RADIO & ELECTRONICS CONSTRUCTOR

APRIL 1975

30p

FOUR CHANNEL SYNTHESISER

PART ONE

SPATIAL SOUND FROM STEREO AT LOW COST

ALSO FEATURED

SMALL CAPACITANCE CHECKER

HAND TREMOR DETECTOR

Each £3 unit of Home Unit Insurance gives you protection up to the limit shown

This is the simplified insurance you have been waiting for. Not just cover on the contents of your home but a package of personal protection you and your family need. And it's how we save you so much money: just ONE policy to issue instead of nine!
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The Home Unit Policy can replace your existing insurances And remember – as you buy more possessions just add more Home Units at any time. *Quote Ref. 20/9468*

THE GENERAL ACCIDENT FIRE & LIFE ASSURANCE CORPORATION LTD

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It pays to be protected by a General Accident company

Please send me further particulars of the Home Unit Insurance.

Name.....

Address.....

.....

.....

20/9468

COMPONENTS

HOBBYIST - PROFESSIONAL - DOMESTIC - SURPLUS - INDUSTRIAL
JUST A FEW OF OUR BARGAINS ARE LISTED BELOW - SEND STAMPED ADDRESSED ENVELOPE FOR A QUOTE ON OTHER REQUIREMENTS. PAY US A VISIT. OVER 90% OF STOCK BELOW QUANTITY WHOLESALE PRICE.

Goods sent at customer's risk, unless sufficient payment for insurance included (2p per £1 Min 5p) U.K. only.

VALVE BASES

Printed circuit B9A – B7G	4p
Chassis B7 – B9G – B7G	4p
Shrouded chassis B7G – B9A	6p
B8A – B9A chassis – B12A tube	6p

TAG STRIP – 6 way **3p** | 9 way **5p** Single **1p**

WRIST COMPASS **30p** with Needle Lock

TO3 Mica Washer **2p**

18 volt 4 amp charger, bridge rectifies **50p**

GC10/4B Cold Cathode **£3.00**

Telescopic aerial
Closed 9½", open 38½" Fitted right angle TV plug, **50p**

1¼ glass fuses— 250 m/a or 3 amp (box of 12)	18p
3" tape spools	8p
Brand new Boxed 6K7G	25p
PVC or metal clip on M.E.S. bulb holder	5p
Geared Knob, Inner to Outer Ratio 8:1	60p
Bulgin, 5mm Jack plug and switched socket (pair)	30p
12 volt solenoid and plunger	40p
250 RPM 50 c/s locked frequency miniature mains motor	50p
200 OHM coil, 2¼" long, hollow centre	10p
Belling Lee white plastic surface coax outlet Box	30p
R.S. 12 way standard plug and shell	30p

SWITCHES

Pole	*Way*	*Type*	
4	2	Sub. Min. Slide	18p
6	2	Slide	20p
4	2	Lever Slide	15p
2	2	Slide	10p
1	3	+ off Sub. min. edge	10p
1	3	13 amp small rotary	12p
2	2	Locking with 2 to 3 keys	£1.50
2	1	2 Amp 250V A.C. rotary	16p
1	2	Toggle	10p
Wafer Rotary, all types			30p

Speaker, 6" x 4", 5 ohm, ideal for car radio etc. **£1**

COMPUTER AND AUDIO BOARDS

VARYING PANELS WITH ZENER, GOLD BOND, SILICON, GERMANIUM, LOW AND HIGH POWER TRANSISTORS AND DIODES, HI STAB RESISTORS, CAPACITORS, ELECTROLYTICS, TRIMPOTS, POT CORES, CHOKES ETC.

3lb. for **85p** + **40p** post and packing
7lb for **£1.75** + **60p** post and packing

Skeleton Presets
Slider, horizontal or vertical standard or submin. **5p**

Clear Plastic Boxes
For component storage or projects, sliding lid. 1¾" x 1½" x 1" **10p**

KNOBS

SILVER METAL PUSH ON WITH POINTER, OR WHITE PLASTIC, GRUB SCREW. WITH POINTER AND SILVER CENTRE **8p** EACH.

ZM1162A INDICATOR TUBE

0-9 Inline End View. Rectangular Envelope 170V 2.5M/A **£2.00**

RESETTABLE COUNTER

English Numbering Machines LTD.
MODEL 4436-159-989
6–14 volt, 6 digit, illuminated, fully enclosed. **£2.50**

PIANOKEY SWITCH UNIT

5 lever, interlocking 2 pole mains + 3 pole 2 way + 3 of 6 pole 2 way **15p**

RESISTORS

⅛–¼–½ watt	1p
1 watt	2p
Up to 5 watt wire	10p
10 watt wire wound	12p
15 watt	14p

Philips transformer, safety fused. In 200-220-240v. Out 240v 60ma + 6.3v 1a approx 2" x 2¼" x 2½" **£1.50**

POTS

Log or Lin carbon	12p
Switched	23p
Dual Pots	38p
Dual & switch	50p
Lin wirewound	25p
Slider Pot	26p
Dual Slider	45p

THERMISTORS

VA1008, VA1034, VA1039, VA1040, VA1055, VA1066, VA1082, VA1100 — **7p**

VA1077, **10p**

VA1005, VA1026 **15p**

PARMEKO P480

6000/55, 20 Henry ·12A, potted choke **60p**

RELAYS

12 volt S.P.C.O. octal mercury wetted high speed **75p**

P.O. 3000 type, 1,000 OHM coil, 4 pole c/o **60p**

ELECTROLYTICS MFD/VOLT. Many others in stock

Up to 10V MFD	25V	50V	75V	100V	250V	350V	500V
10	4p	5p	6p	8p	8p	12p	16p	20p
25	4p	5p	6p	8p	8p	15p	18p	20p
50	4p	5p	6p	9p	13p	18p	—	—
100	5p	6p	10p	12p	19p	20p	—	—
250	9p	10p	11p	17p	28p	—	—	—
500	10p	11p	17p	24p	45p	—	—	—
1000	13p	17p	40p	—	—	—	—	—
2000	23p	37p	45p	—	—	—	—	—

As total number of values are too numerous to list, use this price guide to work out cost of your actual value requirements, i.e. 2MFD, 30V would be 5p, or 330MFD, 50V would be 14p, etc. etc.

8/20, 10/20, 12/20 **Solid tantalum 15p each**
16–32/275, 32–32/275, 100–100/150, 100–100/275 50–50/300 **20p each**
12,000/12, 32–32–50/300, 700/200, 100–100–100–150–150/320 **50p each**
20–20–20/350 **40p each**

INDICATORS

Bulgin D676 red, takes M.E.S. bulb	20p
12 volt red, small pushfit	20p
Mains neon, red, pushfit	16½p

CAPACITOR GUIDE – maximum 500V

Up to .01 ceramic **2p**. Up to .01 poly **3p**. Up to 1000PF silver mica **5p**. 1,200PF up to .01 silver mica **10p**. .013 up to .25 poly etc. **4p**. .27 up to .68 poly etc. **6p**

Over 500 volt order from above guide and few others listed below.

6p. .1/600: **10p**. .01/1000, 1/350, 8/20, .1/900, .22/900, 4/16. .25/250 AC (600vDC) .1/1500 **40p**. 5/150, 9/275AC, 10/150, 15/150, 40/150.

TRIMMERS, 20p each

100PF Ceramic, 30PF Beehive, 12PF PTFE 2500PF 750 volt, 33PF MIN. AIR SPACED 5PF, MIN. AIR SPACED, 50PF CERAMIC.

CONNECTOR STRIP

Belling Lee L1469, 4 way polythene. **3p each**

Strong grey plastic box same design as die cast ali 4⅜" x 2⅜" x 1¼" **40p**

1" or 1½" or ¼" **CAN CLIPS** **2p**

MAINS DROPPERS

36 + 79 ohm	20p
66 + 66 + 158 ohm, 66 + 66 + 137 ohm, 17 + 14 + 6 ohm, 266 + 14 + 193 ohm	25p
50 + 40 + 1k5 ohm; 285 + 575 + 148 + 35 ohm; 25 + 35 + 97 + 59 + 30 ohm	35p

5¼" x 2¾" Speaker, ex-equipment 3 ohm	30p
2 Amp Suppression Choke	5p
3 x 2½ x ¼" **PAXOLINE**	2p
4⅜ x ½ x ⅛"	2 for 1p
220K & 100 ohm 3 watt resistors	4p
VALVE RETAINER CLIP, adjustable	2p

OUTPUT TRANSFORMERS

Sub-miniature Transistor Type	25p
Valve type, centre tapped or straight	40p

3 pin din to open end, 1½yd twin screened lead **35p**

Whiteley Stentorian 3 ohm constant impedance volume control way below trade at **£1**

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SEMICONDUCTORS

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

AC107	14p	BC178A/B	13p	BF194A	12p
AC127/	11p	BC179B	14p	BF200	20p
AC128/176	8p	BC186/7	20p	BF262/3	23p
ACY28	18p	BC213L	10p	BF336	25p
AD149	40p	BC337/8	14p	BFX29/30	25p
AD161/2 matched pr.	69p	BC547/558A	11p	BFX84/88	20p
AF116/7	12p	BCY40	60p	BFY50/1/2	11p
AF124/6/7	20p	BCY70/1/2	12p	BFY90	50p
AF139/178	30p	BD112/3/5/6	50p	BR101 } Programmable Unj Junction	30p
AF180/1	30p	BD131	24p	BRY39 } Programmable Unj Junction	34p
AF239	20p	BD132	30p	BRY56 } Programmable Unj Junction	34p
ASY27/73	25p	BD135	28p	BSV64	40p
BC107A or B	9p	BD201/2/3/4	£1.00	BSX21	18p
BC107/8/9	8p	BD232/4/5	49p	BU105/01	£1.50
BC108A/B/109B/C	10p	BDX77	£1.40	CA3001	£1.00
BC147/8/9	7p	BF115	15p	CV7042 (OC41 OC44,	
BC147A/B	8p	BF167/173	20p	ASY63)	10p
BC148A/B, 9B/C/S	8p	BF178/9	25p	GET111	40p
BC157/8/9	9p	BF180/1/2/3	22p	OC35	32½p
BC158A/B	11p	BF184/5	15p	ON222	30p
BC159B/C, 157A	11p	BF194/5/6/7	8p	SN7483	82p

BRIDGE RECTIFIERS

Amp	Volt			Amp	Volt		
½	1,600	BYX10	30p	2	30	LT120 type	30p
1	140	OSH01-200	30p	0.6	110	EC433	15p
1.4	42	BY164	35p	5	400	IB40K05 Texas	75p

1 AMP RECTIFIERS

IN4004	400 volt	6p
IN4005	600 volt	6p
IN4006	800 volt	7p
IN4007	1,000 volt	7p

HIGH POWER RECTIFIERS

	Amp	Volt	
SR100	1.5	100	7p
SR400	1.5	400	8p
LT102	2	30	10p
BYX38-600	2.5	600	40p
BYX38-300R	2.5	300	36p
BYX38-900	2.5	900	45p
BYX38-1200	2.5	1,200	50p
BYX49-600	2.5	600	34p
BYX49-300	2.5	300	26p
BYX49-900	2.5	900	40p
BYX49-1200	2.5	1,200	52p
BYX48-300	6	300	40p
BYX48-600	6	600	50p
BYX48-900	6	900	60p
BYX48-1200	6	1,200	80p
BYX72-150R	10	150	35p
BYX72-300R	10	300	45p
BYX72-500R	10	500	55p
BYX42-300	10	300	45p
BYX42-600	10	600	65p
BYX42-900	10	900	80p
BYX42-1200	10	1,200	95p
BYX46-300*	15	300	£2.00
BYX46-400*	15	400	£2.50
BYX46-500*	15	500	£2.75
BYX46-600*	15	600	£3.00
BYX20-200	25	200	60p
BYX52-300	40	300	£1.75
BYX52-1200	40	1,200	£2.50

Avalanche type

RG4-1250 Mercury vapour rectifier £5.00

1" Terryclips chrome finish 4p

Cinch 10-way terminal block 15p

Pair of LA2407 Ferrox cores with adjuster 25p

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

DLI Pal Delayline 80p

Relay socket 10p
Take miniature 2PCO relay

B7G or B9A valve can 2p

0-30, or 0-15, black pvc, 360° dial, silver digits, self adhesive, 4¼" dia. 10p

OPTO ELECTRONICS

ORP12	44p	Photo transistor	
BPX40	65p	BPX29	£1.00
BPX42	£1.50	OCP71	35p
BPY10 (VOLTIAC)	£1.00	BIG L.E.D. 0.2" 2v 50m/A max.	
BPY68 } BPY69 } BPY77 } Diodes	£1.00	RED	15p
		ORANGE GREEN YELLOW	16p

F.E.T's

BFW10	45p
BSV79	£1.00
BSV80	90p
N. Channel	
BSV81 M.O.S.T.	90p
BFS28 Dual M.O.S.T.	92p

Wire ended glass neons 5p

650 m/h 2amp. 2ohm chokes 60p

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

Philips Iron Thermostat 15p
Bulgin 2-pin flat plug and socket 10p
McMurdo PP108 8 way edge plug 10p

TO3 HEATSINK

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

Tested unmarked, or marked ample lead ex new equipment

ACY17-20	8p	OC71/2	5p
ASZ20	8p	OC200-5	10p
ASZ21	15p	TIC44	24p
BC186	11p	2G240	2-50
BCY30-34	10p	2G302	6p
BCY70/1/2	8p	2G401	10p
BF115	10p	2N711	25p
BY127	8p	2N2926	7p
BZY88 series	5p	2N598/9	6p
HG1005	2p	2N1091	8p
HG5009	2p	2N1302	8p
HG5079	2p	2N1907	2-50
L78/9	2p	Germ. diode	1p
M3	10p	GET120 (AC128 in 1" sq. heat sink)	20p
OA81	3p	GET872	12p
OA47	2p		
OA200-2	3p		
OC23	20p		

TAA570	£1.20	2N2219	18p
TAD100	£1.00	2N2401 (ASY26-27)	20p
2G302	15p	2N2904/5/6/7	13p
2N393/MA393	30p	2N2907A	15p
2N706	8p	2N3053	13p
2N987	35p	2N3055 (992)	33p
2N1091	45p	741 8 pin dil	25p
2N1302	15p		

THYRISTORS

Amp	Volt		
1	240	BTX18-200	50p
1	400	BTX18-300	65p
1	240	BTX30-200	40p
6.5	500	BT102-500R	75p
10	700	BT106	85p
15	500	BT107	£1.00
6.5	500	BT101-500R	90p
6.5	500	BT109-500R	90p
20	600	BTW92-600RM	£3.00
15	800	BTX95-800R Pulse Modulated	£10.00

OTHER DIODES

IN916	6p	BA182	24p
IN4148	4p	OA5/7/10	10p
BA145	14p	BZY88 Up to 33 volt	7p
Centercel	10p	BZX61 11 volt	16p
BZY61	10p	BR100 Diac.	19p

TRIACS

Amp	Volt		
6	400	Plastic	90p
25	900	BTX94-900	£5.00
25	1200	BTX94-1200	£7.00

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

WESTINGHOUSE 28TIO 30 AMP 1000 VOLT THYRISTER WITHOUT NUT £4

PHOTO SILICON CONTROLLED SWITCH
BPX66 PNPN 10 amp £1.00

.3" red 7 segment L.E.D. 14 D.I.L. 0-9 + D.P. display 1.9v, 10m/a segment 93p

PAPER BLOCK CONDENSER

0.25MFD	800 volt	30p
1MFD	250 volt	15p
2MFD	250 volt	20p
2MFD	1.5 kv	50p
4MFD	250 volt	20p
15MFD	150 volt	50p

METAL CHASSIS SOCKETS

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

8 way Cinch standard 0.15 pitch edge socket 20p

U.E.C.L. 10 way pin connector 2B6000 OA1P10 10p

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

U.E.C.L. 10 way pin socket 2B606001R10 10p

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

BELLING LEE L1354 TV Aerial diplexer 10p

Philips electronic engineer kits add on series E1004 £1.00 each (parts worth more)

SOLDER
Multicore - 2½p foot

ENAM. COPPER WIRE SWG.	PER YD.
18	3p
20-24	2p
26-42	1p

TAA300 T0-74 1 Watt A.F. AMPLIFIER I.C. 4·5 to 9v £1.25

GARRARD
GCS23T Crystal Stereo Cartridge £1.00

HANDLES

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

Rotor with neon indicator, as used in Seafarer, Pacific, Fairway depth finders 20p each

Miniature Axial Lead Ferrite Choke formers 2p

DEE PLUG

McMurdo DA15P 15 way chassis plug 15p

Fairway 18009 Coax. socket 3p

TIE CLIPS

Nylon self locking 7" or 3½" 2p

CINCH 150

12 way edge socket 10p

1lb Mixed nuts, bolts, washers etc. 35p

SMALL ORDERS, ENCLOSE SUITABLE STAMPED ADDRESSED ENVELOPE
LARGE ORDERS, ADD SUFFICIENT FOR POSTAGE, INSURANCE, ETC.
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No matter how little you know now, no matter what your background or education, we'll teach you. Step by step, in simple easy-to-understand language, you pick up the secrets of radio and electronics.

You become a man who makes things, not just another of the millions, who don't understand. And you could pave the way to a great new career, to add to the thrill and pride you receive when you look at what you have achieved. Within weeks you could hold in your hand your own transistor radio. And after the course you can go on to acquire highpowered technical qualifications, because our famous courses go right up to City & Guilds levels.

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BIET

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Products include the broad range of TOKO's coils and filters. (Ceramic, mechanical & LC). VHF tunerheads, **Linear and digital ICs**, like RCA 3123E for AM, and 3089E for FM, 7800 series three terminal voltage regulators for 5,12 & 18v, the Fairchild 95H90 250MHz decade divider for frequency meter prescalers etc.

There is much more in the full datalogue than we have room to show here: if you want a sample of the complete range, then send us an SAE and we send you a copy of the full price list, which has brief details of the complete range.

FROM TOKO :

CERAMIC FILTERS FOR RADIO: 455&470 kHz

CFT455B (8kHz BW) CFT455C (6kHz BW)	£0:45
CFT470C (6kHz BW) CFU470C(6kHz Hi Q)	£0.50
CFS10.7M (WBFM at 10.7MHz-sim.to FM4)	£0.40
CFK10.7 (WBFM at 10.7MHz with IFT)	£0.60

MECHANICAL FILTERS FOR 455 kHz:

MFH41T (4kHz BW) & MFH71T (7 kHz BW)	£1.35

COILS FOR IFs OSCs RF etc

455/470 kHz IFT with capacitor (10 or 7mm)	£0.27
Sets of 1st, 2nd & 3rd IFT either 7 or 10mm	£0.60
10.7 MHz IFTs with capacitor, set of four	£0.85
10.7 MHz IFTs (individually)	£0.30

Remember that all our coils have the TOKO stamp of quality. Full data available, continuity of supplies is assured.

SEMICONDUCTORS:

All brand new guaranteed first quality types bearing the manufacturers own mark. No seconds.

CA3089E	1.94	CA3090AQ	3.75	CA3123E	1.40
ICL8038CC	**3.10**	**MC1310P**	**2.80**	**TBA120A**	**0.75**
7805UC	1.55	7818UC	1.55	78L12	0.45
TBA651	1.81	TBA810S	1.30	CT7001	9.80
NE560/1/2	3.19	NE565/7	2.75	NE566	2.55
40673/MEM616	0.50	BF256LB/TIS88A	0.34		

MODULES: (ready built & tested)

7252 FM radio receiver module. 1uV in for 26dB S/N at the recovered audio. Varicap tuned, double MOSFET head, with ceramic filters, two ICs in the IF & detector from Larsholt electronics of Denmark £20.00

93090AQ The CA3090AQ with audio preamps and TOKO pilot tone filter £7.60

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BRAND NEW FULLY GUARANTEED DEVICES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC107	0.22	AD162	0.39	BC152	0.19	BD135	0.44	BFI87	0.30	MPF105	0.41	2G308	0.39	2N2193	0.39	2N3391A	0.18	2N4060	0.13
AC113	0.20	ADT140	0.55	BC153	0.31	BD136	0.44	BFI88	0.14	OC19	0.39	2G309	0.39	2N2194	0.39	2N3392	0.16	2N4061	0.13
AC115	0.22	AF114	0.27	BC154	0.33	BD137	0.50	BFI91	0.13	OC20	0.70	2G339	0.22	2N2217	0.24	2N3393	0.16	2N4062	0.13
AC117K	0.32	AF115	0.27	BC157	0.20	BD138	0.55	BFI95	0.13	OC22	0.52	2G339A	0.18	2N2218	0.22	2N3394	0.16	2N4284	0.19
AC122	0.13	AF116	0.27	BC158	0.13	BD139	0.61	BFI96	0.16	OC23	0.54	2G344	0.20	2N2219	0.22	2N3395	0.19	2N4285	0.19
AC125	0.19	AF117	0.27	BC159	0.13	BD140	0.66	BFI97	0.16	OC24	0.62	2G345	0.18	2N2220	0.24	2N3402	0.23	2N4286	0.19
AC126	0.19	AF118	0.39	BC160	0.50	BD175	0.88	BF200	0.50	OC25	0.42	2G371	0.18	2N2221	0.22	2N3403	0.23	2N4287	0.19
AC127	0.20	AF124	0.33	BC161	0.55	BD175	0.66	BF222	£1.05	OC26	0.32	2G371B	0.19	2N2222	0.22	2N3404	0.31	2N4288	0.19
AC128	0.20	AF125	0.31	BC167	0.13	BD176	0.66	BF257	0.50	OC28	0.55	2G373	0.19	2N2368	0.19	2N3405	0.46	2N4289	0.19
AC132	0.16	AF126	0.31	BC168	0.13	BD177	0.72	BF258	0.66	OC29	0.55	2G374	0.19	2N2369	0.16	2N3414	0.17	2N4290	0.19
AC134	0.16	AF127	0.31	BC169	0.13	BD178	0.72	BF259	0.94	OC35	0.46	2G377	0.33	2N2369A	0.16	2N3415	0.17	2N4291	0.19
AC137	0.16	AF139	0.33	BC170	0.13	BD179	0.77	BF262	0.61	OC36	0.55	2G378	0.18	2N2411	0.27	2N3416	0.31	2N4292	0.19
AC141	0.20	AF178	0.55	BC171	0.16	BD180	0.77	BF263	0.61	OC41	0.22	2G381	0.18	2N2412	0.27	2N3417	0.31	2N4293	0.19
AC141K	0.32	AF179	0.55	BC172	0.16	BD183	0.72	BF270	0.39	OC42	0.27	2G382	0.18	2N2646	0.52	2N3525	0.83	2N5172	0.13
AC142	0.20	AF180	0.55	BC173	0.16	BD186	0.72	BF271	0.33	OC44	0.17	2G401	0.33	2N2711	0.23	2N3614	0.74	2N5294	0.60
AC142K	0.28	AF181	0.55	BC174	0.16	BD187	0.77	BF272	0.88	OC45	0.14	2G414	0.33	2N2712	0.23	2N3615	0.82	2N5457	0.35
AC151	0.17	AF186	0.55	BC175	0.24	BD188	0.77	BF273	0.39	OC70	0.11	2G417	0.28	2N2714	0.23	2N3616	0.82	2N5458	0.35
AC154	0.22	AF239	0.41	BC177	0.21	BD189	0.83	BF274	0.39	OC71	0.11	2N388	0.39	2N2904	0.19	2N3643	0.10	2N5459	0.44
AC155	0.22	AL102	0.72	BC178	0.21	BD190	0.83	BFW10	0.66	OC72	0.16	2N388A	0.61	2N2904A	0.23	2N3702	0.13	2N6221	0.75
AC156	0.22	AL103	0.72	BC179	0.21	BD195	0.94	BFX29	0.30	OC74	0.16	2N404	0.22	2N2905	0.23	2N3703	0.13	2N8301	0.55
AC157	0.27	ASY26	0.28	BC180	0.27	BD196	0.94	BFX84	0.24	OC75	0.17	2N404A	0.31	2N2905A	0.23	2N3704	0.14	2S302A	0.46
AC165	0.22	ASY27	0.31	BC181	0.27	BD197	0.99	BFX85	0.33	OC76	0.17	2N524	0.46	2N2906	0.17	2N3705	0.13	2S302	0.46
AC166	0.22	ASY28	0.28	BC182	0.16	BD198	0.99	BFX86	0.24	OC77	0.28	2N527	0.54	2N2906A	0.20	2N3706	0.13	2S303	0.62
AC167	0.22	ASY29	0.28	BC182L	0.16	BD199	£1.05	BFX87	0.27	OC81	0.17	2N598	0.46	2N2907	0.22	2N3707	0.14	2S304	0.77
AC168	0.27	ASY50	0.28	BC183	0.16	BD200	£1.05	BFX88	0.24	OC81D	0.17	2N599	0.50	2N2907A	0.24	2N3708	0.09	2S305	0.86
AC169	0.16	ASY51	0.28	BC183L	0.16	BD205	0.88	BFY50	0.22	OC82	0.17	2N696	0.14	2N2923	0.16	2N3709	0.10	2S306	0.86
AC176	0.22	ASY52	0.28	BC184	0.22	BD206	0.88	BFY51	0.22	OC82D	0.17	2N697	0.15	2N2924	0.16	2N3710	0.10	2S307	0.86
AC177	0.27	ASY53	0.28	BC184L	0.22	BD207	£1.05	BFY52	0.22	OC83	0.22	2N698	0.27	2N2925	0.16	2N3711	0.10	2S321	0.62
AC178	0.31	ASY55	0.28	BC186	0.31	BD208	£1.05	BFY53	0.19	OC139	0.22	2N699	0.39	2N2926(G)	0.14	2N3819	0.31	2S322	0.46
AC179	0.31	ASY56	0.28	BC187	0.31	BDY20	£1.10	BSX19	0.17	OC140	0.22	2N706	0.09	2N2926(Y)	0.12	2N3820	0.55	2S322A	0.46
AC180	0.22	ASY57	0.28	BC207	0.12	BF115	0.27	BSX20	0.17	OC169	0.28	2N706A	0.10	2N2926(O)	0.11	2N3821	0.39	2S323	0.62
AC180K	0.32	ASY58	0.28	BC208	0.12	BF117	0.50	BSY25	0.17	OC170	0.28	2N708	0.13	2N2926(R)	0.11	2N3823	0.31	2S324	0.77
AC181	0.22	ASY73	0.28	BC209	0.13	BF118	0.77	BSY26	0.17	OC171	0.28	2N711	0.33	2N2926(B)	0.11	2N3903	0.31	2S325	0.77
AC181K	0.32	ASZ21	0.44	BC212L	0.14	BF119	0.77	BSY27	0.17	OC200	0.28	2N717	0.39	2N3040	0.77	2N3904	0.33	2S326	0.77
AC187	0.24	BC107	0.09	BC213L	0.14	BF121	0.50	BSY28	0.17	OC201	0.31	2N718	0.27	2N3041	0.16	2N3905	0.31	2S327	0.77
AC187K	0.25	BC108	0.09	BC214L	0.18	BF123	0.55	BSY29	0.17	OC202	0.31	2N718A	0.55	2N3053	0.19	2N3906	0.30	2S701	0.46
AC188	0.24	BC109	0.09	BC225	0.28	BF125	0.50	BSY38	0.20	OC203	0.28	2N720	0.31	2N3054	0.51	2N4058	0.13	40361	0.44
AC188K	0.25	BC113	0.11	BC226	0.39	BF127	0.55	BSY39	0.20	OC204	0.28	2N727	0.31	2N3055	0.45	2N4059	0.11	40362	0.50
ACY17	0.28	BC114	0.17	BC301	0.30	BF152	0.61	BSY40	0.31	OC205	0.39	2N743	0.22	2N3391	0.16				
ACY18	0.22	BC115	0.17	BC302	0.27	BF153	0.50	BSY41	0.31	OC309	0.44	2N744	0.22						
ACY19	0.22	BC116	0.17	BC303	0.35	BF154	0.50	BSY95	0.14	OC171	0.48	2N914	0.16						
ACY20	0.22	BC117	0.20	BC304	0.40	BF155	0.77	BSY95A	0.14	ORP12	0.48	2N918	0.33						
ACY21	0.22	BC118	0.11	BC440	0.34	BF156	0.53	BU105	£2.20	ORP60	0.44	2N929	0.23						
ACY22	0.18	BC119	0.33	BC460	0.40	BF157	0.61	CIFFE	0.55	ORP61	0.44	2N930	0.23						
ACY27	0.20	BC120	0.88	BC300	0.27	BF158	0.61	G400	0.33	P20	0.55	2N1131	0.22						
ACY28	0.21	BC125	0.13	BCY31	0.29	BF159	0.66	G407	0.28	P346A	0.22	2N1132	0.24						
ACY29	0.39	BC126	0.20	BCY32	0.33	BF160	0.44	G424	0.28	P397	0.46	2N1302	0.16						
ACY30	0.31	BC132	0.13	BCY33	0.24	BF162	0.44	G425	0.55	ST140	0.14	2N1303	0.16						
ACY31	0.31	BC134	0.20	BCY34	0.28	BF163	0.44	G426	0.39	ST141	0.19	2N1304	0.19						
ACY34	0.23	BC135	0.13	BCY70	0.16	BF164	0.44	G428	0.22	TIP29	0.48	2N1305	0.19						
ACY35	0.23	BC136	0.17	BCY71	0.22	BF165	0.44	G441	0.33	TIP30	0.56	2N1306	0.23						
ACY36	0.31	BC137	0.17	BCY72	0.16	BF167	0.24	G442	0.33	TIP31A	0.60	2N1307	0.23						
ACY40	0.19	BC139	0.44	BCZ10	0.22	BF173	0.24	G444	0.39	TIP32A	0.73	2N1308	0.26						
ACY41	0.20	BC140	0.33	BCZ11	0.28	BF176	0.39	G450	0.24	TIP41A	0.73	2N1309	0.26						
ACY44	0.39	BC141	0.33	BCZ12	0.28	BF177	0.39	MAT100	0.21	TIP42A	0.88	2N1613	0.22						
AD140	0.42	BC142	0.33	BD115	0.68	BF178	0.33	MAT101	0.22	TIS43	0.34	2N1711	0.22						
AD140	0.53	BC143	0.33	BD116	0.88	BF179	0.33	MAT120	0.21	UT46	0.30	2N1889	0.35						
AD142	0.53	BC145	0.50	BD121	0.66	BF180	0.33	MAT121	0.22	ZN414	£1.20	2N1890	0.50						
AD143	0.42	BC147	0.11	BD123	0.72	BF181	0.33	MJE2955	0.95	2G301	0.21	2N1893	0.41						
AD149	0.55	BC148	0.11	BD124	0.76	BF182	0.44	MJE3055	0.62	2G302	0.21	2N2147	0.79						
AD161	0.39	BC149	0.13	BD131	0.55	BF183	0.44	MJE5000	0.55	2G303	0.21	2N2148	0.63						
AD161 & AD162(MP)	0.75	BC150	0.20	BD132	0.66	BF184	0.28	MPF102	0.46	2G304	0.27	2N2160	0.66						
		BC151	0.22	BD133	0.72	BF185	0.33	MPF104	0.41	2G306	0.44	2N2102	0.39						

DIODES AND RECTIFIERS

Type	Price	Type	Price	Type	Price
AA119	0.09	BY128	0.17	OA10	0.15
AA120	0.09	BY130	0.18	OA47	0.06
AA129	0.09	BY133	0.23	OA70	0.06
AAY30	0.10	BY164	0.55	OA79	0.08
AAZ13	0.11	BYX38/300	0.46	OA81	0.08
BA100	0.11	BYZ10	0.39	OA85	0.10
BA116	0.23	BYZ11	0.33	OA90	0.07
BA126	0.24	BYZ12	0.33	OA91	0.07
BA148	0.16	BYZ13	0.28	OA95	0.08
BA154	0.23	BYZ16	0.44	OA200	0.07
BA155	0.16	BYZ17	0.39	OA202	0.08
BA156	0.15	BYZ18	0.39	SD10	0.06
BA173	0.16	BYZ19	0.31	SD19	0.06
BY100	0.17	CG62		1N34	0.08
BY101	0.13	(OA91Eq)	0.06	1N34A	0.08
BY105	0.19	CG651 (OA70		1N914	0.06
BY114	0.13	791	0.07	1N916	0.06
BY124	0.13	OA5	0.39	1N4148	0.06
BY126	0.16	OA5 short		1S021	0.11
BY127	0.17	leads	0.23	1S951	0.07
BI104		Varicap back-to-back			0.16

LINEAR I.C's—FULL SPEC.

Type No.	1	25	100 +
	Price		
72702	0.50	0.48	0.45
72709	0.25	0.23	0.20
72709C	0.20	0.19	0.18
72710	0.35	0.33	0.30
72741	0.30	0.29	0.28
72741C	0.28	0.27	0.25
72741P	0.30	0.29	0.28
72747	0.85	0.80	0.75
72748DIL	0.38	0.36	0.34
SL201C	0.50	0.45	0.40
SL701C	0.50	0.45	0.40
SL702C	0.50	0.45	0.40
TAA263	0.80	0.70	0.60
TAA293	£1.00	0.95	0.90
TAA570A	£1.85	£1.80	£1.70
μA703C	0.28	0.26	0.24
μA709C	0.20	0.19	0.18
μA711	0.35	0.33	0.30
μA712	0.35	0.33	0.30
TBA800	£1.50	£1.45	£1.40
76003	£1.50	£1.45	£1.40
76023	£1.50	£1.45	£1.40
76000	0.95	0.93	0.90
LM380	£1.00	0.97	0.95
NE555	0.65	0.63	0.60
NE556	0.95	0.93	0.90
ZN414	£1.20		

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Comprises three 66 bit 2 ϕ dynamic shift registers with independent inputs and outputs. TTL compatibility and buffered clock lines to reduce the capacitive load presented at the clock pins. A load-strapped buffer ensures a full logic swing at the output.

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BP932	0.16	0.15	0.14
BP933	0.16	0.15	0.14
BP935	0.16	0.15	0.14
BP936	0.16	0.15	0.14
BP944	0.16	0.15	0.14
BP945	0.30	0.28	0.25
BP946	0.15	0.14	0.13
BP948	0.30	0.28	0.25
BP951	0.70	0.65	0.60
BP962	0.15	0.14	0.13
BP8093	0.45	0.43	0.40
BP8094	0.45	0.43	0.40
BP8097	0.45	0.43	0.40
BP8099	0.45	0.43	0.40

Devices may be mixed to qualify for quantity price. Larger quantity price on application (DTL 930 Series only).

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TO-3 Plastic 1.5 Amps

μA7805 (12V, 5V (Equiv. to MAR5A)) £1.35
μA7812 (30V, 12V (Equiv. to MAR12A)) £1.35
μA7815 (35V, 15V (Equiv. to MAR15A)) £1.35
μA7818 £1.35

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BPS 14	16p	14p	12p
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7401	0.15	0.14	0.13	7450	0.15	0.14	0.13	74123	0.75	0.73	0.70
7402	0.15	0.14	0.13	7451	0.15	0.14	0.13	74141	0.85	0.82	0.79
7403	0.15	0.14	0.13	7453	0.15	0.14	0.13	74145	£1.30	£1.25	£1.20
7404	0.15	0.14	0.13	7454	0.15	0.14	0.13	74150	£1.50	£1.40	£1.30
7405	0.15	0.14	0.13	7460	0.15	0.14	0.13	74151	£1.10	£1.05	£1.00
7406	0.39	0.34	0.31	7470	0.32	0.29	0.27	74153	£1.00	0.95	0.90
7407	0.39	0.34	0.31	7472	0.32	0.29	0.27	74154	£1.70	£1.65	£1.60
7408	0.25	0.24	0.23	7473	0.41	0.39	0.35	74155	£1.20	£1.15	£1.10
7409	0.25	0.24	0.23	7474	0.41	0.39	0.35	74156	£1.20	£1.15	£1.10
7410	0.15	0.14	0.13	7475	0.60	0.58	0.56	74157	£1.00	0.95	0.90
7411	0.25	0.24	0.23	7476	0.44	0.43	0.42	74160	£1.40	£1.35	£1.30
7412	0.28	0.27	0.26	7480	0.60	0.58	0.55	74161	£1.40	£1.35	£1.30
7413	0.32	0.31	0.30	7481	£1.10	£1.05	£1.00	74162	£1.40	£1.35	£1.30
7416	0.30	0.29	0.28	7482	0.90	0.85	0.80	74163	£1.40	£1.35	£1.30
7417	0.30	0.29	0.28	7483	£1.20	£1.15	£1.05	74164	£1.80	£1.75	£1.70
7420	0.15	0.14	0.13	7484	£1.00	0.97	0.95	74165	£1.80	£1.75	£1.70
7422	0.30	0.29	0.28	7485	£1.60	£1.55	£1.50	74166	£1.60	£1.55	£1.50
7423	0.40	0.39	0.38	7486	0.35	0.34	0.33	74174	£1.60	£1.55	£1.50
7425	0.40	0.39	0.38	7489	£4.00	£3.75	£3.50	74175	£1.10	£1.05	£1.00
7426	0.40	0.38	0.36	7490	0.65	0.63	0.60	74176	£1.25	£1.20	£1.15
7427	0.40	0.38	0.36	7491	£1.10	£1.05	£1.00	74177	£1.25	£1.20	£1.15
7428	0.45	0.42	0.40	7492	0.74	0.71	0.64	74180	£1.25	£1.20	£1.15
7430	0.15	0.14	0.13	7493	0.74	0.71	0.64	74181	£3.95	£3.85	£3.75
7432	0.40	0.38	0.36	7494	0.85	0.82	0.75	74182	£1.25	£1.20	£1.15
7433	0.42	0.40	0.38	7495	0.85	0.82	0.75	74184	£1.80	£1.75	£1.70
7437	0.35	0.32	0.30	7496	0.96	0.93	0.86	74190	£1.95	£1.90	£1.85
7438	0.35	0.32	0.30	74100	£1.50	£1.45	£1.40	74191	£1.95	£1.90	£1.85
7440	0.15	0.14	0.13	74101	0.60	0.58	0.55	74192	£1.95	£1.90	£1.85
7441	0.74	0.71	0.64	74105	0.60	0.58	0.55	74193	£1.95	£1.90	£1.85
7442	0.74	0.71	0.64	74107	0.44	0.42	0.40	74194	£1.30	£1.25	£1.20
7443	£1.20	£1.15	£1.10	74110	0.60	0.55	0.50	74195	£1.10	£1.05	£1.00
7444	£1.20	£1.15	£1.10	74111	0.90	0.88	0.85	74196	£1.20	£1.15	£1.10
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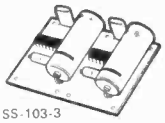

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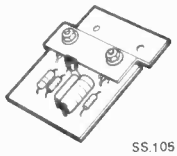

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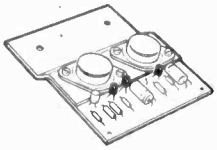

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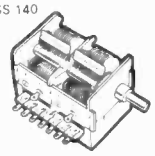

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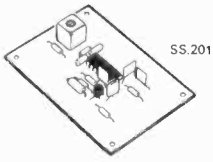

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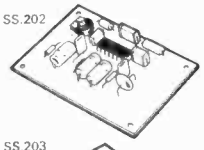

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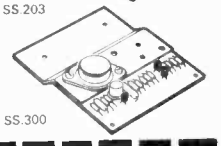

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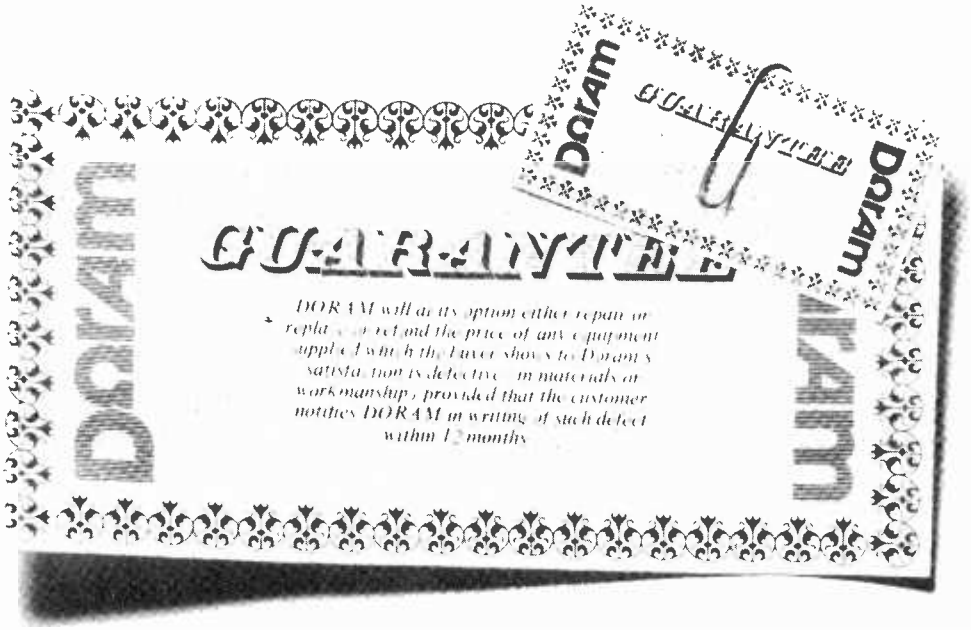

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Coral 8" d/cone, roll/surr. 8 ohm	£3.25
EMI 13 x 8, 3, 8 or 15 ohm	£2.25
EMI 13 x 8, d/cone 3, 8 or 15 ohm	£2.50
EMI 13 x 8 t/tw. 8 ohm	£3.75
EMI 13 x 8 type 350, 8 or 15 ohm	£8.25
EMI 13 x 8 20 watt bass	£6.60
EMI 5" 14A/730 mid-range 8 ohm	£2.50
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EMI 8 x 5, cer. mag. 8 ohm	£1.65
EMI 8 x 5, 10 watt, d/c roll/s 8 ohm	£2.50
EMI 10 x 6 93870 8 ohm	£2.25
EMI 2½" tweeter 8 ohm	.65
Elac 9 x 5, 59RM109 15 ohm, 59RM114 8 ohm	£2.80
Elac 6½" d/cone, roll surr. 8 ohm	£3.50
Elac 6½" d/cone 8 ohm	£2.65
Elac TW4 4" tweeter	£1.50
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Eagle CT10 tweeter 8 or 16 ohm	£2.55
Eagle DT33 dome tweeter 8 ohm	£5.45
Eagle FF5 3 way crossover	£3.15
Eagle 5N75 crossover with tw. control	£4.00
Eagle FF28 multicell, horn	£7.75
Eagle HT15 horn tw. 16 ohm	£3.80
Eagle HT21 horn tw. 8 ohm	£5.88
Eagle MHT10 horn tw. 8 ohm	£3.80
Eagle FR4 4" full range	£5.30
Eagle FR65 6½" full range	£8.35
Eagle FR8 8" full range	£10.65
Fane Pop 15 watt 12"	£5.25
Fane Pop 25T 30 watt 12"	£7.25
Fane Pop 50 watt 12"	£12.00
Fane Pop 55 12" 60 watt	£12.50
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SPEAKERS

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Fane Crescendo 12B 8 or 15 ohm	£30.00
Fane Crescendo 15, 8 or 15 ohm	£36.00
Fane Crescendo 18, 8 or 15 ohm	£51.95
Fane 701 twin ribbon horn	£35.00
Fane 910 horn	£12.75
Fane 920 horn	£33.00
Fane 152/12a 15" 15 ohm	£16.00
Fane 801T 8" d/cone roll surr.	£7.00
Fane 805T 8" d/cone roll surr.	£3.50
Fane 808T 8" d/cone	£2.75
Fane 807T 8" d/cone roll surr.	£3.85
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Goodmans 10P 8 or 15 ohm	£5.30
Goodmans 12P 8 or 15 ohm	£12.95
Goodmans 12P–D 8 or 15 ohm	£16.75
Goodmans 12P–G 8 or 15 ohm	£15.75
Goodmans 12AX 100 watt 8 or 15 ohm	£36.50
Goodmans 15AX 100 watt 8 or 15 ohm	£40.25
Goodmans 15P 8 or 15 ohm	£21.00
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Goodmans Midax 750	£16.00
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Goodmans Audiom 100, 8 or 15 ohm	£12.00
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Goodmans Twinaxiom 10" 8 or 15 ohm	£9.00
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Gauss 12" Bass 8 ohm	£69.50
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Gauss 15" Bass 8 ohm	£75.00
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Kef B200	£8.25
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Kef DN8	£2.00
Kef DN12	£4.95
Kef DN13	£3.30
Richard Allan 12" d/cone 3 or 15 ohm	£2.75
Richard Allan CG8T 8" d/c roll surr. 8 ohm	£6.35
STC 4001G super tweeter	£6.19
2½" 64 ohm, 70mm 8 ohm, 70mm 80 ohm	.65
2½" 75 ohm	.50
7" x 4" 3, 8 or 15 ohm	£1.40
8" x 5" 3, 8 or 15 ohm	£1.50
10" x 6" 3, 8 or 15 ohm	£2.30

SPEAKER KITS (Carr. 75p each. £1.50 pair)

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Goodmans Mezzo	pair	£45.00
Goodmans DIN 20 4 ohm	each	£9.75
Helme XLK25	pair	£22.00
Helme XLK30	pair	£14.95
Helme XLK50	pair	£39.95
Kefkit 1	each	£29.95
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Peerless 20/2	each	£14.95
Peerless 30/2	each	£20.95
Peerless 20/3	each	£22.95
Peerless 50/4	each	£34.95
Richard Allan Twinkit	each	£8.95
Richard Allan Triple 8	each	£13.75
Richard Allan Triple	each	£19.95
Richard Allan Super Triple	each	£23.75
Wharfedale Linton 2 kit	pair	£19.25
Wharfedale Glendale 3 kit	pair	£34.50
Wharfedale Dovedale 3 kit	pair	£52.50

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Linear 80/100	£58.95
Linear 100 watt slave	£44.00
Eagle PRO A120. 120 watts RMS	£129.00
Eagle PRO A65. 65 watts RMS	£98.50
Eagle PRO A35. 35 watts RMS	£77.00
Eagle TPA40 mains/12v mobile	£50.00
Eagle HH5 36 watts mobile 12v.	£37.50
Eagle TPA20 paging amplifier	£45.00
Eagle RA859 Reverb (p. & p. 75p)	£18.25
Eagle RA856 Reverb (p. & p. 75p)	£12.50

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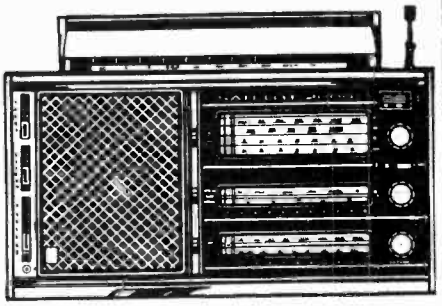

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kom-pre-*hense*-iv

As no doubt you've noticed, Home Radio Components Ltd. are always going on about how comprehensive their catalogue is! So out of interest I looked up the word in a dictionary. It said . . . . . "KOM-PRE-*HENSE*-IV, having the quality of comprising much; extensive; full."

Well, on that definition, the catalogue certainly lives up to their claim. In its 240 pages there are over 6,000 items listed and there must be getting on for a couple of thousand illustrations. What's more, to make it easy to find your way around, the catalogue is most carefully indexed, with cross references where necessary. Recently someone at Home Radio Components told me that they've sold over 150,000 copies of the catalogue. I'm not surprised! They also mentioned that many professional people in the world of radio and electronics regard it as a standard reference work. I don't know about the professionals, but I know lots of we amateur freaks would be quite lost without it.

But perhaps you have managed to struggle along so far without this invaluable catalogue. Why hamper yourself any longer? *Send off the coupon below with cheque or P.O. for 98 pence.* (65p plus 33p postage & packing). Every catalogue contains 14 vouchers each worth 5p when used as directed. This means that you can recover 70 pence, the whole cost of the catalogue plus 5p towards the postage. Needless to say, the catalogue is backed by a really good Mail Order Service.

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

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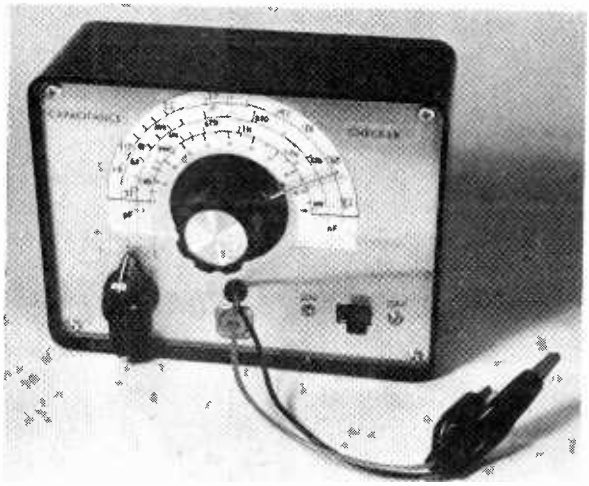


SMALL CAPACITANCE CHECKER

By A. P. Roberts

Incorporating an inexpensive bridge circuit without frills, this unit enables capacitance values from 6.8 to 2,000pF to be quickly measured.

IT IS SURPRISING HOW MANY COMPONENTS ONE ACCUMULATES in the spares box over the years. Among the most numerous and valuable of these are the various types of capacitor. When one operates mainly in the field of radio the majority of these capacitors are usually low value polystyrene, ceramic or silvered mica types, probably with a few variables and trimmers as well.

Unfortunately, even if these components are carefully stored, their identification markings, which usually just consist of a printed value and tolerance, often become erased. Variable and trimmer types are frequently not marked with a value, anyway.

CAPACITANCE BRIDGE

A simple capacitance bridge such as that described in this article can be a very useful addition to the workshop test gear since it enables the values of these capacitors to be established. It is also a very useful servicing aid where, for instance, one suspects that a small capacitor has become unserviceable and a definite check of its capacitance is required.

Three ranges are covered, and with the prototype these are 170 to 2,000pF, 33 to 410pF, and 6.8 to 85pF. These coverage figures are only approximate, and will vary slightly between one bridge and another due to the tolerances of the components used. The unit is very simple, being battery powered and employing only a single active device. Current consumption is a mere 1mA from a PP3 battery, which in consequence has a very long life.

BASIC BRIDGE

The design of the checker is based on a simple bridge circuit, and operation can best be explained by referring to the resistive Wheatstone bridge which is illustrated in Fig. 1(a).

The bridge is said to be balanced when no current flows through the meter and, under these conditions, R1/R2 is equal to R3/R4. This is because the potential dividing action in R1, R2 and in R3, R4 then causes the same fraction of the input voltage to be applied to the terminals of the meter. There is, in consequence, no voltage difference at the meter terminals and no current can flow throught it. With any other resistor value ratios the bridge will be unbalanced, and the meter needle will be deflected accordingly from its zero reading.

A development is shown in Fig. 1(b), in which an a.c. input at an audio frequency is used and the meter is replaced by headphones. Also, the resistors R3 and R4 are replaced by capacitors.

If R1 and R2 are of equal value the circuit will be balanced, as indicated by a null in the audio tone in the

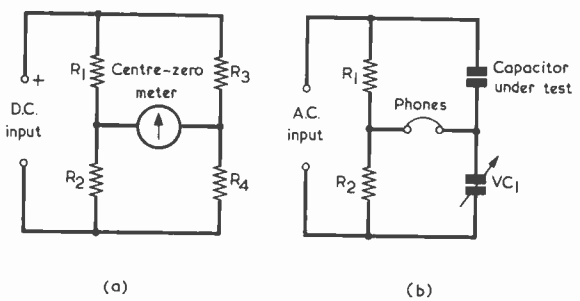


Fig. 1 (a). The basic Wheatstone bridge. The meter gives a zero reading when the voltage at the junction of R1 and R2 is equal to that at the junction of R3 and R4

(b). Adapting the basic bridge to enable it to measure capacitance

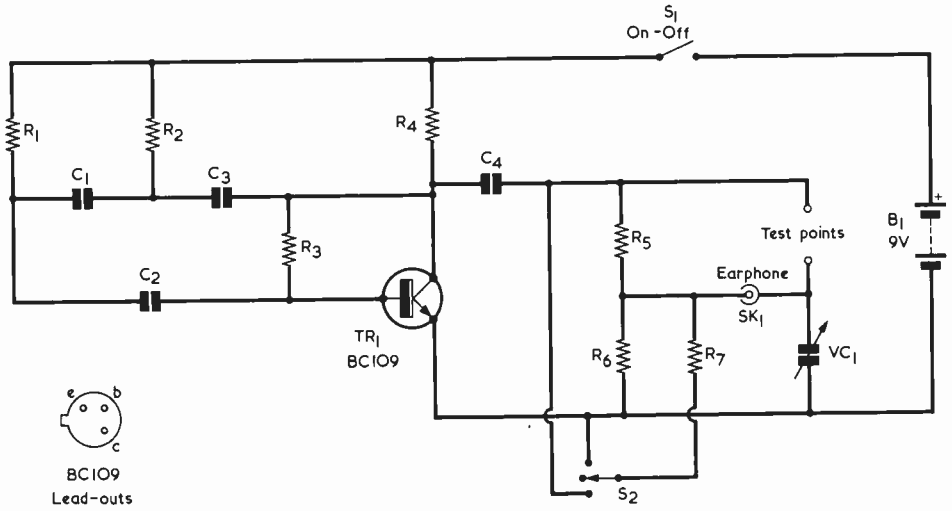


Fig. 2. The complete circuit of the small capacitance checker

phones, when VC1 is adjusted to the same value as the capacitor under test. If the control knob of VC1 is provided with a scale indicating its capacitance, then the value of the test capacitor can be found by adjusting VC1 for the null and reading the capacitance value from its scale.

As the circuit stands it is only capable of measuring capacitance values which lie between the minimum and maximum capacitances of VC1. The circuit can, however, be made to measure capacitances outside this range by altering the ratio of R1 to R2. Additional scales are then provided at VC1 control knob to cater for these alternative ratios.

PRACTICAL CIRCUIT

Fig. 2 shows the complete circuit diagram of the capacitance checker.

TR1 is employed in an RC phase shift oscillator. It is biased as a high gain common emitter amplifier, and its collector is coupled back to the emitter by way of the network including C3, C1, C2 and the associated resistors. This network produces an overall phase shift of 180° at a frequency of approximately 1.5kHz. Since the gain of TR1 is sufficient to overcome the loss of signal in the feedback circuit, the transistor oscillates at this frequency. The output of the oscillator is fed via C4 to the bridge circuit.

In this, R5 and R6 carry out the function of R1 and R2 in Fig. 1(b). As before, VC1 and the capacitor under test form the other half of the bridge. The output of the bridge is monitored by a crystal earphone connected to socket SK1. Two additional ranges are provided by shunting R7 across R5 or across R6 by means of S2. S1 is an ordinary on-off switch. VC1 consists of a 2-gang 208 + 176pF capacitor with both sections in parallel, giving thereby a maximum capacitance of 384pF. The version required is without trimmers, and this is available from Henry's Radio Ltd. S2 is shown as 1-pole 3-way in Fig. 2, but a single pole of a 4-pole 3-way miniature rotary switch was employed in the protoype as this type of switch was found easier to obtain. The unused poles are ignored.

COMPONENTS

Resistors
(All ¼ watt 5% unless otherwise stated)

R1	4.7kΩ
R2	4.7kΩ
R3	1.5MΩ 10%
R4	4.7kΩ
R5	10kΩ
R6	10kΩ
R7	2.7kΩ

Capacitors

C1	0.0068μF polystyrene, or paper or plastic foil
C2	0.0068μF polystyrene, or paper or plastic foil
C3	0.0068μF polystyrene, or paper or plastic foil
C4	0.022μF plastic foil, type C280 (Mullard)
VC1	208 + 176pF 2-gang variable, Jackson type '00' without trimmers (see text)

Transistor

TR1	BC109

Switches

S1	slide switch
S2	1-pole 3-way rotary (see text)

Socket

SK1	3.5mm jack socket (see text)

Battery

B1	9-volt battery type PP3 (Ever Ready)

Miscellaneous

Crystal earphone with 3.5mm. jack plug
2 knobs (see text)
2 crocodile clips
Battery connector
Veroboard, 0.1in. matrix
Case and panel (see text)

CABINET

In a simple bridge unit of this nature, in which neither terminal of the null indicator (i.e. the crystal earphone) is at chassis potential, it is necessary to avoid having large areas of metal connected to any part of the circuit. This is because such areas of metal have a correspondingly high capacitance to earth and do not allow a sharp null to be obtained as VC1 is adjusted. In consequence, the bridge must be assembled in an insulated case, which may be plastic or home-constructed from plywood. An all-metal case must not be employed. The author used an aluminium front panel which was common with the frame of VC1, and the completed unit gave very sharp nulls. A slight improvement, with even sharper nulls, would be given by having an insulated front panel, this being made of s.r.b.p. ('Paxolin') or any other insulating material. Some constructors may, in consequence, prefer to employ an insulated front panel.

The author fitted the bridge in a plastic case measuring approximately 5 in. wide by 4 in. high by 2 in. deep, and this housed the components comfortably. The front panel layout is shown in Fig. 3, and precise dimensioning here is left to the constructor. The capacitor specified for VC1 requires a $\frac{1}{2}$ in. central hole in the panel and three 4BA clear holes around this equi-spaced on a 1 in. diameter. These last three holes can be marked out by pressing a piece of paper against the front of the capacitor and then using this as a template. The capacitor is secured by three 4BA bolts passing through the panel holes into tapped holes in the front of the capacitor. Short bolts are required here, and their ends must not pass beyond the inside surface of the capacitor front plate or they will damage the fixed or moving vanes. If the capacitor spindle is positioned $1\frac{5}{8}$ in. or more from the top of the front panel, sufficient space will be left for a scale cut out from 'Panel Signs' Set No. 5.

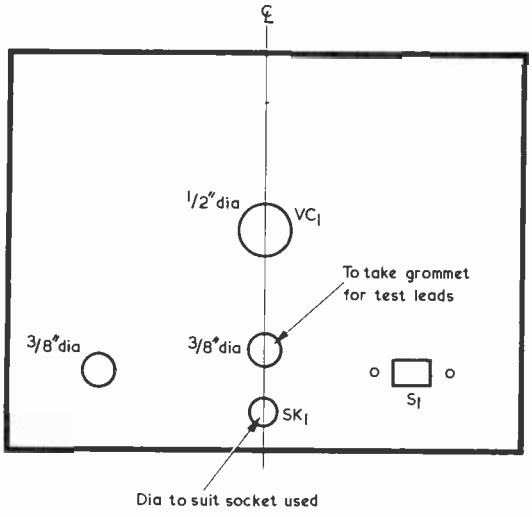
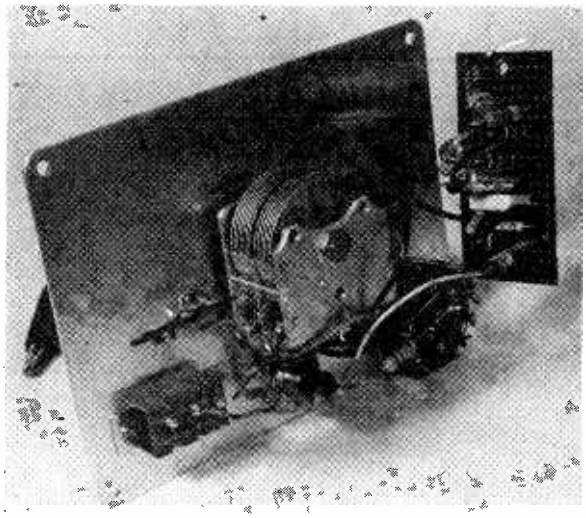


Fig. 3. General layout of components on the front panel



Wiring behind the front panel. Many of the parts are assembled on a piece of Veroboard

In the author's unit the two leads for the test capacitor pass through a single grommet on the front panel and are terminated in crocodile clips. If desired, the test leads may pass separately through two grommets spaced apart by approximately 1 in. This will reduce the stray capacitance between the test leads and will enable slightly smaller values of test capacitance to be measured. The reduction in stray capacitance is, however, marginal only.

If the front panel is aluminium, the jack socket for the earphone must be a type having its contacts insulated from the mounting bush. Any type of 3.5mm. jack socket may be employed if the front panel is made of an insulating material.

COMPONENT PANEL

Most of the components are assembled on a piece of Veroboard of 0.1 in. matrix, and having 24 holes by 11 copper strips. The component layout on this board and details of all the other wiring are shown in Fig. 4.

First cut out the board from a larger piece of Veroboard using a small hacksaw. Then drill the two 6BA clear mounting holes. A No. 31 drill will be suitable here. The board will later be secured to the left hand side of the case, and the two 6BA clear holes required here can now be marked out by using the board as a template. The two holes in the case side are drilled next.

The components are then mounted and soldered in their positions on the board as shown in the diagram. There are no breaks in any of the copper strips. Leads are attached for the external connections. The front panel components may next be mounted and the wiring illustrated in Fig. 4 completed, keeping all wires reasonably short. The battery fits behind the front panel above S1, and the leads to the battery connector should be given the requisite length. The Veroboard panel is then fitted to the case side with 6BA bolts and nuts, fitting

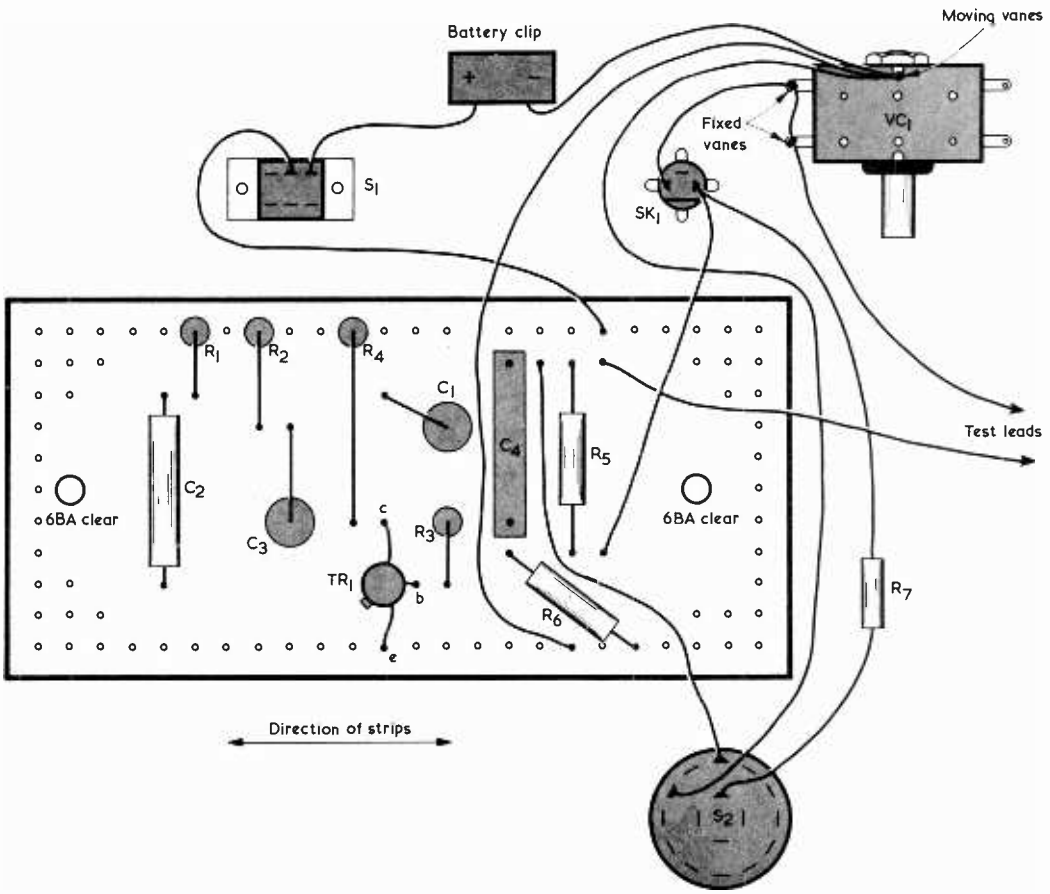


Fig. 4. Most of the components are mounted on a Veroboard panel, as shown here. At S2, confirm the outer contacts corresponding to the centre tag with a continuity tester before wiring to them, as relative positioning may differ with some switches

small insulated spacing washers between the copper side of the board and the inside surface of the case. Some means of securing the battery in place has to be devised. In the prototype it was simply held in position by pieces of foam plastic when the front panel was fitted.

A scale is required and, as already stated, this may be cut out from 'Panel Signs' Set No. 5. Legends taken from 'Panel Signs' Set No. 4 may also be added, should this be desired. VC1 requires a round knob fitted with a cursor, and the latter can consist of a short length of stiff wire glued to the underside of the knob with Araldite. S2 is fitted with a pointer knob.

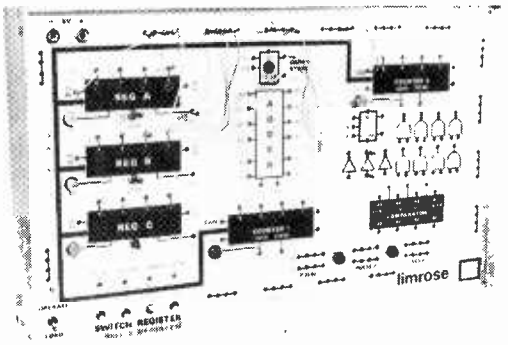
CALIBRATION

The scale of VC1 has to be calibrated before the unit can be used, and this is carried out by finding the settings required for known capacitors having values between 6.8 and 2,000pF. The capacitors should preferably have tolerances of 5% or better. Apart from some ceramic capacitors above 200pF or so, most low value capacitors have a low tolerance, and this fact assists in calibration. When sufficient capacitors have been checked a permanent scale for all three ranges of VC1 can be marked out. The process is rather time-consuming, but it is the only practical way of obtaining a scale with adequate accuracy. Obviously, this task must be undertaken with some care, so that the accuracy of the scale is not unnecessarily impaired. The number of calibration capacitances can be increased, if necessary, by temporarily connecting two or more known capacitors in parallel.

To determine the value of an unknown capacitor, it is connected to the crocodile clips and VC1 adjusted (on all three ranges if necessary) until a null is obtained in the crystal earphone. The value of the capacitor can then be read off the scale. If a null cannot be obtained on any of the ranges, the capacitor either has a value outside the measuring capability of the bridge, or is faulty. ■

NEWS . . . AND .

DIGITAL ARITHMETIC TUTOR



Limrose Electronics have recently introduced a Digital Arithmetic Tutor to complement their range of computer educational aids.

This advanced logic trainer has been designed for teaching the principles of binary arithmetic and four-bit data word manipulation to senior students who have completed a basic course in combinational and sequential logic circuits.

The Digital Arithmetic Tutor consists of three general purpose 4-bit Shift Registers, two 4-bit Synchronous Binary Counters, one 4-bit Comparator, one 4-bit Adder, a Carry Store, one J-K Master-slave Flip-flop, four 2-input Nand Gates, four 2-input And Gates and three Logic Inverters. Two manual Single Pulse Generators and one Continuous Clock Pulse Generator are also available.

Logic states are displayed on the anodised aluminium front panel by means of red light emitting diodes and interconnections are made using Limrose's 1 mm gold-plated terminal pin and patch lead system.

The equipment is accompanied by an illustrated instruction book containing numerous computer circuits which can be constructed on the equipment. These circuits include loading and shifting of registers, 1's and 2's complements, addition and subtraction of 4-bit numbers by serial and parallel methods and multiplication and division by the shift-and-add method. The instruction book also deals with the Octal Number System, binary fractional notation and overflow conditions in fixed point arithmetic.

Prices from £150.00. Further information can be obtained from Limrose Electronics Ltd., 8-10 Kingsway, Altrincham, Cheshire, WA14 1PJ.

FRENCH STEREO AMPLIFIER - ERA ST70

De Banks Electronics Ltd., of Tring, Herts, major distributor of ERA equipment, announces that its latest high fidelity amplifier, the ST70, is now available at approved dealers throughout the United Kingdom.

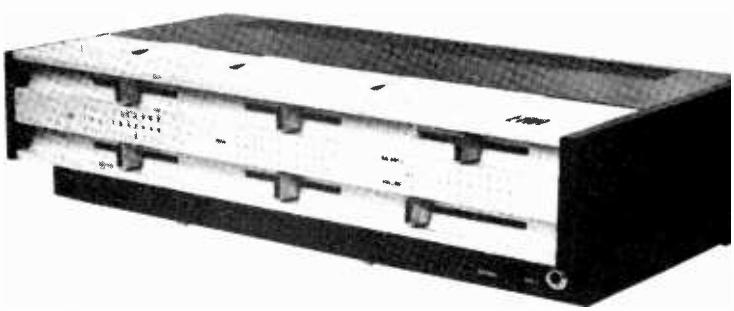
Retailing at £165, the ST70 is part of a matching range of ERA hi-fi equipment designed for serious devotees of high quality sound reproduction.

The amplifier delivers 40W RMS per channel (both driven), with output impedances of 4 and 8 ohms, through both DIN sockets and screw terminals. Dual inputs are also provided, through DIN and phono sockets.

Its operating controls are logically positioned, and include piano-key switching, with sliders for tone, balance and volume adjustment. Principal facilities include: separate bass and treble controls for each channel; high and low cut filters; loudness control; separate input sensitivity adjustments for pick-up, tuner and tape recorder; 4-channel output facility. Styling is in crisp black and silver, with heavy gauge matt aluminium panelling.

The ST70 is available through ERA De Banks appointed dealers, selected for their experience in high fidelity retailing, and their ability to honour the ERA guarantee.

ERA (Etudes et Recherches Acoustiques SA) has its factory at Lagny, near Paris, where the range of hi-fi equipment is designed and built.



Designed for serious devotees of high quality sound reproduction. Output 40W RMS per channel, with separate bass and treble controls for each. 4-channel output facility. Piano-key switching. Styled in crisp black and silver

. . . COMMENT

MORE RADIO HELP FOR MOTORISTS?

The BBC's Director of Engineering, Mr. James Redmond, has outlined a proposal for getting traffic news to motorists by radio. The BBC scheme is designed to provide motorists, and motorists only, with the traffic news flashes.

To cover the country, 80 low-power medium wave stations would be set up, each dealing only with traffic information for its own particular area. They would all operate on the same frequency, but not all at once.

Announcements about traffic conditions would be made in sequence from different transmitters. A simple addition to the car's ordinary radio receiver would allow the local announcement to break into the programme about once every eight minutes. The more distant announcements wouldn't be heard, because the transmissions wouldn't be strong enough.

The BBC is studying the proposal jointly with the Transport and Road Research Laboratory.

ITU CHIEF TO OPEN AMATEUR RADIO CONFERENCE

Mr. N. Mili, Secretary-General of the International Telecommunication Union, has accepted an invitation to open the triennial conference of the Region 1 Division of the International Amateur Radio Union in Warsaw commencing on 14th April.

The 42 national societies of the Region 1 Division will be represented and, in addition, there will be officials present from Regions 2 and 3. A major item for discussion will be the 1979 World Administrative Radio Conference.

SEAPHONE AWARD IN SAFETY AT SEA COMPETITION

Picture shows Cliff Michelmore presenting the Seaphone to Mr. W. G. Bateman. Also present from left to right are Mr. P. Rowe, Sales Director and Mr. G. Stow, Managing Director of Reslosound Ltd., manufacturers of Seaphone

At this year's International Boat Show, Earls Court, the "will float" Seaphone May-day radio telephone receiver for waterborne craft was awarded as the second prize in the Safety at Sea Competition organised by Teleflex Morse Ltd. The Seaphone is manufactured by Reslosound Ltd.

At the prize-giving ceremony, TV/Radio celebrity, Cliff Michelmore, presented the Seaphone to Mr. W. G. Bateman, of High Wickham, Buckinghamshire.

The Seaphone is now standard issue to all inshore Class 'D' lifecraft of the R.N.L.I.

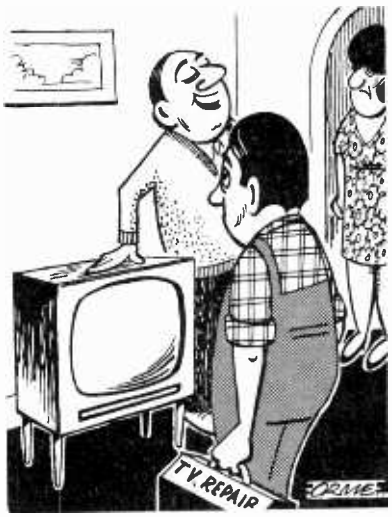
SOME DIARY DATES

April 2nd – 8th	**4th International Audio/Visual and Communication Exhibition** at Parc des Expositions, Porte de Versailles, Paris. Topic: "The audio/visual has come into our daily lives."
April 8th – 13th	**High Fidelity 75** at Heathrow and Skyline Hotels, London Airport, First 3 days Trade and Press only.
April 11th – 13th	**1st Midland Audio/Visual Show** at National Agricultural Centre, Kenilworth, Warwickshire. First day Trade and Press only.
April 20th	**North Midlands Mobile Rally** at Drayton Manor Park, Tamworth. Details from Midland Amateur Radio Society, Birmingham and Midland Institute, Margaret Street, Birmingham, 3.
April 27th	**Northern Radio Societies Annual Convention** at Bellevue, Manchester. Details from D. G. Mott, 17 Newall Carr Road, Otley, W. Yorkshire.

AN INTERESTING GLIMPSE

Some of our readers have kindly informed us that a copy of the March 1973 issue of this magazine appeared, quite prominently, in an episode in the TV "Crossroads" serial, recently broadcast in the Anglia area. Apparently one of our articles was of particular interest – *we wonder which one?*

We know our back number service is popular!



"If you need any help, call on the wife – She's been fault-finding with me for years!"

L.E.D. — L.D.R. ISOLATOR

By G. A. French

Suggested Circuit 293

A VERY USEFUL DEVICE WHICH HAS been available to the home-constructor for quite some years now is the ORP12 light dependent resistor, or photoconductive cell. This is a small robust component which exhibits decreasing resistance as the light falling on it increases in intensity. When fully illuminated, its resistance is of the order of 75 to 300Ω, whilst under completely dark conditions the resistance is greater than 1MΩ.

ISOLATING CIRCUIT

One application for the ORP12 is in a 'light relay' assembly, in which it is enclosed in a light-proof box with a small filament lamp. The ORP12 resistance is high when the lamp is extinguished but falls to a low value when the lamp is lit. An external circuit is operated by the changing resistance of the ORP12, whereupon overall control of the circuit is given by switching the filament lamp on and off. The advantage of this arrangement is that there is complete electrical isolation between the lamp and l.d.r. circuits. The l.d.r. circuit can, for instance, be at mains potential whilst the lamp circuit can be safely earthed.

The only disadvantage with the lamp-l.d.r. arrangement is that the lamp has a limited life and will eventually burn out. A light-emitting diode, with its virtually limitless life, would appear to be an attractive substitute for the lamp, and the writer decided to check the possibilities of a 'light relay' isolating assembly incorporating an l.e.d. instead of a filament bulb.

An l.e.d. emits considerably less light energy than does a filament lamp but, due to a fortunate coincidence, the light wavelength at which the ORP12 has maximum response is almost identical with that at which a readily available l.e.d., the TIL209, offers peak intensity. The spectral response peak for the ORP12 occurs at a wavelength of 0.62 to 0.64 micrometres, whilst the peak intensity of the TIL209 appears at 6,500 Angstroms, or 0.65 micrometres. (10,000 Angstroms equal 1 micrometre).

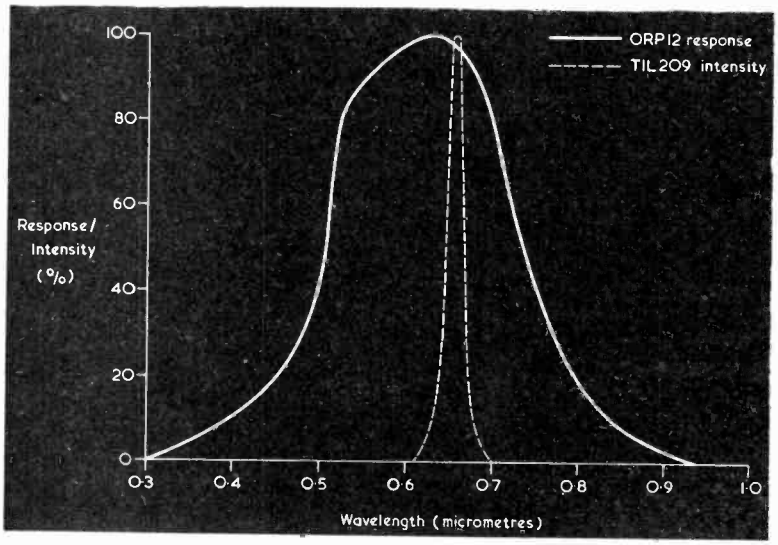


Fig. 1. The spectral response curves of the ORP12 and the relative intensity curve of the TIL209, drawn on the same wavelength axis

Fig. 1 shows the response curve of the ORP12 and the intensity curve of the TIL209, both curves being on the same wavelength axis. As can be seen, conditions could hardly be better for light energy coupling between the two devices.

The author installed an ORP12 and a TIL209 in a small light-proof box with the forward end of the TIL209 slightly spaced away from the centre of the active face of the ORP12, as in Fig. 2. Different currents up to 25mA

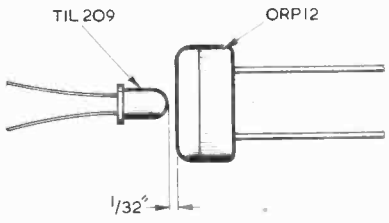


Fig. 2. In the isolating assembly, the TIL209 and ORP12 are positioned in the manner shown here

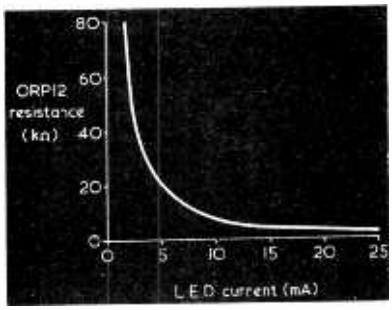


Fig. 3. Curve showing l.d.r. resistance against l.e.d. current

were then passed through the TIL209, and the consequent resistance of the ORP12 noted. The results are illustrated by the curve of Fig. 3. For l.e.d. currents above 5mA the l.d.r. resistance falls from some 20kΩ to approximately 2.5kΩ at 25mA. Below 5mA l.e.d. current, the l.d.r. resistance rises rapidly as current decreases until, eventually, it reaches the value given for completely dark conditions. Fig 3 illustrates that an isolating circuit incorporating a TIL209 and an ORP12 is a practicable proposition, even though the l.d.r. resistance does not fail to the lowest value which the device can produce.

PRACTICAL APPLICATION

An obvious application for an l.e.d.-l.d.r. isolating circuit is in the control of a triac. A triac is capable of switching a.c. mains loads on or off, the Main Terminal 1 and Main Terminal 2 of the device being connected between the source of a.c. and the load. The triac is made conductive by passing a triggering current through its gate and Main Terminal 1. The only disadvantage with this mode of operation is that the circuit supplying the triggering current must connect to the Main Terminal 1, whereupon it becomes common with one side of the mains. It is often desirable to have the controlling circuit isolated from the mains, this being the case where, for instance, there are long control wires which should preferably carry a low voltage and have an earth connection at a suitable point.

The working circuit shown in Fig. 4 employs an l.e.d.-l.d.r. assembly to provide the requisite isolation. The triac is an R.C.A. device type 40430. When switch S2 is closed the a.c. mains is applied to the primary of T1, whereupon a low rectified supply voltage appears across reservoir capacitor C1. The positive rectified voltage is applied to the collectors of TR1 and TR2 via the Main Terminal 1 and gate of the triac, and it is also applied to one terminal of the ORP12. This and the TIL209 are mounted in a light-proof box with the mutual positioning shown in Fig. 2. If S1 is open the l.e.d. is not illuminated, whereupon the ORP12 exhibits a high resistance. The base of TR1 is, in consequence, only slightly positive of TR2 emitter, and both transistors are cut off. No gate current flows in the triac and the 240 volt lamp which connects to its Main Terminal 2 is extinguished.

If S1 is closed a current of around 20mA flows through the TIL209 and it lights up, whereupon the ORP12 exhibits a low resistance. Current flows into the base of TR1, and TR2 turns hard on, causing a gate current limited in amplitude by R4 to flow in the triac. This becomes conductive and the 240 volt lamp lights up. When S1 is opened the l.e.d. at once extinguishes and the circuit reverts to its previous state, with the triac non-conductive and the 240 volt lamp extinguished. Thus, S1 is capable of turning the 240 volt lamp on and off even though it is completely isolated from it. In practice, the control circuit illustrated by S1, R1 and B1 could be replaced by any control circuit which caused 20mA to flow through the TIL209 with the same polarity.

It would be possible to have a single transistor instead of the two that are shown between the ORP12 and the triac gate, but the use of two transistors offers the following advantage. The ORP12 is a little sluggish in producing its resistance change when the intensity of the light which illuminates it

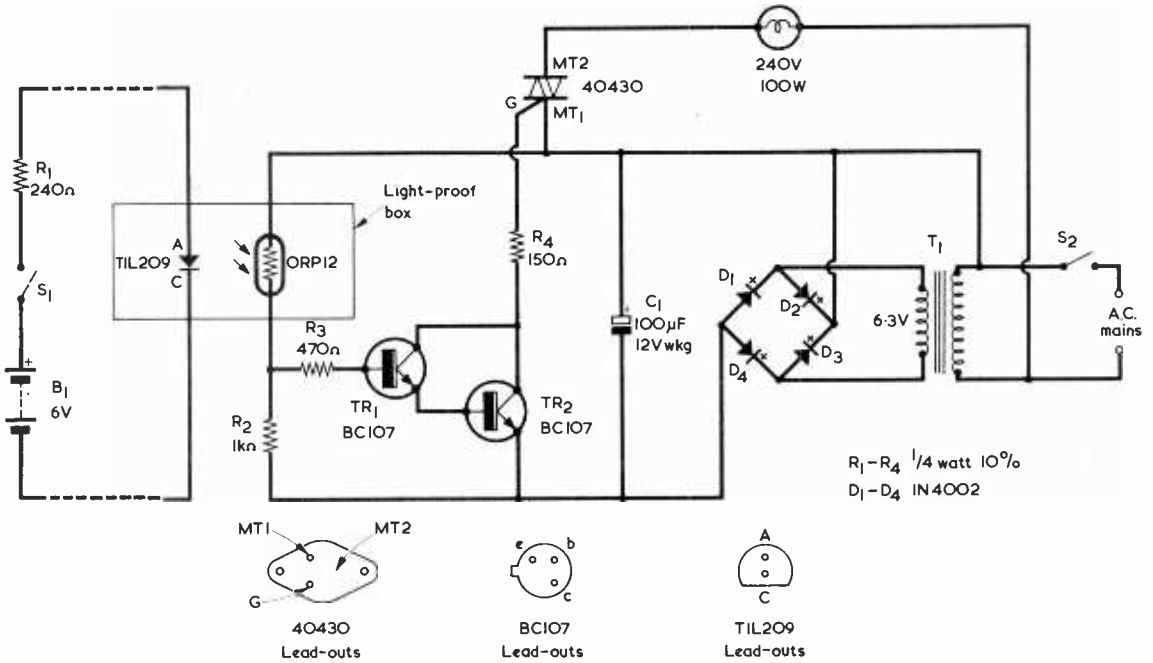


Fig. 4. A typical application for the isolator. In this circuit the triac is controlled by S1

varies. The very high gain offered by the combination of TR1 and TR2 ensures that the range of resistance in the ORP12 between the value which just allows the triac gate current to start and the value which causes the gate current to reach its full level is narrow. In consequence, the triac is turned on abruptly during the period when the ORP12 resistance falls, and is also turned off abruptly when the ORP12 resistance rises. Since TR1 and TR2 are silicon devices, it is necessary for the base of TR1 to be about 1.2 volts positive of the emitter of TR2 for both transistors to start turning on. This voltage is given when the ORP12 resistance is of the order of 6kΩ. Resistor R3 is a current limiting component, and its only function is to prevent excessive current flow in the ORP12 if the latter should happen to be accidentally illuminated by a bright light when the circuit was switched on.

LIGHT-PROOF BOX

The light-proof box can be any small box capable of housing the TIL209 or ORP12. A plastic box is preferable for reasons of isolation and, in any event, the insulation between the TIL209 and ORP12 circuits must be suitable for mains voltage. The constructor is advised to check the performance of the particular TIL209 and ORP12 he is employing after they have been fitted in the box, and before they are connected into circuit. An ohmmeter should be connected to the ORP12 and a forward current of approximately 20mA passed through the TIL209. If the ORP12 resistance falls to less than 4kΩ then the assembly is ready for use in the circuit. If the resistance is higher than 4kΩ it may be necessary for the value of R2 to be increased slightly.

Should the gate current in the triac be slightly below the minimum needed for turning this device fully on, it will remain non-conductive for part of the mains a.c. cycle and the 240 volt lamp will glow at reduced level. This condition can be detected by positioning a medium wave portable radio near the triac wiring. This will pick up strong interference modulated at 50Hz if the triac is only partly conductive. The interference disappears when the triac is turned fully on. Should it be found that the circuit takes the triac only up to partial conduction the value of R2 should, again, be slightly increased. *It must be remembered that the circuit around the two transistors and the triac is at mains potential and that precautions against shock must be observed at all times. The mains supply must be removed when making any adjustments to component values.*

The author mounted the triac on a small flat heat sink measuring 1½ by 2 in. The triac ran quite cool on this sink. Suitable triac loads are domestic mains filament lamps. Lamps having wattages higher than 100 watts should not be used although it will be in order to employ lamps of lower wattage.

The mains transformer, T1, can be any small heater transformer offering 6.3 volt at 0.5 amp or more.

The author's prototype circuit functioned reliably and controlled the 240 volt lamp without any trouble. To finally check circuit operation, the current through the l.e.d. was taken slowly from zero up to the recommended value of 20mA. The lamp turned on with the triac partly conductive at a current of 7mA. This condition continued until the l.e.d. current reached 11mA, at which level the triac became fully conductive. It stayed fully conductive at all further currents up to the final 20mA level. ■

"MATERIALS FOR ELECTRONIC COMPONENTS"—INTERNATIONAL CONFERENCE

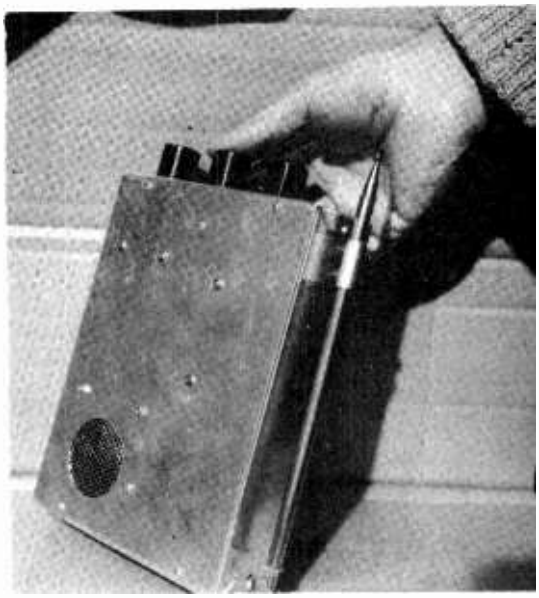
A special feature on 2nd, 3rd, 4th April will be an international Conference on the topic "Materials for Electronic Components". The argument is that hitherto, progress accomplished in the materials used by the components industry has been conditioned by the dual striving for ever improved performance, and cost considerations.

Today two further concerns are added: Problems related to raw materials shortage, and pollution. It has therefore seemed of interest to take the opportunity afforded by the Salon International des Composants Electroniques to organize a Conference in which will be discussed the various aspects of the search for and manufacturing of materials and of their use in the production of electronic components, taking into account the considerations of cost shortage and pollution.

The materials will be examined in the following aspects: *Physical and Chemical:* Comparative properties of new and known materials. *Technical and industrial:* Utilization processes, other products required for processing, feasibility in use, reliability, toxicity, miscellaneous sources of supply, dependence in regard to such sources and/or products utilized. *Economic:* purchase price, processing costs, riddance costs, comparative component costs.

Among the results expected of this conference are a better understanding of problems requiring solution, in the near of far future, solutions already discernible, lastly conclusions covering research required to resolve problems left in abeyance.

PORTABLE 28MHz TRANSMITTER – RECEIVER



Part 2

by

F. G. Rayer,
T.Eng.(CEI), Assoc.I.E.R.E., G3OGR

This article concludes the description of the portable transmitter-receiver intended for operation on the 28-29.7MHz amateur band. The next article in the series will deal with a super-regenerative receiver which also functions in this band.

IN LAST MONTH'S ISSUE THE CONSTRUCTION OF THE r.f. and modulator sections of the transmitter was discussed. The next part of the overall transmitter-receiver circuitry to be described is the function switch. After this, modulation tests and the assembly of the superhet receiver will be dealt with.

FUNCTION SWITCH

The function switch has three positions, these being 'Transmit', 'Off' and 'Receive'. It is mounted on the top panel of the case above the transmitter r.f. section, and the connections to it are shown in Fig. 6. In this diagram the switch tags are towards the reader.

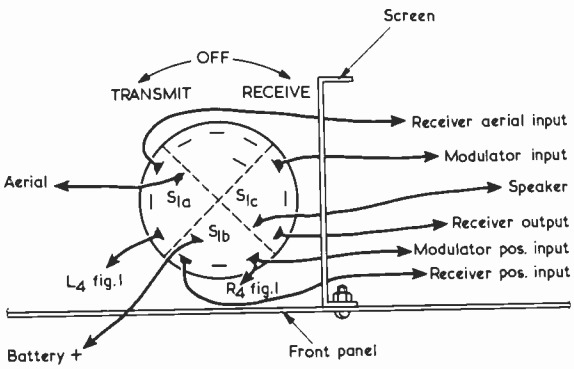


Fig. 6. The wiring at the function switch

S1(a) of the switch connects the telescopic aerial to the receiver on 'Receive', and to the transmitter output coil (L4 of Fig. 1) on 'Transmit'.

S1(b) provides on-off switching. On 'Receive', the 9 volt positive supply from the battery is fed to the receiver circuit. When the switch is set to 'Transmit', the positive supply is passed to the modulator and to the crystal oscillator (via R4 of Fig. 1). The transmitter output stage obtains its positive supply by way of the modulator output transformer secondary.

On 'Transmit', section S1(c) of the switch connects the 80Ω speaker to the modulator input (at the junction of C6 and C8 in Fig. 3). On 'Receive' the speaker is connected to the output of the receiver. The remaining tag of the speaker is earthed to the case by a lead from the modulator board. This lead was shown in Figs. 4 and 5.

The aerial and transmitter output leads at S1(a) are kept clear of the wiring to S1(c). Also, the wires connecting to S1(c) pass directly through the central screen alongside the switch. This avoids unnecessary stray coupling of r.f. into the input of the modulator.

The component employed for S1(a)(b)(c) is a small 4-pole 3-way rotary switch, one pole being unused. Before wiring to the switch, an ohmmeter or continuity tester should be used to determine the three outer tags which correspond to each centre tag. With some switches, the centre tags may have a positioning relative to the outer tags which differs from that shown in Fig. 6.

MODULATION TESTS

Some means of checking and adjusting the transmitter modulation should be used, and the method

adopted can take one of several forms according to the equipment available. A short wave receiver tuned to the signal from the transmitter can be employed, and the pocket super-regenerative receiver to be described in the next issue would be satisfactory here if operated with the regeneration control set below the regeneration level. Another method of checking the modulation consists of employing headphones, a series diode and a pick-up loop of a few turns, the loop being held near the transmitter r.f. output coil.

The modulation depth given depends on the transmitter loading, as well as on the loudness of the voice and the closeness of the mouth to the speaker functioning as a microphone on 'Transmit'. It is easy to overmodulate, despite the simplicity of the modulator amplifier.

For an initial test, it is in order to hold a 6 volt 0.04 amp bulb against the aerial and the case so that it connects across the transmitter output. The aerial should be closed. Speaking should cause the brilliance of the bulb to vary moderately. Bright flashes and almost extinguished dips indicate heavy overmodulation. Speech should sound reasonably satisfactory in a receiver. If this has a speaker, take care that there is no acoustic feedback to the transmitter-receiver microphone, and ensure also that the receiver is not overloaded by the transmitter signal.

Final adjustments should be made with the aerial fully extended. The bulb just mentioned should by now be removed. Adjustments to the drive from the oscillator and to the transmitter output coil will influence speech quality and volume as well as r.f. output. In consequence the transmitter cores are adjusted a little, as necessary, for best results.

RECEIVER

The circuit of the superhet receiver is given in Fig. 7, and this employs three transistors and an integrated circuit type ZN414. If some overall simplification of the transmitter-receiver is wanted, the super-regenerative receiver just mentioned could be employed instead with, perhaps, some slight re-arrangement of its controls. The lower selectivity of the super-regenerative receiver is not likely to be a disadvantage in most cases, in view of the purposes for which the equipment will be generally required and the low occupancy of the 28MHz band.

In Fig. 7 the aerial is routed via S1(a) of the function switch to the primary of L1, and this is tuned to the

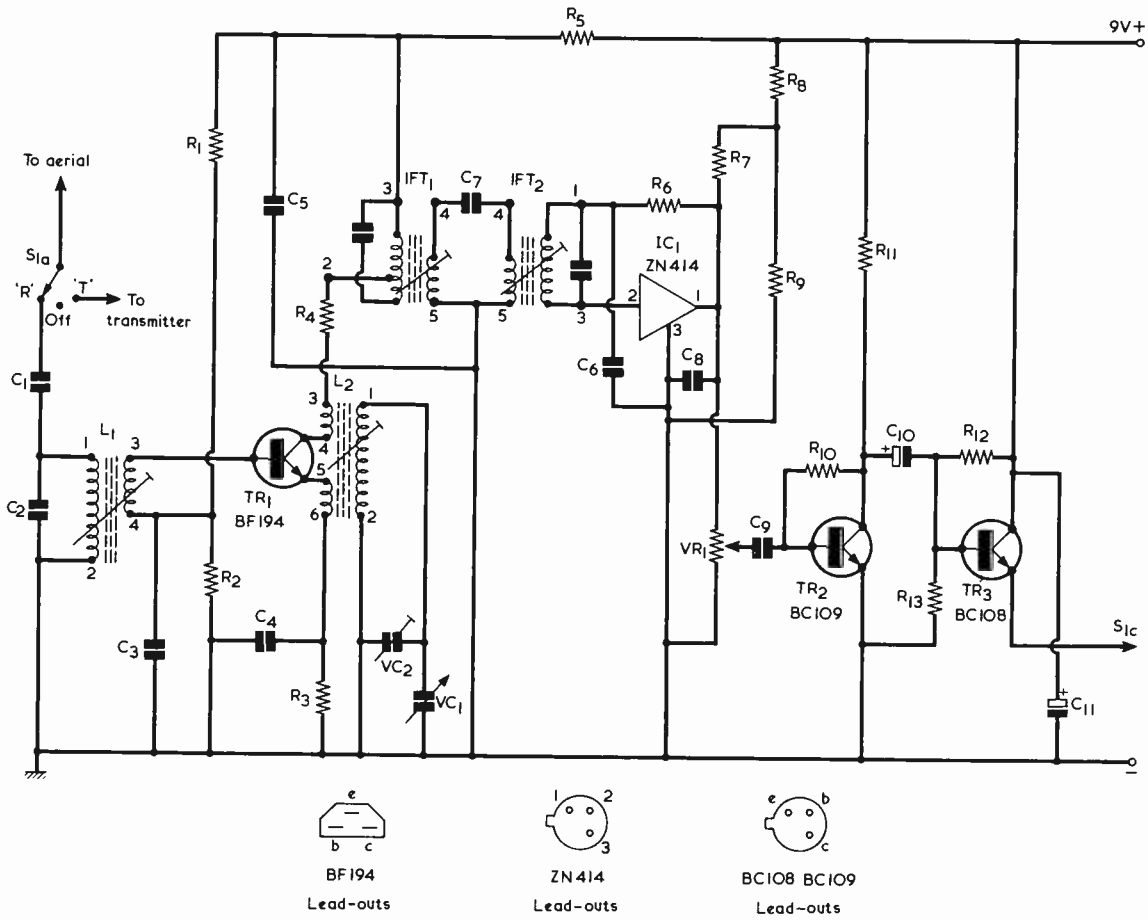


Fig. 7. The circuit of the 28MHz superhet receiver

COMPONENTS

Resistors
(All fixed values ¼ watt 10% unless otherwise stated)

R1	18kΩ
R2	15kΩ
R3	2.7kΩ
R4	100Ω
R5	1.2kΩ
R6	100kΩ
R7	10kΩ
R8	1.8kΩ 5%
R9	3.3kΩ 5%
R10	1.8MΩ
R11	10kΩ
R12	56kΩ
R13	12kΩ
VR1	25kΩ poteniometer, log

Capacitors

C1	18pF silvered mica or tubular ceramic
C2	22pF silvered mica or tubular ceramic
C3	0.047μF plastic foil
C4	1,000pF tubular ceramic
C5	0.1μF plastic foil
C6	0.02μF plastic foil
C7	56pF tubular ceramic
C8	0.1μF plastic foil
C9	0.1μF plastic foil
C10	1μF electrolytic, 12 V. Wkg.
C11	100μF electrolytic, 12 V. Wkg.
VC1	5pF variable, type C804 (Jackson Bros.)
VC2	60pF trimmer, mica

Inductors

L1	aerial coil (see text)
L2	oscillator coil (see text)
IFT1	I.F. transformer type IFT13/470 (Denco)
IFT2	I.F. transformer type IFT13/470 (Denco)

Semiconductors

TR1	BF194
TR2	BC109
TR3	BC108
IC1	ZN414

Switch
S1(a)(b)(c) 4-pole 3-way rotary

Speaker
80Ω speaker, 2½ in.

Battery
9 volt battery type PP9 (Ever Ready)

Aerial
Telescopic aerial, 48 in., type TA16 (Henry's Radio)

Case
(All case parts Home Radio)
2-off Universal Chassis plates, 8 x 6 in., Cat. No. CU178
3-off Universal Chassis sides, 8 x 2 in., Cat. No. CU137
2-off Universal Chassis sides, 6 x 2 in., Cat. No. CU135
1-off Hardware Kit, Cat. No. CU154A

Miscellaneous
Plain Veroboard, 0.15 in. matrix, 2½ x 2½ in. (see text)
3 knobs
Expanded metal for speaker aperture
Battery clips
Nuts, bolts, solder tags, etc.

required frequency by its adjustable dust core. TR1 is a self-oscillating mixer with oscillator tuning by VC1. The oscillator tuned circuit is brought onto the desired tuning range by trimmer VC2 and the adjustable core of the coil.

The author has used a similar circuit with a crystal controlled oscillator; whereupon two crystals are required, one for the transmitter and one for the receiver. Crystal control of the receiver has the advantage that the receiver is automatically set up for the wanted channel, but it severely limits the usefulness of the equipment in other ways since the receiver cannot then be employed for reception of signals which are not exactly on the pre-set frequency. In consequence, variable tuning over a small band, by means of VC1, is incorporated in the present receiver design.

The i.f. transformers, IFT1 and IFT2, form a quite effective intermediate frequency filter following the mixer. They couple into IC1, which gives i.f. amplification, automatic gain control and a.m. detection. TR2 is a high gain audio amplifier, and it is followed by the output transistor, TR3, which operates as an emitter follower. Its emitter couples via S1(c) of the function switch to the speaker. This method of speaker drive allows one tag of the speaker to be earthed to the case, as is required when the speaker is employed as a microphone on 'Transmit'. A reasonable volume is available from the speaker with a current drain of about 20mA from the 9 volt supply.

The equipment does not employ the modulator as an a.f. amplifier on 'Receive'. This would provide higher volume but would necessitate more complicated switching and inter-connection of the units, and the disadvantage that each could not be operated alone.

CONSTRUCTION

Most of the receiver components are wired on a piece of 0.15 in. matrix plain Veroboard having 15 by 16 holes and measuring approximately 2½ in. square. This has a cut-out to clear VC1, and the component and wiring sides of the board are shown in Figs. 8 and 9. Two holes are drilled out 6BA clear to take 6BA bolts and nuts. These bolts will later pass through holes in the case and they provide the chassis return to the board.

The coils are fixed by adhesive in push-fit holes. The author used formers having a diameter of $\frac{3}{16}$ in. and adjustable dust cores. The 5 mm. coil formers listed by

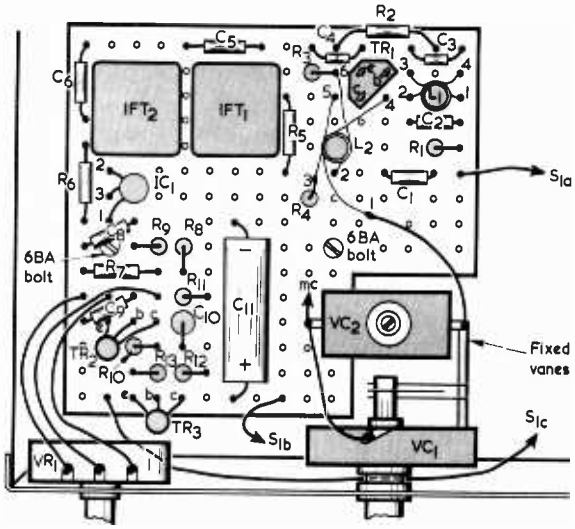


Fig. 8. The component side of the receiver Veroboard panel

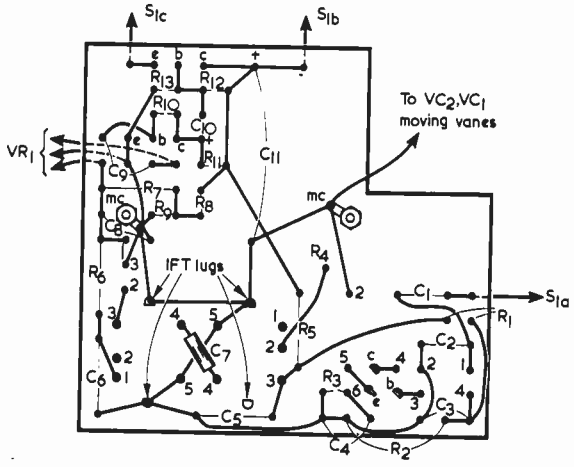


Fig. 9. Wiring on the underside of the receiver panel

Home Radio will be equally suitable. These formers have a length of 14 mm.

The coil lead-outs are numbered in Figs. 7, 8 and 9 to assist in describing the manner in which they are wound and connected. Coil L1 has 12 turns between points 1 and 2, and 4 turns between points 3 and 4, both windings employing 32 s.w.g. enamelled wire with the turns side by side and no space between the windings. Fix the end of the enamelled wire as near the bottom of the former as possible with adhesive, and this becomes end 3. Wind on 4 turns and secure the wire, giving end 4. Immediately after this fix the wire for end 1, and wind 12 turns in the same direction, finishing off at end 2.

The oscillator coil, L2, has 7 turns of 32 s.w.g. enamelled wire between points 1 and 2, 4 turns of 40 s.w.g. silk covered wire between points 3 and 4, and 2 turns of 40 s.w.g. silk covered wire between points 5 and 6. Start a little from the bottom of the former for end 1, and wind 7 turns downwards, finishing at point 2. Point 2 is closer to the coil former bottom than point 1. Winding in the same direction, start at end 4 and finish at end 3, these 4 turns being on top of the 7 turn winding. Again winding in the same direction, and starting at 5 and finishing at 6, wind 2 turns, also on the 7 turn winding. Ensure that all coil ends are secure.

On the board, lead 6 of L2 shares the same Veroboard hole as R3. Lead 3 of L2 connects to the free lead-out of R4, which is mounted vertically and has only its lower lead-out passing through the board. Lead 1 of L2 passes across the board to the fixed vanes tag of VC1. Capacitor C7 is under the board, as shown in Fig. 9. VC2 is soldered to VC1, as illustrated. The connections between VC1, VC2, VR1 and the board are completed after the board has been mounted in the case.

Assembly on the board is fairly compact, though there is a little free space. Connections should be checked against Fig. 7 as they are made. In view of the difficulty of seeing any error later, it is suggested that each component and lead is marked with coloured pencil in Fig. 7, as it is fitted and soldered. A mistake or omission is then unlikely. So far as the connections to L1 and L2 are concerned, the winding wire itself passes direct to the various circuit points.

ADJUSTMENTS

Receiver adjustments will be carried out after the board has been fitted in the transmitter-receiver case, but they will nevertheless be dealt with now in order to complete the description of the receiver.

Since the degree of coupling provided in a home-wound oscillator coil may vary according to the exact disposition of the windings and, also, since the oscillation level depends on the performance within its spread of TR1, trimmer VC2 is provided for setting up frequency in addition to the adjustable coil core.

When setting up the oscillator circuit, adjust VC1 so that its vanes are half enmeshed. Tune in the transmitter signal by rotating the core of the oscillator coil and by adjusting VC2. If the signal is accompanied by audible oscillation and whistles, the oscillation level is too high. This can be modified by setting VC2 to an increased capacitance, adjusting the core of the coil at the same time to keep to the wanted frequency. Alternatively, R4 may be increased in value.

The exact coverage given by VC1 depends on the setting of VC2 and the oscillator coil core, but is not important provided the band of frequencies required can be tuned.

The aerial circuit does not tune sharply, and is peaked by adjustment of the core of L1. The adjustment should be made in the case with the telescopic aerial fully extended.

Commercially made coils which can be tuned to the 28MHz band are available, but a larger circuit board would be needed to accommodate them.

The two i.f. transformer cores can be adjusted by placing an output lead from a signal generator close to R4, and peaking for best results at about 470kHz. Alternatively, adjust the cores for best reception of a steady signal in the 28MHz band. The i.f. transformers

The interior of the transmitter-receiver with all sections mounted in position

are pre-aligned at the factory, and only a relatively small adjustment to the cores should be needed.

METAL CASE

The case is made up from Universal Chassis members, available from Home Radio. If the photographs of the interior of the transmitter-receiver are studied, it will be seen that the construction consists essentially of an assembled Universal Chassis, inside which is fitted a Universal Chassis side acting as a vertical screen between the r.f. section and the receiver and modulator units. A flat Universal Chassis plate can be screwed to the rear of the case to cause it to be completely enclosed.

The Universal Chassis consists of an 8 by 6 in. plate, two 6 by 2 in. sides and two 8 by 2 in. sides. The three controls are fitted to one of the 6 by 2 in. sides, and their precise positioning may be gauged by the fact that the PP9 battery just fits comfortably into the left hand section between the left side of the case (with a portion of flange removed) and the centre screen. S1(a)(b)(c) is above the r.f. section and should be fairly close to the screen so that the leads passing through the screen to S1(c) are reasonably short. VC1 and VR1 are on the other side of the screen, VC1 being the central control of the three.

The 6 by 2 in. side with the controls now becomes the top panel of the complete case and is secured to the 6 by 8 in. plate. The latter has an aperture for the speaker in the position shown in the photographs, the aperture being covered on the inside with expanded metal.

About $\frac{3}{8}$ in. is cut from the long flange ends of the 8 by 2 in. side which forms the centre screen to enable this to fit inside the case top and bottom. This screen may next be fitted to the top and the 6 by 8 in. plate. It requires holes at the appropriate points to allow interconnecting wires to pass through it.

The transmitter r.f. section, the modulator and the receiver each require two 6BA clear mounting holes in the 6 by 8 in. plate which now forms the front panel, and these boards may be fitted, the r.f. section and receiver boards being spaced off slightly from the back surface of the front panel to prevent short-circuits to their wiring. Two extra 6BA nuts on each bolt on either-side of the front panel provide the mounting and spacing required. The modulator board is also spaced off but by a greater distance than the other two boards as it has to clear the edge of the speaker.

The 8 by 2 in. side nearer VR1 may next be fitted, and it is positioned inside the flange of the top panel. The other 8 by 2 in. side may also be fitted, again inside the top panel flange, but it must first have about $3\frac{1}{2}$ in. cut from one flange, as indicated in the photographs, to allow the battery to be inserted and removed. It also requires holes to take home-constructed insulated mountings for the telescopic aerial and to allow a wire from the aerial to pass through to S1(a). The nominal thickness of a PP9 battery as stated by the manufacturer is, incidentally, slightly in excess of 2 in., but the actual batteries retailed have a thickness that is a little less than this figure.

The remaining 6 by 2 in. side forms the bottom of the case and this may now be secured in place with its flanges outside the side members. A solder tag under one of the securing nuts provides the chassis connection for the negative terminal of the battery.

The second 6 by 8 in. plate forms the back of the case, and this is screwed in place with self-tapping screws passing into the rear flanges of the sides and the top and bottom panels. The Components List includes a 'Hardware Kit'. This contains the bolts and nuts required for the assembly of a normal Universal Chassis.

When the case has been assembled, the inter-connecting wiring between the various units may be completed. If, however, no other tuning signal is available for the receiver, the r.f. section of the transmitter may be left temporarily outside the case and its oscillator only powered by a separate 9 volt battery. This can be used to provide a signal for final setting up of the receiver with the aerial extended. The r.f. section may then be fitted in the case and wired up. All final adjustments to tuning should be carried out with the aerial fully extended and the metal case held in the hand.

The Components List accompany this article completes, in conjunction with that given last month, the listing of parts required for the transmitter-receiver. The resistor, capacitor, inductor and semiconductor references apply to the circuit of Fig. 7.

The description of the 'Talkie' 28MHz transmitter-receiver is now concluded. The construction of the 28MHz super-regenerative receiver will appear shortly. ■

New Products

NEW TOOL CASE

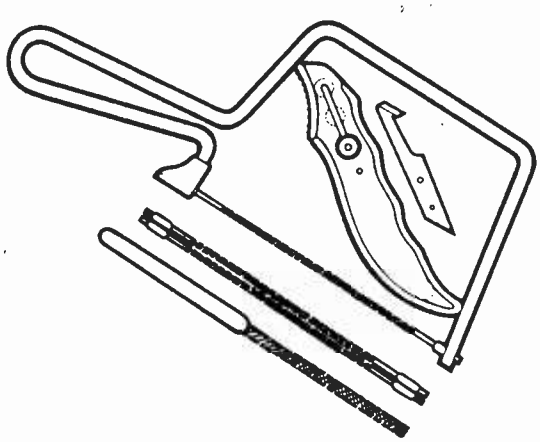
Neat adaptation of a standard small-parts cabinet has produced the Link-MK service engineer's cabinet and tool case, introduced by Link-Hampson Ltd. of Bone Lane, Newbury, Berkshire.

The case consists of a Link-MK cabinet, containing four sizes of transparent drawer in various combinations, together with a wooden tray for larger tools, all housed in a lockable, simulated leather carrying case.

When open the rigid front of the case folds down to make a convenient platform for tools. All the drawers can be subdivided to hold large or small items (an assortment of dividers is supplied) and each drawer has a label slot.

The cabinet, measuring 15 in. x 12½ in. x 8 in., is intended to meet the needs of both professional service engineers and hobbyists of all sorts.

It is obtainable from storage specialists at a recommended price of £14.80 plus VAT. Names of local stockists will be provided by the manufacturers on request.



ABRAFILE ACRYLICS KIT

Mr. Fix It and Mr. Do It Yourself will try and do even more in the home this year. One of the kits which would be most handy to them for working plastic sheeting such as Perspex or Plexiglass, to name just two famous brands, has now been launched.

The ABRAFILE ACRYLICS KIT is intended mainly for use with plastics and it comprises:

Deep (3½ in.) ABRAFRAME for radius and profile cutting.

Two-position retractable knife featuring dual-purpose blade.

Special ABRAFILE craft roundfile for finishing work.

Two spare ABRAFILES and one extra knife blade.

This kit is ideal for cutting rectangular sheets supplied by DIY shops to required sizes for such applications as shower screens, safety windows and models etc. ONLY £1.62 including VAT.

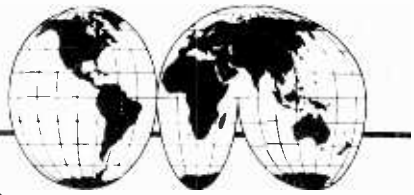
NEW 10-PAK FOR C60 CASSETTES

Agfa-Gevaert announce details of their latest addition to the compact cassette scene: **The 10-Pack.**

This has a Clear acrylic lid which lifts off to reveal 10 x C60 low-noise cassettes in compartmentalized lower section. The whole is dust-proof and ultra-compact. Measures 5½″ x 4¼″ x 2¾″ and has integral index-card. It is much more convenient to carry, has ten hours' playing time in one space-saving box, and is much easier to store.

Price (inc. VAT) £7.43.

SHORT WAVE NEWS
FOR DX LISTENERS



By Frank A. Baldwin

Times = GMT

Frequencies = kHz

The clandestine Radio Pathet Lao has been heard on several occasions during the winter 'season' for Far Eastern reception and there may still be the odd occasion on which this can be logged before the period ends. The most likely time is that from 1300 to 1500 on the nominal channels of **6200** and **6215**, the actual frequencies measured by us as **6211.5** and **6199**. Also listed are the **4660** and **7480** channels but of these, the former is unlikely and the latter is occupied by R. Peking during the period. The language in use at the time quoted is Laotian. The station claims to be in Laos but is thought to be actually located in North Vietnam. "Radio Pathet Lao" = "Thi Ni Witayu Kachai Siang fai Pathet Lao".

Whilst on the intriguing subject of clandestines, how about Patriotic Voice Radio ("Pyichit Athan Athan Hwint Htaana") the anti-Burmese Government transmitter which operates, in Burmese, from 1230 to 1315 on **7198, 7230, 7235** and **7240**. The frequencies given are nominal, those actually used vary considerably from day to day.

Voice of the Malayan Revolution ("Ini-lah Suara Revolusi Malaya") is anti-Malaysian and Singapore Governments and pro-Peking (surprise, surprise) and thought to be located in the Hunan Province of China. Probably the best chance of logging this one would be from 1330 to 1405 in Standard Chinese, 1405 to 1450 in Tamil and from 1500 to 1530 in English on **11830** and on **15790.**

All of these transmissions are Asian in origin but next month we'll list some that are European and non-political.

CURRENT SCHEDULES

● **MONGOLIA**

Radio Ulan Bator operates an External Service in which English is radiated to S.E. Asia and the Far East from 1220 to 1250 on **15440** and on **17785** and from 2200 to 2230 on **9545** and on **11855**, excluding Sundays.

● **VATICAN CITY**

Vatican Radio broadcasts in English to the U.K. and Eire from 1450 to 1505 on **6190, 7160, 9625** and on **11825**; from 2045 to 2100 to the U.K., Eire and Africa on **6190, 7250, 9625, 9645, 11705** and on **15120.**

● **ROMANIA**

Radio Bucharest offers an External Service, in English to Europe, from 1300 to 1330 on **9690, 11940** and on **15250**; from 1930 to 2030 on **6150** and on **7225**; from 2100 to 2130 on **5990** and on **7225.**

● **CHILE**

Radio Nacional, Santiago, radiates the Chilean External Service in English on **15150** at the following times – 0030, 0230, 0430, 1020, 1220 and at 2210.

● **ALBANIA**

Radio Tirana offers an English Service to Europe from 0630 to 0700 on **7065** and on **9500**; from 1630 to 1700 on **7065** and on **9480**; from 1830 to 1900, from 2030 to 2100 and from 2200 to 2230/all on the two latter channels.

● **INDIA**

All India Radio, Delhi, presents a General Overseas Service directed to the U.K. and West Europe in English from 1745 to 1945 on **7215, 9525, 9575, 11620** and on **15080**; from 1945 to 2045 on **7215, 9525, 9755, 9912, 11620** and on **11880** and from 2045 to 2230 on **7215, 7260, 9525, 9912, 11620** and on **11740.**

● **VIETNAM (NORTH)**

Radio Hanoi, "Voice of Vietnam", beams a programme in English to Europe from 1800 to 1900 on **10040** and on **15012.** Hanoi is also in English, to S.E. Asia, from 1000 to 1030, from 1300 to 1330 and from 1600 to 1700 on **10040** and on **12032.**

For the Dxer, broadcasts in Vietnamese are made to both North and South Vietnam from 0758 to 0600 on **10065**; from 0758 to 0600 on **7375**; from 0758 to 1700 and from 2058 to 0600 on **6385**; from 1100 to 1700 and from 2058 to 0300 on **4892**; from 0758 to 1525 and from 2203 to 0600 on **4708.**

● **KOREA (NORTH)**

Radio Pyongyang directs an English programme to Europe from 2000 to 2200 on **3890, 6575** and on **9415.** Other programmes in English are, to S.E. Asia from 1200 to 1400 on **3560, 7580, 9372** and on **15630**; to S.E. Asia from 2300 to 2400 on **3560, 11535** and on **15630** and to the Middle East and Africa from 1800 to 2000 on **3560, 6338** and on **9977.**

● **BANGLADESH**

Radio Bangladesh has a broadcast in English to Europe from 1815 to 1915 on **5825** and on **7380.** For Dxers, the domestic service is reported on **4780** from 0030 to 0310; from 0030 to 0213 on **4890** and from 0600 to 0930 on **6008** and on **7230.**

● **U.S.S.R.**
Yerevan, the "Voice of Armenia", at 1513 on **4990** with announcements and identification as "Radio Yerevan" in Arabic to the Arabic world (scheduled from 1500 to 1530 and in parallel on **6085**).

● **FINLAND**
Pori can be heard at 1615 on **9550**, at which time we logged them when radiating a programme in English about the current Finnish weather and temperatures.

● **POLAND**
Warsaw at 1620 with a programme in English on **9540** all about Polish fairy stories and little people at the bottom of the garden.

● **CZECHOSLAVAKIA**
Prague at 1750 on **7345** presenting the English programme "Weekend Mailbox", all very interesting at that.

● **CHINA**
Radio Peking at 1413 on **9440** with OM and YL alternate in the Cambodian Service to Cambodia (Khmere Republic). The schedule is from 1400 to 1500 for this service and is in parallel on **6430, 6520** and on **11695**.

Radio Peking at 1421 on **7315** with YL reading a news commentary in English directed to South East Asia. Schedule for this service is from 1400 to 1500 and in parallel on **7470** and **9860**.

Radio Peking at 1550 on **4800**, YL in Chinese in the Home Service First Programme.

Lanchow at 1543 on **4865**, YL with songs in Chinese, local music.

Wuhan at 2140 on **3940**, OM and YL alternate in Chinese.

Changsha at 1546 on **4990**, programme of Chinese music, YL announcer, schedule of this one is from 2105 to 1620. Not often reported in the SWL press.

Urumchi at 2310 on **4500**, martial music, Army male chorus, also at 2309 on **4110**, local music and YL with songs.

PBS Sinkiang at 2313 on **6280**, YL in Chinese, choral songs, local music.

Hailar at 1431 on **3900**, YL with song, local music in relay of Radio Peking Mongolian Service, schedule 1400 to 1500.

Radio Peking at 1555 on **3450**, local music, YL in Chinese in Home Service programme. Schedule, October to April, 1200 to 1735, 2000 to 2200 and in parallel on **4905**.

● **3.5MHz AMATEUR BAND**
This obviously isn't a country, neither is it an error in an article devoted to Broadcast Band Reception, but simply to let readers know that there are even some broadcast stations operating within this band. Providing one can dive beneath the sea of amateur CW signal nets, one may fathom out, amid a shoal of surrounding QRM, PLA Fukien on **3535** at 1910. At this time, we heard a YL speaking in the Amoy Service directed to Taiwan and Offshore Islands. Also heard in parallel on **4380** but with a much weaker signal and less QRM. Schedule 2005 to 2230, 1120 to 2000.

Another denizen of this band is Radio Pyongyang on **3560**, logged by us at 2225, YL in (presumably) Korean with local music at 2230. The schedule of this one is from 0300 to 1545 and from 1600 to 2400.

● **NORTH KOREA**
Pyongyang may also be logged around 1430, we actually logged them at 1435 on a measured **4708**, OM in an Asian dialect.

● **SOUTH AFRICA**
Always good for a log entry, Johannesburg is to be heard at 2050 on **4810**, at which time we logged a record request programme with English announcements. Also, Johannesburg may be heard at 2100 on **4835** for a time-check and newscast in English.

● **ZAIRE**
Lubumbashi at 0427 on **4750**, OM with announcements in French then into dance music records, Euro-style.

● **MOZAMBIQUE**
Radio Clube Mozambique at 1940 on **3210**, OM in Portuguese then light orchestral music Palm Court style.

Also at 1946 on **3265**, OM in Portuguese, songs, light orchestral music.

● **LIBERIA**
Radio St. ELWA, Monrovia, at 2125 on **4770** with a religious programme in English.

● **BRAZIL**
Radio Tabajara at 0242 on **4795**, station identification simply as "Tabajara", YL with songs in Portuguese, Latin American music then identification again at 0245 as "Tabajara".

Radio Vitoria at 0329 on **5055**, piano solo, clear identification at 0330 then YL with song in Portuguese.

● **PERU**
Radio Atlantida at 0250 on **4790** (was **4788**), Andean-type music, identification at 0258, frequent 'noticias'.

● **VENEZUELA**
Radio Sucre at 0334 on a measured **4958.5** (nominal **4960**), YL with songs, local music till 0345 when identification as part of Radio Cadena Nacional network. This one would prove difficult for the beginner in that it exhibits that charming trait of some LA stations in being off-frequency. Additionally, when identifying, mention is made of many other radio stations in the network, such as Maracaibo, Cumana, Caracas, Popular etc.

● **DOMINICAN REPUBLIC**
A new one here is Radio Norte, Santiago, heard at 0110 on **4807**, and logged at other times from November last. Identification at 0115 as "Radio Norte".

● **NEPAL**
Radio Katmandu can be heard on **3425** from around 1530 onwards but it can also be logged in parallel on **5007**, where we heard it at 1510 with Indian-type musical programme and a YL announcer.

● **SINGAPORE**
Radio Singapore at 1533 on **5010**, OM with a newscast in English. Radio Singapore can also be heard on **5052**.

New. Sinclair IC20.
20 watts stereo amplifier kit
for only £7.95 (plus VAT)

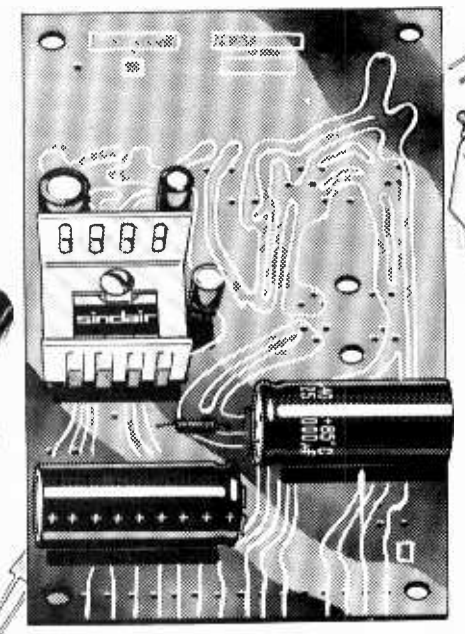
A build-it-yourself stereo power amplifier with latest integrated circuitry... 10 W RMS per channel output... full short-circuit and overheat protection.

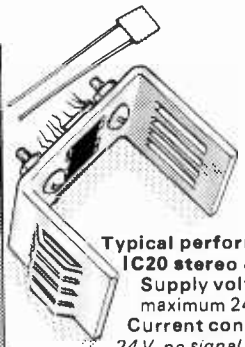
Latest from Sinclair – the brand new IC20 power amp. It incorporates state-of-the-art integrated circuits – 2 monolithic silicon chips each containing the equivalent of over 20 transistors! These deliver 10 W per channel into 4 Ω speakers. And the IC20 has integral short-circuit protection and thermal cut-out – it's virtually indestructible!

How should I use the IC20?

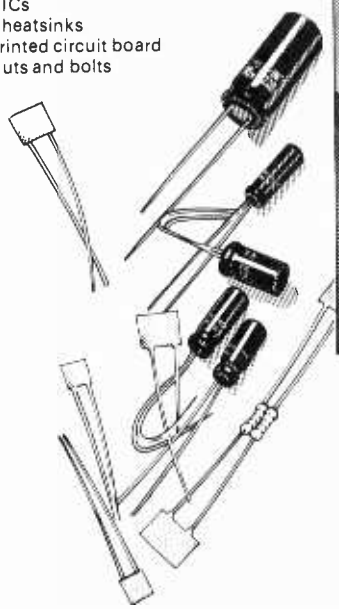
Use the IC20 for converting your mono record player to stereo . . . for upgrading your existing stereo . . . for improving your car radio/tape player. The IC20 runs off a 9-24 V power supply. If you're running the IC20 off the mains, simply add a Sinclair PZ20 power supply (£4.95 plus VAT).

Using the IC20 to improve your car radio/tape player's quality and volume? Run the IC20 off the car battery direct. You don't need a separate power supply, and you're reducing the drain on the player's dry batteries.





A complete kit!
6 resistors
15 capacitors
2 ICs
2 heatsinks
Printed circuit board
Nuts and bolts



Typical performance of the IC20 stereo amplifier

Supply voltage: absolute maximum 24 V, minimum 6 V.
Current consumption: *24 V, no signal* – 20 mA each channel.
18 V, 9 W into 4 Ω – 770 mA each channel.
Power output: *14 V supply, 4 Ω load, 10% distortion* – 5½ W RMS per channel, *20 V supply, 4 Ω load, 10% distortion* – 10 W RMS per channel.
Total harmonic distortion: at *50 mW, 4 Ω load, 20 V supply* – less than 0.1%.
Input sensitivity: *for 9 W into 4 Ω* – 90 mV.
Frequency response: – 3 dB at 40 Hz and 16 KHz.
Load impedance: 4 Ω or 8 Ω, but device is safe with any load.

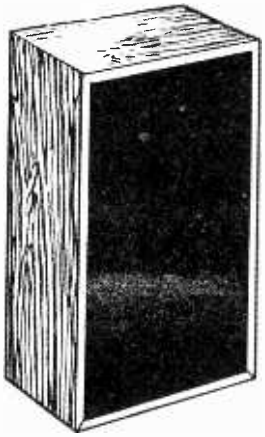
Improve your audio equipment – today

Both the IC20 and the PZ20 are covered by the Sinclair one-year, no-quibble guarantee – if absolutely any defect arises, Sinclair will replace the whole unit – unconditionally.

You can find both the IC20 and the PZ20 at stores like Laskys and Henry's. But if you have any difficulty, send us a cheque direct and we'll send you an IC20 and/or a PZ20 at once. 14-day money-back undertaking, naturally.

Sinclair Radionics Ltd,
London Road, St Ives,
Huntingdon, Cambs., PE17 4HJ.
Tel: St Ives (0480) 64646
VAT Registration number: 213 8170 88.

sinclair



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CHANNEL S

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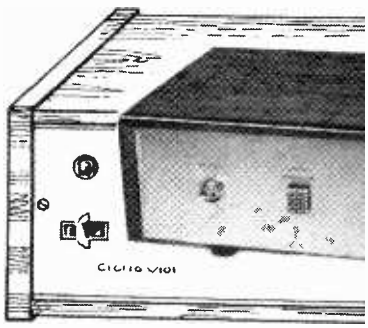
By R. A



An add-on unit which may be cou
to increase the spatial sound
programme material. Constructi
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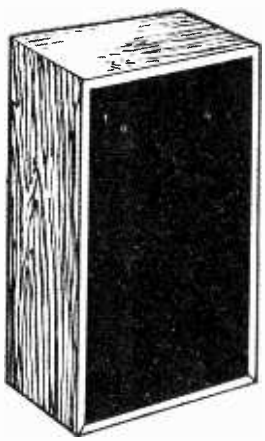


SPATIA
FROM
AT LO

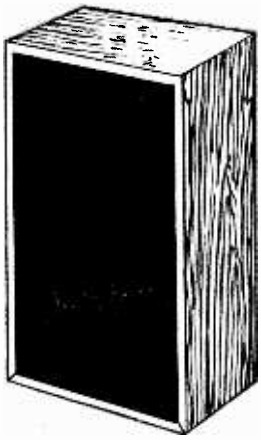
THE EQUIPMENT DESCRIBED IN THIS ARTICLE ENABLES virtually any stereo amplifier to feed four speakers, two at the front and two at the rear. The system does not provide true quadrophonic operation, but in the author's opinion the results are subjectively superior to those given with a normal stereo installation which has just the two speakers at the front. Operation is from a standard two channel stereo signal source.

The synthesiser is an add-on unit whose construction is greatly simplified by the use of two integrated circuit amplifiers and a ready-made case. The two i.c.'s are supplied with ready etched, drilled and labelled printed circuit boards, a fact which further simplifies construction.

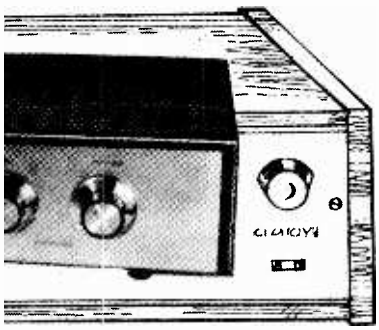
Two 8Ω speakers are required for the rear channels, and the synthesiser can deliver slightly less than 6 watts to each of these when they are operating simultaneously. The synthesiser unit is self-contained and has its own internal mains power supply unit. No modifications are required to the existing stereo equipment, which will give normal two channel operation when the synthesiser is switched off or disconnected.

UR

NTHESISER



Penfold



led to an existing stereo amplifier field from two channel stereo nal details of the synthesiser are ocedure will be described in next uding article.

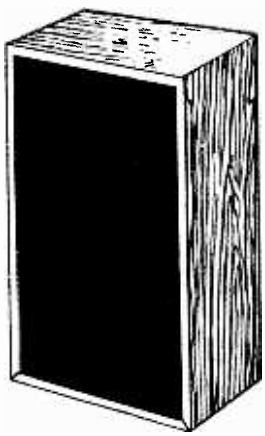
PRINCIPLE OF OPERATION

The principle behind the present system is perhaps best explained by first looking at mono, stereo and three channel systems.

In a mono system the sound usually comes from a single speaker. Even when more than one speaker is used the output from each is identical. A mono system reproduces the original sound but can give no spatial impression of the direction of the individual components of that sound.

A mono system will therefore tend to lack realism, as human hearing is capable of perceiving direction as well as the other qualities of sound, i.e. pitch and amplitude, etc. When sound is reproduced over two or more channels, added realism is given due to the directional information which is then provided.

Stereo is the simplest of the directional systems and, of course, it uses two speakers which are positioned to the left front and right front of the listener, as in Fig. 1(a). If a signal is fed to only one speaker the sound is obviously heard from that speaker. By feeding signals to



.SOUND
STEREO
/ COST

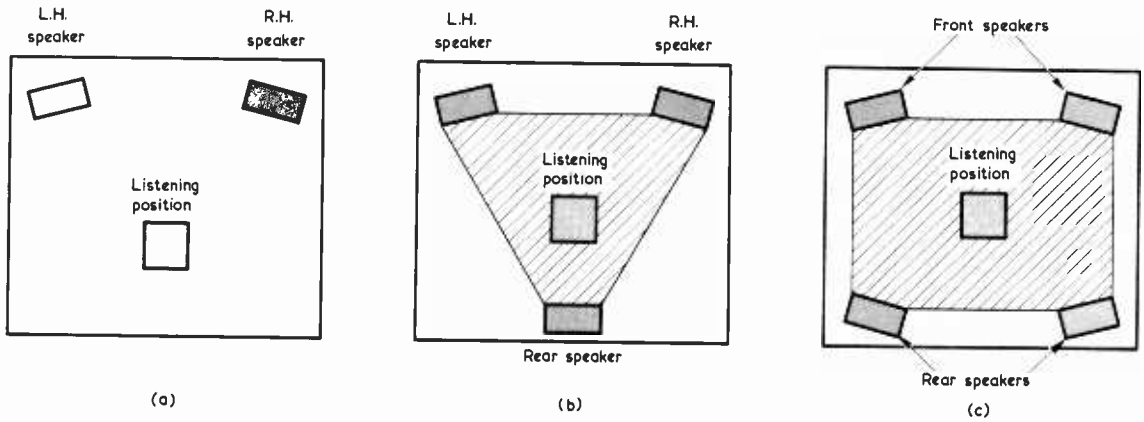


Fig. 1. (a). Speaker positioning in a simple stereo system
(b). Three speakers can be employed for three channel listening
(c). A four channel speaker system

both speakers in the requisite proportion the apparent source of sound may be given at any point between the speakers.

With an orchestra it is possible to give the impression that the individual players are at different positions. Whilst the actual placing of performers may not be of prime importance, in a few cases classical composers have drawn plans of the orchestra on the score when a particular layout of the instruments is important for the production of some special effect, as in the Bartok Piano Concerto No. 1. Apart from musical reproduction, stereo can also considerably enhance the realism of radio plays.

A shortcoming of stereo is that it gives only width to the reproduced signal, and not depth. If two instruments of an orchestra are placed one beind the other, their reproduced sounds will appear to come from one direction at a single point. A depth dimension can be added by employing a three channel system, as in Fig. 1(b), or a four channel system as in Fig. 1(c). If signals are fed to the speakers in the correct proportion a sound can be made to apparently originate anywhere in the shaded area. The three channel system is the simpler of the two but it does not provide by any means as large an area of apparent sound source as does the four channel system.

Four channel reproduction employing true quadraphonic equipment represents the best approach, but this is also expensive. The scheme described in this article gives two rear channels by way of a synthesiser, and only two relatively inexpensive amplifiers, together with the rear speakers, are required. The impression given is of a considerably increased depth dimension when listening to normal stereo discs, tapes or radio transmissions.

The synthesiser unit is housed in a ready made instrument case

SYNTHESISED FOUR CHANNEL

One way of synthesising a four channel signal from two stereo channels is to take each of the stereo outputs to a frequency selective network. High tones can then, for instance, be fed to the front speakers and low tones to the rear speakers whereupon instruments having a wide compass will appear nearer the front than those having a lower frequency range. It is desirable to have a volume control for each speaker if the system is to be set up satisfactorily. The scheme has technical drawbacks, however, particularly if the frequency selective networks and the volume controls are to be inserted between the stereo amplifier outputs and the speakers. There are problems of matching, as well as difficulties due to power losses in the networks and volume controls.

An alternative three channel system was tried, as in Fig. 2(a). The stereo amplifier feeds the two front loudspeakers in the normal way. Two outputs at a low voltage level are also taken from the stereo amplifier, passed through high pass filters which attenuate the low frequencies, combined in a single amplifier and then fed to a single centre rear speaker. The result was an increase in sound source area but the reproduction was unrealistic, since there was an excess of treble from the rear. Changing the high pass filters for low pass filters produced a different effect with bass predominating at the rear, and this was no more realistic.

Further experiments were carried out with two rear speakers and the arrangement which was finally adopted is shown in Fig. 2(b). The two front speakers are driven by the stereo amplifier in normal fashion. The left-hand channel is also fed through a low pass filter to an amplifier and then applied to the left rear

speaker, whilst the right-hand channel is passed through a high pass filter to a second amplifier and thence to the right rear speaker. In the author's opinion this gives a much more convincing effect. Theoretically, there will be some loss of a two dimensional impression towards the centre of the speakers although in practice this is not apparent. Whilst obviously not offering a true four channel system, the method of synthesis adopted caused the reproduction of the basic stereo signal to be significantly enhanced. There is also plenty of room for the more experienced constructor to experiment with the system in order to satisfy his own personal taste.

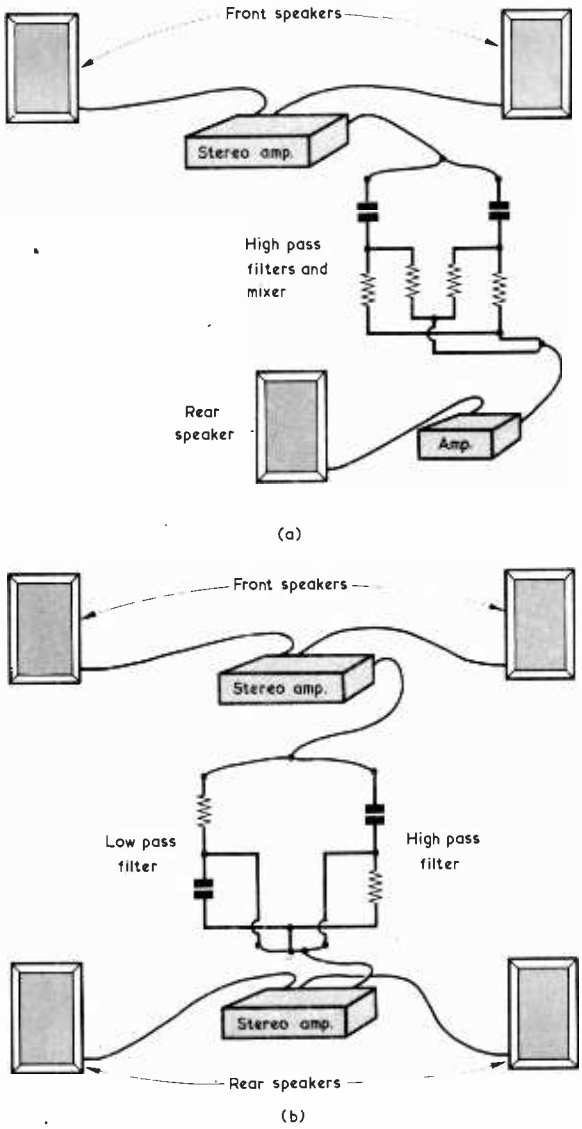


Fig. 2 (a). An experimental set-up for three channel synthesis
(b). The final system to be adopted. The manner in which the low and high pass filters are employed is described in the text

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)

R1, R1(a)	100kΩ
R2, R2(a)	150kΩ
R3, R3(a)	15Ω
R4, R4(a)	100Ω
R5, R5(a)	22kΩ
R6	10kΩ
R7	10kΩ
R8	10kΩ
R9	10kΩ
VR1, VR1(a)	2-gang potentiometer, 25kΩ log
VR2	50kΩ potentiometer, linear

Capacitors

C1, C1(a)	0.1μF plastic foil, side wires
C2, C2(a)	82pF ceramic
C3, C3(a)	10μF electrolytic, 15 V. Wkg.
C4, C4(a)	100μF electrolytic, 15 V. Wkg.
C5, C5(a)	100μF electrolytic, 30 V. Wkg.
C6, C6(a)	1,000pF disc ceramic
C7, C7(a)	1,500pF disc ceramic, or paper or plastic foil
C8, C8(a)	0.01μF plastic foil, side wires
C9, C9(a)	1,000μF electrolytic, 16 V. Wkg.
C10	0.022μF plastic foil
C11	0.022μF plastic foil
C12	1,500μF electrolytic, 30 V. Wkg. (see text)
C13	1,500F electrolytic, 30 V. Wkg. (see text)

Transformer

T1	Mains transformer, secondary 9-0-9 volt at 1 amp, Osmabet type MT9V (Home Radio)

Integrated Circuits
IC1, IC1(a) Super IC-12 (Sinclair)

Rectifier

D1 – D4	silicon bridge rectifier, 100 p.i.v. 2 amp or more

Switch
S1 d.p.s.t. toggle

Neon
NE1 240 volt panel-mounting neon assembly

Speakers
2-off 8Ω speakers in enclosures

Miscellaneous
Instrument case, 11 x 6 x 3 in. (Bi-Pak Semiconductors)
2-off control knobs
1-off 3-way DIN socket
2-off 2-way speaker sockets (see text)
Stereo screened cable and DIN plugs, as required
3-core mains lead
S.R.B.P. board
4-off rubber feet

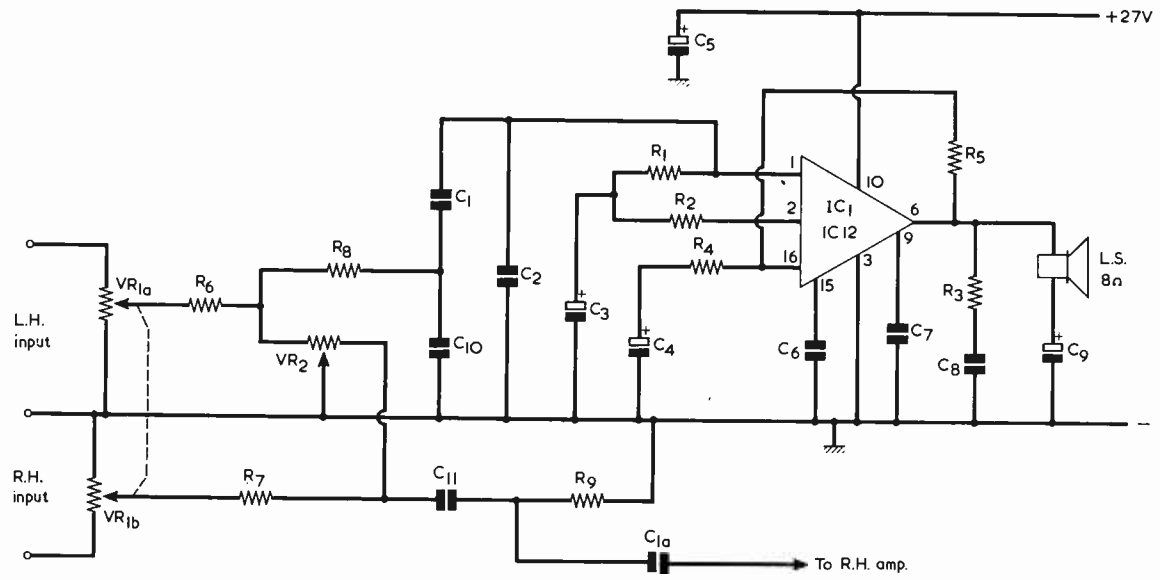


Fig. 3. The synthesiser amplifier circuit. The circuit of the right-hand amplifier is identical with that of the left-hand amplifier

CIRCUIT DIAGRAM

The circuit diagram of the synthesiser amplifier is given in Fig. 3, whilst that of the power supply is illustrated in Fig. 4.

Low voltage outputs at 100mV or more are taken from the two channels of the stereo amplifier and are fed to the 2-gang volume control VR1(a) (b). The manner in which these outputs are obtained from the stereo amplifier is discussed later. The signals on the volume control sliders are then passed via R6 and R7 to VR2, which functions as a balance control. The signal from VR1(a) is fed by way of R8 and C10 to C1 and then to the left-hand channel amplifier. The presence of C10 causes the treble frequencies to be attenuated.

The right-hand signal from VR1(b) is applied to C11 and R9, C11 attenuating the bass and lower middle frequencies. It is then fed via C1(a) to the right-hand amplifier. The right-hand amplifier is identical with the left-hand amplifier. Its capacitors and resistors have the same C and R suffix numbers as the corresponding components in the left-hand amplifier, the letter 'a' being added for convenience in the Components List.

Both amplifiers employ the Sinclair Super IC-12 integrated circuit. This is supplied complete with its own printed circuit board, on which the i.c. and its immediate discrete components are mounted. Component positions are marked on the printed circuit board, the components concerned being C1 to C9 and R1 to R5. The component numbering in Fig. 3 corresponds with that on the printed board. Some of the values in the present amplifier differ slightly from those in the circuit provided in Sinclair literature, and these changes are within the permitted design variations.

The power supply circuit is quite straightforward. The 9-0-9 volt secondary of mains transformer T1 is used here as a single 18 volt winding, and this feeds the silicon bridge rectifier, D1 to D4. The rectified output is coupled to C12 and C13 which are connected in parallel to provide the reservoir capacitance. Two smaller capacitors are used in preference to one large capacitor as they fit more conveniently into the physical layout of the synthesiser. They should offer a combined capacitance of at least 3,000μF, and a value of 5,000μF or more is advisable if a very low level of mains hum is required. The size of each capacitor should not be

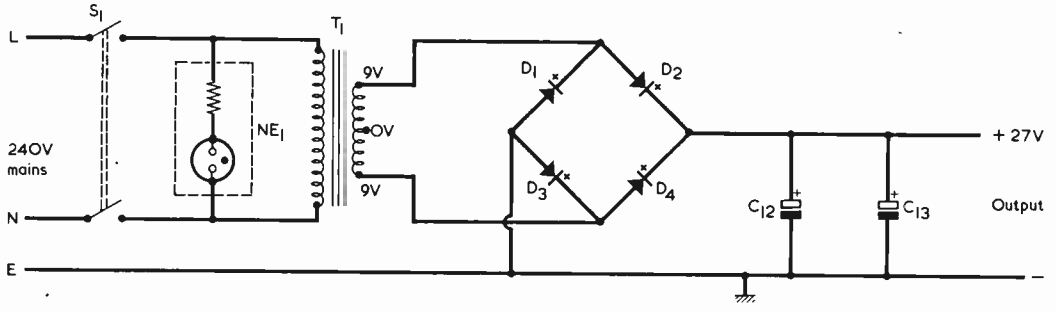


Fig. 4. Circuit of the power supply section of the synthesiser

greater than 1 in. diameter and 1⅝ in. length. Readers who do not have access to retail shops and thus purchase their components by mail order may note that a Siemens axial lead capacitor having a value of 2,200μF at 40 V. Wkg. and dimensions of 26mm. diameter and 41mm. length is available from Electrovalue Ltd. This just meets the maximum dimension requirement, and it is of course in order to use a higher working voltage than that specified.

The neon lamp NE1 is a panel mounting neon indicator having its own integral series resistor. Any type suitable for 240 volt operation may be employed here.

The rectified voltage across C12 and C13 is 27 volts under quiescent conditions. This is a little higher than would be theoretically expected from an 18 volt transformer secondary, and is due to the fact that mains transformer secondary voltages at low current loading are commonly a little in excess of their nominal values.

CONSTRUCTION

The unit is housed in a ready-made instrument case measuring approximately 11 by 6 by 3 in. high. This has an aluminium base, front and rear, together with a removable black vinyl coated steel cover. Drilling details for the rear and front panels are shown in Fig. 5. So far as the rear panel is concerned, the input socket is a 3-pin DIN type. The two loudspeaker sockets may be 2-pin and similar in size to the DIN socket. Alternatively, they may be 3-pin DIN sockets with only two of the pins used. The hole for the main lead must be fitted with a rubber or p.v.c. grommet for protection of the lead. A means of anchoring the mains lead inside the case, by means of a plastic clamp or similar, should also be devised.

The photographs of the interior of the prototype synthesiser show the positions in which T1 and the

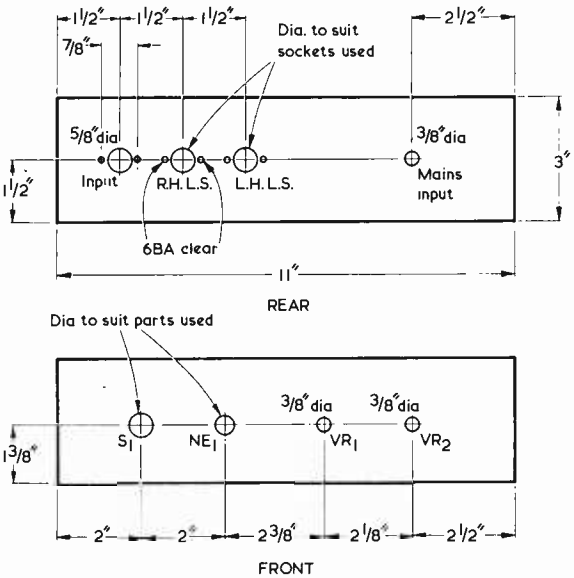
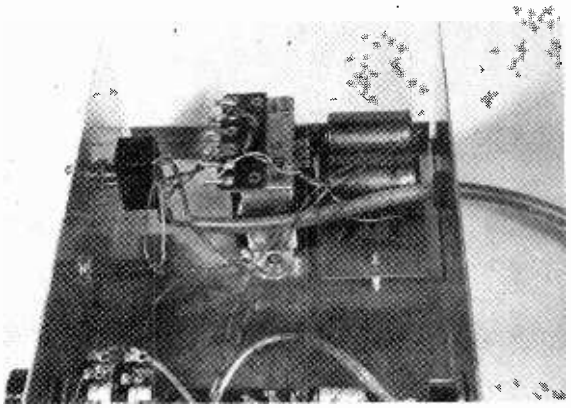


Fig. 5. Drilling details for the rear and front panels



The power supply components are fitted at the left of the cabinet base

three circuit boards are mounted. T1 is secured with two short 4BA bolts and nuts with the bolt heads underneath the base of the case. When it is fitted, a solder tag is held under the 4BA nut nearer the amplifier boards. The amplifier and power supply boards are secured with 6BA bolts, the heads of which are also below the base. The boards themselves may be employed for marking out the positions of the 6BA clear holes needed in the base. (The power supply board is shown in the wiring diagram of Fig. 6). A 4BA clear hole for a chassis solder tag is also required, this being in the approximate position shown in Fig. 7. The power supply circuitry is kept as far to the left of the case, and the amplifier circuitry as far to the right, as is reasonably possible. This ensures minimum pick-up of hum from the mains.

Four rubber feet are fitted near the corners of the base, and the holes needed for their securing bolts are also drilled at this stage.

POWER SUPPLY WIRING

A complete wiring diagram for the power supply section is given in Fig. 6. For convenience of presentation, S1 and NE1 are shown alongside T1, rather than on the front panel. Note that the green-yellow earth wire of the mains lead is connected to the solder tag under the mounting nut for T1.

Capacitors C12 and C13 and the bridge rectifier are wired up on a plain s.r.b.p. ('Paxolin') board measuring 3⅜ in. by 2 in. This has two 6BA clear mounting holes as well as a number of smaller holes for component lead-outs and wiring. The precise positioning of these holes is not important provided they appear approximately in the positions shown. The broken lines represent wiring underneath the board.

The negative output at the board is connected to chassis by a thick lead passing to a solder tag secured under one of the 6BA mounting nuts. Extra nuts are used to space the board off by about ⅜ in. from the base of the cabinet, thereby ensuring that there are no short-circuits to the underside wiring. All connecting leads are insulated, and those carrying the 27 volt positive supply from C12 and C13 should be of a fairly heavy gauge.

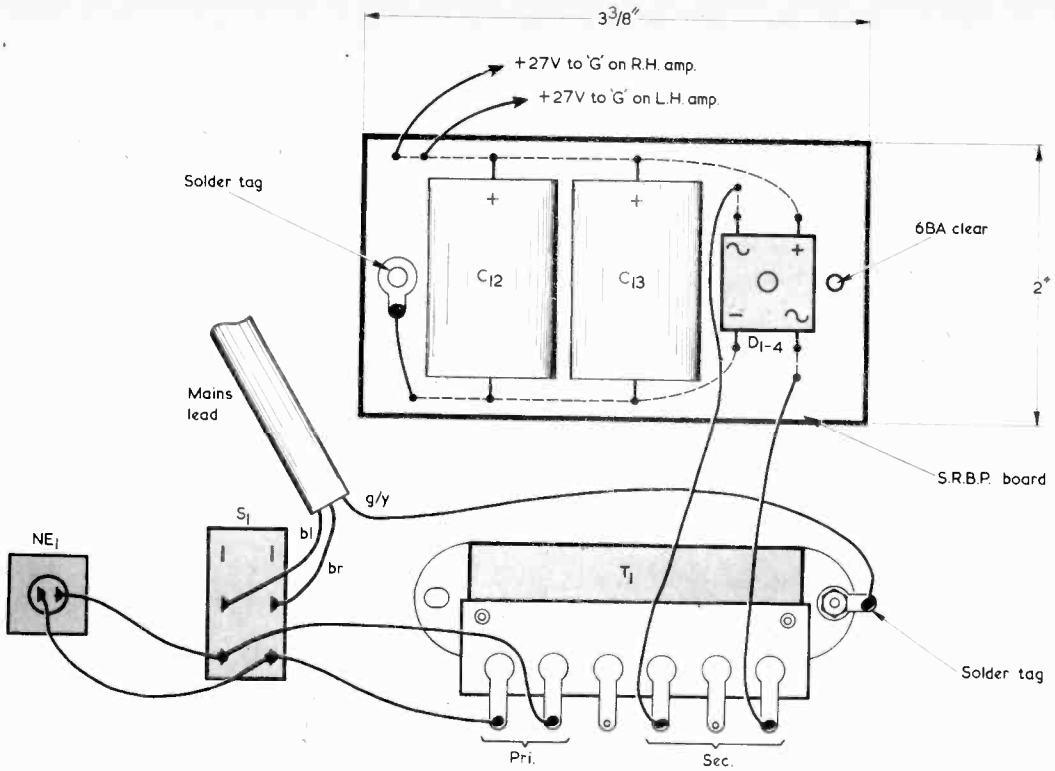


Fig. 6. How the power supply section is wired

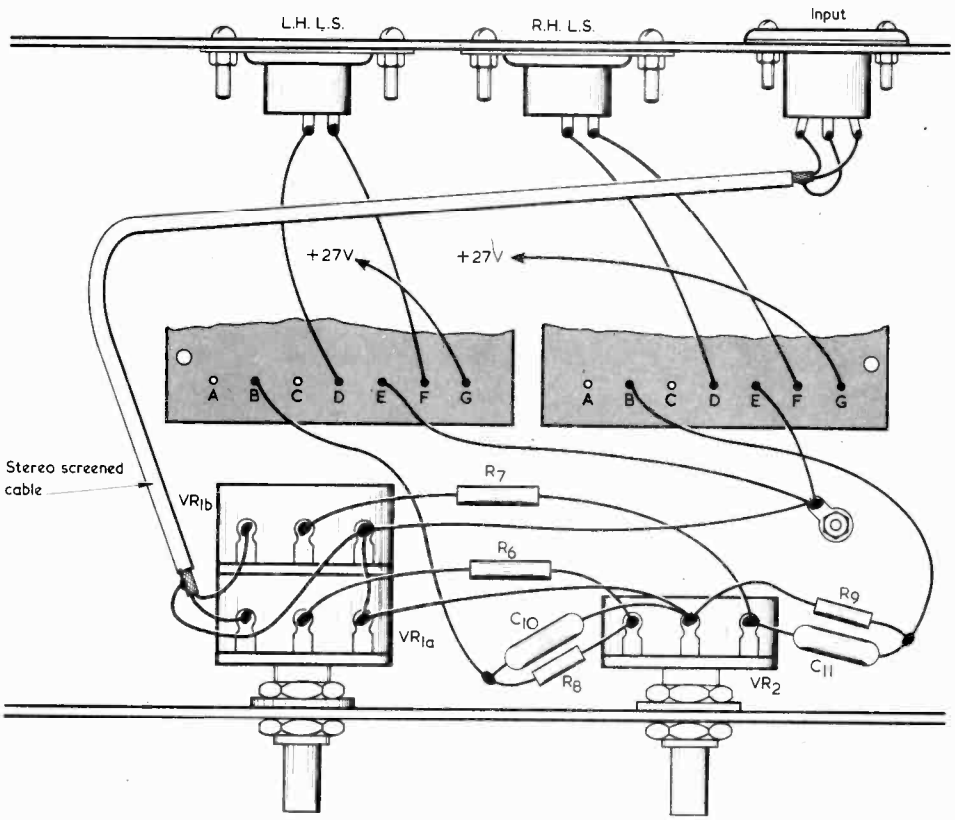


Fig. 7. Wiring up the two amplifiers and the input circuit

AMPLIFIER WIRING

The amplifier wiring is illustrated in Fig. 7. The integrated circuits and their components are fitted to the printed circuits as indicated on the boards themselves. Be very careful to fit the integrated circuits right way round. These have a dot after the words 'Sinclair Super IC-12' on the heat sink to indicate pin 1, and there is an identification groove in the plastic body at the pin 1 end. The printed board has the legend 'Pin 1' at the appropriate hole.

The printed boards also have connection points identified by the letters 'A' to 'G', and these are connected as shown in the diagram.

The boards need to be spaced away from the base of the cabinet by a distance which ensures adequate protection against short-circuits, and spacing washers made of an insulating material should be fitted over the 6BA mounting bolts. These washers may be cut from narrow bore s.r.b.p. tubing, or any similar material having good insulating properties.

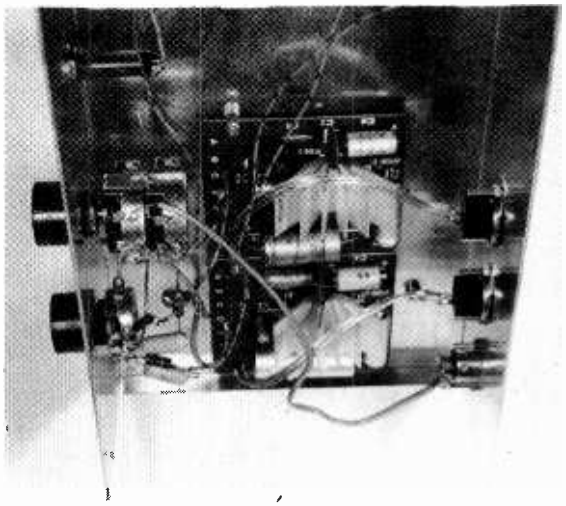
The screened wire between the input socket and VR1 (a) (b) should be stereo cable, i.e. it should have two separately screened wires. Alternatively, two single lengths of single screened wire may be employed. The braiding is connected to chassis at the potentiometer end. At the input socket, pin 1 may connect to the non-earthy end of VR1 (a) track and pin 3 to the non-earthy end of VR1(b) track, with pin 2 connecting to the screened wire braiding and thence to chassis.

STEREO AMPLIFIER OUTPUT

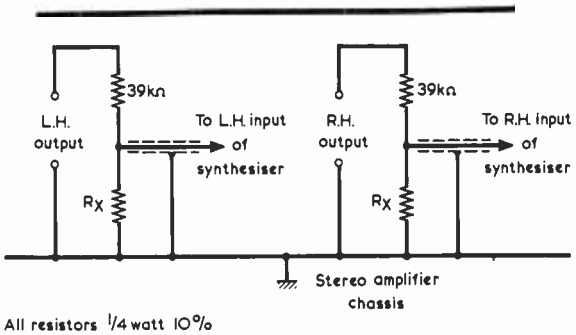
The input to the synthesiser should be taken out from the stereo amplifier at low level, the signal voltage being 100mV r.m.s. or more. Many amplifiers have a 'Tape' or 'Aux' socket which will provide a suitable output. Readers who are uncertain whether the requisite output is available on their own amplifier should consult the manufacturer's literature supplied with it. It is regretted that, due to the extremely wide range of stereo equipment which is currently available, it is impossible for the writer or the staff of this journal to answer queries concerning the output facilities offered by any particular make and type of stereo amplifier. Units with which the writer has checked synthesiser operation are a Sanyo G-2601KL-2 Music Centre, and an Ultra portable stereo record player.

It is, in any case, possible to obtain a suitable signal from the stereo amplifier by coupling to its loudspeaker outputs in the manner shown in Fig. 8(a). This arrangement can be employed if a suitable 100mV output is not available and, as may be seen, a potential divider across the left and right channel speaker outlets causes a small proportion of the speaker signals to be fed to the synthesiser. Although this arrangement does not theoretically allow as high a level of fidelity to be available from the synthesiser, it has been found to give perfectly satisfactory results in practice. The stereo amplifier should have sufficient feedback to produce a voltage at its speaker output terminals that is directly proportional to signal voltage, and the synthesiser amplifiers introduce negligible distortion themselves. The circuit of Fig. 8(a) also allows operation with the more inexpensive types of stereo record player provided that an acceptable fidelity level is offered by these.

Taking a synthesiser input signal from the stereo amplifier speaker outputs instead of from a 'Tape' or

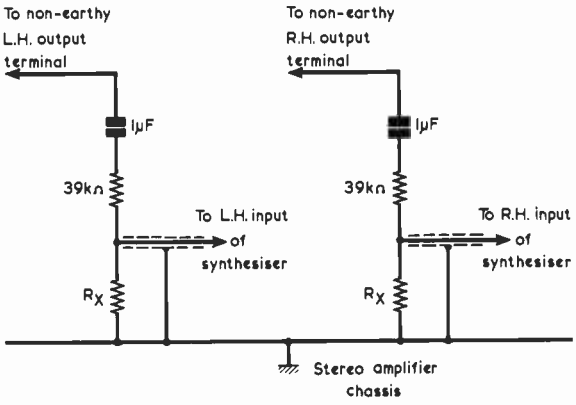


The two integrated circuit amplifiers are mounted at the right



All resistors 1/4 watt 10%

(a)



(b)

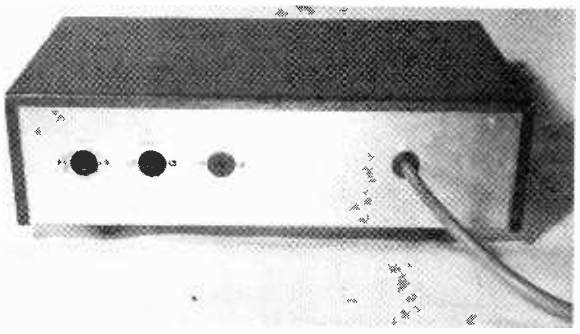
Fig. 8 (a). If necessary, inputs for the synthesiser may be obtained from the stereo amplifier speaker outputs by way of the potential dividers shown here (b). Blocking capacitors are required if the speaker outputs are not common with the stereo amplifier chassis

'Aux' outlet has the slight disadvantage that the settings of the amplifier volume, tone and balance controls also affect the synthesiser, but this merely necessitates setting up the front speakers first before adjusting the synthesiser. The value of the two resistors marked 'Rx' in Fig. 8(a) depends upon the rated output impedance and power per channel of the stereo amplifier, and the accompanying table gives values to meet anticipated requirements here. The potential divider resistors may be positioned near the speaker output sockets of the stereo amplifier. Take care to ascertain which speaker output points are at chassis potential when wiring in the resistors as an incorrect connection at one of the speaker outputs could result in a short-circuit which could damage the amplifier.

If the stereo amplifier speaker outputs do not have one terminal at chassis potential the alternative circuit shown in Fig. 8(b) can be used. The series 1μF capacitors block any direct voltage which may be present at the speaker outputs.

TABLE

Power per channel (watts)	*Value of Rx for rated output impedance of:* 4Ω	8Ω	16Ω
5	1kΩ	680Ω	470Ω
8	750Ω	470Ω	390Ω
10	680Ω	470Ω	330Ω
12	560Ω	390Ω	270Ω
15	560Ω	360Ω	270Ω
20	470Ω	330Ω	220Ω
30	360Ω	270Ω	180Ω



The rear panel of the synthesiser, showing the input and output sockets

The synthesiser should be coupled to the output from the stereo amplifier via stereo screened cable or two lengths of single screened cable, the braiding connecting to the stereo amplifier chassis at one end and to pin 2 of the synthesiser input socket at the other end.

NEXT MONTH

In next month's concluding article, details will be given of speaker phasing and balance adjustment.

(To be concluded)

DX NEWS BROADCASTS

By Steve A. Money

You can lose much of the pleasure of short-wave listening if you do not have the latest DX news and information.*

ONE OF THE SECRETS OF SUCCESSFUL LISTENING FOR DX signals on the short wave broadcast bands is to know when and where to listen for the stations you want to hear. Many beginners in this field give up after a short time, complaining that either their receivers are useless or that there is nothing interesting left for them to hear. Often at this stage they have heard little more than the major high power stations, even though the receivers they are using are probably quite capable of picking up the weaker DX signals. If these beginners only knew when and on what frequencies to listen they would discover that there were all kinds of signals to be heard which they had missed earlier whilst tuning at random across the short wave bands.

FREQUENCY CHANGES

From time to time throughout the year many of the international short wave stations change their frequencies of operation in order to make optimum use of the seasonal changes in radio propagation conditions. Stations used for local services usually remain on the same frequencies all year round, but reception of these stations at a distance is more favourable at certain times of the year only. Apart from frequency changes, stations also make programme time changes to match changes in local time in the country for which the programme is intended.

One valuable reference book for the short wave DX enthusiast is 'World Radio and TV Handbook' which is published annually. This book, obtainable from The Modern Book Company, lists all of the known broadcast stations of the world together with their operating frequencies, schedules and much other useful information. Unfortunately, some of this data can become out of date in a few months so that the keen DXer needs a more frequent source of information about new stations and frequency or schedule changes if he is to keep abreast of the latest developments on the short wave bands. To meet this need, several of the international broadcast stations produce special news programmes for short wave enthusiasts.

RADIO AUSTRALIA

One of the more popular programmes for DXers is that presented by Radio Australia. This programme, which is named appropriately enough 'DXers Calling' is presented every Sunday by Peter Homphrey during the English language broadcasts from Radio Australia. In Britain the best time to listen for 'DXers Calling' is at 0730 GMT in the morning when the transmission is beamed towards the British Isles. Two frequencies are used, one at 9,570kHz in the 31 metre band and the other at 11,765kHz in the 25 metre band. Of these the 11MHz frequency usually gives better signals in Southern England although in other parts of the country the 9,570kHz channel may provide better reception.

The programme consists almost entirely of reports from listeners giving details of new stations heard on the bands and of changes of frequencies used or operating schedules. Usually the bulletin of DX news lasts for about ten minutes of the fifteen minute programme slot, with the rest of the time being filled in with musical items.

Although the early morning programme from Radio Australia is perhaps the easiest to receive in Britain there are a number of repeat broadcasts which can be heard at other times of the day. These transmissions are beamed to other parts of the world but, despite this, reception can often be quite good in Britain. During the afternoon a transmission is made on 9,580kHz and 11,710kHz at 1300 GMT with a second broadcast at 1530 GMT on frequencies of 7,150kHz and 9,770kHz. For the night owls there is a transmission beamed to North America at 0430 GMT on 17,820kHz and 21,680kHz.

ADVENTIST RADIO

A news bulletin prepared by the World DX Club is aired over Adventist World Radio every Sunday morning. This station, which is primarily a religious broadcaster, uses a frequency of 9,670kHz and broadcasts from a transmitter at Lisbon, Portugal. The English language transmission begins at 0930 GMT on Sunday morning with a brief bulletin of world religious news followed, at 0935 GMT, by the programme for DX enthusiasts. Following the DX programme there is a religious programme until the station closes down at 1000 GMT. The DX programme is similar to that from Radio Australia except that in addition to news of stations there are also short talks or features on subjects of interest to DXers. On one Sunday each month a part of the DX programme contains news for medium wave DX enthusiasts.

* See our 'SHORT-WAVE NEWS—For DX Listeners' feature, by Frank A. Baldwin, which appears each month.

SWEDEN

One country in Europe which has a large number of keen short wave enthusiasts is Sweden and it is only natural that Radio Sweden should run a special programme for DXers. This programme is broadcast every Tuesday during each of the half-hour English language transmissions. Good reception is possible in Britain during the broadcast at 2045 GMT which is radiated on a frequency of 6,065kHz in the 49 metre band. An earlier broadcast at 1830 GMT on both 9,625kHz and 11,860kHz also provides fairly good reception. Apart from a short newscast of stations reported by listeners the programme contains talks on short wave radio topics and interviews with DX personalities.

NORTH SEA

Anchored in international waters a few miles from the coast of Holland is the ship 'MEBO II', on board which is the pirate station Radio North Sea International. This station, which is one of the few commercial pirate stations to broadcast on short waves, runs a programme for DXers on Sundays. The programme, called 'North Sea Goes DX', begins at 0900 GMT and is broadcast on a frequency of 6,210kHz. Regular conductor and producer of this programme is A. J. Behrens, and the items featured include a DX newscast, talks on short wave listening, interviews with radio personalities and musical numbers. Information on activities in the pirate radio field is sometimes presented together with tape recordings of pirate stations both past and present. Normally, the DX enthusiast's part of the programme occupies about a half of the two hour broadcast in English on Sunday mornings.

The author should add that he has not heard this station for several weeks up to the time of writing, and is not sure if this is a temporary failure or if the station has gone off the air completely.

VOICE OF THE ANDES

High in the Andes mountains of South America is radio station HCJB, known as 'The Voice of the Andes' and located at Quito the capital city of Ecuador. Like Adventist Radio, this station is primarily concerned with broadcasting the Christian Gospel to the world, but each week it also presents special programmes for short wave listeners interested in the DX side of the hobby.

A programme called 'DX Party Line' is broadcast in English three times a week on Monday, Thursday and Saturday evenings at 1930 GMT. Frequencies used are 11,745kHz and 15,300kHz in the 25 and 19 metre bands respectively. Normally both frequencies give fairly good reception in Britain although sometimes fading presents a problem.

In 'DX Party Line' frequent use is made of tape recordings sent in by listeners and radio clubs. In this way the listeners are able to communicate their news and views to one another over the air. Usually the tapes contain reports of stations logged and of frequency or schedule changes noted by the listener or club sending in the tape. The programme also contains talks on DX topics, news of DX club activities and advertisements for items of interest to short wave enthusiasts. Short musical items and religious messages are used to fill the gaps between DX items in the programme. In all, the programme runs for a period of thirty minutes, most of which is for the DXer.

CANADA

From North America the Canadian Broadcasting Corporation presents, in its overseas service, a special programme for short wave DXers. This programme, broadcast every Saturday, is called 'Radio Canada Short Wave Club' and contains a selection of answers to listeners' queries as well as short features on DX topics and general DX news.

English language programmes for Europe are broadcast at 0600 and 2100 GMT. The short wave club programme is only broadcast during the evening transmission and can be heard on frequencies of 11,865kHz, 15,325kHz and 17,820kHz in the 25, 19 and 16 metre bands. At 1800 GMT the programme is beamed to Africa on the same three frequencies.

DX JUKEBOX

'DX Jukebox' is the title of a programme for DXers broadcast by Radio Nederland on Thursday evenings. Items included are a DX newscast, talks on short wave radio topics and record requests. In Europe the broadcast can be heard on 6,020kHz and 6,085kHz from 1800 GMT onwards. After the world news and comment on news items, the DX part of the programme starts at around 1845 GMT and fills the final fifteen minutes of the English language programme.

Another programme similar to 'DX Jukebox' is called 'Swiss Short Wave Merry-Go-Round' and is presented on alternate Saturdays by Radio Switzerland. Several transmissions are made throughout the day on frequencies of 3,985, 6,165 and 9,535kHz. Convenient times to listen are 0700, 0900, 1530 or 2100 GMT.

AMATEUR RADIO

Amateur radio enthusiasts are catered for by special news broadcasts presented by the Radio Society of Great Britain on Sunday mornings. Normally amateur radio stations in Britain are not permitted to use their transmitters for broadcasting purposes but by a special arrangement with the authorities the R.S.G.B. uses amateur transmitters to radiate its weekly newscasts. Each of the amateur stations taking part in this broadcast uses the special call sign GB2RS whilst transmitting the news bulletin but reverts to its normal call sign when talking with other amateur stations before or after the newscast.

A frequency of 3,600kHz in the 80 metre amateur band is used for all of the news broadcasts and normally single sideband modulation is employed. In addition to the 80 metre transmissions the news is also carried by a number of amateur stations using the 2 metre band.

First transmission of the day is at 0930 a.m. local time and is radiated from a station in Kent for listeners in the south eastern area of England. At 1000 a.m. a station in Cheltenham takes over for a repeat broadcast aimed at Wales and the south-west of England. Northern Ireland is served by a station in Belfast which comes on the air at 1030 a.m. The Midlands area and the north of England are covered by two transmissions at 1030 a.m. and 1100 a.m. respectively. For Scotland two broadcasts are made, one covers the southern part and

comes from Motherwell at 1130 a.m., and the second is intended for north Scotland and starts at midday.

Details of forthcoming meetings of radio clubs, news and results of contests and other items of interest to amateur radio operators and listeners are included in the R.S.G.B. news bulletins. From time to time information on the OSCAR amateur radio satellite is presented, including details of contacts made via OSCAR and predicted times of the satellite orbits.

EASTERN EUROPE

Several of the Communist Bloc countries in eastern Europe broadcast programmes for short wave DXers. A fairly easy one to find is Radio Sofia in Bulgaria operating on 9,700kHz and 6,070kHz in the 31 and 49 metre bands. On Friday evenings during this station's English programme at 2130 GMT there is a section for DXers compiled by the Central Radio Club (LZ1KAB) of Sofia. An earlier transmission at 1930 GMT using the same two frequencies also provides quite good reception in Britain.

Rumania, Hungary, Czechoslovakia, Russia and East Germany also present programmes for DXers.

OTHER COUNTRIES

Radio Japan presents a DX programme as part of its 'Tokyo Calling' broadcast in English on Sundays. There is one unique DX programme which is compiled by a short wave listener from his own listening activities. This is 'Arthur Cushens' DX World', presented once a month by Radio New Zealand. Reception of Radio New Zealand is not very good in Britain but fortunately most of the details compiled by Arthur Cushens are included in the Radio Australia DX programme from time to time.

Several other countries present special DX programmes but for most listeners the ones already mentioned in this article are likely to provide all the information needed.

USE A TAPE RECORDER

Unless you happen to be expert at high speed writing or shorthand it can be rather difficult to write down all of the information on station frequencies, schedules and addresses as it is read over the air. This is where the use of a tape recorder can be very helpful. Make a recording of the whole programme whilst you put a few rough notes on paper. Later, it will be possible to play the recording through a number of times to pick out interesting details which you might have missed during the original broadcast. This technique is especially useful when the reception conditions are difficult due to interference or fading. Once the relevant information has been extracted from the tape it can be used again for the next broadcast.

A rather useful service, mainly intended for editors of DX club news sheets, is provided by Radio Sweden. Upon request they will send out to listeners a transcript of their DX news programme.

For convenience a summary of the main news programmes for DXers is given in the Table, together with the frequencies and times of transmissions which give favourable reception in Britain. ■

TABLE
Summary of DX news broadcasts

Day	*Station*	*Time (GMT)*	*Frequency (kHz)*
Sunday	R. Australia	0730	9,570, 11,765
		1300	9,580, 11,710
		1530	7, 150, 9,770
	R. Japan	0810	17,825
	A.W.R., Portugal	0930	9,670
	R. North Sea	0900	6,210
Monday	HCJB Ecuador	1930	11,745, 15,300
Tuesday	R. Sweden	1830	9, 625, 11,860
		2045	6,065
Thursday	HCJB Ecuador	1930	11,745, 15,300
	R. Nederland	1800	6,020, 6,085
Friday	R. Sofia	1930	6,070, 9,700
		2130	6,070, 9,700
Saturday	CBC Canada	2100	11,865, 15,325, 17,820
	HCJB Ecuador	1930	11,745, 15,300
	R. Switzerland (fortnightly)	0700	3, 985, 6,165, 9,535
		0900	3,985, 6,165, 9,535
		1530	3,985, 6,165, 9,535
		2100	3,985, 6,165, 9,535

NEW POSTAL CHARGES

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HAND TREMOR DETECTOR

By Stephen Price

This article presents a new look at a very old fairground game and describes how it may be considerably improved by the application of electronics.

THE IDEA OF THE GAME IS TO PASS A SMALL METAL ring mounted on a handle along a length of stout bent wire without allowing contact between the two. The simple circuit employed is shown in Fig. 1. If the ring touches the wire a circuit is completed between the battery and the bell, whereupon the latter gives an audible indication that contact has taken place. A steady hand is required if the ring is to be traversed over the whole length of the wire without the bell sounding.

DISADVANTAGES

Unfortunately, although possessing the virtue of simplicity, this system has several disadvantages. The first and most obvious is that the bell will only ring during the time that contact is sustained. A trembling hand may produce contact for a fraction of a second only and this may be too short for the bell to ring effectively. Secondly, many electrical bells consume a high current, and may even cause visible sparks to appear between the ring and the wire, an effect which could alarm people whose ignorance of electricity is matched by their fear of it.

A further disadvantage is that it is not posible to provide a control of the volume of sound from the bell. A buzzer may be substituted for the bell of the game is to be played indoors, but the sound of a buzzer, when repeated frequently, is not particularly attractive.

Fig. 2 shows an electronic version of the game, and this overcomes the disadvantages of the simpler version. TR1 and TR2 appear in a multivibrator circuit which runs at approximately 700Hz. Diodes D1 and D2 are included to ensure that the reverse base-emitter voltage ratings of the transistors are not exceeded. Power is applied to this multivibrator and to capacitor C1 whenever the ring touches the wire. C1 charges up immediately and then acts as a second power source if the contact between the ring and the wire is broken, allowing the oscillator to continue operating for several seconds until it discharges.

The output of the multivibrator is coupled to TR3, which drives the speaker. The series potentiometer, VR1, functions as a volume control. The output circuit is connected across the supply rails all the time, but it is interesting to note that it draws negligible current if the multivibrator is not oscillating. This is because the base of TR3 is then coupled to the negative supply rail via R5, and the only current in the output circuit is the very small leakage current in the transistor. During oscillation positive-going pulses are fed to TR3 base, causing this transistor to actuate the speaker at multivibrator frequency.

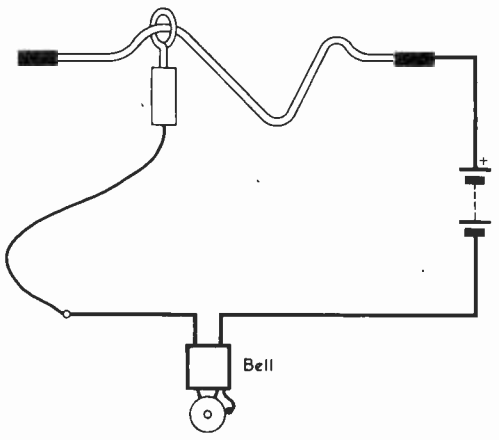


Fig. 1. The circuit employed for a simple electrical game. The metal ring has to be passed along the bent wire without causing the bell to ring

CONSTRUCTION

Any method of construction may be employed. If the unit is to be used indoors as a children's game all the parts can be assembled in a plastic case measuring some 10 by 8 by 3in., this having an aperture cut out for the speaker. Two holes will also be required for S1 and VR1, and a socket may be provided into which can be plugged a flexible lead connecting to the metal ring. The ring consists of stiff wire bent to shape and mounted in a handle. The bent wire along which the ring passes may be mounted on the top of the case,

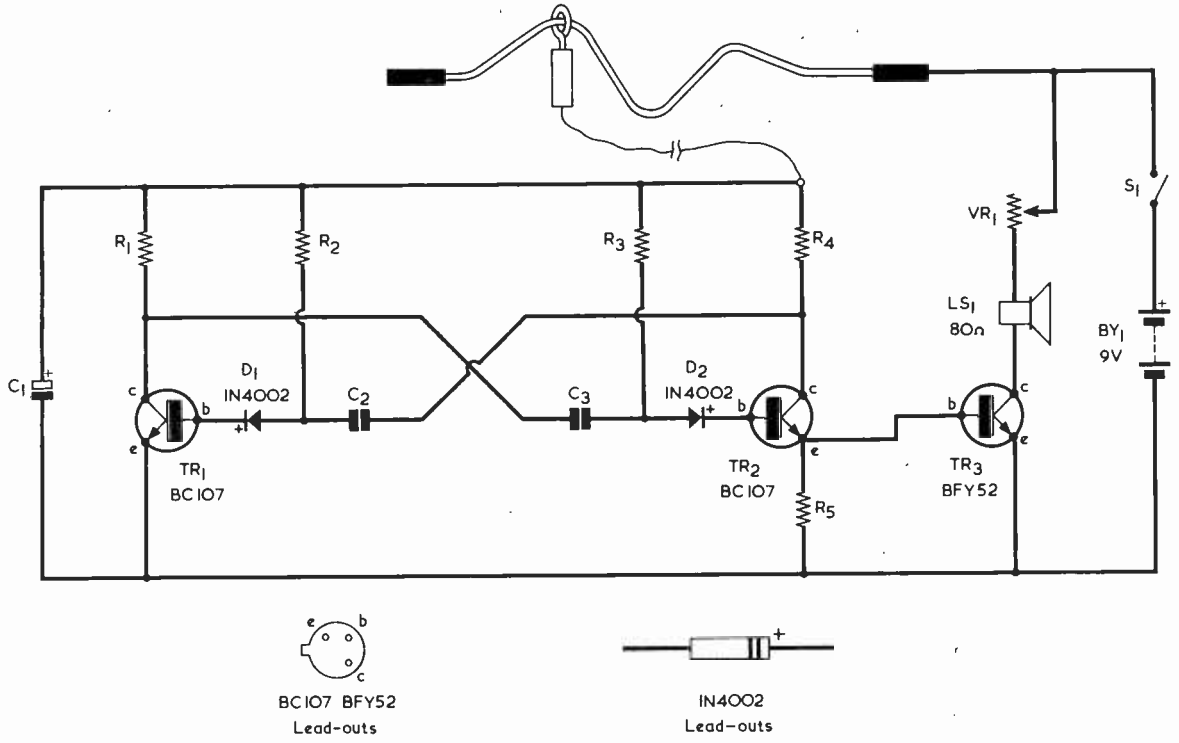


Fig. 2. Electronic version of the game. This offers a number of distinct advantages when compared with the simpler circuit

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)

R1	2.2kΩ
R2	18kΩ
R3	18kΩ
R4	2.2kΩ
R5	1kΩ
VR1	1kΩ potentiometer, wire-wound, 3 watts

Capacitors

C1	1,000μF electrolytic, 10 V. Wkg.
C2	0.047μF plastic foil
C3	0.047μF plastic foil

Semiconductors

TR1	BC107	D1	1N4002
TR2	BC107	D2	1N4002
TR3	BFY52		

Speaker

LS1	80Ω speaker

Switch

S1	s.p.s.t. toggle

Battery

BY1	9 volt battery

Miscellaneous
1 knob
Material for ring and wire
Case, etc.

and its ends are covered with insulating tape for an inch or so to allow the ring to be rested against it without the oscillator sounding. A wire coat-hanger offers a suitable source of stiff wire for both the ring and the bent wire. One of the sturdier types of plastic food container could provide a suitable case, and these are available in bright colours which will be attractive to children. It is used 'upside-down', whereupon its lid forms a removable base which allows access to the battery.

If desired, several rings having different diameters may be made up, thereby providing varying grades of difficulty. In this case it will be necessary to have a means of removing the bent wire easily. Its ends may be secured to large terminals, or may fit into wander sockets mounted on the case. For long life and efficient operation a fairly large battery, such as the Ever Ready PP7, should be used.

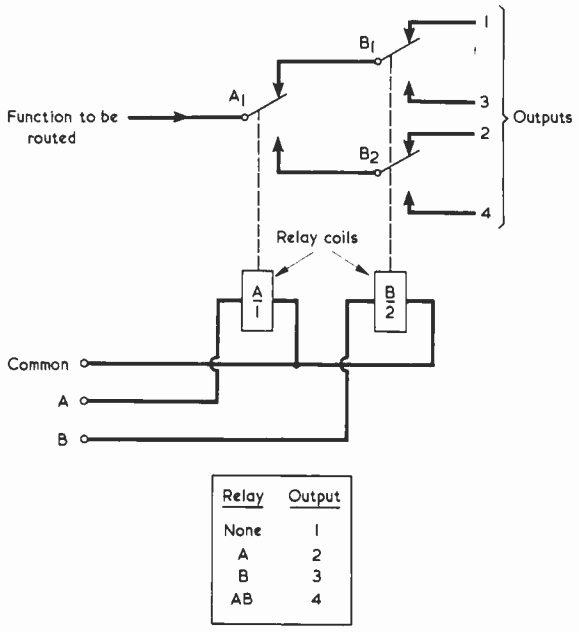
In practice the circuit is very effective. When contact is made between the ring and the wire, even if only momentarily, the loudspeaker emits a loud high-pitched note. This gradually dies away when the contact is broken, giving a pleasing glissando sound.

The game will obviously appeal to children, but adults may obtain enjoyment from it also. A particularly interesting experiment could be conducted to evaluate the effects of alcohol on human dexterity and steadiness of hand! ■

RELAY ROUTING CIRCUITS

By D. Snaith

There are still many functions which can be usefully carried out by the electromagnetic relay.



Relay	Output
None	1
A	2
B	3
AB	4

Fig. 1. A relay circuit which enables a function to be routed to any one of four outputs

IN THESE DAYS OF THE TRIAC AND THE THYRISTOR, THE electromagnetic relay may appear to be a device which belongs to an era of the far distant past. And yet manufacturers are continually introducing new relay designs, and we find relays clattering away busily in such diverse equipment as that employed in telephone exchanges and one-armed bandits. In the home-constructor world, at least two pages devoted to relays are to be found in the popular mail-order catalogues. There is little doubt that the relay, even though theoretically outdated by modern semiconductor devices, will still be with us for quite a long while to come.

The main fascination of the relay is the fact that it can be actuated by a circuit which is completely isolated from the circuit which the relay switches. This factor enables relays to be employed in logic circuits which have delightfully unconstrained design rules.

FUNCTION ROUTING

Fig. 1 shows a simple relay circuit in which two relays allow a function to be routed to any one of four outputs. The relays may be controlled remotely, and can be employed for such purposes as selecting inputs for an a.f. amplifier, controlling amateur transmitter operating modes or any similar application. In the diagram the relay coils are depicted as rectangles accompanied by a letter which identifies the relay over a figure which denotes the number of contact sets the relay has. The contact sets are all shown in the de-energised state.

If neither of the relays is energised, the function to be switched is routed via contacts A1 and B1 to output 1. When relay A is energised, the function is routed to output 2, and when relay B is energised the function is switched to output 3. If both relays are energised, the function is routed to output 4.

The two relays can be controlled remotely by the switching circuit illustrated in Fig. 2(a). When the switch is in position 1 no relay is energised. When it is set to position 2 relay A is energised, and when it is set to position 3 relay B is energised. At position 4 both relays are energised. The switch numbering corresponds with the outputs that are selected by the relays. If the switching circuit is in the same premises as the relays, the common connection between the two can be carried by the mains earth.

Fig. 2(b) shows an alternative switching circuit in which a single pole switch is used. In positions 2 and 3 the relay coils are energised as before. When the switch is in position 4 both coils are energised via the diodes D1 and D2. The diodes are necessary here to isolate the alternative coil when the switch is in position 2 or 3. The diodes are silicon rectifiers having a fairly large peak inverse voltage rating to allow for the high back-e.m.f. which appears across each relay coil when it is switched off. Rectifiers type 1N4003 with a p.i.v. of 200 volts would be suitable. Silicon rectifiers with a higher p.i.v. may also be used.

When two relays have to be controlled, the alternative switching circuit shown in Fig. 3 may be employed. This has the advantage that only two wires are needed between the switching position and the relays. Where possible, the lower connecting line could be a mains earth, whereupon only one connecting wire is needed.

When, in Fig. 3, the switch is in position 2, positive half-cycles are applied to the relay coils, whereupon only D3 passes current and only relay A energises. On position 3, negative half-cycles are fed to the relay coils, with the result that only D4 passes current and only relay B energises. When the switch is in position 4, both positive and negative half-cycles are applied to the relay coils and both relays energise. The mains transformer requires a secondary voltage sufficiently high to energise the relays after rectification and will typically be of the order of 9 volts. The diodes are silicon rectifiers and, in this circuit, do not need as high a p.i.v. rating. Rectifiers type 1N4002 with a p.i.v. of 100 volts could be em-

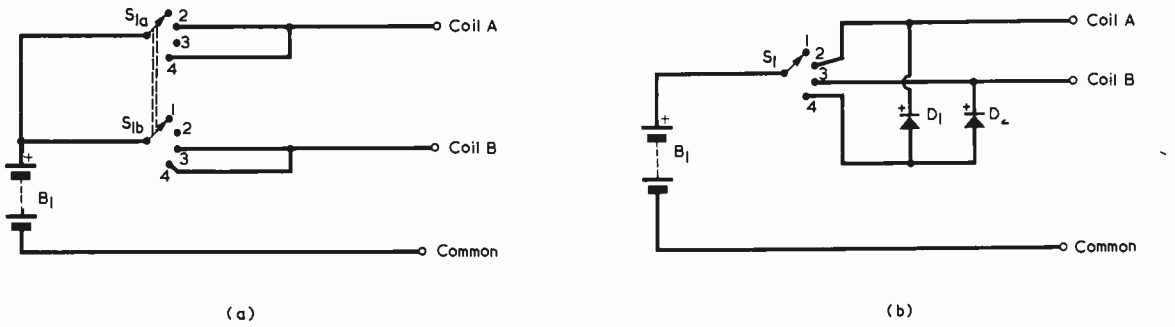


Fig. 2(a). A switching circuit for controlling the relays
(b). An alternative circuit which enables a single pole switch to be used

ployed. The electrolytic capacitors require values which are found by experiment, and they should be just large enough to allow the relays to energise without chattering at mains frequency. Too high a value will cause the relays to be excessively sluggish when de-energising. The capacitance required will be around 20 to 200μF with most relays. The relay coil resistance should be in excess of some 250Ω to ensure that high parallel capacitances are not needed.

THREE RELAYS

If three relays are controlled it becomes possible to switch a function to one of no less than eight outputs, and a suitable circuit is shown in Fig. 4. The possible

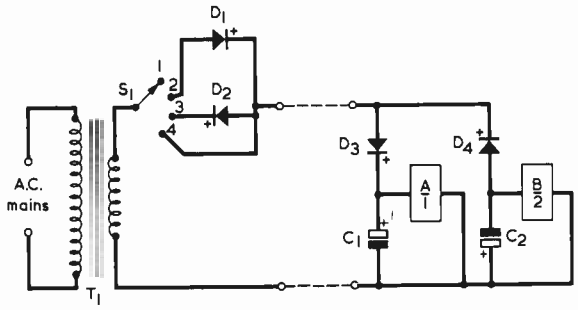
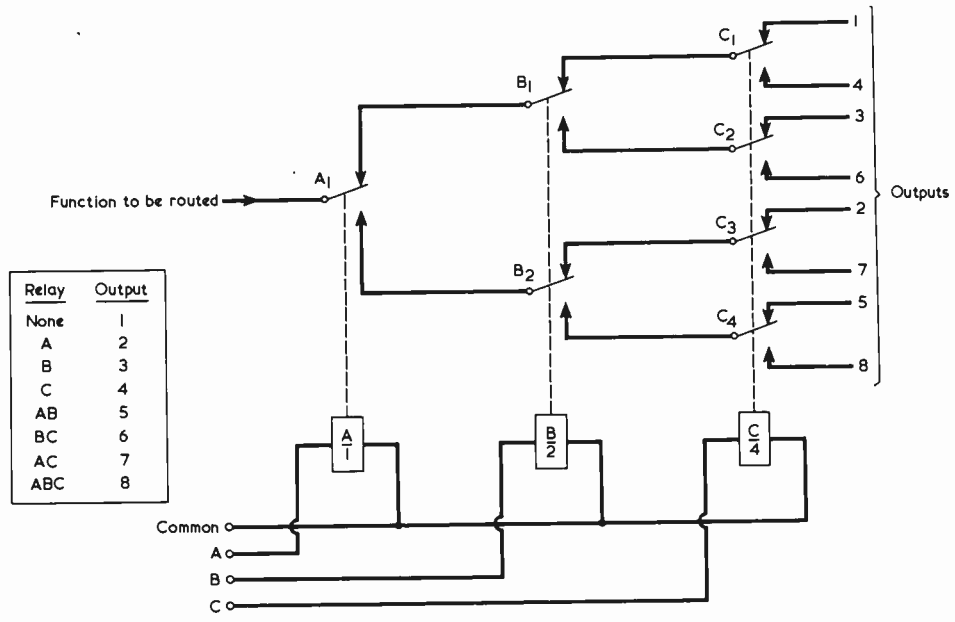


Fig. 3. A switching circuit which requires only two interconnecting wires



Relay	Output
None	1
A	2
B	3
C	4
AB	5
BC	6
AC	7
ABC	8

Fig. 4. With three relays it is possible to route a function to one of eight outputs

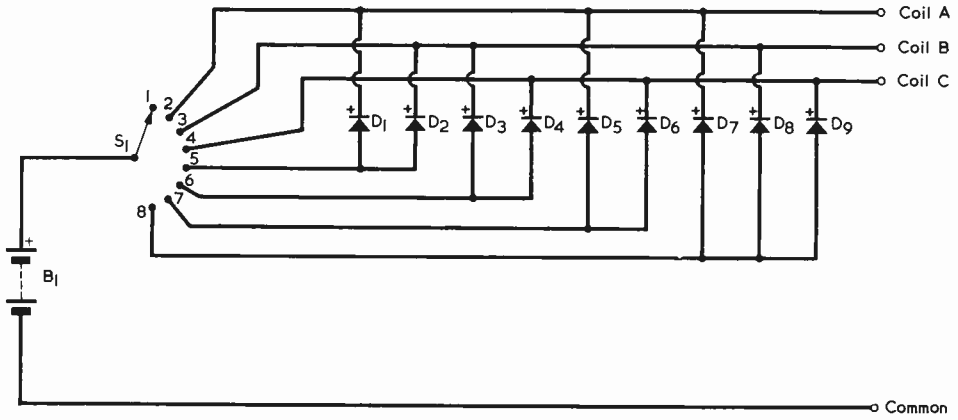


Fig. 5. A switching circuit for the three relays

relay combinations start with all relays de-energised and then proceed through the series, A, B, C, AB, BC, AC and ABC. To take an example, when relays B and C are energised the function is routed through contact set A1 (de-energised), contact set B1 (energised) and contact set C2 (energised) to output 6. The circuits through to other outputs may be readily traced through.

The controlling switch can be a 3-pole 8-way type, but switches of this nature are not readily available at low cost on the home-constructor market. A single pole 8-way switch can alternatively be used with nine diodes, as in Fig. 5. These diodes carry out the same functions as did the diodes in Fig. 2(b) and they enable two or three relay coils to be energised at a single switch position without unwanted coupling between them at other switch positions. The switch numbers correspond with the output numbers. Thus, when S1 of Fig. 5 is set to position 6, the positive terminal of the battery couples via D3 and D4 to the coils of relays B and C, thereby energising these relays and selecting output 6. As with Fig. 2(b) the diodes are silicon rectifiers with a p.i.v. of 200 volts or more, and 1N4003 would be suitable. Once again, the common connection may be carried by a mains earth.

An alternative relay contact circuit which offers the same facilities as that of Fig. 4 appears in Fig. 6. This has the advantage of requiring fewer contact sets in relay C.

Any relays having the requisite contact sets may be used in the circuits. Naturally, all the relays used in a circuit should have approximately the same coil energising voltage. As already mentioned, the relays in Fig. 3 should have coil resistances in excess of 250Ω. It is also desirable, although not essential, to have coil resistances in excess of 250Ω in the other circuits, as this enables thin connecting wire to be employed between the switching and relay stations. A battery having a

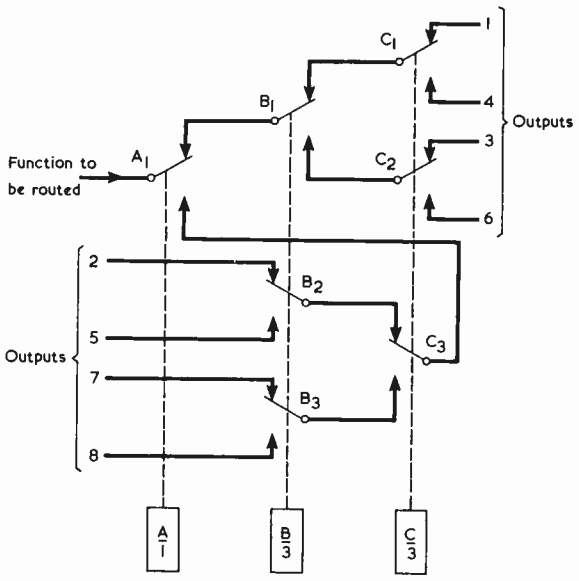
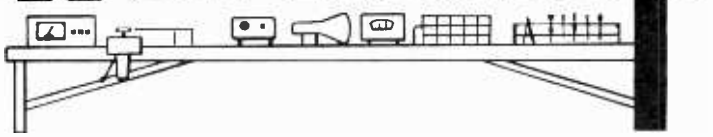


Fig. 6. Another function routing circuit with three relays

voltage suitable for the relays is shown in Figs. 2(a), 2(b) and 5, but operation will, of course, be much more economic if a small mains power supply is used instead. ■

In your workshop



This month Dick and Smithy take a rest from their usual Workshop chores and devote their time to discussing the latest selection of hints received from readers.

"I THINK," REMARKED SMITHY purposefully, "that a little development is called for here."

He frowned thoughtfully.

"What," asked Dick anxiously, "do you intend doing?"

"I feel," pronounced Smithy, "that I won't go far wrong if I put a hotel on Park Lane and another one on Mayfair."

"Ye gods," snorted Dick disgustedly. "No sooner do you get a bit of money than you start building all over the place."

"Well, what's happened to all the property you had?"

"You darned well know what's happened to it. It's all flipping well mortgaged."

"Even your Electric Company?"

"Even my Electric Company."

READERS' HINTS

Gloatingly, Smithy placed the little plastic hotels in position on the Monopoly board.

"Blimey," complained Dick, "just look at you – you're positively drooling! Rachman isn't in it when *you* get your hands on property."

Cheerfully, Smithy threw the dice and made a move which resulted in his finishing on an item of his own property. He handed the dice to his assistant.

"All you've got to do," he said happily, "is throw a three or a five."

"Like heck I do," retorted Dick, rattling the dice noisily. "Either one of those numbers will have me ending on Park Lane or Mayfair."

He threw the dice onto the board vigorously. One lodged against one of Smithy's newly acquired hotels and exhibited a single dot. The second skated off the board and fell to the floor.

"Back away!" shouted Smithy immediately. "Don't you dare touch it!"

Feverishly, the pair got down on their knees to look at the second dice. It had come to rest underneath Smithy's bench, and it showed a symmetrical pattern of four dots.

"Oh no," moaned Dick. "That puts me right on Mayfair."

"It does, doesn't it?" agreed Smithy, rubbing his hands. "And I must now trouble you over a little matter of rent."

"How much?"

"Two grand."

"Two grand?" wailed Dick. "Then I'm bankrupt. Hell's teeth, that's the third game you've won."

"Well," pronounced Smithy smugly. "I *am* the better businessman, you know."

"All right, don't rub it in. Isn't there anything else we can do?"

They looked out of the rain-bespattered Workshop windows. The month of April was proving true to its name, and yet another heavy shower was in progress. Dick and Smithy had cleared up all the sets that were in for repair earlier in the afternoon, and were now passing the time until they could officially leave the Workshop.

"Well," said Smithy, consulting his watch, "there's still another half-hour left before packing-in time. Now I wonder what we can do with it?"

He mused for a moment, then his face brightened as a thought came to him.

"I've got just the right idea," he said brightly. "Why don't we have a session on the latest batch of hints sent in by readers?"

"Readers' hints?" exclaimed Dick excitedly. "Now that *is* an idea. We haven't had a readers' hints sesh for ages."

"It is quite a long time since the last one," agreed Smithy. "Well, let's have a look to see how many have reached us in the meantime."

He stood up, pulled open a drawer in his bench and took out a sheaf of letters. Pushing back the Monopoly board, he placed the letters on his bench, sat down again and proceeded to look through them.

"Ah," he remarked, selecting a letter. "Here's a good one for starters. It describes a method of reducing the physical strain on a wire which is connected to a crocodile clip. A sample clip showing the idea is enclosed with the letter."

Smithy took a modified crocodile clip from the envelope in his hand and passed it over to his assistant. (Fig. 1).

"Hallo," said Dick, examining the clip, "it's got an extra spring on it."

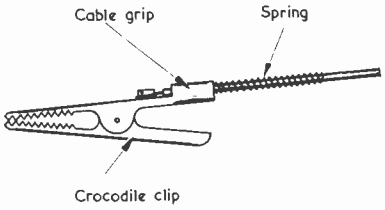


Fig. 1. A spring taken from a retractable ball point pen can be added to a crocodile clip to relieve strain on the lead connecting to the clip

"That's right," confirmed Smithy. "Now, the normal way of fixing a wire to a crocodile clip consists of passing the wire through the cable grip and securing its bared end under the terminal screw. This is perfectly all right when the crocodile clip is only used occasionally, but there is quite a lot of long-term strain on the wire at the point where it leaves the grip if the clip is moved a lot from one point to another. The strain can be alleviated by adding that spring. It's the internal spring from an old retractable ball point pen and one end of it is passed into the cable grip. The grip may need to be widened a little to take the spring. It is then tightened up to hold the spring securely. After that the wire is passed through the spring to the terminal screw."

"That's a crafty scheme, I must say," commented Dick. "I get wires breaking off crocodile clips occasionally, and so I'd better start hunting around for old ball pens."

"It's surprising how useful those ball pen springs can be," commented Smithy. "If ever you throw out one of the retractable types it's always a good idea to retain the spring and keep it in your junk box. You never know when you may want a small spring for some gadget you're making up, apart from using it for this crocodile clip idea. Anyway, let's have a look at the next hint."

Smithy read a second letter.

"Well now," he continued, "this is a scheme for putting legends on light coloured panels such as those made from Formica. Our correspondent says that many offices employ transparent adhesive tape which is called 'Magitape' by 3M Company and 'Invisible Tape' by Sellotape Products. This tape is used for covering matter that is likely to become smudged, and it has the advantage that it can be written or typed on. The idea is to write or type onto a piece of the tape the legend required, attach this to the panel and then protect it by covering it with another piece of transparent tape or clear Fablon."

"If this tape is sticky," put in Dick, "how do you get it through a typewriter?"

"Ah," said Smithy, studying the letter, "that's the secret of the scheme. What you have to do is to find something to stick the tape to while it is being typed. One suitable material is the backing paper on which sticky office labels are attached, and another is the backing paper on Fablon. The transparent tape is stuck to the side of the backing paper which was originally against the sticky surface of the label or the Fablon. First, a straight pencil line is drawn on the backing paper surface and the transparent tape is then stuck on below this line. Like this."

Smithy unclipped from the letter a piece of backing paper with transparent tape affixed to it, and showed it to his assistant. (Fig. 2.)

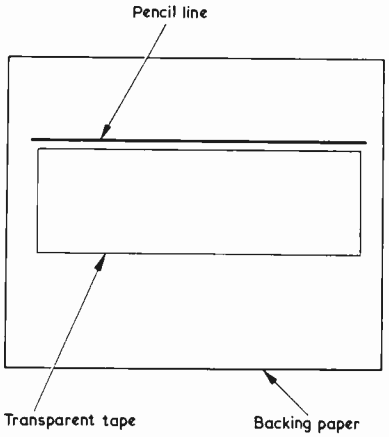


Fig. 2. Certain types of office transparent tape may have legends typewritten on them, after which that can be fixed to light coloured panels. The tape is affixed to backing paper to enable it to be fed through the typewriter

"What do you need the pencil line for?"

"So that you know where the tape is when it comes through on the typewriter," replied Smithy. "It really *is* almost invisible, and you'd have difficulty in locating it without the pencil line as a guide."

"I can understand what you mean," said Dick, looking closely at the sample of the tape. "It's as much as I can do to see it, even when I know it's there."

"Exactly," stated Smithy. "Well, after you've typed on the legend, the transparent tape is carefully peeled off the backing paper and fixed to the panel. A piece of ordinary paper is placed over the tape so that it can be pressed well down. The paper is then taken away and the transparent tape is protected by covering it with another piece of the same tape. Alternatively, the legend or, better, the whole panel can be covered with clear Fablon."

SATIN FINISH

"That's certainly a knobby idea," stated Dick enthusiastically. "What's the next hint, Smithy?"

"It's to do with obtaining a satin finish on aluminium panels," replied Smithy, glancing through several letters. "Actually, there are two hints in separate letters from the one reader here, and I'll start off with this satin finish one. He describes this as the 'lazy man's approach', and it certainly doesn't involve much work. The first thing to do is to drill all the holes that are required in the aluminium panel, and then remove all dirt and grease with the aid of a detergent. This applies even to bright panels which are brand-new from the shop, as these can still be greasy. The panel is next put in a suitable shallow dish which may be plastic or otherwise, but which must not be aluminium, and is just covered with a strong solution of common household soda in water. It is then left overnight. Next morning it is taken out and rinsed under the cold water tap. The result is a satin finish which looks particularly effective if the panel is the front panel of an item of equipment."

"That's a scheme which would suit me down to the ground," commented Dick. "No effort required at all!"

"There's a little more work involved with the second hint from this reader," remarked Smithy. "It's a tool for delving into the wiring looms or harnesses in ex-Government or other surplus gear. There's a sketch of it in the letter."

Smithy showed Dick the sketch. (Fig. 3.)

"It looks," said Dick, "rather like a modified screwdriver."

"It *is* a modified screwdriver," said Smithy. "A V-cut is filed at the end of the screwdriver blade, and this becomes the wire 'pusher-downer'. And a notch is filed into the side of the blade and this becomes a wire 'puller-upper'."

"That gadget," remarked Dick, "should be jolly useful if you're trying

Fig. 3. A screwdriver modified for dealing with leads in a wiring harness

to sort out one of those harnesses."

"It should, indeed," agreed Smithy, already engrossed in the next letter. "Now here's a method of terminating coaxial cable. There are some drawings of the scheme in the letter and we can both look at these."

Smithy detached a page from the letter and placed it on his bench. (Fig. 4.)

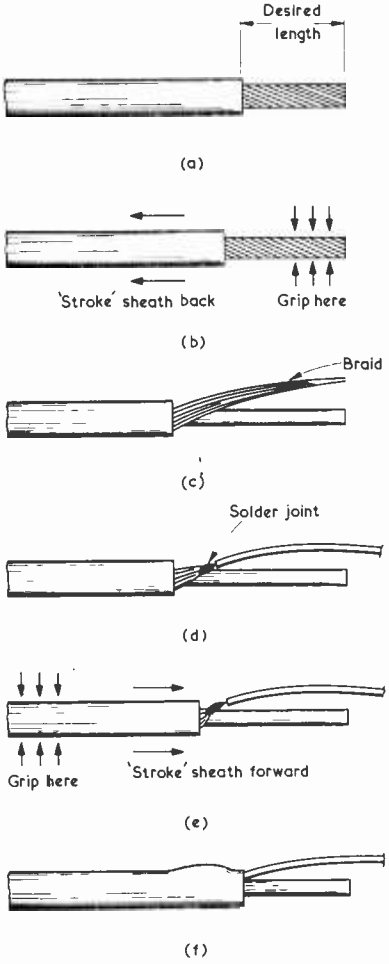


Fig. 4(a). The first step in terminating a coaxial cable consists of removing the outer sheath over the desired length
(b). The outer sheath is 'stroked' back
(c). The braid strands are twisted together
(d). The braid strands are cut and an insulated wire soldered to them
(e). 'Stroking' the outer sheath forward
(f). The sheath covers the solder joint and two insulated leads then emerge from its end

"The first thing to do," said Smithy, "is to strip off the plastic outer sleeving of the cable to the desired length of terminating lead. Then, holding the braid and inner conductor in one hand, the last six inches of outer sheath is firmly 'stroked' back with the other so that it recedes back for a half to one inch. If the braid is in the form of twisted but not plaited wires, these are untwisted and collected up to form a bundle of wires, as would be given by any flexible wire. The bundle of wires is lightly twisted up and soldered to keep it together, and is then cut a quarter inch from the end of the outer sleeving. A piece of thin insulated flexible wire is soldered to the remaining braid, making the joint as smooth as possible. The last six inches of the outer sleeving is next 'stroked' back again, whereupon it covers the joint and gives a very neat termination with only two insulated leads projecting."

"What happens," asked Dick, "if the braid is of the plaited type?"

"The process," said Smithy, "is pretty well the same. The outer sleeving is 'stroked' back as before. The braid is pushed back and gently teased out to give an opening through which the inner conductor can be taken. As before, the braid is next brought together in a neat bundle, soldered and cut off a quarter inch from the outer sleeving. The piece of insulated wire is then soldered to it and the outer sleeving 'stroked' back over the joint."

"That method of termination," stated Dick, thoughtfully, "would be particularly tidy if the cable is connected to a coaxial socket or to two tags on a tagstrip."

"It would be even more tidy," added Smithy, "if the cable end is connected to two points on a printed circuit board. There would be no risk of accidental shorts due to odd strands of braiding or things like that."

HIDDEN NUT

The Serviceman picked up a further letter from the pile on his bench, then grinned.

"I've got an excellent hint here," he said cheerfully. "It's another simple one and, in fact, the writer says that it's so obvious that he almost didn't send it in."

"What's it about?"

"It concerns that perennial problem which is given if you have to get a screw into a nut which is hidden behind a panel. A typical instance occurs when you're trying to fit the screws and nuts for a meter on a front panel. It's easy enough to pass a screw in from the front, but it's the devil's own job to hold the corresponding nut in place behind the panel until the screw has started in it."

"I know all about that," said Dick ruefully. "I've spent ages on some jobs trying to hold a nut in place until the screw enters it. You think you've got

the screw just going into the nut then suddenly the nut shoots away and you waste the next five minutes trying to get it out of the equipment!"

"It sounds," said Smithy, "that this hint is just tailor-made for you, then. What you do is first check the screw end nut to see that the screw runs nice and smoothly into the nut. Then you put a blob of clear Bostik on the tip of a finger of your left hand, the second finger being usually the handiest. You leave the Bostik on your finger for about ten seconds and then put the nut on it, whereupon it will stick as firmly as is needed for the present job. This applies, even, for nuts up to five-eighths inch Whitworth. You then waggle your finger around behind the panel until you've got the nut in the right position and then run the screw in and through it. Easy as pie, and the Bostik also provides a good shake-proof lock to the nut after the screw has been fitted."

"Blow me," said Dick, impressed. "I must remember that dodge for the future."

"It should certainly save you a lot of grief."

"Hang on a bit, though," said Dick. "What about the Bostik that's left on your finger? If you have a lot of nuts to do, you'll end up with a gradually extending second left finger, half meat and half Bostik."

"There's no problem there," replied Smithy soothingly. "You give the Bostik several minutes drying time, and you can then remove it from the finger by rubbing with the thumb. Our correspondent says he has used this nut holding scheme on many occasions in the past when doing jobs in the house and on the car, as well as when working with electronics. I'd say that this was one of those classic ideas that are just as useful now as they were in the good old days."

"Hey, come on, Smithy," said Dick impatiently. "Don't say you're going to start another of your jags where you get all reminiscent about the past."

"Well, why shouldn't I get reminiscent?" retorted Smithy defensively, as he mounted a favourite hobby-horse. "You youngsters just don't realise how much you've missed. Now, when I was young things were a darned sight better than they are now. Just think of food, for instance. There were none of these modern cotton-wool beefburgers and things like that around then. It was the same with fish. If you wanted fish you got proper fresh fish, not those frozen cod-pieces they flog in the super-markets these days."

" 'Fish fingers'," suggested Dick, "might be a better term."

"There was more taste to things then too," went on Smithy, ignoring his assistant. "Take something as simple as chewing-gum. When I was a kid you could get chewing-gum that really had flavour. But nowadays, blimey. Only the other day I got some out of a slot machine, and it was *terrible*. All hard and rubbery, and no taste to it at all. I had to spit it out in the end."

Dick looked quizzically at the Serviceman.

"Perhaps," he said gently, "it's the slot machines that have changed since you were a kid."

"Well, I don't know," replied Smithy morosely. "Still, it's no good moaning on about the old days, so I suppose I'd better get back to 1975 again."

"It wouldn't be a bad idea," commented Dick. "How about the next reader's hint?"

Doggedly, Smithy threw off his nostalgic mood and applied himself to the letters in front of him.

PANEL-SIGNS

"Very well," he said resolutely. "Let's see what we've got here. Hallo, this is interesting. It's concerned with Panel-Signs."

"Do you mean the transparent signs you cut out for panel legends and dials and things?"

"That's right," said Smithy absently, as he concentrated on the letter. It was obvious that he had already forgotten his preoccupation with matters of the past. "You may remember that Panel-Signs Set No. 3 consists of white wording and Set No. 4 consists of black wording. There's also a Panel Signs Set No. 5 which gives dials and scales."

Smithy put down the latter and showed Dick a sketch in it. (Fig. 5).

"This reader" he went on, "has been using Panel-Signs Set No. 4, and he has been cutting out single figures for fixing to a meter scale. He's found that an excellent way of cutting out these figures is to use a leather punch like the one in his sketch. This cuts out very neat circles with the number in the centre, and these numbers give a really impressive appearance when they're stuck to the meter scale. The punch he uses has a revolving head with six

Fig. 5. The upper section of a small leather punch. This may be employed for punching out single Panel-Signs figures

dies, and he just selects the one which gives the particular size he wants. In fact, he's stuck a single figure cut out by this method to the top of his letter. See?"

Dick looked at the point in the letter indicated by Smithy's finger.

"That really looks neat," he said appreciatively. "A nice clean circle which is hardly visible, with the figure in the middle. We're definitely getting some good ideas today, Smithy."

"We certainly are," agreed Smithy, taking up another letter.

"What's the next hint?"

"It's an idea," replied Smithy, "for adjusting Philips concentric air-spaced trimmers."

"Do you mean the ones which are sometimes referred to as 'beehive' trimmers?"

"Those are the ones," confirmed Smithy. "Now there are proper insulated tools for adjusting these trimmers, but most amateurs don't have them in their tool-kits. It's tempting to adjust the trimmers with the fingers, but this is an unwise approach because it could detune the associated tuned circuits. Also, if the trimmers appear in valve circuits it's possible to get some nasty shocks off them. A suitable trimming tool is given by a length of soft plastic tubing with a fairly large wall thickness. Like this."

Smithy removed a length of tubing which had been secured to the letter with a paper clip and handed it to his assistant. (Fig. 6).

"That's a useful tip," remarked Dick, taking up the tubing. "I suppose this fits over the hexagonal bit at the top of the trimmer."

"That's the idea," stated Smithy. "The soft plastic conforms to the shape of the top of the moving section, and the latter turns round easily as you rotate the tubing. The plastic tubing doesn't have to be a perfect fit because the trimmer head can be easily turned with small torque."

"I knew a chap like that once," said Dick carelessly.

"Like what?"

"Like that trimmer."

"What on earth do you mean?"

"Well," said Dick triumphantly, "he was a vain sort of bloke and *his* head could be easily turned with small-talk."

Smithy glared balefully at his assistant.

"Sorry, Smithy," said Dick hastily. "It just sort of slipped out."

"We shall," pronounced Smithy firmly, "proceed to the next hint."

He picked up another letter from his bench and read it through carefully.

"That's a coincidence," he remarked. "This is another hint about aluminium surfaces, although it's quite different from the satin finish one we had just now."

"How does this one go?"

"The writer," said Smithy in reply, "suggests that if you want to give an aluminium box a 'new look', try using aluminium paint. If this is stippled on

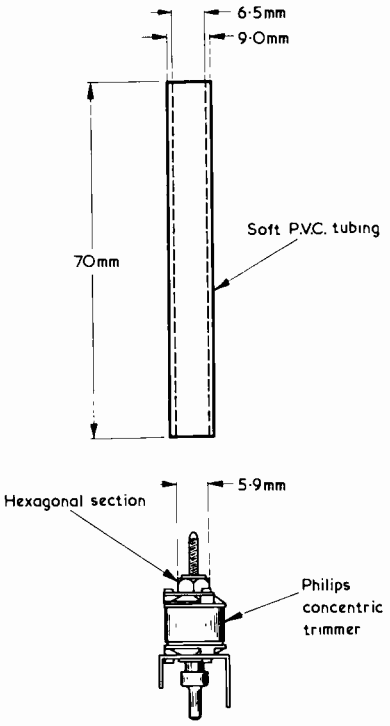


Fig. 6. A Philips concentric trimmer, together with a suitable trimming tool consisting of a short length of plastic tubing. The tubing dimensions are approximate only

before mounting switches and controls, etc., the effect is quite like a die-casting."

"That's unusual," commented Dick. "It's an idea that's well worth trying if you want to get an out-of-the-way effect. Also, aluminium boxes do look rather uninteresting if the outside surface isn't treated in some way."

"True," said Smithy. "Well, that's two different treatments for aluminium in one hint session."

"Any more hints?"

"Just one more," replied Smithy. "And this, I'm afraid will have to be the last for today."

He read through the letter carefully, then handed a page with a diagram on it to his assistant. (Fig. 7).

"Aluminium appears here yet again," he announced. "But it's not an aluminium finish this time. The idea in this letter makes use of aluminium alloy angle strip which is obtainable from most do-it-yourself shops in five-eighth by five-eighth inch. Six foot lengths of this strip should be available at a little less than a pound each."

"The diagram," remarked Dick, "seems to be showing a small chassis assembly."

"It does," confirmed Smithy. "The drawing gives an example of the sort of thing that can be made up with this angle strip. At the ends are two aluminium rectangular plates which are rivetted to the pieces of angle. The centre section is a printed circuit board which is held down on the strips by nuts and bolts. Small light components are mounted on the printed board and heavy items such as transformers are fitted to the aluminium plates. The writer says that he's currently using a chassis assembly like this for a power supply."

"The diagram," put in Dick, "also shows how you can cut out small angle brackets from the angle strip."

"Not to worry," replied Dick equably. "It was an extra twenty minutes very well spent. Hey, hang on a minute!"

His forehead suddenly furrowed ferociously.

"Oh dear," remarked Smithy, recognising the signs. "Don't say you're going to come out with some more of that awful poetry of yours."

"Here Smithy," said Dick proudly, his brow clearing. "Just listen to this.

If you have a workshop idea
About which you feel others should hear,
Just send it to us
Without any fuss
And in print you may see it appear!"

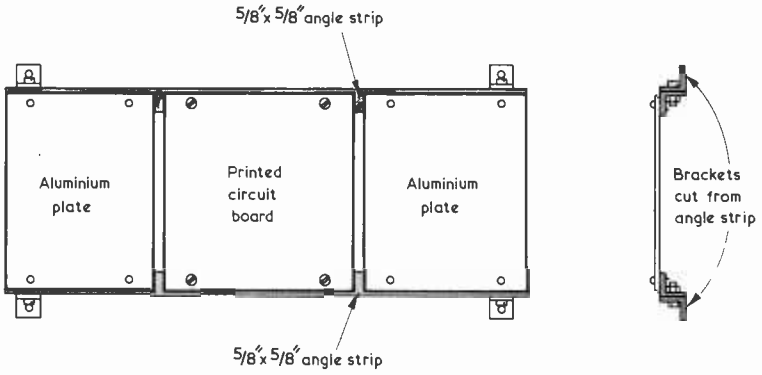


Fig. 7. Lengths of aluminium alloy angle strip are available from many do-it-yourself shops. The strip can be particularly useful for small chassis assemblies, as illustrated here

"That," stated Smithy, "is another use for the angle strip."

"You could use it also," said Dick musingly, "for long angle brackets intended for mounting vertical panels and things like that. All you'd have to do would be to cut off the length of angle that you require from the strip. This would save all the bother of bending odd bits of ali in the vice."

FINISHING OFF

"As you say," said Smithy. "Well, that's the final hint for today. We've had quite a successful session."

"We have, haven't we?" agreed Dick warmly. "I always enjoy hearing about other peoples' ideas."

Smithy gathered together the letters, returned them to the drawer in his bench and then glanced at his watch.

"Do you know," he remarked mildly, "that it's twenty minutes after packing-up time?"

Dick grinned happily.

"Now how about that?"

"Er, very good," replied Smithy politely. "The rhyming may be a little haphazard and the scansion absent, but the sentiment is admirably commendable."

And with this diluted praise Dick, as is the lot of most budding versifiers, had to consider himself satisfied. ■

EDITOR'S NOTE

The hints appearing in this episode of "In Your Workshop" were received, in the order in which they appear, from R. D. Morrison, J. P. Carlile, F. H. Osborn, A. Rawlings, D. Smith, W. J. Gadsby, J. Kerrick, J. Ballard and R. J. Smith.

As intimated by Dick, further hints for this feature are welcomed. Payment is made for all that are published.

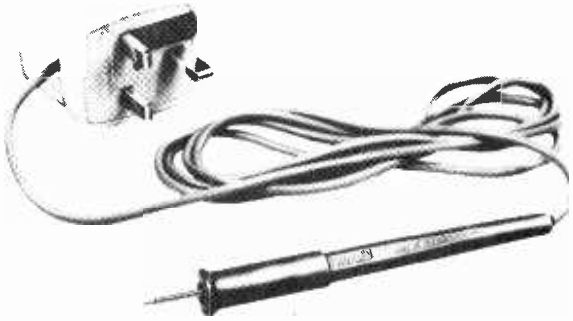
Trade News . . .

NEW WAY OF APPLYING COLOUR

The problem of applying colour precisely to small models is solved by the Litesold Adamin Electric Stylus. This novel method uses standard transfer tape, available in a wide range of colours including gold and silver, in conjunction with a low voltage heated stylus, which is no bigger than a ball point pen.

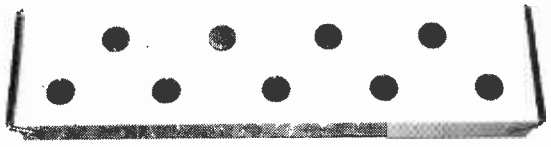
In use, the transfer tape is simply placed over the area to be coloured and rubbed down with the heated silver alloy tip of the stylus. The colour is immediately transferred from the tape to the model. Areas from the size of a pin-head up to several square inches can be covered with colour, which is permanent and waterproof.

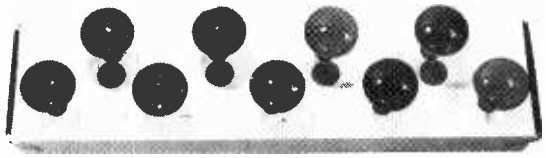
The operating voltage of only 4½ volts is supplied by a special transformer built into the 13 amp mains plug. The tip takes only 30 seconds to reach operating temperature, which never becomes hot enough to scorch even paper. The stylus is therefore suitable for use by children and is likely to cause much less mess than oil paints. Permanent markings may be applied to a wide range of materials such as paper, plastic, wood, leather, nylon, paint, but not glass or metal surfaces.



The Adamin Electric stylus complete with a supply of transfer tape costs £7.10 including postage, packing and VAT and is available direct from Light Soldering Developments Limited, 97-99 Gloucester Road, Croydon, Surrey.

NEW SOUND TO LIGHT KIT





Following up the dramatic success of their 'Unit Visual' sound to light set (designed primarily for home use), Lab-Craft have announced a nine lamp spot bank for the disco market. The new model known as the 'UV 9' takes nine 100 watt PAR 30 coloured spot flood bulbs, arranged to suit the user and is designed to operate from the standard Unit Visual sound to light control unit.

Price for the spot bank (excluding bulbs) is a modest £21.00 + V.A.T. and the control unit retails at only £24.75.

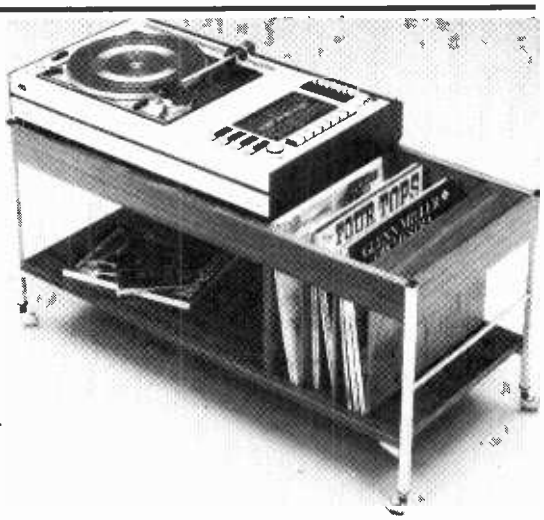
The original Unit Visual kit, complete with control unit, stand and three 100 watt spot flood bulbs, is still only £45 + V.A.T.

Further details from LAB-CRAFT Limited, Church Road, Harold Wood, Essex.

NEW ANGLE FORM HI-FI TROLLEY

A revolutionary new product is ideal for the audio enthusiast who wishes to make an elegant hi fi trolley or an ambitious wall storage unit, but who has little or no experience of woodworking or joinery. The new product, called Angleform, is a clever new make-it-yourself construction method which enables the amateur, without any specialist knowledge of woodworking or joinery, and using only basic tools, to make pieces of furniture such as hi-fi trolleys to a professional standard using his own timber, or laminated or veneered chip-board. The Angleform system consists of ⅝" square section aluminium, plus a number of joining devices, plastic trims and channels.

This good-looking hi-fi trolley may be made for approximately £15.50 including timber materials, using a Harrison Angleform kit. The timber material shown is Contiboard mahogany veneered chipboard, although other material of the correct thickness could have been used. Further information from: Forman House Public Relations Ltd., 39 Charing Cross Road, London WC2H 0AS.



"NOTES FOR NEWCOMERS"

VOLTS, AMPS and OHMS

By S. L. Martin

Getting down to the real nuts and bolts.

EVERYBODY HAS TO START SOMEWHERE IN AMATEUR electronics and some of the keenest newcomers to the hobby are those who have had no formal schooling in electricity at all. One young aspirant told the author that his major difficulty was that electronic magazine articles always assume that the reader has a knowledge of electrical and electronic basics. But without such knowledge the articles become almost incomprehensible so far as their theoretical aspects are concerned.

Here is an article which should help that enthusiast and many others with the same predicament. It deals with the Big Three of electricity: Volts, Amps and Ohms.

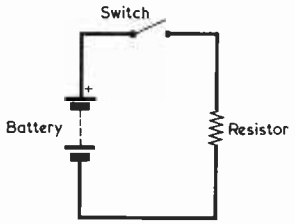


Fig. 1. A basic circuit incorporating voltage, resistance and current

ELECTRICAL CIRCUIT

Almost every exercise carried out in electronics consists of the application of an electromotive force, which is measured in volts, to a circuit in order that a current may flow. The simplest arrangement consists of a battery, a switch and a resistor, as shown in Fig. 1. When the switch is closed the electromotive force (or e.m.f.) of the battery causes a current to flow through the resistor. The amplitude of the current is limited by the resistance offered by the resistor.

Let us now make some changes in circuit values and see what results. Let us, for a start, double the voltage of the battery in Fig. 1 without altering the resistor. What happens? The answer is simple: the current flowing through the resistor becomes double its previous value. This is an obvious result because by doubling the voltage we have doubled the e.m.f. which causes the current to flow. If we leave the resistor as it is and treble the battery voltage, we shall also treble the current flowing in the resistor. The same thing will happen if we make any other change in battery voltage. Provided that the resistor remains unaltered, the current which flows in it is directly proportional to battery voltage.

Let us next turn our attention away from the battery and make some changes to the resistor instead. What will be the outcome if we double the resistance it presents? The answer is that half the previous current will flow through it. Again, this is obvious enough because if we double the resistance we double the opposition to current flow. If we treble the resistance we reduce the current to a third of its previous value, and so on. As resistance goes up current goes down, and the current is inversely proportional to resistance.

As will be gathered the three quantities, voltage, current and resistance, are all interdependent. Their mutual relationship is summed up in the well-known Ohm's Law equations, which are shown in Fig. 2. In

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

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

$$E = IR$$

Fig. 2. The three equations relating voltage, current and resistance. Ohm's Law is expressed by the centre equation

these, R stands for resistance in ohms, E stands for e.m.f. in volts and I stands for current in amps. In everyday talk about electronics we don't use the term 'e.m.f.' very often. Instead, we refer to 'voltage', which means virtually the same thing in practice. We shall use the term 'voltage' from now on here.

The second equation in Fig. 2 repeats what we have learned from Fig. 1. The current, I, is doubled if voltage, E, is doubled, and it is halved if resistance, R, is doubled. In consequence, this equation represents a common-sense relationship which can be readily visualised. The first and third equations merely have the three letters re-arranged. We use the first if we know the current and voltage and want to find the resistance, the second if we want to find the current and the third if we want to find the voltage.

MNEMONIC

Despite the obvious truth of the Ohm's Law equations, many people find it necessary to learn at least one of them off by heart if they are to bring it to mind when needed. Don't be worried if you fall into this category. One of the author's colleagues has spent his life in electronics, but he still falls back on the truly dreadful mnemonic 'Rain is 'Eavy over India' to remember the first of the equations!

Let's next get down to some actual figures. It is evident that if we apply a voltage of 1 volt across a resistance of 1Ω, the current which flows is 1 amp. If the voltage is 10 volts and the resistance is 1Ω the current is 10 amps. If the voltage is 10 volts and the resistance is raised to 10Ω then the current once more becomes 1 amp.

In electronics we are usually confronted with current values in milliamps (mA) which are, of course, thousandths of an amp. To repeat the previous exercise, if we apply a voltage of 1 volt across a resistance of 1 kilohm, or 1kΩ (which is the same as 1,000Ω) then the current which flows is 1mA. 10 volts across 1kΩ give a current of 10mA, and 10 volts across 10kΩ produces a current of 1mA. To take some more difficult figures, 10 volts across 2.7kΩ causes a current of about 3.7mA to flow; 12 volts across 4.7kΩ results in a current of about 2.6mA; 100 volts across 470Ω (=0.47kΩ) produces a current of about 210mA; and 240 volts across 33kΩ gives a current of about 7.3mA. There is no point in calculating the current beyond two significant figures for normal work because we will usually be using 5% or even 10% resistors and, unless our measuring instruments are expensive types, they will probably have an accuracy of only some 2% at best.

Frequently we want to find the current which flows in a resistor of known value in an electronic circuit. One way of doing this is to disconnect one end of the resistor and insert a current-reading meter in series. A much easier method consists of leaving the resistor in circuit and measuring the voltage across it. Provided the voltmeter has a much higher resistance than the resistor so that it doesn't draw too much current itself, it will tell us the voltage dropped across the resistor, whereupon a quick Ohm's Law calculation gives the current.

If we want to find the value of a resistor, a simple method consists of applying a known voltage across it and measuring the current which flows, as in Fig. 3(a). This is basically what happens inside a testmeter when we switch it to an ohms range, and the manufacturers of the meter have already done the Ohm's Law calculations for us when they calibrated the resistance range scale. If we want to measure a voltage, we can connect a known resistor and a current-reading meter across it, as in Fig. 3(b). Again, this is just what we get inside a testmeter when it is switched to a voltage range, and the manufacturers have once more done the Ohm's Law calculations for us when they selected the series resistor and calibrated the voltage range scale.

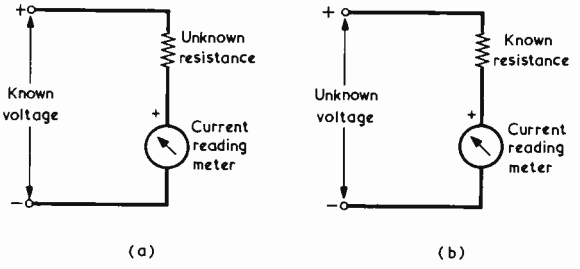


Fig. 3(a) Determining the value of an unknown resistance
(b) Measuring a voltage by means of a current-reading meter and a series resistor

Quite a lot of currents in electronics are lower than 1mA, and we measure these in microamps, or μA (which are millionths of an amp). If we apply 1 volt across 1 megohm, or 1MΩ (a million ohms) we get a current of 1μA. 10 volts across 1MΩ gives 10μA, 100 volts across 1MΩ produces 100μA, and 1,000 volts across 1MΩ results in a current of 1,000μA, or 1mA.

And that's the Ohm's Law story. Try using the Ohm's Law equations whenever you play around with circuits involving voltage, current and resistance. After a little practice you'll find yourself thinking directly in terms of the third unknown, whether it be voltage, current or resistance. You'll also obtain a much greater insight into what goes on inside the apparatus that you are constructing and wiring up. ■

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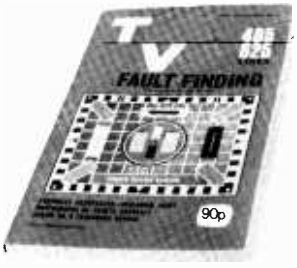

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(Continued on page 573)

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0.47µF (1⅜"×¾")	71p	4.7µF	£1.30	£1.05	85p
0.5µF (1⅜"×¾")	75p	6.8µF	£1.64	£1.29	£1.09
0.68µF (2"×¾")	80p	10.0µF	£2.00	£1.60	£1.40
1.0µF (2"×¾")	91p	15.0µF	£2.75	£2.15	£1.90
2.0µF (2"×1")	£1.22	22.0µF	£3.50	£2.70	£2.55

TANTALUM BEAD CAPACITORS – Values available: 0.1, 0.22, 0.47, 1.0, 2.2, 4.7, 6.8µF at 15V/25V or 35V; 10.0µF at 16V/20V or 25V; 22.0µF at 6V 10V or 16V; 33.0µF at 6V or 10V; 47.0µF at 3V or 6V; 100.0µF at 3V. ALL AT **10p** EACH; 10 for **95p**; 50 for **£4.00.**

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BC114	12p	BC184/184L	12p	BF196	13p	BFY52	20p
BC147/8/9	10p	BC212/212L	14p	BF197	13p	OC71	12p
BC153/7/8	12p	BC547	12p	AF178	30p	2N3055	50p
BC182/182L	11p	BC558A	12p	BFY50	20p	2N3702/4	11p

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IS44 **5p**; 11 for **59p**; 24 for **£1.00.** IN4148 **5p**; 6 for **27p**; 12 for **48p.**

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SMALL ADVERTISEMENTS

(Continued from page 571)

FOR SALE: Teak finish wooden amplifier sleeves. Internal 3¾ x 10¼ x 7 ins. £1.75 plus 50p P. & P. 29 Laburnham Grove, Winchmore Hill, London N21. Telephone: 01-360 4499.

SERVICE SHEETS for Radio & TV etc. 40p each plus s.a.e. Bell's Television Services, 190 Kings Road, Harrogate, Yorkshire, Telephone: 0423-55885.

WORLD DX CLUB covers all aspects of SWLing on Amateur and Broadcast Bands through its monthly bulletin *"Contact"*. Membership costs £1.60 a year. Enquiries to John Rush, 12 Northfield Road, Thatcham, Berks.

FOR SALE: Eddystone E.C.10 short wave receiver in good condition, £30. Avo 8 multimeter, condition as new, £30. Box. No. G254.

STEREO JACK PLUGS (standard) desoldered from new equipment, 50p for 5 (including P. & P.). Price for larger quantities on request. 5 Powderham Road, Exeter, Devon, EX2 9BS.

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FOR SALE: Minuteman 6 calculator £10.00. Sinclair Cambridge £15.50. Sinclair Executive £20.00. Mains auto transformer 8A, £5.00, 16A, £8.00. FM transmitter kit £4.50. Avo 47A £15.00. Low band Pye Rangers £10.00. Philips N2204 cassette recorder £22.00. Portable 8-track with 2 band radio £15.50. Overhauled Avo 8 with calibration certificate £28.50. 110V a.c. 7A stereo amplifier £8.50. C-size rechargeable ni-cad cells £1.50; U7 size £1.25. Box No. G.257.

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(Continued on page 574)

SMALL ADVERTISEMENTS

(Continued from page 573)

FOR SALE: Super Servisol switch cleaner 70p, 5 tins £2.50. 100 feet insulated copper aerial wire 75p. 9-digit calculator £13.50. 4½" watchmaker's pliers £1.00. ¼ H.P. electric motor £5.50. 2" watchmaker's screwdrivers 5p. Second book hi-fi loudspeaker enclosures 60p. Second book transistor equivalents 95p. Sound and loudspeaker manual 50p. BIB34 cassette case £1.50. Hi-Fi test cassettes and cartridges £1.90. Box No. G259.

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FOR SALE: Goodmans speakers, 6 watt 8 ohm, complete with 100V line transformer. £3.50 including P. & P. Mahogany finish wall cabinet £2 extra. From: West Country Vending Service Ltd., 5/6 Grove Street, Bath, Avon.

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8 VOLUMES Newnes *Radio & Television Servicing* from Volume 1 to 1959/60 edition. £16.00, post paid. Bell's Television Services, 190 Kings Road, Harrogate, Yorkshire. Telephone: 0423-55885.

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(Continued on page 575)

SMALL ADVERTISEMENTS

(Continued from page 574)

ELECTRONIC PIANO (five octave) with synthesised piano – honky tonk – plucked string bass with harpsichord effects. Complete with carrying case and service information. Perfect working order and condition. £100 o.n.o. Send s.a.e. for full details. Francis Morton, 65 Malmsey House, Vauxhall Street, London SE11 5LU.

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1972 *World Radio TV Handbook,* only 75p post paid. Bell's Television Services, 190 Kings Road, Harrogate, Yorkshire.

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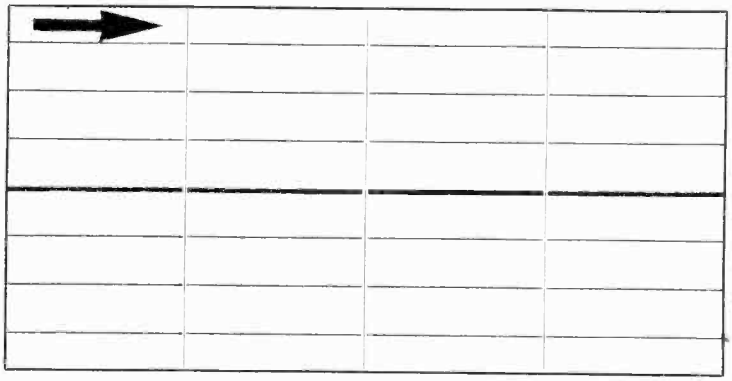

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PLEASE MENTION THIS MAGAZINE WHEN WRITING TO ADVERTISERS

COMMON MUSICAL TERMS I

The Table gives generally accepted definitions of common musical terms. The list will be completed in next month's Data Sheet.

Accelerando	accelerating
Adagio	slow
Affettuoso	tender
Agitato	hurried
Allegro	fast, brisk
Andante	flowing, even, moderately slow
Animato	animated
Appassionato	passionately
Aria	song, for one voice
Arpeggio	chord formed with notes sounded successively
Assai	very
Bolero	Spanish dance
Cadenza	a flourish
Cantabile	graceful, singable
Cantata	choral work
Canto	song
Canzone	song in two or more parts
Capriccio	free composition, quick
Chaconne	dance with slow movement
Chorale	slow, harmonised, choral work
Chromatic	using notes outside traditional keys
Coda	final passage
Coloratura	having florid vocal technique
Con	with
Con moto	with increased motion
Counterpoint	combining melodies
Crescendo	growing in force
Da ballo	dance style
Da capo	repeat from start
Da capo al fine	repeat to word 'fine'
Diatonic	music conforming to traditional keys
Diminuendo	decreasing
Doloroso	sadly
Entr'acte	interval or music between acts
Entree	introduction
Espressivo	with expression
Etude	study
Fandango	Spanish dance
Fantasia	fanciful composition
Forte (f)	loud
Fortissimo (ff)	very loud
Fortississimo (fff)	as loud as possible
Fugue	composition with contrapuntal melodies
Furioso	furiously
Galop	round dance
Gavotte	simple dance
Glissando	gliding, slurred
Grave	solemn, slow
Intermezzo	short intermediate movement
Largo	slow, broad
Langsam	slowly
Legato	smooth, with notes blending
Lento	slow
Maestoso	stately
Marcando	precise, with distinct notes
Mazurka	Polish dance

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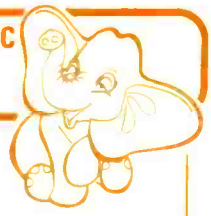

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Selectivity 35 dB
Signal to noise at limiting threshold 40 dB
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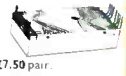

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