22p
BC147/8/9	8p	BD140	42p	1N4003/4	5p	2N2926(G)	10p	748 DIL	33p
BC157/8/9	10p	BF194/5	11p	1N4005/6	6p	2N3053	14p	CA3130	89p
BC167/8/9	10p	BF196/7	13p	1N4148	3p	2N3055	38p	LM380	94p
BC177/8/9	12p	BFY50/51	15p	2N697	12p	2N3702/3/4	8p	LM381	130p
BC182/3/4L	10p	BFX29	25p	2N706	9p	2N3903/4/5	12p	LM382	75p
BC212/3/4L	11p	BFX84	20p	2N1711	18p	2N5457	33p	NE555	35p
		MJ2955	104p	2N2219	18p	2N5459	36p	NE556	80p

TTL All famous manufacturers. Quantity discount 25+ 10%, 100+ 15%, 1000+ 20% any mix.

7400	13p	7422	25p	7450	14p	7491	65p	74145	68p	74182	84p	4012	16p	4042	80p
7401	13p	7423	25p	7451	14p	7492	45p	74150	115p	74184	164p	4013	46p	4043	95p
7402	13p	7425	30p	7453	14p	7493	40p	74151	74p	74190	148p	4014	85p	4044	95p
7403	14p	7426	32p	7454	14p	7494	80p	74153	80p	74191	132p	4015	80p	4045	142p
7404	14p	7427	30p	7460	14p	7495	65p	74154	125p	74192	118p	4016	47p	4046	132p
7405	14p	7428	38p	7470	30p	7496	78p	74155	75p	74193	116p	4017	88p	4047	106p
7406	29p	7430	14p	7472	25p	74100	97p	74156	75p	74195	93p	4020	95p	4049	48p
7407	29p	7432	26p	7473	30p	74104	38p	74157	75p	74196	103p	4021	95p	4050	52p
7408	14p	7433	46p	7474	30p	74105	38p	74160	110p	74197	103p	4022	85p	4055	150p
7409	14p	7437	30p	7475	36p	74107	32p	74161	110p	CMOS		4023	16p	4056	130p
7410	13p	7438	30p	7476	33p	74110	50p	74162	110p	4000	15p	4024	72p	4069	20p
7411	22p	7440	14p	7480	48p	74111	75p	74163	110p	4001	16p	4025	16p	4070	40p
7412	22p	7441	62p	7481	93p	74118	90p	74164	93p	4002	16p	4027	52p	4071	22p
7413	25p	7442	62p	7482	75p	74119	130p	74166	130p	4006	88p	4028	84p	4072	22p
7414	55p	7443	108p	7483	92p	74121	30p	74175	90p	4007	16p	4030	50p	4081	22p
7416	28p	7444	108p	7484	92p	74122	47p	74176	110p	4008	88p	4035	110p	4082	22p
7417	28p	7446	85p	7485	115p	74123	45p	74177	110p	4009	45p	4037	97p	4510	130p
7420	14p	7447	85p	7486	30p	74136	75p	74180	105p	4010	45p	4040	95p	4511	140p
7421	25p	7448	78p	7490	41p	74141	71p	74181	190p	4011	16p	4041	80p	4516	125p
														4518	125p
														4520	120p
														4528	120p
														4585	118p

Electrolytic Capacitors
Axial leads

25V	25V	25V	50V	50V	50V
10	22	100	1.0	4.7	22
	47		2.2	10	47
5p	5p	7p	5p	5p	7p

Optoelectronics

LEDs	Red	Green	Yellow	Clip
0.125"	TIL209	TIL211	TIL213	3p
0.2"	FLV117	FLV310	FLV410	3p
	10p	21p	21p	

DL707 66p. DL727 150p. DL747 130p.

DIL sockets

8 pin	11p
14 pin	12p
16 pin	13p
24 pin	30p

Potentiometers
Carbon track. Log + Linear values.

5K-2M single gang	24p
5K-2M single gang D/P switch	52p
5K-2M dual gang stereo	68p

Zener Diodes
BZY88 Series, 400mW 5% E24 series from 2.7–33V. Any selection, 7p each, 6p 100+, 5.3p 1,000+.

Polyester Capacitors
C280 Series 250V PC mounting 0.01, 0.015, 0.022, 0.033, 0.047, 4p; 0.068, 0.1, 4½p; 0.15, 0.22, 6p; 0.33, 0.47, 9p; 0.68, 12p; 1.0, 15p; 2.2uF, 24p.

Thyristors

PIV		1A	3A	7A	10A
	200	33p	38p	58p	59p
	400	38p	48p	65p	70p
	600	52p	55p	75p	90p

Carbon Film Resistors
0.25W 5% Hi-stability E12 series 4.7 -1M. Any selection **0.9p** each. **0.8p** 100+ **0.75p** 1000+ Special Pack 10 of each value (650 resistors), **£5.10.**

Orders sent by return of post. All components guaranteed brand new and full specification. Prices include VAT. Please add 20p carriage (first class). Official orders welcomed otherwise cash with order please. We will gladly quote for items not listed. Overseas customers please use these prices as VAT exclusive carriage paid (minimum £3). SAE for our latest list.

C. N. STEVENSON (RC4)
22 Tiverton Drive, London SE9 2BY, England

SPECIAL EVENT STATION G.B. 3 MSA

POLDHU HOTEL

POLDHU COVE, MULLION, CORNWALL

Telephone: Mullion 240339 Telex: 45137

Saturday 14th to Saturday 21st January, 1978 commemorates the 75th Anniversary of Marconi's first commercial two-way trans-oceanic spark-gap radio transmission. To mark this exciting event the Cornish Radio Amateur Club are establishing a special radio room at the Poldhu Hotel which will be worked 24 hours a day from noon 14th January to noon 21st January, 1978.

During some vital experiments Marconi's aerial structure was blown down in a gale. This resulted in him sending an aerial aloft in a giant kite. This dramatic kite transmission will be re-created on Sunday, 15th January on the very foundations of Marconi's Radio Station at Poldhu.

A static display of equipment, books, plans and photographs will be at the Poldhu Hotel all that week.

For this week only we are able to offer very special terms, to all enthusiasts, of £10.00 per day for dinner, bed and breakfast, at the very hotel where Marconi once stayed.

For further details please contact A. Ricketts.

SMALL ADVERTISEMENTS

(Continued from page 381)

AUDIO ACCESSORIES: leads, plugs, sockets, cartridges, stylii. Send s.a.e. for free list. Barras Electronics, 11 North Street, Coventry, CV2 3FP. Telephone: 441141.

FOR SALE: Plans for Benson Cyroscope, £30. Box No. G347.

FOR SALE: 100 unmarked BZY88 £1.00. 1000 mixed resistors, £1.00. 25 unmarked 2W zeners, 50p. Unmarked BC107/8/9, 40/50p. 100 high wattage resistors, 50p. Stereo cassette mechanisms £10.00 & £15.00. Non-working video tape recorder £50. 6" TV less tube, £10.00. Box No. G348.

CLEARANCE OF NEW COMPONENTS. Our mix of values. Carbon resistors: 100/50p. Zeners: 10/40p. 1A silicon diodes: 25/50p. Bridge rectifiers: 5/£1. Glass Neons: 5/15p. Capacitor discharge transformers (ETI): £1.50. 2N3055: 48p. 1.6A, 400V triacs: 30p. TAG 1/500: 40p. 1mF/600V d.c.: 50p. Plus 15p P. & P. Padec Components, P.O. Box 71, Southend-on-Sea, Essex.

ANTIQUE WIRELESS: For valves, radios, components and service sheets, 1920 to 1950. Contact The Vintage Radio Shop. 1977 Full Catalogue 70p. 64 Broad Street, Staple Hill, Bristol BS16 5NL. Telephone: (0272) 565472.

POSTAL ADVERTISING? This is the Holborn Service. Mailing lists, addressing, enclosing, wrapping, 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 6444.

TIRRO ELECTRONICS the mail order division of Ritro Electronics UK, offers a wide range of components for the amateur enthusiast. Large s.a.e. or 20p brings list. Grenfell Place, Maidenhead, Berks., SL6 1HL.

THE BRITISH AMATEUR ELECTRONICS CLUB for all who are interested in electronics. Four Newsletters a year with help and special offers for members. Major projects sponsored by the B.A.E.C. designed and made by members, currently the B.A.E.C. Z-80 Computer. Membership fee for 1978 £3.50 U.K., overseas £4.50 surface mail and £5.50 airmail, payable in sterling. S.A.E. for details and application form to the Hon. Sec. J. G. Margetts, 42 Old Vicarage Green, Keynsham, Bristol.

FOR SALE: capacitors, mixed, ceramic, poly, mica, 100 – £1. Mullard C280's, 100 – £1. ½W resistors, assorted, 100 – 75p. BC107/8/9 assorted, untested, 40 – £1. 2N3055 – 25p. P. & P. 25p. S.A.E. for list. Galloway, 10 Osborne Gardens, Falkirk, FK1 5EU.

FOR SALE: Used t.t.l. i.c.'s. 90% good. £4/100 gates, bistables. J. Bruere, 17 Heald Close, Shawclough, Rochdale, Lancs.

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 and 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 7p. Data Publications Ltd., 57 Maida Vale, London, W9 1SN.

(Continued on page 383)

SMALL ADVERTISEMENTS

(Continued from page 382)

PERSONAL

JANE SCOTT FOR GENUINE FRIENDS. Introductions to opposite sex with sincerity and thoughtfulness. Details free. Stamp to: Jane Scott, 3/Con North St. Quadrant, Brighton, Sussex, BN1 3GJ.

REPRESENTATION FOR OUR COMPANY. West German Manufacturer of coaxial cables 60 and 75 ohm, coaxial cables for underground installation CATV and with carrier cables, RG/U-coaxial cables 50, 75 and 93 ohm, video-coaxial-cables 75 ohm, microphone, diode and stereo cables, measuring cables, cables for loudspeakers, television and radio aerials 240 and 300 ohm, heat resistant coaxial cables, requires a representation for Great Britain & Ireland. Box No. G349.

ESSEX GARDENERS. Buy your Bedding and rock plants, shrubs, etc., also cacti from May's Nurseries, 608 Rayleigh Road, Hutton, Brentwood, Essex. Callers only. Monday to Saturday.

SPONSORS required for exciting scientific project. Norwich Astronomical Society are building a 30" telescope to be housed in a 20' dome of novel design. All labour being given by volunteers. Already supported by Industry and Commerce in Norfolk. Recreational. Educational. You can be involved. Write to: NAS Secretary, The Manse, Back Lane, Wymondham, Norfolk.

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.

IN 4148 TEXAS/I.T.T.
100 FOR £1.50
RCA THYRISTOR T03 CASE
100V 12.5 AMP. £2.00

TEXAS T1S 88A
V.H.F. F.E.T.
10 FOR £2.30
100 FOR £20.00

7410	10 for £1.00	7476	10 for £2.50
7412	10 for £1.50	7483	10 for £7.00
7420	10 for £1.00	7496	10 for £4.50
7430	10 for £1.00	74107	10 for £2.00
7432	10 for £2.00	74121	10 for £2.50
7442	10 for £3.50	74153	10 for £4.00
7474	10 for £2.00	74161	10 for £8.00

555 TIMERS 10 for £2.80
741 OP. AMPS. 10 for £2.00
BD607/BD608 £1.50 Pr.

1 OCTAL VALVEHOLDERS
10 for £1.50
.01 C280 100 for £2.50

1200μF. 63V 2 for £1.00
3300/63V 2 for £1.60
2200/63V 2 for £1.50

Prices include Post & VAT

XEROZA RADIO
306 ST. PAUL'S ROAD, HIGHBURY CORNER
LONDON N.1.
Tel: 01-226 1489

PRINTED CIRCUITS AND HARDWARE

Comprehensive range Constructors' hardware and accessories. Selected range of popular components. Printed circuit boards for individual designs. Drawing materials for printed circuits. Resist coated laminate, epoxy glass for the d.i.y. man. Full processing instructions, no unusual chemicals required.

Send 15p for catalogue

Ramar Constructor Services

Masons Road · Stratford-on-Avon · Warwks CV37 9NF

THE DALESFORD SPEAKER BOOK
By R. F. C. Stephens

This book is a must for the keen home constructor. Latest technology DIY speaker designs. Contains full plans for infinite baffle and reflex designs for 10-100 watts, also unusual centre-bass system for those who want hifi to be "heard and not seen". £1.95 (£2.20 post paid. $5 Overseas).

VAN KAREN PUBLISHING,
5 SWAN STREET, WILMSLOW, CHESHIRE.

PMS PACK Prov. Patt.
CARBON COPY

If you make your own PCB's try:
Making a mask from suitable self adhesive paper, make carbon copies from project, or draw own design. Apply copy to laminate, cut out, etch, simple and economic

Each pack contains 5 sheets 10" x 12"
+ carbon and instructions

£1.30 per pack + 20p pp UK

Mail orders only from:
JDM ELECTRONICS
11 Woodland Close, Crawley Down
West Sussex RH10 4JZ

For Semi-Conductors
including

Small Signal Transistors
Power Semi-conductors
TTL, CMOS, I.C.s
Linear I.C.s
Signal and Power Diodes
Zener Diodes
Magneto Resistors
Hall-effect devices
Magnetic Proximity Switches
Opto-electronic devices

Go to
ELECTROVALUE
TO MAKE THE BEST OF

For passive components
including

Plastic Film Capacitors
Electrolytics
Semi-precision capacitors
Transformers
Pot Cores
R. M. Cores
Ring Cores, etc.

Go to
ELECTROVALUE
THE PROJECTS YOU BUILD

The Open Door to Quality

It's the Electrovalue Catalogue No. 8 (4th edition black and white cover) with completely up-dated prices. 144 pages, well illustrated. **40p** post free with **40p** voucher usable on orders for **£5** or more. Send for yours now and order in confidence.
GOODS SENT POST FREE IN U.K. FOR C.W.O. ORDERS. FOR £5 OR MORE (If under, add 25p for handling charge). Keenly competitive prices plus **ATTRACTIVE DISCOUNTS** and only best quality goods.

ELECTROVALUE LTD
(RC2.) 28 St. Jude's Rd., Englefield Green
Egham, Surrey TW20 0HB Tel. Egham 3603
Telex 264475
North: 680 Burnage Road, Burnage, Manchester
Tel. (061) 432 4945

RADIO & ELECTRONICS CONSTRUCTOR

Single Copies
Price **45p** each, p&p 13p
Issue(s) required ....

Annual Subscription
Price **£6.50,** post free, commence with .... issue

Bound Volumes:

Vol. 27. August 1973 to July 1974	Price **£2.60,** post & pkg 90p
Vol. 28. August 1974 to July 1975	Price **£3.00,** post & pkg 90p
Vol. 29. August 1975 to July 1976	Price **£3.30,** post & pkg 90p
Vol. 30. August 1976 to July 1977	Price **£3.70,** post & pkg 90p

CORDEX SELF-BINDERS *NEW FORMAT* (Available mid-January)

With title, 'RADIO & ELECTRONICS CONSTRUCTOR' on spine,
maroon only — Price **£1.60,** post & pkg 30p
With no title on spine, maroon — Price **£1.50,** post & pkg 30p
With no title on spine, green — Price **£1.50,** post & pkg 30p

SMALL FORMAT (7½" x 9½")
With title, 'RADIO & ELECTRONICS CONSTRUCTOR' on spine,
maroon — Price **£1.20,** post & pkg 30p

Prices include V.A.T.

DATA BOOK SERIES

DB5	**TV Fault Finding,** 132 pages	Price **90p,** P. & P. 20p
DB6	**Radio Amateur Operator's Handbook,** 88 pages	Price **70p,** P. & P. 13p
DB17	**Understanding Television,** 504 pages	Price **£3.25,** P. & P. 70p
DB19	**Simple Short Wave Receivers** 140 pages	Price **80p,** P. & P. 20p

STRIP-FIX PLASTIC PANEL SIGNS

Set 3: Wording — White	Price **75p,** P. & P. 8p
Set 4: Wording — Black	Price **£1.00,** P. & P. 8p
Set 5: Dials	Price **38p,** P. & P. 8p

Prices include V.A.T. on Panel Signs

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

NAME ....

ADDRESS ....

.... (BLOCK LETTERS PLEASE)

Postal Orders should be crossed and made payable to Data Publications Ltd.
Overseas customers please pay by International Money Order.
All publications are obtainable through your local bookseller

Data Publications Ltd., 57 Maida Vale, London W9 1SN

PLEASE MENTION THIS MAGAZINE WHEN WRITING TO ADVERTISERS

FOR THE BEGINNER

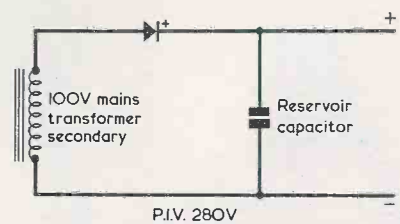
FULL-WAVE RECTIFIER RATINGS

In (a) the 100 volt secondary of a mains transformer connects to a half-wave rectifier and a reservoir capacitor. As we saw in "Electronics Data 29" the peak voltage across the secondary is 140 volts and the peak inverse voltage applied to the rectifier is 280 volts, or 2.8 times the applied r.m.s. voltage.

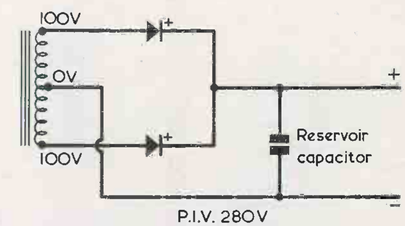
A full-wave rectifier circuit is shown in (b), where a centre-tapped 100-0-100 volt secondary is connected to two rectifiers. The rectifiers conduct on alternate half-cycles. On half-cycles when the upper end of the secondary is positive the upper rectifier is in the same circuit as (a), as is the lower rectifier on half-cycles when the lower end of the secondary is positive. In consequence, the p.i.v. applied to each rectifier is 280 volts, or 2.8 times the r.m.s. voltage across each half of the secondary.

The full-wave bridge rectifier of (c) has four rectifiers. D2 and D4 conduct when the upper end of the secondary is positive (trace the conducting path — from positive to negative — through D2, the load and D4 back to the lower end of the secondary). D3 and D1 conduct when the lower end of the secondary is positive. With little or no load current the voltage across the reservoir capacitor is virtually 140 volts.

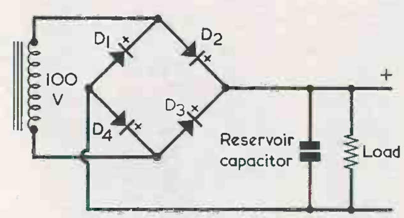
In (d) the peak voltage of 140 volts appears across the secondary and, since D2 and D4 are conducting, this 140 volts is applied, with inverse polarity, across D3 and D1. A similar inverse voltage appears across D2 and D4 on alternate peaks. Thus, in a bridge rectifier circuit the peak inverse voltage applied to the rectifiers is 1.4 times the applied r.m.s. voltage.



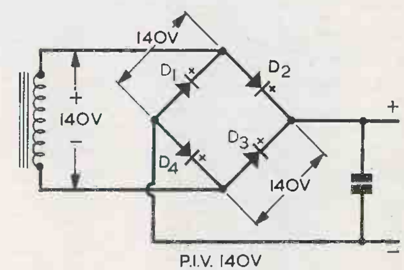
(a)



(b)



(c)



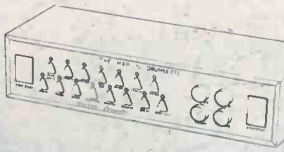
(d)

MAPLIN

in a modern world of electronics

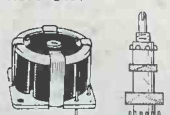
THE 'DRUMSETTE' RHYTHM GENERATOR

Organists, pianists, guitarists . . . an automatic drum set to accompany you! Nine highly realistic instruments play fifteen different rhythms. Fifteen rhythm-select touch switches and a touch plate for stop/start without rhythm change gives absolute ease of operation. Build it yourself for under £65 including smart teak-effect cabinet. See it and hear it in our shop! Send for full construction details now: MES 49 price 25p.



WIDE RANGE OF COILS & CHOKES

Component section in our catalogue includes a wide range of coils, pot cores, ready-wound coils and chokes from microHenries to Henries, plus ranges of Denco coils and i.f. transformers etc.

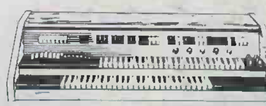


10 CHANNEL STEREO GRAPHIC EQUALISER

A new design with no difficult coils to wind, but a specification that puts it in the top-flight hi-fi class. All this for less than £70 including fully punched and printed metalwork and woodwork. Send for our component schedule now. Full construction details price 40p.

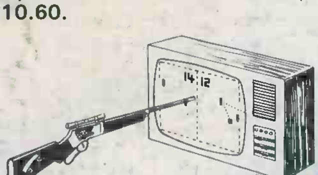
ELECTRONIC ORGAN

The only organ you can build in stages and tailor to your requirements as you go along — and at each stage you'll have a fully working instrument! We haven't got the gimmicks yet (they're coming soon) but we have got the most beautiful sounds — you won't find them on any organ less than twice our price. So get our MES50 series leaflets now! 65p buys the three available so far.



T.V. GAME

A fascinating TV game kit that plays football, tennis, squash and practice for only **21.59.** Reprint of construction details **35p.** Add-on rifle kit only **£10.60.**



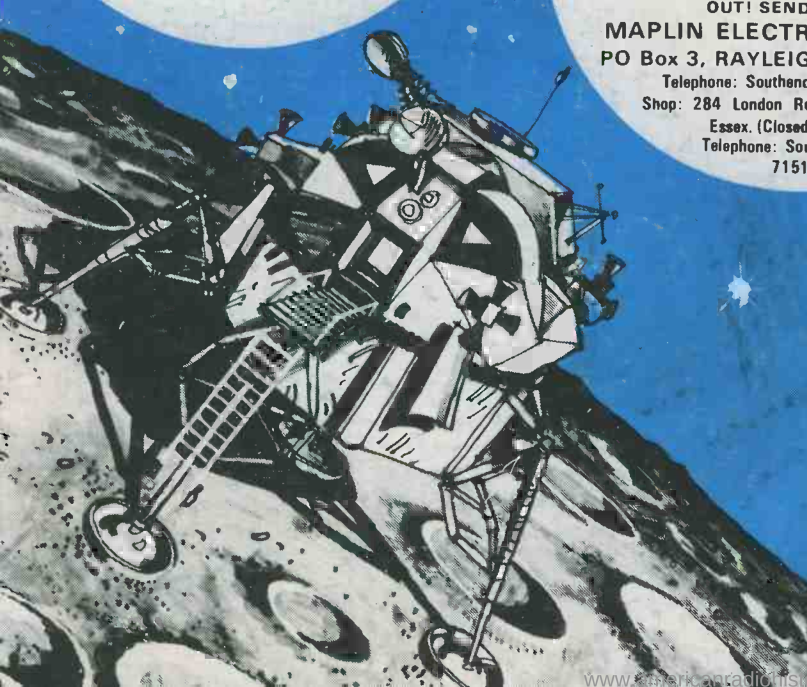
Who says the Maplin Catalogue's worth having?

"in our 'musts' for readers-to-collect list" — **P.E.**
"contains . . . just about everything the DIY electronics enthusiast requires" — **P.W.**
"probably the most comprehensive catalogue we have ever come across" — **E.E.**
"has been carefully prepared and is very well presented" — **R.E.C.**
"make the job of ordering components an easy, accurate and enjoyable pastime" — **P.W.**
"only one word describes the publication — superb!" — **E.T.I.**

OVER 60,000 COPIES SOLD — DON'T MISS OUT! SEND 60p NOW

MAPLIN ELECTRONIC SUPPLIES
PO Box 3, RAYLEIGH, ESSEX SS6 8LR
Telephone: Southend (0702) 715155
Shop: 284 London Road, Westcliff-on-Sea, Essex. (Closed on Monday)
Telephone: Southend (0702) 715157

Our bi-monthly newsletter keeps you up to date with latest guaranteed prices — our latest special offers — details of new projects and new lines. Send 30p for the next six issues (5p discount voucher with each copy).



POST THIS COUPON NOW FOR YOUR COPY OF OUR CATALOGUE PRICE 60p

Please rush me a copy of your 216 page catalogue. I enclose 60p, but understand that if I am not completely satisfied I may return the catalogue to you within 14 days and have my 60p refunded immediately.

NAME ....

ADDRESS ....

....

REC