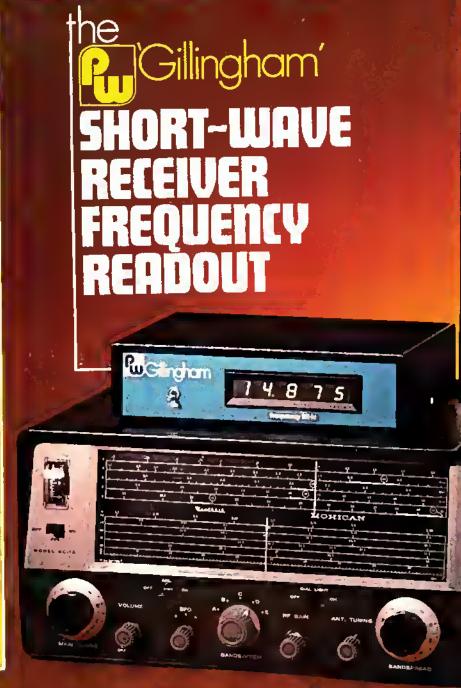


うと言うと言いた。

NAU4O. STOREGIE

actica



**4**5p

1978

85c 85c 80c \$2-25

OCT

Australia New Zealand South Africa

also: 2m Mosfet Converter conomical VMOS Power Devices

www.americanradiohistory.com

TTL **	LINEAR	TRANSISTORS ENAMEL COVERED COPPER WIRE 14 SWG 40p 15 SWG 40p 18 SWG 43
7400 14p 74109 50p 7401 14p 74118 80p 7402 14p 74120 80p	AY38500 450p SL917B 650p AY38710 690p SN78003N 160p AY38760 890p SN76013N 160p	A A113 19p BC171 12p BDX42 50p BY128 15p 20 SWG 50p 22 SWG 50p 24 SWG 50 A A217 30p BC172 12p BDY10 100p BY127 15p 26 SWG 50p 28 SWG 55p 30 SWG 55 AC121 30p BC177 15p BF115 20p BY133 25p 33 SWG 60p 34 SWG 60p 38 SWG 65
7403 14p 74121 25p 7404 14p 74122 48p 7405 14p 74123 60p 7406 40p 74125 55p	CA3080 225p 5N76013ND 125p CA3085 290p SN76023N 180p CA3084 250p SN76023ND 125p CA3085 85p SN76023ND 125p CA3085 85p SN76033N 180p	AC126 20 BC178 15 BF120 50 BY184 50 38 SWG 70 40 SWG 70 42 SWG 66 AC127 20 BC182 10 BF121 45 BY184 50 AC127/01 25 BC182 12 BF123 45 C1120 30 AC127/01 25 BC182 12 BF123 45 C1120 30 AC128 24 BC183 10 BF125 45 C1134 20 BC184 20 BC1
7407 40p 74126 50p 7408 20p 74128 75p 7409 20p 74130 130p 7410 15p 74131 100p	CA3088 60p SN76227N 160p CA3088 180p SN78228N 180p CA3089 210p SN76660N 75p	AC151 25p BC183L 12p BF187 50p E100 42p ROTARS WATCHES BLECKLIN POLE AC153 30p BC184L 10p BF137 50p E201 50p 1 POLE 12 WAY, 2 POLE 6 WAY, 3 POL AC153K 40p BC184L 12p BF154 11p E204 45p 4 WAY, 4 POLE 3 WAY, All at 40p Each.
7411 20p 74132 45p 7412 20p 74135 100p 7413 30p 74136 44p 7414 66p 74137 100p	CA3130 100p TAA350 190p CA3140 100p TAA570 220p CA3123E 200p TAA661B 140p	AC187 200 BC204 120 BF131 100 E310 400 AC188 200 BC205 120 BF133 200 E420 1800 ACY17 330 BC207 120 BF138 200 E420 1800 ACY17 330 BC207 120 BF138 200 E420 1820
7414 66p 74137 160p 7410 36p 74138 125p 7417 30p 74141 66p 7420 15p 74142 270p	LM300 T05 170p TAA700 350p LM301AN 15p TAD100 100p	ACY20 35p BC212L 12p BF180 30p MPSA03 30p ACY22 40p BC213 12p BF181 30p MPSA06 32p SPECIAL SCOOP OFFER ACY40 50p BC2131 13a BF182 30p MPSA06 32p 0125 ach 2 inch RED LEDS
7421 30p 74143 270p 7422 28p 74144 270p 7403 25p 34145 25p	LM307N 45p TBA1203 60p LM307N 45p TBA1207 125p LM308 T05 130p TBA1207 125p LM308 DU 130p TBA480Q 200p	ACY41 Sep EC214 13p EF183 25p TIP22 47p 5p each, 10 for £1 00, 100 for ACY42 Sep EC214L 13p EF184 20p TIP22A 47p 50, 1000 for £68 00. AD130 135p EC237 1950 EF186 235 TIP22A 49p D1747 Seven Serument Common
7425 25p 74147 210p 7426 25p 74148 100p 7427 25p 74148 100p 7428 40p 74151 45p	LM300K 100p TBA530Q 235p LM310 T05 150p TBA530Q 215p LM311 T05 280p TBA540 230p	AD149 BC254 B50 DF195 00 TIP30 550 Melpht 0 C 21 0 A A A A A A A A A A A A A A A A A A
7430 15p 74158 85p 7432 25p 74154 120p 7433 40p 74155 70p	LM324 1560 TBA5500 1350 LM326 1560 TBA560C 1350 LM346N 2000 TBA641A12	A D151/2MP BC301 25p BF198 25p 11P31 35p Character Helpht 0.5" Nop BC303 33p BF199 25p 11P31 35p £1 30 each, 4 for £5 60. A F114 25p BC307 15p BF200 30p 11P31A 51p 2N5777 Photo-Darlington
7437 25p 74158 70p 7438 25p 74157 70p 7440 15p 74160 90p 7441 45p 74161 90p	LM382N 135p TBA700 200p LM391 150p TBA720 250p LM555 25p TBA720 250p	AF116 25p BC337 12p BF225 20p TIP31C 76p 00 pact. AF116 25p BC336 12p BF225 20p TIP32 60p 0 125 or 0 2" Yellow and AF117 25p BC316 12p BF241 15p TIP32 100p Green LEDS 15p each. 10 for AF118 8ep BC323 35p BF244 15p TIP32 100p cf 4 A 100 for ff2 0. HP5082-
7442 05p 74162 05p 7443 110p 74163 56p 7444 110p 74164 125p 7445 80p 74165 525p	LM709C 500 TBA7800 2350 LM710 T05 860 TBA800 1180 LM710 DIL 650 TBA800 1180 LM723 T05 T5P TBA810 1100 LM723 T05 T5P TBA820 1000	AF130 35p BC337 26p BF257 25p TIP35C 256p ORP12 Japanese 75p each. AF239 45p BC336 19p BF258 25p TIP35C 256p Mullard £t 25 each.
7445 85p 74167 325p 7447 75p 74170 200p 7448 75p 74173 150p	LM723 DIL 75p TBA9200 300p LM733 180p TBA990 200p LM741 25p TCA270Q 250p	AU110 180p BC451 35p BF271 25p 119418 75p BA114 12p BC516 50p BF274 35p T1P21C 86p BA121 12p BC517 50p BF324 30p T1P22A 50p BA121 12p BC517 50p BF324 30p T1P22A 50p
7451 15p 74175 75p 7453 15p 74176 100p 7454 15p 74177 190p	LM1303N 155p TCA760 330p LM1458 100p TCA4500A 450p LM3080 90p TDA2020 325p	BA15/ 155 BC5478 135 BF337 355 T1P42C 909 CONTAINING BA173 136 BC548 125 BF337 205 T1P2053 700 BAX13 56 BC548C 146 BF384 355 T1P2055 557 18×74156.2×74155.2×7609
7480 15p 74178 140p 7470 30p 74179 140p 7472 25p 74180 500p 7473 38p 74181 200p	LM3900N 10p XR320 250p MC1310P 185p XR2206 675p MC1312P 190p XR2207 450p MC1314P 190p XR2208 650p	BAW21 20p BC549C 14p BF594 35p TiS91 25p 2,50 WAY BB105 35p BC537 13p BF594 50p IN914 5p EDGE CONNECTORS BB100 35p BC537 85p B5692 60 (N3754 20n Faw only eff of fits
7474 30p 74182 75p 7475 30p 74184 150p 7476 30p 74185 150p	MC1315P 230p XR2216 50p ML747CP 85p XR2587 250p MM5314 430p XR4136 150p	BC107 10p BCY33 10p BFRan 30p IN4001 5p unrepeatable bargain £3 58 each BC108 10p BCY38 10p BFR80 30p IN4002 5p BC108C 13p BCY42 23p BFRW38 20p IN4003 5p
7481 950 74189 350p 7482 80p 74190 140p 7483 85p 74191 140p	MM5316 559p XR4202 150p NE529K 150p XR4212 150p NE555 28p XR4739 194p NE556 100p 2H414 120p	BC109C 15p BCY59 15p BFW88 30p (N4005 5p 5" Scopetubes SE5J (for BC113 12p BCY59 25p BFW89 35p (N4006 5p callers only £15-06 each. BC114 15p BCY70 15p BFW81 35p (N4007 7p Bias Relers only £15-06 each.
7484 000 74192 1200 7485 1000 74193 1200 7488 300 74194 1000 7489 2500 74195 750	POWER SUPPLY	BC115 135 BC171 240 BFX34 250 215 21345 94 65p each BC116 135 BC172 155 BFX34 255 21456A 45p BC118 135 BC172 155 BFX38 255 21929 205 BC118 125 BD12 85p BFX48 355 21939 200
7490 35p 74196 109p 7491 75p 74197 100p 7492 45p 74198 165p 7493 40p 74199 185p	CAPACITORS 2200/16 35p 4700/63 120p 2200/63 80p 4700/70 135p	BC118 25p BD131 35p BFX88 45p 2N1302 25p Push to Make Switches BC125 16p BD132 35p BFX88 104p 2N1303 30p 209 each. BC1255 210p BD133 45p BFX88 30p 2N1305 30p Chokes 10uH 35p each.
7494 80p 74293 100p 7495 80p 74LS00 25p 7495 70p 74S112 100p	2200/100 138p 10000/10 100p 3300/39 50p 10000/25 150p 3300/63 90p 15000/13 150p 4700/25 50p 22000/25 200p	BC134         15p         BD135         35p         BFX88         25p         PN1306         56p         Futaba 5L792 Non-Multiplexed           BC136         15p         BD137         46p         BFY10         36p         2M1711         22p         4         Digit Phosphor Diode Display           BC135         15p         BD139         40p         BFY18         10p         2M274         42p         4         Digit Phosphor Diode Display
74100 85p 74104 40p 7805 140p 74105 40p 7812 140p	4700/40 45p ENQUIRIES FOR ANY OTHER TYPES	BC140 306 BD144 1806 BFYS0 206 180 BC141 306 BD144 1806 BFYS0 206 180 BC141 306 BD151 1006 BFYS1 206 2N2907 280 BC142 316 BD152 1006 BFYS2 206 2N3053 200 PRE SET POTS MICRO BLOCK
74103 30p 7815 140p 74108 125p 7818 140p 74165 125p 7624 150p LM340	ELEC CAPACITORS	BC143         30p         BD188         130p         EFY53         23p         2N3054         50p         Yertical 50R-IM         2102 250         Nano-Sec           BC147         10p         BD207         70p         BFY30         125p         2N3055         80p         Vertical 50R-IM         Static RAM (1024 x 1)           BC148         10p         BD220         65p         BR101         35p         2N3702         11p         Ohm         Bit j         £2 20 each           BC148C         14p         BD222         65p         BR139         35p         2N3703         12p         4 tor         £1 40
* TTL OFFERS *	1/18 7p 47/16 8p 1/25 7p 47/25 8p 1/59 7p 47/25 8p	BC1149 10p BD233 10p BRY56 35p 2N3704 12p BC153 16p BD238 50p BSX20 20p 2N3705 12p BC154 18p BD232 10p BSX40 25p 2N3705 12p BC154 18p BD232 10p BSX40 25p 2N3705 12p BC154 18p BD232 10p BSX40 25p 2N3705 12p
7410 10 for 150p 7412 10 for 150p 7420 10 for 150p 7420 10 for 108p	2 2/25 7p 47/50 8p 2 2.25 7p 100/10 8p 3-3/25 7p 100/16 8p 4-7/10 7p 100/25 8p	BC158 100 BD607 100 BT1007A 100 2N313 300 TA 100-500KHZ BT10 A 100-500 BT10 A 100-500 BT10 A 100-500 BT1 100 A 100-500 BT1 100 A 10-500 BT1 100 BT1
7430 10 for 103p 7432 10 for 203p 7442 10 for 350p 7474 10 for 350p	4 7/16 7p 100/50 8p 4 7/25 7p 100/63 16p 4 7/50 7p 220/16 12p	BC169         15p         BDX32         20p         BY100         25p         2N8027         S0p         LAs 30-100KHZ         BIT)         £2 95 each           SPECIAL QUANTITY PRICES         250234         50p         160p         4 for £11 59         4 for £11 59
7476 10 far 250p 7483 10 far 700p 7493 10 far 250p	6 8/25 Tp 220/25 14p 10/10 Tp 220/50 22p 10/18 Tp 330/25 17p 10/25 Tp 330/25 15p	Thirtes The Line State S
7495 10 for 450p 74107 10 for 200p 74121 10 for 250p 74153 10 for 450p	10/50 7p 330/50 20p 22/6V3 7p 470/10 14p 22/10 7p 470/25 19p	DIODES BY ITT/ SK LIN 10K LOG BC37 100/ £5 00 TEXAS 10K LIN 25K LOG BF257 100/ £12 02 100 for £1 50. 25K LIN 50K LOG BC147 Please note. these 50 LIN 100K LOG BC147 Please note. these 50 LIN 100K LOG BC147 BC147
74151 10 for 800p	22/18 7p 476/35 20p 22/25 7p 470/50 24p 22/35 7p 1009/16 27p 22/50 8p 1000/23 30p	are full spec de- vices
4000 14p 4043 250p 4001 14p 4046 150p 4002 14p 4047 100p	33/6V3 7p 1000/35 35p 33/16 8p 1000/40 40p 33/25 8p 1000/63 50p	V.F.F. To for £2 30 2M LIN All at 30p Each BF194 £6 50p RECTIFIERS 8212 8 Bit injout 555 TIMER CAMPER Port £3 06 each BF195 1 AMP 50V 30p Port £3 06 each
4008 90p 4048 55p 4007 16p 4049 40p 4009 55p 4050 40p 4011 14p 4054 120p	33/40 6p 1200/63 60p 33/50 9p 2200/10 30p POLY CAPS	10 for £2 50 5K +5K LIN or LOG 5K167 1 AMP 200V 35p 1 £12 00 each 741 D P. Amp 7 10K +10K LIN or LOG NIXLE TUBES 1 AMP 200V 35p 1 £12 00 each 10 for £2 00 25K +25K LIN or LOG 5833 75p 1 AMP 600V 400 8831 TriState Line
4012 140 4055 140p 4013 509 4056 135p 4015 509 4056 135p 4016 40p 4066 125p	1000 PF 5p 0 1 uF 6p 2200 5p 0 22 uF 7p 3300 5p 0 33 uF 9p	MULLARD JOR + 100K LIN or LOG B502 125p 1 AMP 100V 55p Driver £2 to each MODULES 100K + 100K LIN or LOG C043 125p 2 AMP 50V 40p 8633 Trl Siste Trans
4017 90p 4089 20p 4018 90p 4070 23p 4020 100p 4071 16p	4700 Sp 0.47 uF 12p 5800 Sp 1.0 uF 20p 0.01 uF 5p 2.2 uF 25p 0.022 uF 5p 4.7 uF 35p	LP1183 4000 IM+1M IIN or LOG GN9A 122p Z AMP 2014 530 Francever LP1186 4000 ZM+2M LIN or LOG V39181 70p LP1186 4000 ZM+2M LIN or LOG X39181 70p LP1186 4000 ZM+2M LIN or LOG X39181 70p
4022 90p 4072 16p 4023 16p 4077 35p 4024 85p 4081 16p 4025 16p 4082 15p	0 032 UF 3p 6-8 UF 40p 0 047 UF 5p	LP1163 000P DIL SOCKETS XFW47 500 000V 8 AMP E2 00 each LP1173 000P DIL SOCKETS XFW47 500 000V 8 AMP E2 00 each LP1163 000P 1 Pin 130 XFW50 500 £1:30 LP1163 000V 15 AMP AY5-1013 U:ART
4026 188p 4510 120p 4027 50p 4518 130p 4028 80p 4520 130p 4029 110p 4528 500p	TANT. BEADS 0-1/35V 14p 3-3/16V 14p 0-15/35V 14p 4-7/16V 14p	EP9000 280p EP9001 280p EP9001 280p
4030 55p ★ ★ 4032 66p ★ ★	0.22/35V 14p 4 7/25V 14p 0.33/35V 14p 4 7/25V 14p 0.47/10V 14p 5 8/6V3 14p 0.47/35V 54p 5 8/35V 14p	
	0.68/35V 14p 1-0/35V 14p 1.00/10V 14p 22/15V 21p 1.00/35V 14p 33/16 25p	Countrie/Decoder R8 25 DATA 330 High quality Telemere Cash 306 ST PAULS ROAD HIGHBURY CORNER
TRANSDUCERS MA40 LIR/S £2 50 Each £4 00 Pair	1.5/35V 14p 47/3V 20p 2.2/25V 14p 47/16V 25p 2.2/35V 14p 100/3V 25p	Trimmer Caps Min-Mas 2-50F-60F All 3-50F-130F one 7-00F-350F brice Core-set price Core-set price Core-set price Core-set price
TOGGLE SWITCHES SUB MIN Single Pole C.O. 85p Single Pole C.D. Sized 85p	* SPECIAL OFFER * 2000uF 35v 40p 100/£30	100F-500F 200 to select to Low Access master charge , Select Always welcome in minute walk from
RESISTORS (JRDW 100 of 1 lyps £1 %p £12 only	REED INSERTS One Price 26MM Long 10 for 56MM Long £1 00p	6MM long OD 3MM 10 1MM 30 sach 100 for 62 00 ALL PRICES INCLUDE POST AND VAT
Les and the second		



OCTOBER 1978 VOLUME 54 NUMBER 6 ISSUE 860

# BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

# Published by IPC Magazines Ltd., Westover House, West Quay Rd., POOLE, Dorset BH151JG

#### COPYRIGHT

© IPC Magazines Limited 1978. Copyright in all drawings, photographs and articles published in *Practical Wireless* is fully protected and reproduction or imitation in whole or in part is expressly forbidden. All reasonable precautions are taken by *Practical Wireless* to ensure that the advice and data given to readers are reliable. We cannot however guarantee it and we cannot accept legal responsibility for it. Prices are those current as we go to press.

#### CORRESPONDENCE

All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Practical Wireless", King's Reach Tower, Stamford Street, London SE1 9LS. All other correspondence should be addressed to the Editor, "Practical Wireless", Westover House, West Quay Road, Poole, Dorset BH15 1JG.

#### BINDERS AND INDEXES

Binders (£2-85) and Indexes (45p) can be supplied by the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. Both prices include postage and VAT. Overseas orders for binders should include 80p to cover despatch and postage. All remittances should be made payable to IPC Magazines Limited. Commencing with Volume 52, the index is included in Number 1 of the following Volume.

#### **BACK NUMBERS**

Some back issues, mostly those published during the last two years, are evailable from our Post Sales Department (address above) at 65p each, including postage and packing to both home and overseas destinations. Remittances should be made payable to IPC Magazines Limited.

#### SUBSCRIPTIONS

Subscriptions are available to both home and overseas addresses at £10.60 per annum, from "Practical Wireless" Subscription Department, Oakfield House, Perrymount Road, Haywards Heath, West Sussex RH16 3DH. Remittances should be made payable to IPC Services Limited.

#### QUERIES

We do not operate a Technical Query Service except on matters concerning constructional articles published in *PW*. We cannot offer advice on modifications to our published designs, nor comment on alternative ways of using them. We do not supply service sheets nor information on commercial radios, TVs or electronic equipment.

All queries must be accompanied by a stamped self-addressed envelope, otherwise a reply cannot be guaranteed. We cannot answer technical queries over the telephone.

	NEWS & VIEWS
20	Editorial Caveat Emptor
20	PW Personality Ted Parratt
21	News News News
38	Hotlines
50	Production Lines
65	On the Air
	Amateur Bands.MW Broadcast Bands.S'V Broadcast Bands.Charles Molloy G8BUSVHF Bands.VHF Personality—Frank Luman.Ron Ham BRS15744
	FOR OUR CONSTRUCTORS
22	2m MOSFET Converter
30	PW "Wimborne" Music Centre—2 N. B. Mattey The amplifier/power supply module
36	#DeCnology Project No. 6
44	PW "Gillingham" Frequency Readout
61	Aerial Tuner
	GENERAL INTEREST
26	Using Transistor Pads Improve the appearance and reliability of your projects
29	Amateur SSTV. P. Barker An introduction to slow-scan television
39	The Norton Amplifier
51	Economical VMOS Power Devices Brian Dance Using the new high-current f.e.t.s
54	AM Receivers-Devices & Circuits—2,
60	Landsat System Scans the Earth Seeking out areas of natural resources
	Our November issue will be published on October 6th (for details see page 43)
	We regret that part 4 of our series "introduction

to Logic" has been held over due to pressure on

editorial apace

SUPERSOUND 13 HI-FI MONO AMPLIFIER

SUPERSOUND 13 H1-FI MONO AMPLIFIER A superb solid state audio amplifier for Brand new components throughout. 5 silicon trans-throughout. 5 silicon trans-throughout. 5 silicon transitors in push-pul. Full wave rectification. Output reprox. 13 watts r.m.s. into 8 ohms. Frequency re-sponse 12Hz 30KHz ± ohms. Frequency re-sponse 12Hz 30KHz ± separate Volume. Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceraritic or crysial carridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, scutcheon panet, input and output plugs. Overall size 3' high × 6' wide × 74' deep. AC 200/250V. PRICE £15:00. P. & P. £1:20. HARVERSONIC MODEL P.A.

#### HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general



An advanced solid state general purpose mono amplifier sulable for Public Address system, Disco, Guitar, Gram., etc. Peatures 3 individually con-trolled inputs (sech input has a separate 2 stage pre-amp). Input 1, 15mv into 47k. Input 2, 15mv into 47k Guitable for use with mic, or guitar etc.). Input 3 200mv into 1 mer. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inp its plug into standard lack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 20 watts R.M.S. Very attractively flatshed purpose built cabinet made from black vnyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240v. Size approx. 124" w. x5" h. x7j\*d. Special introductory Price £28:00+£2:50 carr. & pkg. Metlard LP\_1159 RF-1F Module 470 kHz £2:25 + Special introductory Price  $$28 \cdot 00 + £2 \cdot 50$  carr. & pkg. Multard LP1(39 RF-1F Montule 370 KHz  $$22 \cdot 25 + P_{c}P_{c}$  200 Full spec, and connection details supplied. Pyc VHF/FM Tuner Head covering 88-108 M/Hz. 10-7 M/Hz 1.F. output, 7-8 Volt + earth. Supplied pre-aligned, with full circuit diagram with precision-geared FM gang and 323Pf + 323Pf A.M. Tuning gang only $<math>$33 \cdot 15 + P_{c} & P_{c} \cdot 35p_{c}$ 

ESTEREO DECODER STEREO DECODER SIZE 2" × 3" × 4" ready built. Pre-aligned and tested for 9-16V neg, earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (in-clusive of hints and tips) supplied. £6 60 plus 20p P. & P. Stereo beacon light if required 40p extra.

CRESCENT RADIO LTD

I ST. MICHAELS TERRACE, WOOD GREEN. LONDON, N22 45J. 01-888 4474

in

P & P. Orders up to £5, add 30p. Orders £3-£10, add 50p. All orders over £14 post (reel Please add V.A.T. as shown S.A.E. with all engulates please.

Personal callers welcome at: 21 Green Lanes, Palmers Green, N.IJ.

All prices and specifications correct at time of press and subject to alteration without notice,

\*\* FLIP\*\*L

An electronic version of two-up or odds and evens. We supply a complete kit of parts which includes a strong case and attractive front panel to give the finished game a long life and pro-feasional appearance. Full assembly instructions are supplied. "If you can solder you can make this great game."

groat game', An ideal first project to introduce

An local time provide you to electronics. Not only will 'FLIP' start you on a great hobby but you will own a game which will amuse you and your friends

COMPLETE KIT 43 15 + 8% VAT POST FREEI

FERRIC CHLORIDE Anhydrous (erric chloride double sealed 115. 'poly packs', PRICE: 65p per lb + 8% VAT

HEAVY DUTY XOVER 2 WAY 8 OHM

A 2 way 8 ohm H/D Xover suitable

A 2 way 8 onm H/D Xover suitable for L/S systems up to 100 wate. Fitted with screw terminals for input and a three position 'HF LEVEL' switch which selects either Flat, -308 or -6dB.

ONLY 23-00 + 8% VAT

H/D loudspeaker,

Buy it with Access

A CRESCENT 'SUPERBUY' Goodmans 5" 8 ohm long throw

H/D Hourspeaker, Mounting plate is integral with L/S chassis and has fixing holes with centres spaced at  $54^{\prime\prime\prime}$  (diagonally),

ONLY 25.00 + 124% VAT

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

AM/FM STEREO TUNER 200/240V Mains oper-ated Solid State FM AM Stereo Tuner. Covering WW A.M. 540-1603 KHz. VHF/FM 88-108 MHz. Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Storeo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600m/v RMS into 20K. Simulated Teak finish cabinet. Will maich almost any amplifier, Size 31° w X 4°h X Will match almost any amplifier. Size 84"w × 4"h ×

91'd approx. LIMITED NUMBER ONLY at 228:00 + £1:50 P. & P.

MAINS TRANSFORMER Pri, 0:110 and 240. Sec. 28v at 1.4 amps. Also tapped at 12v · 3 amp. Overall size  $22^{+}h \times 32^{+}w \times 22^{+}d$ .  $22 \cdot 50 + 21 \cdot 00$  P. & P.

22-50 + 21-00 P. & P. 10 14 WAIT HI-FI AMPLIFIER KIT A stylishly disished monaural amplifier with an output of 14 watts from 2 EL64s in push-publ. Super repro-duction of both music and speech with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 D speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL64s, EC683. EF86 and EZ80 rectifier, Simple instruction booklet 25p + SAE (Free with parts). All parts sold separately, built and lested 219 00P. & P. 81-40. "POLY PLAMAR" WAFFER-TYPE. WIDE BANGE

built and tested £19 00 P. & P. £1:40. "POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER Size 11\$"  $\times$  14 $\frac{1}{16}$ "  $\times$  1 $\frac{1}{16}$ " deep, Welght 1902, Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40H2-20kH2. Can be mounted on cellings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only £8:40 each  $\rightarrow$  p. & p. (one 90p, two £1:10). Now available in either 8" round version or 44"  $\times$  81" rectangular, 10 watts RMS 60H2-20kHZ £5:25 + P. & P. (one 65p, two 75p).

MAGNETIC PRE-AMP. Sens. 3mV in for 100mV out. 15 to 35V neg. earth. Equ. ± 1dB from 20Hz 10 20KHz. Input impedance 47K. Size 11r x 21r X 51rH. \$2\*60 + 20n P. & P.

2" PLASTIC CONE HF TWEETER 4 ohm, \$3-50 per matched pair + 50p P. & P

HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT

**HARVERSONIC SUPERSOUND 10 + 30 STEREO AMPLIFIER KIT** A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass, Trebie and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridges. Next stable for use with ceramic or Crystal cartridges. Very simple to ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminam froot panel with matching knobs, wire, solder, nuts, bolts--no extras to buy. Simple size by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts t.m.a. per channel into 5 ohms. Frequency response: 43(B) 12-0,000 Hz. Sensitivity: better than B6mV into IM 01: Full power bandwidth: ±3d3 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to --fodB. Negative feedback 16dB over main amp. Power requirements 35v. at 1-0 amp. Overall Size 12'w. × 8'd. × 24'h. Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E. AMPLIFIER KIT ... £35:50 P. & P. 80p (Magnetic input components 33p exita) POWER PACK KIT ... £35:50 P. & P. 95p CABINET ... £5:50 P. & P. 95p SPECIAL OFFER—only £32.75 [f all 3 items ordered at one time plus £1.25 b. & p.

Also avail ready bilit and tested £31.25, P. & P. £1.50. HARVERSONIC STEREO 44 A solid state stereo smplifter chassis. with an output of 3-4 watts per channel into 8 ohm speakers. Using the intest high technology integrated circuit amplifters with built in short term thermal overload protection. All components including rectifter smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockels & 5 pin din tape rec./pisy socket are mounted on the printed circuit panel, size approx.  $9^+ \times 24^+ \propto 1^-$ max. depth. Supplied brand new & tested, with knobs-brushed amodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically at only  $50^-$ 00 plus 500 P. & P. Mains transformer with an output of 17v atc at 500m/a can be supplied at £1.50.  $400^-$  P. & P. if required Full connection details supplied. HA34 3 Valve Audio Amp. 4 w. output ready built and HA34 3 Valve Audio Amp. 4] w. output ready built and tested  $\$8 \cdot 50 + \pounds1 \cdot 40$  P. & P. Also HSL 'FOUR' amplifier kit.  $\$3 \cdot 90 + \pounds1 \cdot 40$  P. & P.

HARVERSON SURPLUS CO. LTD.

-LEGENTIC ABRIAL  $\pm 124$  °<sup>n</sup> YAT 11 section telescopic aerial. Extended length: 1 metre (354") Fully closed: 135 mm (54") Fixing: nut and bols fixing through recess at base of aerial. TELESCOPIC AERIAL + 12+ % VAT

ONLY 75p EACH! LOUDSPEAKERS + 121% VAT

214" (57mm) 8 or 75 ohm 90p (please state impedance req'd) 5" 8 ohm Ceramic £1 50 8" "ELAC" 8 ohm ISW dual

BARGAIN LOUDSPEAKERS + 121% VAT 21" (60mm) 8 ohm (limited

stocks) 60p 87×5" 4 ohm (limited stocks) £2:00

LOUDSPEAKERS + 8% YAT 12" "McKENZIE" 8 ohm 75W Bass £23-82 12" "McKENZIE" 8 ohm 75W dual

cone £13-82 12" "McKENZIE" 8 ohm 75W general purpose £18-37 12" "GOODMANS" 'Audiom 12P' 233-80

8 ohm 50W **(23-0** 12" "FANE" POP 33T 16 ohm 33V

12" "FANE" POP 50/2 16 ohm

65-00

64-76

£4-50 £2-00

60p

423-00 £12-92

50W

€15 70

BARCLAYCARD

VISA

cone 8" "GOODMANS" 'Audiom 8PA' 8 ohm 15W 10" "ELAC" Bohm 10W dual

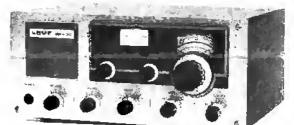
stacks) 21" (70mm) B ohm (limited

cone ' × 4″ 8 ohm 4W

(Dept. P.W.) 170 MERTON HIGH ST., LONDON, S.W.19. Tel.: 01-540 3985 A few minutes from South Wimbledon Tube Station. Open 9.30-5.30 Monday to Friday. 9.30-5 Socurday. Closed Wednesday. MAIL ORDER DEPT.

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.R. ONLY, SEND SAE WITH ALL ENQUIRIES.

#### OPEN UP THE EXCITING WORLD OF SHORT WAVE LISTENING



#### SRX-30

SRX-30 For the advanced, keen short wave listener, the choice of receiver has usually been between cheap and nasty or very good but very expensive equipment. We think that the SRX-30 will provide that listener with excellent performance at a reason-able cost and is the answer to this ternal problem. The SRX-30 provides AM, CW. USB and LSB reception on all frequencies from 500 kHz to 30MHz. All right, so does your Scoper Blooper Mk. 3 but you can't set the Scoper Blooper dial to the frequency you want and be sure that it's correct The SRX-30 time provides a simple to operate. You have a dial reading in MHz from 0-29 and a main tuning dial reading 0-1000 kHz. So-If you know that Radio Slobovia is broadcasting on 10.295 MHz, you set the MHz dial to 10, the kHz dial to 295 and there you are. The MHz dial setting is not critical, as stability is guaranteed by a triple mixing drift cancelling system, thereby overcoming another problem in your Scoper Blooper MX. 3: drift. A further drawback to cheap receivers is massive image interference on the higher

another problem in your Scoper Blooper MK. 3; dntt. A further drawback to cheap receivers is massive image interference on the higher frequencies due to the use of a low IF, typically 455 kHz. The cure for this problem is the use of a high IF and the SRX-30 employs a first IF of around 40 MHz-so goodbye to first IF images. You could of course find the same system as this in the Racal RA17 series receivers: after all, the SRX-30 has copied the basic idea from this very receiver. The big drawback to the RA17 (apart from the price II) is that unless you have the muscles of a prize fighter, lifting the RA17 may send you for a holiday at Hernia Bay (staying at the Truss House?).

To summarize, the SRX-30 covers 500 kHz to 30 MHz with excellent dial readout and reset accuracy; it has all mode (AM, CW, SSB) reception and is equally at home in broadcest or amateur bands; it has all the facilities of a top class com-munications receiver. RF gain, fine tuning, selectable sidebands, built in loud-speaker, operation from ac mains or 12v. Dc, rugged construction and super styling and all at an attractive price—£158 inc. VAT. Cart £3. See it soon at your nearest stockist, you will be agreeably impressed.

For all that's good in Amateur Radio, contact: LOWE ELECTRONICS LTD., 119 Cavendish Road, Matlock, Derbyshire. Tel: 0629 2430 or 2817.

For full catalogue, simply send 45p in stamps and request catalogue CPW.

READ	ERC P	<b>B</b> SERVICES
	ASED TO ANNOUNCE OUR	PLEASE NOTE OUR NEW MAILING ADDRESS:-
SPECIAL OFF	FERS SERVICE	BOX 11, FLEET HOUSE—WELBECK STREET
	ELECTED-BRANDED PRODUCTS D PRICES TO P.W. READERS. ONTHLY,	WHITWELL — Nr. WORKSOP — NOTTS Tel: (0909) 720695 TELEX: 547616 FLEET G
		PW PCBs
		PLEASE SUPPLY SPECIAL OFFERS/P.C.B. AS INDICATED BY TICK/SIN BOX/ES.
		Issue         Project         Ref         Price P/P           Dec 75         Sound-To-Light Display         DN0798         1-15+12
		Dec 75 Disco System, Amp (2 reg'd) each AM0421 4-40+22
		Dec 75 Diaco System, Light Modulator AM0429 3-50+22
		Mar 76         CMOS Crystal Calibrator         AM0438         1-19+12         III           July 76         Disco Preemplifier         A003         0-65+12         IIII
1.0.5		Oct. 76 Digital Car Clock (set) A011/012/013 2:58+12
		Oct 76 Interwipe DN8JM 0-80+12
		Oct 76 Video-Writer (set) D002/3/4/6 A1007 21-44+50
	[[J]	Nov 76         Cirtest Probe         A018         0·48+12         □           Nov 76         Burglar Alarm         A019         0·50+12         □
		Dec 76 Chromachase A021 5-70+22
		Jan 77 Oscilloscope Calibrator A023 1-25+12 🗌
	10.06 mm	Apr 77 Gas/Smoke Sensor Alarm A028 0-65+12
		May 77         2-Way Intercom         D019         1-28+12         I           May 77         Protected Battery Charger         A027         2:38+12         I
		May 77 Seekit Metal Locator A031 3-38+12
		June 77 Versatile AF Generator A033 2-38+12
a start of the second start of		June 77 Tele-Games D029 3-22+12
= 23.17 ATT MARKET		July 77         20W IC Amplifier         A034         1:38+12         I           July 77         Radio 2 Tuner         A035         1:68+12         I
· · · · · · · · · · · · · · · · · · ·		July 77 Digital Clock Timer A036 3-28+12
		Aug 77 Shoot (Telegames) D035 1-55+15
WATCH BATTERIES ALWAYS AV	AILABLE-ANY TYPE 49p each	Aug 77 Atomic Time Receiver D038 2/65+15
A GLCDB4, L.C.D. WATCH	G LLEDAS. LADIES L.E.D. WATCH	Aug 77 Morse Code Tutor Cards (SRBP) A037 4-75+15 Sept 77 Jubilee Electronic Organ A038 19-00+75
7 Function Gents L.C.O. quartz watch	As LLED/43 but housed in an everyday stainiess steel case & strap. PRICE: 29-56	Sept 77 Electronic Car Voltage Regulator D037 1-25+12
Stainless Steel case & fully ad), strap, FUNCTIONS: Hrs, mins, secs, date, month,	+ 50p P& P.	Oct 77 Audio Level Indicator D039 0-98+12
Stainless Steel case & fully add, strap, FUNCTIONS: Hrs, mins, secs, date, month, siternating time/date, back Hight, Water resistant, PRICE: £15 \$1 + 50p P & P.		Oct 77 Sine-Square Wave Generator D040 2-35+15
BLCCROF, LC.D. CRONOGRAPH	H. CLI. L.R.D. ALARM CLOCK	Nov 77 Laboratory Power Supply A039 3:50+12 Jan 78 Direct Conversion Receiver D043 1:83+15
Up to 25 Function: 8 digit display of Brs., mins, seconds, day, date, month. Messures	Full facility afarm clock, big green display and 24hr, alarm with sleep/anooze timer-	Jan 78 Proportional Power Controller DN9JM 0-78+12
nett times, Lap times, place times to 1/100th second, Swiss Stainless Steel case & fully	absolutely overwhelming value. PRICE: £9:99p + 75p P & P.	Mar 78 Audio/Visual Logic Probe R001 1-40+15
ed), strep: Back light, American electronica. With record time elepsed whilet displaying		Apr 78 Europa Stereo Amplifler R002 9/55+45
watch functions or date. Water resistant. PRICE: £20-56 + 500 P & P.		May 78 DX'ers Audio Filter D001 2·35+15 June 78 Bovington Tank Game R006 3·80+20
C SOLAR 1. BOLAR POWERED/ CHARGED WATCH	RA1. & Waveband AM/FM/SW Mains/batt RADIO	June 78 Audio Distortion Meter (set) R007/8/9/10 6-75+25
A superbly engineered 10 function SOLAR	The UNIOUF VEGA SELENA FEATURES	June 78 Darkroom Timer R011 1-55+15
watch. Will operate without batteries even in subdued or artificial light. Batteries fitted provide power at night for watch 4 back light,	5 short Wave Bunda: 80 to 160 + 42 to 50 + 30 4 to 32 5 + 24 7 to 25 + 19 3 to 20 Mtrs. A/M-L/W & M/W. F.M. with A.F.C. Panal	July 78 Avon Transmitter R015/16/19/20 5-10+40
these being charged by the solar panel during the day. Functiona: Hra, mina, mess, day, date, month AM/PM todo, Date	lighting: Full tone control: Extending rod serial. Opprts., S/W & F/M: Batt/Tuning indc. SOCKETS FOR: External 80 phm	July 78 Digital Lock R002 1 25+15 July 78 Morse Tutor R014 2 35+15 J
Ind, Alternating Lime/Date, Sugar stylish	APPlat + AIM APPILI; TIDE Recorder Reci	Aug 78 Point Motor C.D. Supply D005 1-25+15
'Polished' stainless steel case & fully adj. strap. PRICE: £23-86 + 50p P & P.	playback: Earth. The Vage Selena WE(GHS 9 Ibs. Finished in black with eilyer trims and a rest wood surround. PRICE: <b>£32-95</b> + £1-75 P & P.	Post and packing is for one board or set of boards or one item. Prices include VAT. Remittances with overseas orders must be
D LLCDS. LADIES L.C.D. WATCH	MR/218C L.E.D. Clock Radio Alazm (Matra)	sufficient to cover despatch by sea or air mail as required.
American/Swiss very practical every- day ladies watch, Functione: hrs. mine, secs. date, month, back fight, sit, Time/	FEATURES: 24 hr time and shrm clock $\rightarrow$	I enclose Postal Order/Cheque ACCESS welcome. Send card number only.
secs, date, month, back fight, et, Time/ Date, in a water resistant, steinless steel case & Adj. strap. Size: approx, 18mm face × Bmm thick. PRICE: £15-95 + 60p P & P.	A/M, F/M Radio. Full alarm features include snooze Nimer, radio set and off. Radio steep timer. Bright green t2hr LED display with A/M, P/M Indicator. PRICE: £21-78 + £1-25 P & P.	No
E SOLAR 2 SOLAR POWERED! CHARGED CHRONOGRAPH OR	K'AM/FHIL DIGITAL CLOCK/RADIO/	Box 11, Fleet House, Welbeck St., Whitwell, Nr. Worksop, Notts.
ALARM Up to 25 function 6 digit display chronograph watch, functions as LCCRO1 with Solar facilities as SOLAR 1, Alarm version very	As MR/218C but evailable AM/FM only and Mech., digital display. Usual full, elsep, snooze, radio/buzzer elarm facilities. PRICE: 218-95 + 30p P 4 P.	NAME
alim featuring full starm facilities. ALARM OR CHRONOGRAPH PRICE:		ADDRESS
£27-54p. + 50p P & P.	L CRAM L.C.D. TRAVELLING ALARM CLOCK	
F LLED/43. SHUGAR L.E.D. COCKTAIL	Features: 12 hour time and afarm clock (12 hour display with AM/FM indicator), Nitelite, 4 minute snooze timer. Large	Post Code
For the night blrd: A 6 function L.E.D. watch housed in a prefty cocktail bracelet. Func- tione: Hra, mina, seca, day, date, month. Gold or allver. PRICE: £13.95p. + 50p P & P.	There is a structure of the structure o	Any correspondence concerning this service must be addressed to READERS PCB SERVICES and not to the Editorial offices.
ALL ITEMS FULLY GUARANTE		IF YOU DO NOT WANT TO MUTILATE THIS MAG. YOUR
BACK WITHIN 7 DAYS IF NOT		WRITTEN ORDER IS ACCEPTABLE.

Practical Wireless, October 1978

# ESSENTIAL **BOOKS** for RADIO AMATEURS

#### A GUIDE TO AMATEUR RADIO (NEW 17th edition) by Pat Hawker, G3VA

This book has been deservedly popular for many years as an introduction to amateur radio-what it is, how it works, and

Most of the questions usually asked by the newcomer are answered in an introductory chapter, and then the book takes the reader from the first steps in setting up a receiving station to the basic theory and practice of antennas, transmitters and

to the basic theory and practice of antennas, transmitters and receivers, and how to obtain a transmitting licence. Operation of an amateur station is discussed, and there are lists of Q-codes, amateur radio callsign prefixes and other useful data. Chapter titles are: This is amateur radio; Getting started; Communication receivers; Transmitters; The Antenna; Amateur radio equipment; Workshop practice; The licence examinations; Operating an amateur station; The RSGB and the radio amateur. International amateur radio organizations, 120 pages 61.71

#### THE RADIO AMATEURS' EXAMINATION MANUAL (7th edition) by G. L. Benbow, G3HB

A pass in the Radio Amateurs' Examination is required before A pass in the Radio Amateurs' Examination is required before the authorities will grant an amateur radio transmitting licence, and the aim of this book is simple; to provide sufficient informa-tion to enable its readers to pass that examination. This edition may be used to prepare for the December 1978 exam-ination (but not the May 1979 examination). Chapter titles are: Becoming a radio amateur; Elementary electrical principles and calculations; Thermionic valves and their applications; Introduction to semiconductors; Power supplies; Receivers; Transmitters; Measurements; Propagation and aerials; Interference; Licence conditions; Tackling the Radio Amateurs' Examination.

Amateurs' Examination.

87 + viii pages

£1-60

# RADIO AMATEURS' EXAMINATION QUESTIONS AND ANSWERS

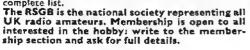
This book is a collection of model answers to typical Radio Amateurs' Examination questions, and should prove invaluable to candidates as a revision aid. The answers given are complete with diagrams and worked calculations where necessary, **118** pages £2.00

#### **RECEIVING STATION LOG BOOK**

One of the essential features of a listener's station is a well-kept log book of stations heard. The RSGB Receiving Station is a wein-kept log book of stations heard. The RSGB Receiving Station Log Book is specially designed for the listener to the amateur bands, with columns for date, time, frequency, callsign of station heard, signal report, mode, other station being contacted and its report given, remarks and QSL information. Plastic comb binding

£1-54

Prices include postage, packing and VAT. These are just a few of a complete range of technical publications, log books and maps for the radio amateur. Send a large stamped self-addressed envelope for the complete list.



**Radio Society of Great Britain** 35 DOUGHTY STREET, LONDON, WCIN 2AE

SINCLAIR PRODUCTS\* Microvision TV now in stock £200. PDM35 digitel multimeter £27 23. mains adaptor £3.24. delure padded case £3.25. 304 probe £13.28. New OW235 digital multi-mater £47.50. Cambridge programmable scientific calculator £13.15. prog. Ibbray £2.95. mains adaptor £3.20. enterprise programmable calculator £3.25. S. Der 5.0 FCS AND T-DECS\*

Schullter Calculator 22:00. enterprises
 Schultter Calculator 22:00. enterprises
 Schultter Calculator 23:05.
 Schultter Calculator 24:05.
 Schultter Calculator 25:05.
 Schultter 25:05.
 Schultter 2

Total and LF 22. Case 1: Set as 50 rec PRINTED CIRCUIT MATERIALS PC etching hits:--economy 65 10, standard 23 #2.59 kg ins pch 409, 10 FeC 24: 95. Small drill bits 1/32 ins or 1mm 20 pecho. Etching dish 400, Laminale cutler 75p.

BATTERY ELIMINATORS 3-way models with awtiched output and 4 way multi-lack:- 3/4/4/9/ 100ma £2:92. 6/7/3/9/ 300ma £3:30. t00ma radio models stud connectors. 9V £2:85. 6V £2:85. 4/V £2:85. 9V + 9V £4:50. 6V £2:45. 4/V £2:85. 9V + 9V £4:50. 6V £4:45. 4/V £2:85. 9V + 9V £4:50. 6V £4:45. 4/V £2:85. Car convertors 12V dc input, 0utput 9V 300ms £1:40. Output 7/V 300ma£1:50.

300m 21:50. BATTERY ELIMINATOR KITS Send sale for free lenfel on range. 100m radio types with press stud connectors. 4/V £1 80. 69 x51:46. 9V £3:46. 41 + 4/V £2 56. 61 + 6V £2:56. 9 + 9V £2 50. Cas-sette type 7/V 100m with din plug £1:36. Heavy-duty 13 way types 4/16/17/8/11/13/ 14/11/6/12/15/8/31/42/V. 1 Amp £4:45. 2 Amp £7:55. Transistor stabilized 8-way types for low hum 3/4/16/7/8/12/15/18/ 100m £3:20. 1 Amp £6:46. Variable voltage stabilized models. 2-18V 100m £3:66. 2-30V 1A £8:95. 2-30V 2A £19:95. Car convertors 12V d.c. input. Output 9V /72/V/6V 1 Amp £1:95.

(IIV)441 AMD £1-95. BJ-PAK AUDIO MODULES Send sae for data. S450 tuner £23-51. AL60 £4-86. PA100 £15 71. SPM80 £4-47. BMT80 £5-55. MK60 £38-74. Siereo 30 £20-12.

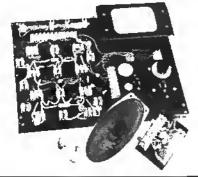
But Table 5: 91. MHR60 258-74. Silereo 30 420 12. But K BUY OFFERS Minimum purchase £10 any mix from this section. N4166 139. NH602 3: 45. BC712 49. 741 8 dil 159. NESS 8 dit 259. 720 14 dil 459. Dalo pens 359. ACT60203 encot equival SNP003N with Improve haar ink at 59. 2000 4: 40. BC71 4: 70. Exection. 10: 49. BC71 4: 70. Containing type 3: 40. Realitors 5% E12 10 ohn to 10M. 3W 9 Ap. NV4 Nya 9: 70. Antisiripe type 3: 40. Realitors 5% E12 10 ohn to 10M. 3W 9 Ap. 1W 49. Poly-ester canacitors 250V 01. v022. 603. 047mi 2: 70. 015mi 3: 00. 033mi 2: 59. 047mi 2: 70. 015mi 3: 00. 033mi 2: 59. 047mi 2: 20. 01000 1: 70. 47000 129. Electrolytice 58V 0: 47. 1, 2m 55. 25V 5mi 59. 10mi 59. 18V 22mi 5p. 33. 47. 100mi 59. Zenes 400mW E24 2V7 to 33V 6: 10. Feeset pots sub miniature 0: 1W horls or vert 100 to 4M7 6: 59. Potsmines 14 4K7 to 2M2 log or lin. single 28p. Dual 78p.

SWANLEY ELECTRONICS DEPT, PW. 32 Goldsel Rd., Swanley, Kent BRS BEZ

Mail order only. Please add 30p to the total cost of order for postage. Prices Include VAT. Oversess customers deduct 7% on items marked \* and 11% on others. Official credit orders welcome.



# RADIO EXCHANGE



# NEW ELECTRONIC MASTER KIT

NEW ELECTRONIC MASTER KII WITH SPECIAL V.H.F. TUNER MODULE TO CONSTRUCT. A completely Solderless Electronic Construction Kit, with ready drilled Bakelite Panels, Nurs, Bolts, Wood Screws etc, Also in the kit: transistors, Capacitors, Resistaros, Pots, Switches, Wire, Sleeving, Knobs, Dials, 5" × 3" Loudspeaker and Speaker Case, Crystal Earpiece, etc. Also ready wound Coils and Ferrite Rod Aerial. These are the Projects you can build with the components supplied with the kit, together with comprehensive Instruction Manual Pictorial and Circuit Diagrams. PROJECTS: V.H.F. Tunner Module ★ A.M. Tuner Module ★ M.W. L.W. Diode Radio ★ Six Transistor V.H.F. Expriece Radio ★ One Transistor M.W. L.W. Radio ★ Two Transistor Meth variable beat control ★ Three Transistor and Diode Radio M.W. L.W. Availation Manual Projects: V.H.F. Lundspeaker Receiver ↓ Variable A.F. Oscillator ★ Jiffy MultiTester ★ Four Transistor and Diode M.W. L.W. Radio ★ A.F. R.F. Signal Injector ★ Five Transistor Push Pull Amplifier ★ Eight Transistor Push Pull Amplifier ★ Tone Transistor Class A Output Stage to drive Ludspeaker ★ Sensitive Haaring Aid Amplifier ★ Tone Transistor Class A Output Stage to drive Ludspeaker ★ Sensitive Transistor H.W. L.W. and Diode Tuner ★ Sensitive Three Transistor Regenerative Radio ★ Four Transistor H.W. L.W. and Diode Tuner ★ Five Transistor Class A Output Stage to drive Ludspeaker ★ Sensitive Transistor H.W. L.W. and Diode Tuner ★ Five Transistor Class A Output Stage to drive Ludspeaker ★ Sensitive Transistor H.W. L.W. and Diode Tuner ★ Five Transistor Class A Output Stage to drive Transistor Regenerative Radio ★ Five Transistor V.H.F. Tuner ★ Three Transistor Code Practice Oscillator ★ Five Transistor Regenerative Radio ★ Four Transistor M.W.L.W. Radio ☆ Five Transistor Regenerative Radio ★ Seven Transistor M.W. L.W. Radio with Loudspeaker Push Pull output ★ One Transistor Home Broadcaster.

# NEW ROAMER TEN MODEL R.K.3

MULTIBAND V.H.F. AND A.M. RECEIVER.

13 TRANSISTORS AND SIX DIODES. QUALITY 4" ROUND LOUDSPEAKER. WITH Multiband V.H.F. section covering Mobiles, Aircraft, T.V. Sound, Public Service Band, Local V.H.F. Stations, etc. and Multiband A.M. section with Airspaced Tuning Capacitor for easier and accurate tuning, covering M.W.I. M.W.2, L.W. Three Short Wave Bands S.W.I, S.W.2, S.W.3 and Trawfer Band. Built-in Ferrite Rod Aerial for Medium Wave, Long Wave and Trawler Band, etc., Chrome Plated 7 section Telescopic Aerial, angled and rotatable for peak Short Wave and Y.H.F. reception. Push-Pull output using 600mW Transistors. Gain, Wave-Change and Tone Controls, Plus two Slider Switches. Powered by P.P.9-9 volt Battery.

Complete kit of parts including carrying strap. E14.79 | P& P £1.10 Building Instructions and operating Manuals.

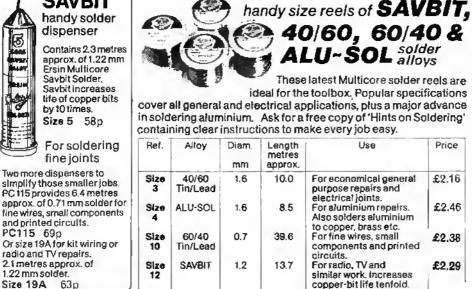




SAVBIT

# Handy size Reels & Dispensers OF THE WORLD'S FINEST CORED SOLDER TO DO A PROFESSIONAL JOB AT HOME

Ersin Multicore Solder contains 5 cores of non-corrosive flux that instantly cleans heavily oxidised surfaces and makes fast, reliable soldering easy. No extra flux is required.





**BIB WIRE** 

STRIPPER

& CUTTER

8-gauge selector and

Fitted with unique

Sole U.K. Sales Concessionaires:

Bib Hi-Fi Accessories Limited, Kelsey House, Wood Lane End, Hernel Hempstead, Herts. HP2 4RQ

Prices shown are recommended retail, inc. V.A.T. From Electrical and Hardware Shops. In difficulty send direct, plus **20p** P&P. Prices and specifications subject to change without notice.



GBOUV

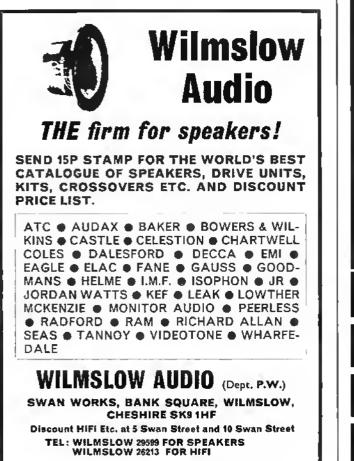
D. J. PATTLE HILLBURY RD., ALDERHOLT, FORDINGBRIDGE, HANTS SP6 3BQ.

# GIVE YOUR P.W. PROJECT A PROFESSIONAL LOOK

Anodised aluminium front panels Matt finish, Artwork almost indestructible. Available for the following projects:-

Issue	Project	Ref.	Price	p/p
Dec. 74.	Car Cassette Player	12741	£2·00 +	20p
Dec. 77.	Power Unit.	12771	£2.00	20p
Mar. 78.	Europa Amplifier.	3781	£3 · 50 +	35p
May 78.	Audio Distortion Meter.	5781	£5.06 +	40p
June 78.	Bovington Tank Game.	6781	£2 ·25	20p
June 78.	Darkroom Timer.	6782	£1.50 +	15p
July 78.	Axon Transmitter.	7781	£5 · 50 +	50p

Prices include VAT. Remittance with overseas orders must be sufficient to cover dispatch by sea or air mail as required. Postal Order or Cheque with order.





# TWICE the information

The I.C.E. range of multimeters provide an unrivalled combination of maximum performance within minimum dimensions, at a truly low cost. Plus, a complete range of add-on accessories for more ranges, more functions.

#### 4.... 111111111111111 111 104 0 IAO 4 -PATENTED hzfi Б ê ē Ë. ð 6 ъ 500-4- 5-4- Mex- 500-4- 5A= 2.5 tester seek Ω Ω.1 Ω.10 Ω/00 noo ъ ð REG-

# Supertester 680R (illustrated)

- \*  $20k\Omega/V$ ,  $\pm 1\%$  fsd on d.c.
- $4k\Omega/V$ ,  $\pm 2\%$  fsd on a.c.
- \* 80 Ranges 10 Functions
- \* 140 × 105 × 55mm

#### £32.00 + VAT (For Mad Order add 80p P&P)

## Supertester 680G

- \*  $20k\Omega/V$ ,  $\pm 2\%$  fsd on d.c.
- $4k\Omega/V$ ,  $\pm 2\%$  fsd on a.c.
- \* 48 Ranges 10 Functions
- \* 109 × 113 × 37mm

#### £24.50 + VAT (For Mail Order add 80p P&P)

#### Microtest 80

- \* 20kΩ/V, ± 2% fsd on d.c. 4kΩ/V, ±2% fsd on a.c.
- \* 40 Ranges 8 Functions
- Complete with case only 93 × 95 × 23mm

# £16.60 + VAT

(For Mail Order add 80p P&P)

All I.C.E. multimeters are supplied complete with unbreakable plastic carrying case, test leads, etc. and a 50-plus page, fully detailed and illustrated Operating and Maintenance Manual. Now available from selected stockists. Write or phone for list, or for details of direct mail-order service.



Electronic Brokers Ltd. 49-53 Pancras Road, London NW1 2QB Tel: 01-837 7781



Advance Board No. 79055. A modern fibre glass circuit board made for computer but never Issued, all components can be assumed perfect. Major Itoms:-B transistors type BC 107, 8 transistors type BC 212, 9 miniature diodes, 4 presot vertible poto/10 to 20 to 2 2000F 10 volt capacitors, 1 3UF 83 volt capacitor, 5 assorted resistors 1, 2 watt. Board size approx. 5 x 4)<sup>27</sup>. Most compo-nents can be removed with working length leads 61.

restitions 4, 5 watt board size approx. 5x 44°. Most compo-nants can be removed with working length leads £1. Telephone Answering Machine. Used, but we undersland are in pood working order, however, we can supply only for breaking up-they are not to be used for tolephone enswering. They contain: 4 pole tabe motor, twin capstains with heavy flywheels, 4 record-playback heads, erase head, tabe spools to take standard recit, tape guides and solenoid operated biake, 8 plano, key type switching and control mechanism, tape used counter, efficient specific and the set of the standard recit and sockel. 35 pin plug and socket. 5 Circuit boards containing writed assocriment of transistors in small parts. All the above mentioned compenents are mounted in the main chassis and there is a sub chassis with 5 ministure 4 pole relays, ferrile transformer, 4 iron cored transformers, 5 variable pols, 35 transistors, over 300 various resistors, capacitors, diodes etc., full wave recitifier panel, 4 way push down wire connec-tion block, the way duito, stereo loput socket, 3 push in naon builbs, lid switch, 4 electrolytic capacitors, 2 pawer output transistors. The unit is nicely capacitors, 2 pawer output transistors. The unit is nicely capacitors, 2 pawer output transistors. The unit sock machine, echt othember etc. etc. price f12:75. Migh Voitege Mains Transformer. Normal mains primary,

Migh Voitage Maine Transformer. Normal meina primary, escondary by our measuring equipment is 8KV approx. at 5 ma. We are offering these at a bargain price of £4-75, Our ref. no. TM45. secondary I 5 ms. We a

ref. no. TM45. Sarry said out of Transformer ref. No. TM 37 but we have just received another transformer which may fill your need. This is a 100 mtransformer glo volt secondary, topped at 20, 40 and 60 volts. So this could be used as a 80x. 1:5 amp, 60v at 2 amp, 40 volt 3 amp, a 20-20 volt 3 amp or a 40-040v 1:5 amp price £3 55. Smith\* 8 Siewer. Snall shaps with exterior motor, oblong outlet size  $41^{\circ\circ} \times 14^{\circ\circ}$  approx, paddle type air rotor coupled to mains induction motor, with anti vibralion mountings overall size of fan approx  $41^{\circ\circ}$  high >  $51^{\circ\circ}$  size of fan approx  $42^{\circ\circ}$  dismeter, 45 55.

alze of ian approx 41" high × 51" wide × 42" diameter, 25.56. Torrin Blower. Snail type similar but smatler to above, berlure size 21" × 13" approx. Normal mains induction motor overall size 32" × 13" approx. Normal mains induction motor overall size 32" × 13" approx. Normal mains induction with Voitage Capacitors. Binf SKV working ex equipment but with useable length leads. Normally a very expensive capacitor, our price 23,9 + 29 each. Flax Bargain, 3 Core (standard colour coding) black outer Flax Bargain, 3 Core (standard colour coding) black outer connecting direct to heating appliances but being lougher than usual II is detail all of re attension leads especially outdoor ones. Som conductors so suktable for up to 7.5 amp 100 mel coli, price 510 55.

coll, price **Clo 95**. (3) of the permittion mains driven motor, 2 walls also autable only for limers or other lightweight operations,

Note for the permitter matter and the solution of the first second solution of the first second solution of the solution of th

30-80°F or fower or higher. 30p-44p each, 10 for 24 59-36p. Car Speakers. Two bargains this month both elliptical, both 4 ohm site price £1:56 plus 10p, post 60p. Immersion Meater thermastate made by Satchwell 7", 11" and 17" (ength slandard fit in most inmersion heaters, £2 10. Thermostat Pocket. To fit the above thermostat into a lank without heater then you need a pocket to hold this thermostat, 13" long threaded complete with nut and washer, price £1 42 -also evailable 3" long for 7" thermostat and price £1 42 -also evailable 3" long for 7" thermostat and price £1 42 -also evailable 3" long data bi-metalle strip causes without heat coil wound around a bi-metalle strip causes awitch on after a lime which is adjustable. The energiaing voltage varies belween 4y 5 7y time delay time-from a few aeconds upwards price £1 43. Boller 51al 50-90°C remote philal type capillary length approx, with control knob marked 20 to 80°C, price 52 14p.

Transition holder for TOS (OC 26 stc) allows (transistor to be replaced quickly, also threaded for holding screws. AC conaction 1 25ul for 40 volts rms. Atuminium can with tog connections as new aquipment coverad by normal guarantee Do-120. 0+2

30p+2p. Mains operated Siren. Don't let intrudars get sway with your possessions-they will never stay in a house when one of these sitenes is going. Quite small bui very starming £313-59. Lever Switch as fitted to modern telephone switch boards. 8 pole changeover contacts made by PyerIMC biassed to return when pushed up, stays fown when pushed down, order £1 dop. price £1 dip

Puising Switch. Motorized unli which gives puises every 30 seconds, length of puise can be adjusted up to 30 seconds and the puise can be up to 20 amps at normal meins vollage. Made up by famous Cramer Company of America, the drive motor of this device is at 15% 50% but we aupply complete with aeriss voltage dropping device to make it suitable for our meins. This is in a cylindricel phasic case overall aits, wilh a knob on the front for adjusting the puise fongth. 20 amp switch "inside" is a changeover switch ao this device could size be used as a time sharing switch, when one circuit is on the other circuit would be off for a length of time determined by switch control setting, price 54-92.

Catemplaci by switch control setting, price 44-82. 16 Line Connecting Box. This is 16 way livin grub screw type connecting atting mounted in a standard 2 gang MK while surface box with cover made for Stichwell so ob-toward a good product. The cables, are brought in through numbered for save identification, price 51-92. This is a Satch-well thermostat using a sensor connected to the switch by a 26° irength of califary. The control setting data This is a Satch-well thermostat using a sensor connected to the switch by a 26° irength of califary. The control setting data This is a Satch-well thermostat using a sensor connected to the switch by a 26° irength of califary. The control setting adustable from 30° to 160° complete with control knob showing temperature setting 22-48. Twish 13 amp Rocker Switches (DOT) price 49g the pair. Pressure Gauge, clandard aritine thread. Reads 0-301bs per a, inch price 11p. Bargain for califars only. YOU with 18° CR Tube rather large 54 Sop. 4 Way Terminal Blocks twin grub acrew type, PYC covered to (or 55p.

to for 45p. Sparse for Dimplex Hexters. We have just laken delivery of a large quantily of various spars parts for Dimplex heaters including slotage hesters, if you need any of these liken please let us have your enquiries. Heavy Duty Casters. Four of likes would carry a tan, set of 4 £2 45.

#### MULLARD UNILEX

MULLARD UNILEX A mains operated 444 sieres system. Rated and of the finast perior at the sieres field this would make a wonderful gift for atmost enyone in essy-to-assemble modular form and complete with a pair of Pleasey speakers this should's est at the system complete with a pair of Pleasey speakers this should's est at the system complete with a pair of Pleasey buy this month we ofter the system complete at only £15 including VAT and postage, 10 watt amps to upgrede unifex £350 each.



#### UNISELECTORS

These are pulse operated switches as used in sulomatic telephone switchboards, sic. vilch The pulse moves the even through one post In pulse moves the evillon arm through one position, Except where indicated the selectors are 25 position types and 50 Y Coil is standard. 24 per switch. 3 position 25 5 0 1 4 pole 25 5 0 1 4 pole 25 5 0 1



#### 24 HOUR TIMERS

The one Hiustrated is the 'E' conirol, this uses the Smitha mechanism as in their autoset. 2 onjoff's per 24 hours, 13 amp contacts, override switch £5 56. Smiths 100 amp model one onjoff per 24 hours file

Simiths 100 amp model one on ion of der 24 hours £19 30, extra contacts £1 40 per set. A£G 60 amb model with clockwork stand-by, one onioff per 24 hours £3 50, axtra contacts £1 90 per set.

B pole

RELAYS 12 volt two 10 smp changedver plug in 35p 12v three 10 smp changedver plug in £1:21. 12v two changedver miniature wire encod 35p. 12 volt open single scraw fixing two 10 smp change-over #15p 12 volt open three 10 amp changedver £1:25. Latching refer mains operated 2 c/o contacts £2:11. Mains operated three 10 amp changedvers open type one acrew fixing £1:25. Many other types with different coll volteges and contact strangements are in stock, enquirles invited.



£13 60 £15 88 £8 60 £11 40

#### ROTARY PUMP



RUIARY PUMP Self priming portable, fits drill or slectric motor, pumps up to 200 pailons per hour depending upon revs. Virtually uncorredable, use to suck water, oil, petrol, fartiliser, chemicels, enything Uquid, Hose connectors each end. £2 gast paid.

#### DELAY SWITCH

Mains operated-delay can be ac-curately set with pointers knob for periods of up to 21 hrs. 2 contacts suitable to switch 10 amps-second contact opens few minutes effer fat contact #5p.

#### HUMIDITY SWITCH

HUMIDITY SWITCH American mide by Ranco, Ineir type No. J11. The sclion of this device depends upon the demoness causing a membrane to stratch and trigger a sensitive-mitive-breaking on the sensitive-breaking sensitive-breaking on the for instance will switch it on. Micro 3 amp at 250V a.c. Overall size of the device approx. 31 long. 1 wide and 13 deep 75p.

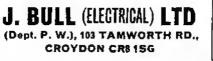
#### INDUCTION MOTORS

One illustrated is our reference MM11 made for ITT ½ stack 14 spindle £2:25, ½ stack model £1 75, 1 stack £2 75, 11 stack £3 25.

#### SMITHS CENTRAL HEATING CONTROLLER

HEATING CONTROLLER push-button gives 10 vertainan as follows (5) conlinuous hot waler and continuous central heating (2) continuous hot waler but central heating off at high (3) con-tinuous hot water but central heating on only for 2 perioda during the day (4) hot water and central heating on but day time anly (5) hot water and central heating only for 2 perioda during the day time only-then for summer time use with central heating off (7) hot water continuous (8) hot water and central heating off (7) hot water continuous (8) hot water and the awitches and other parts necessary to salect the desired programme of heating. Supplied complete with wiring dia-prom. Originally and we believe at over £15-we offer these, while stocks last st £7 56 each including VAT & Postage.

Terms: Prices Include Post & VAT. But orders under £6.00 please add 50p to offset packing. Bulk enquiries-Please Phone for Generous Discounts 688 1833.



Super power 2N3055. RCA52360 In our triete this does all that the 2N3055 will do but very much batter—truly a remarkable

Super power 19395. RCA52360 In our triate this does all that the 203055 will do but very much better—iruly a remerkable transietor 850. 350 Watt Transformer (0x-0-d0x normal lype construction and primary wound for 230 50% r 45 85. Mich Vollage Rectiffers. Six working at 5mA, these are an unuad equipment but have good length leads, ideal for use with the EHT (ransformer 11 joined in series, price 3D). Speaker Cabinets. Six multiple task finish, nice handy size modern blick apong etype front 13-75. In Car Speaker Cabinet. White with black edge very modern looking plastic with threaded stude for meuning apeaker complete with back, price 42-25. AC Capacitas for use on fluorescent lighting for power factor correction or as a valtage dropping device, these are very rugged end will stad DC voltages up to 3 times their RMS vollage. A big purchase enables us to offer these all about one third of the current memotacturers price, all are 300 RMS working or higher and are in aluminium cans with ings, and 780, 711 f20, 811 61 e31. 33. Mumerical Display Tubes (Nike tabee) Mullard rol. ZM 1175, this is a stdewnys viewing device where this is mounted outside or in a greenhouse, price 61 e62. Waterproof Discast Box very suitable for protecting a witch or a thermost are similar device where this is mounted outside or in a greenhouse, price 61 e62. Multiway Switches. GEC silver finished mat box with cable knockeuts each complete with witch mounting grid and matching receased cover, suitable for coduit or TRS. Single switch 50, twin switch 600, 4 switch 750, 6 switch c1, 12 switch 51 550.

L1, 12 switch at 300. Modern toggle type miniature awitches by GEC to fit above boxos, mains tating 5 amp on/off 350, 15 amp on/off 459, 5 amp 2 way 300, 2 way and off 500, intermediate (potently) changeover 500) bell pueh 359 (avsiteble in several colours). Piesse add 5% VAT to total cost of boxes and awitches. Most of the above awliches can be supplied without togeles but operated by a special key, add 10p per switch and 25p per

but operates by a spectra nor, are tracked as a spectra nor, are tracked as the spectra nor, are tracked as the spectra norm of the spectra norm o

packing £2. Boller Stal. Satchwell remote dial type with knob calibrated 20-90°C, price £2 42

Project Boxes. Nicely made in black plastic with threaded brass inserts to hold the lid which is fixed by four corner acrews. There are three sizes available 75 x 56 x 35mm, price 50p, 95 x 11 x 35mm price 70p and 115 x 93 x 36mm price **80p**. instrument Buzzers, made for the GPO ex unused equipment price 54p.

Klaxtan Type Alarm. Battery operated gives a good note with only a 1-5v battery, gets unbearable as vol increases, ideal for personal or car alarm, price 80p.

Stereo Heedphone Lead. Black curly 10th approx. temina-tions, elereo jackolug one end-minizture two in plugs the other. Price 56p

Storeo Decoder Kit uses latent techniques, size approximately  $S^{2}$  x 1" x  $\frac{1}{2}$ " complete price £3.05 or made up and lested £1.50 extra.

Steres Beacon Light II required 45p extra.

Steren Bascon Light II required 43p extra. Cassett Microphone. Dynamic 600 ohm with onjoff switch and stand for desk lop work, price £1-42. Mains Operated Pomp. Most readers will know that we stock the Jebsco pump which was made to work with partable drills, the price is £2-66, now in response to demand for a mains operated pump we have coupled this to a 100 pp motor, mounted them on a metal chassis and offer this as a general purpose pump. If is suitable for most liquids and carlinity for water. The pump is self priming and will fill the liquid up to upon the Mit. Price £11 28. Early bat Candults made from a this but year tough desult.

upon the fill. Price £11 28. FiskUbs Conduits made from a thin but very tough plastic ribbed to give extra strength but very lightweight and very featible and can be bant through a very small radius. Deas in addition to carrying most fluids, these conduits can also be used for cable tidying and projection and even make do fieldible drive for a slow speed turning operation. Two slaves available 4° and 4° internal dismeters approximately. It is interesting to note that the 4° one is a reasonably good fit an the intellouties of the above mentioned Jabsco pump. Pice 7D new mote note that an the intel/ounets of the autor. Price 27p per metre, post 11p per metre.

The styp per metry, bust hip per metre. Double Ended Motor, mains operated, capacitor run approx.  $\frac{1}{2}$  h.p., this has spindle coming out each side and should be very suitable for converting into a double anded poinsher or grinder, holes conveniently placed in the housing make if very easy to stand in the right position and the speed although not high is adequate. Limited quantity only, we are offering these with capacitor et £8-50.

# H.P. Molors. Normal base mounting, ex computers but tested, 230-2409 50hz good length spindle mostly American make, £8-59,

13 Amp Rocker Switch made by Carr Fastener Co. (Dol) again available, price \$70.

Luminous Rocker Switch, suitable for 13 amps at mains voltage, these are illuminated with neon through amber panel, aneg-in fixing into hole size  $1_1^{\prime\prime} \ge 1_2^{\prime\prime\prime}$  Special bargain 38p.

These position Rocker Switch. It amp chargeover with a centre off slandard size clip fixing pushes into hole area size approximately 1" x  $\tau_x^2$  which is standard for many rockers. Special barghia (high month, 10 tor ±1-82).

Special bargant into find, by the first sec. 34 Mircute Clockwork Trains Switch made by Smiths and as fitted to many lumble dryars, washing machines, etc. Vary useful for other limed applications, when rotated 15 double pole mein switch makes circuit and stars on for up to 1 hour depending on the amount you turn the spindle. Special ship usetu nole mai nole mai rice £1-23

Clockwork Alr or Gas Switch made by the famous Smithe Company, winding the clockwork opens the valve and leta the air or gas come through for maximum of two hours depending upon the amount the clockwork is rotated. Iniet and oullet are threaded normal gas size, price £3-78.

Connecting Wire Bargain 100 yards PVC Insulated con-necting wire 14/35 on a drum, conductors made by BICC, price necting wire



EXTRACTOR FAN Es-computers made by Woods of Colchester ideal for fixing Ihrough panel-reasonably quiel running-very powerful 2500 rom. Choice of two sizes 5 or 61 dia £5 and £6.

# READERS' P.C.B. SERVICES-THIS MONTH'S EXTRA SPECIAL OFFER

# Why D.I.Y. when you can purchase W.Y.E. Music Centre 902A complete and Guaranteed



Price: £139.50 Inclusive of V.A.T. and Post & Pack. DELIVERY EX-STOCK — For Colour illustration send S.A.E.

TOU GE	1
FEATURES	
'S' shaped cubular tone arm	simbal mounted with ,
dampened cueing device	
Padded front speakers with twin	
Automatic Frequency Control	Stereo Beacon
Headphone Socket	Auto Stop
Internal AM Aerial Twin Microphones	Auto CRO2 switching Cassette storage rack
Digital Turns Counter	Casselle stolage lack
SPECIFICATIONS	
AMPLIFIER	
Output 2 × 14 watts R.M.S. into	1 ohms
T.H.D. 0-5% typical Controls Valume, Balance, Trebi	- P
Push button selection for all funct	e oass
Sockets Headphone, FM Aeria	lions
RECORD PLAYER	
Uniz B.S.R. P182 Semi-automatic	single player
Speeds 33, 45, 78	Cartridge SCI2M
10.5 inch Bevel-edged Turntable	
SPEAKERS	seppine
Drive Unit 8" x 5"	
Bating 15 WATTS M.P.	Impedance 4 ohms
RADIO	
VHF 87-5-108MHz with A.F.C.	LW 155-280KHz
MW 520-1650kHz	AFC Switchable
CASSETTE RECORDER	
Auto CRO2 (Chrome)	
6 piano keys including pause conti	
	Digital turns counter
	ockers for microphones
CABINET	
Available in Teak, Walnut or Blac	
Full width, hinged tinted dustcove	
DIMENSIONS MUSIC COVER	SPEAKERS
(Including Duste	
Height 108mm	
Width 610mm	
Depth 460mm	
This price breaking offer will exit	
	DISAPPOINTMENT
All Units sold carry a full 12	month Guarantee.

YOU GET

READERS' PCB SERVICES LTD., Fleet House, Welbeck Street, Whitwell, Worksop, Notts. Tel. (0909) 720695 Telex 54761

# Electronics. Make a job of it....

Enrol in the BNR & E School and you'll have an entertaining and facinating hobby. Stick with it and the opportunities and the big money await you, if qualified, in every field of Electronics today. We offer the finest home study training for all subjects in radio, television, etc., especially for the CITY AND GUILDS EXAMS (Technicians' Certificates); the Grad. Brit. I.E.R. Exam; the RADIO AMATEUR'S LICENCE; P.M.G. Certificates; the R.T.E.B. Servicing Certificates; etc. Also courses in Television; Transistors; Radar; Computers; Servo-mechanisms; Mathematics and Practical Transistor Radio course with equipment. We have OVER 20 YEARS' experience in teaching radio subjects and an unbroken record of exam successes. We are the only privately run British home study College specialising in electronics subjects only. Fullest details will be gladly sent without any obligation.



# Become a Radio Amateur.

Learn how to become a radio-amateur in contact with the whole world. We give skilled preparation for the G.P.O. licence.



# RST VALVE MAIL ORDER CO. CLIMAX HOUSE, FALLSBROOK ROAD, LONDON SW16 GED

SPECIAL EXPRESS MAIL ORDER SERVICE

BrG skirled e 35 BrG skirled e 35 BrJ skirled e 36 BrJ skirled e 39 BrJ Sk	BASES CRT'S B7G unekhited 0 13 1CP31 31-1	INTEGRATED         CIRCU           7400         330         7412         450         7432           7401         330         7412         450         7433           7402         330         7413         450         7433           7403         330         7417         450         7433           7404         330         7417         450         7433           7405         330         7410         460         7433           7405         315         7423         333         7440           7405         315         7423         333         7442           7405         315         7423         333         7447           7480         315         7422         333         7447           7480         315         7422         333         7447           7480         316         7427         333         7447           7480         316         7433         323         7453           7400         316         7433         320         7453           7400         316         7433         320         7453	VALVES         EH90           AZ11         11*         ECCB31         0.55*           CBL33         1.64         ECCB41         0.65*           CBL33         1.64*         ECCB41         0.65*           CV33         1.64*         ECCB41         0.65*           CV33         1.64*         ECCB41         0.65*           CV33         1.64*         ECCB41         0.5*           CV31         1.64*         ECCB41         0.5*           DAF66         1.64*         ECCB41         65*           DAF66         1.60*         ECCB21         7.0*           DF66         1.60*         ECF821         7.0*           DF67         1.64*         ECH31         2.0*           DK92         1.5*         ECH43         1.5*           DK94         1.5*         ECH43         1.5*           DL94         1.5*         ECLB3         1.50*         EM96           DL94         1.5*         ECLB07         9.6*         EY84           EA4C01         9.5*         ECLB07         6.0*         EY84           EA450         1.5*         ECA14         1.5*         EZ01           EA	SEMICONDUCTORS
36         35P1*         10:06           35CP1A         6:60           90         5CP1A         6:60           91         5FP15A         6:60           90         5G71A         6:60           90         5G71A         6:60           90         5G7-5         25:80           90         DG7-5         25:80           90         DG7-5         15:80           90         DG7-5         15:80           90         DG7-51:31:80         90           90         DH7-11:31:43         90           90         VCR138*         10:90           90         VCR138*         10:90		7470         435           936         7472         36           937         7473         36           937         7473         36           937         7473         36           937         7475         58           937         7475         58           937         7475         58           937         7476         642           937         7476         642           937         7480         642           938         7480         66           937         7482         645	1 50° 0024 73° 1 25° 024 13° 1 35° 024 13° 1 35° 024 13° 1 35° 0264 13° 1 35° 0264 13° 1 36° 0265 14° 1 35° 06° 0265 14° 1 35° 06° 05° 05° 1 35° 06° 05° 1 35° 05° 1 35° 06° 05° 1 35° 06° 05° 1 35° 06° 05° 1 35° 05°	167         0.13*         B0123         1.48           170         0.14*         B0131         0.51           171         0.14*         B0133         0.51           171         0.14*         B0133         0.51           173         0.15*         B0133         0.51           173         0.15*         B0133         0.35*           173         0.15*         B0133         0.37*           176         0.23         B0133         0.37*           176         0.23         B0133         0.37*           177         0.13*         B0137         0.37*           177         0.12*         B0144         B0143         0.37*           183         0.15*         B0143         0.47*         B0144         2.42*           184*         B0147         B0140         0.42*         1.44*         B0127         1.44*           122         0.41*         B0120         0.75*         1.44*         B0120         7.5*           180         0.17*         B0237         0.45*         B0200         7.5*         1.44*           100         0.15*         B0140         0.5*         1.45*         1.45*
VCR517C* <b>FIE</b> Tubb Basse <b>1 75</b> - Surplus VAT 3%	VCR138A* 12:56 VCR138A* 12:56 VCR517A* 10:66 VCR5178* 10:66	7401 A.N         0         5         74110         2         00           7482         61         74120         1         1         1           7482         61         74120         1         1         1           7484         61         7422         64         7432         64           7484         67         7422         64         7432         64           7485         68         74122         64         7432         64           7486         67         74123         64         7432         64           7490         17         74128         64         74432         64           74100         17         74128         64         74432         64           74100         17         74128         64         64         64           74100         13         74128         64         64         64         64           74100         14         74432         64         64         64         64         64         64         64         64         64         7414         74         74         74         74         74         74         74         7	PL341         6 67         UCC235 0 55*           PL504/5007         UCF80         -73*           PL504/5007         UCF80         -73*           PL504         1 67*         UCH81 5 63*           PL504         1 69*         UCH81 5 63*           PL507         3 64*         UCH81 5 63*           PL801         1 8**         UCH81 5 63*           PL801         1 8**         UCH81 5 63*           PL801         1 8**         UCH31 5 63*           PY83         63**         UF80 5 8**           PY83         618*         UF80 5 8**           PY83         1 8**         US1 1 8**           PY83         1 8**         US1 1 8**           PY83         1 8**         US1 8**           PY800/61         1 8**         1 8**           PY800/61         1 14*         0 4**           QU70-8 3**         1 55*         40*           QU70-8 4*         1 55*         40*           QU70-	BF184         0.12"         BZX61         0.20           BF195         0.12"         Scries         Scries           BF195         0.12"         Scries         Scries           BF205         0.12"         Scries         Scries           BF224         28"         CRS140         -8"           BF224         28"         CRS160         -4"           BF224         28"         CRS160         -5"           BF224         28"         CRS1705         -6"           BF224         43"         CRS1705         -6"           BF235         -4"         GSX61         -7"           BF336         18"         GSX61         -7"           BF337         54"         GSX61         -7"           BF338         18"         GSX61         -7"           BF337         54"         GSX61         -7"           BF338         14"         SGX74         -7"           BF338         28"         MJE370         6"           BF338         28"         MJE371         6"           BF458         23"         MPF102         -3"           BFX64         53"         MJE371
FROM SUITABLE FOR £8.00 each. Base VA	3 BP1 TUBE	74147         2:45         74178         1:16           74180         1:65         1:4178         1:85           74196         1:76         74170         1:85           74191         1:66         74180         1:85           74191         1:66         74180         1:85           74194         2:66         74190         1:46           74195         1:66         74190         1:46           74195         1:60         74190         1:46           74135         1:60         74193         1:25           74150         2:80         74194         1:35           74150         2:80         74194         1:35           74150         2:80         74195         1:50           74150         2:80         74195         1:51           74170         2:80         74195         1:51           74170         2:80         74195         1:51           74170         2:80         74195         1:51           74170         3:80         74195         1:51	BAC7         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••••         ••         •••         •••	OA70         14         OCB2         75           OA70         34         OCB3         15           OA81         34         OCC4         54           OA85         34         OC124         150           OA85         34         OC123         155           OA81         64         67         160           OA90         64         67         123         155           OA81         64         OC139         23         06           OA90         64         OC140         123         155           OA20         14         OC139         23         06           OA220         11         OC140         123         155           OA210         715         OC200         145         0250         140           OA2200         455         OC201         140         042         154           OA2201         715         OC202         156         OC201         150           OC10         125         OC205         135         0506         135           OC22         256         OC207         135         0506         135           OC23         156
STOCK P.W. PROJECT 575p. Postage 75p T 8% Telephone 01-4 Telephone 01-4		74199 2 25 TBA5500 76013N 1.75* TBA560C0 3.22* TAA510 2.0* TBA673 2 18* TAA510 2 30* TBA673 2 18* TBA6505 18* TBA7500 1 18* TBA7500 2 30* TBA7500 2 30* TBA500 2 0* TBA500 2 0* TBA500 2 0* TBA500 2 0* TBA500 2 0* TCA2700 2 18*	6L6GC         1-95*         12AUg         5.35*           6L7         9.75         12AU7+***         9.95*           6H2P         75         12AU7+***         9.95*           6H2P         75         12AV7         9.95*           6H2P         78         12AV7         9.95*           6H2P         78         12AV7         9.95*           6P29         3.6**         12AV7         9.95*           6P29         3.6**         12AV7         12*           6P27         12**         12BA7         12**         12B           6SC7         12**         12BH37         5**         12AV7         12**           6SS7         12**         12BH37         5**         12AV7         5**           6SS7         12**         12BH37         5**         125*         5**           6SL7GTf         30FL12         12*         17*         5**         15*           6SS7         7**         30L15         14*         5*         5**           6SS7         7**         30L12         17*         5**           6U37         4**         30PL12         12*         5**           6U37	Z 5371 • 22* 2N867 • 14 Z 5378 • 56* 2N868 • 39 Z T X107 • 11* 2N705 • 69 Z T X107 • 11* 2N705 • 69 Z T X107 • 11* 2N706 • 12 Z T X109 • 12* 2N706 • 12 Z T X109 • 12* 2N706 • 21 Z T X109 • 12* 2N108 • 21 Z T X109 • 13* 2N109 • 37 Z T X11 • 13* 2N104 • 45 Z T X11 • 14* 2N107 • 59 Z T X591 • 14* 2N107 • 59 Z T X591 • 14* 2N107 • 59 Z T X591 • 14* 2N107 • 59 Z T X593 • 17* 2N108 • 54 Z T X591 • 14* 2N107 • 59 Z T X593 • 17* 2N108 • 54 Z T X591 • 14* 2N107 • 59 Z T X593 • 17* 2N108 • 54 Z T X593 • 17* 2N108 • 54 Z T X593 • 17* 2N108 • 54 Z T X593 • 17* 2N108 • 59 Z T X593 • 18* 2N108 • 59 Z T X593 • 18* 2N107 • 13 Z T X593 • 18* 2N107 • 13 Z T X593 • 18* 2N107 • 13 Z T X593 • 18* 2N108 • 59 Z T X593 • 18* 2N229 • 18 I N4007 • 15 2N229 • 11 N4007 • 15 2N229 • 11 N4008 • 11 2N222 • 11 N4007 • 15 2N239 • 12 Z N404 • 52 2N209 • 31 Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z
i77 2424		DIL Sockets	22.AV 19622 195 190C2 213 190C4 213 2077 199 213 213 214 214 215 215 215 215 216 217 216 217 218 219 219 219 219 219 219 219 219	2N3055 • 85 EN3140 • • • • • • • • • • • • • • • • • • •

ł	7408 7409 7410	22p 74104 22p 74105 16p 74107	75p 74197 75p,74198 36p 74199	130p 4071 250p 4072 250p 4073	250 BC178 30p BC179 30p BC182	17p BF198 16p BF199 10p*/BF200	15p* TIP30B 20p* TIP30C 32p* TIP31A	48p 2N2904 50p 2N2904 A 58p 2N2904 A	25 p 2N554 28 p 3N128 25 p 3N140	123p	MC1458	150p*a 50p	326AJ Voltage	25p	π	Zener 20 f	lor£1
	7411 7412 7412 Al	25p:74109 25p:74110 25p:74111	60p,74221 68p,74H00 75p-74H05	175p 4076 85p 4081 45p 4082	170p BC183 20p BC184	10p* 8F224 11p* 8F240 30p 8F241	20p* TIP318 13p* TIP31C 18p* TIP32	58p 2N2905A 60p 2N2906	250 3N141 20p 3N201	85p	1101100	420p 95p 95p	Regulate 7805 5v+	95p	Books		
I	7413	40p 74116 40p 74118	220p 74H10 110p 74H11	4093	94p BC212	11p* BF244B 11p* BF257	35p TIP32A 35p TIP32A	66p 2N2905A 68p 2N2907 70p 2N2907A	280 40347	65p	MC3360	120p* 120p*	7812 12+ 7815 15+ 7818 18+	15p	IC 555 Pr 50 CMOS	5 IC Projects	145p 95p
1	7417 7420 7421	40p;74119 18p(74)20 43p(74)21	2250 74H20 130p 74S10 32p	40p 4160	\$45p SC213 105p SC213L	11p* 8F258 12p* 8F259 13p* 8F324	380 TIP32C	32p 2N2925 99p 2N3053	9p 40360 28p 40361	40p 45p	MFC4000B	120 p* 120 p* 95 p*	7824 24 + 7905 54-	95p	50 Project	ts IC 741 ts CA3130	75p 15p
I	7422 7423	25p.74122 38p 74123	54p 75p c H o c	4162	1950 BC2141. BC237	13p* BF337 16p* BFR39	36p TIP33B	90p 2N3055 90p 2N3702 110p 2N3703	55p 40362 12p* 40407 12p* 40406	45p	MHQ3475	90p* 85p*	7912 12- 7915 15-	120p	Linear IC	C Equivalents Equivatents	250p 275p
I	7425 7426 7427	33p 74125 43p 74126 40p 74128	85p 4000	18p 4174	1109 BC237B	16p* 8FR40 18p* 8FR41 16p* 8FR52	300 TIP34	95p 2N3704 110p,2N3705	12p 40409 12p 40410	850	MK50362 MK50398 NE555	650p* 758p* 30p	7924 24-			e LÉD Circuits k of Transistor	75p 56p
I	7428 7430	48 p 74130 13 p 74132	4005	95p 4194 18p 4408 120p 4409	TIOP BC238A	16p* 8FR79 16p* 8FR80	200 TIP34B 300* TIP34C 300* TIP35A 300* TIP35A	110p(2N3706 155p(2N3707 220p, 2N3708	14p* 40411 140* 40412 14p* 40430	340p 60p	NE556 NE560	65p 320p	Bridge Rectifier	16	Second E	Book of Transisto	
ł	7432 7433 7437	38p 74135 44p 74136 38p 74137	\$0p 4009	50p 4410 60p 4410	715p 8C328 280p BC337	28p* 8FR81 18p* 8FX29 18p* 8FX30	30p TIP36A	260p 2N3709 260p 2N381p	140° 40584 25p° 40595	90 p 99 p	NE561 NE561B NE562B	420p	100v 1A	20 p) 22 p) 23 p)	DII	Electrolytic	
I	7438 7440 7441	38p.74145 38p.74142 90p.74145	300p 4013	50p 4435	550p BC338 1250p BC516 800p BC517	14p* BFX84 54p* BFX85 50p* 8FX85	30p TIP41A	330 p 2N3820 65 c 2N3823 10 p 2N3866	50p 40603 70p 40673 85p 40841	58 p 99 p	NE565 NE5654 NE566	125p	400v 1A 50v 2A 100v 2A	30 p 46 p		tp 63 Volt	
	7441AN	120p'74148	1600	110p 4450 95p 4451 50p 4501	290p BC547 290p BC547A	16p*/BFX87 16p*/8FX88	300 TIP41C 300 TIP42A	780-2N3903 70p 2N3904 12p 2N3905	160 40842 160 140871	110 p 90 p	NE567 NXD153321	1790	200v 2A	52p	18 nin 2	2P 1-50F, 2 2, 4P 6 8, 8, 10, 5P 33, 470F, 12	3 3 4 7 15, 22 0° each.
I	7444	75p'74150 120p 74151 120p 74153		100p 4502	95p BC547B 520p BC548 85p BC549	16p* 8FY50 16p* 8FY51 16p* BFY52	221- TIP42C 221- TIP2905	82p 2N3906 78pi2N4036	20p*	anb	(133P101) SFC2741 SFC5325KI	M 40p	40v 15A		22 pin 3	4p 25 volt 1000 4p 40 volt 220	uF 27p*
н	7445 7446 7447	97p 74154 110p 74155 75p 74156	870 "***	50p 4503 120p 4506 115p 4508	550 BC550 550 BC556 2950 BC557	14p* BFY90 15p* BRY39 14p* BSX19	90p TIP3055 45p TIS43 20p T/S90	70p 2N4037 34p* 2N4058 22p* 2N4058	55p* 12p* Linear 12p* CA301		SN72702 SN72709 A	68p*	Triacs 2A 100v 2A 200v	32p	28 pin 4	2p 16 volt 220	
L	744B 7450	85p 74157 18p 74159	250rd 4022	22p 4510	BC557A BC557B	14p* 85X20 16p* 8U105	20p 1591	25 p* 2N4060 39 p* 2N4061	120* CA301	4 \$45p* 8 70p*	SN76008N	175p* 175p*	2A 400v &A 100v	50p†	LED= TIL209	13p 207 - 10pF	
н	7451 7453 7454	18p 74160 18p 74161 18p 74162	110p 4024 110p 4025 100p 4026	20p 140p Trans	istors BC559	16p* 8U204 18n* 8U205	256p* ZTX108 230p* ZTX300 220p* ZTX500	12p* 2N4062 13p**2N4123 15p* 2N4124	18 p* CA302 22 p* CA302 22 p* CA302	3 170°	SN76013N SN76023N SN76033N	140.5*	6A 200v 6A 400v		TIL211 TIL212	20p 12nF - 47n 25p 100 Volts	1F 6p
C	7460 7470 7472	18p.74163 38p.74164 32p.74165	120014028	65p AC101 95p AC121 120p AC125	20p 8C559C	180 BU208 18p BU406	240p 21 × 502	180*2N4125	220 TO A 364	5 70m*	SN76110	150p* 159p*	10A 200v 10A 400v	99p	TIL216 TIL220 TIL222	18p 16p Resistors 18p -25	1 Sp
L	7473	36p(74166 38p(74167	320 p 4030	50p AD14 250p AD16	70 P BCY59	22p C1509 22p MEO491 22p MJE2955	15p 2N696 16p 2N705 100p 2N705A	20n 2N4239	22p* CA304 100p* CA307 150p* CA308 140p* CA308	0E 74p	SN76560 TAA550		Thyristo	rs.	TIL228 CNps	240 5W 30 1W	2p 5p
Ł	7475 7476 7480	43p 74170 38p 74172 54p 74173	650 p 4035	240p AD152 130p BC107	45p BCY72 16p BCY78 A 12p B0121	22p MJ2955 20p MJE340 95p MJE3055	100 p 2N708 A 65 p* 2N918 70 p 2N930	20p 2N4240	150p* CA300 18p* CA300	220 p*	TAA661A	155p	1A 50v 1A 200v 3A 50v		Diodes BAX13	50: OA200	9,0
L	7481	100174174 900174175	110pi4042 05pi4043	80p BC107 100p BC108	8 12p BD131 12p BD132	50 p MP 5 2389	20p 2N1131 30p 2N1132 30p 2N1132	20 p 2N4287 20 p 2N4288	18p CA313 16p CA314	0 98p. 0 96p	TAD100 TBA120S	150p* 70p*	3A 400v 5A 100v	70p 52p	0A47 0A70	6p 0A202 6p (N914	1p 4p
L	7484	100p 74176 110p 74177 120p 74180		140p BC108	A 12p BD133 B 12p BD135 IC 12p BD136	38p MPSA12	30p**2N1613 45p**2N1711 32p* 2N1893	25p 2N4289 25p 2N4290 35p 2N4291	20p* CA316 20p* LM391, 20p* LM318	AN 30p.		338p*	5A 800v 7A 400v 10A 200v	750	OA81 OA85 OA90	13p IN916 15p IN4001/2 5p IN4003/4	
н	7486	36p 74181 3400 74182	3200 4049 1500 4050	50p BC109	0 10p 80137 8 12p 80139	36 p MPSU08	63p* 2N2218 75p* 2N2218A	28 p 2N4292	24p* LM324 68p* LM329	70p		2400*	16A 400- 30A 200-	99p	OA91	9p IN4005/6 9p IN4148/9	6/7 Up



# **BURGLAR ALARMS**

WE HAVE STOCKS OF EVERYTHING YOU NEED. CALLERS WELCOME. OPEN 6 DAYS EXPRESS POSTAL SERVICE FREE CATALOGUE SEND S.A.E. Maxi guard MK4 Ultra Sonic Detector 12 volts D.C. special price £37-00 + VAT

Control Unit 1006B £19 50 plus £1 20 p&p

	-00
STAIR SIZE 6" × 24" I 20 DOOR LOOPS COMPLETE 5	RS 2. ETE 5



A. D. E. (SECURITY) CO., 217 WARBRECK MOOR AINTREE, LIVERPOOL TEL: 051-525-3440 STOP PRESS 1 Trade Price List Available

Applications on Official Stationery only

STEPHENS-JAMES LIMITED COMMUNICATION ENGINEERS 47 WARRINGTON ROAD, LEIGH WN7 3EA ENGLAND Telephone (0942) 676790

Everything for the Short Wave Listener,

We stock receivers and listening aids by most of the worlds eading manufacturers.

Y4980 FRG7-FRG7000-FR101

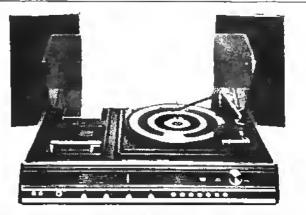
SSR-1 \* SPR4 \* R4C \*

Secondhand Equipment Our secondhand equipment stock changes delly. Send S.A.E. for latest price list. Part exchanges welcome. Access-Barcleycard and H.P. facilities. TRFO R-300 - R599D - R8205

Antenna Multituners Designed and manufactured by ourselves. Over 1000 sold in over 50 countries. Antenna State State State Mk1 covers 2-30Mhz £23:50 Prices include VAT and postage. Send SAE tor Test report,

#### P.W. WIMBORNE REED HAMPTON

is now offering a complete service for this exciting project. Total cost for standard options approximately £110. Comparable price £180.



- No. 1 Hardware Kit. Consists of all accessories to give a professional finish to your project. Precision punched aluminium front and rear extrusions. Vacuum formed top moulding, set of sockets and mounting panel. Tuning drive system and a complete set of knobs and push buttons. Special Price £9-95, in a complete kit £15-95.
- No. 2 Amplifier Module. We are able to supply the PCB, Pots, Rectifiers and I.C.'s or a tully wired amp, pre amp and power supply (11 watts per channel) for £19-95.
- No. 3 We will be supplying the R.F. Section PCB or we can offer a suitable High Performance R.F. board, wired and tested, 1 5 uV sensitivity for 26 dB S/N FM/MPX + MW/LW. Price £21-95
- No. 4 Stereo Cassette Recorder Module. Fully wired and tested with ALC Piano Key mechanism, tape counter, low noise devices throughout, requires 9-12 Vdc, has its own motor regulator circuit. Terrific Value at £24-95.
- No. 5 Limited number of B.S.R. Single Play decks type P172 with A.D.C. MAGNETIC CARTRIDGE only £13-95.
- No. 6 A.D.C. Cartridges at £3 95 + p&p 30p.
- No. 7 Magnetic Pre-amps with R.I.A.A. Equalisation £2-95 + p&p 30p.
- ALL PRICES ARE INCLUSIVE OF V.A.T. No. 8 Teak Cabinet · baseboard £9.95.
  - Please add £1 for p&p items No. 1-5 and 8



# **GIVE AWAY PRICES**

#### MANUFACTURERS SURPLUS EQUIPMENT

STEREO POWER AMPLIFIER

25 Watts RMS per channel

#### £7.50

- Class AB Operation
- 16 Transistor Circuit
- Unstabilised supply required Tip 34A + Tip 33A Output Supply Voltage 50V DC
- \* nominal
- 30 Hz-18KHz @ --1dB
- Output 8 ohm
- Input 50 Kohm \*

This power smplifter which features an advanced us yield design with complementary pair of transistors in class AB push pull. Will comfortably deliver 25 watts per channet, And comes complete with heat sink.

#### Hi-Fi Preamplifier

The PR 020 is a low noise preamplifier with full bass and treble cut and boost. It has four rotary controls and four specially selected transistors. It is designed to match most high quality power amplifiers.

£5-99



# RF BOARD AM/FM/MULTIPLEX

Tel: (01) 647 0851

3 × ICs 3089E MC 1310 3123 3 ceramic filters, meter drive

FET FRONT 3 stage FM tuning

2 Stage AM/MW - LW

LOW PASS AUDIO FILTER -BUILT IN STABILISER

Complete with 4 way switch & ferrite rod assembly £9-99

# SPECIAL OFFER

COMPLETE STEREO AMPLIFIER AND. STEREO PRE-AMPLIFIER FULLY WIRED AND TESTED 8 WATTS PER CHANNEL RMS.

(Just require Tone Controls, Slider or Rotary available)

Incredible Price £6-95 £8.25 with Pots

Also power supplies transformers available

CASH WITH ORDER SEND S.A.E. FOR DETAILS

ELECTRONIC SURPLUS EQUIPMENT **1 RAILWAY HOUSE, HARDHAM CROSSING, PULBOROUGH, SUSSEX.** 

£1.00 Postage and packing. Order in excess of £20.00 total packing free.

74001 7403 7403 7405 7405 7405 7406 7406 7406 7406 7400 7410 7410 7411 7412 7411 7412 7411 7412 7425 7425 7425 7425 7425 7425 7425 742	344404479484549494949494949494949494949494949494	EXAS 7497 180p 74100 180 74100 180 74100 85p 74107 345p 74105 559 74107 345p 74108 559 74111 559 74118 200p 74112 128 74122 128 74123 55p 74124 130 74124 130 74124 130 74124 130 74124 130 74124 130 74124 130 74124 130 74125 190 74135 190 74153 190 74153 190 74155 190 74155 190 74155 190 74155 190 74156 190 74157 190 74156 190 74156 190 74156 190 74156 190 74156 190 74156 190 74157 190 74156 190 74156 190 74156 190 74156 190 74157 190 74156 190 74157 190 74157 190 74157 190 74157 190 74157 190 74158 190 74	14228           174259           174259           174259           174278           174278           174278           174278           174278           174278           174278           174278           174283           174284           174284           174285           174284           174284           174285           174284           174286           174286           174386           174386           174386           174386           174386           174580           1741580           1741580           1741580           1741583           1741583           1741583           1741583           1741583           1741583           1741583           1741583           1741583           1741583           1741580           174158107           1745812	100         74LS123           1400         74LS23           1400         74LS23           1500         81LS98           1500         81LS98           1500         81LS98           1500         81LS98           1500         8129           1500         8129           1500         8001           150	1400 74C 1200 74C 1201 74C 1202 74C 2450 74C 2450 74C 2450 74C 2450 74C 2450 74C 2450 74C 2450 74C 2450 74C 2450 74C 1200 440 1200 44C 1200 4	160 155a 161 155a 162 155b 162 155b 162 155b 164 157 164 157 165 150 164 120 165 165 165 165 165 165 165 165 175 20 175	*A Y1-0212 600 a *A Y1-0313 646 p *A Y1-1313 646 p *A Y1-1313 646 p *A Y1-1313 646 p *A Y1-1313 646 p *A Y5-1313 646 p *C A 5019 60 c CA 3046 19 p *C A 304	0-220	TRANSIBTORS           AC127/5         20           BFY51/2         22           AD143         70           BFY56         339           AD161/2         59           BC167/2         59           BC167/2         59           BC167/2         59           BC167/2         59           BC167/2         59           BC167/2         59           BC167/3         50           BC167/3         50           BC167/3         50           BC167/3         50           BC167/3         19           BC167/3         19           BC177         140           BC177         19           BC177         19           BC177         19           BC177         19           BC137         30           BC133         MJ3001           BC477         30           BC477         30           BC477         30           BC477         30           BC477         30           BC477         50           BC477         50           BC477	TiP42C         820         *2N3903/6 20p         *OA47         9p           TiP2855         786         *2N4986         65p         *OA81         15p           TiP2855         70p         *2N4056/12p         *OA85         15p           *TIS43         349         *2N4056/12p         *OA85         15p           *TIS43         349         *2N4056/12p         *OA85         15p           *TIS43         349         *2N4056/21p         *OA90         12p           *TIS43         12p         *2N4123/42p         *OA92         *OA93         9p           *ZTX500         15p         *2N4289         20p         *OA202         10p         *CA200         9p           *ZTX502         15p         *2N4289         20p         *IN414         4p           *ZTX502         15p         *2N4672         9p         *IN414         4p           2N667         35p         *2N6087         71p         IN4001/2         5p           2N667         25p         *2N5087         71p         IN4003/4         5p           2N667         25p         *2N5179         71p         IN4003/7         15p           2N706A         25p         *2
			74LS123 74LS132 1 74LS133						BFX85/7 30p TIP35C 296p BFX38 30p TIP35A 276p BFW10 90p TIP38A 276p BFW10 90p TIP38C 340p BFY50 22p TIP41A 61p	2N3773 300g 40563 58g 6A 100V 109p *2N3819 25g 40573 80g 5A 400V 120p *2N3820 50p 40841 80p 10A 400V 208p
7475 7475 7480 7481 7482 7483 7484 7485 7485 7485	33500000000000000000000000000000000000	74178 160 p 74180 33p 74181 2008 74181 2009 74183 500 74184 150 74184 150 74184 150 74184 150 74190 100p 74191 100p 74193 100p 74195 55 74196 55 74196 55 74196 55 74196 150	24LS139 74LS151 1 74LS153 74LS153 74LS159 1 74LS169 1 74LS160 1 74LS166 1 74LS166 1 74LS164 1 74LS104 1 74LS173 1 74LS173 1 74LS175 1 74LS181 2	00p         74C10           00p         74C10           00p         74C11           60p         74C11           61p         74C12           74C12         74C20           74C12         74C30           74C32         74C32           74C32         74C32           74C32         74C32           74C32         74C32           74C35         74C36           10p         74C86           10p         74C86           10p         74C93           20p         74C107           700p         74C151	27p 4042 27p 4042 27p 4043 27p 4048 27p 4048 27p 4048 27p 4048 27p 4048 110n 4049 250p 4055 200p 4053 45p 4055 55p 4055 530c 4059 125p 4056 250c 4059	409 409 909 1209 1209 1209 1209 1209 409 409 1009	15V 78:5 960 16V 78:6 900 24Y 7824 900 24Y 7824 900 1907 78 TO-92 5V 78:12 350 19V 78:12 350 19V 78:12 350 19V 78:12 350 15V 78:12 350 15V 78:12 370 15V 70-ELECTR 20:5777 450 OFF	15V 7916 1200 18V 7918 1200 24V 7924 1200 100mA TO.92 5V 79100 800 12V 70112 800 13V 70112 800 13V 70112 800 13V 70112 800 13V 70112 800 78HO5KC 8750 78HO5KC 8750 78HO5KC 8750	VAT RATES. All wi Please add 25p p&p and VAT at appropriate rates. Govt., Colleges, etc. orders accepted. Callers welcome	items at 8% EXCEPT marked * hich are at 12;% TECHNOMATIC LTD 54 SANDHURST ROAD LONDON NW9 Tel: 01-204 4333 Telex; 922800



#### PROGRESSIVE RADIO

21 CHEAPSIDE, LIVERPOOL L2 2D Y. Tel: 051-234-0912 SEMICONDUCTORS ALL FULL SPEC. TGA800 I.C.'s 10 for 65-05. LM380 80p. LM381 tip, NESS 30p. 741 8 PH 72p. 7415 (wide bandwidth) 8 pin 35p. TL305 Alpha numerical display (with data) £2.50p. 8X504 opto isotators infra red (ad to photo call, 4 lead 25p. EFYSD jastic 14p. 723 28 RESS LC.'s 14 pin 35p. BO333 33p. MR50357 iphoto transistors 35p. FETS atmilar to 2008 RESS LC.'s 14 pin 35p. BO333 33p. MR50357 iphoto transistors 35p. FETS atmilar to 2008 RESS LC.'s 14 pin 35p. BO333 33p. MR50357 iphoto transistors 35p. FETS atmilar to 2008 RESS LC.'s 14 pin 35p. BO333 33p. MR50357 iphoto transistors 35p. FETS atmilar to 2008 RESS LC.'s 14 pin 35p. BO333 33p. MR50357 iphoto transistors 35p. FETS atmilar to 2008 RESS LC.'s 159. Special Offer SGS & speed regulated case ten motor ex equip as new 85p. New 8 track 129 cartridge motor 41: 25p. DIODES. BY127 5g. 1M6024 5g. IN005 Tp. 5007 35m. Pot cors unit, has six pot cores including one FX2243 (45mm) and two FX2242 (35mm) 3 TOS sil. power transistors on heat sink 3-200m, mosani tuaeholders and panel with various transistors, diodes and a 5 amp plastic SCR, £1:75p plus 75p postage. MI-SPEED MORRE KEY, ALL METAL 22:25p. PLASTIC VERSION 85p. PLESSEY WINNLER SWITCHES, 1 Pole, 20 way, 28 ank Ad), 50p. 75p. Crystal microphone inserts 37mm 45p. Grundig electret condenser Inserts with built in FET presmp 61:50p. LECTRET PENCIL HAND MICROPHONES 1K INP WITH STAN-DARD JACK PLUG 22:15p. TE CLIP CONDENSER MIKES OMNI, 1K IMP, (uses deat sid battory, supplied) 64:45p. 31 CHEAPSIDE, LIVERPOOL L2 2D Y. Tel: 051-236-0912

Id battery, supplied) E4 159. **SOLDER BUCKER**, high suction, sys protection shield E4 35p. **PROJECT BOXES**, BLACK ABS FLASTIC WITH BRASS INSERTS AND LID, 76 × 56 × 35 449, 95 × 71 × 35 32p, 115 × 95 × 36 59p. **BUZZERS**, GPO open hype 3-54 37p, Large plastic domed type loud note 6 or 12 volts 50p, Solid State buzzers, miniature, 5-9-12-24 volt 15me 75p each. **TAPE HEADS**, Mono Cassotte 51 30p, Stereo cassotte 53 00, BSR MNI330 hsif brack dual imped, heads 45 75p, TDIO Dual head easemblies 2 heads both 1 brack RIP with built in erse, mounted on bracket, 51 30p, SRFGU 1 track RIP 81 45p. New Type Fadded MI2 Phones 82 \* 85 pair relays. Min 24 vd c 2 pole c/o 3 mp contacts 55p, Min sealed 220V AC 2 pole c/o 40p, Open type 12v dc 4 pole c/o 50p, 4 pole reed relays N/O 20p.

Nin sealed 220V AC 2 poie c/o 40p, Open type 12V do 4 pole c/o 50p, 4 pole read relays N/O 20p. CRYSTALS, 300khz 40p, 50V AC cam units, motor switching ten c/o micro switches, supplied with capacitor for 240V AC use £1 85p plus 35p postage. MAINS TRANSECRMERS, all 246V AC primery, postage shown in brackets per transformer. e-0-0 100ms, 0-0-9 73ms, 12-0-12 50ms 75g esch (15p), 0-4-6-9 150ms on mount-ing bracket, 85p (220), 12-0-12 100m 35p (15p), 12V 50ms 85p (22b), 12V 2 cmp £2, 25 (45p), 12V 4 smp £2, 75 (45p), 13-0-15V 1 smp £2 10 (45p), 30-0-30V 1 smp £2 75 (54p), 212-15-20-24-30V lapped at 2 smp £4-86 (46p), 200-20V 2 smp £3 16 (54p), 23V 1-5 shop £4 45 (45p), 12V 4 smp £2, 75 (54p), 13-0-15V 1 smp £2 10 (45p), 30-0-30V 1 smp £2 75 (54p), 20V 2 5 smp, 22 20 (54p), Murate MAOIL 40KM2 receired transducars £3 25 pair. Lefge mains solenoid 251b puil 2' travel. U.M.F. TV Tuners, puid built on for varicap) new and boxed £2-56p, Ministure tograe

Large mains soleroid 2515 puil 2" trevel. U.H.F. TV Tuners, puer builton (not verice) new and boxed £2-56p, Ministure topgis witches, SPST 8 × 5 × 7 45p, DPT 8 × 7 × 7 56p, DPDT c/o 12 × 11 × 9 75p, Min. push to make or push to break 16 × 16mm 15p each type. Silders witches, DPDT elandard 15p, Min 15p, Sid, c/o 20p, Roller action micro awliches 15p. TOOLS Small side cutters 6" insulated handles £1.35p, Snub nosed pliers 5" insulated fandles £1.35p. Washington action micro awliches 15p. TOOLS Small side cutters 6" insulated handles £1.35p, Snub nosed pliers 5" insulated croc citips each end, different colours 45p. Teleschons pick up coll, suction type with insulated croc citips 26p, 6 voit battery eliminators, 240v ac input 6v do out at 120mA stabilized re-pleced PTS, PPG, PPT, PP 8 £4.45p, Edge connectore, 0.1 64 way 55p, 34 way 40p, 0.2 18 way 15p, dia 1 amp rubber trailsr extension sockets 33p. LA1230 adl, core 15mm, Hird bath forbe £2.60, curved probe (creasette) £2.35p.

TERMS: cash with order, (or official orders from colleges etc). Postage 30p unless other-wise shown, oversees post at cost. VAT inclusive prices. S.A.E. for figte. Progressive Redio, 31 Chespelde, Liverpool 12 2DY, Tel: 051 234 0892.

# 15-240 Watts!

# HY5 Preamplifier

HY30

15 Watts

HY50

25 Watts

HY120

HY200

HY400

240 Watts

into  $4\Omega$ 

120 Watts into 8Ω

60 Watts into 80

into 8Ω

into BΩ

The HYS is a mono hybrid amplifier [deality suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The dealined function is achieved either by a multi-way switch or direct connection to the appropriate pitch. The internal volume and long circuits merely require connecting to asternal potentiomaters (not included). The HYS is compatible with all 1.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-simplifier. To ease construction and mounting a P.C. connector is supplied with each pre-simplifier. To ease construction and mounting a P.C. connector is pre-simplifier in single pack-Multi-function equalization—Low noise —Low distortion—High overload—Two simply combined for steres. ADD (ICARC) State III and State Discome Conce\_Public address

APPLICATIONS : HI-FI-Mixets-Disco-Guiter and Organ-Public address

APPLICATIONS: MITTER MIXED == Under State Council Council (Council Council Cou

Price £6 27 + 78p VAT P&P Iree.

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I C. with short circuit and thermal projection. The kit consists of I.C., heatsink, P.C. beard, 4 resistors, 8 copacitors, mounting kit, together with easy to follow construction and obstrating instructions. This amplifier is ideally suited to the beginner in sudio who wishes to use the most up-to-date technology anallable. achoology available

FEATURES: Complete Kit-Low Dislortion-Short, Open and Thermal Protection-Easy to APPLICATIONS: Updaling audio equipment—Guilar practice amplifier—Test amplifier—

audio oscillato autoro oscination. SPECIFICATIONS: OUTPUT POWER ISW R.M.S. Into BD: DISTORTION 6 1% at 1-5W. INPUT SENSITIVITY SCONV. FREQUENCY RESPONSE TOM2-184M2—3dB. SUPPLY VOLTAGE± 13V. Prize 56 37 + 73 PVAT PAP free.

The HY50 leads I.L.P.'s total Integration approach to power emplifier design. The amplifier features an integral heatslick together with the simplicity of no external components. During the past intree years the amplifier has been refined to the extent that it must be one of it most reliable and robust High Fidelity modules in the World.

FEATURES: Low Distortion-Integral Heatsink-Only five connections-7 amp output tran-sistors-No external components

Siston—No esternal components APPLICATIONS: Medium Power HI-FI systems—Low power dis α--Guitar amplifier SPECIFICATIONS: INPUT SENSITIVITY Soany DUTPUT POWER 25W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0-04% at 25W 11100

st 1kHz SIGNAL/NOISE RATIO 75/8 FREQUENCY RESPONSE 10Hz-45kHz-3dB. SUPPLY VOLTAGE ± 25V SIZE 105 50 25mm Price £8 18 + £1 02 VAT P&P free

The HY120 is the baby of J.L.P.'s now high power range. Designed to mast the most exacting requirements including load line and thermal protection this amplifier sets a new standard in requirements in modular design

RearURES: Very low distortion—Integral hestelink—Load Kne protection—Thermal protec-tion—Five connections—No external components APPLICATIONS : HI-FI—High quality disco—Public address—Monitor amplifier—Guiter and

STORATI SEPECIFICATIONS SEPECIFICATIONS SEPECIFICATIONS SEPECIFICATIONS SEPECIFICATIONS SEPECIFICATIONS OUTPUT POWER 80W RMS Into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTIONS 04% at 80W at 18/4 SIGNAL/NOISE RATIO 808B FREQUENCY RESPONSE 10Hz-456Hz – 388 SUPPLY VOLTAGE SEEVEN ± 35V SIZE 114 50 85mm

#### Price £19-01 + £1 52 VAT P&P free.

The HY200 new improved to give an output of 120 Watts has been designed to eland the most rugged conditions such as diaco or group while still retaining true Hi-Fi performance. FEATURES: Thermal shutdown---Very low distortion---Load line protection---Integral heateink -No external components

APPLICATIONS: H-FI--Disco--Monitor--Power slave--Industrial--Public Address SPECIFICATIONS INPUT SENSITIVITY 500mV QUTUUT POWER 120W RMS Into 80 LOAD IMPEDANCE4-160 DISTORTION 0.05% at 100W

at 1kHz. SIGNALINOISE RATIO \$568 FREQUENCY RESPONSE 10H2-45kHz- 3dB SUPPLY VOLTAGE SIZE 114 50 85mm

Price £27 99 + £2-24 VAT P&P free.

The NY400 is 1.2.P.'s "Bio Daddy" of the range producing 240W into 4.0.1 it has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling for is recommended. The amplifier instudes at the qualifies of the rest of the family to lead the market as a true high power hi-fidelity power module. FEATURES: Thermal shutdown--Very low disjointion--Load line protection--No external promonoma.

components. APPLICATIONS : Public address—Disco—Power slave—Industrial

SPECIFICATIONS OUTPUT POWER 240W RMS Into 4 to LOAD IMPEDANCE 4-16 to DISTORTION 6-1% at 240W SIGNAL NOISE PATIO 94dB FREDUENCY RESPONSE 10Hz-45kHz-3dB SUPPLY VOLTAGE

± 45V INPUT SENSITIVITY 500mV SIZE 114 100 85mm Price £38-61 + £3-09 VAT P&P free. PSU36 zultable for two HY30's £4 4 plus 11 p VAT. P/P Iree. PSU30 suitable for two HY30's £6 11 plus £1 42 VAT. P/P free. PSU30 suitable for two HY30's £1 12 plus £1 17 VAT. P/P free. PSU30 suitable for one HY200 ± 514 38 plus £1 21 VAT. P/P free. PSU30 suitable for one HY200 ± 51 19 plus £1 21 VAT. P/P free. B1 £0 45 ± 60 to VAT.

POWER SUPPLIES

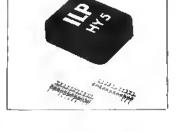
TWO YEARS' GUARANTEE ON ALL OUR PRODUCTS

I.L.P. ELECTRONICS LTD., GROSSLAND HOUSE, NACKINGTON CANTERBURY, KENT, GT4 7AD.

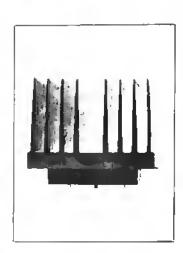
# I.L.P. ELECTRONICS LTD.,

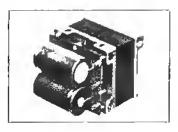
**CROSSLAND HOUSE, NACKINGTON,** CANTERBURY, KENT, CT4 7AD. Tel: (0227) 64723. Regd No. 1032630.

Please Supply		
Total Purchase Price		
l Enclose Cheque 🗐	Postal Orders	Money Order 🗋
Please debit my Acce	ss account 门 🛛 Bai	relaycard account
Account number		
Name and Address —		
	Signature	

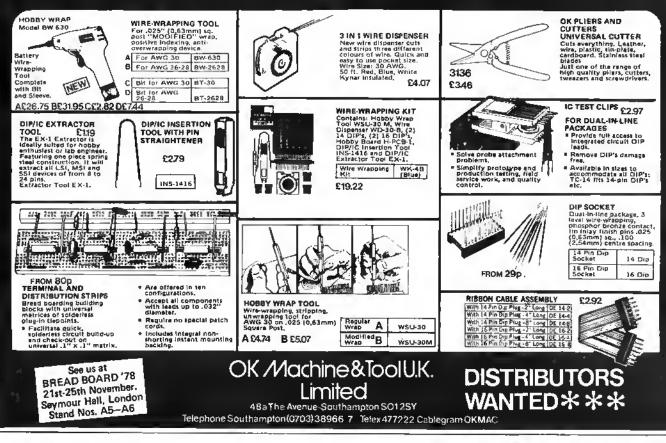


I P HY 50





# WIRE WRAPPING CENTRE



# **B. BAMBER ELECTRONICS**

OSMOR 10V REED RELAY COLLS It obm coll) to fit \$" reeds (not supplied)2 for 50p. HF CHOKES wound on \$" × 1" long territes. 4 for 50n. VHF CHOKES wound on 6-hole tubular

lerrites. 5 for 10p. DUAL TOIS MEATSINKS 1" × 4" × 4" with screw-in clamps. 3 for 50p.

MAINS TESTER BCREWDRIVERS 100 Io 500V, Standard size Stp. Lerce 700. RADIO PLIERS Str %1 + 0, 54" & 2 & 64. DIAGORAL SIDE CUTTERS 64" (2 : 20. SMALL SIDE CUTTERS 64" (2 : 20. SMALL SIDE CUTTERS 64" (2 : 20. MINIATURE FILE SETS. Set of 6 & 2 : 20. TAB 64ND DIE SETS (16 place) and 10. TAP AND DIE SETS (18 biece) contain 1 each of 0, 2, 4, 8, 8, 8A SIZES in Oles, Plug Taps, Taper Taps + American type tap wrench, Ttype tap wr'ch, Die Holder £12-59.

LARGE ELECTROLYTIC PACKS. Con-tein renps of large electrolytic aspacitors, low and high voltage types, over 40 pieces, 63 49 per pack (+12; % VAT).

Silder Switches. 2 pole make and break (or can be used as 1 pole change-over by linking the two centre pins), 4 for 50p.

	m Boxes with fids.	
AB10	51 × 4 × 14	750
AB13	5 × 4 × 2 7 × 5 × 2	£1-00
AB14	7 × 5 × 2+	£1-25
AB15	5 × 6 × 3	£1-58
816	10 × 7 × 3	£1.75
AB17	10 × 4± × 3	£1 54
AB25	6 × 4 × 3	£1-25
ight Blu 'ery ama	eled Instrument Cases a lops and plain lows rt finish	
Light Blu	ated Instrument Cases	
.ight Blu /ery sma NB1	nied Instrument Cases e lops and plain lows rt finish 5 × 2 ± × 2 ±	
.ight Blu /ery sma NB1 NB2	nied Instrument Cases lops and plain fows rt finish 5 × 2‡ × 2‡ 8 × 4‡ × 7≩	r sections,
.ight Blu /ery sma NB1 NB2 NB3	eled Instrument Cases to lops and plain lowe rt finish 5 × 2 ± × 2 ± 5 × 4 ± × 7 ± 8 × 5 × 2	r sections. 75p £1-35 £1-19
.ight Blu /ery sma NB1 NB2 NB3 NB3 NB4	ried instrument Cases is lops and plain lows it finish $5 \times 2\frac{1}{4} \times 2\frac{1}{5}$ $3 \times 4\frac{1}{4} \times 7\frac{1}{5}$ $8 \times 5 \times 2$ $9 \times 5\frac{1}{5} \times 2\frac{1}{5}$	r sections. 75p £1-35
light Blu /ery sma VB1 VB2 VB3 VB3 VB4 VB5	ried instrument Cases to lope and plain iows of finish $5 \times 2\frac{1}{4} \times 2\frac{1}{4}$ $8 \times 5 \times 2$ $9 \times 5\frac{1}{4} \times 2\frac{1}{4}$ $11 \times 6\frac{1}{4} \times 3$	r sections. 75p £1-35 £1-19
/ight Blu /ery sma VB1 VB2 VB3 VB4 VB5 VB5	Hed Instrument Cases te lops and plain towe thintsh 5 × 24 × 24 5 × 24 × 24 5 × 24 5 × 2 9 × 54 × 24 11 × 64 × 34 11 × 74 × 34 11 × 74 × 34	r sections, 75p £1-35 £1-19 £2 00
light Blu /ery sma VB1 VB2 VB3 VB3	ried instrument Cases to lope and plain iows of finish $5 \times 2\frac{1}{4} \times 2\frac{1}{4}$ $8 \times 5 \times 2$ $9 \times 5\frac{1}{4} \times 2\frac{1}{4}$ $11 \times 6\frac{1}{4} \times 3$	r sections, 75p £1-35 £1-19 £2 94 £2 25

240V input, 15V at 300m A output, £1-36 rach, MAINS TRANSFORMERS, Type 45/100, 240, 220, 110, 0V input, 45V at 100m A output, £1 59 each

PLEASE ADD 8% VAT UNLESS OTHERWISE STATED

PLEASE ADD 8% VAT UN A NEW RANGE OF SPEAKERS & CABINETS, BRAND NEW 4 BOXED. AT BARGAIN PRICES. CELESTION 5" × 5" ELIPTICAL BFEAKERS, 20 ohm, 3 watte rated, E1:30 Pach + 121% VAT. TYPE L2 TRIANGULAR CORNER CABI-NETS, Smart woodgrain Formics fyres finish with nylon grille. Ownail helpath 22" × 12" wide, Contain three 15 ohm 81" × 4" Full range speakers in parallel + 100V line franklarmer (seally disconnecied for 5 ohm of 21 Contain three 15 ohm 101" range franklarmer (seally disconnecied for 5 ohm of 21 Contain three 15 ohm 101" range franklarmer (seally disconnecied for 5 ohm of 21 Contain three 15 ohm 101" range mesker, Borry sold out, TYPE L4 PORTABLE SPEAKERS. White plastic facts 10" square, for recease mounting into celling, with 8" dia. 15 ohm 1011 range snesker, Borry sold out, TYPE L4 PORTABLE SPEAKER CABI-NET, Smert woodgrain Formics type fails with nylon grille, 15" high × 14" wide × 7" deep (tapering), Containing 10" round, 15 ohm full range speaker + 100V (ine trans-former, 27: 40 each + 12; VAT. DECIMAL KEVBOARDS, pressure sen-silive type, when pressed contact go from 6/C to approx. 25 ohms. Switches any, no encoders. Size approx. 3" A 3", with large square touch glates, 0-4 + Clear, A, B, Dual Watch, and space. Few only, 62 W while etacks last. TYPE 50 FULL RANGE SPEAKER, 10" dia. 75 ohm, 25: 40 each (or 2 for 20 to 10 + 12% VAT. SEMECONDUCTORS SX20(VH C 0 sciMult). 3 for 50p.

121% VAT. SEMICONDUCTORS BSX20 (VHF Osc/Mult). 3 for 50p. BC108 (metal can), 4 for 50p. BF305 (10 lossic BC100), 6 for 50p. BF431 Transistore. 4 for 50p. BCY2T transitetore. 4 for 50p. BCY2T transitetore. 4 for 50p. BC152 (UHF amp/misser), 3 for 50p. BC158 PNP SILICON, 4 for 50p. BC148 NPN SILICON, 4 for 50p. BC197 (Metal can) 4 for 50p. BC197 (Metal c

741CG op amps by RCA, 4 for £1. RED LEDs (Min 1, ue) 5 for 74p.

SPEAKER CABINET TYPE M321, White matt finish wood cabinet with white sorayed cloth grills, 9" × 9" × 4" deep, containing 61" dis, 15 ohm full range speaker, with 100V line transformer. 24 52 ecch or 2 for 28 do + 122% VAT = TRACK CADINITS,

Dept. P.W.5 STATION ROAD, LITTLEPORT, CAMBS., CB6 1QE Telephone: ELY (0353) 860185 (2 lines) Tuesday to Saturday

B-TRACK CARTRIDGE PLAYER UNITS, with internal mains pou and 25 wat mono amplifier (100V line). To play standard strack carinidges. All contained in a smart veneared wood cabinet, size approx. 14" wide x 51" high - 11" deep. Supplied with circuits. Brand new and boxed. SPECIAL OFFER 23 de aach. + 121% VAT. VIDICON SCAN COLLS (Transistor type, but no data) complete with vidicon base £4 Sé each. Brand New.

Let 39 each. Brang New. IC TEST CLIPS, clip over IC while still soldered to pcb or in socket. Gold-plated pins, Ideal for experimenters or service engineers. 32 pin DIL 21 73, 40 pin DIL 22-00. Or save by buying one of each for 43-36 GLASS BEAD FEEDTHROUGH INSU-LATORS. Solder-in type, overall dia approx 3mm, Pack of approx. 30 for 90p.

# DIE-CAST ALUMINIUM BOXES Send for Latest Price List.

PLASTIC PROJECT SOXES with acrew on lids (in block ABS) with brass inserts. Type NB3 approx 3 in × 24 in × 14 in 45 each Type NB3 approx 14 in × 24 in × 14 in 45 each Type NB3 approx 14 in × 34 in × 14 in 45 each TO3 transistor insulator sets, 10 for \$6p

PLUGS AND SOCKETS BNC Plugs, new 53p each. N-Type Plugs 50 ohm, 60p each, 3 for £1-30, Pl256 Plugs (PTFE) brand new, packed with reducers, 75p each, SO239 Sockets (PiFE), brand new (4-hole fixing type) 46p each.

SOLDER SUCKERS (Plunger type) Slan-dard Model, 63-50, Skirled Model E6, Spare Nozzles (6p each.

NEW MARKSMAN RANGE OF SOLDER-ING IRONS. S1400 40W 240V 450. S1250K 25W 240V + bits etc., KIT £5 38. BENCH STAND with spring and sponge for Markaman Irons 4 2 \* Spare bits MT8 (fcr 15W) 40p, MT5 (for 25W 36p, MT6 (for 40W) 35p. ALL PRICES + 1, VAT.

TCP2 TEMPERATURE CONTROLLEO IROM. Temperature controlled iron and PSU, £30+ VAT (52-40). **SPARE TIPS** Type CC single flat. Type K double flat fine 110. Type P. very fine tip £1:50 each +VAT (50). MOST SPARES AVAILABLE.

WELLER SOLDERING IRONS EXPERT. Bull-in-apolight Illuminates work, Piatol grip with fingerthy trigger. High efficiency copper soldering tip EXPERT SOLDER GUN KIT (spare bits. case, etc.) £15-66. Spare bits 40p pair.

MIXED COMPONENT PACKS, containing resistors, capacitors, pois, etc. All new, Hundreds of items. £2 per pack, while stocks last.

Isst. USSR AUTOCHANGE RECORD PLAYER DECKS with cue device, 33-45-78RPM, for 7", 10", 12" records. Fitted with SC12M Streso Ceramic carticides and styll. Brand new £14-60 + 12% VAT GARRARD AUTOCHANGE RECORD PLAYER DECKS, Model 6 300, with cue device, 33-45-76 r.pm, for 7", 10", 19" records. Fitted with KS418 Storeo Ceramic catridoe and styll Brand new £18 40 + 121% VAT. Plese note, record decks seat by Raddine, ellow 14 days for delivery.

FULL RANGE OF BERNARDS/BABANE ELECTRONICS BOOKS IN STOCK. S.A.E. FOR LIST

VARICAP TUNERS Multerd type ELC1043 05. Brand New, £5-08 + 121% VAT.

BARGAIN PACK OF LOW VOLTAGE ELECTROLYTIC CAPACITORS. Up to 50% working. Sestronic Manufactura. Approx 100. £1:50 per pack + 121% VAT.

The set av per pace + 1472 VAL. Dubling Electrolylics, 500F, 450V, 2 for 50p. Dubling Electrolylics, 1000F, 273V, 2 for 50p. Pleaseve Electrolylics, 1000F, 273V, 2 for 50p. TGC Electrolylics, 7000F, 30V, 3 for 50p. Dubling Electrolylics, 50000F, 35V, 50p each. DIT Electrolylics, 50000F, 50V, 65p each ITT Electrolylics, 50000F, 50V, 65p each Comparison of the set of the each.

PLEASE ADD 124% VAT TO ALL CAPACITORS.

Terms of Business: CASH WITH ORDER. MINIMUM ORDER 12, ALL PRICES INCLUDE POST & PACKING (UK ONLY) SAE with ALL ENQUIRIES Please PLEASE ADD VAT AS SHOWN, ALL GOODS IN STOCK DESPATCHED BY RETURN CALLERS WELCOME BY APPOINTMENT ONLY



# **BOOKS BY BABANI**

Purcl and d	hase books to the value of £5-00 from the list hoose any 60p pak from this page FREE	below
BP2	Handbook of Radio, TV & Industrial & Trans- mitting Tube & Valve Equivalents	60p†
625	Engineers and Machinists Reference Tables	40pt
8P7	Radio & Electronic Colour Codes and Data	15p1
BP10	Modern Crystal and Transistor Set Circuits for beginners	35pt
BP15	Constructors Manual of Electronic Circuits	50p†
8 <b>P</b> 22	79 Electronic Novelly Circuits	75p†
BP23	First book of Practical Electronic Projects	75p†
BP24	52 Projects Using IC741(or equivalents)	75p†
8P26	Radio Antenna Handbook for Long Distance Reception and Transmission	85p†
BP27	Giant Chart of Radio Electronic Semi- conductor and Logic Symbols	60 p.)
BP29	Major Solid State Audio HI-FI Construction Projects	85pt
BP32	How to Build Your Own Metal & Treasure Locators	\$\$p†
BP34	Practical Repair & Renovation of Colour TVs	95p7
BP35	Handbook of IC Audio Preamplifier & Power Amplifier Construction	05pt
BP36	50 Circuits Using Germanium, Silicon & Zener Diodes	75p†
8937	50 Projects Using Relays SCR's and TRIACS	£1+10†
BP39	50 (FET) Field Effect Transistor Projects	£1·25;
BP43	How to make Walkie-Talkies	£1-25†
8944	I.C.555 Timer Projects	£1·45†
BP47	Mobile Discoleque Handbook	£1-35
129	Universal Gram-motor Speed Indicator	1001
160	Coil Design and Construction Manual	75p†
195	AF-RF Reactance Frequency Charl for Con- structors	<b>15</b> p†
202	Handbook of Integrated Circuits (ICs) Equiva- lents and Substitutes	75p†
205	First Book of Hi-Fi Loudspeaker Enclosures	75p†
213	Electronic Circuits for Model Railways	85pt
214	Audio Enthuslaste Handbook	\$5pt
216	Electronic Gadgets and Games	85p†
217	Solid State Power Supply Handbook	65p†
219	Solid State Novelty Projects	13pt
220	Build Your Own Solid State Ni-Fi and Audio Accessories	85p1
222	Solid State Short Wave Receivers for Beginners	95p†
223	50 Projects Using IC CA3130	95p1
224	50 CMOS IC Projects	95p1
225	A Practical Introduction to Digital IC's	95p†
225	How to Build Advanced Short Wave Receivers	
RCC	Resistor Colour Code Disc Calculator	10p '
_		

#### **BOOKS BY NEWNES**

	-
No. 229 Beginners Guide to Electronics	Price £2-251
No. 230 Beginners Guide to Television	Price £2 251
No. 231 Beginners Guide to Transistors	Price £2-251
No. 233 Beginners Guide to Radio	Price £2 751
No. 234 Beginners Guide to Colour Television	Price £2-251
No. 235 Electronic Diagrams	Price £1-801
No. 236 Electronic Components	Price £1 081
No. 237 Printed Circuit Assembly	Price £1 081
No. 238 Transistor Pocket Book	Price £3 901
No. 225 110 Thyristor Projects Using SCRs & Triacs	Price £2 501
No. 227 110 COS/MOS Dignal IC Projects For the Home Constructor	Price £2-251
No 225 110 Operational Amplifier Projects for the Rome Constitucion	Price £2.501
No. 242 Electronics Pockat Book	Price £3.901
No. 239 30 Photoelectric Circuits &	FILE \$3.90
Systems	Price £1-801

#### **NUTS AND BOLTS**

BA BOLTS packs of BA threaded cadmium plated screws slotted choose head. Supplied in multiples of 50.

Type Tin OSA Tin OBA Tin 2BA Tin 2BA Tin 2BA	NO 839 840 842 843 843 845	Price £1-20 £0-75 £0-85 £0-45 £0-52 £0-44	Type In 4BA In 6BA In 6BA In 6BA	No. 845 847 848 849 850	Price £0.32 £0.25 £0.40 £0.21 £0.25
BA NUTS 50.	packs of	cadmuum p	lated full me	its in mul	tiples of
<sup>Туре</sup> 08А 28А	No. 855 856	Poce £072 £048	Түре 48А 68А	No. 857 858	Price 00-30 60-24
8A WASHI supplied in r			stated plain	stamped	washers
Type DBA 26A	No 859 860	Prico £0 14 £0 12	Турв 48А 68А	No. 861 862	Price £0-12 £0-12
SOLDER TA	GS - hour	nned suppli	ed in multiple	es of 50,	
Îvpe OBA 29A	No. 851 852	Price £0.40 £0-28	Түре 48А 68А	No. 853 854	Price £0-22 £0-22

0111	UNLU		
Description OPDT ministure slide DPDT standard slide Toggle switch SPST	No. 1973 1974		Price £0-11* £0-14*
Toggle switch DPDT	1975		£0-33*
To gate switch Er of a c. Rotary on-off mains switch Push switch – Push to make Push switch – Push to break	1976 1977 1978 1979		£0-42* £0-50* £0 13* £0 18*
ROCKER SWITCH A range of rocker switches SPST - moulded in high Insulation, Material available in a choice of colours ideal for small apparatus.	Colour RED BLACK WHITE BLUE YELLOW LUMINOUS	No. 1980 1981 1982 1983 1984 1984	Price 20-26* 20-26* 20-26* 20-26* 20-26* 20-26* 20-26*
Description	No.		Price
Miniature SPST toggle, 2 amp 250V a.c	1958		£0-50*
Miniature SPST toggle, 2 amp 250V a.c. Miniature DPOT toggle 2 amp	1959		£0-55*
250V a.c.	1960		€0 70*
Miniature DPDT toggle, centre off, 2 amp 250V a c. Push button SPST 2 amp	1961		£0-85*
250V a.c. Push button SPST, 2 amp	1962		£0 78*
250V a.c.	1963		£0-83*
Push button DPDT, 2 amp 250V a c	1964		£0.98*
MIDGET WAFER SWITCHE Single-bank water type — suit 100mA or 150V d.c. in non-re contacts. These switches have indexing.	able for switch activer loads m	ake-befo	re-break
Description 1 pole 12 way 2 pole 6 way 3 pole 4 way 4 pole 3 way		der No, 1965 1966 1967 1968	Price E0:48* £0:48* £0:48* £0:48*
MICRO SWITCHES Plastic button gives simple prooff action	Or	der No.	Price
Rating 10 emp 250V a c. Button gives 1 pole change over action		1969	£0 20
Rating 10 amp 250V a.c.		1970	£0 25

SWITCHES

#### **FUSE HOLDERS** AND FUSES

						1 "
Description 20mm x 5m 1 ± in x ± in cl 1 ± in cor inte Panet moun Panet moun	m chassis hassis mou he type ting 20mm	តារមាដ្ឋ		Order No. 506 507 508 509 509 510	Prico £0-07* £0-12* £0-15* £0-20 £0-30	t2 12 12
OUICK BL	0W 20mg					12
Type 150mA 250mA 550mA 800mA	No. 611 612 613 614	Тура 1А 1 5А 24 2-5А	No. 615 616 617 618	Туре ЗА 4А 5А	No. 619 620 621	13 13 13
			ach exc	epting 616 white	:h is 7p.	
ANTI-SUR	GE 20mm	1				12
Type 100mA 250mA 500mA	No 622 623 624	Type 1A 2A 1-6A All 7p	No. 625 626 827 627	Type 2 5A 3-15A 5A	No. 628 629 630	13 13 13
QUICK BL	DW 14ia					l
Type 250mA	No. 631	Type SOOmA All 7p	No. 632	Type 800mA	No. 634	
Τγρε 1Α 1.6Α 2Α	No 635 636 637	Type 2.5A 3A All 6p	No. 638 639	îγpa 4A 5A	No. 641 642	A mi 16: 16:

#### **CASES AND BOXES**

ŝ

lo. 55 56 57 58	es, eluminium Length Sin 1 Jin Gin Sio	Width 51in 6in 41in 51in	Hoight 2in 3in 1≩in 2≩in	Price £1-52* £2-12* £1-30* £1-76*
	ction such by		am brìght a with balfind	
le.	Langth	Width	Height	Price
59	51m	2 1 11	14in	62p'
59	5¦in 4in	2 2 11	14in 14in	62p* 62p*
59 50 51	5 in 4in 4in	2 1 11	1+in 11in 11in	62p* 62p*
59 50 51 52 33	5¦in 4in	2 ‡in 4in 2 1 • n 4in 2 \$in	14in 14in 14in 14in	62p* 620* 62p* 74p* 64p*
59 50 51 52 53 54	51m 4in 4in 51in 4in 3in	24in 4in 21in 4in 23in 21in	14in 14in 14in 15in 2in 14in	62p* 62p* 62p* 74p* 64p* 44p*
59 50 52 53 54 55	51m 4in 4in 51in 3in 7in 7in	2 1 in 4 in 2 1 in 4 in 2 1 in 2 1 in 2 1 in 2 1 in 3 in	14in 11in 15in 2in 19a 24in	62p* 62p* 62p* 74p* 64p* 44p* £1:04*
	51m 4in 4in 51in 4in 3in	24in 4in 21in 4in 23in 21in	14in 14in 14in 15in 2in 14in	62p* 62p* 62p* 74p* 64p* 44p*

#### METAL FOIL CAPACITOR PAK

Containing 50 metal foil Capacitor-like Mullard C280 series. Mixed values ranging fram :01uf-2:2uf. Complete with dentification sheet O/N 16204 £1:20\*

### TRANSFORMERS

MINIATURE MAINS Pumary 240V

)MP(

ñ

1

1

1

ī

1

1

No. 2021 2022 2023	Secondary 6V-0-6V 9V-0-9V 12V-0-12V	100mA 100mA	Prica 90p* 90p* 95p*
	MT280 D-5V, D-6V	vindings / RMS	Price £1 50* £1 50*
No. 2025 2027 2028	MAINS Primary 240V Secondary 6V-0-5V 1 amp 9V 0-9V 1 amp 12V 0 12V 1 amp 15V-0-15V 1 amp 3DV 0-30V 1 amp	Price 62-50* 62 60* 62 60* 62-75* 63-45*	P.88 P.455 P.88 P.455 P.88 P.4556 P.88 P.856 P.88 P.866 P.88 P.
Multi-tap amp, 1 0 19-25	ARD MAINS Primary 24 (ped) secondary mains amp and 2 amp current 33 40-50V	transformers a	vailable in 🖁 idary laps are
	available by use of taps. 0, 14-15-17, 19, 25, 31,	33 40, 25-0 2	5V
No. 2031 2032 2033	Rating   amp   amp 2 amp	Price £5:50* £6:60* £7:40*	P.& P.86p P.& P.85p P.& P.(1-10

## **AUDIO LEADS**

13     3.5mm Jack plug to 3.5mm Jack plug. Length 1.5m     50 75*       14     5pin DIN plug to 3.5mm Jack connected to pin 38.5. Length 1.5m     C0 85*       15     5pin DIN plug to 3.5mm Jack connected to pin 38.5. Length 1.5m     C0 85*       16     car aerial extension. Scienced insulated lead. Fitted plug 8 ekt.     £1 10*       17     AC mains connecting lead for cessette recorders 8 radios. Z metres     £0 68*       18     5 pin DIN plugs to stereo headphone Jack socket:     £1 05*       19     2+2 pin DIN plugs to stereo headphone Jack socket:     £1 05*       20     Car stereo connective Visible geometry plug to fit most car cassette. 8 track catridige 8 combination units. Supplier     £0.60*       23     ab DIN plugs to 5 pin DIN plug.     £0.75*       24     3 bin DIN plug to 5 pin DIN plug.     £0.75*       25     S pin DIN plug to 5 pin DIN plug.     £0.75*       26     S bin DIN plug to 5 pin DIN plug.     £0.75*       27     S pin DIN plug to 5 pin DIN plug.     £1 30*       28     All cubbin coded. Length 1.5m     £1 30*       29     S pin DIN plug to 5 pin DIN plug.     £1 30*       29     S pin DIN plug to 5 pin DIN socket.     £0 80*       29     S pin DIN plug to 2 pin DIN socket.     £0 68*       20     S pin DIN plug to 2 pin DIN socket.     £0 68*       20			
Length 1.5m <sup>1</sup> 52 5 mm Jack connected to pms 38.5. Length 1.5m <sup>2</sup> 126k connected to pms 38.5. Length 1.5m <sup>2</sup> 126k connected to pms 18.4. Length 1.5m <sup>3</sup> 126k connected to pms 18.4. Length 1.5m <sup>3</sup> 120 35 <sup>4</sup> 120 35 <sup>4</sup> 110 <sup>4</sup> 10 <sup>4</sup>	07		£0.60*
to pust 38.5. Length 1.5m C C 35* 5 by nD IN plug to 3.5mm Jack connected to pust 18.4. Length 1.5m C 20 35* C at actival actansion. Screated insulated tead. Fitted plug 8, skt. AC mains connecting lead for cessette recorders 8 radius. 2 metres C 0.68* 5 by nD IN plugs to steres plack socket with attenuation network for steres headphone Jack Socket C 105* C at stere ponnector. Variable geometry plug to fit most car cassette. 8 fit ack cartridge 8 combination units. Supplied with inline fused once all strack cartridge 8 combination units. Supplied with inline fused over lead ent misturctions. C 0.60* 15 bin DIN plug to 5 pin DIN plug. Longth 1.5m C 0.75* 25 pin DIN plug to 5 pin DIN plug. Longth 1.5m C 0.75* All cabur coded. Length 1.5m C 1.30* 28 Spin DIN plug to 5 pin DIN plug. Longth 1.5m C 0.60* All cabur coded. Length 1.5m C 1.30* 29 Spin DIN plug to 5 pin DIN plug. Longth 1.5m C 0.60* 30 C 66* All cabur coded. Length 1.5m C 1.30* 29 Spin DIN plug to 5 pin DIN plug. Longth 1.5m C 0.60* 31 Spin DIN plug to 5 pin DIN plug mirror image. Length 1.5m C 0.60* 32 Spin DIN plug to 2 pin DIN plug. Longth 1.5m C 0.60* 33 Spin DIN plug to 2 pin DIN plug mirror image. Length 1.5m C 0.60* 31 Spin DIN plug to 2 pin DIN socket Length form C 0 68* Connected pin 35 S. Length 1.5m C 0 75* 4 pin DIN plug to 2 pinono plugs. Connected pin 35 S Length 2.3cm C 0 68* Connected pin 35 S Length 2.3cm C 0 68	-	Length 1.5m	£0 75*
to puns 18.4. Length 1.5m       £0.85*         15       Cat activities and the stand of the sessence insulated interface of streed plug 8, skt.       £1.10*         17       AC mains connecting lead for cessence insulated interface of streed plug 8, skt.       £1.10*         17       AC mains connecting lead for cessentie insulated interface of the streed plug 10, streed instructions.       £0.60*         20       Car streed connector. Variable geometry plug 10, fit most car cassente, 8, track cartridge 8, combination units. Supplied with interfused owner lead end instructions.       £0.60*         23       6 6m Coiled Guitar Lead Mono Jack Plug 10, 5 pin DIN plug, 10, 5 pin DIN plug.       £0.75*         25       5 pin DIN plug 10, 5 pin DIN plug.       £0.75*         26       5 pin DIN plug 10, 5 pin DIN plug.       £0.75*         27       5 pin DIN plug 10, 5 pin DIN plug.       £0.75*         28       5 pin DIN plug 10, 5 pin DIN plug.       £1.30*         29       5 pin DIN plug 10, 5 pin DIN plug mirror image, Length 1, 5m       £1.30*         29       5 pin DIN plug 10, 5 pin DIN plug. 1&4       £0.68*         31       5 pin DIN plug 10, 2 pin DIN plug. 1&4       £0.68*		to pins 385. Length 1.5m	£0 85*
ieod. Fitted plug 8, ski.     £1 10*       AC mains connecting lead for cessettle recorders 8, radius. 2 metres     £0.68*       b pin Oli N phono plug to stereso headphone jack socket     £1 05*       12 2-2 pin OliN plugs to stereso jack socket with attenuation network for stereo headphones, Length 0.2m     £0 90*       20 Car stereo connector. Variable geometry plug to fit most car cassette, 8 fit rack cartridge 8 combination units. Supplied with inline fused ower lead and mistructions.     £0.60*       23 6 6m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug B LACK     £1 150*       24 3 pin DIN plug to 5 pin DIN plug. Longth 15m     £0.75*       25 5 pin DIN plug to 5 pin DIN plug. Longth 15m     £0.75*       26 5 pin DIN plug to 5 pin DIN plug. Longth 15m     £0.75*       27 5 pin DIN plug to 5 pin DIN plug. Longth 15m     £0.75*       28 5 pin DIN plug to 5 pin DIN plug. Longth 15m     £0.75*       29 5 pin DIN plug to 5 pin DIN plug mirror imaga, Length 15m     £1.30*       29 5 pin DIN plug to 2 pin DIN plug mirror imaga, Length 15m     £1.30*       30 2 pin DIN plug to 2 pin DIN plug 1&4 and 35. Length 15m     £0.68*       31 5 pin DIN plug to 2 pin DIN plug 1&4     £0.68*       32 2 pin DIN plug to 2 pin DIN socket Length 10m     £0.68*       33 5 pin DIN plug to 2 pinono plugs. Connected pins 35. Length 1.5m     £0.75*       33 5 pin DIN plug to 2 pinono plugs. Connected pins 35. Length 1.5m     £0.68*       34 b pin DIN plug to 2 p		to pins 184. Length 1.5m	£0 85°
17       AC mains connecting lead for cessette recorders & radius, Z metres       £0.68*         18       b pin DIN phono plug to stereo headphone elack socket       £1.05*         19       2-2 pin DIN plugs to stereo headphone elack socket       £1.05*         19       2-2 pin DIN plugs to stereo headphone elack socket       £0.90*         10       Cor stereo connector. Variable geometry plug to fit most car classette, 8 track cartifidge & combination units. Supplied       £0.90*         23       66 m Coiled Guttar Lead Mono Jack Plug       £1.50*         24       3 pin DIN plug to 5 pin DIN plug.       £0.75*         25       5 pin DIN plug to 5 pin DIN plug.       £0.75*         26       5 pin DIN plug to 5 pin DIN plug.       £0.75*         27       5 pin DIN plug to 5 pin DIN socket.       £0.80*         28       All carbour coded. Length 1.5m       £1.30*         29       5 pin DIN plug to 2 pin DIN socket.       £0.68*         29       5 pin DIN plug to 2 pin DIN socket.       £0.68*         29       5 pin DIN plug to 2 pin DIN socket.       £0.68*         20       5 pin DIN plug to 2 pin DIN socket.       £0.68*         20       20 pin DIN plug to 2 pin DIN socket.       £0.68*         20       5 pin DIN plug to 2 pin DIN socket.       £0.68* <tr< td=""><td>15</td><td></td><td>£1.10*</td></tr<>	15		£1.10*
<ul> <li>18 5 pin Oliv prono plug to stered headphone Jack socket</li> <li>19 2-2 pin Oliv plugs to stered Jack socket</li> <li>19 2-2 pin Oliv plugs to stered Jack socket</li> <li>10 5-</li> <li>19 2-2 pin Oliv plugs to stered Jack socket</li> <li>10 5-</li> <li>10 2-2 pin Oliv plugs to stered Jack socket</li> <li>11 05-</li> <li>12 2-2 pin Oliv plugs to stered Jack socket</li> <li>12 2-2 pin Oliv plugs to stered Jack socket</li> <li>13 2-2 pin Oliv plugs to stered Jack socket</li> <li>14 2-2 pin Oliv plugs to stered Jack socket</li> <li>15 5 pin Oliv plug to 5 pin Dliv plug.</li> <li>15 5 pin Oliv plug to 5 pin Dliv plug.</li> <li>15 5 pin Oliv plug to 5 pin Dliv plug.</li> <li>15 5 pin Oliv plug to 5 pin Dliv plug.</li> <li>15 5 pin Oliv plug to 5 pin Dliv plug.</li> <li>15 pin Dliv plug to 5 pin Dliv socket.</li> <li>15 pin Oliv plug to 5 pin Dliv plug mirror</li> <li>15 pin Oliv plug to 2 pin Dliv plug.</li> <li>16 5 pin Oliv plug to 2 pin Dliv plug.</li> <li>16 5 pin Oliv plug to 2 pin Dliv plug.</li> <li>16 5 pin Oliv plug to 2 pin Dliv plug.</li> <li>16 5 pin Oliv plug to 2 pin Dliv plug.</li> <li>16 5 pin Oliv plug to 2 pin Dliv socket.</li> <li>16 pin Oliv plug to 2 pin Dliv socket.</li> <li>17 pin Dliv plug to 2 pin Dliv socket.</li> <li>18 pin Oliv plug to 2 pin Dliv socket.</li> <li>19 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pin Dliv socket.</li> <li>10 pin Dliv plug to 2 pinone plugs.</li> <li>10 pin Dliv</li></ul>	17	AC mains connecting lead for cassette	
headphone jack socket     £1 05*       2-2 pin DIN plugs to stereb jack sockst     £0 90*       with attenuation network for stereb     headphones, Leight 0.2m     £0 90*       20 Gar stereb connector. Variable geometry     plug to fit most car classette, 8 fit sock     £0 90*       23 6 6m Coiled Guitar Lead Mono Jack Plug     £0 60*     £0 60*       24 3 pin DIN plug to 5 pin DIN plug.     £0 75*       25 pin DIN plug to 5 pin DIN plug.     £0 75*       26 fin Coiled Guitar Lead Mono Jack Plug     £0 75*       27 bin DIN plug to 5 pin DIN plug.     £0 75*       28 pin DIN plug to 5 pin DIN plug.     £0 75*       29 pin DIN plug to 5 pin DIN plug.     £0 75*       29 pin DIN plug to 5 pin DIN plug.     £0 75*       29 pin DIN plug to 5 pin DIN plug.     £1 30*       29 pin DIN plug to 5 pin DIN plug mirror     £1 30*       29 pin DIN plug to 2 pin DIN plug mirror     £1 05*       30 2 pin DIN plug to 2 pin DIN plug.     £0 68*       31 5 pin DIN plug to 2 pin DIN plug.     £0 68*       32 2 pin DIN plug to 2 pin DIN plug.     £0 68*       33 5 pin DIN plug to 2 pin DIN socket     £1 30*       29 pin DIN plug to 2 pin DIN socket     £0 68*       33 5 pin DIN plug to 2 pin pins sockets.     £0 68*       20 Connected pins 35 & Length 1.5m     £0 75*       35 pin DIN plug to 2 pinono plugs. <t< td=""><td>18</td><td></td><td>TA-89.</td></t<>	18		TA-89.
with attenuation network for stereo     F0 90*       backphanes, Lergth 0.2m     £0 90*       20 Car stereo connector. Variable geometry     plug to fit most car cassette, 8 firack       cartinge & combination units. Supplied     with inline lused ower lead and misturctions.     £0-60*       23 6 6m Coiled Guitar Lead Mono Jack Plug     £0 75*       24 3 pin DIN plug to 5 pin DIN plug.     £0-75*       25 pin DIN plug to 5 pin DIN plug.     £0-75*       26 Length 1.5m     £0-75*       27 5 pin DIN plug to 5 pin DIN plug.     £0-75*       28 5 pin DIN plug to 5 pin DIN plug.     £0-75*       29 and DIN plug to 5 pin DIN plug.     £0-75*       29 and DIN plug to 5 pin DIN plug.     £0-75*       29 and DIN plug to 5 pin DIN plug to 6 pin DIN plug to 6 pin DIN plug to 600*     £0-75*       29 bin DIN plug to 2 pin DIN plug mirror     £1-30*     £1-30*       29 and DIN plug to 2 pin DIN plug. 1&4     and 35. Length 1 5m     £0-68*       31 5 pin DIN plug to 2 pin DIN plug. 1&4     and 35. Length 1 5m     £0-75*       29 and DIN plug to 2 pin DIN socket     £0-98*     £0-98*       20 connected pins 35. Length 1.5m     £0-75*       33 5 pin DIN plug to 2 pinono plugs.     £0-68*       20 DIN plug to 2 pinono plugs.     £0-68*       21 DIN plug to 2 pinono plugs.     £0-68*	19		£1 05*
with Inline lused power lead and instructions.     E0-60*       3 6 dm Coiled Guitar Lead Mona Jack Plug     E1 50*       4 3 pin DIN plug to 5 pin DIN plug.     E0-75*       Longth 1 5m     E0       5 pin DIN plug to 5 pin DIN plug.     E0-75*       26 b pin DIN plug to 5 pin DIN plug.     E0-75*       27 5 pin DIN plug to 5 pin DIN plug.     E0-75*       28 jun DIN plug to 7 bin Plug Plug.     E0-75*       29 jun DIN plug to 7 bin Plug Plug.     E0-75*       28 jun DIN plug to 7 bin Plug Nockel.     E0-80*       29 jun DIN plug to 8 pin DIN sockel.     E0-86*       20 jun DIN plug to 2 pin DIN sockel.     E0-68*       21 Longth b form     E0-68*       22 pin DIN plug to 2 pin DIN socket     E0-86*       23 pin DIN plug to 2 pin DIN socket     E0-86*       24 pin DIN plug to 2 pin DIN socket     E0-86*       23 pin DIN plug to 2 pin DIN socket     E0-86*       23 pin DIN plug to 2 pin DIN socket     E0-86*       24 pin DIN plug to 2 pin DIN socket     E0-86*       25 pin DIN plug to 2 pin DIN socket     E0-86*       26 pin DIN plug to 2 pinono plugs.     E0-66*       27 pin DIN plug to 2 pinono plugs.     E0-66*       285 D pin DIN Socket to 2 phono plugs.     E0-66*       295 D DIN Socket to 2 phono plugs.     E0-66*       20-66*     S Length 23*	20	with attenuation network for stereo headphones. Langrh 0.2m Car stereo connector. Variable geometry plug to fit most car cassette, 8 track	£0 90*
<ul> <li>To Mono Jack Plug BLACK</li> <li>S pin DIN Plug to 5 pin DIN Plug.</li> <li>Longth 1 5m</li> <li>S pin DIN Plug to 5 pin DIN Plug.</li> <li>Longth 1 5m</li> <li>Longth 1 5m</li> <li>Din Plug to 5 pin DIN Plug.</li> <li>Longth 1 5m</li> <li>Din Plug to 7 pin DIN Plug.</li> <li>Longth 1 5m</li> <li>Din Plug to 7 pin DIN Plug.</li> <li>Longth 1 5m</li> <li>Din Plug to 4 Phong Plugs.</li> <li>S pin DIN Plug to 5 pin DIN socket.</li> <li>Longth 1 5m</li> <li>S pin DIN Plug to 5 pin DIN socket.</li> <li>Longth 1 5m</li> <li>S pin DIN Plug to 6 pin DIN socket.</li> <li>Longth 1 5m</li> <li>S pin DIN Plug to 2 pin DIN socket.</li> <li>Z pin DIN plug to 2 pin DIN socket.</li> <li>Longth 1 5m</li> <li>C 0 83*</li> <li>S pin DIN plug to 2 pin DIN socket.</li> <li>Longth 1 5m</li> <li>C 0 83*</li> <li>S pin DIN plug to 2 pin DIN socket.</li> <li>Longth 1 5m</li> <li>C 0 83*</li> <li>S pin DIN plug to 2 pin DIN socket.</li> <li>Longth 1 5m</li> <li>C 0 83*</li> <li>S pin DIN plug to 2 pin DIN socket.</li> <li>C 0 83*</li> <li>C 0 85*</li> <li>Longth 1 5m</li> <li>C 0 68*</li> <li>C</li></ul>	77	with inline fused power lead and instructions.	£0-60*
Lingth 1 5m <sup>-</sup> £0.75 <sup>•</sup> 25 Spin DIN plug to 5 pin DIN plug. Length 1.5m <sup>-</sup> £0.75 <sup>•</sup> 26 Spin DIN plug to Tinned open end Length 1.5m <sup>-</sup> £0.75 <sup>•</sup> 27 Spin DIN plug to 4 Phong PLugs. 41 autour coded. Length 1 5m <sup>-</sup> £1 30 <sup>•</sup> 29 Spin DIN plug to 5 pin DIN socket. Length 1 5m <sup>-</sup> £0 80 <sup>•</sup> 29 Spin DIN plug to 2 pin DIN plug mirror Image. Length 1.5m <sup>-</sup> £1 30 <sup>•</sup> 20 Zpin DIN plug to 2 pin DIN plug mirror Image. Length 1.5m <sup>-</sup> £0 68 <sup>•</sup> 31 Spin DIN plug to 2 pin DIN plug. 1&4 and 345. Length 1 5m <sup>-</sup> £0 88 <sup>•</sup> 22 Zpin DIN plug to 2 pin DIN plug. 1&4 and 345. Length 1 5m <sup>-</sup> £0 98 <sup>•</sup> 23 Spin DIN plug to 2 pin DIN socket Length 1 0m <sup>-</sup> £0 98 <sup>•</sup> 26 Onected pins 354. Length 1.5m <sup>-</sup> £0 68 <sup>*</sup> 26 Contected pins 354. Length 23cm <sup>-</sup> £0 68 <sup>*</sup> 26 Contected pins 354. Length 23cm <sup>-</sup> £0 68 <sup>*</sup> Black. Length 5m <sup>-</sup> £0 68 <sup>*</sup> 5 pin DIN socket to 2 phono plugs. Contected pins 354. Length 23cm <sup>-</sup> £0 68 <sup>*</sup> Black. Length 5m <sup>-</sup> £1.75 <sup>*</sup>		to Mono Jack Plug BLACK	£1 50*
25     5 pin DIN plug to 5 pin DIN plug. Length 1.5m     £0.75*       26     5 pin DIN plug to Tinned open end Lingth 1.5m     £0.75*       27     5 pin DIN plug to 4 Plong Plugs.     £1.30*       28     5 pin DIN plug to 5 pin DIN plug mirror image, length 1.5m     £1.30*       29     5 pin DIN plug to 5 pin DIN plug mirror image, length 1.5m     £0.680*       30     2 pin DIN plug to 2 plo DIN inline socket Length 15 m     £0.68*       31     5 pin DIN plug to 2 plo DIN plug. 1&4 and 3&5. Length 1 5m     £0.68*       32     2 pin DIN plug to 2 plo DIN socket Length 10 m     £0.98*       33     5 pin DIN plug to 2 plong plugs Convected pins 356. Length 1.5m     £0.75*       34     b pin DIN plug to 2 plong plugs Convected pins 356. Length 1.5m     £0.75*       35     5 pin DIN socket to 2 plong plugs Convected pins 356. Length 1.5m     £0.68*       35     5 pin DIN socket to 2 plong plugs Convected pins 356. Length 1.5m     £0.68*       36*     Coiled stered pens 356. Length 1.23cm     £0.68*       36*     Coiled stered pens 356. Length 1.23cm     £0.68*       36*     Coiled stered pens 356. Length 2.3cm     £0.68*       37*     Coiled stered pens 365. Length 5.3cm     £0.68*       37*     Coiled stered pens 365. Length 5.3cm     £0.68*       38*     Coiled stered pens 365. Length 5.3cm     £0.68* <td>24</td> <td>3 pin DIN plug to 3 pin DIN plug. Length 1 5m</td> <td>£0.75*</td>	24	3 pin DIN plug to 3 pin DIN plug. Length 1 5m	£0.75*
26       5 µin DIN plug to Tinned open end Lingth 1.5m       £0.75*         27       5 µin Din plug to 4 Phone Plugs.       £1.30*         28       5 µin Din plug to 5 µin DIN plug mirror       £1.30*         28       5 µin DIN plug to 5 µin DIN plug mirror       £0.60*         29       5 µin DIN plug to 5 µin DIN plug mirror       £1.05*         30       2 µin DIN plug to 2 µin DIN plug. 1&4       £0.68*         31       5 µin DIN plug to 2 µin DIN socket       £0.83*         23       5 µin DIN plug to 2 µin DIN socket       £0.98*         33       5 µin DIN plug to 2 µin plug sockets.       £0.68*         26       5 µin DIN plug to 2 µin plug sockets.       £0.68*         26       5 µin DIN plug to 2 µin plugs       £0.68*         33       5 µin DIN plug to 2 µin sockets.       £0.68*         27       5 µin DIN plug to 2 µin sockets.       £0.68*         27       5 µin DIN socket to 2 µin sockets.       £0.68*         35       5 µin DIN socket to 2 µin plugs.       £0.68*         36       5 Length 1.5m       £0.68*         37       5 µin DIN socket to 2 µin plugs.       £0.68*         38       5 µin DIN socket to 2 µin plugs.       £0.68*         38       5 µin DIN socket to 2 µin plugs.	25	5 pin DIN plug to 5 pin DIN plug.	
27       S pin Uin plug to 4 Phone Plugs.         All cubur coded. Length 1 5 m       £1.30°         28       S pin DIN plug to 5 pin DIN socket.       £0 60°         29       S pin DIN plug to 5 pin DIN plug mirror       £0 60°         29       S pin DIN plug to 2 pin DIN plug mirror       £1.30°         29       S pin DIN plug to 2 pin DIN plug mirror       £1.05°         30       2 pin DIN plug to 2 pin DIN plug. 1&4       £0 68°         31       5 pin DIN plug to 2 pin DIN socket       £0.98°         20       DIN plug to 2 pin DIN socket       £0.98°         33       5 pin DIN plug to 2 pinono plugs.       £0.68°         Connected pins 365. Length 1.5m       £0.75°         34       b pin DIN plug to 2 pinono plugs.       £0.68°         25       pin DIN socket to 2 phono plugs.       £0.68°         26       connected pins 365. Length 1.5m       £0.68°         35       S pin DIN socket to 2 phono plugs.       £0.68°         26       Connected pins 365. Length 2.3cm       £0.68°         36       Conted sieree beadphone sugnsion lead       £1.75°	26	5 pin DIN plug to Tinned open and	
All cubur coded. Length 1.5m     £1.30*       S pin DIN play to 5 pin DIN socket.     C0 80*       Length 1.5m     C0 80*       29 5 pin DIN play to 5 pin DIN socket.     C0 80*       20 5 pin DIN play to 5 pin DIN play mirror     C1 05*       30 2 pin DIN play to 2 pin DIN inline socket     C1 05*       31 5 pin DIN play to 2 pin DIN play. 1&4     £0 68*       32 2 pin DIN play to 2 pin DIN socket     Length 1.5m       33 5 pin DIN play to 2 pin DIN socket.     £0 98*       33 5 pin DIN play to 2 pin DIN socket.     C0 98*       20 Conjected pin 3 26. Length 1.5m     £0 75*       34 pin DIN play to 2 pinono plays.     Conjected pin 3 26. Length 23cm       35 pin DIN socket to 2 pinono plays.     Conjected pin 3 26. Length 23cm       36* Colled stereo headphone system lag     C0 68*       36* Colled stereo headphone system lag     C0 68*       36* Colled stereo headphone system lag     C1 75*	27		£0.75*
Longth 1 5m CO 80° 29 6 pin DIN plug to 5 pin DIN plug mirror mage, Length 1.5m CI 305 CI 305 2 pin DIN plug to 2 pin DIN inline socket Length 5m CI 305 2 pin DIN plug to 2 pin DIN socket Length 10m CI 305 2 pin DIN plug to 2 pin DIN socket Length 10m CI 365 Contected pins 345 Length 1.5m CI 35° Contected pins 345 Length 23cm CI 68° Contected pins 345 Length 50° Contected pins 350 Length 23cm CI 68° Black. Length 5m CI 75°		All colour coded, Length 1 5m	£1-30*
image. Length 1.5m     C105*       2 pin DIN plug to 2 plo DIN inline socket     C0 68*       1 5 pin DIN plug to 3 pin DIN plug. 1&4     C0 68*       and 3&5. Length 1 5m     C0 83*       2 pin DIN plug to 2 pin DIN socket     C0 83*       2 pin DIN plug to 2 pin DIN socket     C0 88*       33 5 pin DIN plug to 2 pinono plugs     C0 75*       34 b pin DIN plug to 2 pinono plugs.     C0 68*       35 pin DIN socket to 2 pinono plugs.     C0 68*       36 Contected pins 3&5. Length 1.5m     C0 75*       37 S pin DIN socket to 2 pinono plugs.     C0 68*       38 S pin DIN Socket to 2 pinono plugs.     C0 68*       39 S Contected pins 3&5. Length 23cm     C0 68*       39 Colled stereo headphone extension lead     Black. Length 6m		Length 1 5m	CO 80*
Length 5m     £0 68*       15 pin DIN plug to 3 pin DIN plug. 1&4     £0 68*       2 pin DIN plug to 2 pin DIN socket     £0 88*       Langth 1 0m     £0 pin DIN socket       Langth 1 0m     £0 98*       33 5 pin DIN plug to 2 pinono plugs     £0 98*       Contected pins 3&5 Length 1.5m     £0 75*       34 pin DIN plug to 2 pinono plugs.     £0 68*       25 pin DIN socket to 2 pinono plugs.     £0 68*       35 5 pin DIN socket to 2 pinono plugs.     £0 68*       36 Contected pins 3&5 Length 1.3m     £0 68*       37 5 pin DIN socket to 2 pinono plugs.     £0 68*       38 5 pin DIN socket to 2 pinono plugs.     £0 68*       39* Colled stereo headphone Extension lead     Black. Length fin       81 ack. Langth fin     £1.75*		umage. Length 1.5m	£1-05*
31     5 pin DIN plug to 3 pin DIN plug. 1&4       and 3&5. Length 1 5 m     C0 83*       32     2 pin DIN plug to 2 pin DIN socket     20.96*       Length 1 0m     20.96*     20.96*       33     5 pin DIN plug to 2 pinono plugs.     Convected pins 365. Length 1.5m     C0 75*       34     b pin DIN plug to 2 pinono sockets.     Convected pins 365. Length 2.3cm     E0 68*       35     5 pin DIN socket to 2 phono plugs.     Convected pins 365. Length 2.3cm     E0 68*       35     5 pin DIN socket to 2 phono plugs.     Convected pins 365. Length 2.3cm     E0 68*       36     Coiled stereo headphone extension lead     Black. Length 5m     C1.75*	30		£0 68*
32     2 pin DIN plug to 2 pin DIN socket     £0.96*       Length 1 0m     £0.96*     £0.96*       33     5 pin DIN plug to 2 phono plugs     £0.75*       Convected pins 365. Length 1.5m     £0.75*       34     b pin DIN plug to 2 phono sockets.     £0.668*       Convected pins 365. Length 2.3cm     £0.68*       35     5 pin DIN socket to 2 phono plugs.     £0.668*       Convected pins 365. Length 2.3cm     £0.68*       36*     Colled stereo headphone extension lead     Black. Length 5m	31	5 pin DIN plug to 3 pin DIN plug, 1&4	
33     5 pin DIN play to 2 phono plags       Converted pins 346 5. Longth 1.5m     C0 75*       34     b pin DIN play to 2 plana sockets.     Converted pins 36 5. Length 23cm       Converted pins 36 5. Length 23cm     E0 68*       35     5 pin DIN socket to 2 phono plags.     Converted pins 36 5. Length 23cm       Converted pins 36 5. Length 53c     E0 68*       36     Coiled stereo headphone suppion lead       Black. Langth 6m     C1-75*	32	2 pin DIN plug to 2 pin DIN socket	
34     b pin DiN plug to 2 pluone sockets.       Connected p.ns 356. Length 23cm     E0 68*       35     5 pin DIN socket to 2 phono plugs.     E0 68*       Connected pins 365. Length 56.     E0 68*       36     Colled stereo headphone extension lead     Black. Length 5m	33	5 pin DIN plug to 2 phono plugs	
35     5 pin DIN socket to 2 phono plugs.     60.68*       Connected pins 38.5     Length 23cm     60.68*       36     Colled stereo headphone extension lead Black.     E1.75*	34	5 pin DIN plug to 2 phone sockets,	
Connected pins 38/5 Length 23cm E0.68* 36° Colled stereo headphone Extension lead Black, Length 6m E1.75*	75		EO 68*
Black, Langth 6m £1-75*		Connected pins 385 Length 23cm	£0 68*
78 AC mains lead for calculators etc. £0-68*		Black, Langth 6m	
	78	AC mains lead for calculators etc.	£0-68*

#### ELECTROLYTIC PAKS

A range of paks each containing 18 first quality, mixed	value
miniature electrolytics.	
	440
16202values from 10mFO100mFD	66p*
16203—values from 100mFD—680mFD	60.0"

# **BI-PAK CATALOGUE**

NEW EDITION NOW AVAILABLE Send for your copy of our revised catalogue and price list NOW! It contains 127 pages packed with literally hundreds of semiconductors, components and bur famous range of BI-KITS audio modules. OULY CENDICT ERCE ONLY 650 POST FREE

ORDERING Do not lorget to state order number and your hame and addres V.A.T. Add 121% to prices marked\* 8% to those unmarked ttems marked are zero rated

P&P. 35p unless otherwise shown.



DEPT. WID , P.O. Box 6, Ware, Herts COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.

0450		audio mod	88-108 Mhz	MDAZO		
S450		SENSITIVITY	3 0 µV	MPA30		1
TEREO		BANDWIDTH SPURIOUS REJECTION	250 kHz 50 dB	MAGNETIC CARTRID	GE CE	10
itted with Sky	A REAL PROPERTY AND A REAL	SELECTIVITY ± 400 kHz	55 dB	PRE-AMPLIFIER	A LEMAN	CO (
con on	1244	AUDIO OUTPUT (22 S kHz deviatio		Enjoy the quality of a	And share .	£2-9
£22 ·30	4411	STEREO SEPARATION SUPPLY REQUIREMENTS	30 dB 20 to 30V (90mA max)	existing caramic equi	oment using	+ 35p p + 12; %
+ 40p p&p + 123% VAT		AERIAL IMPEDANCE	75 ohme	the MPA 30 which is amplifier enabling me	s high quality pre- gnatic cartridges to be used a	where (acilit
		DIMENSIONS	240mm × 110mm × 32mm	exist for the use of ce	ramic cartridges only.	
The 450 Tuner provides inst distions, say of which may features include FET incut	ant programme aslective be altered as often as slage. Vari-Cap diode t	on at the touch of a button ensuring an you choose, simply by changing the r uning. Switched AFC LED Stereo India	counte tuning of 4 pre-selected lettings of the pre-set controls.	SENSITIVITY EQUALISATION	3 5 mV for 100 Within ± 1 d9 20 kHz	
		OUTPUT POWER		SUPPLY	50 K phms 18 to 30 V-re	earth
Stereo 30	- The second	LOAD IMPEDANCE	7 Watis RMS S ohma	DIMENSIONS	110 × 50 × 25	
OMPLETE	And the second states	TOTAL HARMONIC DISTORTION			socket)	
HASSIS		FREQUENCY RESPONSE	50 Hz IQ 20 kHz ± 3dBs ± 12 dBs at 100Hz and 10kHz	D440	A Carting and and	
E18 95		SENSITIVITY	190 mV for full output	PA12	asatak	£7-1
49 0 80		INPUT IMPEDANCE TRANSFORMER REQUIREMENTS	1 Mohme	STEREO	THE PERSON	+ 30p p
123% VAT	1 + Tw R.M.S.	DIMENSIONS	the state of the s	PRE-AMPLIFIER The PA12 Stereo Pre-		+ 123%
		(Less controls and panel)	200 m.m) × 130 m.m. > 33 m.m.	Amplifier chassis is a	lesigned and recommended for their Modules, the PS12 power	or use with
he Stareo 30 comprises a c	sma-erg cerela stelgmo	lifler, power amplifiers and power supp	bly. This, with only the addition	T538 Transformer, Fe	atures include on/off volume, Complete with lape output	Balance, Ba
usily ceramic pick-up, ster	ea luner, stereo lape de	rality audio unit suitable for use with r ckletc. Simple to install, capable of pro ont panel, knobs, main switch, fuse	ducing really first class teaults,	FREQUENCY RESPON		-368)
his unit is supplied with fu nounting brackets.	n metructions, black in	ont panel, knobs, main switch, fuse	and fuse holder and universal	BASS CONTROL	± 12 dB at 60	Ηz
100	A 4-			TREBLE CONTROL INPUT IMPEDANCE	± 14 dB at 10 1 Mag. phm	kHz
AL60	25w	OUTPUT POWER	25 Watte RMS 30-50 V	INPUT SENSITIVITY	1 Meg. Dnm 300 mV	
upio oiqu	R.M.B.	LOAD IMPEDANCE	8-16 ohms	CROSSTALK	60 dB	
MPLIFIER	10	TOTAL HARMONIC DISTORTION	Leas than 1% (Typically 05%)	SIGNAL/NOISE RAT		
ODULE 5 Watts RMS	Sand Sand	FREQUENCY RESPONSE SENSIT/VITY	20 Hz to 30 kHz × 2 dBs 280 mV for full output	TAPE OUTPUT IMPE	DANCE 25 K ohms	
ha ee	A WWW	MAX. HEAT SINK TEMPERATURE		DIMENSIONS	152mm × 84m	m s 25mm
C4 * 33 p ± p 12¦% VAT		DIMENSIONS	103mm × 64mm × 15mm			
his high quality audie ampli 25 RMS with distortion lev	fler module is for use in rela below 0-1%.	audio equipment and stereo amplifiers	and provides pulput powers up		OWER SUPP	_
				with iransformer T538.	the AL30A \$.450 and MPA30 i	IN CONJUNCE
AL80	35w	OUTPUT POWER SUPPLY	35 Watts RMS 40-80 V	INPUT VOLTAGE OUTPUT VOLTAGE	17-20V AC 27-30V DC	£1∹
	R.M.S.	LOAD IMPEDANCE	8-16 ohms	OUTPUT CURRENT	800m A	+ 35p p
MPLIFIER WITH		TOTAL HARMONIC DISTORTION	Less than 1% (Typically -06%)	SIZE	60mm × 43mm × 26mm	+ 123%
IODULE	The second	FREQUENCY RESPONSE SENSITIVITY	20 Hz to 30 kHz × 2 dBs 260 mV for full output			
£7·15* ™‡	Sec. And St.	MAX. HEAT SINK TEMPERATURE			NINE CHANN	
350 p#p 8% VAT	AN THE REAL	DIMENSIONS	103mm + 64mm × 15mm	MONO-GF	RAPHIC EQUA	LIZER
	to the AL60 shove and	is of the same high quality but provider	autput powers up to 35W with	The GE100 has nine 1 active filters. Boost a bandling 2 V RMS T	octave adjustments using inte ind Cut timits are ± 12dB H.D005%. Input impedence	Max Volta
AL250	125W R.M.S.	OUTPUT POWER	125 Walta RMS continuous	i Imperiance less than 16	I. Frenuenzy response 20 Mz	-20 K H 2 (3d)
	12011 H.M.S.	OPERATING VOLTAGE	50-80 V	400, 800, 1,600, 3,200, suggested gain conirg	a are centred at 50, 100, 200, 6,400 and 12,800 Hz. The is are 10 K LIN eliders (not	+ 35p p4
OWER MPLIFIER	Charles and the second	LOADS	4-16 ohms	supplied with the mod	ute) See Paks S31 and 16192.	+ 121% ¥
A STALL	STATE OF STREET	FREQUENCY RESPONSE	25 Hz 20 kHz measured at 100 Watta	BG30 POWER SUPPL 121% VAT + 350 pEr	Y BOARD for GE100 15-0-15 V	OLT #3-54
	A	SENSITIVITY FOR 100 WATTS D/P AT 1 kHz	450 mV			
and the second sec		INPUT IMPEDANCE	33 K ohms			
" Martine and a second	0.70	TOTAL HARMONIC DISTORTION	0 1%	SIREN	ALARM MODU	JLE
17 ·25* + 400 p40		50 WATTS into 4 ahms 50 WATTS into 6 ahms	0.06%	4 or 8 ohm speaker, Id.	amer powered from any 32 vo sal for car burglar slarm, fraea	ar breakdo
	+ 1% VAT	vidios se outout ol no to 125W BMS in	to a 4 obm load.	and other security pury Only £3 54 + 5% VA	ases Order No S15, No. BP T + J3p g4p	124
his unit designated Al 950		traing an eacher of op to report ring, in				
his unit, designated AL250,	is a power simplifier pro	MAXIMUM SUPPLY VOLTAGE	30 V			
130A 10w	is a power amplituder pro	MAXIMUM SUPPLY VOLTAGE	30 V 19 Walts RMS	MA60 HI-	FI AMPLIFIER	KIT
10w	Fight a power amplifier pro	POWER OUTPUT for 2% THD	19 Walts RMS Less than -25%	Build you own top gu	ality amplifier, save yourself	pounds. T
130A 10w		POWER OUTPUT for 2% THD	10 Walts RMS Less than -25% 8-16 chms	Build you own top gu MA60 kit comprises the	ality amplifier, save yourself following BI-kits modules, 2 :	pounds. T × A 50 am
L30A 10W RMLIFIER ODULES	a a power ampliture pro	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE IMPUT IMPEDANCE FREQUENCY RESPONSE	10 Walts RMS Less than -25% 8-16 chms 100 K ohma 50 Hz-25 kHz ± 3 dBs	Build you own top gu MA60 kit comprises the 1 × PA100 pre-amp, 1 trans giving 37 watt	ality amplifier, save yoursell following BI-kits modules, 2 > SPMB0 stab power supply RMS per channel STEREO	pounds. T × A 50 ami v. 1 × BMT . All ⊨odu
AL3OA 10W RMLIFIER ODULES 3.75 + 35p p4p		POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD WRPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY	10 Waits RMS Less than -25% 8-16 ohms 100 Kohma 50 Rz-25 M4z ± 3 dBs 75 mV for full outgut	Build you own top gu MA60 kit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt r ered by the Bi <sup>p</sup> X eta s of the shove m	ality amplifier, save yoursell following Bi-kits modules, 2 * SPMB0 stab power supply a RMS per channel STEREO K sa' staction or money be poures are in this ad.	pounds. T × A 50 am v. 1 × BMT . All ⊨odu
10w R.M.B. 401/FIER 000UES 3.75 + 330 P40 121% VAT		POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS	10 Writz RMS Less than -25% 8-16 ohms 50 K2-25 M4 ± 3 dBe 75 mV for full autgut Mmm - 68mm × 28mm	Build you own top gu MA60 kit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt r ered by the Bi * 3	ality amplifier, save yoursell following Bi-kits modules, 2 * SPMB0 stab power supply a RMS per channel STEREO K sa' staction or money be poures are in this ad.	pounds. T × A 50 am v. 1 × BMT . All ⊨odu
AL3OA 10W MPLIFIER ODDLES 3-75 + 35p P&p 121% VAT base low cast 5 and 10 ws		POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS Imast in reliability and performance.	10 Weits RMS Less than -25% 8-16 phms 100 K phms 50 Rz-25 kHz ± 3 dBe 75 mV for full autgut 75 mV for full autgut 74 mm - 65 mm × 28 mm while! being compact in size.	Build you own top gu MA60 kit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt r ered by the Bi <sup>p</sup> X eta s of the shove m	ality amplifier, save yoursell following Bi-kits modules, 2 SPM80 stab power supply a RMS per channel STEREO K sa utaction or money be poures are in the ad. VAT + 62p p&p.	pounds. T × A 50 ami v. 1 × BMT . All ⊨odu
AL3OA 10W MPLIFIER DOULES 3 -75 + 35p pEp 121% VAT bese low cast 5 and 10 ws PM80		POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS Imast in reliability and performance.	10 Write RMS Less than -25% 8-16 ohms 100 K ohms 50 R2-25 Mt ± 3 dBs 75 mV for full autout 74mm - 63mm × 28mm whilet being compact in size. 33-40V	Bulld you own top qu MA60 hit comprises the 1 × PA100 pre-amp, 1 Irana gleing 17 watt r ered by the Bi <sup>25</sup> ela so the shove m Price £32 06 + 121% 1	ality amplifier, save yourself tollowing Bi-kits modules, 2 • SPM80 stab power supply • RMS per channel STEREO K sa' staction or monry be boures are in this ad. VAT + 62p p&p. TC60 KIT	pounds, T × A 50 amp y, 1 × BMT , All Lindul ck guarante
AL3OA 10W MPLIFIER DOULES 3 -75 + 35p pEp 121% VAT bese low cast 5 and 10 ws PM80		POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS Impat in reliability and performance. INPUT A.C VOLTAGE OUTPUT CURRENT	10 Weits RMS Less than -25% 8-16 phms 100 K phms 50 Rz-25 kHz ± 3 dBe 75 mV for full autgut 75 mV for full autgut 74 mm - 65 mm × 28 mm while! being compact in size.	Build you own top ou MA60 hit comprises the 1 × PA100 pre-amp, 1 trans glving 17 watt eta s ot the shove m Price £32 05 + 121% 1 A beautifully designed to put the professional	ality amplifier, save yourself toilowing Bi-kits modules, 2 • SPM60 stab power supply a RMS per channel STEREO K sa' staction or monry be boules are in this ad. VAT + s2p pSp. <b>TC60 KIT</b> § genuine TEAK WOOD yen fouches to your home built	pounds. T × A 50 am; , 1 • BMT . All I rodu ck guarante marred cabre amplifter. F
AL3OA MPLIFIER DODUES 3 · 75 + 35p p4p 121% VAT takk VAT takk VAT BPM80 ABILISED DVER SUPPLY		POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS Imast in reliability and performance. INPUT A.C VOLTAGE DUTPUT D.C. VOLTAGE DUTPUT CURRENT OVERLOAD CURRENT	10 Write RMS Less than -25% 8-16 ohms 50 Kz-25 kHz ± 3 dBs 75 mV for full autout 74mm - 63mm × 28mm whilet being compact in size. 33-40V 33 V nominel 10 mA-1 5 smps 17 genps approx.	Build you own top ou MA60 hit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt eta s ot the shove m Price £32 06 + 12}% A beautifully designed to put the professional set of parts Inci. From Sockets, Noen, etc. Idd	ality amplifier, save yourself following Bi-kits modules, 2 • SPM80 stab power supply • RMS per channel STEREO K sa' staction or mante be poules are in the ad. VAT + stop pap. • TC60 KIT	pounds. T × A 50 am; , 1 × BMT . All I lodu ck guarante sered cebus amplifier, F assis, Fusi
AL3OA 10W MPLIFIER DOULES 3 -75 + 35p pEp 121% VAT bese low cast 5 and 10 ws PM80		POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS Impat in reliability and performance. INPUT A.C VOLTAGE OUTPUT CURRENT	10 Winits RMS Less than -25% 8-16 phma 100 K ohms 50 Ra-25 kMz ± 3 dBe 75 mV for full autget 74mm + 65mm + 28mm whilet being compact in size. 33-40V 33 V nominel 10 mA-1 5 smps	Build you own top gu MA60 hit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt r ered by the BiP3 eta s of the above m Price £32 06 + 121% 1 A beautifully designer to put the professional set of parts Inci. From	ality amplifier, save yourself following Bi-kits modules, 2 • SPM80 stab power supply • RMS per channel STEREO K sa' staction or manty be poules are in the ad. YAT + 62p p&p. • TC60 KIT • Genuine TEAK WDOD ven (ouches to your home built z • 4 Bach Panela, Knobs, Ch pal for the MA60. Size: 425mm	pounds. T × A 50 am; , 1 × BMT . All I lodu ck guarante sered cebus amplifier, F assis, Fusi
AL3OA 10W RMSLIFIER ODULES 3 -75 + 35p pEp 121% VAT 121% VAT ABILISED ABILISED ABILISED ABILISED ABILISED ABILISED 123% VAT	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS Imast in reliability and performance. INPUT A.C VOLTAGE DUTPUT D.C. VOLTAGE DUTPUT CURRENT OVERLOAD CURRENT	10 Write RMS Less than -25% 8-16 ohms 100 K ohms 50 R2-55 kHz ± 3 dBs 75 mV for full output 74mm - 65mm × 28mm whilet being compact in size. 33 40V 33 V nominal 10 mA-15 smps 1.7 smps approx. 105mm × 63mm × 30mm	Build you own top gu MA60 hit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt r ered by the BiP 1 eta s of the above m Price £32 06 + 121% 1 A beautifully designer to put the professional set of parts Inci. From Sockets, Noen, etc. id 95mm.	ality amplifier, save yourself following Bi-kits modules, 2 • SPM80 stab power supply • RMS per channel STEREO K sa' staction or manty be poules are in the ad. yAT + 62p p&p. • TC60 KIT • Genuine TEAK WDOD ven (ouches to your home built z • 4 Bach Panela, Knobs, Ch pal for the MA60. Size: 425mm	pounds. T × A 50 am; , 1 × BMT . All I lodu ck guarante sered cebus amplifier, F assis, Fusi
ABILISED DWER SUPPLY AT 125 + 35p pip 121% VAT 128% VAT 1	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD MPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS IMOUT A.C VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT CURRENT OVERLOAD CURRENT DIMENSIONS annel simultaneously. Circuit Technic	10 Write RMS Less than -25% 8-16 ohms 50 R2-25 kHz ± 3 dBs 75 mV for full autout 74mm - 63mm × 28mm whilet being compact in size. 33 40V 33 V nominel 10 mA-1 5 amps 17 amps approx. 105mm × 83mm × 30mm ques Include full short circuit	Build you own top gu MA60 hit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt r ered by the BiP 1 eta s of the above m Price £32 06 + 121% 1 A beautifully designer to put the professional set of parts Inci. From Sockets, Noen, etc. id 95mm. Price £13 35 + 121% 1	ality amplifier, save yourself following Bi-kits modules, 2 • SPM80 stab power supply • RMS per channel STEREO K sa' staction or manty be poules are in the ad. yAT + 62p p&p. • TC60 KIT • Genuine TEAK WDOD ven (ouches to your home built z • 4 Bach Panela, Knobs, Ch pal for the MA60. Size: 425mm	pounds. T × A 50 am; , 1 • BMT . All i odu ck guarante sered cebur amplifier, F assis, Fusi
ALIGOA 10W R.M.B. HPLIFIER ODDIES 3 · 75 + 35p p&p 121% VAT heate low cast 5 and 10 ws PM80 ABILISED DWER SUPPLY 4 · 25 + 35p p&p 121% VAT	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS Imput A.C VOLTAGE OUTPUT D.C. VOLTAGE	10 Write RMS Less than -25% 5-16 ohms 100 K ohms 50 R2-25 kHz ± 3 dBs 75 mV for full output 74mm - 65mm × 28mm whilet being compact in size. 33 40V 33 V nominal 10 mA-1-5 smps 17 smps approx. 105mm × 53mm × 30mm ques Include full short circuit 20 Hz to 20 kHz × 1 dB Less than 1% (Typically -07%)	Build you own top au MA80 hit comprises the 1 × PA100 pre-amp, 1 trans gluing 17 wait et a so the above m Price £32 06 + 123% 1 A beautifully designee to put the pratestional set of parts Inci. From Sockets, Noen, etc. id 65mm. Price £13 35 + 121% 1 TRA T538 For use with 5.4	ality amplifier, save yoursell following Brkits modules, 2 • SPM80 stab power supply • RMS per channel STEREO K sa' staction or marke be poules are in the ad. • VAT + 82p p&p. • TC60 KIT • Samulne TEAK WOOD van fouches to your home built a t & Back Panele, Knobs, Ch tal for the MA60. Size: 425mm VAT + 85p p&p • NSFORMERS 50 AL30A MPA30	pounds. T × A 50 ammy , 1 × BMT , All J odu ck guarante amplifar, F assig, Fus n 290mm
AL3OA UDIO HPLIFIER ODDIES 13.75 + 35p pEp 121% VAT SPM80 ABILISED DWER SUPPLY 4.25 + 35p pEp 121% VAT Seigned to power two ALE otoction. PA100 EREO	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD MPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS IMPUT A.C VOLTAGE OUTPUT CURRENT OVERLOAD CURRENT OVERLOAD CURRENT DIMENSIONS annel simultaneously. Circuit Technic FREQUENCY RESPONSE TOTAL HARMONIC DISTORTION SENSITIVITY 1. TAPE	10 Write RMS Less than -25% 8-16 ohms 50 K2-25 M3 ± 3 dBs 75 mV for full autgut 14mm - 63mm × 28mm whilst being compact in size- 33-40V 33 V nominal 10 mA-1.5 amps 11 r amps approx. 105mm × 63mm × 30mm gues Include full short circuit 20 Hz to 20 kHz × 1 dB Less than 1% (Typically 07%) 100 mV/100 K ohms ) For an	Build you own top ou MA80 hit comprises the 1 × PA100 pre-amp, 1 trans gluing 17 wait t ered by the Bir 2 eta 5 of the above m Price £32 06 + 123% 1 A beautifully designee to put the pratestional set of parts Inci. From Sockels, Noen, etc. idd 95mm. Price £13 35 + 123% 1 TRA T538 For use with 5.4 Order No. 2034 T2050 For use with 5.4	ality amplifier, save yoursell following Brkits modules, 2 · SPM80 stab power supply s RMS per channel STEREO K sa' staction or mark be poules are in the ad. VAT + 82p p&p. TC60 KIT S genuine TEAK WOOD van fouches to your home built 2 t & Back Panela, Knobs, Ch tal for the MA80. Siza: 425mm VAT + 81p p&p NSFORMERS 50 AL30A MPA30 Price: £3 20 + 55p p&p	pounds. T × A 50 amm, , 1 > BMT . All J rodul ck guarante amplifier, F assis, Fusc a 290mm + T23% VA
AL3OA MPLHIER DOULES 3.75 + 35p p4p 121% VAT 128% V	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS IMPUT A.C VOLTAGE OUTPUT O.C. VOLTAGE OUTPUT CURRENT DIMENSIONS annel simultaneously. Circuit Technic FREQUENCY RESPONSE TOTAL HARMONIC DISTORTION SENSITIVITY 1. TAPE INPUTS 2. RADIO TUNER 3. MAGNETIC P.U.	10 Write RMS Less than -25% 5-16 ohms 50 K2-25 kH2 ± 3 dBs 50 K2-25 kH2 ± 3 dBs 74mm - 63mm × 28mm whilst being compact in size. 33-40V 53 V nominel 10 mA-1 5 amps 10 mA-1 5 amps 5 amps 10 mA-1 5 amps 5 amps 10 mA-1 5 amps 5 amps 10 mA-1 5 amps 5 amps	Build you own top ou MA80 hit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt r ered by the BiP3 eta s of the above m Price £32 06 + 121% 7 A beautifully designed to put the professional set of parts Inci. From Sockets, Noen, etc. Id 95mm. Price £19 35 + 121% 7 TRA T538 For use with 54 Order No. 2006	ality amplifier, save yourself following Bi-kits modules, 2 · SPM80 stab power supply or RMS per channel STEREO K sa' staction or manry be boules are in the ad. YAT + 62p p.c. <b>TC60 KIT</b> · genuine TEAK WDOD yen (ouches to your home built z · d Back Panels, Knobs, Ch tal for the MA80. Size: 425mm YAT + 63p p&p <b>NSFORMERS</b> S0 AL30A MPA30 Price: £3 25 + 55p p&p ereo 30 Price: £3 25 + 55p p&p	pounds. T × A 50 amm, , 1 > BMT . All J rodul ck guarante amplifier, F assis, Fusc a 290mm + T23% VA
AL3OA UDIO HPLIFIER ODDIES 13.75 + 35p pEp 121% VAT SPM80 ABILISED DWER SUPPLY 4.25 + 35p pEp 121% VAT Seigned to power two ALE otoction. PA100 EREO	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS IMPUT A.C VOLTAGE OUTPUT D.C. VOLTAGE T.C. A.	10 Write RMS Less than -25% 5-16 ohms 100 K ohms 50 Rr-25 kHz ± 3 dBs 75 mV for full autput 74mm - 65mm × 28mm whilet being compact in size. 33 40V 33 4 nominal 10 mA-15 smps 1.7 smps approx. 105mm × 83mm × 30mm ques Include full short circuit 70 Hz to 20 kHz × 1 dB Less than 1% (Typically 07%) 100 mV100 K ohms For an 100 mV100 K ohms For an 105 mV50 K ohms 250 mV	Build you own top ou MA60 hit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt r ered by the Bir 2 eta s of the above m Price £32 06 + 121% 7 A beautifully designed to put the pratessional set of parts Inci. From Sockets, Noen, etc. Id 95mm. Price £19 35 + 121% 7 TTRA T538 For use with S.4 Order No. 2034 T2050 For use with S.4 Order No. 2054 BMT30 For use with S.4	ality amplifier, save yourself following Bi-kits modules, 2 · SPM80 stab power supply or RMS per channel STEREO K sa' staction or manty be poules are in the ad. <b>TC60 KIT</b> · and the state of the state of the source set in the ad. · AT + stap pape. · AT + stap pape. · AT + stap pape. · AT + stap pape · AT + stap pape · AT + stap pape · Price: S1 20 + 55p pape · Price: S1 40 + 85p pape	pounds. T × A 50 amm, , 1 > BMT . All I rodu ck guarante amplifier. F assie, Fusi - 290mm + 121% V/ + 121% V/
AL3OA UDIO HPLIFIER ODDIES 13.75 + 35p pEp 121% VAT SPM80 ABILISED DWER SUPPLY 4.25 + 35p pEp 121% VAT Seigned to power two ALE otoction. PA100 EREO	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD MPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS IMPUT A.C VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT CURRENT OVERLOAD CURRENT DIMENSIONS annel simultaneously. Circuit Technic FREQUENCY RESPONSE TOTAL HARMONIC DISTORTION SENSITIVITY 1. TAPE INPUTS 2. RADIO TUNER 3. MAGNETIC P.U. EQUALISATION BASS CONTROL BANGE	10 Weitz RMS Less than -25% 5-16 ohms 50 K-25 kHz ± 3 dBs 50 K-25 kHz ± 3 dBs 33-40V 33 V nominal 10 mA-1 5 amps 11 mA-1 5 amps 10 mA-1 6 0 kHz ± 1 dB Less than 1% (Typically 07%) 10 m V100 K ohms 1 20 mV Writin ± 1 dB from 20 Hz 10 20 kHz ± 15 dBs st 75 Hz	Build you own top ou MA60 hit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt t ered by the Bi P 3 eta 5 of the above m Price £32 06 + 121% 1 Price £32 06 + 121% 1 Price £32 06 + 121% 1 Price £13 06 + 121% 1 Price £13 06 + 121% 1 TERA TS38 For use with 5.4 Order No. 2014 TS38 For use with 5.4 Order No. 2014 BMT80 For use with 5.4	ality amplifier, save yourself following Bi-kits modules, 2 · SPM80 stab power supply or RMS per channel STEREO K sa' staction or manty be poules are in the ad. <b>TC60 KIT</b> · and the state of the state of the source set in the ad. · AT + stap pape. · AT + stap pape. · AT + stap pape. · AT + stap pape · AT + stap pape · AT + stap pape · Price: S1 20 + 55p pape · Price: S1 40 + 85p pape	pounds. T × A 50 amm, , 1 > BMT All I odu angelifier, F assie, Fus > 290mm + 121% V/ + 121% V/
AL3OA UDIO HPLIFIER ODDIES 13.75 + 35p pEp 121% VAT SPM80 ABILISED DWER SUPPLY 4.25 + 35p pEp 121% VAT Seigned to power two ALE otoction. PA100 EREO	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS Imput A.C VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT S.C. RANGE TOTAL HARMONIC DISTORTION SENSITIVITY 1. TAPE INPUTS 2. RADIO TUNER 3. MAGNETIC P.U. EQUALISATION BASS CONTROL RANGE	10 Write RMS Less than -25% 5-16 ohms 100 K ohms 50 R2-25 kHz ± 3 dBs 75 mV for full autput 74mm - 65mm × 28mm whilet being compact in size. 33 40V 33 V nominal 10 mA-1:5 amps 17 amps approx. 105mm × 53mm × 30mm ques Include full short circuit 20 Hz to 20 kHz × 1 dB Less than 1% (Typically -07%) 100 mV/100 K ohms } or an 20 mV /100 K ohms } or an 20 mV /100 K ohms } 250 mV Writin ± 1 dB from 20 Hz to 20 kHz × 1 dB from 20 Hz to 20 kHz × 1 dB from 20 Hz to 20 kHz × 1 dB from + 10% for an 20 Hz to 20 kHz × 1 dB from + 10% for an 20 Hz to 20 kHz × 1 dB from + 10% for an + 10%	Build you own top ou MA60 hit comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt t ered by the Bi P 3 eta 5 of the above m Price £32 06 + 121% 7 A beautifully designee to part the professional set of parts Inci. For Sockets, Noen, etc. 1dd 95mm, Price £13 25 + 121% 7 TERA T538. For use with 5.4 Order No. 2034 BMT30 For use with S4 Order No. 2034 BMT30 For use with S4	ality amplifier, save yoursell following Brkits modules, 2 · SPM80 stab power supply s RMS per channel STEREO K sa' Jacilion or mark be poules are in the ad. VAT + 82p p&p. <b>TC60 KIT</b> is genuine TEAK WOOD van fouches to your home built a Back Panele, Knobs, Ch sal for the MA60. Size: 425mm VAT + 84p p&p <b>NSFORMERS</b> 50 AL30A MPA30 Price: £3 20 + 55p p&p Price: £3 25 + 55p p&p Price: £3 25 + 55p p&p Price: £5 40 + 85p p&p AL250	pounds. T × A 50 amm, , 1 > BMT All I odu angelifier, F assie, Fus > 290mm + 121% V/ + 121% V/
AL3OA UDNO HPLIFIER ODDULES 13.75 + 35p p&p 121% VAT 121% VA	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS IMPUT A.C VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT OURRENT DIMENSIONS annel simultaneously. Circuis Technic FREQUENCY RESPONSE TOTAL HARMONIC DISTORTION SENSITIVITY 1. TAPE INPUTS 2. RADIO TUNER 3. MAGNETIC P.U. EQUALISATION BASS CONTROL RANGE TREBLE CONTROL RANGE SIGNALIMOISE RATIO	10 Write RMS Less than -25% S-16 ohms 50 K2-25 kH2 ± 3 dBs 50 K2-25 kH2 ± 3 dBs 75 mV jor full autout 74mm - 63mm × 28mm whilst being compact in size. 33-40V 53 V nominel 10 mA-1 5 amps 10 mA -1	Build you own top ou MARGN is comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt c ered by the Bi P 3 eta s of the above m Price £32 06 + 123% 1 A beautifully designed be of parts Inc. Fron Sockets, Noen, etc. Id 95mm. Price £13 35 + 123% 1 TCSB For use with 5.4 Order No. 2036 T0350 For use with 5.4 Order No. 2036 BMT80 For use with 51 Order No. 2036	ality amplifier, save yourself following Brkits modules, 2 - SPM80 stab power supply a RMS per channel STEREO K sa' staction or marry be poules are in the ad. VAT + 62p p&p. <b>TC60 KIT</b> S genuine TEAK WD0D ven louches to your home built z t & Back Panels, Knobs, Ch al for the MA80. Size: 425mm /AT + 63p p&p <b>NSEFORMERS</b> 50 AL30A MPA30 Price: £3 20 + 55p p&p Price: £3 25 + 55p p&p AL50 Price: £5 49 + 85p p&p AL250 Price: £5 49 + 85p p&p AL250 Price: £5 49 + 85p p&p	pounds. T × A 50 amm, , 1 > BMT . All I odu ck guarante savid, Fass h 290mm + T23% V/ + T23% V/ + 123% V/ + 123% V/
ABILISED DWER SUPPLY A 25 + 35p pep DWER SUPPLY A 35 per ABILISED DWER SUPPLY A 35 per ABILISED	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS Imput A.C VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT CURRENT OVERLOAD CURRENT DVERLOAD CURRENT DVERLOAD CURRENT DVERLOAD CURRENT DVERLOAD CURRENT DIMENSIONS annel simultaneously. Circuit Technic FREQUENCY RESPONSE TOTAL HARMONIC DISTORTION SENSITIVITY 1. TAPE INPUTS 2. RADIO TUNER 3. MAGNETIC P.U. EQUALISATION BASS CONTROL RANGE SIGNALINOISE RATIO INPUT OVERLOAD SUPPLY	10 Write RMS Less than -25% 5-16 ohms 50 R2-25 kHz ± 3 dBs 50 R2-25 kHz ± 3 dBs 75 mV for full autout 74mm - 63mm × 28mm while! being compact in size. 33 V nominal 10 mA-15 smps 10 mA-15 smps 10 mA-15 smps 11 mm × 83mm × 30mm ques include full short circuit 20 Hz to 20 kHz × 1 dB Less than 1% (Trpically -07%) 700 mV/100 K ohms } cotput 3 5 mV/50 K ohms } 250 mV Writhin ± 1 dB from 20 Hz to 20 kHz × 1 dB Less than 1% (Trpically -07%) 700 mV/100 K ohms } cotput 3 5 mV/50 K ohms } 250 mV Writhin ± 1 dB from 20 Hz to 20 kHz ± 15 dBs st 75 Hz + 19-20 dBs at 15 kHz Better than 56 dBs (All inputs) 8 citer than 26 dBs (All inputs) 20 to 40 V	Build you own top ou MARGN is comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt c ered by the Bi P 3 eta s of the above m Price £32 06 + 123% 1 A beautifully designed be of parts Inc. Fron Sockets, Noen, etc. Id 95mm. Price £13 35 + 123% 1 TCSB For use with 5.4 Order No. 2036 T0350 For use with 5.4 Order No. 2036 BMT80 For use with 51 Order No. 2036	ality amplifier, save yourself following Brkits modules, 2 - SPM80 stab power supply a RMS per channel STEREO K sa' staction or marry be poules are in the ad. VAT + 62p p&p. <b>TC60 KIT</b> S genuine TEAK WD0D ven louches to your home built z t & Back Panels, Knobs, Ch al for the MA80. Size: 425mm /AT + 63p p&p <b>NSEFORMERS</b> 50 AL30A MPA30 Price: £3 20 + 55p p&p Price: £3 25 + 55p p&p AL50 Price: £5 49 + 85p p&p AL250 Price: £5 49 + 85p p&p AL250 Price: £5 49 + 85p p&p	pounds. T × A 50 amg , 1 > BMT . All J adult ck guarante sered tabir amplifier, F saste, Faz saste, Faz + T23% VA + T23% VA + 123% VA + 123% VA
ABILISED WER SUPPLY 12% VAT WEB SUPPLY 12% VAT WEB SUPPLY 4.25 + 35p pip 12% VAT Signed to power two ALE Diver SUPPLY 4.25 + 35p pip 12% VAT Signed to power two ALE Diver SUPPLY 4.25 + 35p pip 12% VAT Signed to power two ALE Diver SUPPLY 4.25 + 35p pip 12% VAT Signed to power two ALE Diver SUPPLY 4.25 + 35p pip 12% VAT Signed to power two ALE Diver SUPPLY 4.25 + 35p pip 12% VAT Signed to power two ALE Diver SUPPLY 4.25 + 35p pip 12% VAT Signed to power two ALE Diver SUPPLY 4.25 + 35p pip 12% VAT Signed to power two ALE Diver SUPPLY 4.25 + 35p pip 12% VAT Signed to power two ALE Diver SUPPLY 4.25 + 35p pip 12% VAT Signed to power two ALE Signed to power two ALE	tt modules offer the u	POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS Imput A.C VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT S.C. RANGE TOTAL HARMONIC DISTORTION SENSITIVITY 1. TAPE INPUTS 2. RADIO TUNER 3. MAGNETIC P.U. EQUALISATION BASS CONTROL RANGE TREBLE CONTROL RANGE SIGNALINOISE RATIO INPUT OVERLOAD	10 Write RMS Less than -25% S-16 ohms 100 K ohms 00 Rr-25 kHz ± 3 dBs 75 mV for full autput 74mm - 85mm × 28mm whilet being compact in size. 33 40V 33 4 nominal 10 mA-15 smps 1.7 smps approx. 105mm × 83mm × 30mm 10 mA/15 smps 1.7 smps approx. 105mm × 83mm × 30mm 10 mV/100 K ohms } For an 10 mV/100 K ohms } For an 20 Hz to 20 kHz × 1 dB Less than 1% (Typically 07%) 10 mV/100 K ohms } For an 20 Hz to 20 kHz × 1 dB Less than 1% (Typically 07%) 10 mV/100 K ohms } 50 rem 20 Hz to 20 kHz × 1 dB Less than 1% (Typically 07%) 15 dB st 75 Hz + 10-20 dBs at 15 Hz + 10-20 dBs at 15 Hz	Build you own top ou MARGN is comprises the 1 × PA100 pre-amp, 1 trans giving 17 watt c ered by the Bi P 3 eta s of the above m Price £32 06 + 123% 1 A beautifully designed be of parts Inc. Fron Sockets, Noen, etc. Id 95mm. Price £13 35 + 123% 1 TCSB For use with 5.4 Order No. 2036 T0350 For use with 5.4 Order No. 2036 BMT80 For use with 51 Order No. 2036	ality amplifier, save yoursell following Brkits modules, 2 · SPM80 stab power supply s RMS per channel STEREO K sa' Jacilion or mark be poules are in the ad. VAT + 82p p&p. <b>TC60 KIT</b> is genuine TEAK WOOD van fouches to your home built a Back Panele, Knobs, Ch sal for the MA60. Size: 425mm VAT + 84p p&p <b>NSFORMERS</b> 50 AL30A MPA30 Price: £3 20 + 55p p&p Price: £3 25 + 55p p&p Price: £3 25 + 55p p&p Price: £5 40 + 85p p&p AL250	pounds. T × A 50 am, , 1 > BM1 . All I du ck guarant eered tabhar arabitar. F arabitar. F

Practical Wireless, October 1978



#### EDITOR

Geoffrey C. Arnold

ASSISTANT EDITOR Dick Ganderton C. Eng., MIERE

ART EDITOR

Peter Metalli TECHNICAL EDITOR

Ted Parratt, BA

NEWS & PRODUCTION EDITOR Alan Martin

TECHNICAL SUB-EDITOR

Peter Preston TECHNICAL ARTIST

Rob Mackie

LAYOUT ARTIST

Keith Woodruff

SECRETARIAL

Sylvia Barrett Debbie Chapman

#### EDITORIAL OFFICES Westover House,

West Quay Road, POOLE, Dorset BH15 1JG Telephone. Poole 71191

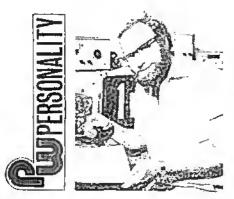
ADVERTISEMENT MANAGER Telephone: 01-261 6671 Roy Smith

REPRESENTATIVE Telephoner 01-261 6636 Dennis Brough

CLASSIFIED ADVERTISEMENTS Telephone: 01-261 5762 Colin R. Brown

MAKE UP & COPY DEPARTMENT Telephone: 01-261 6570 Dave Kerindi

ADVERTISEMENT OFFICES Kings Reach Tower, Stamford St., London, SE1 9LS TELEX: 915748 MAGDIV-G



# Caveat Emptor

ET THE BUYER BEWARE!---a very old Latin tag, but one which is still sound, even with the advent of present-day consumer protection legislation. Perhaps not quite its usual application, but none the less important for the home constructor of electronic projects, would be in warning readers to make sure that they can still get the specialised bits and pieces used in a past design, before spending out money on the rest of the components.

Every few months we seem to get a spate of letters from readers who have suddenly decided to build something which we published five, ten or even more years ago. They have gone ahead and spent a considerable sum getting together the "easier" components, only to find that they can't find a source of one awkward one anywhere. Then they write to us for help.

If it's a semiconductor device, it's usually not too difficult to find an equivalent, though to replace some early audio i.c.s. will often involve modifying a printed circuit board layout. The real problem area is that of transformers, sometimes for power supplies for valved equipment. A careful check through the advertisement pages, or some suppliers' catalogues, will often reveal something suitable for these.

More difficult are audio transformers, particularly inter-stage coupling or push-pull output types for early transistorised power amplifiers. The coming of direct-coupled amplifier designs with complementary or quasi-complementary output stages, and the more recent single-chip audio power amplifiers, has meant that the demand for such transformers has largely disappeared, and as a result many manufacturers have stopped producing them. Obviously it's possible to use a more modern design if just a straightforward audio amplifier is involved, but if it's doing a special job, things can sometimes be more complicated.

While we will always try to help a reader in difficulty with a project (but do please send an s.a.e.) we simply do not have the manpower to research and produce modifications to past designs to accommodate new components. It is often tempting to store away a circuit for future use—I know, I have a box-file full at home which I have collected over the past ten years or so. To any reader contemplating building a project from previous years, I would say please, please check that you can still get the "difficult" bits and pleces before you invest many pounds in the remainder.

#### Ted Parratt BA—Technical Editor

Ted's entry into the world of electronics began with RAF service as a Wireless Operator, followed by spells as a Test Engineer in industry with GEC and Solartron.

During a period as a freelance Audio/Visual Aids Technician he studied for an Open University degree, graduating in 1974, and just before coming to PW worked as a contract technician with another university. Apart from active involvements as a musician (a classical and jazz guitarist with a quartet), he enjoys jogging and real ale, although not simultaneously! Ted is married (his wife has an unusual "mobile" museum of domestic items), with one daughter a Legal Executive in the City, and a younger daughter and son just beginning work.







Plymouth Radio Club, G3PRC are now meeting at their new venue, The TAVR Centre, Lambhay Hill, Plymouth, on alternate Mondays commencing 17th July. Visitors and newcomers are particularly welcome. Beginners and those who may feel uncertain are invited to phone or write to the secretary at the following address, Len England, 62 Fullerton Road, Milehouse, Plymouth, Devon. Tel: 0752 58841.

The Sully and District Amateur Radio Club formerly the Sully and District Short Wave Club, would like to extend a warm welcome to prospective new members. At the moment the club is quite small and although they have their own call sign there are not quite enough members to keep it operational, so, for the time being it is in 'cold storage'. The club meets fortnightly at The Sully Bowls Club at 7.30pm until 10.15pm. Those interested please contact the new secretary at, 13 Nailsea Court, Sully, Cardiff, S. Glam. Tel: 0222 530787.

#### Shine on

Amalgamated Wireless (Australasia) Ltd., has commenced work on a \$600,000 scheme to convert the entire trunk telecommunications network in Papua New Guinea from battery to solar power.

This is believed to be the first time such a project has been undertaken, and involves the installation of power cells at about 20 microwave repeater stations located at strategic points throughout the Territory.

Many outstations currently using mechanical generators will also be included in the scheme.

#### Long Distance TV

We have been asked to advise readers that Roger Bunney's book Long Distance Television, formerly available from Weston Publishing, Romsey, is now out of print. A revised and expanded version of the work is to be published shortly by Babani Press.

Practical Wireless, October 1978

#### Girls, Girls, Girls

The Caroline Haslett Memorial Trust and The Institution of Electrical and Electronics Technician Engineers have introduced an annual electrical and electronic engineering award valued at £250 for 'The Girl Technician Engineer of the Year'. With a closing date of 1st October for nominations, the announcement of the 1978 Award will be made in December.

The engineering industry needs to attract more young people of the highest calibre and the aim of the Award is to focus attention on electrical and electronic engineering as a worthwhile career for women. By selecting the most outstanding girl technician engineer-who will have successfully undertaken the necessary technical education and training, and have proved herself capable of holding a responsible job-it is the Award sponsors' express hope that she will, by her example, encourage more girls to enter the electrical and electronic engineering profession.

For further details and copies of the Award nomination form please apply to: Joan Ashton, IEETE, 2 Savoy Hill, London WC2R 0BS. Tel: 01-836 3357.

#### **Diary Date**

I am informed by Blackwood & District Amateur Radio Society that this year's Welsh Amateur Radio Convention will be held on Sunday, 24th September at the usual venue, Oakdale Community College, Oakdale, Blackwood, Gwent. The Convention will be opened by Dr D. S. Evans, G3RPE, President of the R.S.G.B.

Apart from a Trade Exhibition, demonstrations and advice on amateur TV (Gwent TV Group), RTTY (BARTG), satellite communication (AMSAT UK) and 'ORACLE', the I.B.A. teletext system, the programme will include a film of the 1978 Clipperton Island DXpedition, the ARRL film 'Ham's Wide World', an illustrated lecture by S. Cherry, G3SJK, of the Appleton Laboratory on 'Telemetry Communications from High Altitude Transatlantic Balloons Using Low Power h.f.', and a talk on R.S.G.B./ W.A.R.C. 1979' by Dr. D. S. Evans, There will be increased exhibition space this year and advice on overnight accommodation is available from F. B. Davies GW3KYA, 16 Vancouver Drive, Penmain, Blackwood, Gwent NP2 0UQ. Tel: 0495 225825.

#### **RAE** courses

RAE courses are available this Autumn at the following locations:-

Hemel Hempstead (Herts.)—Commencing Tuesday 12th September, enrolment on 4th and 5th September. The course lecturer will be C. Burke G3VOZ, tel: 0442 833300. Hemel Hempstead College of Further Education, Marlowes, Hemel Hempstead, Herts.

Knottingley (West Yorks.)—Commencing mid-September, enrolment on 11th September. Course lecturer G3HCW. Knottingly High School, Knottingly, West Yorks.

Birkenhead (Cheshire)—Commencing mid-September on Thursday evenings, enrolment from 4th to 11th September, or at class meetings. Course lecturer D. E. Owen G4GGB. Dept. of Electrical Engineering, Birkenhead College of Technology, Borough Road, Birkenhead, Wirral.

Openshaw (Manchester)—Commencing Tuesday 18th September, enrolment 4th, 5th and 6th September between 6pm and 8pm. Course lecturer A.B. Langfield G3IOA. Openshaw Technical College, Whitworth Street, Openshaw, Manchester 11.

Swinton (Manchester)—Commencing Thursday 28th September. Details from G8BFP, tel: 061-794 3706. Moorside High School, East Lancashire Road, Swinton, Manchester.

Gosforth (Newcastle upon Tyne)---Theory and morse classes to be held on Tuesdays and Thursdays respectively, between 7pm and 9pm, commencing in September. For further information telephone the course lecturer on 0632 668439. Gosforth High School, Knightsbridge, Gosforth, Newcastle upon Tyne.

#### **RAE** reprint

For full details of availability and price, see page 64.



The circuit to be described was developed as a simple and effective version of a more complex converter which has been in use at the Author's station for the past five years. It was decided that the new converter should use the most up-to-date circuit techniques in order to achieve low noise figures, good gain and good cross-modulation performance.

The previous converter employed cascode f.e.t. i.f. stages and performed well but it had been tricky to set up and therefore would not be reproducible by the newcomer to amateur radio. Replacing the cascode f.e.t.s with a new MOSFET r.f. stage made it possible to achieve a greater signal-handling capability, about the same gain but a slight degradation in the noise figure. The new stage presents no problems with regard to stability and is easy to tune. Although the noise figure for the converter is about 2.5-3.5dB this is perfectly adequate and not exceeded by many commercial units aimed at the amateur market.

The new stage was exhaustively tested using sophisticated equipment, including a spectrum analyser, to optimise its performance.

During the tests it was found that non-linearity did not become severe until a signal of 120mV r.m.s., (350mV p-p) was applied. The gain of the stage was about 18dB (x8), there were no signs of instability with or without the aerial connected, and it was simple to tune.

# **Principle of Operation**

The signal arriving at the aerial is matched into the input of a MOSFET r.f. amplifier which magnifies its amplitude by 8 times and passes the larger signal to the mixer. Here the input signal is fed to the most sensitive electrode (gate 1) of another MOSFET, and a signal from the oscillator/multiplier chain is fed to the other control electrode (gate 2). These are then mixed together in the electron stream of the device emerging at the drain, together with the sum and difference of the two frequencies.

The biasing conditions for the mixer do not allow it to provide much gain but it does amplify the signal by a further two-and-a-half times. The signal selected from those present at the drain is the difference signal, which is 144-116=28MHz. This is now matched to a low impedance suitable for feeding via coaxial cable to the receiver.

The local oscillator signal is developed from an oscillator running at 38.6666 MHz as a reference, and a multiplier stage which produces multiples of this frequency. Then it selects the tripled frequency at 116MHz and filters it before injection into the mixer.

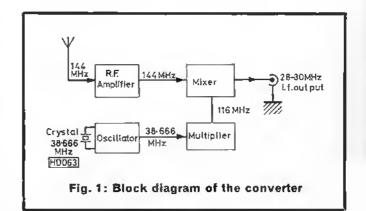
\*Development Engineer, Electronic Laboratories Ltd., Poole.



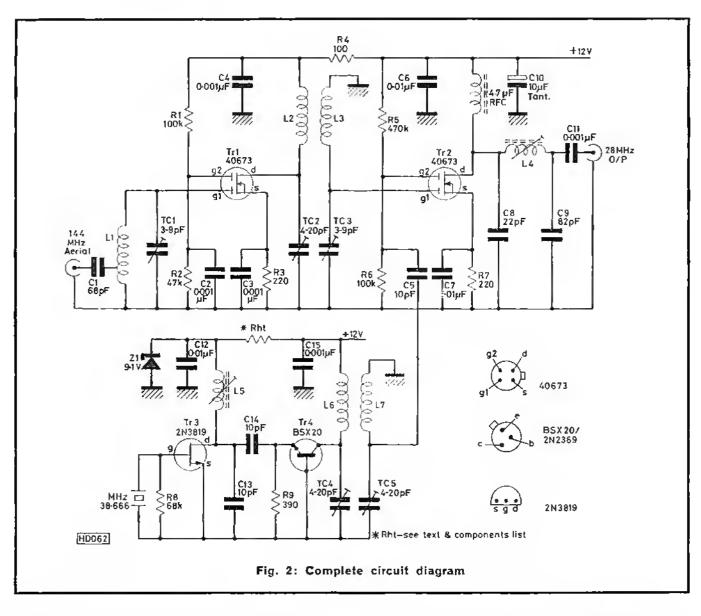
# **Circuit Description**

The 144MHz signal enters the input terminal at an impedance of  $50\Omega$  and is coupled via capacitor CI to a low impedance tapping point on Ll. This coil steps up the voltage in a manner which is proportional to the ratio of input turns to output turns. Similarly, the impedance is transformed up by the square of the turns ratio to provide a suitable match into gate 1 of Trl. The trimmer TCI tunes Ll to resonance in the 2 metre amateur band.

Resistors R1 and R2 provide bias at 33% of the supply voltage to the gain control electrode gate 2.



Practical Wireless. October 1978



Capacitor C2 decouples any variations of this voltage at radio frequencies to maintain constant gain conditions in the stage. Resistor R3 provides a voltage drop from the source/drain current flowing through it, making the source more positive than gate 1, or conversely, making gate 1 more negative than the source. This is the manner in which gate 1 bias is achieved and again this voltage is smoothed at signal frequency by the decoupling action of C3.

The amplified signal appears at the drain electrode and is developed across L2, this being tuned to resonance by TC2. The coil is closely coupled to L3 and draws off any signals that appear on it at their mutual frequency, other unwanted signals being heavily attenuated. Trimmer TC3 tunes L3 to resonance at the same frequency as L2 and TC2. The signal then passes into gate 1 of Tr2, as the impedance of L3/ TC3 presents a fairly good match to the gate. Bias for this gate is developed in a similar fashion to Tr1 by the operation of R7 and C7.

The bias for gate 2 of Tr2 is more critical than for 'Tr1, as this device, when acting as a mixer, must be driven well down on its characteristic curve for good mixing to take place. The bias voltage developed by the combination R5 and R6 should normally be 1/11th of the supply rail voltage but its precise value for good mixing is solely dependent on oscillator drive. For a mass-produced unit such as this one, it is better to bias the gate slightly higher than normal—i.e. 1/16th of the supply voltage—to take account of low gain devices in the oscillator strip and ensure that all units will work fairly well. For the perfectionist, it would be worth trying a 47k resistor for R6 to take full benefit of the low noise figures that can be obtained with this converter.

The r.f. choke in the drain circuit allows all the products of mixing to be developed across it whilst the pi circuit C8, C9 and L4 tune out the required difference signal at 28-30MHz for feeding to the receiver. One of the principal purposes of the pi arrangement is to match the signal to the low impedance coaxial output capacitor. Capacitor C11 separates the d.c. connection via RFC and L4 from the output terminal.

Supply line components C4, C6 and C10 decouple any r.f. signals leaving the unit and prevent undesirable interaction between the various stages.

Resistor R4 aids the decoupling whilst providing good isolation from large local oscillator signals appearing on its supply. The oscillator works due to feedback from the drain of Tr3 being passed back to the gate by virtue of the internal capacitance of the device, thus maintaining tuned gate/tuned drain oscillation in a similar manner to that developed by Miller for thermionic devices. To start and maintain the oscillation, the resonant circuit formed by L5, C13 and C14 must be tuned to the same frequency as the crystal.

Resistor R8 provides a d.c. path for the gate without damping the crystal, at the same time limiting the voltage across it to a reasonable level. This ensures that the f.e.t. works over a fairly linear section of its characteristic curve, to reduce the generation of harmonics.

The components Z1, C12 and  $R_{h1}$  stabilise the oscillator supply voltage to minimise frequency shift due to variations of the supply line voltage. The value of resistor  $R_{h1}$  is dependent on the  $I_{des}$  of the f.e.t. and may be determined by the expression shown in the components list.

e.g.  $R_{ebt} = \frac{12 - 9 \cdot 1}{0.005 + 0.004} = \frac{2 \cdot 9}{0.009} = 322\Omega$ 

Therefore, in this case use a  $330\Omega$  resistor.

The  $I_{des}$  can be found by coupling the source of the f.e.t. to the gate and connecting the combination to the negative rail of a low voltage supply—say 6V. Wire the drain via a 50mA meter to the positive pole of the supply: the  $I_{des}$  can then be established.

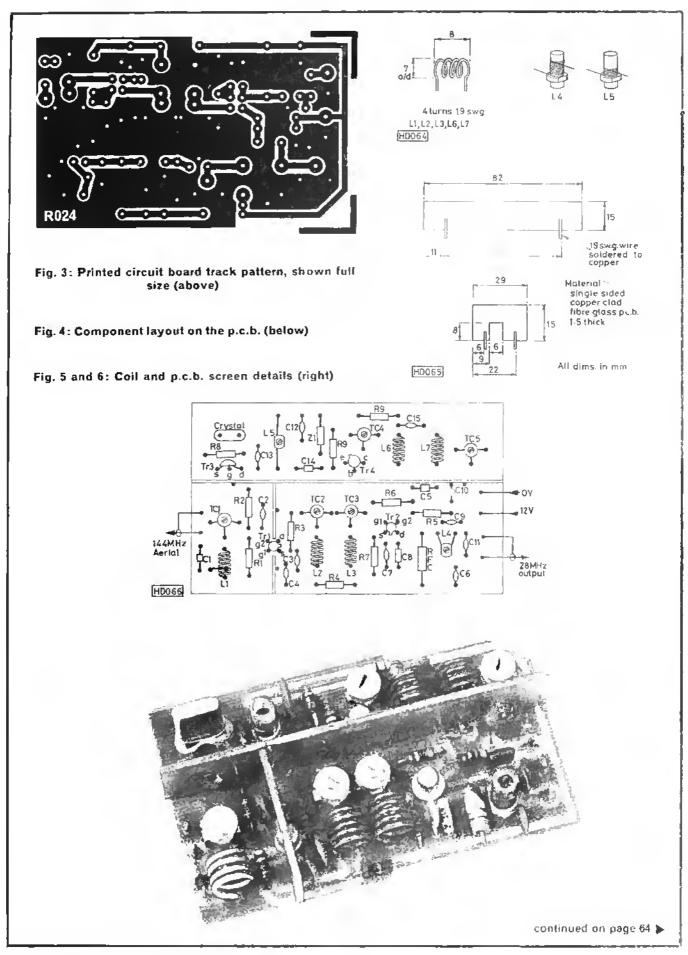
The multiplier transistor Tr4 operates in the grounded-base mode and is normally non-conducting. This is because no forward bias is applied to the base/ emitter junction. The transistor requires 0.6V to switch on and thus does not conduct during negative half-cycles of the oscillator output signal; only for that proportion of the positive half-cycle which exceeds 0.6V. In this manner, only short-duration pulses arrive at the collector and these are transformed into a rough sine wave by the flywheel action of the tuned circuit L6/TC4. The composite waveform contains many multiples of the original or fundamental frequency, but usually the signal of greatest magnitude is that to which the circuit is tuned. The coil L7 extracts the required signal by mutual coupling at a specific frequency, rejecting, to a large extent, those frequencies which are unwanted. The trimmer TC5 tunes L7 to the same multiple frequency as L6/TC4. In this way the 116MHz signal has an amplitude 50dB (300 times) greater than any of the unwanted multiples, providing virtually a pure sine waveform to the mixer and a relatively clean mixing action.

# **Construction and Layout**

The component layout provided puts the circuit into a small and stable form. Copper-clad chassis techniques could be employed, but would probably result in a reduction in overall performance. The board is easy to assemble and no problems should be encountered provided the coils are wound to the specified dimensions and the screens reproduced as shown.

The board may be mounted within the cabinet of a receiver, which will tend to reduce stray pick-up at the intermediate frequency of 28-30MHz. No difficulties should arise from internally mounting the unit unless the local oscillator of the receiver should happen to be poorly screened, and be producing harmonics which fall within the 2 metre band. Resistors 0 25W 5% Carbon Film 1000 R4 1  $220\Omega$ 2 R3, 7 390(2 R9 1 47kΩ 1 R2 **R8** 68kΩ 1 100kΩ 2 R1, 6 470k51 1 R5 Rht)----33012 if f.e.t. Idss 4mA 270Ω if f.e.t. Idss 8mA otherwise, 12 9-1 Rht -0.005 + 1dss Capacitors Sub-miniature Plate Ceramic 10pF 3 C5, 13, 14 68pF 1 C1 82pF C9 1 0.001 /r F 5 C2, 3, 4, 11, 15 0.01*µ*F 3 C6, 7, 12 Silver Mica 1 22pF C8 Tantalum Bead 10//F C10 1 Trimmers 👘 Miniature Single-turn Ceramic 3-9pF 2 TC1, 3 4-20pF 3 TC2, 4, 5 Semiconductors Transistors Tri, 2 2 40673 2N3819 1 Ťr3 Tr4 (2N2369 can also be used) BSX20 1 Diodes. 9V1 Zener 1 Z1 Crystal 38-6666MHz 3rd overtone 30pF series-resonant HC18U Coil Data L1 4t 6mm i.d. 8mm long 19s.w.g. tinned. L 2, 3, 6, 7 4t 6mm i.d. 8mm long 19s.w.g. enam. 17t on 5mm slug-tuned former. 30s.w.g. enam. L4 9t on 5mm slug-tuned former, 30s.w.g. enam. L5 RFC 4 7 µH choke (RS type 228-135). Hardware BNC Sockets 5002 2 \*\* Die-cast box. Bopal 102 or 103. \*\* Available from West Hyde Developments, Unit 9, Park Industrial Estate, Aylesbury, Buckinghamshire HP20 1ET Miscellaneous Switch, Miniature SPDT, if required

Another method of using the converter is as an out-board unit, connected to the receiver at its aerial socket and to a 12V supply line. In this case it would be ideal if the unit were fitted in a  $111 \cdot 1 \times 60 \cdot 3 \times 27$ mm die-cast box, such as the Eddystone EDD 20, or West Hyde "Bopal" 102/103 with suitable coaxial connectors fitted and a supply input socket.





Have you ever wondered how manufacturers of high quality equipment manage to get their components arranged so neatly on their printed circuit boards, indeed just why do they go to such lengths to achieve such neatness?

With our free gift this month you too can mount your transistors neatly and evenly on your p.c.bs and reap the benefits.

What then are these benefits? Our mounting pads hold each transistor the correct distance away from the board allowing you to solder the leads with less fear of damaging the transistor itself. The very act of pushing the transistor leads through the holes in the mounting pad ensures that the leads are not twisted or touching each other.

Having a solid pad of plastic between the transistor envelope and the board surface provides a means of mechanically supporting the transistor, preventing it from being displaced with the consequent danger of lead fracture or short circuits.

Reliability of equipment is usually improved as a result of using such aids as transistor mounting pads. This comes about as a direct result of neatness assisting visual inspection as well as improving your pride in your work. This lifts the standard of work giving better joints with less damage to p.c.b.s and components.

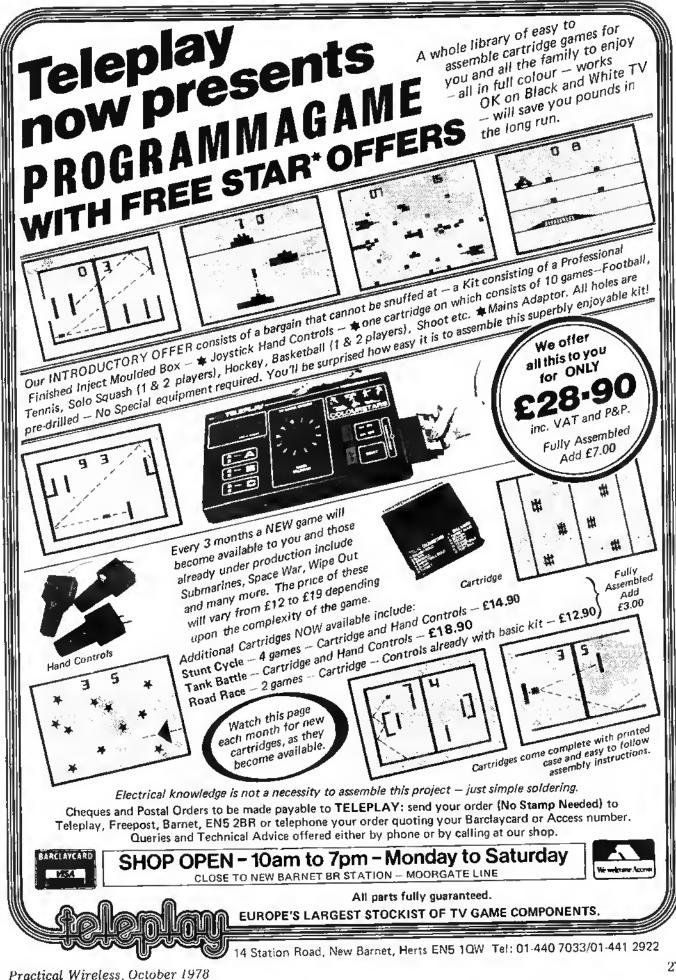
A properly designed and constructed printed circuit board should be a work of art. Take care with mounting components and the reliability and operation of your projects should improve. To use our free transistor mounting pads carefully remove each one from the sprue to leave a disc of plastic with four holes and a small tab. Select the appropriate size of pad for the transistor you are fitting. The small pads fit TO18 size packages and can be used for the small plastic encapsulations as well although they cannot be seated right down onto the pad. The larger pads fit TO5 packages.

To help with feeding the leads through the pads the top of the holes are countersunk and the leads should be fed through from this side. Push the pad right up to the transistor envelope and then insert the leads into the appropriate holes in the p.c.b. Push the transistor right down so that the pad is sandwiched between the transistor base and the board surface and solder the leads to the copper pads, finally cropping off the excess leads. It is important that the pads do not just float around but are firmly sandwiched to ensure that the transistor is properly supported.

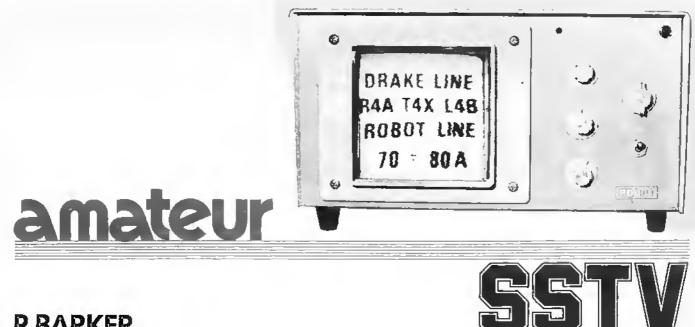
Using the small pads with plastic type transistors will help you to change the lead configuration to the same as a TO18 type without fear of the leads shorting together.

Mounting pads are extensively used in industry and are available in many different shapes and sizes including types to convert 10 lead TO5 can i.c.s. to d.i.l. configurations and types to cross transistor leads over. Ours are the simplest type which are designed just to hold the transistor correctly on the board.

Use them on your next project and see for yourself just how much better your board looks.







# **P** BARKER

Slow-scan television is a method of transmitting video information within the bandwidth of a normal singlesideband signal. The video occupies the 800Hz between 1-5kHz and 2-3kHz, the former representing black level and the latter peak white.

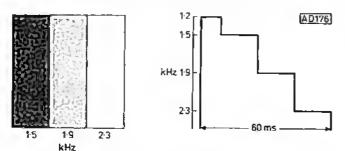


Fig. 1: A typical grey-scale and its corresponding line waveform

Consider the picture suggested in Fig. 1. A 5ms pulse at a frequency of 1.2kHz is used to start the line scan, followed by approximately 18ms of 1.5kHz (black), 18ms of 1.9kHz (mid-grey) then a further 18ms of 2-3kHz (white). After 120 lines have been 'written' a frame pulse of 30ms replaces the line pulse and is used to return the beam to the start of its scan.

Each frame takes about seven seconds to complete and so, in order to retain the information contained in earlier lines, it is necessary to use a long-persistence cathode ray tube as the display. Radar tubes, such as the 5FP7, could be employed and these can often be obtained quite inexpensively from 'surplus' distributors.

#### continued on page 72

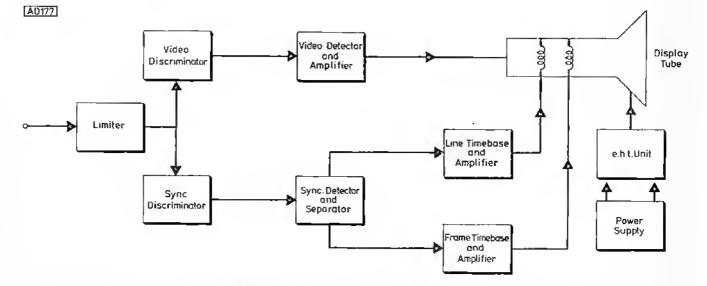


Fig. 2: Block diagram of a typical SSTV monitor



## Main Amplifiers and Power Supplies

The input stages, power amplifiers and regulated d.c. power supplies are contained on one board, connections being made via plugs and sockets "out" to cassette unit, disc equipment and radio circuitry. Inter-unit connections will be dealt with in later instalments.

# **Circuit Description**

The circuit configuration consists basically of a dual high gain pre-amplifier (LM387), passive tone control circuitry, a dual driver/output amplifier (LM378), and a complementary pair transistor output stage for each channel. Amplifier functions are identical throughout, and so only one channel will be described.

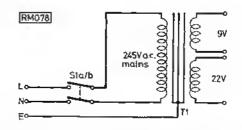
Initial amplification is effected by the use of the LM387, which is a later version of the LM381 although its equivalent input noise figure is an improvement at only  $0.65\mu$ V r.m.s., as is supply rejection (f=1kHz) at 110dB. In the description which follows, components prefixed "1" (i.e. R104) refer to the left hand amplifier, while prefixes "2" and "3" refer to right hand amplifier and power supply components respectively.

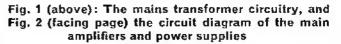
Each pre-amplifier is used in the inverting a.c. amplifier mode, signal input being applied via R101 and C101 to the inverting input of the LM387. Matching to high impedance inputs (crystal and ceramic cartridges) is direct at this point, although provision will be made later (in part 3) to match to magnetic cartridges (47k impedance), with consequent standard equalisation to the RIAA characteristic. R101 and R102 act as input voltage dividers, while R103 provides feed-back. This technique tends to raise the limits on input voltage, and thereby, produces virtual unity gain stability.

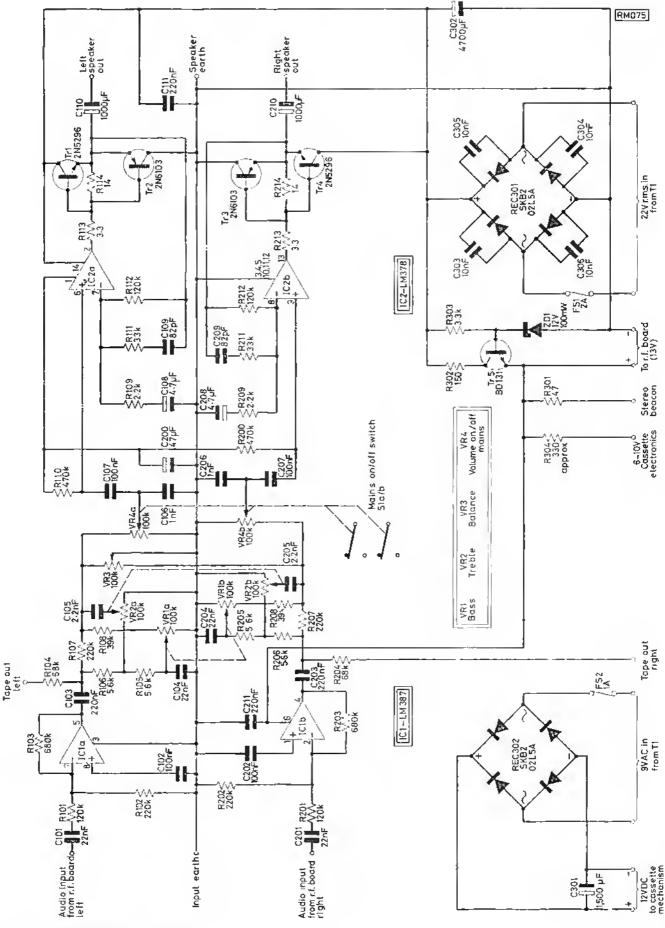
# **Tone Controls and Output Stage**

Due to the fairly high gain of the stage, it is possible to make use of a passive tone control network, insertion loss being rendered less dominant than it mitht otherwise be. Tape "out" signal is taken from the output of ICI via C103/R104 and is virtually "ffat" in terms of frequency response. VR1 is the bass control, VR2 the treble control, and the R-C network R105 to R108 and C104/C105 provides "tailoring" to effect bass and treble boost and cut.

VR3 is the single balance control, and after balancing the signal is fed via the volume control (VR4) to the non-inverting input of IC2 which acts as a driver/output stage in combination with the complementary pair Tr1 and Tr2. C106 provides a degree of treble roll-off, and R112 provides d.c. feedback.







# ★ components

Resistors		
+ Wall 5% ca	rbon	
3.30	2	R113, 213
14Ω	2	R114, 214
.4711	1	R301
150Ω( <u></u> \$W)	1	R302
33012*	1	
		R304
2 2k	2	R109, 209
3•3k	1	R303
5.6k	4	R105, 205, 106, 206
33k	2	R111, 2111
39k	2	R108, 208
68k	2	R104, 204
120k	• 4	R101, 201, 112, 212
220k	4	R102, 202, 107, 207
470k	1	R110
680k	2	R103, 203
* depends up	on casse	tie unit
Potentiomete	rs	
p.c.b. mounli	ng	
100k lin. dual	track	1 VR1
100k lin, sing	ie track	1 VR3
100k log. dua	I track	2 VR2, VR4
Semiconduct	ors	
LM387	1	JC1
LM378	1	1C2
2N5296	2	Tr1, Tr4
2N6103	2	Tr2, Tr3
BD 131	+ 1	Tr5
BZY 88	1	ZD1
		·REC301, 302
SKB2/02L5A	2	RECOVI, duz
Capacitors		
Polystyrene		
	0	C100 000
82pF	2	C109, 209
Polyester		0.444 PPP
1nF	2	C106, 206
2·2nF	2	C105, 205
22nF	4	C101, 201, 104, 204
100nF	4	C102, 202, 107, 207
220nF	3	C103, 111, 203
Ceramic		
10nF	4	C303, 304, 305, 306
Electrolytic		
4.7#F 50V	2	C108, 208
	1	C200
47µF 50V	2	
10000µF 25V		C110, 210
1500µF 40V	1	C301
4700)+F 40V	1	C302
Fuene		
Fuses		
Cartridge		
2A	1	FS1
1A	1	FS2
····		
Mains Transfe		
240V primary	, second	aries 22V(r.m.s.) centre-tapped
(# 1 5A,9V (	a 600m A	40
Miscellaneous		
Aluminium h	eatsink,	fuse holders (2) 6BA nuts and
boits SW16	v honner	vith VR4) d.o.d.t. Staver type

Aluminium heatsink, fuse holders (2) 6BA nuts and bolts, SW1 (ganged with VR4) d.p.d.t. Staver type heatsink for IC2 (fins), heatsink compound, mica washers

while R111 and C109 are responsible for a.c. feedback. C200 (47 $\mu$ F) and C111 (220nF) provide decoupling for the supply rails. C110 feeds the loudspeakers and prevents the establishment of high standing d.c. levels.

# **Power Supplies**

Supply rails are provided by two mains transformer secondary windings from T1, 9V and 22V, (this must be 22V r.m.s. to maintain supplies at a safe level) being rectified by bridge unit REC301 for the 30V rail, and REC302 for the 12V supply to the cassette mechanism. Tr5 drops the 30V line and in combination with ZD1 regulates the 13V line to supply the r.f. board. Smoothing is effected by C301 and C302, the bridge rectifier technique providing good regulation overall The LM387 is supplied from the regulated 13V supply (Vcc pin 6), and the LM378 from the 30V rail (Vcc pin 14). Supplies are fused at a.c., i.e. the inputs to the bridge rectifiers REC301 and REC302.

On no account must the supply rail for the LM387 be allowed to rise above 30V, since the establishment of safe working tolerance demands that the maximum rating of 35V should not be approached too closely.

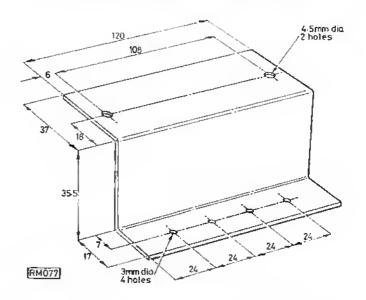


Fig. 3: Dimensions and bending details of the output stage heat sink

# Construction

Component assembly on the printed board should present no problems, although it is worth noting one or two points concerning specific items.

While ICl can be pushed straight into the board and then soldered in, the heatsink for IC2 must be lightly bent onto the body of the device before fitting and soldering. The reason for this is that the large lugs on the heatsink could prove difficult to engage simultaneously with the i.e. pins, and it is as well to keep heating of the unit (from the soldering iron) at a minimum. The aluminium heatsink should be bent as shown.

The output transistors should be bolted in after applying heatsink compound. Tr2 and Tr3 are connected straight to chassis via the heatsink, while Tr1 and Tr4 are installed using standard mica insulating washers. In order to make a good electrical connection to each collector, a wire bridge is connected from the middle pin of each transistor to the relevant part of the track. These are shown as dotted lines on the layout illustration.

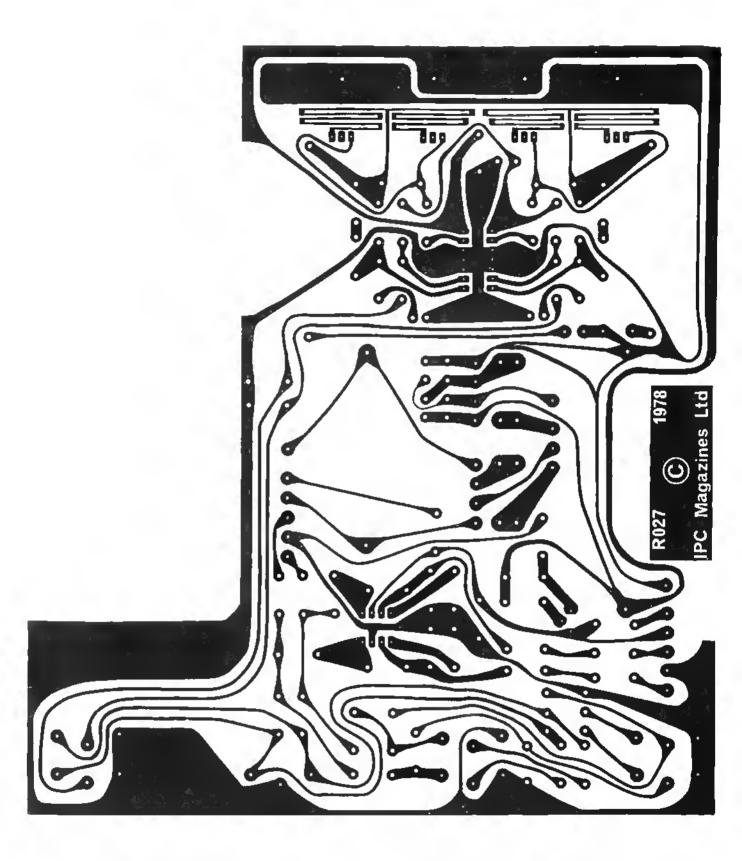


Fig. 4: The p.c.b. copper track pattern; the emitter resistor tracks (see text) are clearly shown at the top of the board Although not shown on the circuit diagram, the output stage emitter resistors are included on the p.c.b. as a part of the track, but where a different construction is employed, lengths of 32 s.w.g. shellac-covered wire approximately 150mm in length will suffice. Alternatively, if available,  $0.5\Omega$  wire-wound resistors may be employed.

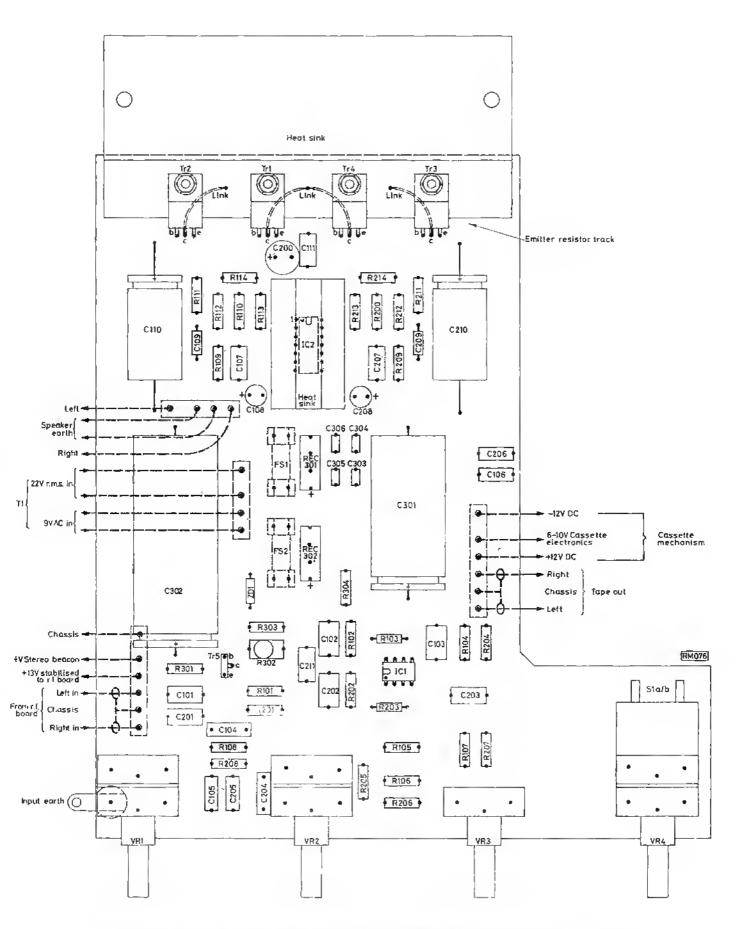
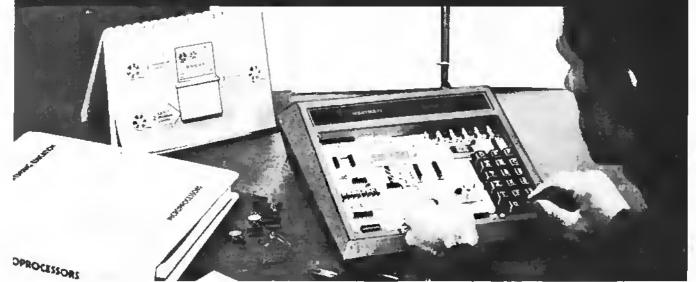


Fig. 5: Component overlay, relating directly to the board details on the previous page

continued on page 59

# You'll learn a lot from Heathkit electronics courses.



Heathkit electronics courses are a most effective way to learn - with fast, reassuring results.

Each course is a complete self-instructional package with clear, concise instructions in everyday language. You follow at your own pace, using modern teaching aids and expert guidance.

## Four basic courses to start with.

DC electronics, AC electronics, semi-conductors and electronic circuits. These courses give you a thorough and practical understanding-the key to all knowledge in the field of electronics.

## Microprocessors and digital techniques.

The advanced Heathkit courses take you on to higher levels. of computer technology and advanced circuit design, using the same easy-to-follow learning system.

## Experimenter-Trainers.

With the benefit of increased practical guidance, these optional aids will help you through the courses with exceptional speed.

## The finest way to learn.

Heathkit courses are used by home students, industrial concerns, technical colleges and schools. They're acknowledged as the finest way to learn. And the range of courses is complete from the earliest stages to the most advanced steps in specialist fields.

To Heath (Gloucester) Ltd., Dept: PW Bristol Road, Gloucester, GL2 6EE. Please tick the literature you want and enclose the appropriate amount in postage stamps. Heathkit Catalogue only (enclose 20p). 16 page Computer Brochure only (enclose 20p)

Registered in England, number 606177

Name

Address. Soldering

Iron offer

FREE

Send for the Heathkit Catalogue now.

As well as electronics courses, the Heathkit catalogue contains scores of electronics kits which you can build yourself. Burglar alarms, radios, digital clocks, car tune-up systems, test instruments, metal locators...and an exciting new range of personal computers!

Forty pages packed with exciting kits you'll be proud



There are Heatbleit Electronics Centres at 233 Tottenham Court Road, London (01-636 7349) and at Bristol Road, Gloucester (Gloucester 29451). Practical Wireless, October 1978



## DAVID GIBSON





# Audio Oscillator'

## The Basic Oscillator

Most circuits are designed to do one particular job. This month's "DeC project will do at least three jobs.

Basically, the 741 is made to oscillate and the exact frequency is set by C1/R3/VR1. Making the resistor variable means that by simply turning a single control we can alter the frequency of our oscillator. The output is a series of square waves and because of the very high gain of the op. amp, these have quite steep sides.

Two things to note. Don't forget the three jumper or shorting leads marked as "link wires". Secondly, the circuit requires two separate batteries to give a  $\pm 6V$  supply. If you take the two 6V batteries and connect the  $\pm 6V$  of one to the -6V of the other, then this junction becomes zero volts and is connected to hole Q23. The free  $\pm 6V$  lead then goes to  $\mu$ DeC hole Q1, while the remaining lead from the negative 6V terminal is plugged into hole G22.

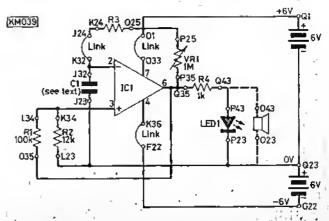
## Metronome

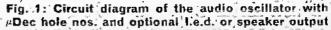
Let us now look at the three projects we can have with our circuit. The first is a simple electronic metronome. In this case, you should try a 47<sub>1</sub>/F capacitor for Cl. If you have connected a light-emitting diode to the output as shown, this will flash on and off. The rate of flashing can be set by adjustment of VR1. Thus we have a visual metronome. This can be useful when no noise can be tolerated while playing—for example in a group with no drummer and where the "beat" is taken from one player, as in some folk groups.

If (an, audible output is' required, then this can be obtained very simply by connecting an earpiece across the diode or by plugging it in instead of the l.e.d. A cheap crystal earpiece works well. Purists may wish to leave the diode in to form a d.c. path but the circuit works well without it 'using only the earpiece. 'A series of clicks was obtained using a small crystal microphone although these are not really loud enough when playing a musical instrument at the same time, hence the need for an earpiece.

## **\*** components

· · · · · · · · · · · · · · · · · · ·	(a) A set of the property o
R1. 100kΩ	ICI 741 op. amp. (8-pin d.i.l.)
R2 12kΩ	C1 see text
R3 100ks1	One 74DeC
R4 tks	One #DeC i.c. d.i.l. holder
VR1 1MΩ	one l.e.d.
//DeC jumper lead	two 6V batteries (PP6 or similar)





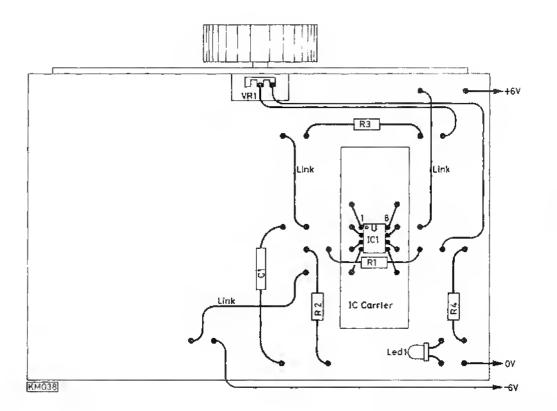


Fig. 2: The component layout of the completed unit

## Signal Injector

By making the value of CI smaller (i.e. less  $\mu F$ ) the pitch of the output waveform rises so that it goes above just clicks to being a musical tone or note. By setting VR1 to mid travel and substituting a  $0.1\mu$ F capacitor for Cl, a steady audio tone can be obtained from the earpiece. This tone can be used for injecting into audio equipment for test purposes. Things like loudspeakers, headphones, earpieces, amplifiers etc may be checked very quickly and simply in this manner. If this were to be the prime use of the circuit, then it would be simpler (and cheaper) to make VR1 a 470k $\Omega$  fixed resistor,  $C1\!=\!0\!\cdot\!1_{l'}F,$  and transfer the whole project onto a piece of Blob Board which could then be stuck inside a suitable small case using adhesive on the blank side (no track side) of the Blob Board—switch on, inject signal, listen for tone.

## Electronic Organ

By suitable choice of C1, the circuit can be made to oscillate over an extremely wide range; from well below 1Hz to well over 15kHz. To make a simple electronic organ one has only to select a series of fixed resistors and connect this string of components between holes P25 and P35 in the place of VR1. This idea is shown in Fig. 3. If really accurate notes are required, then it would pay to use 13 (for one octave) skeleton slot potentiometers. In this way each note can be individually adjusted spot on. Fig. 4 shows this plus a refinement of an octave switch and a set pitch pot. With none of the keys depressed all the skeleton pots will be in circuit and the lowest note will be obtained if the two pots (VR2/VR3) are set at maximum resistance. With the  $1M\Omega$  pot shorted out, the 100k pot is adjusted to bring the lowest note to one octave above that required. The individual pots in the chain are tuned and the lowest note again checked

and adjusted by the 100k $\Omega$  pot. Now remove the short across the IM $\Omega$  pot and adjust it to bring the lowest note to one octave below the pitch which it was when the IM $\Omega$  pot was shorted out. The switch now becomes an octave switch and will take the whole keyboard *down* one octave when the switch is opened removing the short across the pot.



Fig. 3: Connection points for a basic organ

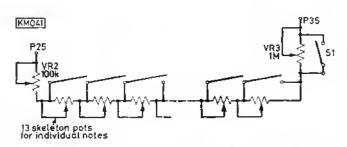


Fig. 4: A more "sophisticated" version of the organ

To give some indication of the range of the Fig. 1 circuit, a coverage from G below middle C to over three octaves above was obtained in the prototype using  $0.01\mu$ F for CI and a 1M $\Omega$  pot for VR1.

One word of warning. When using the circuit to inject audio signals, care should be exercised—especially in mains equipment. It would be prudent to use  $0.1\mu$ F JkV capacitors in series with each lead i.e. the audio inject output from  $\mu$ DeC holes 043 and 023 should have a capacitor in series with each lead. These capacitors should be permanently connected into the circuit.



A REVIEW OF RECENT DEVELOPMENTS In general, the author does not have any more information on products than appears in the article.

## Digital r.f. meter

Measuring voltage is a thing commonly carried out fairly easily with the aid of a simple meter. Measuring radio frequency voltage is a little more difficult. But it's no problem for a new instrument from Germany. This beautiful little box will give you an immediate digital readout of r.f. voltage from 300µV up to 1kV over the frequency range 10kHz to 2GHz. Besides the digital readout, an analogue readout is simultaneously given in dBs. This is effected by a single line of l.e.d.s which move a light point along and are calibrated in 1dB steps. The whole instrument can be run from a 12V battery (mains, too), consumes less than 4W, and weighs only 2-6 kilograms. Launched in the US it costs around 2,000 dollars. Wonder if the Germans run a Christmas Ciub?

## Power!

For those who like to be "with it", the in word for Autumn is "Transcalent". This is the name for a comparatively new type of semiconductor. Basically it means that you can push extremely high currents through the device without arc-welding it to your collar stud. The wafer on which the business area is contained measures 50mm. The substrate is bonded to a heat pipe which will get rid of the generated heat efficiently. The devices will not suit miniaturisation enthusiasts. We're taiking about things weighing around 2 kilograms and measuring some 190 imes 150 imes 150mm However, these devices include 900A rectifiers, 1,400A thyristors, and 400A transistors. Pop groups will doubtless welcome the latter!

## **Stable resistors**

How stable is stable, especially when it comes to resistors? A British company has just announced a range of resistors with values from 0.10 to  $1.5M\Omega$ which have exceptional stability. The stability is claimed to be so good that it is almost impossible to measure any slight deviations reliably; typically they vary between 5 and 10 p.p.m. (parts per million) over several years. They also offer a resistance tolerance matching capability of 0.001%. Called NPRL21 resistors, they cost around 90p each.

## **Bubbles**

Things are bubbling at IBMliterally. Some time back, bubble memories were a novelty. Then they became practicalities. One of the materials used for bubble memories is garnet. The IBM researchers have now discovered a way in which a 25mm square piece of garnet can be made to hold 100 million bits of informationinstead of the 3 million bits more common so far. But it doesn't stop there. From the same company comes news of mobile "light" bubbles which hide in magnesium-doped thin films of zinc sulphide. The current theory is that these light bubbles might be electrical analogues of the magnetic bubbles which are already well established.

#### Sonar Snooper

Mix microprocessors with submarines and you end up with a kind of sonar snooper. That's what French researchers have done. Their sonar transducer fires out low frequency signals, between 6 and 8kHz, which gives them a range of about 40km. But it's no ordinary transducer. The head consists of 48 arrays of piezoelectric transducer elements. These can all be powered in a single shot, or individually in sequence. The enormous amount of information coming back from this complex array is handled by the microprocessors and the net effect is that the system can electronically divide the sea around it into something like 500,000 little cells. The electronics processes the signals received from the transducers and can differentiate between the various echoes received.

Certain things give known echoes, and these are stored in a memory, so the system can compare anything it receives with all things in its memory for immediate check on identification. It also compares the echoes in time, checking if the same echo came from the exact same place for each sweep.

Look out little sardine; big brother is watching!

## Invest in technology

Buy British was a cry not too long ago, and if you want random access memories you may soon be able to do just that. The National Enterprise Board, no less, may "invest" something like £50 million in a semiconductor manufacturing facility in the UK. This could be interesting because, starting from scratch, only the very latest equipment would be purchased so the new venture could be in the forefront of technology.

But I do remember another fantastic, latest, state-of-the-art semiconductor facility in Essex which cost a lot of money—and died. Watch this space!

## Thin Television

Flat screen television time is booming again. The Japanese have a 16in colour display on the go which uses plasma techniques, while at the recent Chicago Consumer Electronics Show one exhibitor proudly displayed an electroluminescent screen which was just 50mm thick. Although the size was only 7 inches brightness has reached 15ft/lamberts with power consumption barely 7W. This manufacturer reckons that it will be marketing portable television sets using such a screen within two years.

## **Better Photocells**

An American scientist from a University talked at a special conference on photovoltaics, and caused a very big stir among energy producers. He claimed thata teamat the university had produced a cadmium sulphide/copper sulphide cell, using thin film techniques, which produced an efficiency of well over 9 per cent. This represented an impressive increase on earlier efforts when efficiency stood at around 7.8 per cent.

By 1980, this scientist believes that the cost will be down to 30 cents/watt. A final shattering fact was the cost comparison of the materials. Silicon cells (single crystal) work out at around 150 dollars per square metre, whereas the cadmium sulphide/copper sulphide thin film approach costs just 3 dollars per square metre.



Practical Wireless, October 1978

# The NORTON plifies

## Introduction

Most readers will by now be familiar with the conventional operational amplifiers, such as the 741 and 709. In recent years a new type of op-amp has come onto the scene. This has received the title "Norton Amplifier", and it amplifies the difference between two currents rather than two voltages. The Norton amplifier is best suited to amplifying a.c. signals where the utmost precision is not required-in such situations its ability to operate from a single power supply is very useful. When used as an audio preamplifier, it can give up to 10dB more gain than a 741 before the bandwidth suffers. The ability to operate at supply voltages as low as 4V means that it can replace discrete component amplifiers in many situations. The four amplifiers come in a 14-pin DIL package, for around 80p, making it economical as well as space-saving. Its main disadvantage is the difficulty of designing d.c. amplifiers, since it is also necessary to consider the biasing of the amplifier in such cases.

There are at least three manufacturers of the Norton amplifier—Motorola (MC3401), RCA (CA3401), and National Semiconductor (LM3900). The Motorola and RCA devices are completely compatible. Specifications of the various devices are given in Table 1, and circuit diagrams of one amplifier in Fig. 1. For clarity the biasing circuitry has been omitted. The significant differences are the wider supply range and additional transistor Q5 of the National Semiconductor device.

#### TABLE 1-Typical characteristics of the LM3900 and MC3401

Parameter	LM3900	MC3401
Supply Range (V+)	4-36V	5-18V
Supply Current	6 2mA	6-9mA
Power Dissipation	570mW	625 m W
Operating Temperature Ran	ge 0-70 C	0-75 C
Open Loop Voltage Gain	70dB	66dB
Unity Gain Bandwidth	2.5MHz	5MHz
Output Voltage Swing	V+ -1	V + -1
Output Current-High	3mA min	5mA min
Low	0.5mA min	0.5mA min
Output Slew Rate	0.5V/us	0.6V/us
Output Resistance	8802	8kΩ
Power Supply Rejection	70dB	55dB
The output resistance figu	re is quoted at	100Hz. This
value is maintained until 1kH.	z, and then starts	s to decrease,
reaching 200 ohms at approx	200kHz for the f	MC3401.

This additional transistor is useful for sinking large output currents—up to 30mA. Motorola also make the MC3301, which will operate with a supply of up to 28V, and is specified over a wider temperature range. For more detailed information the reader is referred to the manufacturers' data sheets, in particular the National Semiconductor application note AN-72, which gives comprehensive information on the amplifier itself and design requirements.

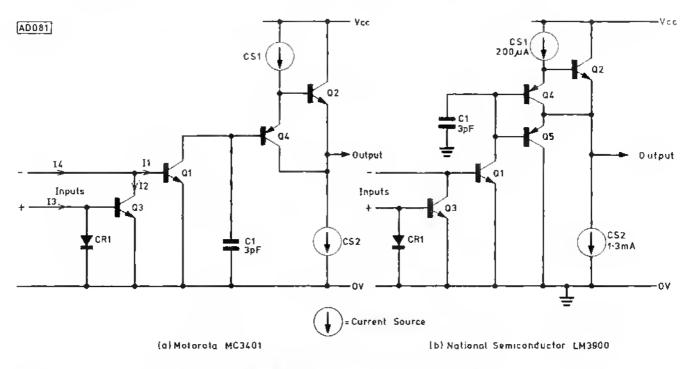


Fig. 1: The Motorola and N. Semiconductor variations in type.

## The Circuit

Consider first the circuit of Fig. 1(a), with Q3 and CR1 omitted for the present. It is then essentially an inverting amplifier with considerable current gain, the output voltage and current being controlled by I<sub>1</sub>. The main limitation on output current is the current source CS2 at the output. The values of the current sources are set by biasing circuitry on the chip, and since they depend on diode voltage drops, are essentially independent of supply voltage. Cl rolls off the amplifier gain at high frequencies, giving the open loop voltage gain frequency characteristic of Fig. 2, where it is compared with that of a 741. This voltage gain is the gain between inverting input and output, and provides a useful comparison with conventional operational amplifiers. Thus, although the open loop gain of the Norton amplifier is lower than that of a 741 at d.c., it is about 10dB higher above 1kHz, making it more suitable for a.c. amplifiers.

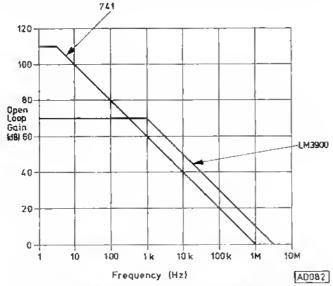


Fig. 2: Essential gain and frequency response (openloop)

We now come to the operation of CR1 and Q3, which together form a "current mirror". The bulk of the input current I<sub>3</sub> will pass through CR1, causing a voltage drop across it, the same as the base-emitter voltage of O3. A small part of I<sub>3</sub> will enter the base of Q3, causing an emitter current to flow. If Q3 and CR1 are properly matched, this emitter current will be approximately equal in magnitude to  $l_{3}$ , as will the collector current of Q3 (provided Q3's current gain is high). It can then be seen that if the collector of Q3 is connected to the base of Q1, the current into the base will be the difference between I<sub>2</sub> and I<sub>4</sub>, which is in turn equal to  $I_4 - I_3$ . Thus the amplifier will amplify the difference between the two input currents-the current mirror has effectively inverted I<sub>3</sub>. It can also be seen from the circuit that the input potential will remain approximately constant at about 0.5V (i.e. one base-emitter junction voltage drop). The additional transistor Q5 in the NS amplifier is of little consequence until the output is required to sink large currents-then if Q1 is driven hard on, Q5 will turn on to provide the additional capacity.

A slightly different symbol is used for the Norton amplifier in order to differentiate it from the more common type. This is shown in Fig. 3, and will be used in future.

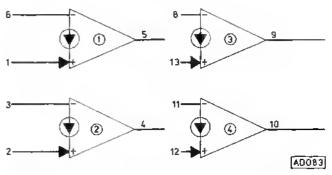


Fig. 3: Circuit symbols for the Norton Amp.

## Biasing the Amplifier

The Norton amplifier requires particular attention to be paid to biasing—this unfortunately does not look after itself as with conventional op-amps. It will be assumed here that the amplifier is being used with a single supply rail.

When both inverting and non-inverting inputs are being used it is necessary to maintain a certain average current through the current mirror. This entails feeding equal currents into the two inputs, one of the currents being derived from the output in order to set the output voltage. The simplest and commonest way of achieving this is shown in Fig. 4(a). A current is fed into the non-inverting input via R1, from the positive supply rail. The inverting input is fed from the output via R2. Thus we have a feedback systemif the output voltage rises above its equilibrium value, it will increase the current into the inverting input. which will act to decrease the output voltage. This fact can be used to set the d.c. level of the output voltage-normally to half supply voltage to obtain maximum voltage swing. Since the currents into the two inputs must be equal, it is clear that in this case RI should be twice R2. The recommended bias current for the current mirror is in the range 10-100<sub>0</sub>A, with  $10\mu$ A being a suggested value for many applications.

A disadvantage of the simple type of biasing described is that any ripple on the power supply is fed into the amplifier by R1, and appears on the output at half the amplitude. This can be eliminated by using the circuit of Fig. 4(b). Here the bias supply for the non-inverting input is derived from a potential divider which provides a well-smoothed supply at half supply voltage. Biasing resistors for all such amplifiers in a circuit may be taken from this one potential divider, so the extra cost is minimal. Needless to say, to maintain equal currents into the inputs, R1 and R2 should now be equal in value.

There is a third method of biasing, using only the inverting input, and therefore only really suited to inverting amplifiers. This method will be described later.

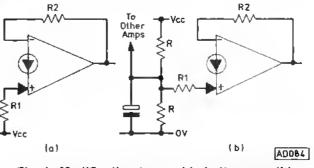
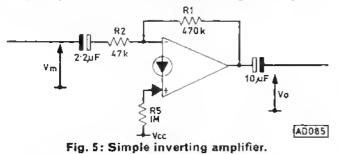


Fig. 4: Modification to provide better smoothing.

## **Practical Circuits**

Having considered the biasing arrangements peculiar to the Norton amplifier, we are now in a position to consider some practical circuits. In most cases a marked similarity to circuits using conventional opamps will be noticed. The main difference is the more frequent need for d.c. blocking capacitors between stages, apart from the additional biasing circuitry.



## Inverting Amplifier

The simplest inverting amplifier circuit is shown in Fig. 5. The voltage gain, as with the more conventional circuit, is R1/R2, or 10 with the values shown; the input impedance is equal to R2, or 47k here. The design procedure is to choose R1 and R2 to give the required gain and input impedance, and then make R3 approximately equal to twice R1. The d.c. blocking capacitors should be large enough to pass the lowest frequencies needed.

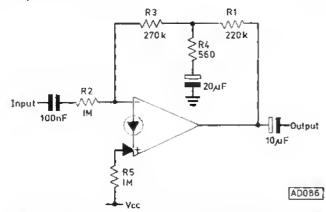


Fig. 6: Additional circuitry to raise imput impedance.

A disadvantage of this circuit is that it is not possible to have high gain and high input impedance simultaneously, since R1 must be low enough to pass at least  $10\mu$ A into the inverting input. With a 12-15v supply, this sets an upper limit of about 560k on R1. The problem can be overcome by using the circuit of Fig. 6. albeit at the expense of extra complexity. The d.c. bias is now provided via R1 and R3 in series, so R2 should be equal to twice their sum. No d.c. passes through R4, due to the blocking capacitor. A.C. signals, however, are attenuated first in the potential divider of R1 and R4, then passed to the inverting input as negative feedback via R3. Then, provided R3 does not load the potential divider (i.e. R3>R4), the voltage gain of the circuit is given by:

$$A_{v} = \frac{R1 + R4}{R4} \frac{R3}{R2}$$

and to satisfy the biasing conditions, R1+R3<560k (with 12V supply). The values shown in the circuit

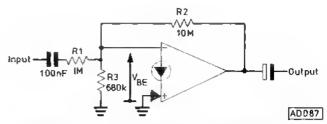


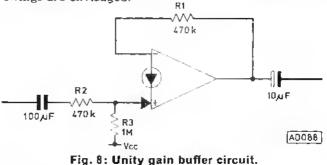
Fig. 7: Simplification avoiding the use of the "current mirror."

should give a gain of around 105, which is about the maximum obtainable when used as an audio preamplifier.

A third possibility eliminates the current mirror and its associated bias current. The only bias current needed then is the actual inverting input current (I<sub>1</sub> in Fig. 1a), which is typically  $30\mu$ A. The circuit is shown in Fig. 7. Initially the values of R1 and R2 are chosen to give the desired values of gain and input impedance. R3 is then chosen to give the required output voltage V<sub>0</sub>, using the relation:

$$V_0 = V_{BE} \left( 1 + \frac{R2}{R3} \right)$$

where  $V_{BE}$  is the voltage at the inverting input, typically 0.5V. The main disadvantage of this circuit is that the output voltage depends on  $V_{BE}$ , which, being due to a semiconductor junction, is extremely temperature dependent. Output voltage drift will only be a problem, however, when large output voltage swings are envisaged.



## **Non-Inverting Amplifier**

The Norton amplifier is not really recommended for use as a non-inverting amplifier, since accurate determination of the gain is not possible, due mainly to variations in the current mirror circuitry. Motorola state that the voltage gain of a non-inverting amplifier may vary by up to 20% from the calculated value. However the circuit of a unity gain buffer amplifier is given in Fig. 8 for completeness. One advantage of the non-inverting configuration is that the bandwidth of the amplifier depends only on the value of the feedback resistor R1, since the input resistor R2 is outside the feedback loop. In calculating the gain it is necessary to include the small signal resistance R<sub>8</sub> of the current mirror input, which is given by 26,000/I<sub>3</sub>. (I<sub>3</sub> is the non-inverting input current, in  $\mu$ A.) The voltage gain then becomes:

$$A_{x} = \frac{R1}{R2 + Rs}$$

This equation assumes that the gain of the current mirror is exactly unity—in fact it may vary between 0.8 and 1.16, which accounts for much of the uncertainty in the gain. As an example, with R1=470k, bandwidth will be over 200kHz for gains up to 100.

## Oscillators

The Norton amplifier is not particularly suited to oscillator configurations. The only sinewave oscillator given in the application notes uses all four amplifiers on the chip, as well as considerably more discrete components than the very common Wien Bridge circuit used with conventional op-amps or individual transistors. With square wave oscillators the main limitation is the low slew rate of about  $0.5V/\mu s$ . Thus with a supply of 15V, the rise-time will be of the order  $30\mu s$ , which is too slow for most applications.

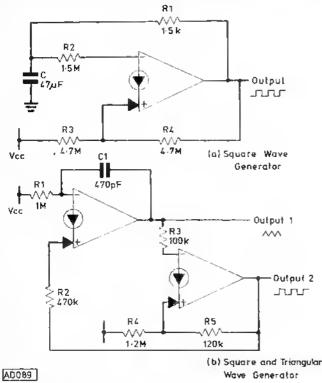


Fig. 9: Typical op. amp oscillators.

Two examp .s, based on the well-established op-amp circuits, are given in Fig. 9. The first is a square-wave oscillator, which will oscillate at about 1kHz with the values given. The output frequency is given by 0.6/ CR<sub>1</sub> approximately, and the output has good symmetry. The second circuit is the well-known triangular and square wave generator, and is an example of a circuit utilising the properties of the current mirror (in the integrator section) to give a circuit as simple as its op-amp counterpart. The values shown give a period for the waveforms of about 0.9ms. The timing depends on R1 and C1, and to obtain good output symmetry R2 should be half R1.

Various other oscillator circuits are possible—the most interesting is a complete phase-locked loop with linear voltage controlled oscillator, using only three of the amplifiers. However such circuits are not given here since they tend to need designs suited to the particular application.

## Voltage Regulators

Some very simple voltage regulators are possible using the Norton amplifier. The simplest is shown in Fig. 10, and makes use of the fact that the input potential of the amplifier remains substantially constant with variations in input current. The output voltage is then  $V_Z + V_{\rm HE}$ , at currents of up to 1A. Bias current for the Zener is provided by resistor R—the

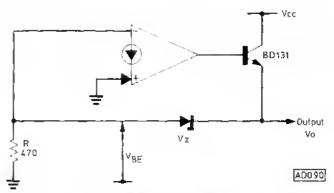


Fig. 10: A simple voltage regulator using a Norton Amplifier.

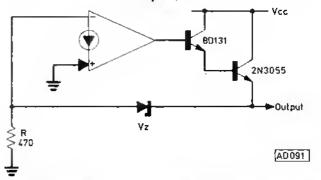


Fig. 11: Increasing current capability with an external transistor.

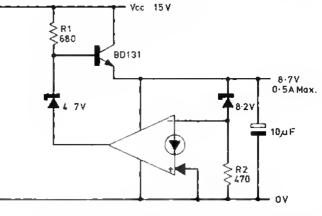


Fig. 12: Self-regulation circuit.

AD092

value of  $470\Omega$  specified will provide a bias of about 1mA. An additional transistor could be connected as in Fig. 11 to increase the current capability—outputs of up to 10A are then possible, provided the transistors will dissipate the power. An extension of this idea uses the voltage regulating circuit to regulate the supply to the amplifier chip itself—this is shown in Fig. 12.

## Conclusions

It is unlikely that the Norton amplifier will ever be used extensively in mains-powered equipment, since in this situation it is relatively simple to provide a split power supply and use conventional op-amps, with their simpler design and generally lower component count. The most likely application is where the power supply is battery derived, in particular in cars and portable radios. The circuits described here give some of the more common applications—with a little ingenuity the Norton amplifier can be made to extend the range of a conventional operational amplifier.



Sillingham frequency Mitt SHORT-WAVE RECEI D2 12 V 222222222222 1N4001 FREQUENCY READOL 01 6V. 1N4001 o

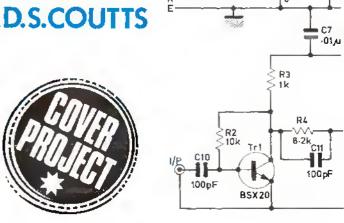
There are many simple "communications" type of receivers in the hands of s.w.l.s which are single conversion types using an i.f. of 460 or 455kHz. These receivers are doing an excellent job, but how often have you wished for a digital readout of the frequency you are tuned to, instead of relying on the pointer and string method used?

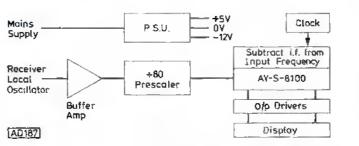
The General Instrument AY-5-8100 m.o.s. integrated circuit gives you this readout on a 5 digit l.e.d. display, to an accuracy of ±5kHz, up to 29.95MHz. This allows you to find a net reasonably quickly if you know the frequency being used.

The AY-5-8100 was specifically designed for use in radio receivers. It accepts the receiver local oscillator frequency after suitable prescaling ( $\div$ 80 on s.w. range), subtracts the i.f. frequency from it, and outputs the frequency the receiver is tuned to the l.e.d. display, via suitable drivers. The receiver local oscillator must therefore be at a higher frequency than the receiver frequency and the short wave receiver i.f. must be 460kHz (or 455kHz with link changes on the p.c.b.). Many of the cheaper receivers around fall into this category.

\* An Engineer with General Instrument Microelectronics, Glenrothes







Practical Wireless, October 1978

The unit has been designed as a free standing unit to be connected to the required receiver via coaxial cable. This allows you to multiplex the unit to more than one receiver and to use it for experimental work on home-brew receivers.

The unit should only be used on receivers which are isolated from the mains, i.e., using a double wound mains transformer.

A block diagram of the unit is shown in Fig. I. A simple power supply provides the necessary voltage of +5V and -12V. The receiver local oscillator is buffered by a 2-stage amplifier and fed to the  $\div 80$  prescaler and then into the AY-5-8100 i.c. A 1.28MHz clock is also fed into the i.c. for system timing. The segment and digit outputs are fed via transistors to the display.

To consider the circuit in more detail refer to the circuit diagram Fig. 2. The two 6 volt windings of transformer T1 are connected in series to give 6V and 12V to feed the unit.

Components D1, C1, C2, IC5 and C3 provide a stabilised +5 volts for the unit and D2, C4, C5, R1, C6 and D3 provide the -12 volts. The input is fed to the 2 stage amplifier formed by Tr1 and Tr2 and the output of Tr2 is fed to the buffer, IC1c.

The output of IClc feeds IC2,  $(a \div 8)$  and this in turn feeds IC3  $(a \div 10)$ . IC3 output, pin 12 is either connected directly to pin 27 of IC4 by linking A to B on the p.c.b. (455kHz i.f.) or A is linked to C on the p.c.b. and D is linked to B (460kHz i.f.). ICla and b provides the 1.28MHz crystal controlled clock to the 8100. Pin 26 of IC4 outputs a 12ms positive pulse to reset the prescaler every 20ms and this is buffered by IC1e and f.

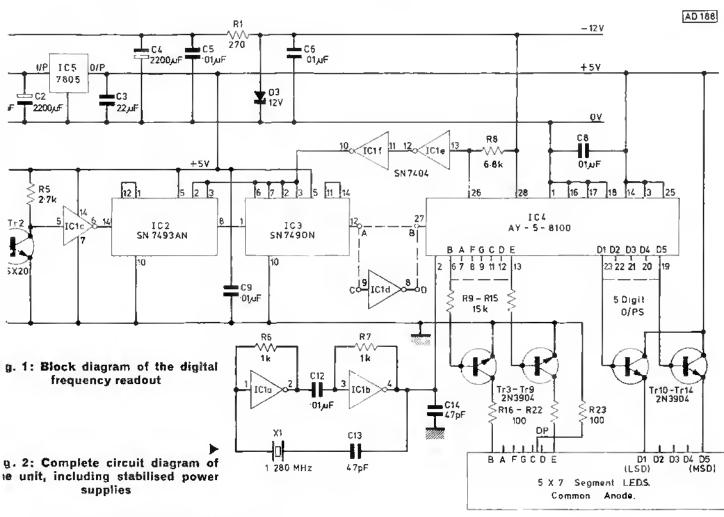
Pins 6-9 and 11-13 of the 8100 output the signals to drive the l.e.d. segments via the transistors Tr3-Tr9. Resistors R16-22 and R23 limit the current through the l.e.d.s. Pins 19-23 output the positive going multiplex signals to drive the digits D1-D5 with D1 as the least significant digit (l.s.d.).

As the digit outputs have limited drive capability emitter followers, Tr10-14 are used to increase the drive. Five common anode 7-segment l.e.ds are used for the display. The l.s.d. only displays a 0 or a 5, giving the  $\pm$ 5kHz accuracy.

## Construction

The case is 2-piece all metal case approx. 200mm wide by 50mm high by 125mm deep. Commence construction by drilling the case as shown in Fig. 5 and carefully cut the rectangular slot for the display. Spray the front panel and put the case on one side to dry and await lettering.

Assemble the main p.c.b. using the component layout in Fig. 4 and parts list as a guide. It is advisable to use a socket for the AY-5-8100 and to fit this i.c. after the board has been completed and checked for correct assembly.



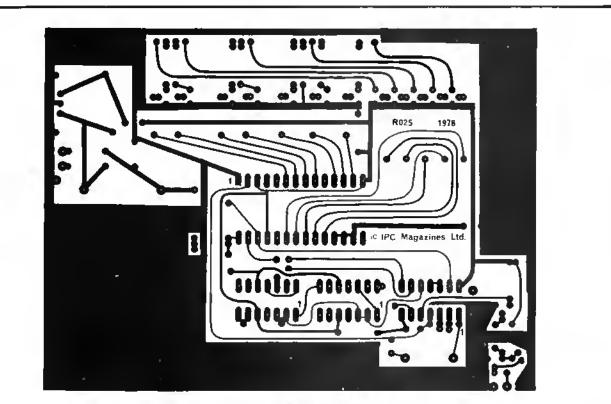
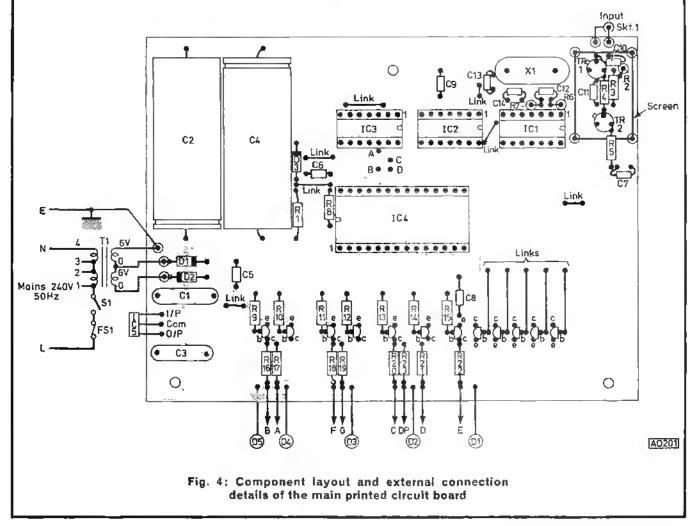


Fig. 3: Full size print pattern of the main p.c.b.



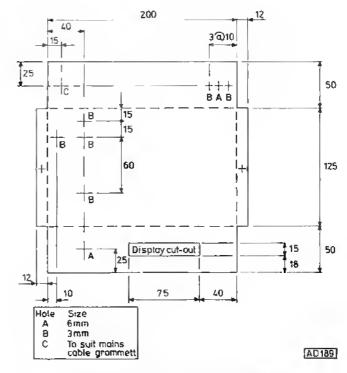
Practical Wireless. October 1978

## **\*** components

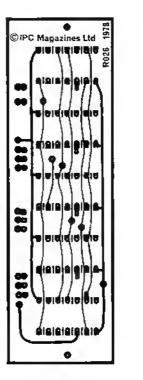
Resistors		
1 W 5%		Dia 17 18 18 08 01 00 03
100Ω	8	R16, 17, 18, 19, 20, 21, 22, 23
27011	1	R1
1kΩ	3	R3, 5, 7,
2 · 7kΩ	1	R5
6-8kΩ	1	R8
8·2kΩ	1	R4
10kΩ	1	R2
15kΩ	7	R9, 10, 11, 12, 13, 14, 15
	*	
Capacitors		
Plate Ceram	110	
47pF	2	C13, 14
100pF	2	C10, 11
0.01 //F	6	C5, 6, 7, 8, 9, 12
V V1/1	·	60, 0, 7, 0, 0, re
Polyester		
0 22/1F	2	C1, 3
• ==/··	-	the second se
Electrolylic		
2200 // F 25V	2	C2, 4
LEVONT ED.	~	64, T
Semiconduc	tors	
Diodes		
1N4001	2	D1, 2
BZY88C12	1	D3
Transistors		
BSX20	2	Tc), 2
2N3904	12	Tr3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
2143504	12	10, 4, 5, 0, 7, 0, 5, 10, 11, 12, 10, 14
Integrated C	acoit	5
SN7474	1	ICI
SN7490N	1	1C3
SN7493AN		103
AY-5-8100		104
7805	1	IC5
Displays		
RS 586-532	5	(7 segment l.e.d. green common
		anode:)
		(alternative red display RS 586-526.)
Miscellaneo	48	
1 280 MHz (	crysta	l (McKnight)
Printed circ	uit bo	pards (2 in set)
		207-194 0-6V, 0-6V (1)
Case Marst		
Mains on-o		
Fuseholder	11 2 441	ten
	l. at	
Coaxial soc	-	from DC EQC 077 for arrange display or
Display filte	er cut	from RS 586-677 for green display or
		ed display. Optional bezel for display
(replaces di	splay	p.c.b. and filter) RS 587-002.

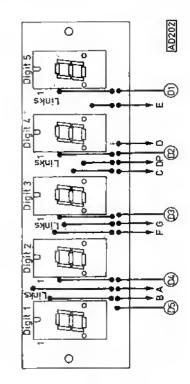
A logical building sequence is:

- 1. Fit all resistors and socket for IC4.
- 2. Fit all capacitors (note polarities of C2 and C4).
- Fit wire links.
- 4. Link A to B or A to C and D to B on the p.c.b. depending on the i.f. used. (A to B=455kHz i.f.)
- 5. Fit Veropins where indicated on Fig. 4.
- Fit diodes, transistors and IC5 (7805) taking care to orient them correctly.
- 7. Fit crystal.
- 8. Fit IC1, 2 and 3 observing correct orientation.
- Check board very carefully for solder bridges between tracks and for proper orientation of semiconductors.

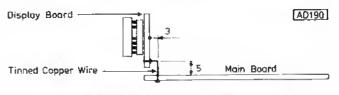








#### Fig. 6 (left) and Fig. 7 (right): Full size print pattern and component layout for the display p.c.b.





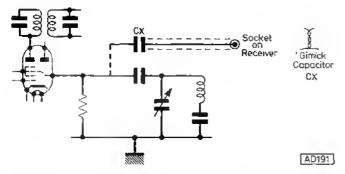


Fig. 9: Signal take-off from a valved receiver local oscillator

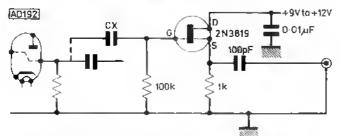


Fig. 10: Adding f.e.t. isolation to the circuit of Fig. 9

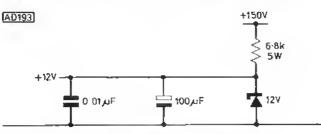
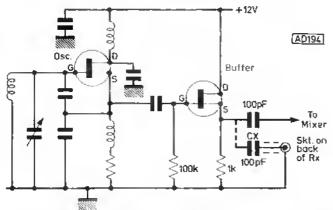
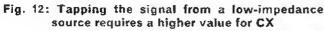


Fig. 11: Deriving a stabilised 12V supply from a 150V h.t. line





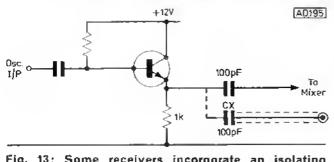
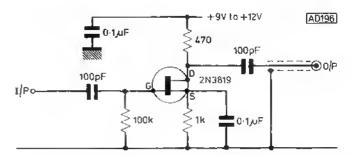


Fig. 13: Some receivers incorporate an isolating emitter follower



#### Fig. 14: If the receiver local oscillator output is too small, this simple amplifier will raise it to the 50-100mV necessary to drive the "Gillingham"

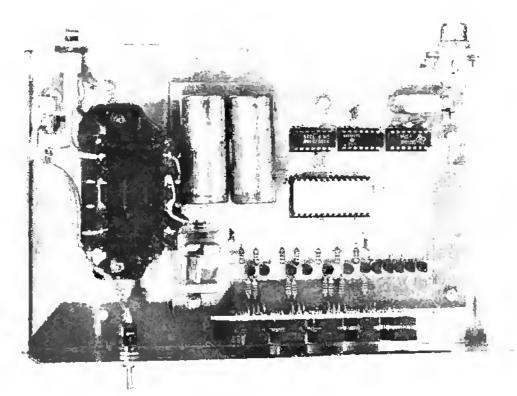
- 10. Lay the main board to one side and start assembly of display board (Fig. 7).
- 11. Fit the eleven wire links to the display board.
- 12. Fit the 7-segment l.e.ds to the display board noting that pin 1 is at the top left, looking from the front.
- Check for any shorts between tracks on the display board.
- 14. When you are satisfied that both boards are correct fit 13 lengths of tinned copper wire through the holes at the bottom of the display board. Solder the wires to the board. Bend them down at right angles and fit the boards together as in Fig. 8, trimming off any surplus wire protruding through the holes.
- 15. Fit a small tinplate screen round the input amplifier. Take the completed p.c.b. assembly and lay it in the case, line the display up horizontally with the slot in the front panel and mark through the three fixing holes on the p.c.b. Drill 6BA clearance holes in the case. Mount the p.c.b. assembly in the case using 6BA bolts through the holes and adding 6BA nuts to pack the board up until the display lines up with the front panel slot. Fit a piece of filter material behind the slot and make up a small "picture frame" bezel to finish off the slot. As an alternative to the p.c.b. mounted display an R.S. Components bezel assembly (587-002) can be used with hard wiring instead of the p.c.b. Fit the mains transformer T1, fuse holder FS1 and mains on/off switch S1 to the case. Also fit a coaxial socket in the rear of the case for the input. Wire the unit up as shown in Fig. 4.

## TABLE 1.

## PIN CONNECTIONS OF AY-5-8100

1 OV (Gnd)	15 No connection
2 1-28 MHz clock input	16 OV
3 +5V	17-OV
4 No connection	18 OV
5 No connection	19 Digit 5 output (m.s.d.)
6 Seg. B output	20 Digit 4 output
7 Seg. A output	.21 Digit 3 output
8 Seg. Foutput	22 Digit 2 output
9 Seg. G output	23 Digit 1 output (l.s.d.)
10 No connection	24 No connection
11 Seg. C output	25 +5V
12 Seg. D output	26 Prescaler reset output
13 Seg. E output	27 Counter input
14 VSS + 5V	28 VDD-12V

Practical Wireless, October 1978



An internal view of the completed unit

## Testing

Testing the unit is fairly straightforward, but remember that it runs off the mains and requires a little more respect than battery powered equipment. Switch the unit on and check that the voltage across C3 is +5V and the voltage across D3 is -12V. If the voltages are correct and you have an oscilloscope available monitor IC1 pin 4 for the 1-28MHz clock. Switch off the unit, fit IC4 into its socket and power up again. The display should light up. IC4 pin 26 should now be outputting 12ms positive puls-s every 20ms, and these pulses should appear at IC2 pins 2 and 3 and IC3 pins 2, 3, 6 and 7.

To check that the unit is counting you can temporarily connect a wire from IC1 pin 2 to the amplifier input. This provides us with a signal which we can trace through the unit. Monitoring it at IC1 pins 5 and 6 we should have a continuous 1.28MHzsignal. At IC2 pin 8 we will have 8ms bursts of  $(1.28 \div 8)MHz$  (i.e. 160kHz) every 20ms and at IC3 pin 12 we will have 8ms bursts of  $(1.28 \div 80)MHz$  (i.e. 16kHz), which should also appear at IC4 pin 27. At this time the display should read around 820kHz.

If this checks out the unit is functioning and we can consider interfacing it to our receiver, using one of the methods indicated in Figs. 9 to 14.

If the unit is not functioning and we have +5Vand -12V available then check that -12V appears at IC4 pin 28. If this is so check that +5V is appearing at IC1 pin 14, IC2 pin 5, IC3 pin 5 and IC4 pins 3, 14 and 25, and also at Tr10 collector. If you suspect the crystal oscillator is not running you can listen for it on your receiver around 1.28MHz and harmonics of this frequency. Trouble with the display may be caused by shorts between the tracks on either of the boards causing extra segments to light up.

## PRINTED CIRCUIT BOARDS SERVICE FOR PW PROJECTS

It has now been decided, commencing with our issue dated September 1978, to enlarge the facilities for the supply of p.c.b.s to readers by authorising additional suppliers. It is hoped that readers may benefit from being able to purchase boards as part of component kits, thereby reducing the number of separate orders for a project.

For some time, most p.c.b.s published in *Practical Wireless* have been available exclusively from Reader's PCB Services Ltd., P.O. Box 11, Worksop, Notts, who will continue to be a supplier and to whom we would wish to say thank you for helping us to get the service started.

Applications for permission to reproduce boards for resale must be made to the editor in writing.

# PLEASE MENTION PRACTICAL WIRELESS WHEN REPLYING TO ADVERTISEMENTS



## **Hacksaw**?

Recently introduced from Abrafile, Squarecut Hacksaw Files. Designed for the rapid cutting of a wide range of materials including tool steel.

When fitted into a hacksaw frame and tightened in the usual manner, these files can be used for straight cuts, internal and external slots and to follow limited profiles; in ferrous and non-ferrous metals (including stainless steel), ceramic tiles and plastics. These files will outlast and out-perform the well-known Abrafile tension files, but they do not have peripheral teeth nor can they be used for more intricate shapes and profiles; they are not suitable for wood.

Supplied in three widths and two lengths, each card contains one of each ot the three different width files (1.5, 1.8 and 2.5mm). Card SC25 contains 250mm (10") long files and costs £1.24, and SC30 300mm (12") long costs £1.46. Available from, Abrasive Tools Ltd., Abrium Works, Colne Road, Twickenham TW2 6QE. Tel: 01-894 1273.

#### **POWer**

At last an h.f. afterburner to complement the fine Trio range of transmitters and tranceivers.

The TR922 grounded-grid linear amplifier packs quite a punch from two husky Eimac 3-500Z tubes in class AB2, delivering a mighty 2kW p.e.p.— 1kW c.w. or r.t.t.y. for 80W excitation.

Covering all bands 160m-10m the amplifier matches other Trio equipment in both performance and appearance and must certainly appeal to those already using transmitters of this manufacture barefoot.

The price is £763 at the time of going to press and further details can be obtained from the importers, Lowe Electronics Ltd., 119 Cavendish Road, Matlock, Derbyshire. Tel. 0629-2817/ 2340.





## Safe cutting

The new OK SAF 01 safety shears, which can handle hard or soft wires up to 1mm diameter, incorporate an adjustable clip to hold wire firmly after it has been cut. This prevents the hazard of clippings flying into the eyes or dropping into the workpiece.

A spring loaded scissors action ensures a clean cut, and the shears' handles have a bright orange padded covering which not only makes them comfortable during prolonged use but also enables them to be found easily on a cluttered workbench.

Priced at £2.58 which includes VAT and P&P, the SAF 01 shears are available from OK Machine & Tool (UK) Ltd., 48 The Avenue, Southampton SO1 2SY. Tel: 0703 38966[7.



#### Safe time

Trying to read the time from one's watch whilst driving can be a dangerous operation, especially at night. So, why not install a car clock? W.K.F. Electronics can supply the 'Harvard', an inexpensive 12V electronic car clock with digital display.

The clock utilises a low power consumption circuit and a quartz crystal oscillator, with a claimed accuracy of  $\pm 0.5$  seconds per day.

Displaying hours and minutes on a dark blue display with brightness control, the display extinguishes when the car ignition is switched off, whilst of course the clock continues to operate.

Designed with a swivel mounting bracket the clock can be fitted either above or below the dashboard.

Priced at only £12.50 plus 50p P&P, the 'Harvard' is available as an optional 12 hour or 24 hour version and comes complete with supply leads, connectors and inline fuse. W.K.F. Electronics, Welbeck Street, Whitwell, Worksop, Notts. Tel: 0909720 695.

# ECONOMICAL

## J. B. DANCE

Vertical MOS (VMOS) power field effect transistors have been produced by Siliconix of Swansea for more than two years. The first VMOS devices were encapsulated in TO-3 or TO-39 hermetically sealed metal packages, but more recently similar devices in plastic packages have been marketed by the same manufacturer at about one quarter of the price. They can be used in many simple circuits and are equally suitable for use by both the amateur experimenter and by the professional engineer.

A VMOS power device incorporates the high input impedance of a field effect transistor and yet it can control a moderately high current. The devices under discussion have a maximum continuous current rating of 2A and voltage ratings from 40V to 80V. They can be used for audio or radio frequency amplification, as fast switches, etc.

## VMOS Structure

The structure of the VMOS power device shown in Fig. 1 may be contrasted with that of the conventional f.e.t. shown in Fig. 2. In the VMOS device of Fig. 1 the current flows vertically through the structure from the drain to the source and this allows a much higher power dissipation than is possible in the

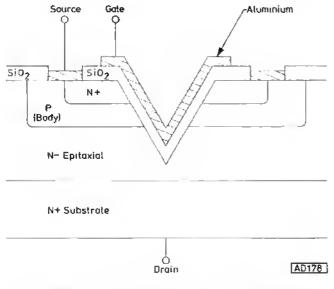


Fig. 1: General physical structure of a VMOS device

Practical Wireless, October 1978

ordinary f.e.t. structure of Fig. 2 in which the current flows horizontally along the layers at the top surface of the silicon.

EVICES

VER

 $\Box S$ 

An interesting feature of the VMOS devices is the V-shaped groove shown in Fig. 1 which produces two vertical channel regions bringing the advantage of a high current density.

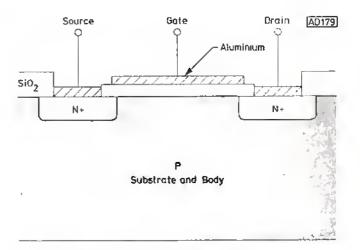


Fig. 2: The physical structure of a conventional f.e.t.

## Package

The plastic encapsulated VMOS devices are supplied in the type of package shown in Fig. 3. The device has the same electrodes as a conventional f.e.t., namely source, gate and drain; the metal tab at the back of the device is internally connected to the drain electrode. The internal circuit of a VMOS device is shown in Fig. 3; it can be seen that a Zener diode is connected between the gate and source electrodes. This protects the thin layers of silicon dioxide against the accumulation of any stray electrostatic charges which could produce a voltage great enough to puncture the thin layer. The Zener diode will break down when the voltage across it exceeds 15V positive with respect to the source electrode, causing the charge to leak away. Nevertheless, it is wise to take reasonable precautions when using VMOS devices; in particular, soldering irons should be well earthed. These devices should be kept in metal foil when not in use. The current into the gate should not exceed 2mA and the reverse current out of the gate should not exceed 100mA.

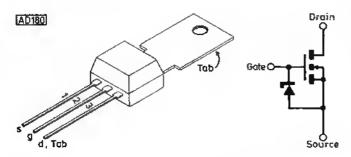


Fig. 3: Package, pin connections, and internal circuit of a VMOS device

## Types

The main difference between the three types of VMOS device under discussion is the maximum voltage which can be safely applied to the drain relative to either of the other two electrodes. These voltages are shown in Table 1 together with the drain-source saturation voltage which is slightly higher for the highest voltage device.

Table 1: Differences between the three basic devices

Device type	Max. drain voltage	Maximum drain- source saturation voltage at V <sub>es</sub> = 10V and I <sub>D</sub> = 1A
VN46AF	40 V	3V
VN66AF	60 V	3V
VN88AF	80V	4V

The maximum dissipation in the device itself without any heat sink is 2W for temperatures up to  $25^{\circ}$ C, whereas the device can dissipate  $12 \cdot 5W$  at a case temperature of  $25^{\circ}$ C or 6W at a case temperature of  $90^{\circ}$ C as shown in Fig. 4.

## Advantages

VMOS devices have a very high input impedance and can provide an extremely high current gain of the order of a million or more. Another advantage over conventional bipolar transistors is the very short switching time of typically 2ns (maximum 5ns). This can be achieved because they are majority carrier devices in which only electrons contribute to the current flow. Their speed is not limited by minority carrier storage time effects found in bipolar transistors enabling them to be used in high efficiency voltage converters operating with a very small internal dissipation.

Conventional transistors are subject to a phenomenon known as "secondary breakdown" due to local temperature rises; VMOS devices do not suffer from this effect, since any local increase in temperature produces a fall of current in that region owing to the negative temperature coefficient. This also prevents the possibility of thermal runaway.

## Applications

VMOS devices are very useful in the control of a device requiring an appreciable current using a high impedance signal source. For example, the circuit of Fig. 5 shows an oscillator using two gates of a CMOS 4011 quad NAND gate device; when the input of the left hand NAND gate goes high, the circuit oscillates at a frequency of around 2kHz. The output from the

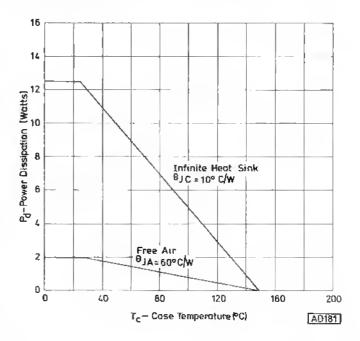


Fig. 4: Power dissipation in relation to case temperature

gate can supply a square wave of about 5V amplitude, but only a small current. However, this output can be employed to switch the VN46AF device which can control enough current to produce a loud noise in the loudspeaker. Thus when the input goes 'high' (a few volts positive with respect to ground), the circuit emits the alarm sound from the loudspeaker.

The frequency of the alarm signal can be set by choosing suitable values of R1 and C1. The VN46AF device imposes a negligible load on the CMOS output circuit and does not affect its waveform.

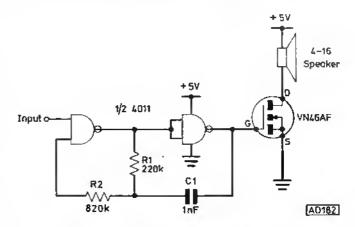


Fig. 5: A circuit which uses a VMOS device as a "slave" current driver. The impedance of the speaker should read "4-16 $\Omega$ "

The high switching speeds of VMOS devices render them suitable for switching laser diodes. The type of circuit shown in Fig. 6 may be used, the values of R1 and R2 being chosen according to the bias and pulse currents required by the laser diode.

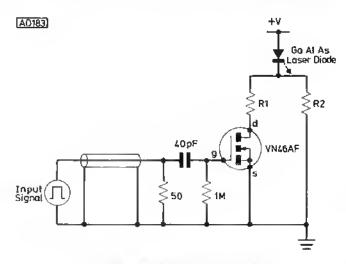


Fig. 6: A laser switching circuit

VMOS devices can be employed in voltage converters which enable a steady input voltage to be converted into a steady output voltage of another value. A typical basic circuit using a pair of VMOS devices is shown in Fig. 7, but the transformer design would depend on the input and output voltages concerned and on the power output level required. High efficiencies can be obtained with this type of circuit, since the rapid switching of the VMOS devices ensures that they spend little time in the intermediate voltage state where power is wasted.

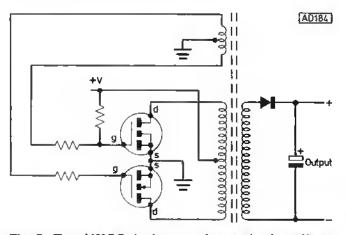


Fig. 7: Two VMOS devices used as a steady voltage converter

It would be possible to use a VMOS device to control the brightness of a tungsten filament lamp by merely varying its gate voltage; however, this would result in much power being wasted in the device when the light output of the lamp is fairly low. A pulse-width-modulation lamp dimming circuit is shown in Fig. 8. The 4011 gates act as a square wave oscillator with a duty cycle which varies according to the setting of VR1. The VN46AF is either fully conducting or completely switched off at all times except during the very rapid switching transients, so

#### Practical Wireless, October 1978

little power is wasted. The brightness of the lamp can be controlled and one of the inputs of the left hand gate used as an ON/OFF switch.

## Amplifiers

VMOS devices form excellent low distortion amplifying devices, since their characteristics are very linear at drain currents exceeding about 400mA. Simple VMOS device amplifiers such as that shown in Fig. 9 can have a response which is almost level to frequencies up to 10MHz.

High quality amplifiers and a transmitter/receiver for the 144MHz amateur band have also been produced using similar VMOS devices.

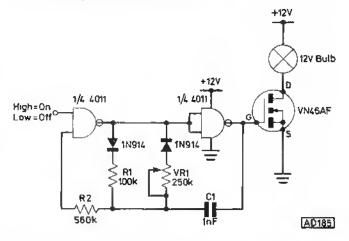


Fig. 8: A lamp dimming circuit which is economical in terms of power consumption. VR1 controls the duty cycle

## Conclusions

VMOS devices have many advantages over conventional bipolar power transistors, including much higher current and power gain (better by a factor of about 10,000), faster switching, no secondary breakdown or thermal runaway and the ability to operate with several devices connected in parallel.

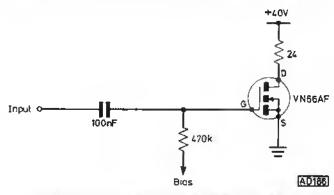


Fig. 9: A high impedance broadband amplifier circuit

Plastic packaged VMOS devices are available from Arrow Electronics Ltd., Leader House, Coptfold Rd., Brentwood, Essex CM14 4BN. The price of the VN46AF is £1.36, the VN66AF is £1.43 and the VN88AF is £1.58 including VAT, but 25p must be added to orders under £5 to cover packing and postage. A.M. RECEIVERS

# **DEVICES & CIRCUITS**

## M. J. DARBY

Last month we discussed simple tuned radio frequency receivers using the ZN414 device, but we now turn our attention to the more complex superheterodyne receivers which are able to provide much better selectivity and also higher gain over a wider frequency range.

## **Basic Circuit**

The basic circuit of a typical superheterodyne receiver is shown in Fig. 12. The incoming signal from the aerial (which may be a ferrite rod) is coupled into an optional radio frequency stage which amplifies the signal at the same frequency as that at which it is transmitted. The signal is then coupled through another tuned circuit to a mixer stage.

If the radio frequency stage is omitted, the signal from the aerial is fed directly to T2 and the mixer stage. A high frequency oscillation is generated in this stage (or in a separate oscillator stage) and the incoming signal is "mixed" with this locally generated oscillation. The resultant output signal from the mixer-oscillator stage contains not only the input signal frequency and the oscillator frequency, but also the sum and difference of these two frequencies.

The transformer at the output of the mixer-oscillator stage, T3, is normally resonant at the difference frequency so that other frequencies are greatly attenuated. This required different frequency is known as the intermediate frequency (i.f.) and remains constant as the tuning varies; in most a.m. receivers the i.f. is in the range 455kHz to 475kHz, but other frequencies such as 1.6MHz are sometimes used.

The output from the i.f. stage is fed into a second pair of coupled tuned circuits resonating at the intermediate frequency, T4, so that good selectivity can be obtained. In many modern receivers T3 is replaced by a ceramic or a mechanical filter to obtain still better selectivity. The output is demodulated by the diode D1 and the resulting audio signal is fed to a power amplifier which in turn drives a loudspeaker.

PART 2

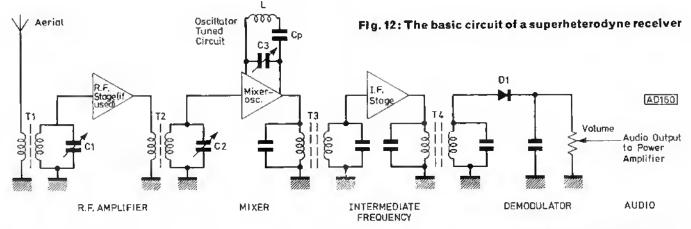
## **Advantages**

The advantage of using the superheterodyne type of circuit is that the transformers T3 and T4 always operate at the same frequency and need not therefore be retuned each time the station being received is changed. It is thus possible to add further tuned circuits if required, and special types of filter.

In the circuit of Fig. 12, the capacitors C1, C2 and C3 are ganged together so that the transformers T1 and T2 are resonant at a frequency close to the wanted signal, whilst C3 controls the oscillator frequency. The so-called padder capacitor  $C_p$  and the value of the inductance L used for the oscillator coil are chosen so that the difference between the resonant frequency of T1 (or T2) and the oscillator frequency remains almost constant as one tunes through the band using the gauged capacitor. The three tuned circuits are said to "track" with one another.

The tracking cannot be made exact at more than about three points on the tuning scale. The selectivity of the four tuned circuits in T3 and T4 is much greater than that of the two tuned circuits in T1 and T2, and it is this which determines the frequency being received. A small variation of the oscillator circuit tuning will produce a large effect on the tuning of the receiver, whereas a small variation of the tuning of either T1 or T2 will only produce a small change in the gain of the circuit.

The disadvantages of the superheterodyne receiver, apart from its complexity relative to a t.r.f. receiver, are the generation of spurious frequencies which can



result in "whistles" in the output, plus the problems of aligning the receiver after construction so that the radio frequency and oscillator circuits track correctly.

One has to accept these disadvantages if one wishes to receive distant signals. One cannot increase the selectivity of a t.r.f. receiver by an adequate amount by using more and more tuned circuits at the incoming radio frequency, since the number of sections in a ganged capacitor which can be practically useful is limited. Tuned circuits using a ganged capacitor cannot be designed for optimum selectivity, whereas the tuned circuits of T3 and T4, which operate at a relatively low and constant frequency, can be designed so that they give optimum selectivity at that frequency. In addition, the use of a constant frequency makes the use of ceramic or mechanical filters possible.

The performance of t.r.f. receivers leaves much to be desired when one attempts to use them at high frequencies of, perhaps 30MHz, since the relatively low value inductances required to tune the circuits results in a low gain and poor selectivity

## A.M. Devices

A number of integrated circuits are readily available from advertisers which contain all of the semiconductor elements required for the radio section of an a.m. receiver for use at frequencies of up to at least 30MHz. Some of them include a provision for a radio frequency input stage, whereas others do not. Although such devices contain many of the components required for the radio section of a receiver, all of the tuned circuits are separate components external to the integrated circuit used. A few a.m. superhet integrated circuits are now becoming available with a low power audio amplifier integrated onto the chip.

One of the best known a.m. devices has become an "industry standard" type and is available from National Semiconductor as the LM1820, from RCA as their CA3123E, from Fairchild as the  $\mu$ A720, from Signetics as their NE546 and also as the HA1197, etc. Another somewhat similar device with an r.f. amplifier stage on the chip is the SGS-ATES TBA651 which provides a very good performance. The Siemens devices are their TCA440 for use at signal frequencies of up to 50MHz and the TDA1046 for use at up to 30MHz.

A number of manufacturers are introducing devices for use in a.m./f.m receivers. Apart from the semiconductor devices required for the radio section of the a.m. receiver, these also include the i.f. amplifier and demodulator for the f.m. section of the receiver. Examples of such a.m./f.m. devices include the Fairchild µA721, whilst other a.m./f.m. devices such as the SGS-ATES TDA1220 and TDA1230 and the Siemens TBA460 include an audio pre-amplifier on the chip. The Mullard TBA700 a.m./f.m. device incorporates a 1W audio amplifier. The circuits in which a.m./f.m. devices are used are relatively complex, since one has both the a.m. and the f.m. receiver circuits, so these devices will not be discussed further. However, some constructors may find the new Telefunken TDA1083 and the equivalent Sprague ULN2204 a.m./f.m. device with a 0.8W output attractive (available from Ambit International).

Some of the earlier a.m. devices (such as the Mullard TAD100 and the RCA CA3088) are still

available from retailers, but we will confine our attention to the more recent devices.

## 6V Superhet

The circuit of a simple 6V superheterodyne receiver is shown in Fig. 13. This employs the LM1820 device which has provision for a radio frequency amplifier before the mixer stage, but the radio frequency amplifier is not used in the simple circuit shown. A two-gang capacitor can therefore be used in this circuit for tuning.

The aerial TI is normally a ferrite rod type, the secondary winding consisting of a few turns of wire connected between the mixer input at pin 1 and the supply voltage at the lower end of R1. The oscillator operates at a frequency determined by the inductance of T2 and the value of the oscillator section of the ganged capacitor C1. The difference frequency appearing at the mixer output at pin I4 is selected by T3 and fed into pins 11 and 12. These pins are connected to what is normally used as the radio frequency amplifier stage, but in this circuit is used as an additional intermediate frequency amplifier.

The output signal from this stage appears at pin 13 and is coupled to the input of the intermediate frequency amplifier at pin 7. The output from this stage appears at pin 6 and feeds a transformer T5 also resonant at the intermediate frequency. Part of the signal from pin 6 is fed through C3 to the automatic gain control circuit incorporated in the LM1820 device.

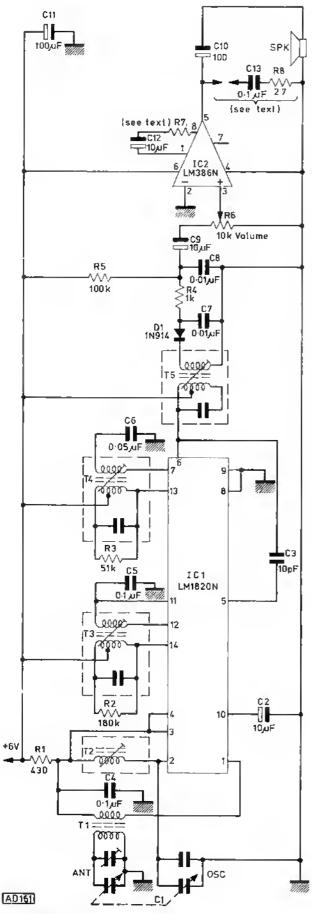
The signal from T5 is also fed into the demodulator diode D1 which is connected to the i.f. filter components R4, C7 and C8. The resulting audio signal is coupled through C9 to the volume control.

A simple LM386 audio amplifier stage is used in Fig. 13. The gain of the audio stage is set by the value of R7. If R7 is completely omitted together with C12, the voltage gain will be 20 times, whereas if R7 is zero (C12 being connected directly between pins 1 and 8 of the LM386), the voltage gain will be 200 times. Values of R7 intermediate between these values of infinity and zero will produce intermediate values of gain, for example if R7 is 168 ohms, the gain of the audio stage is about 100 times.

The components C13 and R8 may be required to suppress high frequency instability in the audio amplifier stage, but should not be needed if the loudspeaker has an impedance of more than about 40 ohms. These components form the so-called Zouci network which compensates for the inductance of some loudspeakers and reduces the variation of loading on the amplifier with frequency.

In small radio receivers of this type a miniature loudspeaker is often employed for convenience, but it must be stressed that one cannot expect to obtain good reproduction unless one employs a speaker and a speaker enclosure which are of a reasonable size. This applies to all radio receivers; miniature speakers just cannot reproduce a good audio signal with good bass notes.

For simplicity no waveband switching is shown in the circuit of Fig. 13. However, arrangements may be made to switch the transformer T1 and the oscillator inductance T2 to provide the wavebands required. Obviously a better aerial than a ferrite rod will be required for the reception of very distant stations.





## The R.F. Stage

A similar circuit employing a radio frequency stage before the mixer involves the use of a three-gang tuning capacitor and three coils for each waveband instead of two. What advantages does this bring?

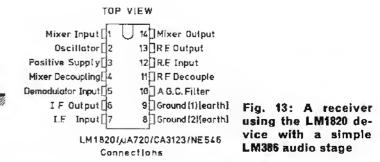
One advantage of the use of a radio frequency stage is a lower noise level when receiving signals at high frequencies. The conversion gain of a mixer stage is considerably less than the gain of a radio frequency amplifier and hence the noise added to the signal by a mixer stage is greater than the noise added by an amplifier stage. If one has an amplifier before the mixer, the signal is brought up to such a level that the noise added by the mixer is less noticeable in the larger signal voltage. At long, medium and the lower short wave frequencies, however, the amount of noise entering the receiver from a good aerial is so great that the mixer noise is relatively insignificant, so one does not usually bother to include a radio frequency stage unless one wishes to receive relatively high frequency signals.

A further advantage of the use of a radio frequency stage is the greater rejection of signals at the "image" frequency which can interfere with reception of the wanted signal. Image rejection is also important only at the relatively high short wave frequencies. In order to understand the term "image" frequency, let us consider the case of a receiver tuned to a signal at 1000kHz with an oscillator circuit operating at 1455kHz so that the intermediate (difference) frequency is 455kHz. If a signal at 1910kHz is also present at the mixer input, this will mix with the 1455kHz local oscillator frequency to form a spurious difference signal at the 455kHz intermediate frequency which interferes with the wanted signal. If a radio frequency stage is used, the additional tuned circuit will attenuate the unwanted 1910kHz signal before it reaches the mixer and therefore the interference will be minimised. No amount of extra selectivity in the intermediate frequency stages will affect image interference; the additional selectivity is required before the mixer.

## **TBA651** Receiver

A receiver with an r.f. stage can be made using the LM1420,  $\mu$ A720, NE546 or CA3123E devices, but as we have already considered the use of one of these 14 pin dual-in-line integrated circuits in the receiver shown in Fig. 13, we will now discuss a receiver using the TBA651 device which also incorporates a radio frequency stage.

A circuit using the TBA651 is shown in Fig. 14; no audio amplifier is included in this circuit, but the audio output can be fed into any standard type of



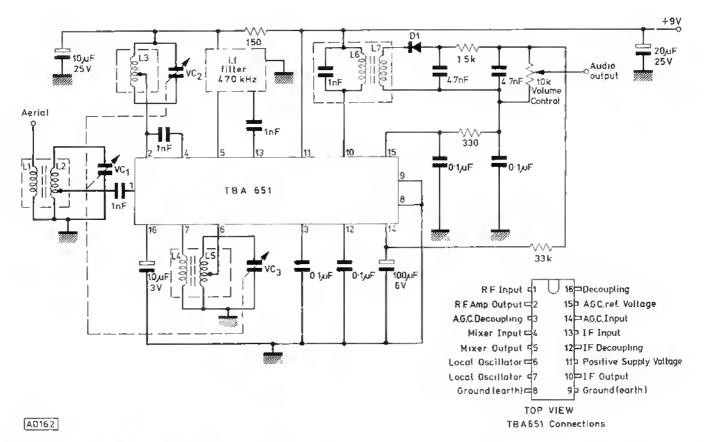


Fig. 14: A TBA651 receiver (no audio amplifier is shown)

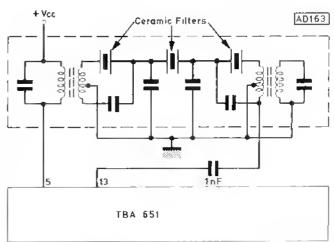
audio amplifier circuit. The TBA651 is a quad-in-line device with the connections shown, quad-in-line devices having alternate pins bent so that their tips are at different distances from the body of the device.

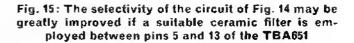
In the circuit of Fig. 14, the radio frequency signal from the aerial is coupled to the amplifier input at pin 1. The signal at the input frequency appears in amplified form at pin 2, further selectivity being added by the parallel tuned circuit L3—VC2. The oscillator tuned circuit consists of L5—VC3, the three sections of the tuning capacitor (VC1, VC2 and VC3) being ganged together.

The output from the mixer stage at pin 5 is fed to an intermediate frequency filter. This may consist of an intermediate frequency transformer, a simple ceramic filter with suitable coupling or a more complex ceramic filter of the type indicated in Fig. 15. The selectivity (and hence the performance of the whole receiver) is mainly determined by the type of filter used between the mixer output at pin 5 and the input to the intermediate frequency amplifier at pin 13. This filter must be included before the amplifier, or unwanted signals may overload the amplifier.

The output from the intermediate frequency amplifier at pin 10 is fed to the transformer containing L6 and L7, the L6 circuit resonating at the intermediate frequency. The diode D1 and the following filter components demodulate the signal and provide the required audio output.

An a.g.c. reference voltage from pin 15 is mixed with the voltage obtained by demodulating the signal and the resulting voltage is fed through a 33 kilohm resistor to the a.g.c. input at pin 14 so that it can be used to keep the gain fairly constant.

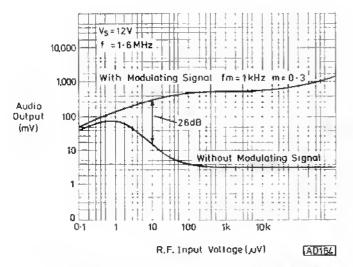




## Noise

The TBA651 employs a high gain, low noise radio frequency amplifier and this enables an excellent overall noise performance to be obtained This noise performance is conveniently shown by the type of graph of Fig. 16. The lower curve shows the noise output when no signal is present at the input, whereas the upper curve shows the output with a signal modulated to a depth of 30 per cent with a lkHz tone. The carrier test frequency is 1.6MHz.

It can be seen that the signal output is about 26dB above the noise under these conditions when the input voltage is only  $10\mu$ V, whilst an input signal of only  $1\mu$ V produces a 6dB signal-to-noise ratio.



#### Fig. 16: The typical noise performance of the TBA 651 device. The lower curve shows the output noise level without any input signal

The a.g.c. control range of the TBA651 is some 120dB, this being made up of about 50dB for the first stage and 70dB for the mixer stage. A variation in the input signal level of 80dB can be made to produce a change of less than 10dB in the output level. The a.g.c. voltage is applied to the first stage only when the input voltage exceeds  $100\mu V$  so as to obtain optimum signal to noise ratio. The TBA651 will operate at supply voltages in the range 4.5V to 18V, the current required being of the order of 12mA.

## The TCA440

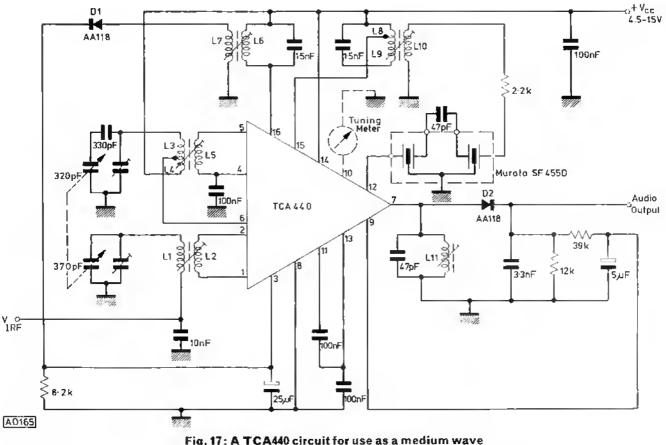
The Siemens TCA440 is another high performance a.m. superhet device. It uses a multiplicative mixer so that few harmonic mixing products and therefore few "whistles" are formed.

A typical TCA440 circuit for medium wave use is shown in Fig. 17. The aerial input to L1 is coupled to the signal frequency amplifier at pins 1 and 2, but this signal frequency amplifier output is internally connected directly to the mixer stage without the use of any external tuned circuit. The oscillator tuned circuit is connected to pins 4 and 5.

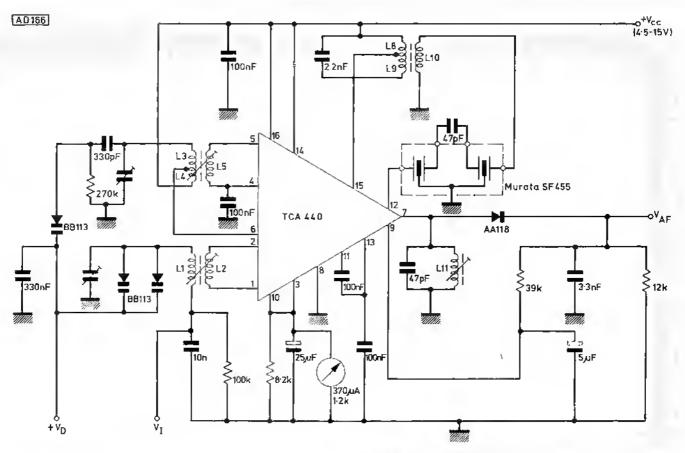
An output from the mixer stage appears at pin 16, is coupled from the tuned circuit containing L6 to L7 and hence D1 which rectifies the signal and provides a.g.c. The other mixer output at pin 15 passes through the transformer containing L9 and L10 and hence to the SF 455D ceramic filter element. It then passes into pin 12, is further amplified and appears at pin 7. The audio signal is obtained from D2, the demodulator diode, whilst an a.g.c. signal is fed back into pin 9 for controlling the gain of the final amplifier stage.

When a 1MHz signal modulated to a depth of 30 per cent with a 1kHz tone is fed to the TCA440 circuit, input levels of  $1\mu$ V,  $7\mu$ V and 1mV will produce signal-to-noise ratios of about 6dB, 26dB and 58dB respectively.

The tuning meter, if used, may have a full scale deflection of  $100\mu$ A, in which case it should have a resistance of about 1500 ohms, but a  $500\mu$ A meter with an internal resistance of about 300 ohms may also be used.



g. 17: A TCA440 circuit for use as a medium wave receiver



## Varicap Diodes

Another circuit using the TCA440 for medium wave reception is shown in Fig. 18, but instead of a ganged tuning capacitor, semiconductor "varicap" diodes are employed. Tuning is carried out by varying the voltage applied to the terminal marked  $+V_p$ . In a typical case, a tuning voltage of +8.5V will result in the receiver being tuned to a frequency of 800kHz, whilst increasing the tuning voltage to +30V will change the tuning point to the uppermost part of the medium wave band at about 1620kHz.

The tuning voltage is applied to the BB113 triple a.m. tuning diode. Two of the three diodes are used in the radio frequency aerial circuit, whilst the third diode is used in the oscillator circuit where the required capacitance is considerably smaller.

The supply from which the tuning voltage for the BB113 diodes is obtained must be regulated. The use of a low current integrated circuit voltage regulator is convenient for this purpose, since it will stabilise the tuning voltage against drift with temperature or against mains voltage changes and will also reduce the mains frequency ripple to the very low level required for the supply to the tuning diodes. Tuning is carried out by using a ten-turn potentiometer to tap off the required tuning voltage.

## Conclusion

We have looked at a variety of integrated circuit a.m. receivers; although these have not been discussed in any great detail, it should be clear that an excellent performance can be obtained at frequencies of up to at least 30MHz (corresponding to a wavelength of 10m). Fig. 18: A TCA440 circuit for medium wave use in which tuning is performed by varying the voltage+ $V_D$  applied to the BB113 varicap diodes

#### **PW WIMBORNE** continued from page 34

## **Precautions Against Hum**

As with the majority of audio amplifiers, care must be taken in the physical layout to avoid high levels of hum, especially where earthing at various points on the chassis is concerned. The emphasis placed upon "input earth" and "speaker earth" in the circuit diagram is no idle instruction; it is essential to take external earthing to only one of these points in order to prevent the creation of circulating currents ("hum loops"), and a consequent high residual hum level.

With the same aim in view, caution in the layout of current carrying conductors such as mains transformer secondary cables will help to prevent hum by routing them well away from sensitive points on the audio pre-amplifier layout.

One very important point is that the mains transformer itself can, by virtue of its high field intensity, radiate hum to the amplifier sections. This is especially true of the cassette unit, where the replay head will be very sensitive in this respect. As a result, it should not be permanently sited until after the cassette unit has been installed, at which point it should be swung in different directions while the cassette unit is switched to "play", noting the best position for minimum hum.

Succeeding instalments will cover the remaining circuit elements, which includes the r.f. board and tuner unit, along with the two optional magnetic cartridge pre-amplifiers, and notes on installation of the cassette unit.



The third Landsat satellite was launched from the US Western Test Range on March 5, 1978. It joins an earlier Landsat craft to scan the entire earth every nine days from an altitude of 500 miles. The satellites detect variations in sunlight patterns reflected from objects on the earth and even from subterranean materials such as mineral deposits and water.

Information thus provided is transmitted to earth stations and converted into photographic prints and tapes which can provide solutions to many problems in food, minerals and other critical resources. It has been estimated that the Landsat craft will save thousands of millions of dollars annually and cut the cost of obtaining data about environmental resources by a factor of about 20 times.

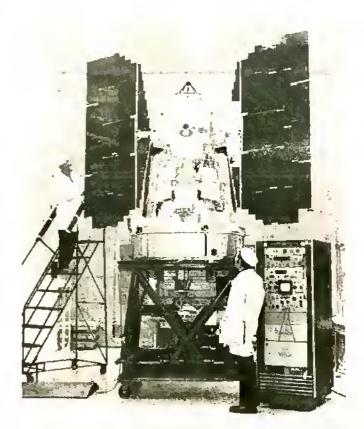
The imaging systems aboard Landsat-3 (weight 940 kg) are improved versions of the multi-spectral scanner subsystem and return-beam vidicon units employed in the two earlier Landsat craft. The developments in these infra-red sensors allow the detection of temperature differences in vegetation, bodies of water and urban areas, during either the day or night.

The Landsat craft have provided over half a million electronic images of the earth to over one hundred nations and are said to have affected more people than any other space programme. Information contained in the Landsat images is vital to the intelligent management of our natural resources.

The third Landsat spacecraft during its final checking at the General Electric Space Division Laboratory, Valley Ford, Pennsylvania. Although the prime contractor for the construction of each of the three Landsat craft was the US General Electric Company, the work required ground support equipment for the launch operations, satellite tracking and data-collection receiving site apparatus for NASA tracking and data stations. The initial ground data system at the NASA Goddard Space Flight Centre, Greenbelt, Maryland, USA decodes the Landsat data to the required form for distribution to the various user agencies.

Landsat-1 was launched in July 1972 and was operating successfully when its transmitters were turned off in January 1978 in preparation for the launching of Landsat-3. Both Landsat-2 (launched in January 1975) and Landsat-3 will continue to provide data in the coming years, but plans are well advanced for the launch of a Landsat-D craft in the early 1980's. The new spacecraft will provide more and better data at a faster rate; in addition, major improvements have been made to the ground datahandling system.

Although the Landsat programme was initially experimental, undertaken to ascertain the feasibility of the remote sensing of earth resources from space, more and more demands for information obtained by the spacecraft are being received from an increasing number of users. The Landsat observations have been employed as a vitally important part of the information required to estimate food crop yield, to aid oil and mineral exploration, to measure water quantity and quality, to make inventories of forests and to monitor land use. Indeed, the number of purposes for which the information is being used is growing at a rapid rate.



Practical Wireless, October 1978



This tuner can be used with end-fed or balanced feeder systems, either for reception or transmission. When used with a receiver, a substantial improvement in signal strength is obtainable. For transmission, it allows the usual pi-tank to be matched to endfed, Zepp, and other aerials.

## Construction

L1 is wound with 20 s.w.g. tinned copper wire, and L2 is of well-insulated wire, on top of L1, as in Fig. 2. The former is 89mm x 44mm and 34 turns are used in all. Taps are equally spaced at six turns, two turns, four turns, and five turns from the centre tap. They are made by passing short lengths of 16 s.w.g. wire into holes in the former, and securely

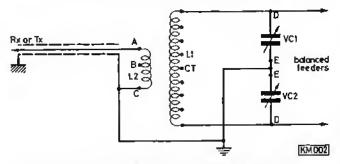


Fig. 1: The circuit diagram of the aerial tuner

soldering these to the winding turns as required. Nine 6BA bolts with tags, mounted on a piece of paxolin about 102mm x 102mm (as in Fig. 2), support the coil. Below these taps fit three bolts for A, B and C. A to B is three turns, and B to C has four turns, so that three, four, or seven turns may be selected. Two further bolts are for E, E, Fig. 2.

Provided plenty of taps are available, other coils may be suitable.

## **Methods of Coupling**

It is possible to find a suitable coupling method by trial only, especially for reception alone. Fig. 3 will help clarify some of the more usual configurations.

"A" is a pi-coupler, and adjustment of the capacitors allows a wide range of impedances to be matched, either to load the transmitter correctly, or to give best reception.

"B" is a popular method for high impedance aerials. With a transmitter, a co-axial lead is generally used, with outer conductor to the chassis. This, shown at "B" may be fitted for any circuit.

"C" employs the link for coupling. For low frequencies, the two capacitors may be put in parallel as shown, and this is useful if they are not of very large value.

## F.G. RAYER G3OGR

"D" is a somewhat similar arrangement to using a centre-tapped coil and having the capacitors in series in this way is most appropriate for a high frequency band.

"E" shows the aerial tapped down, which is useful with parallel tuning when aerial loading prevents proper tuning with "B".

"B", "C" and "D" are appropriate for high impedance. "E" suits many intermediate lengths. "F" is for low impedance (quarter wave) with one capacitor used for series tuning.

Parallel tuning of balanced feeders is shown in Fig. 1. This is satisfactory when the feeder termination is high impedance. For low impedance feeders, "G" in Fig. 3 is necessary. The best balanced system is a tuned doublet. The top is divided into equal lengths, and the twin feeders are spaced about 102mm by spreaders. High impedance feed is expected if onehalf the top, plus the feeder, equals a half-wave or multiple of half-waves. Should one-half the top plus feeder be a quarter wave or odd multiple, lowimpedance coupling "G" is anticipated.

## **\*** components

VC1 and VC2 350pF Jackson 5021/2 or similar. Ceramic or paxolin former, 100 × 100mm. Aluminium base 165×100 × 9mm, aluminium panel 203 ± 152mm, Case 203 × 152 × 152mm. Tinned copper and insulated wire.

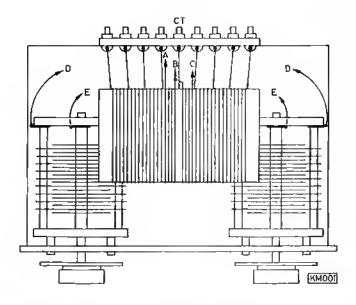
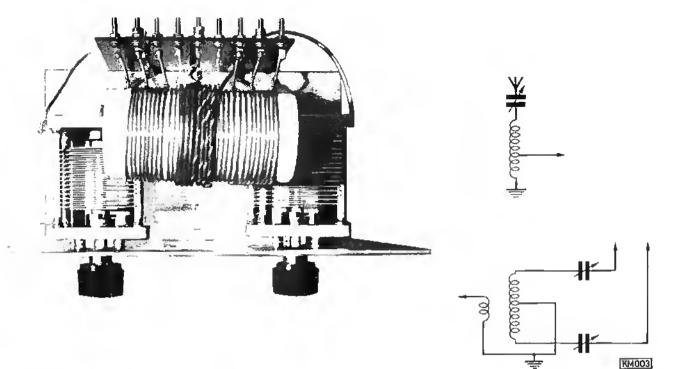


Fig. 2: General layout, showing connections to screw terminals



A view of the unit showing L2 (p.v.c. covered wire) wound over L1

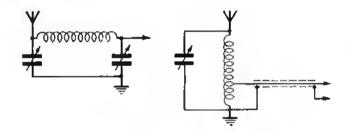
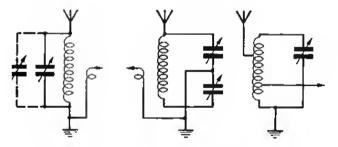


Fig. 3: Coupling circuits A and B





## Frequency

Circuits showing the whole of L1 in use, above, are for the 80m band. For higher frequencies, fewer turns are used. With "A" short out unwanted turns. Circuits such as "B", "C", "E" and "F" are used at higher frequencies by moving the aerial and capacitor connections down the coil.

With balanced circuits, Fig. 1, "D" and "G" in Fig. 3, move taps in equally from each end.

There is sufficient latitude to allow tuning up for reception on 25m, 31m and other broadcast bands, if required.

Fig. 5: Coupling circuits F (upper) and G (lower); details of all coupling circuits are given in the text

## Reception

For reception purposes only, it is an easy matter to try various tappings or circuits, to find which peaks up signals best. This can be done with the aid of the S-meter, selecting a signal not subjected to fading. "B", "E" and "F" will cover most conditions likely to be met with a single wire aerial. The improvement is greatest when the original match with no tuner was poor.

Fig. 1 or "G" will be used with twin tuned feeders (doublet or Zcpp) or Fig. 1 with feeders tapped in equally from each end of L1.

## Transmission

The points already mentioned apply, plus the fact that for correct operation and loading, suitable matching is essential. Mis-matching may in fact cause damage to the transmitter output stage.

An excellent method of matching is to place a standing wave indicator in the co-axial lead from tuner to transmitter, and adjust the tuner for minimum SWR, with reduced power. An indication of 1.5:1 or lower is normally satisfactory. Adjustment to a very low SWR (virtually 1:1) is generally simplified by placing a variable capacitor in series with the link or tap—e.g., between A and the co-axial inner conductor in Fig. 1. A 500pF component is suitable for h.f. bands, and  $2 \times 500$ pF for 80m, receiver type capacitors having adequate spacing. "A" Fig. 3 does not require this item, and can generally provide virtually 1:1 SWR.

Capacitor settings and tappings used for each band should be noted so that re-tuning is possible with a minimum of trouble.



Practical Wireless, October 1978

# What did Flemming say to Edison about Antennas in 1912 P

## SYSTEM "A"

£41.00

250 w. p.e.p. OR for the SWL.

## SYSTEM "J"

£47<sup>.</sup>95

500 w. p.e.p. (improved 'Q' on receive).

## PARTRIDGE SUPER PACKAGES

COMPLETE RADIO STATIONS FOR ANY LOCATION All Packages feature the World Record Joystick Aerial (System 'A'), with 8/E, feeder, all necessary cables, matching communication headphones. Deliv, Securicor our risk. ASSEMBLED IN SECONDS! BIG CASH SAVINGS!

PACKAGE No. I	£222.00
As above with R.300 RX. SAVE £14-15!	
PACKAGE No. 2	0000.00

PACKAGE No. 2 Is offered with the FRG7 RX. SAVE (14-13)

## PACKAGE No. 3

Here is a lower-price, high-quality package featuring the LOWE SRX10., with all the Partridge extras. SAVE (14-15)

RECEIVERS ONLY, inclusive delivery, etc. R.300 £184.50 FRG7 £184.50 SRX30 £14b-75

800 £184-50 FRG7 £184-50 SRX30 £146-75

All prices are correct at time of going to press and include VAT at 121% and carriage.



Just telephone your card number Phone 0843 62535 (ext.5) (or 62839 after office hours)



£184.20

or write for details, send 9p stamp

G3VFA G3CED Partridge House, Prospect Road, Broadstairs CTI0-ILD. (Callers by appointment).

## So You Want to Pass the RAE?

A reprint of the complete series, including details of the new examination format being introduced in 1979, will be available in mid-September 1978. The reprint will cost 85p, including postage and packing to addresses within the United Kingdom.

Order your copy by completing and returning the coupon, together with your remittance, to IPC Magazines Ltd., Post Sales Department, Lavington House, 25 Lavington Street, London SE1 0PF. Please ensure that your name and address are clearly legible.

PRACTICAL WIRELESS—Radio Amateur Examination Reprint
Please send your order and remittance to:
PC Magazines Ltd., Post Sales Department Lavington House, 25 Lavington Street, Londor SE1 0PF
Please send me copies at 85p each to include postage and packing
enclose P.O./Cheque No Value
Remittance must be crossed postal order or cheque name and address on back please) and made payable to IPC MAGAZINES LTD
AME. BLOCK LETTERS)
DDRESS
Post Code
Remittances with overseas orders must be sufficien o cover despatch by sea or air mail as required
ayable by International Money Order only
Company registered in England. Regd. No. 53626
A subsidiary of Reed International Limited
Cut round dotted line

## 2m MOSFET CONVERTER

continued from page 25

An internal supply using a PP3 battery could also be utilised if the Zener stabiliser in the oscillator is changed to a 6V8 type and  $R_{\rm bl}$  suitably adjusted in value.

The converter would then be completely selfcontained and could be used with valve receivers where an internal 12V supply is not normally available.

## **Coil Winding Details**

Coils L1, L2, L3, L6 and L7 are identical, with the exception of a tap at  $1_4$  turns on L1. They are all made using a 6.5mm drill as a winding mandrel.

All coils can be wound using 19 or 20 s.w.g. tinned copper wire and, with the exception of L1, may be constructed from enamelled wire for appearances sake. The turns are separated evenly until the coils are 9mm (0.3 inches) long.

Coil L4 is wound using 30 s.w.g. enamelled copper wire with a total of 17 turns on a 5mm slug-tuned former, which is then fixed to the board with cyanoacrylate adhesive.

Enamelled 30 s.w.g. copper is also used for L5, which is wound with 9 turns on a 5mm slug-tuned former and fixed in the same manner. Both the coils are close-wound, the windings being subsequently waxed to aid stability and to hold in place whilst fitting to the board.

## Alignment and Operation

Once the unit has been completed and checked for faults, the battery or other supply may be connected and the current measured. This should be in the order of 20mA at 12V. If all is well the oscillator can now be adjusted with the core of L5, using a wavemeter to sense when oscillation occurs and to tune for maximum output. At this point, the supply should be switched off and on again to ensure that the oscillator re-starts. If it does not, then detune the coil slightly until instantaneous oscillation occurs at switch-on. Once correct, use a wavemeter to tune L6/TC4 to 116MHz and then tune L7/TC5; return to TC4 and peak, then TC5 again to achieve maximum output, as these coils will tend to detune each other.

Plug the converter into the aerial socket of a receiver and tune the set to 29MHz, now adjust L4 for maximum noise at the speaker.

Carefully tune the station receiver from 28 to 30MHz and try to find a signal. If a station is heard or a locally-generated signal is available trimmers TC1, TC2, and TC3 can be peaked for maximum output from the speaker or against a reading on the Smeter (which is usually much more accurate).

The trimmers TC4 and TC5 should now be carefully turned for optimum converter gain.

No further adjustments are required and the unit should give you years of satisfactory operation without the need for any further adjustment if a small drop of wax is melted into the coil cores to ensure rigidity.





by Eric Dowdeswell G4AR

Looking at the spate of reports on 10 and 15m activity it is fairly obvious that most are from readers possessing one of the relatively new types of receiver, such as the FRG-7. This is only to be expected, of course, but it leads me to wonder just how many readers are plodding away with older sets, which may not be very effective at these frequencies, not hearing very much, and frequently switching off, convinced that the bands are dead.

If you have such a set, don't scrap it but build yourself a converter from some published design. The set is probably quite effective at, say, 3.5 to 5.5MHz, with a good dial, so the converter is used to change signals on the 10 and 15m bands (28 to 29.7MHz and 21 to 21.4MHz) to a frequency within the range of the main receiver, which is used as a tuneable i.f. stage. The simple r.f. tuned circuits can be arranged to cover both bands without any switching.

A good line-up for the converter is an r.f. stage, mixer, and crystal oscillator/multiplier. If, for example, a 3.5MHz crystal is chosen, the oscillator output selects the 7th harmonic on 24.5MHz which is fed to the mixer, producing a difference frequency, on 28MHz, of 3.5MHz which is fed to the receiver. The dial calibration of 3.5MHz will now represent 28MHz and by tuning up to, say, 4.5MHz then signals on 29MHz will be heard, and so on, the converter r.f. circuits being peaked appropriately.

In practice a crystal just below 3.5MHz will be chosen or the receiver will be blocked by the fundamental. A frequency of about 3.490MHz should be suitable

If the fifth harmonic of the crystal is chosen, on  $17 \cdot 5$ MHz, this will mix with 21MHz to produce  $3 \cdot 5$ MHz again, thus covering the 15m band. The only switching involved is for the correct harmonic, the r.f. tuning covering both bands. There are no variable oscillators involved which means that the overall stability of the set-up is as good as the main receiver.

Crystals over a very wide range of frequencies can be chosen, different ones for each band if you like, and the i.f. tuning range can be other than that suggested. However, the use of 3.5MHz gives automatic fixing of the band edges. It is essential that the main receiver be well screened and that the converter is connected up with coaxial cable with proper fittings, otherwise signals may leak through at the chosen i.f. The converter should have a switch to change the aerial input direct to the receiver to avoid having to play around with cables. If solid-state, the converter may be powered by a 9V PP3 battery, or possibly from the main receiver.

I used a valved version of such a converter for some years, coupled to a much-modified HRO, and such a combination would be hard to beat. Remember that in a multiband receiver the necessary r.f. switching can only introduce losses at the higher frequencies.

## Newcomers to the Column

From East Kilbride, Glasgow comes a letter from Greg Duffy who has been listening around the bands for only a few months. He has an FR50B receiver but has been worried about the type of aerial to use, and wants to improve on an indoor wire. I have sent him the PW Aerial Chart that was given away in October '72 and I have a few more copies for any other newcomers who have aerial problems. An 8 x 5in SAE would help, please. My other oft-repeated advice was to write to the RSGB for a copy of the Guide to Amateur Radio which costs £1.70 inc post and packing. Their address is 35 Doughty Street, London WC1 for those just starting in amateur radio.

I'm going to include Neil Clarke of Mexborough, S. Yorks here because although he has written to me before, he has only recently got going with a PCR receiver, although he was after an HRO or AR88. He comments on the very rapid overs that some chaps use so that he is unable to copy the callsigns. This, I'm afraid, is something that only experience, listening on the bands, will sort out, but be patient, Neil.

An appeal from Steve Donnelly of 25 Church Street, Adlington, near Chorley, Lancs, who would like to meet others of like interest in his district. He's been using another FR50B for over a year and if anyone wants to call on Steve and "have a go" they are welcome. Thanks, OM. Steve wants to know all the pros and cons of adding accessories to a set. It so happens that an article from me on the very subject is with the Editor now, so let's hope he looks on it kindly!

## **On the Bands**

Dick Smith of Porthcawl (mid-Glam) is still plugging away with his little t.r.f. set, mainly on 20m where he found HP3AB on s.s.b., and A5JO ostensibly

in Bhutan, which is just too good to be true! Bob Bell (Blyth, Northumberland) reports that about a dozen people have come forward as a result of appeals in this column so it looks as if a local club there will materialise very soon. Any group thinking of starting a club but feeling a bit hesitant about it should write to the RSGB and see if they still have the leaflet which gives a suggested set of rules and general guidance on running a club.

Flat Holme Island was the QTH for the Marconi celebrations and special station GB3FI. Brian Smith of Barry, Glam. can see the island from his QTH but was determined to log the station. He found it eventually on 160m! Brian bought himself a typewriter, unfortunately for me, as his letters are now twice as long! He found DX on 80m at this time of year in the shape of ZP5YW, which is pretty good going.

Steve Turner BRS37620 kept away from radio while working on his O-levels but was amply rewarded on his return by catching the Rodriguez Island DX-pedition 3B9DA on 20m s.s.b., using his ex-Army R208 and 50ft wire. He's contemplating recalibrating his set and would like to hear from anyone else who has managed to do this successfully. So fellow R208 users are asked to drop a line to Steve at 9 Wallingford Road, Handforth, Wilmslow, Cheshire.

According to Ian Marquis A9140 the band with the sparkle has been 15m where he found VP2MZZ on Montserrat, VR4CF in the Solomons and YB0AB in Indonesia, Talking of VP2, I wonder how many people realise that it counts as nine different countries for DXCC purposes? The first suffix letter denotes the island, as shown with VP2MZZ above, and there are nine principal islands. Another one who is just relaxing after his exams is Pete Cockerell of Leigh-on-Sea, Essex. He's asking me when the peak of the current sunspot cycle is likely to be! My guess is as good as anyone's but I'd say around 1981, but there, half the fun of amateur radio is not knowing how conditions are going to turn out! Pete's problem is that he'd like something better than the PW Direct Conversion Receiver that has stood him in good stead, but can't decide whether to go on making up odds and ends of projects or to save for a proper set! Go for the set first OM and get some more listening time in. You can go for the bits and pieces later.

In far-distant Truro, Cornwall Bill Rendell has added a 15m folded dipole to his "elementary" valved Heathkit AR3 and his log seems to justify the work involved, with FP, KC4, KG4 etc appearing in the log, as part of Bill's quest for island calls. Bill comments on the sunspot wipeout in mid-July when the band was full of DX at 1730 but within a couple of hours all he could hear were G's working each other. He managed to bag GJ for a new one on 15m!

## **Club News**

John Howard G4EVI, publicity officer of the Yeovil ARC G3CMH invites interested readers to two lectures. On September 14th Dud Charman G6CJ gives his famous talk and demo on aerials, and on October 12th the RSGB's Region 17 rep Les Hawkyard G5HD will discuss the World Administrative Radio Conference 1979. Club meetings every Thursday at 1930 in Building 101, Houndstone Camp, Yeovil. A club net operates on Sundays 1030 on 3660kHz.

I always thought that Shirehampton was one of those places mentioned in Crossroads! But now R. G. Ford tells me that the Shirehampton ARC meets on Friday evenings at Twyford House, High Street, Shirehampton, Bristol and that a new RAE course starts in September. The club has h.f. and v.h.f. gear plus a programme of lectures and films. Write to Hon. Sec. R. G. Ford, 2 Jersey Avenue, St. Annes, Bristol for details.

## Log Extracts

W. Rendell:— 15m C5AAR EA8LD FP0AM HM1II HS1WR J3AH KA6KN KC4AAC (Anvers Is.) KG4FW KZ5ED SV1IW (Crete) TR8AC YB0ACB 9V1TG. I. Marquis:— 20m FC9UC OH0NA TA1ZB 15m

I. Marquis:— 20m FC9UC OH0NA TA1ZB 15m TU2GM FM7BA VP2MZZ VR4CF 3D6BP YB0AB 10m 3D6BP 8R1J (c.w.).

S. Turner:— 20m DUICLR HB0XAA YB1BF/7 3B9DA (Rodriguez Is.).

B. Smith:— 80m ZP5YW 40m CO2KK TI2RMA TG9IA 15m HS1WR.

R. Smith:-- 20m A5JO CO2FRC HP3AB VP2VEM.

R. Bell:--- 15m P29JS CP3AF 10m LU1NR.

All s.s.b. unless indicated otherwise.



## MEDIUM WAVE DX

## by Charles Molloy G8BUS

During the last war a number of specialist receivers covering the low frequency bands only, were produced and on the face of it, they should be the answer to the medium wave DXers' prayers. Unfortunately there are snags. The majority of these receivers are bulky and heavy. Some are unsightly with jacks and multiway plugs on the front panel, and many were designed to run from unorthodox power sources such as a 24 volt aircraft supply. Reader M. N. Button of 101 The Street, Holt, Trowbridge, Wiltshire, has acquired one of those receivers—the ex-USAF DF Receiver type R101A/ARN6 which covers 100kHz to 1750kHz in four bands and he would be very grateful for any information on it. All letters will be answered.

## Low Frequency Communications Receivers

A general coverage receiver such as the CR100 or the AR88 must have a reasonably high i.f. in order to provide good image rejection at the h.f. end of its range, but the higher the value of the i.f. then the worse the selectivity becomes so usually a compromise is chosen around 460kHz. If the selectivity is not good enough then a crystal or mechanical i.f. filter has to be provided. A receiver for low frequency use only, can have an i.f. as low as 100kHz which provides excellent selectivity with a minimum of complication while at the same time the image rejection is acceptable. Stability is also easier to achieve and two r.f. stages and three i.f. stages are not uncommon. As



R.C.S. 100 watt MIXER/AMPLIFIER ALL VALVE

#### RCS 100 \_\_\_\_\_ \_\_\_\_\_ ŝ. 吉高 2 ē Ğ. -7

Four faguls. Four way mixing, master volume, trable and bass controls. Soits will speakers. This professional quality amplifier thatain is allable for all groups, durce. P.A., where high quality power is required. S speaker outputs. AIO mains operated. Share wurput, Foudared by Gamend for a guality with amplifier.



cartriige.	624-50
BåR Budget Antochanger with ceramic cartridge.	£12-95
Garrard AP76. Single player less cartridge.	\$28.50
BSR. F163, Belt érive Turntable, less caririège.	227-50
Garrard \$800. Autochanger with ceramic cartridge.	114-95
Garrard Minichanger. Plays all size records, Geramic cartridge.	£9-95
BSR. P182. Suske arm, fared urnlable, coramio cartridge. Latter model.	£19-96









SINGLE IZinch CABS COMPLETE 30 WATT R.M.S. £32. WITH HORN £40. 40 WATT R.M.S. 434. WITH HORN 442. 60 WATT R.M.S. £41. WITH HORN £49.

**BAKER DISCO SPEAKERS** 

for Disco or PA all fitted with entrying handles and corners, Black synids covered. Other cabinets in slock. IAE for iseffet

HIGH QUALITY-BRITISH MADE

2 x 12" CABINETS

60 WATT R.M.S.

656



Post 65p

£9.95

Post 65p 337 WHITEHORSE ROAD, CROYDON

1.000

**GOODMANS 20W Woofer** 

6 ohma.

Size 12 × 10in 4 ohms, Rubber cons surrdand, Hi-Pi Bass unit.

RADIO COMPONENT SPECIALISTS Open 9-6 Wed. 9-1 Sat. 9-5 (Closed (or lunch 1.15-2.39) Minimum post 30p. Components List 20p. Cash price incl. VAT. Access & Barclay cards welcome. Phone your order. H.F. available Tel. 01-684 1465

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:-

AMATEUR BANDS Eric Dowdeswell G4AR, Sliver Firs, Leatherhead Road, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

MEDIUM and SW BANDS Charles Molioy G8BUS, 132 Segars Lane, Southport, PR8 3JG. Reports for both bands must be kept separate.

VHF BANDS Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

I have used three of these receivers at one time or another for medium wave DXing I thought it might be useful to pass on what I know of them.

The Marconi Mercury is by far the best receiver I have used for MW DXing. It first came to my attention when detailed in an article on coastal radio stations in Practical Electronics November 1966 edition. At that time the receiver was still in use in these stations. This valved receiver, complete with separate power pack, can be plugged straight into the 240 volt mains and it is ready to use. There is even an internal speaker. The receiver covers 100kHz to 4.0MHz in four bands with an additional band from 15kHz to 40kHz. On the two higher bands, which include the medium waves, it is a double superhet with i.f.s of 4.5MHz and 85kHz. There is a three-position selectivity switch which is adequate and heterodynes can be removed with an external audio notch filter instead of the more usual crystal phasing control. The receiver, although presentable in appearance, is too bulky and heavy for use in domestic surroundings, at any rate in my QTH, and consequently it is temporarily in retirement.

The BC314 is a low frequency version of the well known BC312 and there is also a BC344 which has the same relationship to the BC342. The BC314, which I have used, covers 150kHz to 1500kHz in four bands using an i.f. of 92.5kHz and there are two r.f. stages and two i.f. stages with metal octal valves. The BC314 performs very well on the medium waves. It is heavy but not too bulky but it runs from a 12 volt battery with a consumption of about 5 amps. The one I used was converted to run off 240 volt mains but this is not too easy to do as internal space is limited. The BC344 runs off 110 volt mains.

Older DXers will remember the Medium Wave Command Receiver which at one time was popular as a car radio. The official name is the R24/ARC5 or the BC946. It is compact and light, it has one r.f. and two i.f. stages using metal octal valves and the i.f. is 239kHz. The three i.f. transformers have push-pull rod adjustments for changing selectivity and in the "narrow" position this receiver is excellent for DXing. The frequency range is from 520kHz to 1500kHz in a single band. The tuning scale which rotates, is surprisingly accurate but there is no tuning knob as the receiver was designed for remote control by Bowden cable. It is fairly easy to fit a tuning control. The Command receiver works from 24 volts but the dynamotor can be removed to make space for a mains transformer etc. The heaters are unfortunately wired for 24 volts.

Other l.f. receivers that I know of are the Radio Compass MN26 with the suffix A, C, CA or W for medium wave coverage and the RBM which tunes from 140kHz to 2MHz with an i.f. of 140kHz. Although all of the receivers mentioned here have long since disappeared from the surplus market many are still in private hands and are sometimes on offer in the small ads columns of specialist radio amateur magazines such as *Radio Communications* (RSGB) and the *Short Wave Magazine*. When available, these receivers can usually be obtained for a modest outlay, for apart from the medium wave DXer and perhaps collectors, few people have any use for them.

## **Crystal Calibrators**

"The crystal calibrator you mention presumably applies to your particular set and valves" writes R. E. Steele from Swanley, referring to the notes in the June issue about the gear at my QTH. This is not so. A crystal calibrator is connected to a receiver in place of the aerial and one can be used with any receiver, even a crystal set. A 100kHz calibrator generates a 100kHz carrier plus harmonics at 100kHz intervals. Harmonics are multiples of the fundamental, which in this case is 100kHz. This means that there will be 11 such harmonics or markers across the medium waves starting at 600kHz, then 700kHz and so on up to 1600kHz. Although useful, such a calibrator has limitations on the medium waves and a more complicated model with an additional alternative output of 25kHz or 10kHz will be more useful. My calibrator has switched outputs of 100kHz, 50kHz and 10kHz which are used as markers on the medium waves, enabling me to set my receiver onto any of the North American "channels" which are spaced at 10kHz intervals between 540kHz and 1600kHz. A calibrator with a single output of 10kHz would have its own problems as it would then be difficult to identify the individual 10kHz markers from one another. There would be 107 of them across the band.

These remarks apply to the medium and long waves only. A different approach is required for the short waves where the 100kHz markers become difficult to identify on the higher frequencies and an additional marker of 500kHz or 1MHz is then an advantage. For general DXing a calibrator with three outputs is adequate. One output of either 500kHz or 1MHz, a second of 100kHz and a third of either 25kHz or 10kHz, will cover most requirements.

## DX

The implementation of the new (Geneva) band plan for the medium and long waves on the 23rd November 1978 will make Asiatic, African and Near East DXing more difficult from the UK. The new plan applies to these areas as well as to Europe! At the moment broadcasts from outside Europe are to be found in some of the gaps between European stations. For example, Kabul in Afghanistan can be found on 1280kHz which lies between Europeans on 1276 and 1285. Under the new plan, Kabul moves to 1278kHz which will be a European channel and this station may then become a rarity. So now is the time to have a look around before the change occurs. Listen as darkness approaches in the gaps between the European channels and refer to an up-to-date list, such as the 1978 World Radio and TV Handbook for possible DX. Rivadh in Saudi Arabia is on 587kHz. Kermanshah Iran is on 895kHz, Egypt on 1155, Enugu Nigeria on 1320, Kuwait on 1345, Kirkuk 1360 and Ahwaz 1390 both in Iran and Ban Pachi Thailand on 1580 with sign-on at 2230 GMT.

## **Pirate Radio Stations**

A number of readers, the latest being Richard Casey EI9BL, send in logs of Pirate Radio stations. These stations operate outside the ITU regulations and they ought to be illegal in any country that belongs to this international organisation. It is also illegal in the UK to publicise these stations and consequently details of them cannot be included here. In any event, pirates are seldom DX. To the serious DXer they are just an unwelcome addition to a band already overloaded with QRM.



## SHORT WAVE BROADCASTS by Charles Molloy G8BUS

A reference to the MCR1 receiver in this column prompted John I. Brown of South Ockenden in Essex to write "I designed the MCR1 early in 1943 and it was produced by Philco in Perivale reaching a rate of 500 per week before Christmas that year. The set was packed in Huntley and Palmer biscuit tins, complete with two dry batteries, an a.c./d.c. power pack for 110-240V, earphones and coil boxes for all bands from 150kHz to 15MHz. The tins were solder sealed and 'delivered' in parachute containers, mainly by Halifax and Stirling bombers." John goes on to say that altogether 30,000 of these receivers were made, the majority being used to provide links to resistance movements in occupied countries. John, who has been a PW reader since he was a boy, thinks that many people would regard attempts to modify the MCR1 as vandalism! Strong words, but it does seem rather a pity to muck about with such a famous piece of equipment.

## **Time Signal Stations**

A request for detailed information about the various time signal stations that can be heard on the short waves comes from Findon Vicarage in Wellingborough where the **Revd J. P. Beaumont** thinks this could be helpful to DXers for receiver alignment and calibration checks.

Time signal stations are to be found on 2.5MHz, 5MHz, 10MHz, 15MHz and on a number of other frequencies as well. In the UK, station MSF located at the National Physical Laboratory at Teddington transmits on 2.5, 5.0 and IOMHz, and the 5MHz transmission which is within the 60m broadcast band is a strong signal at my QTH. The "programme" which lasts for 10 minutes is repeated throughout the 24 hours. At 30 seconds before the hour the callsign MSF is sent in Morse code. Then there are second and minute pulses for a period of five minutes and during the following 412 minutes the station is off the air. As well as providing an accurate time check, MSF also provides an accurate frequency check and the DXer will find it useful for locating 5MHz on his receiver and hence the 60m band. He can use MSF as a frequency standard against which to calibrate equipment such as a wavemeter or crystal calibrator (where

Practical Wireless, October 1978

an adjustment is provided). MSF is also a good signal on  $2 \cdot 5$ MHz which marks the upper limit of the 120 metre tropical band. Clock pulses can also be heard from various stations throughout the world on 10MHz (30m) and 15MHz (20m) which lie within the unofficial limits of the 31 metre and 19 metre bands respectively.

Perhaps the most useful and interesting feature of these stations is the guide they give to propagation. Station VNG in Lyndhurst, Australia transmits on 4.5MHz, 7.5MHz and 12MHz, all three transmissions being audible in the UK when propagation is favourable. Others from Taiwan, China, India, Italy, Japan, Argentina, USSR, USA, Hawaii and South Africa are on 5MHz and 10MHz and some of them can be heard in the UK. Identification can be a problem but some information is included in the World Radio and TV Handbook. Full details of all known time signal stations, including a breakdown of each programme which in some cases gives a propagation forecast, are contained in a booklet, printed in English called List of Time Signal Stations, which has been compiled by a German DXer. It is obtainable from Gerd Klawitter. Ochtrupper Str 38, D-4430, Steinfurt, FRG (West Germany) in return for five International Reply Coupons.

## **Aerials and Trees**

Following the comments in the July issue about using a tree as an anchorage for an aerial in place of a mast, E. C. Rowland has written in with some details of his own experiences. He says that if the tree is likely to move a lot then make sure that the pulley is able to move freely and is of as large a diameter as possible. Use stranded wire instead of rope as the latter will absorb moisture and freeze in cold weather. A spring between the end of the rope and the weight is also a help. His first attempt to use a tree was in the early days of wireless when he had a crystal set and the "weight" was an old-fashioned type of cooking pot designed to hang on a hook in a chimney. This rested on the ground when the tree was not in motion. An attempt was made to fit the pulley at the house end of the aerial but this caused problems with the lead-in and the idea was abandoned.

## Receivers

**Phil Grainger** (South Shields) has moved from a Trio 9R59DS to the new Yaesu Musen FRG-7 but he says "I can't say this receiver is that much better than my trusty Trio". Do not expect spectacular results if you swap a good receiver for one that may be better. The law of diminishing returns also applies to receivers and quite a large outlay may bring only a marginal improvement which is not apparent except when listening to a weak or difficult station.

From South Africa regular PW reader Francois Steyn writes to ask if any reader could help him with some information, including a circuit diagram, about a rather old valve receiver which is marked SAJ Geloso Gruppo No 1988 Micro. Replies direct to 26 Voortrekker St, Villiersdorp, 7170, RSA. When connected to a 150ft inverted "L" aerial via a MOSFET (40673) preselector, this receiver pulled in JJY, the time signal station in Japan on 10MHz at 1640, the CBC Northern Service on 11720 SIO 333 at 2104, FEBC Philippines in English on 15440 at 1430 SIO 433 and SLBC Sri Lanka with a test transmission on 17850 at 1850 SIO 433. The Newport Amateur Radio Society is looking for new members, enquiries should go to Martin Liezers, 32 Barrack Hill, Newport, Gwent NPT 5FR. Martin, who looks after the interests of SWLs, uses a Realistic DX160, a home-brew aerial tuner and a large medium wave loop in series with a 200ft long wire. On 60m, DX heard included two Venezuelans, Radio Universo in Barquisimeto on 4880kHz at 2245 and Ecos del Torbes in San Cristobal on 4980 at 2240. Conakry, Guinea on 4910 was also heard at 2305.

Martin is having difficulty identifying Latin Americans and he mentions hearing "Colo Santa Araba" and "Radio Baraba" on 4950kHz approx. This. is probably a reference to Santa Barbara del Zulio which is a medium wave station which may well be linked up in a network, such as Radio Rumbos, with a short wave outlet. The Rumbos network has the habit of announcing the names of all its stations, including the towns, which is very confusing for the DXer. Martin asks for the address of Radio Clarin which is AP 205, Zona 2, Sto Domingo, Dominica. John Dennis Court of Birmingham reports hearing Radio Clarin on 11700kHz (25m) between 2230 and midnight using an Eddystone EC10 and 10ft outdoor aerial. while thirteen-year-old David Wyatt of Oswestry heard Radio Clarin at 2300 in English also on 11700 using a home-brew receiver and 100ft of wire "tangled up" in the loft. From David's penpal in Indonesia comes news of RRI Jakarta on 9710 and 11790 from 0900-0930 and on 11790 from 1100 to 1200.

S. Donnelly suggests that the Radio Ping Pong mentioned in the July issue may be Radio Pyongyang in Korea while David Wyatt asks if anyone has reported recently to Radio Pyongyang. This station sent David a QSL card, a pennant, schedule, letter, set of postcards of Wonsan, a badge, a book about Pyongyang Zoo and two IRCs, as the latter are not valid in North Korea.



by Ron Ham BR\$15744

We all know that the v.h.f.s are full of surprises, but, how many of us would have expected to see adverts on Hungarian television, cartoon films from Italy, sport from Poland, hear east-European and Italian broadcast signals dominating Band II, and UK amateurs working their Italian counterparts on 2m with comparative ease. It was all this, in one 3-hour session which set the telephones buzzing among our readers and disrupted the Saturday evening plans in many of our homes.

## Sporadic-E

Around 1700 on July 8th, the v.h.f. bands were relatively quiet, but, by 1800 my R216, monitoring Ch. R1, 49.75MHz, was receiving strong television sync pulses which were heralding the start of the biggest sporadic-E disturbance for many years. It was soon obvious that frequencies between 30 and 150MHz were wide open and it was amazing to hear the chaos, as signals from a wide variety of international broadcast transmitters, which share the same frequencies throughout Bands I and II, mixed together.

Between 1810 and 1930, Ian Rennison, Horsham, Sussex, using a JVC 3040 UKC, fed by a dipole. received strong pictures from ORF Austria, DDR East Germany, RAI Italy and the USSR. At 1930, Guy Stanbury, Chelmsford, counted 37 Italian stations between 87 and 104MHz, as did Ian who writes "I was also monitoring Band II and it was cluttered with Italian f.m. stations, some were so strong that stereo reception was a 'piece of cake' ". I rang Alan Baker, G4GNX, Newhaven, Sussex, who demolished his piece of cake and rapidly humped his 2m gear up to his loft shack (it had been out for v.h.f. field day), and was rewarded for his immediate efforts, because between 1849 and 1930 he worked IGWJB, I0HKD, 10JFE on 2m s.s.b. and heard Mike Hearsey, G8ATK, Farnham, Surrey, along with several other G stations, in QSO with the Italians. Clive Atlowe, Blofield, Norwich, using three Sony sterco receivers, heard many private stations among the multitude of Italians in Band II and Bob Dewick, Bradwell-on-Sea, Essex, reckons that this event had been brewing up since early morning because during the day he received strong signals from Italian, Portuguese and Spanish broadcast stations in Band II. While most of us were concentrating on the v.h.f.s, Harold Goble, G4FDQ, Lancing, Sussex, used the short skip on 10m to work into GI, ZE and 5N2.

Throughout a similar event during the evening of July 10th, the German beacon, DL0IGI, was very strong and G4GNX had a half-hour QSO with DF2RQ, both on 10m. Guy Stanbury reports that Band II was disturbed early in the evening, and so was 2m, because Peter Henley, G81QO, Eastbourne, Sussex, and John Matthews, G3WZT, near Horsham, worked stations in Greece. Later in the evening Alan Baker and Roy Bannister, G4GPX, Lancing, worked YU00M, on 2m s.s.b. and John Cooper, G8NGO, Cowfold, Sussex, heard similar signals from II, HG, and YU with an indoor 4-element Yagi. Duncan Groves, Chelmsford, described the opening as being like Pandora's box. . "things appeared everywhere" and William Poel. G8CYK, Brentwood, Essex, heard Yugoslavian stations in Band II with only a piece of wire in the aerial socket of his Ambit International Tuner.

During the morning of the 11th, DL0IGI was pounding in on 10m, TV pictures were coming from Sweden and the USSR on Band I and I counted 48 strong signals from east-European broadcast stations between 65 and 73MHz, some of which were heard by **Harold Brodribb**, St. Leonards-on-Sea, Sussex, using an indoor dipole to a home-brew receiver. Important, but much less severe sporadic-E disturbances occurred on June 19th, when I received good pictures from Finland, Iceland and Sweden, 20th, 22nd, and 29th and July 1st, when Ian Rennison received pictures from Austria, Hungary, Italy, Norway, Spain and the USSR, and July 2nd, 7th, 15th and 16th.

## Solar Activity

Radio noise from the "active" sun was recorded at 136/142MHz by Cmdr Henry Hatfield, Sevenoaks, Kent, John Smith, Rudgwick, Sussex and myself on 18 of the 25 days from June 21st to July 16th, during

which time there were two major noise storms, June 24th to 28th and July 9th to 12th, both disturbing the ionosphere and causing radio blackouts on many occasions. On June 26th, John Branegan, GM8OXQ, Saline, Fife, heard solar bursts at 29MHz, while Alan Baker received one at 144MHz and, on July 9th and 12th, many of us heard them at 28, 50 and 70MHz.

On July 7th, Henry Hatfield, using his spectrohelioscope, saw the first appearance of the giant sunspot which reached the Central Meridian Passage on the 14th. Despite overcast skies, Henry did get a look at it on the 10th and noticed its unusually large penumbra. Charlie Newton, G2FKZ, London, tells me that the largest known Xray burst lasting 11 minutes took place on the Sun during the early days of this sunspot, and sent all recording instruments off scale. The thinning cloud during the evening of the 13th enabled Barry Ainsworth, Eric Dowdeswell, G4AR, Ashtead, Surrey, and Mike Rowe, G8JVE, East Preston, Sussex, to see this giant spot with only a filter in front of their eyes. It is not advisable to look directly at the sun under any circumstances unless as Henry Hatfield says, you have a special and carefully designed filter to protect your eyes.

#### **Tropospheric Openings**

To add to the turmoil the atmospheric pressure rose above 30.0in on July 6th and was still high on the 16th during which time there were several tropospheric openings. At 2218 on the 11th G4GNX worked ON5QW on 2m c.w., on the 13th G8JVE worked DK7KO and 4 French stations on 2m s.s.b., at 0130 on the 14th G8NGO had a QSO with DF1JC, first via the French repeater on R9 and then direct on s.s.b. G4GNX and G8JVE both contacted stations in southern France on the 15th and Ern Hoare, G8BDJ, Brighton, heard an OE on 2m.

#### **Microwaves**

Ern Downer, G8GKV, Worthing, Sussex and Ern Hoare, G8BDJ installed their 3cm gear at Chanctonbury Ring, a high spot on the South Downs, to compete in the 2nd round of the RSGB 10GHz Cumulative contest on June 25th. Despite the atrocious weather conditions, both Erns worked G3JHM/P, near Petersfield, G3JVL and G8DIC, in Hayling Island, and G3IFF/P on Portsdown Hill, all in Hampshire. During a contact between G8BDJ/P and G3KSU/P, Isle of Wight, a rain storm was seen crossing the path and the signal strength dropped from S9 down into the noise and came up again when the storm cleared the path.

#### **CB Down Under**

M. A. Penfold, ZL1TUI, Dunedin, New Zealand, read about the American CB stations being heard in the UK in our April issue, and asks if our readers would periodically listen around  $26 \cdot 5$ MHz for CB signals from New Zealand. M. A. Penfold also has a CB call, R0575, and would like to know if their  $0 \cdot 5$ watt signals ever reach the UK.

#### **OSCAR-8**

John Branegan, assisted GM8NXW on the OSCAR stand at the Scottish Mobile Rally on June 10th, and says "I talked OSCAR-8 solidly for five hours, we had about 300 people there and a continuous stream of

Practical Wireless, October 1978

groups of 4 or 5 asking questions the whole time". At 2213 on July 8th John worked WICRL, Maine, his first W contact via the satellite's mode-J. At 2317 on the 9th he contacted VE2LI, Montreal on s.s.b. and the VE replied on c.w. Two minutes later he had an s.s.b. QSO with WA3ZHW in Pennsylvania.

#### **Club News**

One of the attractions at the Worthing and District Amateur Radio Club's mobile rally held at Whiteways, near Arundel, Sussex, on June 20th was the Radio and Television interference detector van belonging to the Brighton area of the Post Office. The officer in charge, **Bob Taylor**, G8JZZ, demonstrated the vehicle's equipment. More than 150 attended the event which was organised by Barry Ainsworth. The talk-in station on 145MHz, operated by G8GKV worked more than 100 stations.



Bob Taylor G8JZZ beside his Post Office interference detector van

The Mid-Sussex Amateur Radio Society had stations on 4m G3XUP/P, 2m G3ZMS/P (the club call), 70cm G3VQN/P and 23cm G3RXJ/P (the club chairman), during the RSGB VHF NFD on July 8th. They were situated 700ft a.s.l. near Brighton and are very pleased with their results, especially on 23cm where they worked 10 stations in 5 counties using RXJ's home brew transmitter and a Microwave Modules converter.

#### **Readers' Equipment**

G8NGO now has a 12ft dish and hopes to use it in the future for moon-bounce on 23cm.

Gordon Goodyer has completed the *Practical Wireless* Audio Filter and is delighted with its performance.

Clive Atlowe, a keen TV/FM DXer has 12 TV receivers installed at his home, nine are fixed channels for sporadic-E and meteor scatter on Bands I, II, and III and the others, Sony 9-306UM, Luxor Colour set, and a German Philips Bellini are for u.h.f. reception. All are fed by a wide variety of aerials and pre-amps.



FRANK LUMAN

by RON HAM



American-born Frank Luman began seriously DXing on the medium wave band, with a Hallicrafter SX-110, when the family moved from Cumberland, Maryland, to Denver, Colorado. The medium waves interested Frank because he could often hear stations some 3000 miles apart (i.e. KNX, Los Angeles and WNBC, New

#### AMATEUR SSTV

continued from page 29

One interesting feature of SSTV is that it can be stored on conventional audio recording tape. This is due to the low frequencies employed, which fall well within the 'audio' spectrum. Consequently, a readily available cassette or reel-to-reel recorder can also double as a storage and retrieval system for your SSTV pictures.

Slow to fast-scan converters are available which will display an SSTV picture on a conventional television monitor or receiver; designs by active amateurs such as DL2RZ are already well known. Alphanumeric information and colour transmissions have also been proved possible.

The accepted UK standards for SSTV are given in Table 1, and are the references to which any wouldbe constructor should work. There is, of course, a variety of commercially produced equipment available for those without the necessary facilities. The typical block diagram for a monitor, for example, is given in Fig. 2, and provides an indication of its complexity. York), and was kept updated with the news as it happened as well as getting a different perspective on the music that was being played.

When Frank came to study in the UK (Pharmaceutical PhD) his hi-fi system, cassette deck, loudspeakers, stereo receiver and turntable came too. Through using the receiver, a Sherwood S-7100 A, at his present QTH in Glasgow, he fell for v.h.f. DX in a big way and began experimenting with aerials. In 1976, he was told that it was next to impossible to receive transmissions from the new station, Downtown Radio, (Belfast,  $96 \cdot 0$ MHz) in Glasgow, so, typically Frank, he mounted a Jaybeam FM9s aerial on his AR40 rotator, built an f.e.t. pre-amp and received the station loud and clear. What's more, with a little help from the troposphere, he heard signals from BBC Radio Carlisle, Radio Cleveland, and Metro Radio, along with Radio 4 from Holme Moss, Pontop Pike, and Sandale.

It was Roger Bunney's column, Long Distance Television in our sister magazine Television, that decided Frank to add DXTV to his radio activities. This meant two more Yagis on the rotator to feed a Hallicrafter S36-A for Band I sound carriers, and an early, dualstandard KB Victor VV-10 for v.h.f. and u.h.f. TV reception.

Frank's regular contributions to my v.h.f. column have shown some of the problems facing a DXer in Scotland and it was his enthusiasm for the subject that moved him to instigate the Scottish VHF and SW DXers Club, which currently meets fortnightly at his home. The members are making plans for a club shack where they can test a variety of aerials and equipment. Already they have an early warning system between them for auroral, meteor shower, sporadic-E and tropospheric events.

Frank Luman gets the most from his radio by coupling his interests in current affairs and music to an urge to receive programmes from stations at almost impossible distances.

#### Table 1

Line Frequency 16-66Hz	
Frame Frequency 0-142 (1/7)Hz	
Lines per Frame 120 4 8	
Aspect Ratio 1:1	
Horizontal Pulse Duration 5ms	
Vertical Pulse Duration 30ms	
Sub-carrier Frequencies:	
Sync. 1-2kHz	
Black 1 5kHz	
White 2-3kHz	

The normal amateur licence permits the holder to use SSTV and no special dispensations are required, provided the standard requirements are observed. The accepted frequencies on which transmissions are made are 3640%Hz, 3740kHz, 7040kHz, 14230kHz, 21350kHz, 28680kHz and 144.230MHz, the bulk of DX traffic being on 14230kHz.

Several publications on this subject are available to those interested and can be obtained from BATC Publications, 64 Showell Lane, Penn, Wolverhampton, Staffordshire.

		OCKSA TOR 12-0-12 >-240 VOLTS 2 54 2 54 3 51 4 03 5 35 6 48	ME D	Pri 220/240 Sec 0- ages available 3, 4,		212         1.A.         1.A.         6.G.         5.4.           13         100         9.0-9         5.2.         5.2.         5.2.           235         330         0.9.         0.9.         9.5.         5.2.         5.2.           207         500.         500         0.9.         0.8.9.         0.8.9.         1.2.           208         1.A.         1.A.         0.4.9.         0.8.9.         1.2.         2.2.         2.2.         2.0.         1.4.         0.4.9.         0.8.9.         1.2.         2.2.         2.2.         2.2.         2.0.         1.5.         0.4.5.         0.7.         1.2.         2.2.         2.2.         7.00.         (DC)         2.0.12.         0.7.0.         5.2.         2.2.         2.2.         7.00.         (DC)         2.0.12.         0.9.         2.2.	2 65 0 78 2 2 14 0 38 150 7 99 0 38 150 2 50 0 71 10 F 3 53 0 78 30 7 35 0 78 30 3 51 0 78 30 3 41 0 78 35 3 41 0 78 35 3 41 0 78 30 3 41 0 78 30 3 41 0 78 30 3 41 0 78 30 5 39 0 96 Her 1 99 0 38 was	Ilon Quality Metal Oxide 5% I + 3 W resistors Mixed Value Capacitors, Reed Switches. Wire Vound Resistors ed. Assorted orasets. I tag terminal strips dware pack nuts, botte, hers, insulatore es. P&P 40p VAT 124%	Iterminai         block         35p.         Iter         p4p.           Panel fues holder 1% comparisity enclosed pull-outlype 38p. 18p pb.         2x Fuesboards, 2 with open 1%" luas holdors 2i x 3" 36p + pp 15p VAT 8%.           AMPLIFIER MODULES         10W (A130)         £3-75 25W (A160)         £4 57 27-15 25W (A1250)         £1 - 15 27-15 125W (A1250)         £1 - 15 27-15 27 Power Supply PS12         £1 a0 23 Power Supply SPM60         £4 - 25 23 VAT 121 % P 4 P 35p.
118 17 115 187 225	10     5       12     6       16     8       20     10       30     15       60     30	10 39 13 18 17 05	1 32 1-32 2-08 2-08 OA	117 6 0 68 8-0 69 10-0 66 VOL1	6 82 2-45 51 73 1-64 13 33 1-84 TRANGE IC 0-24-30-40-48-60V	MINT-MULTIMET DC-1000V AC-1000V DC-1000 10000/V Bargain £5 56. VAT 20,000 ohm/V Multimeter- Renges AC/DC to 1000V DC cc	mA Res-150kΩ a% P L P 62p- mirror scale.	Special Offer Avo Me Ranges DC volts 2 5. 100, 500, 1008V current 10 50, 100, 500 f amp 100, 1000, 3 ohmic ra	10, 50, Cartridge Converter 1ms 2-5, (MPA 30) operating AC 10v, Voltages 20-45 £3 50, nges to VAT 121%, p4 p 35p.
Ages a 33, 40 ( <i>Ref</i> 102 103 104 105 106 107 118 119 MAIN	50 VOLT 1/240v Sec 0-22 vailable 5, 7, 1 or 20/V -0.20V 4 Armag 0-5 1 0 2 0 4 0 5 150LATIN (RIM 120/240 5 VA (Wats) 00 250 250 250 250 250 250 250	-25-33-40-50% 8, 10, 13, 15 2, 25V-0-25V £ 3-41 4, 57 6-98 3-41 4, 57 6-98 3-41 4, 57 6-98 3-41 4, 57 6-98 3-45 14-62 17 05 21 70 6 (SCREEN EC 120/240 C £ 4-40 8-20 7-13 11-58 12 78 16 28 16 28 16 29 17 19 16 29 17 19 16 20 17 19 17 19 18 20 18 20 19 19 19 19 19 19 19 19 19 19 19 19 19 19 19 19 1	17, 20, P & P 0 78 0 85 1 14 1 32 1 50 1 64 2 08 0 A	Vollages evailable: 24. 30, 35. 40, 45 30V-0.30V Ref Amos 124 D 5 128 1 0 127 2 0 125 3 0 125 3 0 125 3 0 129 4 0 120 6 0 121 8 0 129 10 0 129 120 0 115 200	6, 8, 10, 12, 16, 18, 20, 8, 60 or 24V-0-24V, 5 9 4V-0-24V, 5 9 6 0 96 7 60 1 14 10 54 1 32 12 23 1 84 13 85 1 84 14 85 14 85	AVO 73 E2 56 Mecc AVO MAS E26 10 Wee Megger 622 50 BX50 AVD TT189 in circuit Transisto U4315 Budget Meler 20K GIVDC ACIDC, 2 5A ACIDC, 50K Steel camp-leads E35 45. VA 71 NEW RANGE TRANSFORMER: Sec 45-35-0-35-45 Sec 10 36-0-38, 45-0-45V, 72V or 90V. 2A £9 19 3A £11 47 4A £13 90 5A £13 90 5A £16 74 6A £20 77 2* 0-50µA £5 50 4***	5 £58 70 15 £58 70 16 doilei£100 00 18 f BM7 battery 5 Sanwa £33 58 5 Sanwa £33 58 17 Ester £34 00 7 £47 50 100 18% P & P £1 15 5 19 2 8 0 - 32 P & P £1 38 £1 48 £1 48 £1 48 £2 35 £2 30	100 china 10,000 DC : safey cut out 633 00 Pi VAT 8% Piug In Save Batteries MU A30 fits into 13A Si BV 300me multiplug outh MU A36-mits into 13A Si SV 60 t00me ideal for ca S00ma 162 11 VAI 121% DECS SOLDERLE BATAD-BOARDJ S Dcc 70 contects DECS SOLDERLE BATAD-BOARDJ S Dcc 70 contects U Dac "A" for 1.C.s stc VAT 8% P & P 40p ANTEX SOLDERING 10 projects (including 4) CONSTRUCTION 10 projects (including 4) Sorgan, No. soldering	SP £1 15         TRANSFORMERS           SPECIAL OFFER         SPECIAL OFFER           16,75,8         BEI Primo 0-120,07           18,36,8         O-120V (120 or           18,36,8         O-120V (120 or           18,36,8         O-120V (120 or           15,375,8         D-120V (120 or           16,300,8         D-120V (120 or           15,300,8         D-12-80           16,10,10         D-12-80           16,10,10         D-12-80           17,100         D-12-80           18,10         D-12-90,10           11,20,20         P1,120,20,00           12,38         BE7 0-110,120,220,00           11,20,300,050,00         D-12,00           11,20,300,050,00         D-12,00           11,20,200,00         P-12,200,00           11,20,200,00         D-12,000           11,20,200,00         P-12,000,00           11,20,200,00         P-12,000,00           11,200,00         D-12,000,00           11,200,00         D-12,000,00           11,200,00         D-12,000,00           11,200,00         D-0,00           12,300,00,00         10,000,00           11,000,00         10,000,00
Va 50	2000 3000 Volta require VOLTAGE 19 Prim 200/220V Sec 110/120V Ref 243	SOLATOR or 400/440V CT or 200/24 £ 5-88	OA OA Y. P & P 1-32	240V cable in 515V           VA         £           15         4-Mi           150         8-40           200         9.92           250         16.40           500         15-73           500         15-73           750         18.55	TRANSFORMERS           / USA flat pin outleil           P 6 P           P 6 P           0 96           1 14           45           65W           1 45           65W           1 45           69W           1 85           67W	0-1mA £5:54 0- 0-50V £5:59 0- VU Indicator Panel 48 × 45:25 VU Indicator Edge 54 • 14:250, 85p Carriage 8% VAT ISOLATOR-1 KVA 240V to Special offer at £18 76. Carriage	1mA £8.40 50V £8.40 μα FSD £2.60 μα FSD £2.60 240V enclosed	brass nuts, slots to to           cards flush fitting lid           PB1 180mm           PB2 100mm           PB3 120mm           100           4           PS2 200mVAT	B insel BE8 Pri 0-220V sec
250 1000 2000 Our wi Electro	247 250 252 ide range of tr bell and semic	41-75 54 25	1 84 OA OA re too n ckists. J	1000 22 58 1500 26 62 2000 37 55 unerous to list, ple udio accessories.	0A 95W	Prices correct 8-5-78. Pless	3	, THE MINORIES, TELEPHONE:	LONDON EC3N 1BJ 01-488 3316/7/8 ALDGATE & LIVERPOOL ST

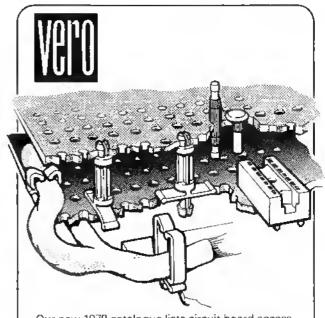


Practical Wireless, October 1978

11



3/ 6 1 3/ 1	C PC600 1-28 SP6 PCC84 9-45 TT2	1 . # S 3E28 5-30.6F17 1 00	125H7 9-70
VALVE	PCC84 0-45 TT2	1 7 50 334 0 60,6724 0 90	12SJ7 0.55
] * ~ ~ ~ * *	PCC89 0-55 U25 PCC189 0 65 U25	1 60 3V4 0 45 6F33 4-20 0 65,58/254M 6M8 4-20	12SO7 0-55 12Y4 0-40
A1085 1-25   EF80	● 40 PCF80 0 80 U27		1308 0 40
AR8 0 60 EF83	1-50 PCF82 0-49 U19	1 9-75 5B/255M  6J5 0-75	1457 1-09
ARP3 0 60 EF85 ATP4 0.50 EF86	0-45 PCF84 0-65 U28 0-55 PCF85 0-65 U30		19AQ5 # 75
B12H 3-00 EF91	0-85 PCF86 0-65 U30 0-85 PCF200 0-90 U80	0 50 5B/258M 0.38 0 50 0 40 0 50 0.47 6 75	19G3 10-00
CY31 0-50 EF92		C80 SR4GY 1 10.6J7G 0 10	1985 17-99
DAF98 0 60 EF95	4-45 PCF801 0-55	0 00 6U4G 0 05 6K7 0.70	20D1 0-80
DET22 10-50 EF163 DF96 8-00 EF164	0.65 PCF802 0-65 UA3	42 0-05 8V4G 8-85 8K7G 8-35	20F2 0-80 20L1 1-00
DH76 D 40 EF804	1 60 PCF805 1 40 UBF 2 00 PCF806 9 5 UBF	80 0 5515Y3GT 0 65 6K8GT 0 55 89 0 50 523 1 66 6L6M 1 90	20L1 1 00 20P1 0 40
DK98 0 40 EFL20			20P3 0.60
DL92 8-59 EH90	0.69 PCH2006 #a: LISI	21 #-73:5Z4GT # 75.6L18 0-60	20P4 1 10
DY60/879 55 E132 DY602 4 35 E134	8-80 PCL81 6-80 UCC 2-29 PCL82 4-45 UCC		20P5 1-00
ESSL 7 50 EL37	2-20 PCL82 4-65 UCC 3-00 PCL84 0-76 UCF	85 8-50 BAC7 0 80 607G 0-70	25L6GT 8-80 2524G 0 70
E68 CC/01   EL41		181 0 40 6AKS 0 55.63A7 0 55	30C15 1-04
1-30 EL81	1-95 PCL805/85 UCL	82 4-75 BAKB 0-44-65G7 4 73	30C17 1-14
E180CC 1 30 EL82 E180E 8 00 EL84	0-60 PO-500 2 24 UEA		30C18 100
E182CC 3 50 EL85	0 50 PD500 2 25 UF8 0 70 PFL200 1 35 UF8		PCF805 30F5 1.00
EA76 2 40 EL90	1-38 PL38 0-60 UL4		30F12 1.20
EABC800 50 ELSI	1-69 PL81 8-75 UL8	0 75 6ANB 0 85 55N7GT0 75	30FL12 1-25
EB91 0 40 EL95 EBC33 9-50; EL504	0 70' PL82 0-50' UME		30FL14 1.00
EBF80 0-50 EL802	4		30L15 1-00
E8F83 8-50 EL822	1.60 Add 121% 10r	Y.A.T. MATS # 756X5GT 0 55	30P12 1-04
E8F89 0-50 EM31	0 75	6AUS 0 40 876G 0 95	30PL1 1-00
EC52 0 40 EM80 ECC81 0 55 EM61	0-00 PL83 0-50 UM8 0-00 PL84 0-05 UV8		30PL13 1 10
ECC82 # 54 EMB4	0-40 PL504 1 40 UY8		
ECC83 1-15 EM87	1 00 PL809 1-30 VR1		35W4 8 40
ECC84 9-45 EY51	8-45 PL509 2 48		35Z4GT # 70
ECC85 0-50 EY81 ECC86 1-23 EY88/3			50C5 0 70
ECC68 0 M EY88	4-55 PY33 0-60 X66		50CD8G1-20 75 1-00
ECC189 8 88 EZ60	0-45 PY80 0-60 X61	4 1-50 6BG6G 1-60 10P13 0-60	75C1 0-80
ECF80 0 50 EZ61	0-60 PY81/800 Z600	U 3 00 68 J8 1-10 1122 11-00	70 4-10
ECF82 0 45 GY60' ECF801 0 75 GZ32	0-50 0-55 Z801 0-65 PY82 0-45 Z900		78 0 75
ECH34 0 05 GZ33	3-35 PY83 0-50 1A3		85A2 2.20
ECH36 1-50 GZ34	2-00 PY88 0-6511L4	0-30,68W7 1-0012AU7 0-51	723A/B11 M
ECH42 0-05 GZ37	2-50 PY500 1-35 1R5	9-55 8C4 4-40 12AV5 0-78	803 6.00
ECH81 0-45 KT60 ECH84 0-05 KT88	4 00 PY852 5-75 154 5-75 PY801 0-60 135		805 18-00
ECLEO 8 60 MH4	1-00 QQV03-10 1T4		813 10-50
ECL82 0.55 MLC	1 00 2-58-104	0.60 6CY5 0.00 12BM7 0.64	8298 11-00
ECL83 1-20 0A2	6 55, QQV03-12   1X2	3 1 10 6D6 0 50,12C8 0 55	832A 4-50
ECL85 0 05' OB2 ECL85 0 55i PABC	8-40 2-50 2D2 80 0QV06-40A 2K2		668A 2-80
EF37A 1 50	9-40: 14 00 2X2		931A 9-90
EF30 2 90 PC85	0-50+0V03-122-00 3A4	0 60 6F12 0 85'12K8GT 0 70	1955 0-50
EF40 0.70 PC80	8-85 SC1/4004-00 3D6	8-40 6F14 9-80-1207GT9-50	956 0 59
EF41 9-75 PC88	8-75 5C1/6004-6013D2		957 0.90
POBTAGE: £1-22	20p; £2-£3 30p; £3-£5 46 ) free, minimum order £1	COLOMO	D 907353/
A lot of these valves	are VALVES AND		
		(ELECTRONICS) LT	D
very for each deliv	INANSISTURS	170 Goldhawk Rd., Lon	don W.12
to we reserve the r	oht Telephone enquirle	• Tel. 01-743 089	9
to change prices	for tors, etc.; rete		riday
new stock when	uo- 749 3934, trado an		
avoldable.	export 743 0899.	9-12.30, 1.30-5.30	p.m.



Our new 1978 catalogue lists circuit board accessories for all your projects — DIP sockets, pins standoffs, cable clips, hand tools. And we've got circuit boards, module systems, cases and boxes everything you need to give your equipment the quality you demand. Send 25p to cover post and packing, and the catalogue's yours.

VERO ELECTRONICS LTD. RETAIL DEPT. Industrial Estate, Chandlers Ford, Hants. SO5 32R Telephone Chandlers Ford (04215) 2956

# ELECTROVALUE Buying Guide

if you have bought before from Electrovalue, you will know just how large and varied our stocks are. For those who have yet to know, we are publishing a series of five ads. month by month to give up-to-date information and prices on the most important items we carry. These ads. will appear in stepped rotation in five journals Pr. Wiraless, Pr. Electronics, Everyday Electronics, Electronics Today intruf. and Elektor, so that the complets series will be available each month. In this way, no matter which journals you read, BY DETACHING AND SAVING THESE PAGES, YOU WILL BUILD UP A VALUABLE AND COMPREHENSIVE MONEY SAVING CATALOGUE.

# Transistors/Zeners

		MONET	SAVING CATA	LOGUE.					
			/			1	BUX28	£4-20	TAG302-600-Triac £1:05
I KO	nsis	tovo		DO	KC		BY164	90p	TIP31A 45p
	11515						8Y238 8YX38-300	8p 45p	TIP32A 45p TIP41A 60p
		COI C					SYX38-300R	65p	TiP4IC 64p
			-				CI06DI	45p	TIP42A 60p
HN914	5p   2N4443	<u>#1-14</u>	ASY27	£1 · 39	BC214 *	12p	C0326-SCR	£4-40N	TIP42C 44p
IN9142	7p 2N4444 6p 2N4906	21-50	ASY28	£1-39 (1.30	BC236B * BC236C *	Sp Sp	C0340	65-14N	TiS43 * 35p
IN916 IN4007		£1-00 £1-00	ASY29 AUTE	£1-39 €2-25	BC239C *	12p	C407 *	17p	W02 30p
	BLASSES A	80p	AUY21	£7-31	BC257A *	8p	C!406	90p	ZTX107* 12p
IN4148 IN5402	5p 2N4991*	45p	AUY22	£10-95	BC2578 *	8p	C1412	90p	ZTX108 IIp
IN5407	20p 2NS163 *		BOIZ6-SCR	30p	8C258A *	8p	C\$2925	20p	ZTX109* 12p
15920	10p 2N5192	B5p	80140 "	35p	BC2588 *	6p	E99A40-Triac	£7-87	ZTX300 * 12p
15940	5p 2N5195	97p	BO226	3Sp	BC2598 *	8p	E2506	£1-48	ZTX301 * 16p
2N697	36p 2N5457 *	39p	B0240 ,.	40p	8C267	lép	E2512	£1-74 £1-48	ZTX302 * 14p
2N706	22p 2N5458 *	39p	B0246	96p	BC268C	17p	MJ481 MJ491	21-63	ZTX303 * IBp ZTX304 * 21p
2N930	21p 2N5459 *	39p	B0680	10p	BC269C	lðp	M[2955	78p	ZTX330 - 10p
2N1132	24p 6F40	61-46	81906	38p 38p	BC300	26p	M)E340	78p	ZTX331 * I9p
2N1302	48p 16F40	£1-65	81912		BC301	24p 30p	MIE2955	72p	ZTX500 * 12p
2N1303	48p 40HF10 57p 40HF40	£1-64 £2-28	6A102 BA127D	28p 5p	BC303 BC327 *	16p	MIE3055	68p	ZTX500 * 15p
2N1304	52p 40HF40 52p 40250	95p	BAI33F	9p	BC328 *	12p	MKY7C38E	70p	ZTX502 * 17p
2N1305 2N1306	56p 40361	36p	8A136	20p	BC337 *	14p	MPF102*	44p	ZTX503 * Ifp
2N1307	56p 40362	35p	BA145	19p	BC338 *	12p	MP\$6531*	24p	ZTX504 * 22p
2N1308	400 40406	40p	BA156	t4p	BC447	29p	MPS6534*	25p	ZTX530 • 12p
2N1309	40p 40408	40p	BA379	25p	BCY31A	96p	NA5206.S.5-SCR		ZTX530 * 20p
2N1599—SCR	88p 40412	56p	BAX13	5P	BCY58	15p	NASO164W3-Tri	ac 58 p	
2N1613	23p 40594	£1+18	861038	37p	BCY59	16p	NA\$0654X5	21.04	
2N1711	22p 40595	£1-50	SB103G	37p	BCY70 BCY71	18p	NAS0654WS	40-	HEAT SINKS
2N1893	35p 40602	75p	88104G * 881058	53p 28p	BCY72	180	ALACIANA/E	41.40	Type Drilled
2N2218	24p 40636 24p 40673	£1-60 66p	86109G *	370	BCY78	250	NASI004X5	11 41	29 - 53p
2N2218A	24p A9903	44p	8C107A	14p	BD130	\$0p	NKT211	25p	2YTO3 1×TO3 54p
2N2219 2N2219A	24p AAU3	9p	BC107B	14p	BD131	62p	NKT212	25p	2YTO66 1×TO66 57p
2N2270	75p AA116	99	BCI08A	14p	BD132	77p	NKT213	15p	2-75R - 22-80
2N2369A	22p AA117	Ťp.	BC109B	14p	BD135 *	38p	NKT274	25p	5-5R - 63-95
2N2484	26p AALIS	d01	BC108C	t4p	BD136 *	42p	NKT275	25p	5F TO5 clip 10p
2N2646	49p AAII9	†p	8C1098	E4p	BD139 *	41p	NKT405	OIS	5F2 TO5 clip 10p
2N2904	22p AC126	30p	8C109C	14p	BD140 *	46p	OA47	12p	6WI
2N2904A	22p AC127	48p	BCi2IW	20p	BDX18N	£1-10	OA90	óp	644 2×TO3 £1-95
2N2905	22p AC128	28p	BC122Y	61p	BDY12	90p	OA91	6p	10DNA - 88p
2N2905A	22p ACISIR	53p	BC125 *	20p	BDY20	50p	OA95	θp	IODNC 2×TO3 41-44
2N2924 *	25p AC153	40p	BC126 *	20p	BFI15	38p	OA202	10p £1-02	17C2 2×AD161 20p 18F TO18 clip 10p
2N2925 *	25p AC153K	40p	BC140	43p	BF167	30p	0C28 0C29	1 .07	18F TO18 clip 10p 18F2 TO18 clip 10p
2N2926 *	25p AC176	58p	BC147A * BC147B *	21p 21p	BF173 BF177	34p i 24p	OC35	61-07	224F TOI clip 10p
2N3053	24p AC176K	40p	BCI48A *	21p	BF178	24p	OC36	61-02	244F DOI clip 10p
2N3054 2N3055	73p AC187K 70p AC188K	70p 70p	BC1488 *	210	BF194 *	Îôp	OC45	61-15	266F DO3 clip 10p
	41p ACY17	92p	BC148C *	210	BF195 *	17p	OC71	70p	Al032 TOI clip dp
2N339FA * 2N3405 *	64p ACYIS	91p	8C148C *	210	BF244B	30p	OC72	70p	A1053 2×TOI clip Bp
2N3663 *	\$2p ACY19	990	BCI49C*	21p	BF254 *	14p	OC75	21 <b>D</b>	A1058 1×TO3 22p
2N3702 *	Hp ACY20	70p	BC154 *	Jóp	BF255 *	14p	0C81	80p	TO921 TO92 clip 7p
2N3703 *	10p ACY21	85p	8CI57A *	21p	BF457 *	36p	OC83	80p	TO922 2×TO92 clip 9p
2N3704 *	Hp ACY22	50p	8C157B *	ZIP.	BF458 *	37p	0C84	80p	TV2 TO66 24p
2N3705 *	10p ACY39	61-70	801588 *	21p	BF459 * BFA39 *	40p 24p	PM7A2	£2-68	TV3 TO3 25p
2N3706 -	7P ACY40	45p	8C159B *	Zip			PN70 * PN72 *	6p 6p	TV4 8D131 21p TV5 TO120 21p
2N3707 +	T2p ACY41	54p	80160	49p	BFR40 * BFR41 *	24p 24p	PN109 *	4p	TV5 TO120 21p
2N3708 *	6p AD136 12p AD132	£1-07 70p	8C167A * 8C1678 *	8p  2p	BFR79 *	24p	PN1613 *	6p	
2N3709 * 2N3710 *	12p AD(42 12p AD(49	80p	BC168A *	80	BR#80 *	24p	PN2904 *	ép.	ZENER DIODES
2N3711 *	12p AD161	960	801688 *	120	BFR81 *	24p	SICNI	I3p	TENER DIODES
2N3794 *	21p AD162	94p	8C168C *	8p	BFT66	£1-83	SIOMI	i2p	400mW 2 7-33V 9p
2N3819 *	28p AF114	270	BC1695 *	0p	BFX29	24p	T2700D	61-55	1-3W 3-3-200V 15p
2N3820 *	54p AF115	30p	BC169C *	12p	BFX84	24p	T2800D-Triac	£1-04	1-5W 3-3-75V \$5p
2N3823E *	24p   AFI16	30p	8C177A	18p	8FX85	24p	TAG3-400-SCR	£1-00	(1.5W are metal cased)
2113904 *	24p AF117	34p	BCI77B	20p	8FX87	24p 24p	TAG302-400-Tria	ac 85p	20W 7-5V-75V 68-25 each
2143906 *	28p AF124	25p	8C178A	16p (	8FX88				
2N4036	68p AF125	32p	8C1788 8C1798	17p 20p	8FYS0 8FYS1	24p			
2N4058 * 2N4059 *	12p AF126 12p AF127	25p	BC182L * -	12p	8FY52	24p 24p	ANOTHER	ELECT	ROVALUE SPECIAL
2114060 *		36p 32p	BC182 *	12-	BFY90	61 05			
2N4061 *	12p AE139 12p AF200U	lSp	BCI81	12p	BRBI WA	80p	We are n	ow Natio	nal Distributors for
2N4062 *	12p AF239	89p	BC183 *	120	8R92WA	61-36		1800	
2N4124 *	21p AF279	30p	BCIB4L *	120	8RY39	60p	C	VASC	
2N4126 *	27P AFY12	62-04	BC184 *	12p	85X20	22p	14100	0000	
2Nt4286 *	ISP AFYI6	62-69	BC202Y	75p	8\$X46	45p	MICR	OCOM	PUTER KITS
2N42B9 *	23p AFY18D	£5-74	BC212L *	12p	BSX63	£3-89	for delivery fr	rom er	07.50
214291 *	24p AFYIBE	£6·15	BC212 *	12p	8T106	61-47	stock from	2.	197·50 <sub>+ У.А.Т.</sub>
2N4292 *	ZIP AFY42	£2-71	BC213L *	12p	BTIO7	£1-60	Quantity disco	note.	Trade Enquiries invited.
2114303 *	30p AL102	£3-60 44-70	BC213*	12p	80105	£2-50 £3-90	Canuary araco	G11684	COMP BUCKINGS DURINGE
2N4410 *	39p   ASY26	£8-39	8C214L *	12p	80208	23.40			
A COODE (51)	T POST FREE U.P		. ACCESS		RD antem				

- GOODS SENT POST FREE U.K. WITH C.W.O. orders over £5 list value. If under, add 27p handling charge. ۰.
- ATTRACTIVE DISCOUNTS on C.W.O. mail orders-5% where list value is over £10; 10% where list value is over £25.
- TOP QUALITY GUARANTEED, MERCHANDISE-ALL •
- V.A.T .- Add 8% to value of order. For items marked \*, add 123%.
- For ACCESS or BARCLAYCARD orders. just phone or write your number.
- No discounts allowable on prices marked NET or N.
- TAKE GOOD CARE OF THIS PAGE AND REMEMBER TO LOOK OUT FOR NEXT MONTH'S TO ADD TO IT. •
- OUR COMPUTER-AIDED SERVICE TAKES GOOD CARE OF YOUR ORDER NO MATTER HOW LARGE OR SMALL.
- Comprehensive price list free on request.

www.americanradiohistorv.com



Section 1

# **Master computers** At home. The new practical Way.

The computer is entering every aspect of modern life and will continue to do so on an ever increasing scale . . . Do you understand the basic principles behind its operation? We can show you in a practical and interesting way ...

A new home study course on digital electronics and the basics of modern computer technology. Full experimental programme of PRACTICAL WORK on demonstration panel.

# Easy, fast and exciting! No previous knowledge needed.

FOR FREE DETAILS with no obligation Post to:- British National Electronics School, P.O. Box 156, Jersey, Channel Islands.

NAME.....

ADDRESS

VALVE BARGAINS

Any 5-80p, 10-£1-50, 50-£6-00. Your choice from the list below.

ECC82, EF80, EF183, EF184, EH90, PCF80, PCF802, PCL82, PCL84, PCL85, PCL86, PCL805, PL504, PY81/800, PY88, 30PL14, 6F28, PFL200.

Colour Valves-PL508, PL509, PL519, PY500/A. All tested, 55p each.

Aerial Splittere-2 way, 75 OHMS. Inside Type, 22-50.

### AERIAL BOOSTERS

Aerial boosters can produce remarkable, improvements on the picture and sound, in fringe or difficult areas.

- BII-For TH stereo and standard VHF/FM radio. B12-For the older VHF television-Please state channel numbers.
- 845—For Mono or colour this covers the complete UHF Television band.
- All boosters are complete with battery with Co-ax plugs and sockets. Next to the set fitting. (4-70

#### MULLARD CAPACITORS

Type C280/I Values from OluF to 1-5uF, 250v/w & 400 v/w. Price per mixed Bargain Pack to clear 100/£1-00, 500/£4-50

All prices include VAT. P&P 30p per order Exports welcome at cost.

#### ELECTRONIC MAILORDER LTD. 62 BRIDGE STREET, RAMSBOTTOM, BURY, LANCS.

TEL: RAMS (070 682) 3036





'H.A.C.' well known by amateur constructors for its Short Wave receivers, now offers a complete range of kits and accessories to suit the novice and the expert. £10-50 INCLUSIVE—the ever popular and easy to construct DX receiver Mark III: containing all genuine short wave components, drilled chassis, valve, accessories and full instructions.

natructions. NEW T TWIN TRANSISTOR RECEIVER, selective, sensitive and with fantastic reception, yet needing only a single PP3 battery, at £12-50 this receiver is outstanding value, and will give you hours of interest and entertainment.

tainment. Lastly the K and K plus (illustrated above) for the more advanced constructor. This receiver has recently been re-designed for even better reception, All orders despatched within 7 days. Send stamped and addressed envelope now for free descriptive catalogue of kits and conceptions. accessories.

SORRY, NO CATALOGUES WITHOUT S.A.E.

"H.A.C." SHORT-WAYE PRODUCTS P.O. Box No. 16, 10 Windmill Lane Lewes Road, East Grinstead, West Sussex RHIT 35Z

### INTRODUCING 2 ESTABLISHED NAMES to PW Readers !

AMATEUR RADIO BULK BUYING GROUP

Since our inception we have atways almed at giving the following 5 STAR service: ★ All components are brand new to menufacturers' full specifications.

- ★ All components are brand new to manufacturers: fun specifica ★ All components carry manufacturer's FULL QUARANTEE
  - An components carry manufacturer and the ca
  - \* Full refund offered on any item not in stock.
  - \* All prices Include V.A.T.

This service is difficult to match - Join the many who now take it for granted.

The sime of the Amateur Radio Bulk Buying Group are simple: To help the construction aide of the hobby by endeavouring to bring come of the more "difficult-to-cet" companents to you and to act as agents for some of the leading manufacturers in this country and abrod. All our regular items are brand new from manufacturers' current atocks carrying full warranty. Semi conductors are generally irom top British and American names such as: Motorola, Mullerd, National, Pleasey and R.C.A., etc. in addition to solling Jaybeam VVH serials. Microwave Modules converters, sic, and Mini-Beam H. F. aerials we are also the leading U.K. supplier of Pleasey SL600 series L.c.s., KVG crystal filters and a wide range of ignition suppression

CATRONICS is the name of our own designed and produced equipment and specialised kits; Amateur Radio Bulk Buying Group is the name of our Amateur Components Division.

			All new, full Mostly Nation	spec., full Guaran tal and Texas prod	lees ucts		
7400 7402 7403 7404 7406 7408 7410 7411 7412 7412 7414	14p 14p 15p 40p 16p 22p 24p 24p	7421 7427 7428 7430 7432 7440 7442 7447 7447 7473 7474	31 p 748; 29 p 748; 34 p 748; 34 p 748; 27 p 749; 31 p 749; 31 p 749; 73 p 749; 75 p 741; 35 p 741; 35 p 741;	£1         12         741           330         742         380         741           380         741         380         741           2         52µ         741         380           3         380         741         380           3         380         741         380           3         380         741         380           5         870         741           5         870         741           2         520         741	50 £1 07 53 09p 57 72p 64 £1 12 66 £1 12 66 £1 40 70 £2 41	74180 74198 74192 74193 74195 74195 74195 74196 74221 74100	23 - E1 E1 E1 E1 E1 E1
7420	170 I NEA			RATED	ver £20.		, S
		90 1 SL6	12C £2	65 1 SL1496	£1 05 1 C	A 3046	e1 <sup>9</sup>

### **40W 2m POWER AMPLIFIER**

Kit for boosting output power of 2m transmitters including 'AVON'

This is a simple-to-build, easity-aligned Class C PA suitable for CW and FM amplification at 2 metres from a nominal 13-5V (-ve earth) supply (Jamps at full power). T/R twitching' is performed by diades and  $\frac{1}{2}$  wave lines. A power input of 10 watts is required for the nominal 40 watts output power. **£19 30+95p P&P**.



We can supply Printed Circuit Boards and components for the RTTY Video Display published by G3PLX in "Radio Communication".

This video display unit is designed to be an all-electronic replacement for a Teleprinter, and therefore does not suffer its disadvantages—bulk, unreliability and noise.

The basic function is to take Murray Code—either from a Terminal Unit (on receive) or from a Keyboard—and produce a complete T.V. signal. This signal may be led into a monitor or modulated and fed into the serial of an ordinary domestic T.V. set. The resulting display is a page of 24 lines of up to 40 characters.

It may also be used (with its keyboard) to send fully encoded Murray Code signals for transmit purposes.

Kit price from £77 15-send S.A.E. for details.

liprices INCLUDE VAT but please add minimum of 30p for post and packing. Send SAE for FREE PRICE LIST or 45p + large (A4) 11}p S.A.E. for copy of our Data-Catalogue.

atronics Ltd. (Dept 680) Communications House, 20 Wallington Square, Wallington, elephone: 01-669 6700. Open Mon.-Fri. also Sat. a.m. Surrey S#6 8RG

#### DIGITAL PANEL METERS



from +5V d.c. Controls include Store, Hold and Reset. The module is fitted with a 10MHz Quartz Crystal to give a highly accurate timebase, with a temperature stability of  $\pm$ 10ppm over the temp. range -20 C to +70°C.

This product is half the price of existing counters with a similar specification.

10MHz Counter Module Suitable Mounting Bezet 150MHz Prescater	01-95 3 3P 15 35	8-49 0-39 1-19	
ELECTRONICS, PO			

Practical Wireless, October 1978

### Half Price Offers S, T, U-DeCnology KITS



Push component into DeC, when circuit is working transfer to exact matching Blob-Board.

DeCnology-Kits contain either a "S," "T" or U DeC "B" breadboard.control panel, 9 matching Blob-Boards, 20 Jumper Leads, 20 preferred value RESISTORS, a project book with step by step instructions and circuit diagrams of exciting projects to build, all in box with pull out component tray.

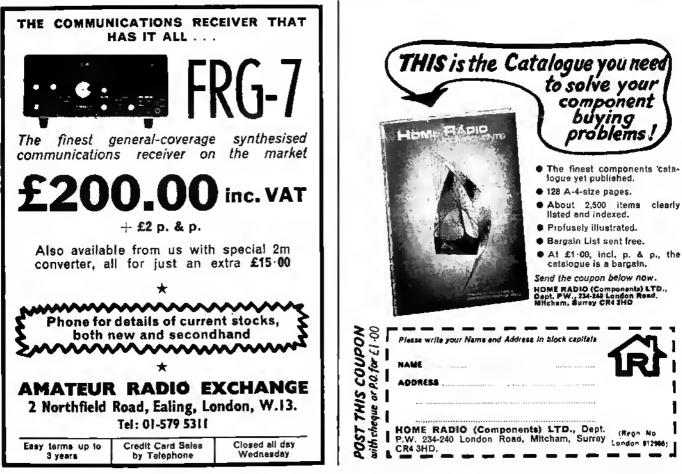
S-DeCnology-KIT	normally £13.00	<b>ONLY £6.50</b>
T-DeCnology-KIT	normally £17.90	ONLY £8.95
U-DeCnology-KIT	normally £23.00	ONLY £11.50
with new 20 project box	ok	

all prices include Post and VAT, send s.a.e. for full catalogue

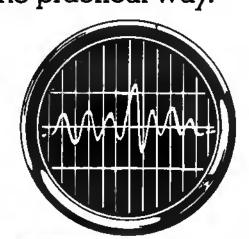


DeC-IT and Blob-IT P.B. Electronics (Scotland) Ltd., 9 Radwinter Road, Saffron Walden, Essex CB11 3HU

CARCE 167 10 100 100 100 100 100 100 100 100 100	OZ4         640         6AQ8         6AQ8         6D         6F32         1-00         8DB         180         1906         6-40         72           1A3         CC         6AAB         1-65         6G4BA         160         9D7         70         19Y8         -40         85A2         160         85A2         160         874         160         85A2         160         874         160         85A2         160         874         160         874         160         85A2         100         177         19Y8         -40         85A2         100         170         19Y8         -40         85A2         100         170         19Y8         -40         85A2         100         100         4A4         100	00       DR81       1.00       DCSS 5.00       ELG6       .80
	6A(25)         125         100         04765         125         125         312607         36126077         3612607	30         EBC91         65         EF68         -90         H Y60         -65         FENA51-00         UF80         -60         FERA51-00         UF80         -60         FERA51-00         UF80         -60         -60         UF80         -60         UF80         -60         UF80         -60         -760         <



# LOOK! Here's how you master electronics. ....the practical way.



This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

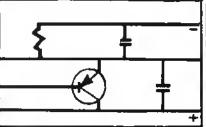
You learn the practical way in easy steps mastering all the essentials of your hobby or to further your career in electronics or as a selfemployed electronics engineer.

All the training can be carried out in the comfort of your own home and at your own pace. A tutor is available to whom you can write, at any time, for advice or help during your work. A Certificate is given at the end of every course.



# Build an oscilloscope.

As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property and represents a very large saving over buying a similar piece of essential equipment.



### 2 Read, draw and understand circuit diagrams.

In a short time you will be able to read and draw circuit diagrams, understand the very fundamentals of television, radio, computors and countless other electronic devices and their servicing procedures.



### 3 Carry out over 40 experiments on basic circuits.

We show you how to conduct experiments on a wide variety of different circuits and turn the information gained into a working knowledge of testing, servicing and maintaining all types of electronic equipment, radio, t.v etc.



All students enrolling in our courses receive a free circuit board originating from a computer and containing many different components that can be used in experiments and provide an excellent example of current electronic practice.

To find out more about how to learn electronics in a new, exciting and absorbing way, just clip the coupon for a free colour brochure and full details of enrolment.
British National Radio & Electronic School
P.O. Box 156, Jersey, Channel Islands.
NAME
ADDRESS
Block caps please
Block caps please

<b>Marsha</b>	Call in and see us 9-5.30 Mon-Fri 9-5.00 Sat
	Express Mail Order Tel. orders on credit cards £10 min. Trade and export enquiries welcome
Retail Sales London: 40 Cricklewood Bdwy, NW2 3ET. Tel. 01-	Ause         Kingsgate         Place         NW6         4TA.         Tel.         01-624         0805.           452         0161/2.         Telex.         21492.         London:         325         Edgware         Rd,         W2.         Tel.         01-723           Bristol:         1         Straits         Pde,         Fishponds         Rd,         BS16         2LX.         Tel.         0272         654201.           AY-3-8500         CA3062         3.75         LM341/P240-00         LM923         9.59         LM78L05CZ         SN76018KE           CA3000         1.36         CA3065         1.40         LM358N         0.55         LM78L19CZ         SN76018KE           CA3000         1.36         CA3065         1.40         LM358N         0.51         LM78L19CZ         SN76028N1-50
2N1503 ************************************	CA3001 4-25 CA3068 3-80 LM350N 3-80 LM330N 1-52 LM380N 1-52 CA3002 3-30 CA3070 1-96 LM370N 3-38 LM130N 1-52 LM78L15CZ 57 CA3071 1-96 LM370N 3-38 LM130N 1-52 6-38 SN76032NO CA3072 55 CA3071 1-96 LM370N 3-36 LM130N 1-32 6-36 SN7603N2 35 CA3076 4-56 CA3072 1-90 LM350X 6-45 LM1351N 1-38 LM136N 0-45 LM371H 7-37 1-76 LM373N 3-35 LM136N 0-45 LM371H 7-37 1-76 LM373N 3-35 LM136N 0-45 LM371H 7-36 LM371H 7-36 LM371H 7-36 LM371H 7-36 LM370N 3-36 LM1802N 1-97 LM327H 1-97 LM371H 7-36 LM371H 7-36 LM373N 3-35 LM146N 1-97 LM327H 1-90 SN76115N 1-96 CA3013 1-85 CA3090 2-15 LM371N 1-86 LM1800N 1-97 MC103P 1-90 SN76115N 1-96 CA3013 1-85 CA3090 2-15 LM371N 1-86 LM1800N 1-97 MC103P 1-91 SN7622N1-96 CA3013 1-85 CA3090A 2-16 LM371N 1-86 LM1800N 1-97 MC130P 1-10 SN7622N1-96 CA3013 1-85 CA3090A 2-16 LM371N 1-80 LM120N 1-97 MC130P 1-10 SN7622N1-96 CA3013 1-85 CA3090A 2-16 LM371N 1-80 LM120N 1-97 MC130P 1-10 SN7622N1-96 LM372N 1-97 LM371N 1-97 MC130P 1-10 SN7622N1-96 LM372N 1-97 LM371N 1-97 MC130P 1-10 SN7622N1-96 LM372N 1-97 LM371N 1-96 LM120N 1-97 MC130P 1-10 SN7622N1-96 LM372N 1-97 MC130P 1-10 SN7622N1-96 LM37N 1-97 MC130P 1-10 SN7622N1-96 LM372N 1-97 MC130P 1-10 SN7622N1-96 LM372N 1-97 MC130P 1-10 SN7622N1-96 LM37P 1-97 MC130P 1-10 SN7622N1-97 MC130P 1-10 S
2N2210         0-32         2N3702         0-14         2N4266         0-12         2N4706         0-55         AF280         0-65         BC2337B         0-15           2N2217         53         2N3703         0-14         2N4266         0-13         2N1212         0-44         ASY28         0-13         BC2338         0-13           2N2217         53         2N3704         0-14         2N4266         0-13         2N1212         0-44         ASY285         0-70         BC2336         0-13           2N2219         0-34         2N3704         0-14         2N4236         0-22         2N6124         0-43         BC107         0-16         BC239C         0-17           2N22219         0-34         2N3705         0-14         2N4236         0-22         2N6124         0-43         BC107         0-16         BC239C         0-17           2N2222         0-23         2N3705         0-14         2N4232         0-27         2N6788         0-18         BC2357A         0-34           2N2222         0-23         2N3709         0-14         2N4232         0-27         2N5783         0-67         BC108         0-18         BC2358B         0-34           2N2220 <th>CA3018 0 75 CA3088F 1 17 LM32016 9 22 LM18201 1 18 MC1433G 1 25 SN7622814 - 55 CA3018A 1 16 CA3069E 2 96 LM320114 46 LM18201 1 96 MC1433G 1 25 SN7623114 - 55 CA3020 2 29 CA3069Q 4 42 LM320114 46 LM13301 1 96 MC1435G 1 75 SN763311 8 22 CA3020 2 29 CA3130 1 96 LM3811 1 96 LM18451 1 55 MC1439G 1 75 SN763311 39 CA3021 2 40 CA3140 1 94 LM3811 1 96 LM18451 1 55 MC1440G 1 15 SN765311 39 CA3022 2 20 LM1841 4 275 LM3821 1 37 LM1841 1 98 MC1456G 2 15 SN755411 39 CA3022 2 20 LM1141 2 75 LM3811 1 55 LM1850N 1 90 MC1456G 2 15 SN7554N1 39 CA3023 2 20 LM1141 2 75 LM381N 1 55 LM1850N 1 90 MC1468G 3 15 SN7554N1 39 CA3023 2 20 LM1141 2 75 LM381N 1 55 LM1850N 1 90 MC1468G 3 15 SN7554N1 39 CA3023 2 0 LM1141 2 75 LM381N 1 55 LM1850N 4 90 MC1468G 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3024 8 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM180N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM180N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM180N 4 90 MC1469B 3 16 SM2569 2 MC1469B 3 16 SM25</th>	CA3018 0 75 CA3088F 1 17 LM32016 9 22 LM18201 1 18 MC1433G 1 25 SN7622814 - 55 CA3018A 1 16 CA3069E 2 96 LM320114 46 LM18201 1 96 MC1433G 1 25 SN7623114 - 55 CA3020 2 29 CA3069Q 4 42 LM320114 46 LM13301 1 96 MC1435G 1 75 SN763311 8 22 CA3020 2 29 CA3130 1 96 LM3811 1 96 LM18451 1 55 MC1439G 1 75 SN763311 39 CA3021 2 40 CA3140 1 94 LM3811 1 96 LM18451 1 55 MC1440G 1 15 SN765311 39 CA3022 2 20 LM1841 4 275 LM3821 1 37 LM1841 1 98 MC1456G 2 15 SN755411 39 CA3022 2 20 LM1141 2 75 LM3811 1 55 LM1850N 1 90 MC1456G 2 15 SN7554N1 39 CA3023 2 20 LM1141 2 75 LM381N 1 55 LM1850N 1 90 MC1468G 3 15 SN7554N1 39 CA3023 2 20 LM1141 2 75 LM381N 1 55 LM1850N 1 90 MC1468G 3 15 SN7554N1 39 CA3023 2 0 LM1141 2 75 LM381N 1 55 LM1850N 4 90 MC1468G 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3023 4 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3024 8 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM1380N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM180N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM180N 4 90 MC1469B 3 15 SN7554N1 39 CA3025 8 96 LM3014H 9 50 LM380N 6 15 LM180N 4 90 MC1469B 3 16 SM2569 2 MC1469B 3 16 SM25
International         Sector	CA3028 B 1 28 LM3014 2 46 LM388 N 1 48 LM2867N 8 MC1495L 5 25 SN76552-2 CA3029 6 75 LM307N 0 50 LM388N 1 48 LM2867N 8 MC1495L 5 26 SN76552-2 CA3029 4 75 LM307N 0 50 LM355CN 9 31 1 50 LM267N 1 50 MC1029G 7 18 SN76570N1 6 50 CA3030 1 50 LM308N 8 43 LM55CN 1 29 LM3301N 6 80 MC4024P 2 20 SN76520AN CA3030 2 75 LM308N 6 45 LM565CN 1 29 LM3301N 6 80 MC4024P 2 20 SN76520AN CA3030 3 3 70 LM317K 3 35 LM7012 2 66 LM3401N 0 35 MM3316 4 60 SN76550N1 29 CA3033 3 71 LM317K 3 35 LM7012 2 66 LM3401N 0 35 MM3306 4 60 SN76550N1 29 CA3033 1 45 LM3075 2 15 LM702C 6 81 LM300N 6 56 MM320 4 20 SN76550N1 29 CA3033 1 45 LM3075 2 15 LM702C 6 81 LM300N 6 56 M1555 6 31 SN76560N6 66
2102030         0-11         2103254         0-22         0.10302         2:29         1.0333         0.26         0.112         0.114         1.11           2102025         0-11         2103254         0-30         2.75         4.0673         0-66         BC142         0-31         BC215         0-14           2102025         0-11         2103254         0-30         2.75         AC125         0-66         BC145         0-15         BC145         0-16           2N3011         5.71         2N3355         0-39         214903         2.75         AC125         0-48         BC148         0-15         BC5478         0-13           2N3020         0.75         2N3858A         0:20         2144905         2.46         AC128         0-48         BC148         0-15         BC5478         0-13           2N3033         8.25         2N3858A         0:20         2144905         2.46         AC128         0-48         BC148         0-13         BC5478         0-13         2N3053         BC5478         0-13         2N3054         0-13         BC548         0-13         2N3054         0-36         BC5478         0-13         2N3054         0-36         BC134         0-15	CA3033 2.9 LM3201124 12 LM709-8 19 LM33111 119 NE569 4.59 SL617 2.75 CA3038 4.10 LM3201724 13 LM709-8 19 LM33111 119 NE569 4.59 SL617 2.75 CA3039 77 LM320142 13 LM709-18 45 LM4250CN NE567 4.59 SL612 2.75 CA3040 3.75 1.15 LM710 107 1.30 NE567 4.59 SL620 3.30 CA3041 1.65 LM320MP5 LM710 107 1.30 NE568 1.73 SL620 3.75 CA3041 1.65 LM320MP12 LM711CN 572 4.55 NE568 1.73 SL620 4.40 CA3041 1.65 LM320MP15 LM723C 1.75 LM78L12CH NE558 1.78 SL620 4.40 CA3043 2.20 LM320MP15 LM723C 1.75 LM78L12CH NE558 1.78 SL640C 4.40 CA3043 1.58 1.58 1.58
2N3133         9 50         2N3004         0 18         2N3059         0 30         AC178         0 54         BC1679         0 13         BC754         2 46           2N3242         6 60         2M3805         0 18         2N3120         0 12         AC178         0 54         BC1679         0 13         BC754         2 46           2N3242         6 61         2M3805         0 18         2N3120         0 12         AC178         0 54         BC1679         0 13         BC754         2 46           2N3250         0 31         2N3500         0 18         2N3130         0 13         BC1688         0 13         BC770         0 21           2N3301         0 45         2N3130         0 12         AC187K         0 59         BC1688         0 13         BC771         0 21           2N3301         0 45         2N1301         0 55         2N5130         0 22         AC187K         0 54         BC178         0 13         BC771         0 24           2N3302         0 71         2N4032         0 455         2N5143         0 22         AC188K         0 55         BC1716         0 17         BC772         0 43           2N3392         0 17         2N4032	CA3049 e*71 LM320MP24 LM728 6 60 673 XA5580 2*17 TAA263 1-33 CA3047 2 20 1-15 LM741C 5*76 LM76L2CH X55370 2*17 TAA263 1-33 CA3047 A3*76 LM322X 6*85 LM741C-98 38 5*76 ZM24CH X55370 2*17 TAA263 7 CA3048 2*45 LM339N 6*68 LM741C-98 38 5*75 SA5500 2*0 TAA320A 143 CA3050 2*45 LM330T5 6*18 LM741C7N 9*81 5*75 SN76001N138 TAA350A 7 CA3051 2*65 LM340T128*18 LM742-18 0*39 LM782KC SN76003N2 38 TAA350A 2*36 CA3053 2*65 LM340T128*18 LM742-18 0*39 LM782KC SN76003N2 38 TAA52A 2*36 CA3053 1*83 LM340T158*18 LM742-18 0*39 LM782KC SN75003N2 38 TAA52A 2*190
1978 CATALOGUE IS AVAILABLE NOW I LOTS OF NEW PRODUCTS AND IDEAS. PRICE 45p POST FAID OR 35p TO CALLERS.	C A3053 8 77 LM34(P5 9 18 LM900 8 38 1-75 SN76013N5-56 TAA550 8-45 CA3054 1 16 LM341P129 80 LM911 8-56 LM7824KC SN76012ND CA3059 2 16 LM341P158-76 LM921 0-58 1-75 1-36 TAA570 2 18 Prices correct at 10 Aug. 1976. All p:Ices include VAT, b & p 40p

### **J. BIRKETT** Radio Component Suppliers

25 The Strait, Lincoln LN2 1JF Tel: 20767

TANTALUM BEAD CAPACITORS '10' 35v.w., '3ui 35v.w., '47ui 35v.w., 10' 35v.w., 2 2ui 33v.w., 3'3ui 16v.w., 4'7ui 50v.w. 6'8ui 35v.w., 6'8ui 35v.w., 10ui 25v.w., '5ui 25v.w., 20ui 50v.w., 22ui 16v.w., 4'7ui 50v.w. 14 18 pa cet. '30v.w., 5'2ui 16v.w., 4'7ui 50v.w. 100 (m 15). '30v.et al. 100 (m 16). '30v.et al. 100v

### **NEW PRODUCTS NEW PRODUCTS**

ant doal

#### POWERAMP KIT

The kit includes all metalwork, hestainks and hardware to house any two of our power amp modules plus a power supply. It is contemporarily styled and it's quality is consistent with that of our other products. Comprehensive instructions and full back-up service enables a novice to build it with confidence in a few hours.

### ADVANCED PRE-AMP CPR1

This stered module accomplishes pre-amplification of disc and other inputs to an impeccable stendard. The disc input has no common mode distortion effects, the of '001%, 4048 overload, 7068 s/n, and 87/J/S slew vale. Other inputs have 70mv sensitivity, the of 001%, 90/3 s/n, 1248/octave subschic filter, 47/J/S slew rate and active balance control. Output la dislayed for 10 seconds. No cantrols are filted.

#### MOVING COIL PRE-AMP MC1

This stered module uses multiple input transistors to achieve 65dB s/n. Sensitivity is switched 70 or 160 $\mu$ V for 3-5mV output.

#### POWER SUPPLY

The requistor module, REG 1 provides 15-0-15v to power the CPR 1 and MC 1, it can be used with any of our power amp supplies or our small transformer TR 6. The power amp sit will accommodate this

POWER AMPLIFIER MDDULES           CE 608         60W/8 ohms 33-0-35v           CE 1004 100W/8 ohms 35-0-45v         CE 1088 100W/8 ohms 45-0-45v           CE 1704 170W/8 ohms 45-0-45v         CE 1704 170W/8 ohms 65-0-45v	£19-22 £23-22 £29-12	POWER AMP KIT . 6.32-40 PRE-AMPS: These are available in two versions—one uses standard componenta, and the other (the S) uses MO resistors where
TOROIDAL PÓWER SUPPLIES           CPS1 for 2 × CE 608 or 1 × CE 1004           CPS2 lor 2 × CE 1004 or 2/4 × CE 608           CPS3 for 2 × CE 1006 or 1 × CE 1704           CPS4 for 1 × CE 1008           CPS4 for 1 × CE 1008           CPS4 for 2 × CE 1004 or 2 × CE 1074           CPS4 for 1 × CE 1708           CPS4 for 2 × CE 1704           CPS4 for 2 × CE 1704	£16 82 £17 68 £15-31 £22 68	mecessary and tantatum capacitors. CPRI £29:49 CPRIS £34:98 MCI£15:39 MCIS£29:49 POWER SUPPLY: REGI£3:75 TR3,£1:75 BRIDGE DRIVER, BDI Obtain up to 34QW using 2 ×
HEATSINKS Light duty, 50mm, 2°C/W. Madium power, 100mm, 1 4°C/W. Diaco/group, 150mm, 1 1°C/W. Fan, 80mm, state 120 or 240v Fan mounted on two drilled 100mm hestinka, 2 × 4°C/W. 55°C max, with two 170W	£2-29 £2-15	CRIMSON ELEKTRIK
THERMAL CUT-OUT, 70°C	£29 16 £1-80	IA STAMFORD STREET, LEICESTER LEI 6NLL Tel. (0533) 537722
All prices shown are UK only and include VAT is no problem, please write for specific quote Coupons for detailed information.		

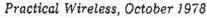


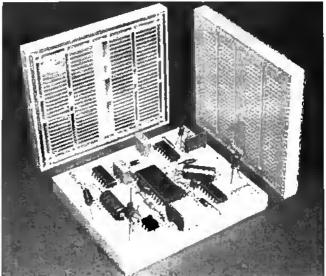
### FOR YOUR GUIDANCE VALUE ADDED TAX

Unless otherwise shown, all prices in advertisements are inclusive of VAT. Where prices are exclusive, readers should ensure that they have added the correct amount of VAT before ordering.

Export orders are not subject to the addition of Value Added Tax.







Logically laid out to accept both 0.3" and 0.6" pitch DIL packages as well as Capacitors, Resistors, LED's, Transistors and components with leads up to .85mm dia.

500 individual connections in the central breadboarding area, spaced to accept all sizes of DIL package without running out of connection points.

4 Integral Power Bus Strips around all edges for minimum interconnection lengths.

Double-sided, nickel silver contacts for long life (10K insertions) and low contact resistance (< 10m, ohms)

Easily removable, non-slip rubber backing allows damaged contacts to be rapidly replaced.

What other breadboarding system has as many individual contacts, offers all these features and only costs £5.80 inclusive of VAT and P.P. - NONE.

At £5.80 each The EuroBreadBoard is unique value for money. At £11 for 2 The EuroBreadBoard is an indispensable design aid. Ship out and Post Divid George Sales, rig 74 Craylord Hip St. Craylord Kent, DAI 455

David Geor /o 74 Cray Crayford, I	/fo	rɗ	Hi	igł					•																
Please send	m or			E E										-				0	[				ea ck		
(All prices overseas or	inc	lu	de																						
Nama,	,			,					ŀ					۲			,						ŀ	ŀ	
Company.					4				,	4	,	•		ī	ı	,			•						
Address, ,					4	4		,	4			•	,	1			,			4				h	
										-		ł	4	ŀ		÷	÷	4			,			ī	-
						+	ł			÷				,		,			ı.	ŀ			,	,	
Tel. No.																					E	٤/	10	17	Ø



**Receivers and Components** 

TRANSIST	088	1114004	€p	7410	190					
ACY21 54p 1	T/S43 45p	IN4008		7411	250					
ACY22 44p	ZTX300 14p	JN4148	30	7413	410					
AFZ12 2000	ZTX450 15p	ic		7420	180					
ASY50120p	ZTX500 17m	NE555	Z1 p	7430	180					
BCI07 #p	2N3053 14p	709	55p	7432	370					
BC108 18p	2N3055 #5p		45p	7437	37p					
8C109C 11p	Diodes	111		7442	75p					
	AAZ15 15p	7400	15p	7445	1980					
BC214 17p	8Y238 20p	7402	15p		37p					
BC413 11p	1N914 4p	7403	100	7475	43p					
BFY61 23p	IN4001 3p	7404	25p	7476	37p					
85X20 24p	N4002 10	7407	atb	7490	34p					
OC35 150p	IN4003 #p			7493	34p					
ELECTROLYTIC CAPACITIORS (V/UF) 8-3v/470										
5p; 1000 13p;	2200 14p; 330	6 15p; 4	700 20	p; 10V/	10, 47,					
220 Ep; 470 1	p; 2200 15p;	3300 16p	1; 16V	/100, 26	0 80;					
330, 470 10p;	1000 15p: 25V	/22, 33 🖲	p; 100	, 220 <b>J</b> p	330.					
470 120; 1000	\$8p: 35V/47.	100, 7p, 5	20, 33	0 150 ; :	50V/1;					
22, 33 7p; 47,	100 89 330, 47	01100;10	00 33b	:						
LA DIN		1								
IC PAK		DIODE PAK								
Unicated		Functional unmarked								
Marked & Un		diodes IN4148 TYPE 50 for 40p								
7400 series 1	00 101 61-00	DU TO	r avp							
RESISTORS	CARBON FI	LM								
	4-7 MD E24 1									
	4-7 MO E12 1									
	CAPACITO		60v							
·0056, 0058, 0	082 Jp61.	-01201	5023	2, .033,	·037,					
047, 058 4p.	- 068, - 082, · 1	1, -12, -1	5. 18	0, 2, 1	22 5p.					
-33, 474p5	8, 68 7p. 82,	1 5 1êp.			-					
Mall arder oal	y. P. & P. 25p.	Pelane In	aluda 1	AT C	114 0					
STELMA du	item Techniqu	rnest in	ciode -		PW/10					
Dafield Slick	Hill, Edenbrid	too Kunt	TNR	5 L10., J	4410					
Landra Street	THE ECONOMIC	And Links								

TRANSISTORS, Resistors, Caps, Pots, Plugs and Sockets, Zeners, TTL, Cable, Boxes. All at very good prices, 65 Railway Road, Leigh, Lancs. Telephone Leigh 679575.

SELTRONICS
Super Value Resistar Pax No 1 ~ 50 ~ 1w 190 chms ~ 820 chms 56p
No 2 - 50 - 1w 10k - 82k 50p
Ng 4 - 50 - 3w 100k - 620k 50p
Super value miniature ceramic capacitor pax preferred values 22pl = +047ut 50 places our mix for only £1-00
SPECIAL OFFER
Ex G.P.O. Micro Switches S.P.D.T. 15p each. • Rodney Gardene, Braintree, Essex. Add 15p Postage and Packing.
the state of the s

BRAND NEW COMPONENTS BY RETURN BRAND NEW COMPONENTS BY RETURN Elactrolytic Capacitors 16V, 23V, 30V, 0.47, 1-0, 2-2, 4-7, 4, (0), 106, -5p, 220, 47-51, (50V-6p), 100-7p, (50V-8p), 1200-6p, (50V-10p), 470-11p, (50V-8p), 1000/15V-13p, 1000/25V-18p, 1000/40V-33p, Subminiature bead tantalum electrolytics, 0.1, 0.22, 0.47, 1-0 (35V, 4-7) (5-3V-8p, 22/13V, 4-7/25V-9p, 107/25V, 15/16V-12p, 22/14V, 33/10V, 47/6V, 68 & 100 (3V-14p, Multard Ministure Caramic El2 Series 65V 2%, 10 pf, to 47 pf, -3p, 56 pf, to 330 pf, -4p, Martinel Meusoine Caramic Black Cara 50V 

 10
 pf. to
 47
 pf.-3p.
 56
 pf. to
 330
 pf.-4p.

 Vertical
 Mounting
 Ceramic
 Place
 Cape.
 300
 pf.-4p.

 Vertical
 Mounting
 Ceramic
 Place
 Cape.
 300
 pf.-4p.

 Polystyrena
 Ella
 Saria
 Saria
 Saria
 Saria
 Saria

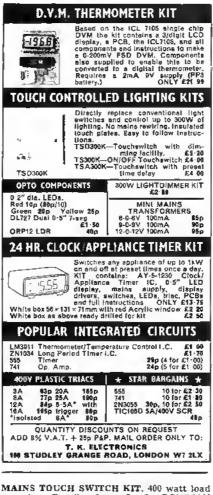
 10
 pf.
 1000
 pf.
 Saria
 Saria
 Saria
 Saria

 10
 pf.
 1000
 pf.
 Saria
 Saria</td 1N4148-3p, 1N4002-5p, 1N4006-7p, 1N4007-8p BC107/8/9, 8C147/8/9, BC157/8/9, BF194 & 7-4p, 20mm, fuses 15, 25, 5, 1-0, 2-0, 3-0 & 5A-3p, Printed Circuit Holders for 20mm, fuses-3p, Post 10p (Free over £4). Prices VAT inclusive. THE C. R. SUPPLY CO. 127, Chesterfield Road, Sheffield S8 ORN

SMALL ADS

The prepaid rate for classified advertisements is 22 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £7.50 per single column centimetre (minimum 2-5 cms). All cheques, postal orders etc., to be made payable to Practical Wireless and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Practical Wireless, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846)

LED's. Mixed bags of 4 different sizes and 4 different colours. 50 at £5.25, 100 at £9.25 including VAT and post and packing. CWO. Michael Williams Electronics, 47 Vicarage Avenue, Cheadle Hulme, Cheshire, SK8 7JP.



capacity. Details free, I. G. BOWMAN (Dept. PW), 59 Fowey Avenue, Torquay, S. Devon.

CRYSTALS as previously advertised plus: CRISIALS as previously advertised plus: HC33/U 1.0, 2.0, 3.0, 1.008, 1.8432, 2.4576, 2.5625, MHz £3.35, 3.579 and 4.433 £1.20 each. HC18/U: 3.2768, 4.096, 4.8, 4.9152, 5.12, 6.144, 6.4, 6.5536, 6.9375, 18.432, 38.6667, 116.0, MHz £3.00, Sub-miniature HF crystals, any freq. 10.180 MHz made to order 6 weeks, £3.75. All prices post paid, Dr. VAT AM/CM/SSB. Communication Bd, no VAT. AM/CW/SSB Communication Re-ceiver and presclector modules and kits. S.A.E. details. P. R. GOLLEDGE ELEC-TRONICS, Merriott, Somerset TA16 5NS. TRONICS, Me: Tel: 0460 73718,

#### CONDITIONS OF ACCEPTANCE **OF CLASSIFIED ADVERTISEMENTS**

Advertisements are accepted subject to the conditions appearing on our current advertisement rate card and on the express understanding that the Advertiser warrants that the advertisement does not contravene any Act of Parliament nor is it an intringement of the British Code of Advertising Practice.

2. The publishers reserve the right to refuse or withdraw any advertisement.

5. Although every care is taken, the Publishers shall not be liable for clerical or printers' errors or their conseauences.

### VALVES Radio - T.V. - Industrial - Transmitting Projector Lamps and Semiconductors We Dispatch Valves to all parts of the world by return of post, Air or Sea mail, 4000 Types in stock, 1930 to 1976. Obsolete types a speciality. List 300, Quotation S.A.E. Open to callers Monday to Saturday 9.30 to 5.00 closed Wednesday 1.00. We wish to purchase all types of new and boxed Valves, Projector Lamps and Semiconductors.

COX RADIO (SUSSEX) LTD. Dept. P.W. The Parade, East Wittering, Sussex PO20 8BN West Wittering 2023 (STO Code 024366)

### **EVERYONE'S A WINNER** WITH CODESPEED

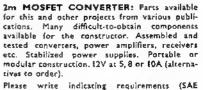
Full Spec. Devices

Full Spec. Devices PACK P1 1 \* MMS330 Digital Voltmeter I.C. With full instructions on how to build a versalite digital multimeter or panel meter, 23-95 PACK M1 2 Celculator Keyboards 61-00 PACK M2 1 × 2102, a 1024 bit staller RAM. The most popular of all random access memorities in professional and emater electronics. With full date, 61-25 PACK M31 × MMS725 4 function Calculator Chip (not designed for use with Pack M1). With data bock, 61-00 PACK E2 1 \* 8 digit 0-33° high 7 segment Liquid Crystal calculator ship display. With data bock, 61-00 PACK E2 1 \* 8 digit 0-33° high 7 segment Liquid Crystal calculator ship display. With data bck 23 PACK T3 beck by popular demand. A 0-2° 31 digit Liquid Crystal writhwatch display with data. 51-06 PACK T3 1 × MMS316 Digital Alarm Clock I.C. 12 PACK T4 1 × 0-6° giant red LED Clock Display. 31 digit with amfpm Indicator. An excellent display for yad ratur X = 0 for opicst at only £4-95 PACK DM15 × 14 bin dus In line chips each con-laining 23 matrixed elipsial in line chips each con-laining 24 matrixed shale with data. SDp Untested Parka PACK T4 1 (30% Gueranteed Good) 15 × DTL logic L.C.'s. Maining dual J-K flip flops, Replaces those costly TTL flip flops in most projects. Saves £25.29 FACK D10 22 5 × SN7400 type I.C.'s 100 two 1/p nand

Cition PACK D2 25 x SN3406 type I.C.'s 100 two 1/p nand gates. We guarantee at least 50 good, A givesway at only £1-00 PACK E1 60% Guaranteed Good) 5 x MAN3 7 sep-ment 0 127 LED displays. Excellent value, £3 + 00 PACK MUI (Untestac—so no guarantees) Another bargain. 2 x Upper half of a calculator case with built-in keyboard, A snip at only 60p the pair, Satisfaction guaranteed or refund.

MAIL ORDER ONLY-NO CALLERS PLEASE Postage and Packing please add 25p

CODESPEED, P.O. Box 23, 34 Seafield Road, Copnor, Portsmouth, Hents PO3 58J



appreciated)

P. N. IEVONS (ELECTRONICS) 691 Christchurch Road, Boscombe, Bournemouth. (Mail Order Only)

TIRRO ELECTRONICS the mail order division of RITRO ELECTRONICS UK offers a wide range of components for the amateur enthusiast. Large SAE or 20p brings list. GRENFELL PLACE, MAIDEN-HEAD, BERKS SL6 1HL.

#### **Radio Receivers**

POCKET SETS
MW/VHF-AIR (88-108 MHz) £9-95
MW/VHF-AIR EXTRA SENSITIVE, DELUXE
£11-45
MW/VHF (88-108 MHz) AIR-PSB (108-174 MHz)
£13-95
MAINS/BATTERY SETS
MW/VHF (88-108 MHz) AIR-PSB (108-174 MHz)
£13-95
MW/LW/VHF (88-108 MHz) SW (4-12 MHz)
£20.95
OTHER PRODUCTS
UEADOUDUSE TO CONTRACTOR
HEADPHONES To Suit Any Radio 64-95
HEADPHONES With Built-in M.W. Radio 64-55
Faulty MW/LW Sats for Spares 62-25
Metal Detector (Telescopic Arm Type) £10-95
All prices include P&P, VAT, Batteries, Guarantee
& Accessories. Full Refund if not completely
satisfield.
NOBLE ELECTRONICS
24 Lloyd Street, Altrinchem, Cheshire WA142DE, Tal. 061-941 4510
WA14 2DE, Tal. 061-941 4510

#### Courses

COURSES-RADIO AMATEURS EXAMINA-TION. City and Guilds, Pass this important examination and obtain your GB licence, with an RRC Home Study Course. For details of this, and other courses (GCE, professional examinations, etc.) write or phone: THE RAPID RESULTS COLLEGE, Dept JX1, Tuition House, London SW19 4DS. Tel: 01-947 7272 (Carcers Advisory Service) or for prospectus requests ring 01-946 1102 (24br Recordacall).

#### Educational

GO TO SEA as a Radio Officer. Write: Principal, Nautical College, Broadwater, Fleetwood FY7 8JZ.

RADIO AMATEUR'S EXAMINATION A course leading to this exemination will be held at: PADDINGTON COLLEGE, 25, Paddington Green W2 1NS. Two evenings each week for 3 terms.

ENROLMENT 11, 12, 18 SEPTEMBER Further details #1-402 4221, Ext. 52 or 55.

### TELEVISION TRAINING

15 MONTHS full-time course for beginners to include all the undermentioned subjects. Short courses, combining one or more subjects, for applicants with previous electronics knowledge.

- 13 WEEKS ELECTRONICS AND RADIO
- 13 WEEKS MONOCHROME TELEVISION
- 13 WEEKS COLOUR TELEVISION
   13 WEEKS CLOSED CIRCUIT

TV & VCR The training incorporates a high percentage of practical work. Next session starts on September 11th.

#### Prospectus from: LONDON ELECTRONICS COLLEGE

Dept. B10, 20 Penywern Road, London SW5 9SU. Tel. 01-373 8721

Practical Wireless, October 1978



REG. OFFICE REAR 14 QUEENS PARADE, NORTH EALING W.5. SERVICE SHEETS - COLOUR TV SERVICE MANUALS Service Sheets for Mono YV, Radios, Record Players and Tapo Recordars 75p. Please send large Stamped Addressed Envelope. We can supply manuals for most makes of Colour Television Receivers by resure of past B.R.C. PYE ECKO PHILIPS IT/KB SONY G.E.C. HITACHI BAIRO ULTRA INVICTA FERGUSON H.M.V. MARCONI AND MANY MORE Let us quote you. Please send a Stamped Addressed Envelope for a prompt reply. Also comprehensive T.Y. repsir manuals by J. M. Court. S.A.E. for details, MAIL ONLY TO

G, T. TECHNICAL INFORMATION SERVICE 10 Dryden Chambers, 119 Oxford St., London WIR IPA

SERVICE SHEETS for Radio, Television, Tape Recorders, Stereo, etc. With free fault-finding guide, from 50p and SAE. Catalogue 25p and SAE, HAMILTON RADIO, 47 Bohemia Road, St. Leonards, Sussex.

LARGE SUPPLIER OF SERVICE SHEETS All models at 73p. TV, Radlo, Tapa Recorders, Record Players, Transistora, Stareograms, Radlograms, All at 73p each plus s.s.e. except Colour TV & Car Redos. TV Sheets full-length, Free fault-finding charl or catalogue with order. Do CALLERS, C. CARANNA

71, Beaufort Park, London NWi1 48X. 41-438 4582

BELL'S TELEVISION SERVICES for Service Sheets on Radio, TV, etc., 75p plus S.A.E. Colour TV Service Manuals on request. S.A.E. with enquiries to B.T.S., 190 King s Road, Harrogate, N. Yorkshire. Tel: (0423) 55885.

SERVICE SHEETS, Radio, TV etc, 10,000 models. Catalogue 24p, plus SAE with orders, enquiries. Telray, 154 Brook Street, Preston PR1 7HP. Aerials

G2DYM ANTI-TVI TRAP DIPOLES Models: S.W.L., £29-81: 500 watt or S.W.L., 641-04: inc. insulators, 75h. feeder, VAT and P & P. Aerial matching units S.W.L. and 500 watt 10-160 metres inc. shipping and B.C. Bands, £16-23: Inc. VAT and P & P. Send 10" × 7" 124p S.A.E. and 3 × 9p stemps for full details, serial article, test reports and testImonials, G2DYM, LAMBDA, WHITEBALL, WELLINGTON, SOMERSET

#### Electrical

STYLI—illustrated equivalents (List 28) also cartridges, leads, etc. Superb quality and service at lowest prices. Fully guaranteed. Free for SAE from Felstead Electronics (PW), Longley Lane, Gatley, Cheadle, Cheshire SK8 4EE.

#### Services

COPY TYPING undertaken, S.A.E. for details. R. G. Hills, 20 Ditchling Rise, Preston Park, Brighton, Sussex BN1 4QL.

**Situations Vacant** 

# **Radio Technicians**

Government Communications Headquarters has vacancies for Radio Technicians. Applicants should be 19 or over.

STANDARDS required call for a sound knowledge of the principles of electricity and radio, together with appropriate experience of using and mainteining radio and electronic test gear.

**DUTIES** cover highly skilled telecommunications/electronic work, including the construction, installation, maintenance and testing of radio and radar telecommunications equipment and advanced computer and analytic machinery.

**QUALIFICATIONS:** Candidates must hold either the City and Guilds Telecommunications Part 1 (Intermediate) Certificate or equivalent HM Forces qualification.

**SALARY** (inc. supps.) from £2,927 at 19 to £3,700 at 25 (highest pay on entry) rising to £4,252 with opportunity for advancement to higher grades up to £4,706 with a few posts carrying still higher salaries.

Opportunities for service overseas.

Further particulars and application forms available from:

### GCHQ

Recruitment Officer, (Ref PW/10), GCHQ, Oakley, Priors Road, Cheltenham, GL525AJ. Cheltenham (0242) 21491 Ext 2270

#### Miscellaneous

### **BBC MONITORING SERVICE**

### **OPERATIONAL ASSISTANT** WORLD SCHEDULES MONITOR

(£3,525-£4,350 p.a. plus Shift Allowance)

Duties include checking of voice transmissions, compiling schedules, writing listening observations and ensuring that language monitors obtain the best possible reception of foreign broadcasts. Shift work, including nights, and periodic overseas duty involved.

Applicants must have a keen interest in broadcasting developments outside the U.K. and be able to operate communications receivers and other monitoring equipment. Ability to identify the main languages is essential and knowledge of at least one foreign language an advantage. Interest in foreign affairs desirable. Shortlisted candidates will be required to take listening and written tests.

Based at Caversham near Reading, Berks.

Please telephone or write immediately, enclosing addressed envelope, for application form quoting reference 78,G,1479PW, to Appointments Department, BBC, London W1A 1AA. Tel: 01-580 4468 Ext. 4619.



#### **Books and Publications**

SIMPLIFIED TV REPAIRS. Full repair instructions individual British sets £4.50. request free circuit diagram. Stamp brings details unique. TV Publications (Ause PW), 76 Church Street, Larkhall, Lanarkshire.

THE END OF COMPUTER CONFUSION; what point have we reached—where are we going? Read Computer Lib/Dream Machine by Ted Nelson, From your Local Computer Store £5.95 or send £6.45 to Computer Bookshop, Temple House (P), 43-48 New Street, Birmingham.

#### THE DALESFORD SPEAKER BOOK by R. F. C. Stephens.

This book is a must tor the keen home constructor. Latest technology DIY speaker designs. Contains [ui] plans for (nfinite baller and reflex designs tor 10-100 watts, also unusual centre-base system for those who want Hi-fi to be "Heard and not seen". 24 85 (22 20 post peld. \$5 Oversees).

TODAD). VAN KAREN PUBLISHING S SWAN OTREET WILMSLOW CNESHIRE

HOW TO START A BUSINESS, By popular demand a fully illustrated manual has now been produced, showing, in easy, step by step, stages, how to rewind ARMATURES & FIELD COILS as used in Vacuum Cleaners, Drills and Portable Tools. Chapters on taking data, materials required, test instruments required, rewind instructions, charts, etc. How to cost instruction manual £4.00 plus 30p P & P. CWO, COPPER SUPPLIES, 102 Parrswood Road, Withington, Manchester 20. Dept. PWA.

WOULD YOU LIKE to understand computing? Send S.A.E. for leafter of £3:45 for our new book "A FAST INTRODUCTION TO COMPUTING" post free, Dept. P.W. Indus-trial Training Press, Ringwood Way, Winch-more Hill N21 2RA.

#### For Sale

NEW BACK ISSUES of "PRACTICAL WIRE-LESS" available 65p each post free, Open Bell's Television Services, 190 Kings Road, Harrogate, N. Yorks. Tel: (0423) 55885.

SEEN WHISTONS CAT? 5000 odds and ends Mechanical/Electrical Cat free. WHISTON (Dept. PW), New Mills, Stockport.

ELECTRONIC KITS-S.A.E. for new cata-logue, and clearance list of obsolete kits. AMTRON UK, 7 Hughenden Road, Hastings, Sussex.

"PRACTICAL WIRELESS" 1934-1978, Over 700 issues. 1934-1939 weekly. Then monthly. £210. WILSON, 54 Chepstow Villas, London W11.

"RUN YOUR OWN BUSINESS as an extra home activity. A genuine opportunity to success." Full details on receipt of SAE. Industrial Supplies, 102 Parrswood Road, Withington, Manchester 20. Dept PW.

#### Tapes

CASSETTE TAPES; C60 six for £1-60, C90 four for £1.60, Case and index included. VAT paid, Please add 10% postage, West, (A2) 56 Frankwell Drive, Coventry CV2 2FB.

C60 MORSE TAPES, Beginners to 27 wpm. £3.50, Badio College, Chorlton Road, Manchester.

#### Wanted

WANTED: Clean new semiconductors, I.C.'s etc. Good prices paid. Hewitts, 52 Barkby Road, Syston, Leicester.

MORSE CODE TUITION AIDS Casselle A: 1-12 w.p.m. for analyur radio examination. Casselle B: 12-24 w.p.m. for protessional examination preparation. Morse by light systems available. Morse Key and Buzzer Unit for sending practice. Prices each Cassette (including booklets) £4 50. Morse Key and Buxers £4-50. Prices Include postage etc., Overseas Airmall £1 50

MHEL ELECTRONICS (Dept P.W.), 12 Longehore Way, Million, Partsmouth PO41LS.

#### DART STATIONERY

Presents For the Amateur

QSL CARDS Personalised to your own choice, also LOG BOOKS, Loose test binder plus 100 printed log sheets £250, extra packets of 100 sheets £150. Cata-logues available containing complete range of radio stationery, price 45p.

#### For the D'Xer

RECEPTION REPORT LETTERS. Professionally alyied latters printed in two colours and supplied in RECEPTION alyied latters printed in pads of 100 letters. 1 pads £1 60 each 2+ pads £1 60 each ^ARRIES A 7

EVERY ORDER CARRIES A MONEY BACK ASSURANCE IF NOT COMPLETELY SATISFIED MAIL ORDERS ONLY PLEASE

Please send cheques or P.O. payable to:

DART STATIONERY 20 Bramley Read, LONDON E17 4PS

#### **PRINTED CIRCUITS and** HARDWARE

Readily available supplies of Constructors' Hardware. Printed circuit boards, too quality for individual designs. Prompt service. Send 25p for catalogue from:

RAMAR CONSTRUCTOR SERVICES Masons Road, Stratford-on-Avon, Warwicks Tel: 4879



ATTENTION SWLs & DYers superior aerial wire 20swg, copper plated, steel core, tough pvc insulation, 4p per metre+2p per metre carr. AMTEST, 55 Vauxhall Street, Worcester WR3 8PA.

	ENAMELL	ED COPP	ER WIRE	
1940	1 10	Soz	4oz	202
14-19	2.40	1.24	-68	- 60
20-29	2 45	1.40	-82	-59
30-34	2 60	1.70	- 69	11 A
35-40	2-85	1 10	1-04	-78
Inclusive of				••
SAE brinds	Calalogue	of copper	and resiste	ance wires
In all coveri				
ТИ	6 CHENT	IFIC WIR	E COMPA	NY
		39, Landa		
Re			aby Garde	n#,

SUPERE INSTRUMENT CASES by Bazelli, manufactured from P.V.C. faced steel. Hundreds of people and industrial users are choosing the cases they require from our vast range. Competitive prices start at a low 90p, chassis punching facilities at very competitive prices, 400 models to choose from, frec literature (stamp would be appreciated). BAZELLI, Dept No 25, St. Wilfrid's, Foundry Lane, Halton, Lancaster LA2 6LT.

#### NO LONG WAVE?

- NEW! 200 KHz to Med. Wave Converter, built-in antenna, inductive (place near receiver) and coax outputs, only 19-70. RARE DX UNDER GRM? DIG it OUT from
- RARE DX UNDER GRM? DIG it OUT from whistles and cw with a Tunable Audio Notch Filter, speaker amplifier, only £8:90.
   Y.LF? 10-150 KHz Receiver only £10:70.
   NEED THE TIME? MSF 60 KHz Receiver, built-in antenna, £13:70, or with parts (no case or pcb) for sequential YEAR, MONTH, DATE, DAY, HOURS, MINUTES, SECONDS display, £24:40.
   PROGRAM YOUR OWN tunes on a MUSICAL DOORBELL, new jingle every day, just needs
- DOORBELL, new jingle every day, just needs bell transformer and speaker, £19.50. Each easy-assembly kit includes all parts, primed circuit, case, postage etc. instructions, money back assurance, so SEND off NOW. CAMBRIDGE KITS

45(PK) Old School Lane, Milton, Cambridge

OUTSTANDING 2200 HI-FI FM TUNER. Latest silicon superhet design, Varicap Tuning, Full Coverage 88-102 MHZ. Ideal for Push button/Manual tuning. Supplied Built & Tested with full instructions only E9-95 (P&P 50p). GREGG ELECTRONICS, 86-88 Parchmore Rd, Thornton Heath, Surrey.





#### Ladders

LADDERS, Varnished 20ft 9in extd., £29.72, carr, £2.70. Leaflets. Also alloy ext. up to 62ft 6in. Ladder Centre (WLS2), Halesfield (1) Telford, Tel: 586644, Callers welcome.

#### PLEASE MENTION PRACTICAL WIRELESS WHEN REPLYING TO ADVERTISEMENTS

Practical Wireless, October 1978

### **NEW FROM CASIO**

Experience has convinced us that for quality, reliability and value for money, CASIO are unbeatable. CASIO have now increased their superb range.

Ail Casio watches have a calendar display, mght illum-ination, minerai glass and stainless steel cases, water resistant to 100 feet (except Sports Watches-60 feet)

31QR-29B Round. Stopwatch	(£3)	95)	£25-\$5
51QR-19B Round. 6 digits. display	Selectable 12 (£35	or 2 95)	4 hour £29 95
\$4QS-16B Square. As above	(£44	95)	£34 #5
54Q8-156 Luxury version	(£49	95)	£39-15

45CS-22B Chronograph. Nel, lap and 1st & 2nd piace times. 12 or 24 hour display Dual time zone (£64:95) £49 95

DRESS WATCHES.	Square.	Stopwatch.	Due	al time.
SICS-18B Square		(£89	95)	£54 \$5
53CS-16B Barrel		(£89	95)	£54 95
53CGS-17L. Gold Pi.	Strap	(£.84	95)	£69-95

All these watches and full details should be available in early September,

#### **NEW LOW COST WATCHES** From reputable manufacturers with full service backup. 4 digits 5 functions £9·95 6 digits chronograph 1/100 second net, lap, 1st & 2nd place 1. 1. 25 1. ST. 18. 2 time £19.95 ALARM WATCH AND ALARM/ CHRONO Hrs. Mins; Secs (or date) AM/ PM, Day. perpetual Calendar £29 95 Alarm/ Chrono 1/100 second sloowatch. Lap times. £37.50 AQ-1000 CALCULATING ALARM CLOCK PLUS 3-WAY STOPWATCH Hours, minutes, seconds, am/ pm 24 hour alarm with sign. Stopwatch. Net, Lap and lat and 2nd place times from 1/10th ascond to 16 hours, Calculator 4 key memory % 1 year batteries, + 20 secarmonth. - 21 × 41 RRP 226-95 £21 · 95 ALARM CLOCK PLUS

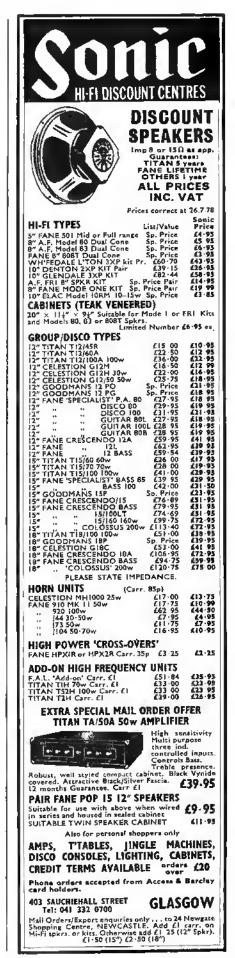
2 ALARM/TIMERS

Two AA batteries last for 10,000 hrs (1 year) LCD 6 digit clock. large angled display. 24 hr Alarm, siso two 24 hr Alarm, siso two 24 hr Alarm, Timers with countdown (ane self-clearing, one repeals) Full Memory, Constants 5(J, 1, 11 × 21 × 5°, RRP \$22-95 £17.95



Send 25p for our illustrated catalogue Prices include VAT and PAP. Send cheque, P.O. or phone your credit card number to:---





<section-header></section-header>	TRANSISTORS         P         BC187A         P           AC107*         23         BC188C         12           AC117*         23         BC188C         12           AC117*         13         BC188C         12           AC125*         19         BC170         17           AC127*         14         BC173         12           AC127*         14         BC173         14           AC127*         14         BC177         14           AC147*         24         BC177         14           AC142*         28         BC182         1           AC142*         29         BC181         10           AC142*         29         BC181         10           AC147*         29         SC182         1           AC147*         29         SC181         10           AC147*         29         SC181         14           AC14	BF161         P         MPSA35         P           BF167         25         MPSA35         24           BF177         24         MPSA35         24           BF177         24         MPSA70         35           BF177         24         MPSU05         35           BF178         30         MPSU05         35           BF187         30         MPSU05         35           BF187         30         MPSU05         35           BF183         30         MPSU32         35           BF184         40         OC23*         120           BF184         40         OC23*         120           BF184         40         OC23*         130           BF184         40         OC23*         30           BF184         40         OC23*         30           BF184         40         OC3*         30           BF244         30         OC4*         31           BF236         30         OC7*         35           BF236         30         OC7*         36           BF236         30         OC7*         36           BF236	D         D         P           T1P3055*         32         2N2107*         43           T1S43         34         2N2217*         43           T1S44         45         2N2218.4*         22           T1S45         45         2N2218.4*         22           T1S46         50         2N2220.4*         23           T1S46         50         2N2220.4*         23           T1S46         50         2N2208.4*         11           T1S46         50         2N2804.4*         11           T1S50         47         2N2804.4*         12           ZTX107         11         2N2804.4*         12           ZTX301         12         2N2804.4*         12           ZTX301         12         2N2804.4*         13           ZTX302         12         2N3955*         12      <
12:0-12V         100mA         180p         9:0-0V         2A         315p+         AY-3-8500*         450         LM3000*         76         SN76           0:12:0-12V         150m         145p         9:0-0V         2A         315p+         AY-3-8500*         450         LM3000*         76         SN76           0:40:0-12V         150p         12:0-12V         2A         315p+         AY-3-5107         550         LM300*         78         SN76           12:0-12V         0:5A         160p+         32:0-2:0-2:0-         AY-5-102:4A*350         LM391*         125         SN76           12:0-12V         0:5A         160p+         32:50-2:0-2:0-         AY-5-1315         560         M252AA*         785         N76           0:12:0-12V         0:5A         150p+         25:40-2:2:0         20         AY-5-5300*         560         M252AA*         785         N76           13:0-0-13V         0:5A         260p+         -8:04'0'8'0'8'7*         AY-5-5300*         510         MC603         27         TAA           12:0-12V         1A         275:5         12:0-0-250:         12:9-0-         CA301*         41         AY-5-530*         710         MC1304P         249         TAD	Yu         170         4400         13         7474         2           440         7400         13         7476         33           1102_2         170         7401         13         7476         33           1103_17         7402         14         7476         33         7476         33           1103_17         7403         14         7466         14         7466         14           122         115         7405         15         7482         14         7466         34           110"         41         7466         31         7483         7         7485         16           110"         41         7469         37         7488         16         7         7488         17           110"         41         7406         37         7488         17         7488         37           113NO         122         7414         51         7496         31         314742         314746         313           113NO         127         7414         51         7402         31         3449         31         31474         31         314746         33         314746         33 <td>74153         80         75         46         4015           74157         815         4016         815         4017           74157         82         815         4017           74157         82         815         4017           74157         82         915         4016           74158         82         107         44         4019           74150         82         1132         85         4021           74153         82         1132         85         4021           74165         82         153         76         4623           74165         82         153         76         4623           74165         163         76         4623         4623           74167         20         156         96         4625           74174         87         150         126         4028           74177         716         161         136         402           74178         73         150         126         4028           74177         73         150         126         4028           74187         137         150         126</td> <td>94         6406         720         6349         340           63         4410         728         4533         440           143         4410         728         4534         152           123         45327         1650         4536         736           124         45327         1650         4536         741           124         45327         1650         4537         451           124         45357         795         4556         117           46         44152         795         4556         117           46         4419         284         4550         288           46         4422         543         1620         281           46         4423         1424         430         823           72         4433         122         431         122           73         4435         823         4556         203           73         4435         823         4526         333           72         4430         823         4582         533</td>	74153         80         75         46         4015           74157         815         4016         815         4017           74157         82         815         4017           74157         82         815         4017           74157         82         915         4016           74158         82         107         44         4019           74150         82         1132         85         4021           74153         82         1132         85         4021           74165         82         153         76         4623           74165         82         153         76         4623           74165         163         76         4623         4623           74167         20         156         96         4625           74174         87         150         126         4028           74177         716         161         136         402           74178         73         150         126         4028           74177         73         150         126         4028           74187         137         150         126	94         6406         720         6349         340           63         4410         728         4533         440           143         4410         728         4534         152           123         45327         1650         4536         736           124         45327         1650         4536         741           124         45327         1650         4537         451           124         45357         795         4556         117           46         44152         795         4556         117           46         4419         284         4550         288           46         4422         543         1620         281           46         4423         1424         430         823           72         4433         122         431         122           73         4435         823         4556         203           73         4435         823         4526         333           72         4430         823         4582         533

IIC44     23     toretagar     142     501 <td< th=""></td<>
--

## INDEX TO ADVERTISERS

A.D.E. (Security) Ltd12
Ace Mailtronix8
Ace Mailtronix8 Alben Engineering6
Amateur Radio/8
Ambit International17
B.B.C. Monitoring Serv. 84
Bamber B16
Barrie Electronics73
Bentley Accoustics78
B.I.B. Hi-Fi6
B.I.B. Hi-Fi
Birkett J
Birkett J80 Brewster S & R14
British National Radio &
Electr's School 10, 76, 79
J. Bull (Electrical) Ltd9
Cambridge Kits85
Caranna C83
Catronics77
Chromasonics6
Codespeed
Colomor74
Colomor
Crescent Radio2
Crimson Elektrik80
C. R. Supply Co82
C.W.A.S. Alarm85
Dart Stationary84
Doram Electronics
63, 73, cover iit
Dudley, John & Co. Ltd 85
Electronic Brokers8
Electronic Design Ass. 7
Electronic Mail Order 76
Electronical Supplies 73
Electronic Surplus
Equipment13
Electrovalue75

Fane Accoustics .....4 Fidelity Fastenings ....81 G2DYM Aerials ......83 George, David Sales 81 Greenweld Electronics 88 H.A.C. Short-Wave Home Radio .....78 I.L.P. Electronics Ltd ...15 Jevons, P.N. Lascar Electronics.....77 Logic Leisure (Teleplay) 27 London Electronics College ......83 Lowe Electronics .....2 Manor Supplies ......8 Maplin Electronic

Progressive Radio .....14

Supplies ..... cover iv

Poweli Tcoverii Radio Components Specialists67
Radio Exchange Ltd5 Ramar Construction
Service
R.S.G.B4 R.S.T. Valve Mail
Order Co11 Radio & T.V. Components Ltd28
Scientific Wire Co., The 84
Selfronics
Southern Valve Co
Stevens-James Ltd12 Strutt Electrical & Mechanical
Engineering Ltd12 S.T.E. Ltd82
Swanley Electronics4 Technomatic Ltd14 Tempus
T. K. Electronics82 Van Karen Publishing 84
Vero
Supplies
Williamson Amplifiers 85 Wilmslow Audio7 Z & I Aero Services88

OSMABET LTD We make transformeta amongas other things Low Voltage TransformERE: physical 5-39 1:54 52 45: 34 52:43; 64 CT 54-30; 129 1:54 22:35; 34 CT 55 30; 64 CT 56-45; 139 0:54 26: 45; 139 1:54 CT 55 30; 329 1:54 CT 55 40; 34 CT 56 40; 54
CT £14-80; 6A CT £25-75; 12A CT £36; 40V 3A CT £9-73 50V 5A £27. TWIN SEC TRANSFORMERS; Prim 240V ac. 6V 0-6A + 6V 0-5A; 9V 0-4A + 5V 0-4A; 12V 0-22A + 12V 0-25A + 6V 0-5A; 9V 0-4A + 5V 0-4A; 12V 0-22A + 12V 0-25A + 16V 0-73A £4-15; 15V 1-5A + 16V 1-5A ±616; 13V 1A + 16V 0-73A £4-15; 15V 1-5A + 16V 1-5A £7-30; 13V 1A + 16V 1A £1-10; 16V 1-5A + 16V 1-5A £7-30; 13V 1A + 16V 1-5A £7 30; 12V 4A + 12V 4A £8 16;
2001 5A + 200 7.5 & 27 30; 122 4A + 120 4A & 16; SV 2A + 200 7A 28: MIDGET RECTIFIER TRANSFORMERS; \$400 sc. 6-080 1.5 a or 0-0-00 1A 22: 45 each; 12-0-120 1A or 20-0200 0 75A 22: 55 each; p-0-90 0:3A or 12-0-120 0-28a or 20-0-200 0:15A 22: 55 each; LT TRANSFORMERS TAFPED \$EC; Prim 240V sc. 0.1012(-14-16-18) ZA 26 + 56; 14 6: 56; 0-(21:25-026-300)
2A 52-55; 4A 24: 4010-5-0-30-60V 1A 24-75; 2A 24-75; 0-40,056-0-60-100-10V 1A 24-76; MAING TRANSFORMERS SPECIAL OFFER: Prim 240V ac. 280-0-250V 60Ma 6-3V 1A 21-50; 250V 100Ma 6-3V 2A 22; 19V 3A 52; 23V 0-5A 24-25; 20W Arths, 110/240V 24: 75. WHITTWAY CARLE REPERENCE PVC COVERED
36 way £1:00;20 way 50 și 14 way 30 pi a way 20 pi 4 way 20 pi 2 way 160 și 14 way 30 pi fi 3 sietoro 150 patrimetra 4 way Individually acreanord 25 patrimetra. LOUDAPEANKERS 36 or 45 mm or 21 m 60. 21 m 6 or 23 11,21 m 8 or 60 0,31 m 35 n 34 m 6 10 pi m 6 n 21 m 6 a chi 5 m 31 m 3.5
15 or 250, 21-23; 7 × 41 3, 8, 16, 25 or 800, 41-75; 8 × 51 4, 8 or 250, 22-90; 81 66, 25 50, "INSTANT" BULK CASSETTE/TAPE ERASER Instant stasure of cossettes and taps spools, any dis- mater, demognetileosi tape heeds, 200/2404 ac, 25-56, POWER SUPPLY, TWIN OUTPUT; Prim 240V ac, New, Britheh manufacture, smoothed d.c. output 20V 1-54, plus sibilised output of 15V 100Ma, plus 12V ac 54, output, complete with diaman. 53-160.
0-5A output, comotore with diagram, £3-00. EDGEWISE LEVEL METER FED 200µA Size 18 × 18 × 20mm 8000, £1-10. SYNCHRONOUS GEARED MOTORS, 240V ac. Brand new, built in gesrbox, 1, 6, 8 or 20 RPH, all at £1-20 each. O/P TRANSFORMERS FOR VALVE AMPLIFIERS.
P.P. acc tapped 3:8-15, AA 9K 30W, 211:80; A-A 3K 50W, \$17:00:100W (EL34, KT88; etc), 222:00 G.E.C. MAWDAL OF POWER AMPLIFIERS Covers valve amplifiers 30W to 400W, 75p. CONDENSERS Electrolytic 1000/50V 30p; 2000/30V 33p; 1200/75V 59p; 3900/100V 21:23; PABer tubuler W/C 0:47/600V, 2:2/250V
47/160V, all all Spoach; £13 per 100.4-way uncreaned, mains, 30p M. Ideal for speakers, Intercome, tele- phones, etc. £4:54, 100m 4 core (Jab) 33p. M fib. 6 £4 \$1 100m. ALL PRICES INCLUDE V.A.T. CARRIAGE £XTRA ON ALL ONDERS Catters by Appaintment only. 5.A.E. engulias, lists
46 Kenilworth Road, Edgware, Middx. HA8 BYG. Tel: 01-958 9314

Head Office and Warehouse 444 WESTBOURNE GROVE LONDON WZ 35F Tel: 727 5641/1/3

## Z & I AERO SERVICES LTD.

Please send all correspondence and Mail-Orders to Head Office

Retail Shop **85 TOTTENHAM COURT ROAD** LONDON WI Tel. 580 8403 Open all day Saturday

SPECIAL OFFER OF BRAND NEW MULTIMETERS VALID UNTIL 31st OCTOBER ONLY Please see conditions of sale below **TYPE U4341** LI4313 U4315 1411 COMBINED MULTIMETER & TRANSISTOR TESTER 20,000 o.p.v. 20,000 o.p.v. 2,000 o.p.v. 50µA-2·5A 2,000 o.p.v. Sensitivity: 16.700Ω/V D.C., 3.300Ω/V A.C. 60aA-1-5A 0-06-0-6-6-60-600mA D.C., 0-3-3 0-30-300mA Current: 0.6mA-1.5A 0.5mA-2.5A AC . 75mV-600V 75mV-100V 0-3-1-5-6-30-60-150-300-900V D.C. Voltage: 0 F ¢, 1V-1000V 15V-600V 1-5-7-5-30-150-300-750V A.C. 1K-1M 300Ω-500kΩ ٠ 2-20-200kΩ-2MΩ Resistance: 0.5µF 0-5#F :10 Collector cut-off current 60µA max Transistors: 2.5% D.C., . 1.5% D.C., D.C. current gain 10-350 in two ranges 2.5% A.C. 4% A.C. PRICE, complete with steel carrying case, test lead, battery and instruc-Price complete with £10.50 £10-50 tion manual £9.90 pressed steel carrying **TYPE U4323** case and test leads. COMBINED WITH SPOT FREQUENCY OSCILLATOR Sensitivity: 20,000 Ω/V **TYPE U4324** Voltage: 2-5-1000V AC DC Current: 0-05-500mA DC D.C. Current: 0-06-0-6-60-600mA-3A 5Ω to 1MΩ 5% FSD. Registance: A.C. Current: 0-3-3-30-300mA-3A Accuracy: D.C. Voltage: 0.6-1.2-3-12-30-60-120-600-Oscillator output: 1kHz squarewave 1200V 485kHz sinewave modulated by 3-6-15-60-150-300-600-900V 1kHz squarewave A.C. Voitage: 500Ω-5-50-500kΩ PRICE, in carrying case, complete with leads £8.00 **Resistance:** PRICE, in carrying case, complete with leads £8.00 Accuracy: D.C. 2-5%; A.C. 4% (of THIS OFFER IS VALID ONLY FOR ORDERS ACCOMPANIED BY REMITTANCE WHICH SHOULD INCLUDE £1-50 FOR POSTAGE AND F.S.D.) PRICE complete with test leads and fibreboard storage case £9.50 PACKING AND 8% VAT.

ANY INSTRUMENT FOUND FAULTY OR OTHERWISE UNSATISFACTORY ON RECEIPT WILL BE REPLACED FREE OF CHARGE OR FULLY REFUNDED, PROVIDED IT IS RETURNED TO US WITHIN 7 DAYS AFTER RECEIPT. NO FURTHER FREE REPLACE-MENT OR FREE REPAIR GUARANTEE IS OFFERED. ANY FAULT OR DAMAGE DISCOVERED LATER MAY BE REPAIRED BY US IF THE INSTRUMENT IS RETURNED WITH EXACT DESCRIPTION OF FAULT. A CHARGE WILL BE MADE FOR SUCH REPAIRS AND SERVICING.

#### **BARGAIN PARCELS SAVE POUNDS**

Rupe quantifies of electronic components must be cleared as space required, 1000's of capacitors, resistors, transistors. Ex soulpment panels sto, covered in valuable com-ponente. No time to sort. Must sell by weight 7 (be-£4-88; felbs-£7-88; felbs-£

Handy Packs Handy Packs 4 sluminium boxes 128 × 44 × 35 mm ideal for signal falectors, stc. 41 60. Ministure Edgewise Panel Meters 200µ A FSD.

100 

De Tr. DE LUXE FIBRE GLABS PRINTED CIRCUIT ETCHING KITS Includes 150 as. i.e., copper clad 1/g board, 1 b farric chiorids, 1 Delo stch resist cen, strastive cleaner, 2 mild drill bits, stch irry end instructions/only 58-38. 150 aq. In. fibre gians board £1:00 Dalo pen, 60 p. 1 Ib ferric chioride to mil apac. 61:55 5 lbs ferric chioride to mil spec. £5-59. I is a terric chartise to mit spec. 45-09. Instruction wheet 300 Ministure maine transformers, fully shrouded, 840V. In 6-05V at 100ms out, 25 new equipment. Complete with mains lead and plug on input and short (ease on output 900. on output 99p. Benicandustor Bargaina 7913 Thermistors (o for 41-99. 100 new 4 marked silicon and germanium translators including BC148. BF194. BC163. etc. 42-96 100 mixed diodes including zener, power and bridge rectifier (000 2-5 amp 4 for 41. Bridge rectifier (000 2-5 amp 4 for 41. Brand new 11T 38 ke triplars for Occes Bradiord chessis 42:60.5 for 419. 60 Germanium diodas. Ideal for creatai Bradiori chessis & 2:60.5 for \$19. 60 Germanium diodes, ideal for crystai sets, etc. \$1. Ministure Vernitron FM4 10-7 MHz Cara-mire Fillers 60p such 3 for \$1. Naw U.H.F. fransister TV tuners 4 push-button type \$2.50 Rolary type with slow drive \$2:60. Hardware Packs each containing 100's of terms including \$6 nuts and bolts, Nylon, 3elf-desping, Foedrive, "P" clips, Cable clamps, Fuse holders, Bptre nuts etc., \$1 ger bound.

 $40_{\text{D}}$  P & P ON ALL ABOVE ITEMS, SEND CHEQUE OR POSTAL ORDER WITH ORDER TO SENTINEL SUPPLY, DEPT PW 149A BROOKMILL ROAD, DEPTFORD, SES CALLERS BY APPOINTMENT ONLY

Aluminium TV cost plugs 5 for £1 98 Standard wire ended means 12 for £1 99 Ministure 5X log pots with e/p switch 4 for £1.

CI. CONST. LET YOUR ENVIRONMENT DENYDRATE YOU OR YOUR POS-BENGDRATE YOU OR YOUR POS-BENGDRATE YOU OR YOUR POS-BENGDRATE YOU OR YOUR POS-CONTROLO-CONST. Adjustable by 4" spindle with fat. Context Reing 3-TBA @ 2404VAC, 7-5A@ 120VAC. Idael for Greenhouses, Centrally Neeted Homes, Offices, eig. Build your own Humid/flars of Dahydration Alarms 21 69 66.4 for 45. New Miniaturs FM Frontands B8-100MHz, 10 7MBtz. LF. or with Integral Tuning-gang E2 56. TBA 180A 80 seech.

SN 70115N 41 each.

20 mm anti-surge fuses your selection \$00MA to 3-16A, 12 for £1 \$6

800MA to 3-16A. 12 for 21 60 Component Bargalor 300 moler resistors 4 A watt 41 66 300 molerum mixed case most types 43 30. 900 mixed resistors mostly 1 & 2 watt. 21 53, 100 mixed polyaster case 42-80. 100 mixed molerum mixture and caramic plate cape 43-90. 100 mixed wirewound 42-20. 300 printed circuit resistors 41-90. 132 mixed bott A pracein 41 60.

A. MARGE THIM TREASTORS, MOSTLY MINISTURE 81-06, 300 for 62-80.
 28 mixed pole & presents 61 69.
 29 mixed pole & presents 41 69.
 20 Might wettage resistors, wirewound etc. 42 30.
 Modern Vertical Presents with elotted knobs. 2000, 470K, 500K, 1 MEG, 25 for 61, 4 Packs 62 160.
 30 mit 50 wirewound Horiz. Convergence Preset with Knob. 10 for 61.
 Matarola I. watt Audio I.C. MFC 6010 8-164, 5-161, 10-400MV. Beneithvity 3.C. proof. complete with elocules and data 61 16 each, 5 for 24.
 100K Sterso Silder Pots. Modern, silm type. Sep each, 3 for 21.
 Double Geng A.M. Tuning Condensors with integrat 100K pot For varias funing on VMF as usad in modern Thoin mulaic cantres 21.
 35 SFND CHEOUE OR POSTA1.

IOmm 12V coil DPCO 2A contests 81-19. W701 6V SPCO 1A contests 30 x 30 x 35mm. Only 36p. W817 11 pin plug in relay, rated 24V ac, but works well on 6V DC. Con-tacts 3 pole c/o rated 10A, 95p. W819 12V 1250R DPCO 1A contests. Size 39 x 22 x 16mm. Min plug-in type 72p. W839 50V sc (24V DC) coil, 11 pin plug in type, 3 pole c/o 10A contests. Only 63p. W846 Open construction mains relay. 3 sets 10A/c/o contests. 61-20. Send SAE for our relay Hat—84 types Head and Hiutzrated.

EDGE CONNECTORE

DIODE SCOOPIII

DIODE SCOOPili We have been fortunts to obtain a large quantity of untested, motify unmarked glass silicon diodes. Testing a sample bach revealed about 70% useable davices—signal diodes, high voltage rects and zeners may all be included. These are being offered at the Incredibly tow price of di-23 /1000—or a bag of 2500 for di-23 /1000 for di-25 /1000 fo

DIEC CERAMIC PACK Amazing variaty of volume and voltages from a few pF to  $2\cdot 2\mu$ F/ 3V to 3kV/ 200 41, 500 42-25, 1000 44-00.

PC STCHING KIT Mk III

Now contains 200 sq. ins. copper clad board, 1b. Parric Chtoride. DALO etch rasist pen, abraive cleaner, two miniature delli bits, etching dish and instructions. 64:25.

RELAYS W847 Low profile PC mitg 10 x 33 x 20mm 6V cell, SPCO 3A contacti,

X 20mm 6V coll, SPCO 3A contacts,
 Sp,
 W0312 Sub, min type, 10 × 19 ×
 10mm 12V coll DPCO 2A contacts
 41-13.

Special purchase of these 0.1% pitch doubla-lided gold-pitchese 0.1% pitch doubla-lided gold-pitchese connectors enables us to offer them et less then one-third their original list price! 18 way 61p; 21 way 47p; 32 way 72p; 40 way 60p.

POT BARGAINS Standard size pots-spindle is 12mm long. In the following values only: 10k lin; 4k7 semi-log; 680R lin; 2k7 lin; 20 for £1 sny mlx.

VEROCASES	
Plastic top and bottom alloy	panela
fronc and back	
1237 154 × 85 × 40	C2 · 53
1238 154 × 85 × 60	62.79
1239 154 × 65 × 60	63 32
3007 180 x 120 x 40	13-30
3008 180 × 120 × 65	£3-50
3009 180 × 120 × 90	63 74
1410 205 × 140 × 40	() 51
1411 203 × 140 × 75	64-05
1412 205 × 140 × 110	(3 12

VERO PLASTIC BOXES Professional quality two cone gray polystyrene with threaded interts for

moun 2518					a	17
2520	130	x B	0 X 10 X	50		-45
51,	OFI			DNT	BOXES	

1798 171 × 121 × 75/37-5 2523 220 × 174 × 100/53 £4-19 £6-90

2323 2.20 X 174 X 100/33 L6 W CAPACITOR BARGAINS B0Dm/d 250V 76 X 38mm \$2pi 400m/d 409V 75 X 38mm \$2pi 400m/d 409V 75 X 38mm 10 for £1 2000m/d 10V 38 X 18mm 10 for £1 100pf dics 100 for £1 05m/d 30V dics 100 for £1 06 -1m/d 20V dics 100 for £1 36 -2m/d 3V dics 100 for £3 4 4-7m/d 100V polysiter 6 for £1

4-7mid 100V polysiter 6 for £1 EXPERIMENTERS CALCULATORS Based on the C300 chip, this pack of parts enables the more experienced constructor to make an 8 digit 4 function calculator. The compre-hensvie data supplied includes full size isyout of PCB required, types of suitable display and keyboard that can be used atc. Components included in the pack are C300 calculator chip, drivar IC, sill compo-nents for Invariancicock circuits, R's C's etc. All for only £3-50.

GREENWEI All prices Include VAT-Just VAT\_Just add 28p post 443 Millbrook Road Southempton 601 OHX

Published on approximately the 7th of such month by IPC Magasines Limited, Westover Hums, West Quoy Hues, Huest, Huts, Lines, Hills, 14th. Franted in Rughan in Index Frantes, Humstable, Red. Aponts for Australia and New Zashani - Hurdon and Both (Asis) Lui, South Arise-Cantral New Aponty Lui, Hubstriptions INLAND and OVERREAM \$10-60 payable to IPO Mervices, Oskidd Humas, Perrymount Road, Haywards Hoch, Ruger, Pasoritan Wrathese is sold subject to the toilowing conditions, namely that it shall not, without the writine nearest of the Publishes fact having heat given, be feet, result, hired out or otherwise disposed of in a mutilated condition or in any unauthorized cover by way of Trade or affine to or advertising, literary or ple-leval wests wests.

## Nights of Delight.....

sent in a plain brown envelope

The new Doram Electronic Hobbies Catalogue is packed full of new exciting merchandise including

MICRO PROCESSOR BASED KITS.

ELECTRONIC KITS FOR ALL THE FAMILY

ELECTRONIC TOOLS AND BOOKS

> AUDIO & CAR ACCESSORIES ETC.

For your Nights of Delight. Send for your copy now.

> Overseas customers (except for N. Ireland)— 60p including despatch by Air (or all-up post)

> > Doram Electronics Ltd., PO Box TR8. Wellington Road Estate, Wellington Bridge, Leeds LS12 2UF

# ELECTRONIC HOBBIES

Name....

Address.....

CATALOGUE

Please send my FREE Hobbies Catalogue. I enclose **25p** contribution to p. & p. **Doram Electronics Ltd.**, PO Box TR8

POBox TR8, Wellington Road Estate, Wellington Bridge, Leeds LS12 2UF

# MIRPLIN

### everything for the modern D.I.Y. electronics enthusiast and more.

