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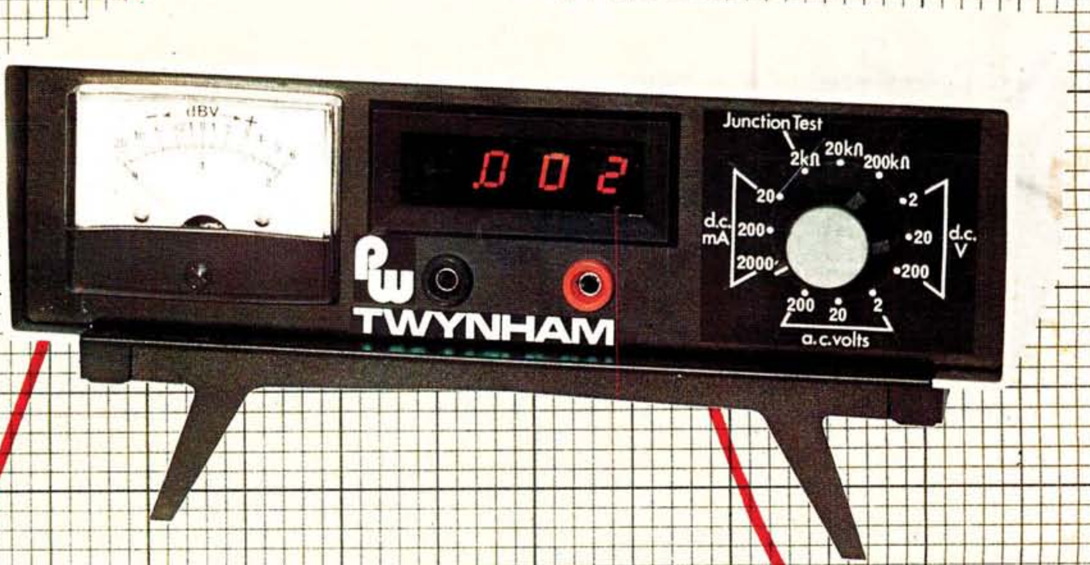

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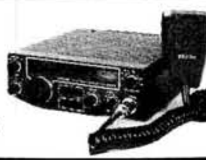

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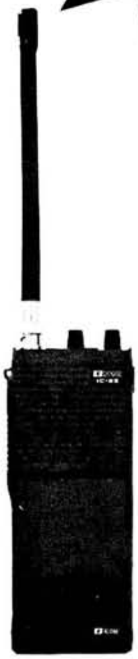

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Assistant Editor

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Art Editor

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Technical Editor

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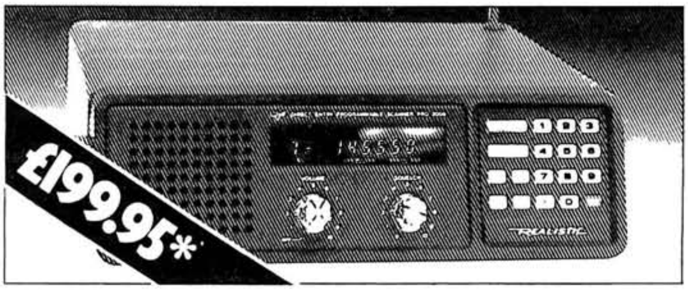

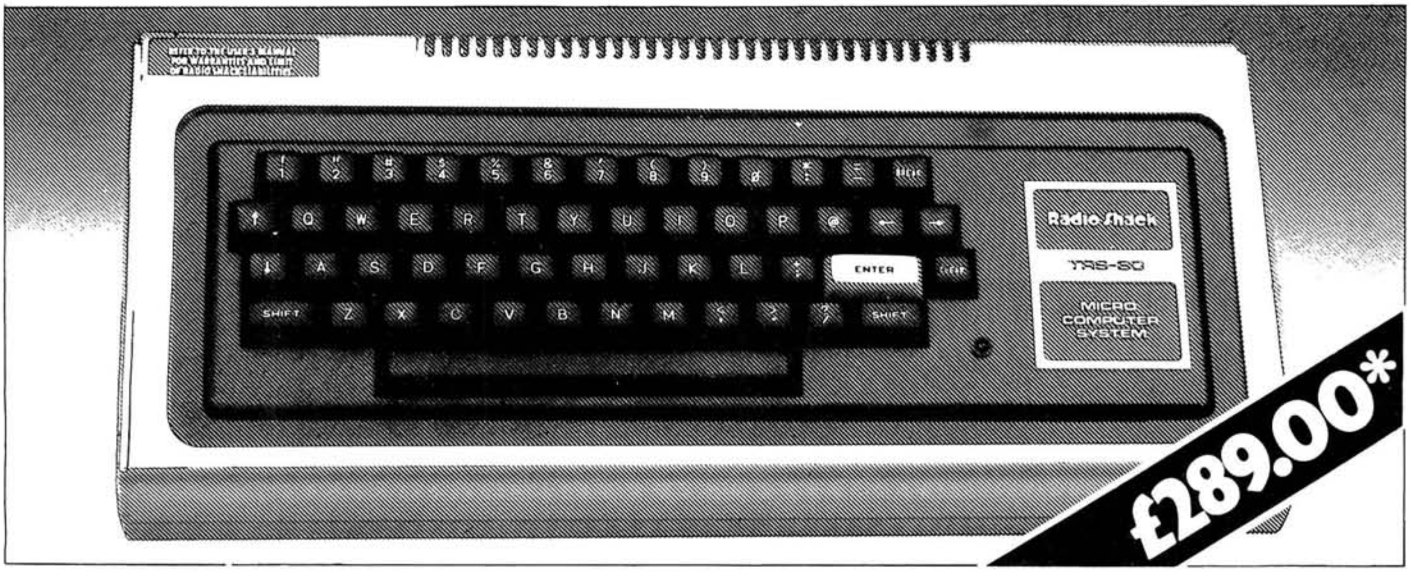

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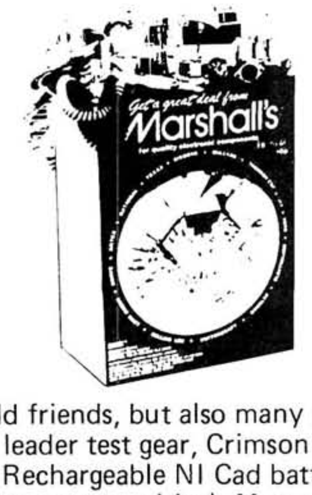

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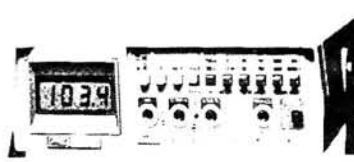

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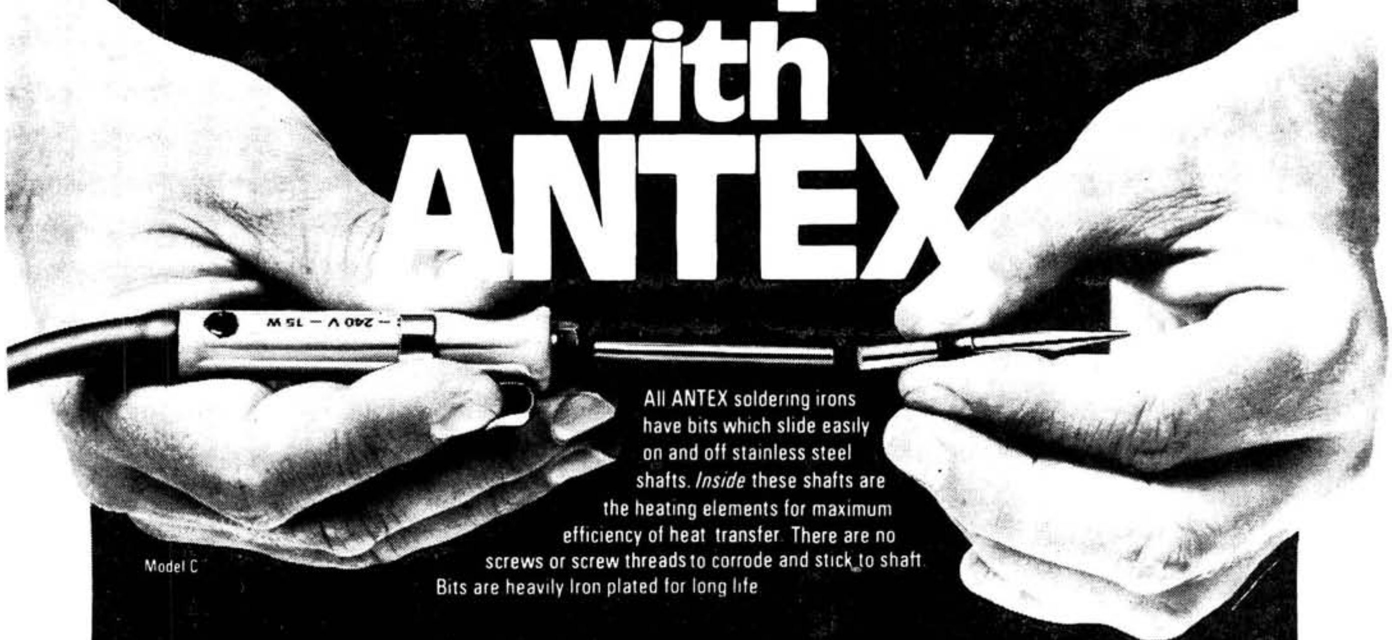

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		4073	17p
		4075	19p
		4076	95p
		4077	35p
		4081	19p
		4082	17p
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(Nov. 75 article by A. C. Ainslie) *Copy of original article supplied on request*

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QUICK BLOW 20mm

Type	No.	Type	No.	Type	No.
150mA	611 7p	1A	615 6p	3A	619 6p
250mA	612 6p	1·5A	616 7p	4A	620 10p
550mA	613 6p	2A	617 6p	5A	621 6p
800mA	614 8p	2·5A	618 7p		

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2·5A	628
250mA	623	2A	626	3·15A	629
500mA	624	1/6A	627	5A	630

All 8p each

QUICK-BLOW 1¼in.

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 8p each

Type	No.	Type	No.	Type	No.
1A	635	2/5A	638	4A	641
2A	637	3A	639	5A	642

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NUTS AND BOLTS

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

Type	No.	Price	Type	No.	Price
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½in. OBA	840	£0·86	¼in. 4BA	847	£0·29
1in. 2BA	842	£0·75	1in. 6BA	848	£0·46
½in. 2BA	843	£0·52	½in. 6BA	849	£0·24
¼in. 2BA	844	£0·60	¼in. 6BA	850	£0·20
1in. 4BA	845	£0·51			

BA NUTS–packs of cadmium plated full nuts in multiples of 50.

Type	No.	Price	Type	No.	Price
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2BA	856	£0·55	6BA	858	£0·28

BA WASHERS–flat cadmium plated plain stamped washers supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	859	£0·16	4BA	861	£0·14
OBA	860	£0·14	6BA	862	£0·14

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Type	No.	Price	Type	No.	Price
OBA	851	£0·46	4BA	853	£0·25
2BA	852	£0·32	6BA	854	£0·25

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V–0–6V 100mA	£1·04
2022	9V–0–9V 100mA	£1·04
2023	12V–0–12V 100mA	£1·29

MINIATURE MAINS Primary 240V
with two independent secondary windings

No.	Type	Price
2024	MT280–0–6V–0–6V RMS	£1·84
2025	MT150–0–12V 0–12V RMS	£1·84

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No.	Secondary	Price
2026	6V–0–6V 1 amp	£2·88 P & P 45p
2027	9V–0–9V 1 amp	£2·30 P & P 45p
2028	12V–0–12V 1 amp	£2·00 P & P 55p
2029	15V–0–15V 1 amp	£3·16 P & P 66p
2030	30V–0–30V 1 Amp	£3·97 P & P 86p

STANDARD AMINS Primary 240V
Multi-tapped secondary mains transformers available in ½ amp, 1 amp and 2 amp current rating. Secondary taps are 0–19–25–33–40–50V. Voltages available by use of taps. 4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25–0–25V

No.	Rating	Price
2031	½ amp	£3·91 P & P 85p
2032	1 amp	£5·06 P & P 85p
2033	2 amp	£6·27 P & P £1
2035	240V Primary 0–55V 2A Secondary	£7·30 P & P £1

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2203 2.5"x17" .1 copper	£2·14	2213 3·75"x5" .15 copper	£0·90
2205 3·75"x3·75" .1 copper	£0·71	2217 3.75"x17.9" .1 Plain	£1·79
2206 3.75"x17".1 copper	£2·76	2218 3.75"x2.5" 1" Plain	£0·44
2207 4.75"x17.9".1 copper	£3·61	2219 5"x3.75" .1 Plain	£0·68
2208 2.5"x1" .5 in pack	£0·85	2223 2.5"x5" .15 Plain	£0·37
2204 3·75"x5".1 Copper	£0·79	2225 5"x3.75" .15 plain	£0·56
2210 2·5"x5" .15 copper	£0·64		

TANTALUM CAPACITORS

3137	1MFD 35V	£0·13	3142	4·4MFD 35V	£0·21
3138	22MFD 35V	£0·13	3157	3·3MFD 25V	£0·21
3139	47MFD 35V	£0·13	3143	10MFD 35V	£0·25
3140	1·0MFD 35V	£0·13	3144	22MFD 16V	£0·25
3141	2·2MFD 35V	£0·14	3145	47MFD 6·3V	
			3156	33MFD 35V	£0·13

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3185 1,000uF 25V	£0·32			
3186 1,000uF 63V	£1·27	3190	4,700uF 25V	£0·92
3187 2,200uF 25V	£0·69	3191	4700uF 63V	£2·42
3188 2200uF 40V	£0·69	3192	2,200uF 100V	£2·88
3189 3,300uF 100V	£3·61	3196	100uF 100V	£0·09

POTENTIOMETERS

CARBON POTS (Linear Track)
Single gang with wire and terminations, 6mm × 50mm plastic shaft 10mm bushes supplied with shake proof washer and nut. Tolerance 20% of resistance.

1831 1k ohms	1835 22k ohms	1839 470k ohms
1832 2k2 ohms	1836 47k ohms	1840 1 Meg
1833 4k7 ohms	1837 100k ohms	1841 2M2
1834 10k ohms	1838 220k ohms	All at 33p each

CARBON POTS (Log Track)

1842 4k7 ohms	1846 100k ohms	1850 2M2
1843 10k ohms	1847 220k ohms	All at
1844 22k ohms	1848 470k ohms	33p each
1845 47k ohms	1849 1 Meg	

DUAL CARBON POTS (Log Law)

1860 4k7 ohms	1864 100k ohms	1868 2M2
1861 10k ohms	1865 220k ohms	All at
1862 22k ohms	1866 470k ohms	99p each
1863 47k ohms	1867 1 Meg	

SINGLE GANG SWITCHED (Lin Law)
These potentiometers are fitted with double pole on-off switches. The switch is incoporated within the rotary action of the pot. Specification of pot is as VC1. Switch rating 1·5 amps at 250v AC.

1870 4k7 ohms	1874 100k ohms	1878 2M2
1871 10k ohms	1875 220k ohms	All at
1872 22k ohms	1876 470k ohms	83p each
1873 47k ohms	1877 1 Meg	

SWITCHED POT (Log Track)
Specification as VC2 but track having (log) law.

1879 4k7 ohms	1883 100k ohms	1887 2M2
1880 10k ohms	1884 220k ohms	All at
1881 22k ohms	1885 470k ohms	83p each
1882 47k ohms	1886 1 Meg	

DUAL GANG LONG-ANTI-LOG POT
1888 Track specification as dual gang pots VC3, but tracks mounted to log-anti-log action 100k ohms £0·98.

SPECIAL VOLUME CONTROLS
A miniature 16mm type replacement volume control, incorporating single pole on-off switch. Resistance value 5k ohms. Tolerance 20% 1/8 watt rating.
1889 £0·31 VC8

MINIATURE ROTARY VOLUME CONTROL
5k ohms log law with on-off switch. 20mm grooved spindle. Tag connections 17mm dia. Supplied with fixing nut. Used mainly for replacement.
1890 £0·62 VC9

WIRE WOUND POTS
A range of wire wound single gang pots with linear tracks of 1 watt rating, fitted with 10mm bush and supplied with shake-proof washer and nut.
VC6

1891 10 ohms	1895 220 ohms	1899 4k7 ohms
1892 22 ohms	1896 470 ohms	All at
1893 47 ohms	1897 1k ohms	92p each
1894 20 ohms	1898 2k2 ohms	

PRE-SET POTS HORIZONTAL MOUNTING
Miniature type for transistor circuits. The wiper of the preset is provided with a slot for screw driver adjustment. The tags of the preset will fit printed wiring boards with a pitch of 2·54mm. All tracks are linear law.
VC7

1801 100 ohms	1807 10k ohms	1813 1M ohms
1802 220 ohms	1808 22k ohms	1814 2M2 ohms
1803 470n ohms	1809 47k ohms	1815 4M7 ohms
1804 1k ohms	1810 100k ohms	All at
1805 2k2 ohms	1811 220k ohms	10p each
1806 4k7 ohms	1812 470k ohms	

PRE-SET POTS VERTICAL MOUNTING
Miniature type for transistor circuits. Wiper adjustment is made by a screw driver slot.
Designed to fit 2·54mm pitch board. All tracks are linear law.
VC7

1816 100 ohms	1822 10k ohms	1828 1 Meg ohms
1817 220 ohms	1823 22k ohms	1829 2M2 ohms
1818 470 ohms	1824 47k ohms	1830 4M7 ohms
1819 1k ohms	1825 100k ohms	All at
1820 2k2 ohms	1826 220k ohms	10p each
1821 4k7 ohms	1827 470k ohms	

ANTEX IRONS

1943	15 watt high quality soldering iron totally enclosed element in a ceramic shaft fitted with 3/32" bit	£4·83
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1944	Iron coated bit 3/32" for 1943 iron.	£0·53
1945	Iron coated bit ⅛" for 1943 iron.	£0·53
1946	Iron coated bit 3/16" for 1943 iron.	£0·53
1948	General purpose 18 watt iron fitted with iron coated bit.	£4·54
1952	Replacement element for 1948 iron.	£2·19
1949	Iron coated bit 3/32" for 1948 iron.	£0·53
1950	Iron coated bit ⅛" for 1948 iron.	£0·53
1951	Iron coated bit 3/16" for 1948 iron.	£0·53
1931	Highly popular × 25, 25 watt quality soldering iron ceramic shafts to provide near perfect insulation break-down voltage of 1500 volts AC and a leakage current of only 3-5uA and another shaft of stainless steel to ensure strength.	£4·83
1935	Replacement element for 1931 iron.	£1·84
1932	Iron coated bit ⅛" for 1931 iron.	£0·58
1933	Iron coated bit 2/16" for 1931 iron.	£0·58
1934	Iron coated bit 3/32" for 1931 iron.	£0·58
1953	SK1 soldering kit–This kit contains 15 watt soldering iron fitted with a 3/16" bit plus two spare bits, a reel of solder heat-sink and a booklet 'How to solder,. In presentation display box.	£6·38
1939	ST3 soldering iron stand. Stand made from high grade bakelite material chromium plated strong steel spring suitable for all models, includes accommodation for six spare bits and two sponges which serve to keep the soldering iron bits clean.	£1·73

CASES AND BOXES

INSTRUMENT CASES in two sections vinyl covered top and sides, aluminium bottom, front and back.

No.	Length	Width	Height	Price
155	8in	5¼in	2in	£2·01
156	11in	6in	3in	£3·10
157	6in	4¾in	1¾in	£1·93
158	9in	5¼in	2½in	£2·59

ALUMINIUM BOXES made from bright alli, folded construction each box complete with half inch deep lid and screws.

No.	Length	Width	Height	Price
159	5½in	2½in	1½in	£0·98
160	4in	4in	1½in	£0·98
161	4in	2½in	1½in	£0·98
162	5¼in	4in	1½in	£1·10
163	4in	2½in	2in	£0·98
164	3in	2in	1in	£0·67
165	7in	5in	2½in	£1·54
166	8in	6in	3in	£1·98
167	6in	4in	2in	£1·32

SLOPE front aluminium boxes with black vinyl base and sides & aluminium back, top & front—strong construction easily accessible.

169	2½in	5¾in	2¾in	12in	3½in	8in	£5·45
168	2½in	7½in	4in	16in	4½in	11in	£8·21

VERO plastic case box. These boxes consist of top and bottom sections which include fixings points for horizontal mounting PC boards/chassis plates, the two sections are held together by four screws which enter through the base and are concealed by plastic feet.

No.	Length	Width	Height	Price
170	140mm	40mm	205mm	£4·35
171	140mm	75mm	205mm	£4·85
172	140mm	110mm	205mm	£6·30

AUDIO LEADS

No.	Type	Price
107	FM indoor Ribbon Aerial	£0·69
113	3·5mm Jack plug to 3·5mm Jack plug length 1·5m	£0·86
114	5 pin DIN plug to 3·mm Jack connected to pins 3 & 5 length 1·5m	£0·98
115	5 pin DIN plug to 3·5mm Jack connected to pins 1 & 4 length 1·5m	£0·98
116	Car aerial extension screened insulated lead. Fitted plug and socket.	£1·44
117	AC mains connecting lead for cassette recorders and radios 2 metres	£0·78
118	5 pin DIN phono plug to stereo headphone. Jack socket	£1·21
119	2 + 2 pin DIN plugs to stereo Jack socket with attenuation network for stereo headphones. Length 0·2m	£1·04
120	Car stereo connector. Variable geometry plug to fit most car cassettes. 8-track cartridge and combination units. Supplied with inlined fuse power lead and instructions	£0·69
123	6·6m Coiled Guitar Lead Mono Jack plug to Mono Jack plug Black	£1·72
124	3 pin DIN plug to 3 pin DIN plug. Length 1·5m	£0·85
125	5 pin DIN plug to 5 pin DIN plug. Length 1·5m	£0·85
126	5 pin DIN plug to Tinned open end. Length 1·5m	£0·85
127	5 pin DIN plug to 4 Phono Plugs. All colour coded Length 1·5m	£1·49
128	5 pin DIN plug to 5 pin DIN socket. Length 1·5m	£0·92
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1·5m	£1·21
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0·78
131	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5. Length 1·5m	£0·95
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£1·13
133	5 pin DIN plug to 2 Phono plugs. Connected pins 3 & 5. Length 1·5m	£0·86
134	5 pin DIN plug to 2 Phono sockets. Connected pins 3 & 5. Length 23cm	£0·78
135	5 pin DIN socket to 2 Phono plugs. Connected pins 3 & 5. Length 23cm	£0·78
136	Coiled stereo headphone extension lead. Black length 6m	£2·01
178	AC mains lead for calculators, etc.	£0·52

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0·16
DPDT standard slide	1974	£0·17
Toggle switch SPST 12 amp 250V ac	1975	£0·38
Toggle switch DPDT 1 amp 250V ac	1976	£0·48
Rotary on-off mains switch	1977	£0·58
Push switch–Push to make	1978	£0·16
Push switch–Push to break	1979	£0·21

ROCKER SWITCH
A range of rocker switches SPST–moulded in high insulation material available in a choice of colours ideal for small apparatus

Colour	No.	Price
RED	1980	£0·35
BLACK	1981	£0·35
WHITE	1982	£0·35
BLUE	1983	£0·35
YELLOW	1984	£0·35
LUMINOUS	1985	£0·35

Description	No.	Price
Miniature SPST toggle 2 amp 250V ac	1958	£0·81
Miniature SPST toggle 2 amp 250V ac	1959	£0·86
Miniature DPDT toggle 2 amp 250V ac	1960	£0·91
Miniature DPDT toggle centre off 2 amp 250V ac	1961	£1·07
Push-button SPST 2 amp 250V ac	1962	£1·04
Push-button SPST 2 amp 250V ac	1963	£1·09
Push-button DPDY 2 amp 250V ac	1964	£1·34

MIDGET WAFER SWITCHES
Single bank wafer type-suitable for switching at 250V ac 100mA or 150V dc non-reactive loads make-before-break contacts. These switches have a spindle 0·25in dia. and 30 indexing.

Description	No.	Price	Description	No.	Price
1 pole 12 way	1965	£0·55	3 pole 4 way	1967	£0·55
2 pole 6 way	1966	£0·55	4 pole 3 way	1968	£0·55

MICRO SWITCHES

	No.	Price
Plastic button gives simple 1 pole change over action Rating 10 amp 250V ac	1970	£0·29

Terms cash with order. Cheques/Postal Orders made payable to Bi-Pak at above address.

Buy it with Access

comment...

Striking a Balance

EACH time we present a complex project in the magazine we have to make decisions on how many pages we should devote to it in each issue, and over how many issues it should run. These two questions are of course related, and are affected by a third—how much technical detail and background should be included?

We know that each project will be built by only a small percentage of readers, but many more will use the article as a source of ideas to adapt to some other application, or simply as a means of keeping up to date with modern techniques and developments.

This last aspect is particularly true of the *PW* "Sherborne" synthesised tuner, where some readers have commented that we could have dispensed with much of the first two parts and got straight into the nitty-gritty of construction. This is true, but had we done so we would have badly let down the many readers who wish to learn the how **and** the why.

AS Eric Dowdeswell mentions elsewhere in this issue, the number of applicants for the May 1980 RAE reached a new record, and the resulting 2500 successful candidates have seemingly swamped the Home Office departments responsible for issuing new amateur licences. The addition of this number of new stations will undoubtedly bring a few problems in some areas, but by and large it must be good for the hobby.

According to reports received here, the May RAE contained far fewer of the "silly" questions of which I have complained in recent months. I gather that my comments worried some candidates, but make no apology for saying what I felt had to be said, which hopefully may have helped in some small way to improve the standard of questions.

A NUMBER of readers have questioned our policy in accepting advertisements for "CB" antennas and accessories, a point about which we have argued amongst ourselves at great length. It seems to us that there is benefit in it for our licensed amateur readers, since it gives them access to a wider range of items, capable of being used on amateur bands, than are available through existing equipment outlets.

Geoff Arnold

services

QUERIES

While we will always try to assist readers in difficulties with a *Practical Wireless* project, we cannot offer advice on modifications to our designs, nor on commercial radio, TV or electronic equipment. Please address your letters to the **Editor, "Practical Wireless", Westover House, West Quay Road, Poole, Dorset BH15 1JG,** giving a clear description of the problem and enclosing a stamped self-addressed envelope. Only one project per letter please.

Components for our projects are usually available from advertisers. For more difficult items, a source will be suggested in the "Buying Guide" box included in each constructional article.

PROJECT COST

The approximate cost quoted in each constructional article includes the box or case used for the prototype. For some projects the type of case may be critical; if so this will be mentioned in the Buying Guide.

CONSTRUCTION RATING

Each constructional project will in future be given a rating, to guide readers as to its complexity:

Beginner

A project that can be tackled by a beginner who is able to identify components and handle a soldering iron fairly competently. Generally this category will be used for simple projects, but sometimes for more complicated ones of wide appeal. In this case, construction and wiring will be dealt with in some detail.

Intermediate

A project likely to appeal to a wide range of constructors, and requiring only basic test equipment to complete any tests and adjustments. A fair degree of experience in building electronic or radio projects is assumed.

Advanced

A project likely to appeal to an experienced constructor, and often requiring access to workshop facilities and test equipment for construction, testing and alignment. Constructional information will generally be limited to the more critical aspects of the project. Definitely not recommended for a beginner to tackle on his own.

SUBSCRIPTIONS

Subscriptions are available to both home and overseas addresses at £11.80 per annum, from **"Practical Wireless" Subscription Department, Room 2613, King's Reach Tower, Stamford Street, London SE1 9LS.** Airmail rates for overseas subscriptions can be quoted on request.

BACK NUMBERS AND BINDERS

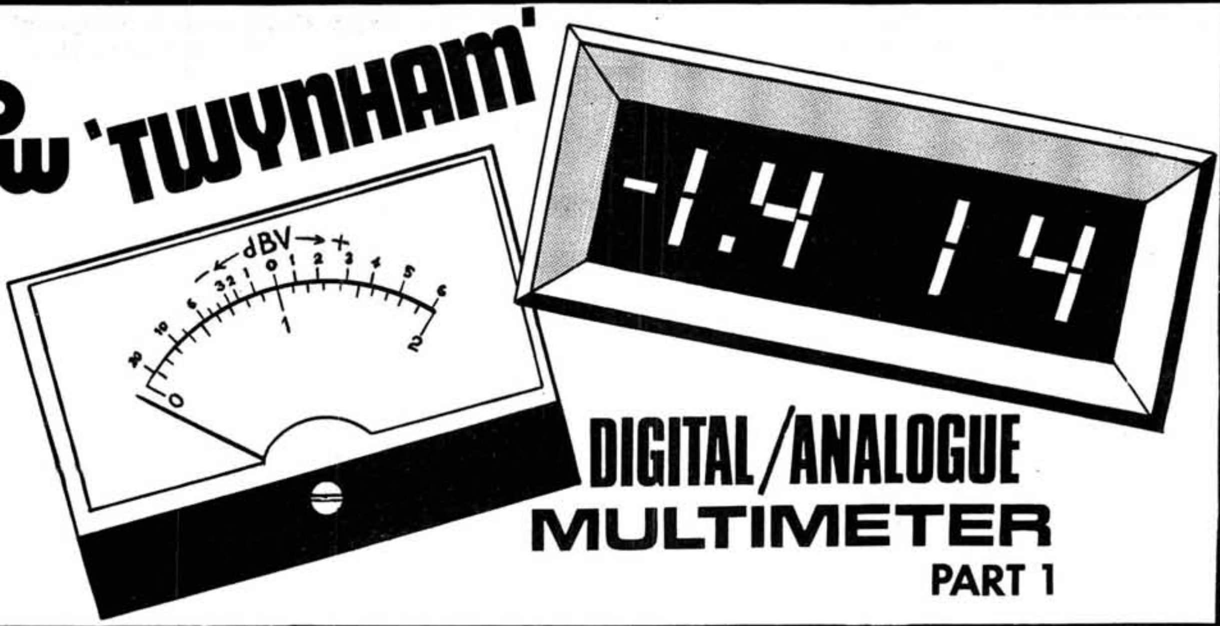
Limited stocks of some recent issues of *PW* are available at 95p each, including post and packing to addresses at home and overseas.

Binders are available (Price £4.30 to UK addresses and overseas, including post and packing) each accommodating one volume of *PW*. Please state the year and volume number for which the binder is required.

Send your orders to **Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF.** All prices include VAT where appropriate.

Please make cheques, postal orders, etc., payable to IPC Magazines Limited.

PW 'TWYNHAM' DIGITAL/ANALOGUE MULTIMETER PART 1



Michael TOOLEY B A & David WHITFIELD M A M Sc

Although a digital instrument is very convenient to read and more accurate than the corresponding analogue unit there are occasions where you are trying to peak up a tuned circuit, for instance. In this instance it is virtually impossible to follow the trends in the voltage being read on a digital display and the only answer is an analogue meter. The *PW* "Twynham" combines both forms of display.

The *PW* "Twynham" digital multimeter has all the features expected of a normal multi-range meter combined with the accuracy and resolution associated with a $3\frac{1}{2}$ digit l.e.d. display. The instrument has a high input impedance of 1MΩ or greater on the a.c. and d.c. voltage ranges, minimising circuit loading effects.

Resolution on the most sensitive voltage range is 1mV. On all direct current ranges the meter exhibits a constant resistance of 1Ω and therefore causes a negligible voltage drop when used to measure currents normally associated with electronic equipment. Alternating currents of up to 2A may also be measured with the addition of an external shunt.

The instrument has three resistance ranges with a maximum indication of 200kΩ at a resolution of 100Ω. If desired the ohms ranges may be extended to provide meaningful indications over the range of 0·1Ω to 2MΩ. An analogue facility is also incorporated. This is very useful when measuring changing quantities as would, for example, be the case when carrying out the alignment of a receiver or transmitter.

The digital multimeter uses a 0·3 inch l.e.d. display together with one l.s.i. integrated circuit, three other i.c.s, two of which are regulators, and a handful of other components. The entire circuit is assembled on a single-sided printed circuit board measuring 130 × 130mm. Range switching is achieved by means of a single rotary switch also mounted on the p.c.b. thereby eliminating the confusion which can be caused when several switches are used

★ specifications

DC VOLTAGE RANGES

Full-scale:	2V, 20V, 200V
Resolution:	0·05% or 1mV, 10mV and 100mV respectively
Accuracy:	0·5% typical ± 1 digit
Input resistance:	greater than 100MΩ on 2V range, 1MΩ on other ranges

AC VOLTAGE RANGES

Full-scale:	2V, 20V, 200V
Resolution:	0·05% or 1mV, 10mV and 100mV respectively
Accuracy:	5% typical ± 5 digits
Input impedance:	1MΩ or greater on all ranges
Frequency response:	substantially flat from 10Hz to 2kHz, 4Hz to 10kHz at −6dB

DC CURRENT RANGES

Full-scale:	20mA, 200mA, 2A
Resolution:	0·05% or 10μA, 100μA and 1mA respectively
Accuracy:	1% typical ± 1 digit
Input resistance:	1Ω on all ranges

RESISTANCE RANGES

Full-scale:	2kΩ, 20kΩ, 200kΩ
Resolution:	0·05% or 1Ω, 10Ω and 100Ω respectively
Accuracy:	2% *typical ± 3 digits*
Test currents:	1mA, 100μA and 10μA respectively

JUNCTION TEST

Direct measurement of junction voltage drop at test currents of 1mA, 100μA and 10μA.

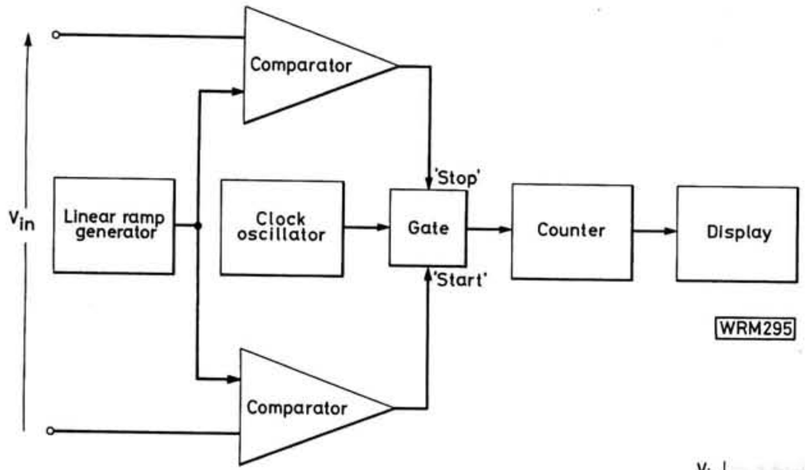
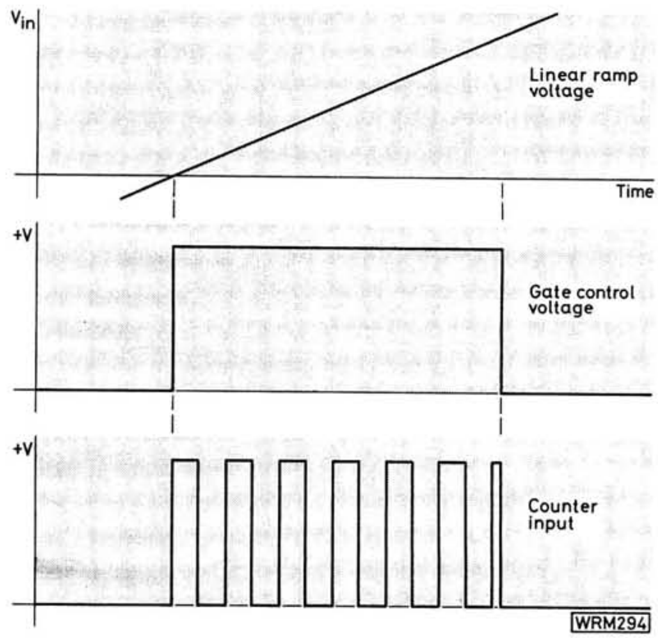


Fig. 1 (left): This block diagram shows the simple single ramp technique of analogue to digital conversion

Fig. 2 (below): The time-related waveforms for the block diagram of Fig. 1



to change ranges as is the case with most digital multimeter designs. The finished meter is simple to construct, straightforward to calibrate and easy to use. Its l.e.d. display is bright and clearer than comparable l.c.d. types and the analogue readout is very useful when aligning circuits. Constructors will undoubtedly find this instrument to be a most valuable addition to their range of test gear.

The Dual Slope Principle

Simple methods of analogue to digital conversion usually involve the generation of a linear ramp signal which is fed to two voltage level comparators, the outputs of which are used to open and close a signal gate connected between a clock oscillator and a counter. The b.c.d. output of the counter is fed to a conventional decoder, display driver and display arrangement. The basic arrangement is shown in Fig. 1 together with associated time related waveforms in Fig. 2.

The disadvantage of this single ramp technique is largely attributable to the need to generate a very stable clock signal and the lack of precision with which the comparators respond to voltage coincidence. The dual slope technique overcomes some of these drawbacks by making the sample time constant.

The measurement is essentially a two-stage operation, with a possible third stage reserved for automatic zero and drift compensation. During the first fixed time period, a ramp is generated, the slope of which is directly proportional to the input voltage. The ramp voltage, generated by an operational amplifier in conjunction with a C-R circuit, is developed across a capacitor. At the end of the fixed time period, the capacitor is discharged at a constant rate, determined by a fixed reference voltage as shown in Fig. 3.

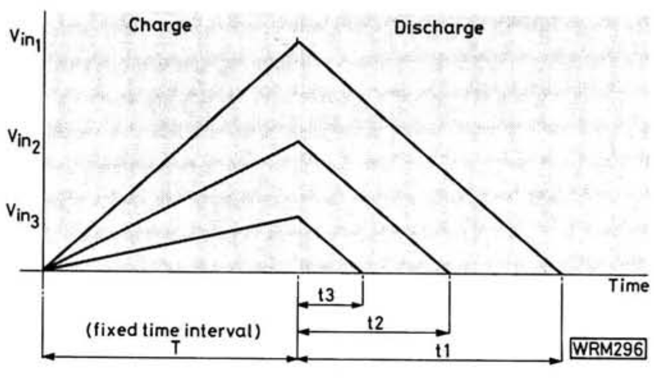


Fig. 3 (above): The charge and discharge characteristics of a dual-slope analogue to digital conversion system

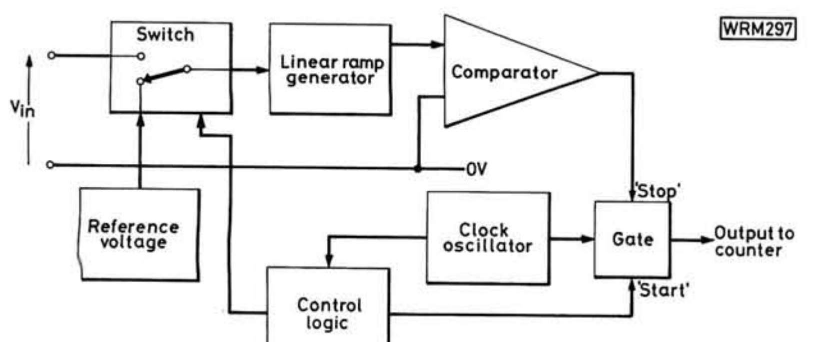


Fig. 4 (left): The block diagram of a dual-slope system

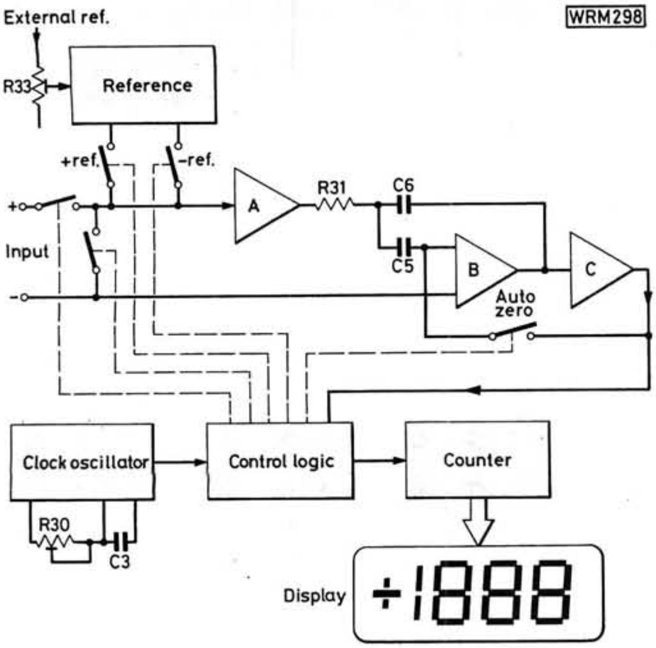


Fig. 5: A simplified block schematic of the 7107 d.p.m. integrated circuit

The time taken for this discharge period is proportional to the input voltage (or "height" attained by the charging ramp). During this second time period, a signal gate is opened which allows clock pulses to be counted and displaced. A typical block schematic for a dual-slope analogue to digital converter is shown in Fig. 4.

CONSTRUCTION RATING Intermediate

BUYING GUIDE

Readers should have little difficulty in obtaining the components for the *PW* Twynham d.m.m. The p.c.b. will be available from several of our regular advertisers and those parts by RS Components Ltd. can also be obtained from those advertisers specialising in this service. For constructors who do not wish to fit the analogue readout, Howard Associates, will be supplying all the parts including a plastics case which is smaller than the Verobox specified.

The approximate cost given below could be lowered by using conventional rotary switches instead of the p.c.b. mounting types.

The meter used is a Model T24 1mA f.s.d. available from several advertisers.

APPROXIMATE COST £75

The 7107 DPM Integrated Circuit

The 7107 i.c. employs the dual slope principle and incorporates all the necessary analogue and digital circuitry to drive a 3½ digit common anode l.e.d. display. The i.c. has the additional refinements of automatic zero and polarity indication and is housed in a 40-pin dual-in-line package. The i.c. can be configured, in its basic form, as a voltmeter reading either 199·9mV or 1·999V full-scale and requires supplies of +5V and −5V. The simplified block schematic of the 7107 is shown in Fig. 5 and consists of a high impedance buffer amplifier, A, an integrator formed by R1 and C1 in conjunction with amplifier B, and a comparator, C. Electronic switches are used both to isolate and to enable various parts of the circuit during the three states of the measurement cycle. The other functions include timing via the clock oscillator and control logic, and a counter coupled to display drivers.

Initially the unknown input voltage is applied via the high impedance buffer amplifier A to the integrator formed by amplifier B, R1 and C1. The integrator output ramps, positively or negatively depending on the input polarity, for a period set by the clock oscillator logic.

At the end of this period the input is open-circuited and the positive or negative reference is connected to the integrator which subsequently ramps back towards 0V. The comparator, C, determines, during the initial ramp, which of the references is used and also detects the state of zero integrator output. The counter accumulates clock pulses until the integrator output reaches 0V with comparator C changing state.

When the automatic zero mode is selected capacitor C2 charges to a value determined by the offsets appearing at the amplifier outputs and the period of the auto-zero state. Upon completion the whole cycle is repeated with the charge on the auto-zero capacitor being subtracted or added to the input voltage and thus correcting for any drift.

When an input voltage is not applied the auto-zero mode ensures that a zero reading is displayed by continuous compensation of circuit drift. The internal clock oscillator controls the timing sequence and maximum rejection of series mode interference is obtained by selecting a clock frequency such that the initial ramp period is a multiple of the periodic time of the mains supply.

Principle of Operation

The block diagram of the complete digital multimeter is shown in Fig. 6. The 7101 is connected for 2V full-scale reading and appropriate input conditioning is selected for the quantity being measured. A band-gap reference device, ZN423T, is used to provide an extremely stable reference voltage for the 7107 analogue to digital converter. The ZN423T operates with a nominal voltage drop of 1·26V, a slope resistance of 0·5Ω typical, and a temperature coefficient of approximately 30ppm/°C. On the d.c. voltage ranges all that is required is a suitable resistive input attenuator preceding the 7107.

For a.c. voltage measurements a precision rectifier is used in conjunction with the d.c. voltage attenuator. The rectifier is mean sensing and the gain is preset so that the output is correctly calibrated for r.m.s. sinewave readings. The arrangement of the a.c. to d.c. converter is as shown in Fig. 7.

On the direct current ranges it is necessary to convert the unknown input current to a voltage drop. This is achieved with the aid of a fixed shunt resistor and an amplifier having a switched gain, as shown in Fig. 8.

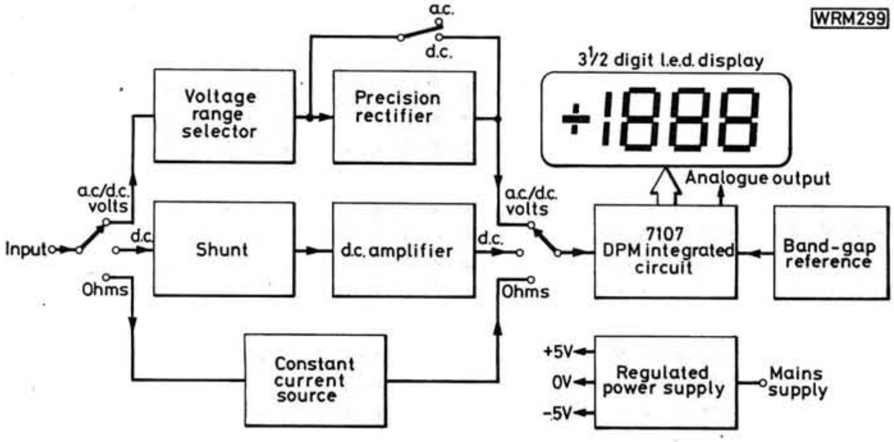
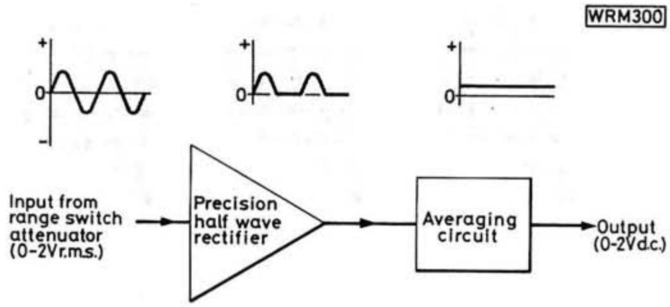
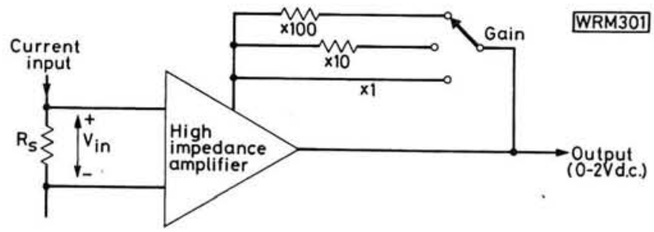


Fig. 6 (left): The block diagram of the *PW* Twynham digital multimeter with digital and analogue readout

Fig. 7 (below): The arrangement of the a.c. to d.c. converter



The ohms ranges employ a switched constant current source the output of which is applied to the resistor on test, as shown in Fig. 9. The current causes a voltage drop across the unknown resistor and this is then passed to the 7107. The indicated voltage is directly proportional to the unknown resistor value. Junction testing of semiconductor devices is carried out in conjunction with one or more of the ohms ranges. If a constant current is applied to a forward biased semiconductor junction the voltage drop will, of course, be developed. This is then passed to the 7107 for measurement and display as shown in Fig. 10.



Circuit Description

The circuit of the digital multimeter is shown in Figs. 11 and 12. The input attenuator for the voltage ranges, both a.c. and d.c., is formed by R1, R2 + VR1 and R3 + VR2, switched by means of S1b. This arrangement provides precise attenuations of 10 and 100 for the 20V and 200V ranges respectively. The voltage developed across the shunt is applied to IC1c the gain of which is switched to 1, 10 or 100 by means of S1d. VR11 and associated components provides a small current to reduce the input offset and set the output of IC1c to zero on the 20mA (highest gain) range. Tr1, Tr2 and associated components form the constant current source which is switched by means of S1c. Tr1 provides a fixed base voltage source for Tr2 thus ensuring that Tr2 operates with a substantially constant collector current. The precise current is adjusted by varying the emitter resistors, VR3, VR4 and VR5.

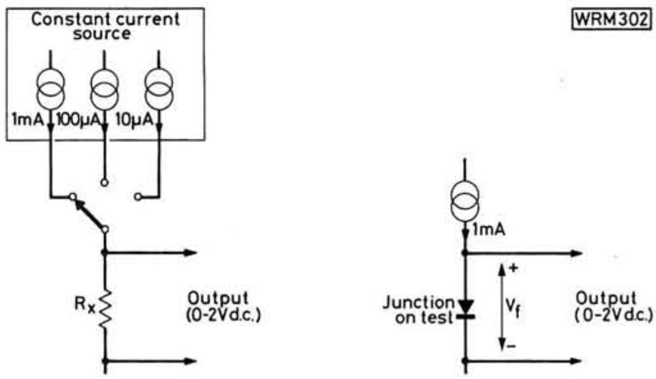
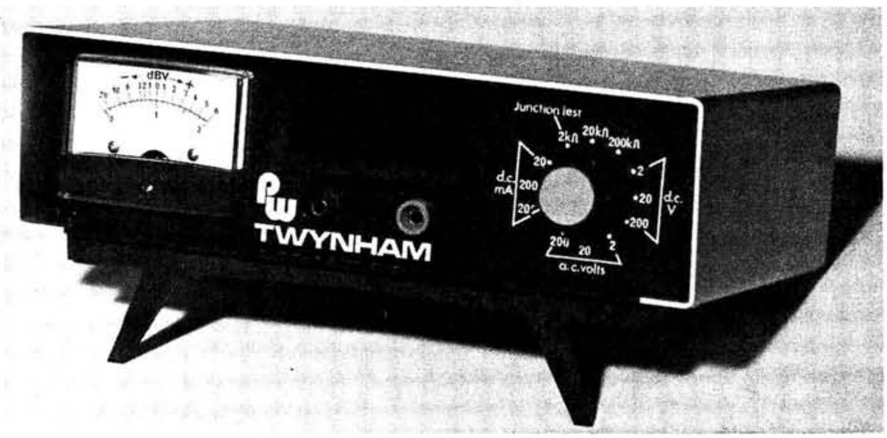


Fig. 8 (centre): The direct current ranges use a shunt with a switched gain amplifier. Fig. 9 (above left): The constant current sources used for the ohms ranges. Fig. 10 (above): Shows the method of testing semiconductor junctions



The *PW* Twynham is housed in an attractive metal case by Vero and incorporates both digital and analogue readouts

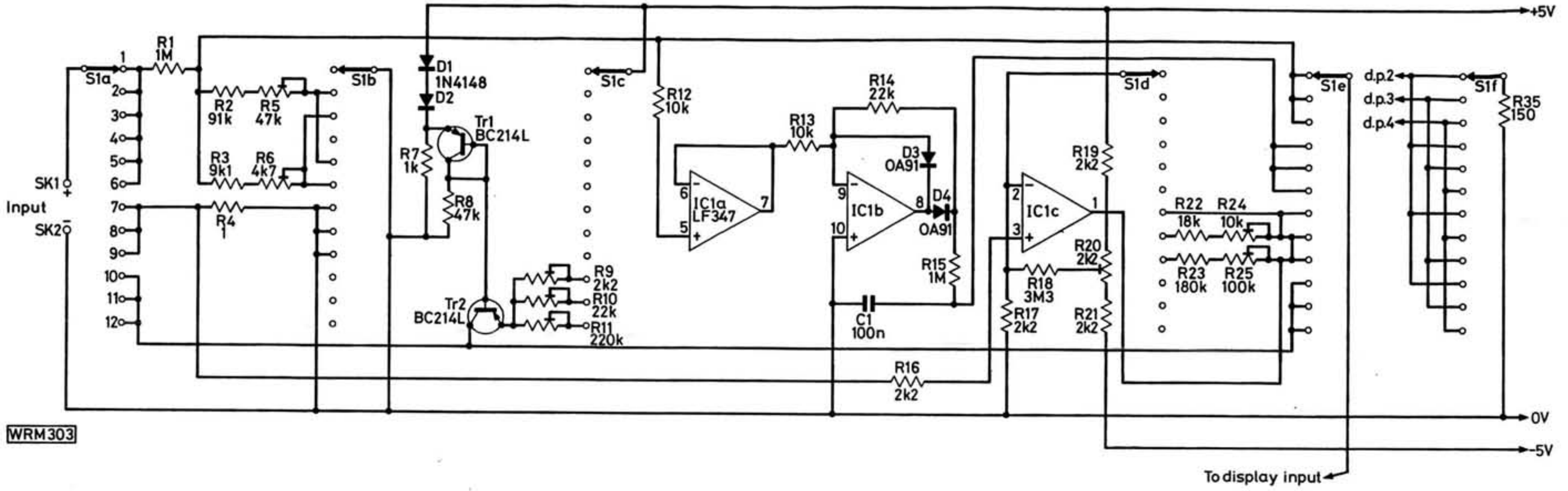
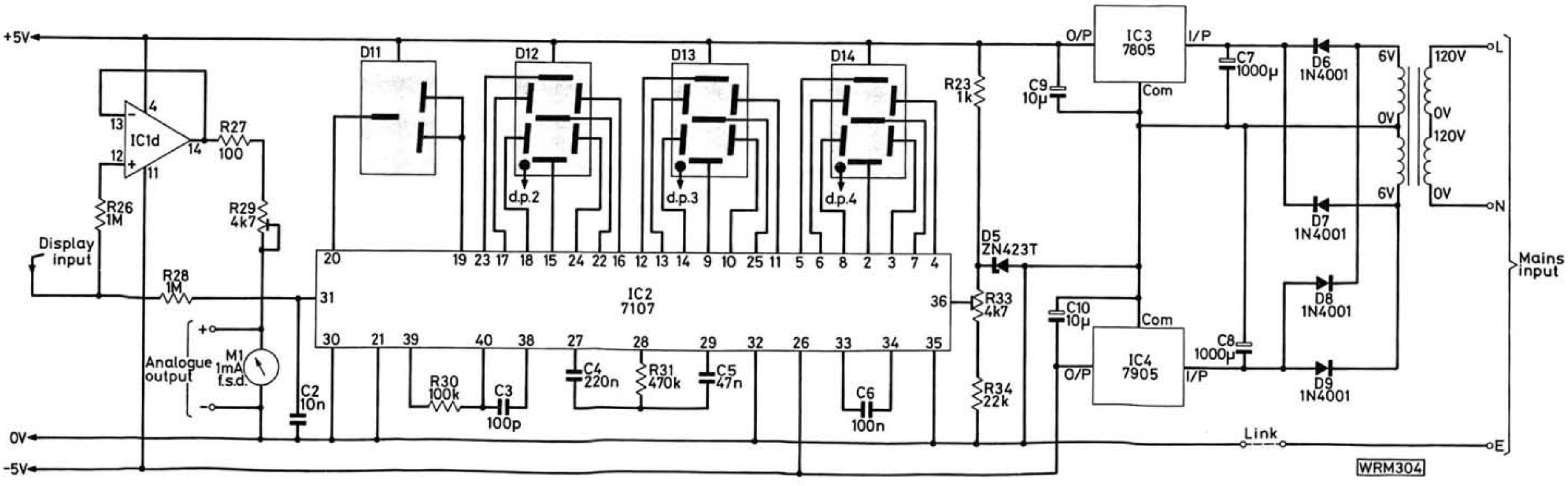


Fig. 11 (above): The circuit diagram of the Twynham multimeter. Fig. 12 (below): The power supply and digital display of the multimeter



★ components

Resistors

¼W 5% Carbon

100Ω	1	R27
1kΩ	2	R7,32
2·2kΩ	3	R16,19,21
10kΩ	1	R12
47kΩ	1	R8
470kΩ	1	R31
1MΩ	3	R15,26,28
3·3MΩ	1	R18

½W 2% Metal Oxide

2·2kΩ	1	R17
9·1kΩ	1	R3
10kΩ	1	R13
18kΩ	1	R22
22kΩ	2	R14,34
91kΩ	1	R2
180kΩ	1	R23
1MΩ	1	R1

2·5W Wirewound

1Ω	1	R4

Capacitors

Silver Mica

100pF	1	C3

Polyester

10nF	1	C2
47nF	1	C5
100nF	2	C1,6
220nF	1	C4

Electrolytic p.c.b. mounting

1000µF 16V	2	C7,8

Tantalum bead

10µF 16V	2	C9,10

Potentiometers

Miniature horizontal preset

2·2kΩ	2	R9,20
4·7kΩ	3	R6,29,33
10kΩ	1	R24
22kΩ	1	R10
47kΩ	1	R5
100kΩ	2	R25,30
220kΩ	1	R11

Semiconductors

Diodes

1N4001	4	D6,7,8,9
1N4148	2	D1,2
OA91	2	D3,4
ZN423T	1	D5

Common Anode l.e.d. Displays

7-segment		
0·3 inch	3	DI2,3,4
'±1' 0·3 inch	1	DI1

Transistors

BC214L	2	Tr1,2

Integrated Circuits

LF347	1	IC1
7107	1	IC2
7805	1	IC3
7905	1	IC4

Miscellaneous

Transformer 6VA p.c.b. mounting 6–0–6V (RS207–740); Rotary switch 6p12w p.c.b. mounting (see text); Bezel with filter and d.i.l. sockets (RS587–204); Meter 1mA f.s.d.; Case Vero G-Range (202–21 090H); 40-pin d.i.l. socket; 14-pin d.i.l. socket; 4mm insulated sockets (1 red, 1 black); Miniature mains connector; 21mm collet wing knob; Panel mounting fuseholder; Fuse 1A.

IC1a acts as a unity gain very high impedance input buffer stage prior to the precision rectifier arrangement formed by IC1b and its associated components. This stage is essential in order to provide matching to the 10kΩ input impedance of the precision rectifier. The output of the rectifier is fed to an averaging circuit formed by R10 and C1. IC1d is a further very high input impedance buffer stage and this is used to provide the current drive for the moving coil meter analogue display. The stage eliminates the loading effects of the meter movement on the very high input impedance of the 7107.

The frequency of the internal clock oscillator of the 7107 is adjusted by means of VR9. The integrator and auto-zero components are C4, R22 and C5, whilst C6 removes noise from the reference source and reduces roll-over error. D5 is the precision voltage reference which has its operating current set by R23. VR10 and R24 are used to provide fine adjustment of the reference voltage to exactly 1V. The power supply is fairly conventional and employs full-wave rectification and two 5V regulators to provide stabilised positive and negative voltage rails.

Next month we will cover construction and setting-up.

the things people say

"I must get a new rotator for my vertical whip, you're right in the noise."

... Brighton & District RS Newsletter

"No, the licence conditions don't permit you to operate within half a mile of an airport, but I'm not sure about marinas."

... Brighton & District RS Newsletter

introducing RTTY part 4

Jeff MAYNARD G4EJA

It is not necessary to build a terminal unit to join the ranks of RTTY enthusiasts, since commercial units are available. The intending purchaser can opt for a straight terminal unit, using the type of modulation and demodulation techniques discussed in earlier parts of this series, or a complete RTTY system.

Catronics

In the first category is the Catronics RTTY Terminal Unit available from 20 Wallington Square, Wallington, Surrey, which is currently available in two versions:

CT101 receive and transmit—TTL
CT103 receive and transmit—TTL and magnet drive

The prices at the time of writing are £99.60 and £104.90 respectively. The model CT103 was supplied for test but this differs only in having an 80V magnet driving interface.

Powered by an in-built mains power supply unit, the CT103 has four DIN sockets on the rear panel for the various connections. These include both types of 5-pin arrangement, to reduce the risk of damage. The receiver input is protected by the simple but effective back-to-back diode technique (Fig. 32). Requiring only 10mV and with an input impedance of 4·7kΩ the CT103 can be connected to the extension speaker or headphone socket of any receiver without imposing any significant loading. More than sufficient drive is provided with the station receiver set for a normal listening level. There are no adjustments for this input.

The AFSK output is driven from a source impedance of some 2kΩ and is adjustable via a 47kΩ on-board preset potentiometer which must be adjusted to give the correct drive or modulation depth for the transmitter in use. Overdriving the transmitter could, of course, introduce "flat-topping" and subsequent distortion. A further pin of this particular DIN socket provides AFSK prior to the preset. This can be fed to a domestic tape recorder for simple message storage. For playback the recorder output is directed to the unit input in lieu of the receiver output.

A TTL-compatible output of demodulated RTTY is available for feeding a VDU (such as the G3PLX design) or a microprocessor. The same socket will also accept TTL-compatible input (from keyboard or MPU or whatever) for conversion to AFSK. This input is not protected, so the user must be most careful not to allow a voltage outside the TTL range 0–5V to be applied. The input is however internally pulled to 5V via a 4·7kΩ resistor, so the input can be left floating or even connected to a tri-state bus without problem.

The CT103 provides for a polar input (see Fig. 22, Part 3) that requires a grounded centre contact and two other contacts giving a ground for mark and space respectively. A flip-flop is used to debounce this input, which is buffered from the TTL gates by small-signal transistors which are themselves protected by current-limiting resistors and Zener diodes.

The final socket provides the magnet driving output (supplied as an optional extra), which can be selected by an internal switch for single or double current. Whichever type of magnet drive is required, the user needs to set the magnet current. This is done empirically with a milliameter temporarily replacing the on-board fuse whilst various switch combinations are tried. The AFSK output level and the magnet drive current limit are the only internal adjustments necessary.

The unit is quite simple to use once the user has accustomed himself to the tuning aids. These consist of two l.e.d.s. The first of these—the "Signal" indicator—will be on steadily when both mark and space tones are within the input passband; the signal l.e.d. flashing indicates mark or

Fig. 32: The input limiter arrangement on the CT103

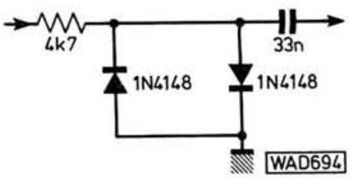
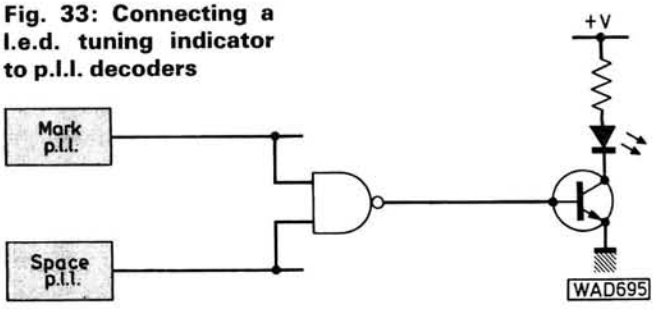


Fig. 33: Connecting a l.e.d. tuning indicator to p.l.l. decoders



space tone (but not both). An incoming signal is correctly tuned when the signal l.e.d. remains on. The second l.e.d.—labelled "Mark"—is on for high tone (usually mark) and off for space (low tone) and so will flash in normal operation.

Some form of tuning indicator is normally desirable on a demodulator to indicate when a mark and/or a space tone is being received. This is easiest to accomplish with p.l.l. decoders which can have a l.e.d. across the output as shown in Fig. 33. An *LC* type demodulator can be modified to drive a milliameter to indicate relative signal strength as shown in Fig. 34.

By far the best form of tuning indicator is the "cross-pattern indicator" using a simple form of oscilloscope. In use a correctly tuned RTTY signal will show a cross with equal length arms. A voltage representing the mark signal is fed to the horizontal oscilloscope amplifier, and that representing the space signal to the vertical amplifier. An incorrectly tuned RTTY signal will show as a cross whose horizontal arm is longer than its vertical arm, or vice-versa. An interface to a standard oscilloscope can be built but the required circuitry is so simple that a stand-alone indicator can be built using a surplus oscilloscope tube such as a 3BP1 as shown in Fig. 35. The 88mH coils are tuned to resonance (one each for mark and space) by careful selection of their parallel capacitors. The coils also provide step-up from an 8 ohm speaker connection.

The two inputs to the CT103 (TTL and polar) are bussed via diodes, and so two devices (such as keyboard and a solid-state message store) can be permanently connected provided each restores to mark when not in use. Also connected to the same bus is the output of the demodulator. This means that any output from a terminal is echoed back on transmission and a machine with local copy will print each character twice. This can be overcome by operating the button designed to stop printing and which forces the output of the demodulator to mark. An extra pair of contacts on this button was used by the author to ground the p.t.t. line of the transmitter feed, and so act as a transmit/receive control. Control keys are also provided for normal/reverse signal switching and wide/narrow shift selection.

Claimed to be a "unique digitally controlled circuit" is Autoprint, fitted to the CT103 in place of antispace and autostart features. The Autoprint works like this—from the steady-state mark position an RTTY signal of at least one second duration must be received for the output to be turned on; following this the output remains on as long as RTTY is not lost for more than 250 milliseconds (control set to fast) or 1 second (control set to slow). If the incoming RTTY signal is dropped for a period exceeding this time, the system is reverted to mark and the Autoprint is reset.

The Autoprint circuitry is accomplished with a pair of 555 timers. In practice it works well to prevent a terminal chattering when tuning across a band. But, as the manual suggests, it is necessary to switch Autoprint off when trying to copy weak signals.

Hal

Ready-built RTTY terminal units are also available, via Radio Shack, from Hal Communications Corporation of USA. These include the ST-6000 with a range of facilities including a tuning oscilloscope at £414 and the ST-5000 at £230. Unfortunately no Hal equipment was available for evaluation.

Hal are perhaps best known for their RTTY terminals which now include three models all based on integral keyboard/VDU units. Top of the line is the DS3100 ASR

WAD696

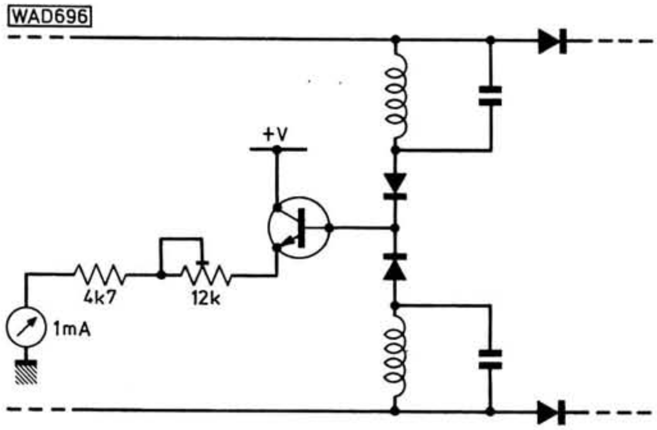


Fig. 34: Attaching a signal strength meter to an *LC*-type demodulator

WAD697

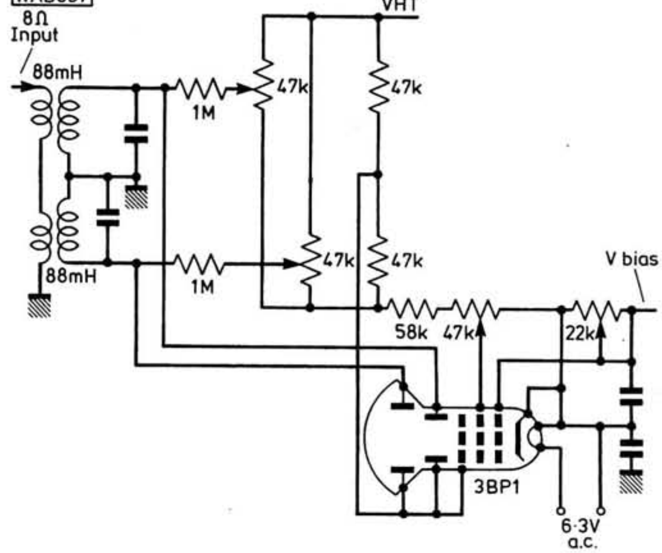


Fig. 35: A simple stand-alone tuning oscilloscope

(or BSR—Buffered Send Receive—as Hal like to call it) again available through Radio Shack at £1536. The DS3100 provides for ASCII and Morse as well as RTTY, and the operational features outlined below are available for all three modes. Speeds available are as follows:

ASCII—110 to 9600 bits per second
Morse—1 to 199 words per minute
RTTY—45 to 100 baud

The RTTY interface is a current loop requiring 18–120mA at voltages up to 200; output is polar. Incoming RTTY traffic is buffered and any 12- or 24-line segment of the 150-line buffer capacity can be displayed at 72 characters per line (green phosphor 12in diagonal screen). Received (and transmitted) data is also available at 300 b.p.s. in ASCII at an RS232 interface.

The DS3100 really comes into its own when transmitting. Text can be precomposed into the buffer during reception if required; otherwise transmission is from the keyboard, either as typed, in complete lines or in complete words. Spaces caused by use of say the line mode are automatically filled with downshift (letters) characters. Line transmission, identified by bursts of full-speed text in-

continued on page 40▶▶

NEWS NEWS NEWS

Kits Catalogue

Heathkit, the world's largest manufacturer of electronic kits, inform me that their latest catalogue is now available.

In addition to computer products there are kits for most interests, including car tune up equipment, digital electronic clocks, weather computers, electronic thermometers, ultrasonic burglar alarms, amateur radio equipment, test instruments and many other kits that should prove of interest to the home constructor.

The catalogue is now available to readers (25p in stamps please) from: *Heath Electronics (UK) Ltd., Bristol Road, Gloucester GL2 6EE, or The London Heathkit Centre, 233 Tottenham Court Road, London W1P 9AE.*

RAE Course

Starting in January 1981, Astley High School, Seaton-Delaval, Tyne-Wear will be running an RAE course.

They would also like to hear from anyone qualified to conduct the course.

Further details are available from: *Mr Ken Fawcett, Astley High School, Seaton-Delaval, Tyne-Wear.*

Be Prepared

All proud owners of the popular FT101/2/2D/FT401/FT901 range of h.f. transceivers should think hard at this time about the increasing difficulty of obtaining spare valves. NEC and Toshiba ceased production two years ago and NEC are now refusing further orders. The FT101 was designed for use with these makes of PA stage valves and other makes are not satisfactory, due to lack of compatability. There is no agreed standard on inter-electrode capacity or mutual conductance, leading to biasing, oscillation and neutralising problems, when apparent equivalent TV Valves are used.

All this aside, it is probably a very sound investment to secure a stock of valves, now, whilst original specification devices are available.

For those who wish to follow this course of action the people to contact are: *Holdings Photo Audio Centre, Mincing Lane, Darwen Street, Blackburn, Lancs. BB2 2AF. Tel: (0254) 59595.*

Dying Swan

After 17 years on the amateur scene the "Swan" brandname is to be phased out in favour of Cubic Communications Incorporated.

In the past, Swan, even though owned by Cubic Communications, has operated as a small "stand alone" company with limited engineering and marketing capability, specialising in amateur products.

To divorce the new "Astro" product line, which the company feel is light years ahead of the old Swan product line, they have now decided to abandon the Swan name totally from new products.

The 100MX transceiver, which *Practical Wireless* reviewed in the Sept/Oct 1979 issues, will be the last item prinicipally designed by the Swan organisation, and will retain the Swan designation as long as it remains in the product line, as will their testmeters.

Further information from: *William Munro (Invergordon) Ltd., 100 High Street, Invergordon, Ross-shire IV18 0DN. Tel: (0349) 852351.*

You Lucky People!

At long last the Radio-2 m.w. transmitter at Start Point on the southern tip of Devon is coming into service. The service should have started on Monday, 15 September but the aerial system was not quite ready. Instead, the service started on Monday, 22 September. Listeners in South Devon, Dorset and parts of Cornwall will find the new service on 693kHz (330m).

BBC Engineering Information Dept., Broadcasting House, London W1A 1AA.

The G-QRP Club

The G-QRP Club was founded in 1975 and it now has over 800 members in 25 countries. The Club exists to promote interest and growth in low power amateur radio communication (5 watts or less). Membership is open to any licensed radio amateur or short wave listener anywhere in the world who has an interest in low power communication. The annual subscription is £2.50 or 5 dollars US. Subscriptions should be forwarded to the Secretary at the address given below.

The Club publishes a quarterly journal called "SPRAT" (from the initial letters of the words Small Powered Radio Amateur Transmitters) which is sent free to members. SPRAT contains many circuits, technical hints and ideas for QRP constructional projects, together with Club news, award and contest information, and other items of interest to QRP operators. SPRAT is the only exclusive QRP journal in the world, and it contains much constructional information in each issue.

Full details of various services the club has to offer are supplied to each member on joining.

The Address of the Secretary is: *Rev G. C. Dobbs G3RJV, 17 Aspen Drive, Chelmsley Wood, Birmingham B37 7QX.*

New Battery

A new battery believed to be the only zinc-chloride chemical system battery of its type available in Europe, is now being marketed in the UK by Ray-O-Vac.

Designed primarily for portable radios, calculators and equipment using or needing a high-rate drain capability, the new AC3 has been introduced into the company's battery range to give a midway performance between the low-cost zinc-carbon PP3 and the more expensive alkaline-manganese MN1604 equivalents.

The VAT-exclusive recommended retail price of 70p to 75p for the zinc-chloride AC3, compares with 45p for the zinc-carbon PPS and £1.29 for the alkaline-manganese MN1604.

Ray-O-Vac, Station Approach, St Mary Cray, Orpington, Kent BR5 2ND.

Special Offer Loudspeaker Brackets

Is your XYL pestering you to tidy up your hi-fi leads and speakers while all you want to do is to get into the shack and work that rare DX? If so then our special offer this month is just made for you.

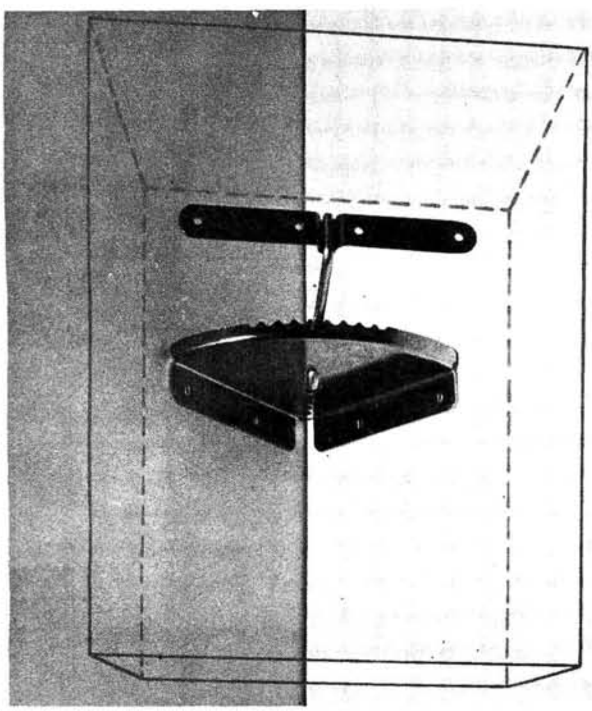
The best place for the loudspeakers, so most of the experts tell us, is well above floor level and positioned in the corners of the room, slightly angled towards each other to give the correct mix of sound. As it is not always convenient to have shelves in the corners to support the speakers, many people never get the best results from their stereo system.

The Wallangle Speaker Brackets offer a convenient and simple solution to the problem of mounting speakers in the corners of a room. The picture shows the clever way in which the bracket holds the speaker back against the two walls, while still allowing for swivelling to almost any angle to give the desired sound distribution.

Wallangle brackets will support speakers up to 11½in wide and up to 50lb in weight. Our special offer kit includes a pair of chromium plated brackets, wall plugs, screws and step-by-step fitting instructions to enable you to install them easily and rapidly.

These ingenious brackets will cost you just £6.25 complete and if you are not completely satisfied with them just return them within ten days and your money will be refunded in full.

Send your order to . . . Practical Wireless, Dept PWL8, Rochester X, Kent ME99 1AA.



HOW TO ORDER

Please complete both parts of the coupon below in BLOCK CAPITALS.

Remittance may be by Access, Barclaycard, Postal Order or Cheque (name and address on back of cheques, please), crossed, and made payable to IPC Magazines Ltd. This offer is open to readers in England, Scotland, Wales, Northern Ireland and Channel Islands only. It is not available in Eire or overseas.

Orders are normally despatched within 28 days but please allow time for carriage. You will be notified if a longer delay may be expected.

If paying by Access or Barclaycard, please do not enclose your credit card with your order.

THE CLOSING DATE OF THIS OFFER IS 28 FEBRUARY 1981 subject to availability.

To: PRACTICAL WIRELESS
Dept PWL8, Rochester X, Kent ME99 1AA
Please send me the set(s) of 'WALLANGLE" speaker brackets (pair) as indicated @ £6.25 per set, including P&P.

I enclose P.O./Cheque No. .... Value ....
Number of sets required [ ]

Name ....

Address ....

....

....

Tel. No. (Home or Work) ....

I wish to pay by Access or Barclaycard.

My number is: [| | | | | | | | | | | | | | |]

Cardholder's Address ....

....

Signature ....

Number of sets required [ ]

Name ....

Address ....

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From: PRACTICAL WIRELESS
Dept PWL8, Rochester X, Kent ME99 1AA

CUT ROUND DOTTED LINE

MODS

IMPORTANT—The ideas presented here are suggestions only, and as they are untried by this magazine, we cannot accept responsibility for any resultant damage, however caused. Before alterations are attempted, care should be taken to ensure that any guarantee is not invalidated, and it should also be borne in mind that modifications usually have an adverse effect on resale prices. In cases where specialist skills or equipment are needed, most dealers will undertake the work for a reasonable fee.

Roger Hall G8TNT (Sam)

No. 2

Some modifications, whether they are from the manufacturer, the dealer, or the amateur who has been "tinkering" with his rig, become known to almost every amateur, but some never get further than the originator and perhaps a few of his friends. I would like to use these articles to give some of these lesser-known mods a wider audience. In order to do this, I would like anyone who has any ideas that he would like published, to write to me at the address below. Some of the mods that will be published are from dealers, but I would like to use as many readers' ideas as possible, so please write in if you have any tips to pass on, not forgetting to include your own name and address.

The first idea this month is for a little gadget that I first made up a long time ago, when I decided to change from using a fist microphone to a boom microphone for mobile working. As it is so simple, I would not have thought of publishing it had it not been for the interest shown by people who have seen it in use.

My 2 metre transceiver, along with most of the more modern models, has two push-buttons on the microphone which are used for up and down frequency shifting and scanning. The very latest boom microphones also have these buttons built in, but as mine is an earlier and cheaper model, I have had to modify it in order to retain the remote scanning facility. All that is needed is a length of screened two-core cable, two push-to-make switches and a small box. The cable does not have to be screened, but it must have three conductors, and I have found that screened twin cable is easily obtainable, not too expensive, and is far smaller than most three-core cables. The two push-buttons should be wired up as in Fig. 1, and then mounted in the small box, or if there is a suitable space, two holes could be drilled in the dashboard of the car and the switches mounted there. If a small box is used, it should be approximately the size of a matchbox, in fact for the prototype it was a matchbox. Double-sided Sellotape or Sticky Fixers on the back of the box will hold it in place on a convenient part of the dashboard.

The cable can then be run along or behind the dashboard and up to the rig. The cable end should then be stripped and the braid formed into a pigtail, and the cable should then be inserted into the microphone plug alongside the lead from the boom microphone. One of the conductors is soldered to the UP pin, the other to the DOWN pin, and the screening braid to the EARTH pin. The pin layout for the TR-9000 is shown in Fig. 2; refer to the handbook for your rig for its connections. With the microphone plug reassembled and inserted into the set, it is now possible to scan up or down by merely pressing the appropriate button on the dashboard.

It has always been my belief that mobile operation should be made as simple as possible; there are far too many distractions for drivers as it is, but my boom microphone with its p.t.t. on the gear-lever and its matchbox attachment has made life a lot easier.

Automatic toneburst and semi-reverse repeater (listen on the input) for the new Yaesu FT-480 are provided with this month's second mod, which has been supplied by Mike G8EWU, of Amateur Radio Exchange in Ealing. Take particular note of our heading comment about guarantee invalidation if contemplating this mod.

The first step, after removing the top and bottom lids, is to locate the synthesiser, remove its lid, take out the four screws holding it in place and lift it out over the side of the rig. Find Q1060, which is on page 27 of the Japanese manual and on page 20 of the European manual, and is to the rear of two 4011 chips. Remove the link which earths pin 6 of Q1060, on the print side of the board.

Turn back to the component side and fit a circuit pin in the hole marked "B SW", which is beside R303 and near to pin 7, and then re-fit the synthesiser. Remove the wire from the "T SQ" pin, which is beside the f.m. modulator, and re-route it, extending it if necessary, to the new pin "B SW". On the bottom of the rig, cut back the black and the white/purple wires from the TONE socket and divert them to the SHIFT switch as shown in Fig. 3. Finally, modify the SATELLITE switch as shown in Fig. 4.

When everything has been put back together, the set should operate as follows:

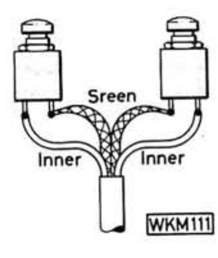
a) The toneburst is automatic when the SHIFT switch is set to + or −.

b) Pressing the CALL button will switch the receiver to the input frequency if repeater shift has been selected.

c) Pressing the CALL button during a transmission will cause a continuous tone to be transmitted.

The address to write to if you have any modifications for publication is: R. S. Hall, Practical Wireless, King's Reach Tower (Hatfield House), Stamford Street, London SE1 9LS.

73's
Sam G8TNT



◀ **Fig. 1**

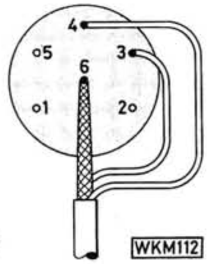
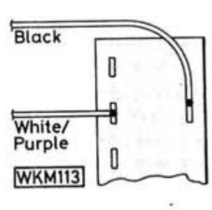
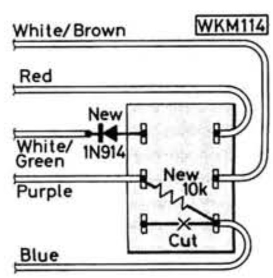


Fig. 2 ▶



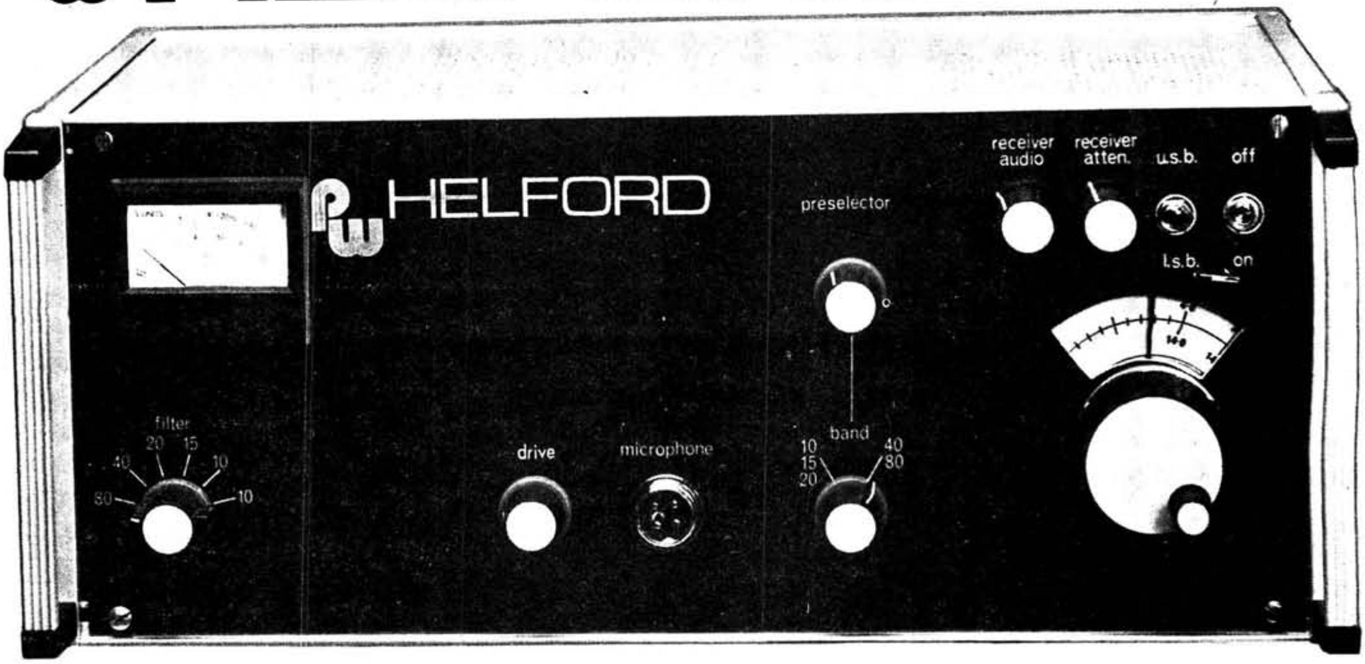
▲ **Fig. 3**

Fig. 4 ▶



PW HELFORD

Part 2

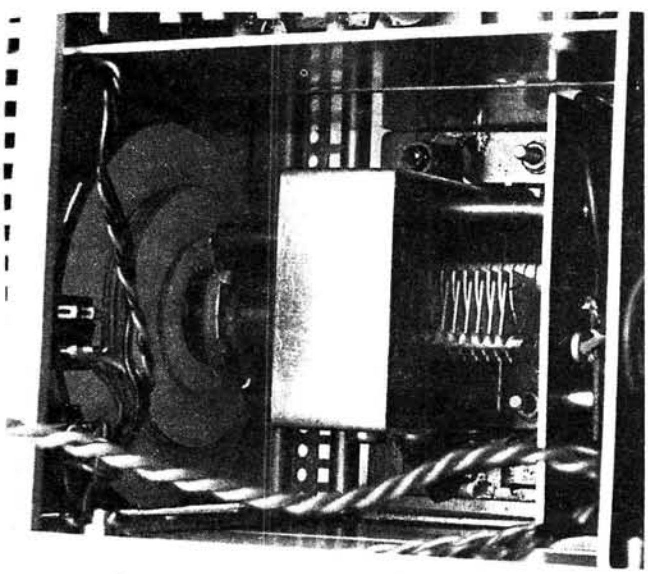


HF SSB TRANSCEIVER

Vic Goom G4AMW

Trying to decide on the order in which to present the constructional details of the boards in any large project always provokes headaches and the *PW* Helford is no exception.

In the first part we covered the main transceiver board leaving the ancillary boards and the mechanical design for later parts. In this month's article we will cover the construction of the v.f.o. and its buffer amplifier, but leaving the metalwork details until later.



This photograph shows the v.f.o. board with the tuning capacitor and slow-motion drives

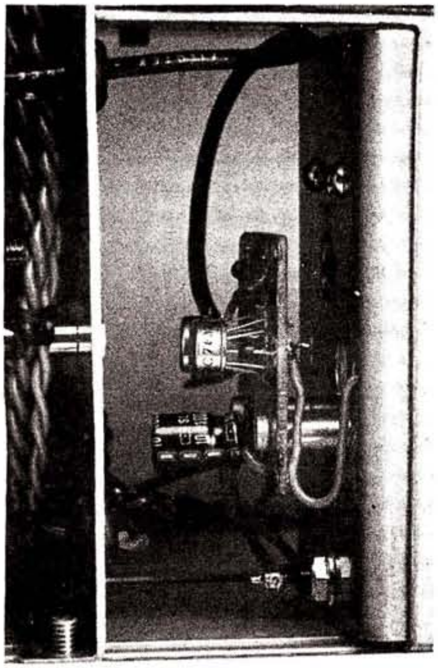
The VFO

The v.f.o. is built on a printed circuit board which has a ground plain on one side and the simple copper track pattern shown in Fig. 2 on the other. No holes are provided for the components which are soldered directly onto the appropriate pads as indicated in Fig. 3. Care must be taken to get the leads of the components as short as possible and each lead is bent at right angles before soldering to the pads on the board. RFC701 is mounted vertically on the board and will be soldered to the feed-through capacitor C708, during the final assembly of the boards into the case.

Flying leads are used to connect the variable capacitor C707 to the board and, again, this component cannot be finally connected until final assembly is carried out.

The variable capacitor used in the v.f.o. tuning circuit is a Jackson Bros. Type 4170/75/023 with built-in 12:1 gear drive. The slow-motion drive from the dial is Jackson Bros. Type 5620 (6:1) giving a total reduction of 72:1. Details of the dial will be given with the mechanical details. Watford Electronics are Jackson Bros. distributors to the amateur market.

Readers who intend to operate the Helford should be in possession of the appropriate licence issued by the Home Office to those who have passed the City and Guilds Radio Amateurs' Examination. Details may be obtained from: The Home Office, Radio Regulatory Department, Amateur Licensing Section, Waterloo Bridge House, Waterloo Road, London SE1 8UA.



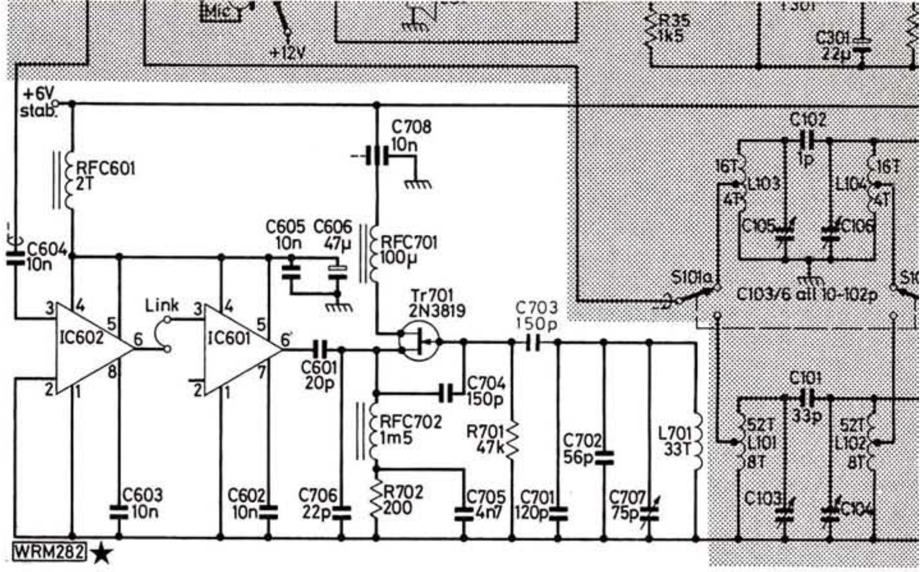
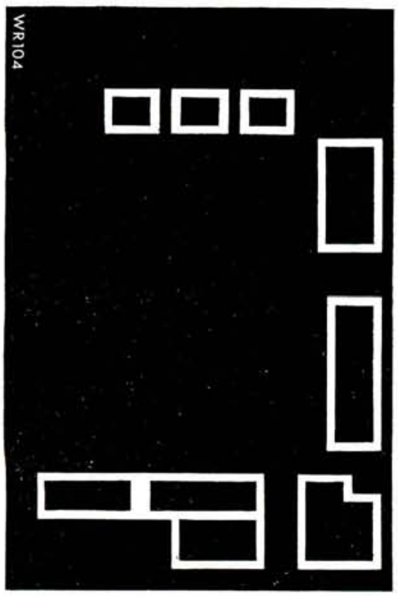


Fig. 1: Circuit diagram of the v.f.o. and buffer amplifier. This is part of the circuit diagram published in Part 1. Note that C703 was omitted from Fig. 5 in Part 1 and also that the two amplifiers IC601 and 602 are shown with the inputs (pin 6) in a non-standard form. The picture on the left shows the buffer amplifier board mounted on the v.f.o. screening metalwork



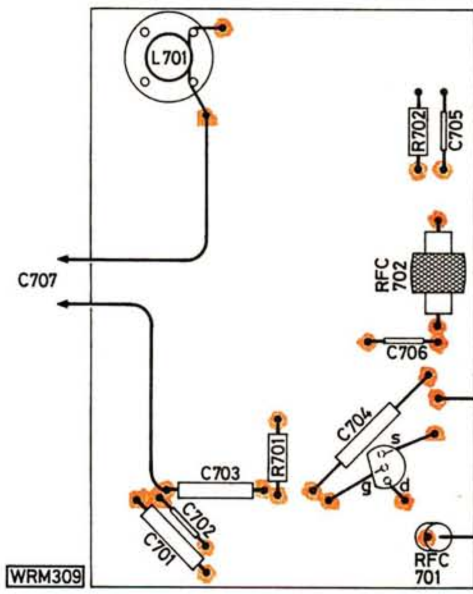


Fig. 2 (far left): The copper track pattern of the v.f.o. board shown full size. Note that this is the component side of the p.c.b. and that the other side is a complete copper ground plane

Fig. 3 (left): The component placement drawing of the v.f.o. board. Note that the components are soldered directly onto the copper pads. The connections shown to C707 go to the fixed vanes, the moving vanes being connected via the metalwork

★ components

VFO BOARD

Resistors		
½W 2% Metal Oxide		
200Ω	1	R702
47kΩ	1	R701
Inductors		
RF chokes		
100µH	1	RFC 701 (Cambion)
1·5mH	1	RFC 702 (Cambion)
23T 22 s.w.g. on ¼ inch former	1	L701
Semiconductors		
Transistors		
2N3819	1	Tr701

Capacitors		
Ceramic Plate		
22pF	1	C706
56pF	1	C702 (see text)
Silver Mica		
120pF	1	C701
150pF	2	C703, 704
4·7nF	1	C705
Feedthrough		
10nF	1	C708
Variable		
75pF	1	C707 (see text)

Miscellaneous

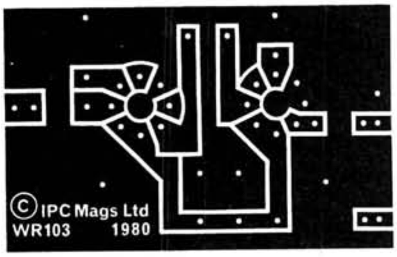
Printed circuit board; ¼ inch coil former; slow-motion drive (see text).

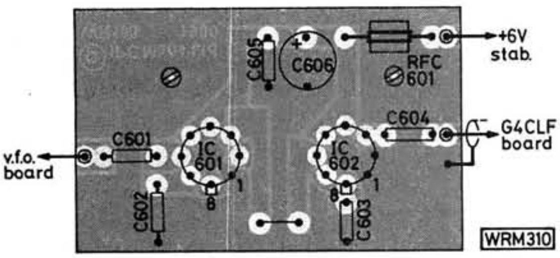
Buffer Amplifier

The buffer amplifier uses a pair of Plessey SL560C 300MHz low noise amplifier i.c.s. The short wire link between IC602 and IC601 has been introduced to allow coaxial line connections to be made to a second mixer when additional bands are added to the Helford at a later date. Apart from the decoupling capacitors and r.f.c.s the circuit is very simple.

A double-sided p.c.b. is used for the buffer amplifier with one side of the board acting as a ground plane. Care should be taken to ensure that component leads are as short as possible and that where shown in the component overlay (Fig. 5) the component leads are also soldered to the ground plane as well as the copper pad on the opposite side of the board.

RFC601 is simply 2T of 22 s.w.g. enamelled copper wire wound on a ferrite bead. The +6V stab line to the buffer board will be picked up during final assembly from the feedthrough capacitor C708.





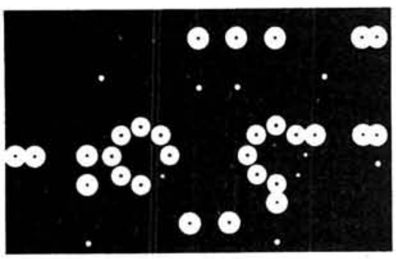


Fig. 4 (top): The copper track pattern of the buffer amplifier p.c.b. shown full size. Fig. 5 (above centre): The component placement diagram of the buffer board. Fig. 6 (above): The copper ground plane on the component side of the buffer amplifier board shown full size

Component Information

It has been brought to our attention that the XF9B crystal filter for the G4CLF board described in Part 1 is available from Webster Electronics, Ilminster. Homebru Radio can supply many of the more difficult to obtain parts for the Helford. Constructors are once again advised to study the advertisement pages for suppliers.

★ components

BUFFER AMPLIFIER BOARD

Capacitors		
Ceramic Disc		
20pF	1	C601
10nF	4	C602,603,604 605
Tantalum Bead		
47µF 16V	1	C606
Inductors		
2T on FX1115 ferrite bead	1	RFC 601
Semiconductors		
Integrated Circuits		
SL560C	2	IC1, 2
Miscellaneous		
Printed circuit board; Ferrite bead FX1115.		

Setting Up

The accuracy with which the v.f.o. is set up depends largely on the equipment available. Ideally an oscilloscope, frequency counter and high impedance electronic voltmeter should be used, but it is surprising just what can be achieved with nothing more than a full coverage receiver. The swing can be adjusted and the quality of the note investigated with such a receiver. Indeed a grid dip oscillator (g.d.o.) equipped with phones will do the job provided its calibration is known to be accurate at 5MHz.

Three v.f.o.s have been built to this design all successfully, so the constructor should have no problems.

Mechanical Details

The metalwork involved in the *PW* Helford chassis is quite involved. Because of this and also because the screens and chassis parts are inter-related, we will be dealing with the metalwork toward the end of the series. The various boards can be built and checked without the metalwork, leaving final alignment of the completed Helford until final assembly has been completed.

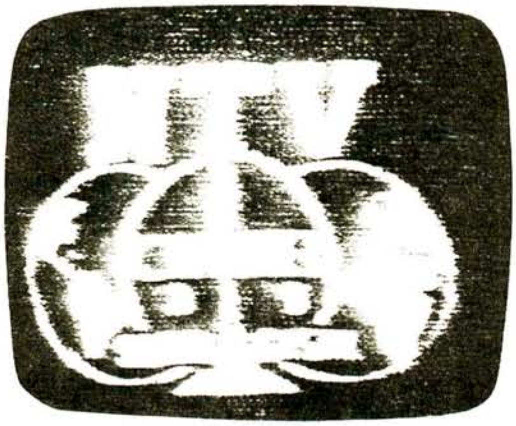
Next Part

The next Part will deal with the Preselector unit, the transmitter pre-amplifier and first amplifier boards. This will allow the constructor to actually run the Helford, albeit at low power, and prove out his work so far.

Next month in PW

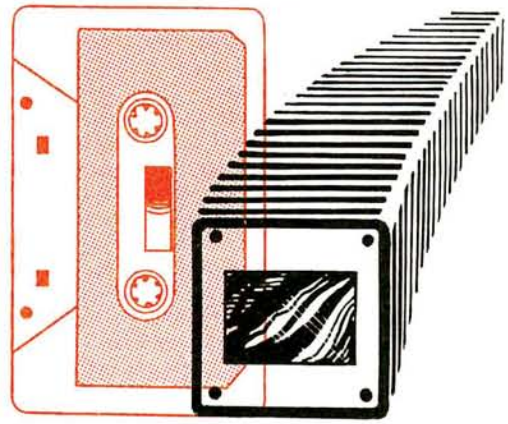
EXTRA 8 PAGES of PROJECTS & FEATURES

DXTV-The Basics



Find out how to get started in long-distance television reception with this article by Roger Bunney, acknowledged expert in this field. Propagation, receivers, amplifiers and aerials for the v.h.f. and u.h.f. TV bands are all covered

TAPE/SLIDE CONTROLLER



Now that you've had all your holiday slides back, why not build them up into an audio-visual show with our Tape/Slide Controller? Incorporating microphone pre-amp and mixing facilities for use with tape recorders lacking these features

&

PW 'NIMBUS' Scanning Module

Back-up Power Supply for a Portable Radio

ON SALE 5 DEC

RADIO SPECIAL PRODUCT REPORT

FRG-7700

YAESU

COMMUNICATIONS RECEIVER

The FRG-7700 is due to be launched on the UK market about the time that this issue of *PW* appears, and the receiver which we evaluated is a pre-production model, kindly loaned by **Lee Electronics Ltd., 400 Edgware Road, London W2, telephone 01-723 5521.**

Previous Yaesu receivers, including the famous FRG-7 and the FRG-7000, used the Wadley Loop triple-conversion system. The FRG-7700 is a double superhet with a first i.f. of 48·055MHz and a second i.f. of 455kHz, with frequency control by means of a phase-locked loop synthesiser.

Band selection is by a 40-position switch which, as well as covering the span 0·15–30MHz in consecutive 1MHz segments, also has the h.f. amateur bands (including the WARC '79 additions) repeated consecutively. This arrangement would offer the possibility of tailoring the r.f. selectivity to give some protection against break-through from local medium wave broadcast transmitters when listening on Top Band, but from our test results this has obviously not been done.

The main tuning knob drives an adjustable analogue dial and is 50mm in diameter. It has a rate ranging between about 40kHz per revolution at the band ends and nearly 80kHz per revolution at the band centre, which is somewhat fast for easy resolution of s.s.b. signals. No fine tune control is provided, although it is possible to use the MEMORY FINE control for this purpose, but more of this later. Digital read-out of frequency is by a 0·3in orange 7-segment display with 1kHz resolution.

As well as using the normal manual tuning, up to 12 frequencies can be programmed into the memory, which retains band information as well as frequency, making it unnecessary to select the appropriate band manually when recalling a stored frequency. The MEMORY FINE control allows around ±2kHz variation on the recalled frequency, and as mentioned above can also be used to advantage as a general fine tune control for s.s.b. reception in the following way. With the MEMORY CHANNEL selector set to an unused position, say 12, tune in the desired signal in the normal way, so that it is roughly resolved, then press the MEMORY button to store the frequency. Press the MEMORY RECALL button, and the MEMORY FINE control can now be used for final adjustment. The process can be repeated for any new frequency, which will simply over-write what was previously in that memory position. Don't forget to centre the MEMORY FINE control before pressing the MEMORY button.

A very effective continuously variable r.f. attenuator is fitted. This will reduce an S9 + 60dB signal to silence at about 50 per cent rotation, and should prove useful at higher settings for monitoring own-station signals. There is also a DX/LOCAL switch on the rear panel, which can bring in additional attentuation if required. The a.f. gain control is mounted concentrically with a tone control which has fairly minimal effect. Sound quality from the front-facing internal loudspeaker is quite good for a metal cabinet. ▶

★ specification

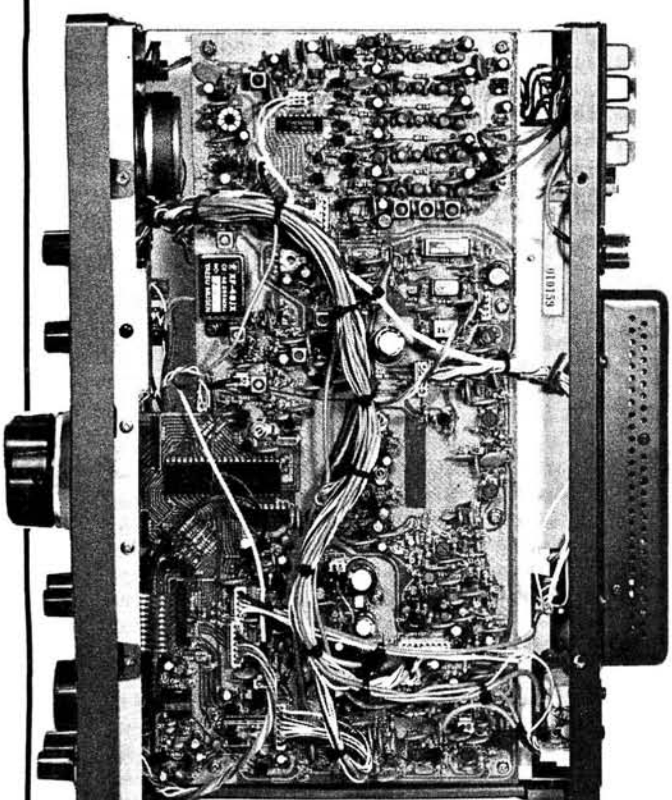
RECEIVER

Frequency Coverage:	150kHz–30MHz in 1MHz bands
Sensitivity:	Below 300kHz; 30μV a.m., 3μV s.s.b./c.w. 300kHz–2MHz; 25μV a.m., 2μV s.s.b./c.w. Above 2MHz; 5μV a.m., 0·5μV s.s.b./c.w., 1μV n.b.f.m. for 10dB S + N/N or better
Selectivity:	AM (WIDE); 12kHz at −6dB, 25kHz at −50dB AM (MEDIUM); 6kHz at −6dB, 15kHz at −50dB AM (NARROW); 2·7kHz at −6dB, 8kHz at −50dB SSB/CW; 2·7kHz at −6dB, 8kHz at −50dB FM; 15kHz at −6dB, 30kHz at −40dB
Antenna Impedance:	Below 2MHz; 500Ω unbalanced Above 2MHz; 50Ω unbalanced
Audio Output:	1·5W into 8Ω for 10% distortion
Audio Load Impedance:	4–16Ω external loudspeaker or headphones Unspecified for tape recorder
Memory Channels:	Twelve
Power Input:	100, 120, 220, 240V 50/60Hz a.c., 39VA max. 13·5V d.c., 1·2A max.
Dimensions:	129 × 334 × 225mm
Weight:	6·5kg

CLOCK/TIMER

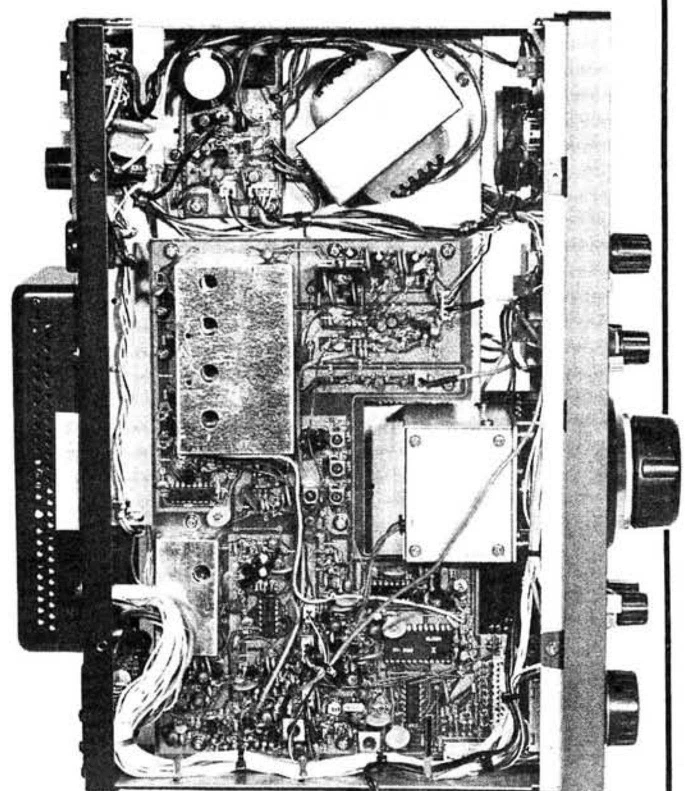
Clock:	12-hour, with a.m./p.m. indicator
Timer:	24-hour
Sleep Timer:	Delayed switch-off up to 59 minutes

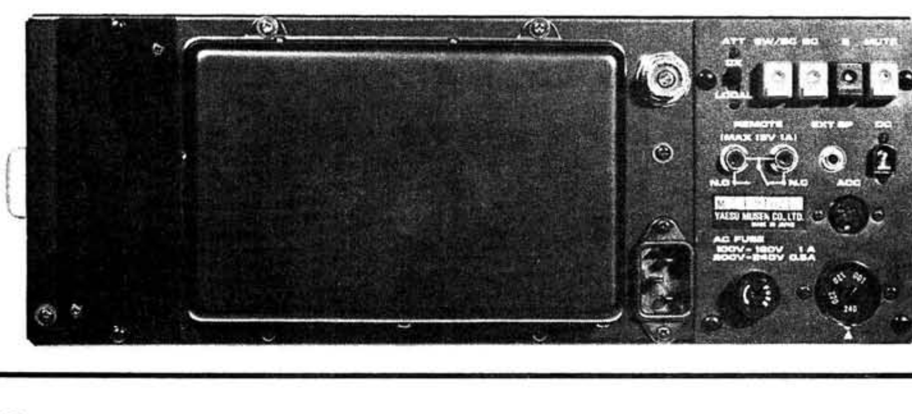
Front view of the FRG-7700, showing the uncluttered panel layout



Top view, showing the largest of the p.c.b.s. The f.m. demodulator board is just visible at the lower right-hand corner

Underneath view of the receiver. The "bulge" on the rear panel is the optional memory unit





Rear view, showing external connection facilities

Fast and slow a.g.c. time constants are available, and there is a somewhat ineffective noise blanker fitted. A squelch control is provided for use in the n.b.f.m. mode.

The DIMMER switch controls illumination of the large "S" meter and the analogue dial, and the brightness of the digital readout. It gives two levels which might be described as rather dim and very dim, respectively. There seems no reason why this should be be improved, with a minimal increase in power consumption.

As mentioned in the specification table, a clock/timer/sleep-timer is incorporated, using the main digital display for read-out. The timer, besides controlling the receiver, also drives a single-pole changeover relay contact rated at 15V 1A d.c., which can be used to switch remote equipment such as a tape recorder.

Front-panel jacks are provided for headphones and audio output to a tape recorder. Rear-panel connections are for antennas (a spring terminal for frequencies below 2MHz, and an SO-239 socket and spring terminal for frequencies above 2MHz), earth, mute (earth to activate), extension loudspeaker, remote control (mentioned above), and a.c. and d.c. power inputs. An accessory socket is also provided, wired up for: ground, 11V, a.g.c. and mute, plus one spare contact. The a.c. mains voltage selector and fuse complete the rear panel features.

A holder is fitted underneath the receiver for optional memory back-up batteries (3 × AA size), which will retain the stored frequencies and keep the clock going if the external supply is disconnected.

The instruction manual provided with the review receiver was in Japanese and appeared to be provisional. No doubt the English version will be to Yaesu's usual standard.

Included acessories are: a.c. power lead, d.c. power socket, 1A fuse for 100–120V operation, 10m of plastics-covered antenna wire and a pair of plastics feet which can be fitted to the front of the receiver to raise the front panel and controls.

Results

The receiver proved very lively on all bands using a 66ft long wire, and on the higher bands using an HF5V vertical. The i.f. bandwidths seem well-chosen for local or DX broadcast listening and for s.s.b. For c.w. there should ideally be something a bit narrower, but this would obviously put the price up. Frequency stability was excellent. Several other points, such as audio quality, display brightness and tuning rate have already been mentioned.

The one significant question-mark in our minds over this receiver is that of spurious responses. On a.m. (i.e. with the b.f.o./c.i.o. switched off) there are a large number of tunable heterodynes throughout the receiver's coverage, some of them strong enough to be heard when receiving a.m. broadcast stations. With the multiplicity of frequencies produced within a synthesiser, this sort of effect is to be expected with no antenna connected, but should more or less disappear when external signals are applied.

In fairness to Yaesu, this is the sort of problem which can be overcome between prototype and production stage. It has been brought to the attention of the UK distributors, and we hope to test a production model shortly. We will report the results in these pages at the earliest opportunity, but in the meantime, we would recommend intending purchasers to check this point carefully for themselves before taking delivery.

The FRG-7700 will be available from Yaesu distributors and dealers at around £390, including VAT. It will also be offered without the memory facility, which can be added later, for around £310.

INTRODUCING RTTY—4

▶▶▶*continued from page 27*

terspaced with idles or shift characters, can be useful for the transmitting station but is annoying—to the author's mind—for the receiving station. It should only be adopted by the worst of typists!

Ten different 32-character messages can be pre-programmed and inserted into the transmit text as required. Such messages may be chained to produce longer messages. A similar feature issued by the author to store four messages:

CQ CQ CQ CQ CQ
CQ DX CQ DX CQ
CQ TEST CQ TEST
DE G4EJA G4EJA G4EJA (CR/LF)

the appropriate combination being selected by one or two key depressions. Two of the ten messages are stored in non-volatile ROM, and one of these can be sent in Morse regardless of selected terminal code.

The DS3100 responds to the WRU character by activating an auxiliary contact and sending its number one pre-programmed message. This can be used to activate, say, a tape recorder or an external alarm in a net. Three other external circuits may be activated by keyboard or character control, and a keyboard switch is available for transmit/receive switching. (This feature is most useful and is worth building into any RTTY system—it is important to be able to call immediately the other station reverts to receive, particularly when working DX. The author's system requires only one key to be pressed to mute the demodulator, switch the rig to transmit, turn on the heat-sink fan and take the terminal from local—for pre-compilation—to on-line.) The time of day and date are available for insertion into transmitted text from a single key. Automatic downshift on space, on-screen status indicators and pre-programmed test messages coupled with two-level screen intensity combine to make operating the DS3100 a simple task.

Other Sources

Other RTTY equipment is sometimes advertised by B. Brookes-Electronics and by Joerg Klingenfuss. The best source of such further information is the newsletter of the BARTG (British Amateur Radio Teleprinter Group). Published four times per year the newsletter is excellent value for the £2 annual subscription. In addition to the newsletter, BARTG organise an annual RTTY convention, broadcast RTTY news bulletins (via GB2ATG), appear at the major rallies, advise on technical matters and maintain a register of "difficult to obtain" spares. Further information in exchange for a stamped addressed envelope from the membership officer:

D. Wicks G3YYD,
31 Westfield Avenue,
Watford,
Herts WD2 4EA

Any reader even slightly interested in RTTY is strongly recommended to join BARTG.

In the final part of this series, we shall look at the application of micro-processors to RTTY

THE PW 'SHERBORNE' SYNTHESISED AM/FM TUNER

PART 3

W. S. POEL

In this issue we look at the stereo decoder/muting pre-amp and the a.m. tuner/ferrite rod aerial system, and start on construction.

The Stereo Decoder

The composite signal from the output of the a.m./f.m. i.f. is fed in to the stereo decoder (Fig. 21) via a buffer amplifier. Provision is made in this circuit for a low-pass filter (of the same type as used at the output of the TDA1090)—although if the described i.f. arrangement is used, it may simply be bypassed and ignored. The low-pass filter must be at the output pin of the TDA1090 if used—since the long path to the stereo decoder module input makes use of the decoder input filter unsuitable to the purposes of decoupling the i.f. signals.

The decoder i.c. a KB4437, is outlined in Fig. 22. Although superficially similar to other types of p.l.l. stereo decoder, it contains a 19kHz pilot-tone phase cancellation circuit. Thus the filters associated with the circuit are only necessary to remove the extremes of the L—R d.s.b. signal, and the reconstituted 38kHz carrier. The filter used has two notches, one at 26kHz, and the second at 38kHz, producing an overall passband that effectively removes all unwanted ultrasonics, but scarcely affects any part of the broadcast baseband of 30Hz to 15kHz. Filters with notches at 19kHz invariably have 1·5–4dB attenuation by the time they reach 15kHz, and so some of the programme content is lost (Fig. 23).

The left and right signals from the KB4437 are developed across two 4·7kΩ resistors, R10 and R11, which are the loads of two open-collector transistors in the i.c. This approach is common to many types of decoder and needs to be watched closely, since the other ends of the resistors go to the positive supply. Many circuits connect the ends directly to the positive supply—but then any hum or noise present on the supply will immediately be included in the audio output from the decoder. It is good practice to decouple the supply (by R28/C32) before the decoder load resistors reach it, and it is surprising how much overall difference this can make in a design where

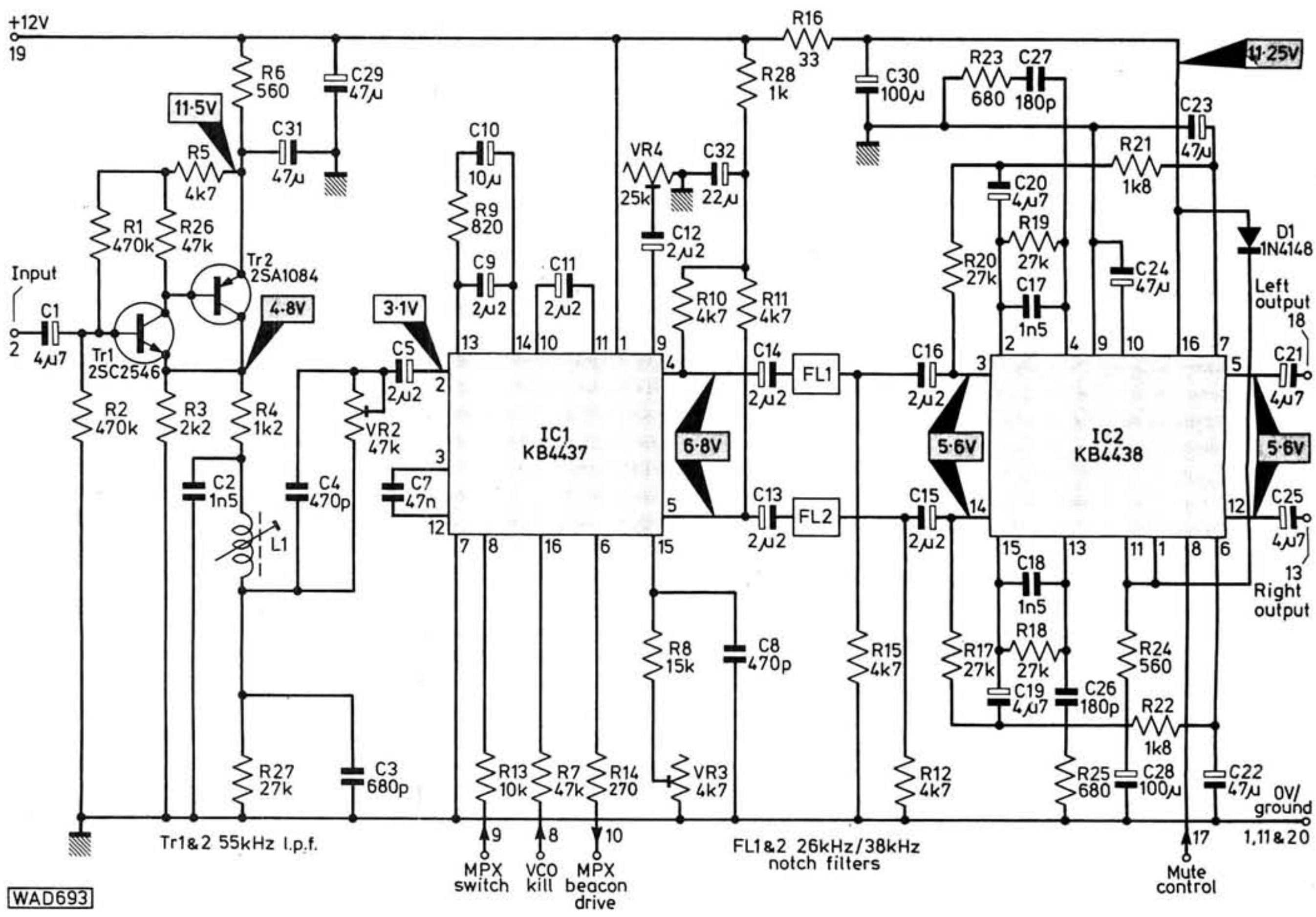


Fig. 21: Circuit diagram of the stereo decoder and muting pre-amplifier module

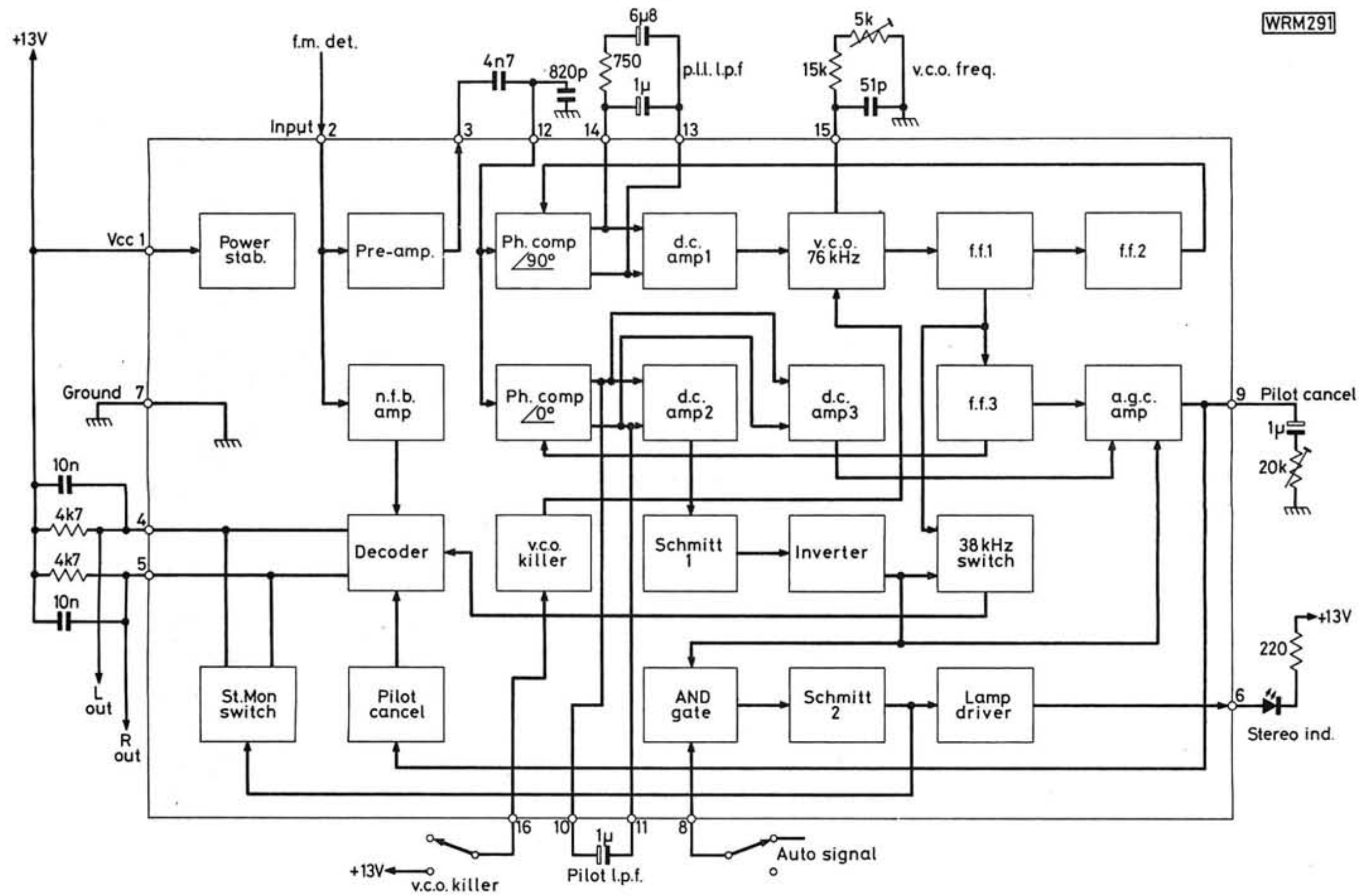


Fig. 22: Block diagram of the KB4437 stereo decoder integrated circuit

noise, previously obtrusive in the preceding i.f. detector system, has been reduced to a minimum by using the improved noise families of i.f. amplifier and detector i.c.s.

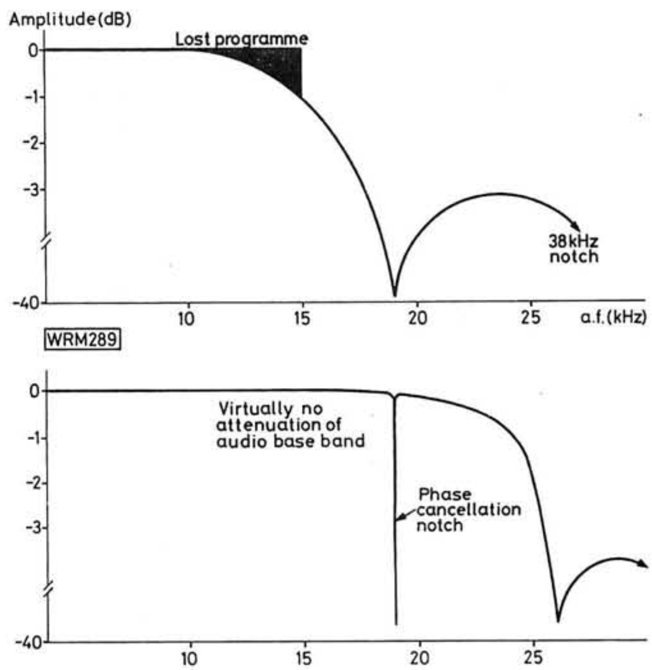
The signals from the filters pass to the KB4438 muting stereo pre-amplifier. This device may be considered as an audio op. amp. (using the same basic design performance equations as you would with any audio op. amp.), but with an additional feature of remote muting—and completely silent switch on/off. Anyone who had dabbled in audio will know how much more satisfactory it is to be able to turn an audio circuit on and off without a great click/thump/crashing sound. The muting control is operated from the tuning synthesiser to ensure silence when tuning operations are being carried out, adding a great deal of refinement to the overall behaviour of the system. The output level is set to approximately 1V r.m.s. per channel, this being more than enough to drive any amplifier system likely to be used.

The AM Tuner Sections

The a.m. section of a mains-powered tuner is always a problem to the set designer. The hi-fi buying public has been educated over the years to be suspicious of f.m. tuners with a.m. wavebands. Not very surprising when many early examples of the art of combining a.m. with f.m. in hi-fi tuners were little more than portable radio chassis in a snazzy box.

One of the more insurmountable dilemmas facing the commercial tuner designer is the attitude of the majority of equipment reviewers in the audio press towards the general nature of a.m. radio as a medium for their various brands of subjective bigotry. Admittedly the audio bandwidth is much reduced when compared to the 15kHz available to v.h.f. f.m., and the signal-to-noise ratio attainable is at best

Fig. 23 (below): Roll-off with standard 19/38kHz notch filters, and (bottom) using 19kHz cancel and 26/38kHz filters



40–55dB when compared with the 70–85dB now being achieved in the latest f.m. i.f. systems. But that on its own should not be an excuse simply to ignore the medium altogether, since there are now so many UK broadcasts which can only be received on a.m. Once the design philosophy has been extended to consider a.m. for long and medium wave, it is only a relatively short extension to consider the addition of a short-wave band, for all the plethora of international broadcasts available around the 5–10MHz spectrum, encompassing the classic 49m, 41m and 39m bands containing things like BBC World Service, Voice of America and most other major international networks.

The tuner described here uses a tuning synthesiser with l.w., m.w. and s.w. already pre-programmed into the MPU ROM, so the problem of tuning stability and tuning accuracy does not arise. Hard-to-find frequencies may even be stored for instant recall at the touch of a button.

The fact that the s.w. coverage is somewhat limited (5·955MHz to 9·775MHz) is an oblique blessing, since the design of multiple-tracking s.w. radio systems using varicap tuning is not easy, mainly due to the residual capacity of the varicaps at the h.f. end of the tuning range. The classic superhet communications receiver endeavours to span a frequency ratio of 3:1 per range (3 times the lowest frequency of that band, e.g., SW1 covers 1·6 to (1·6 × 3) = 4·8MHz). Such a span provides great problems for the designer since there is no room for any inaccuracy in the matching of tuned circuit components, between the r.f., antenna and oscillator circuits.

The self-capacity of the coils, the matching error of tuning capacitors (or varicaps) and the miscellaneous "strays" arising from the physical layout all conspire to put this type of design outside the scope of all but the most experienced constructors. In practical terms, a frequency ratio span of about 1:1 in s.w. is the most that can reliably and repeatably be achieved in a design for enthusiast constructors, using varicap tuning—unless a pre-built and aligned coilpack is available for the job. Thus the range here is well within this rule of thumb, and should lead to a relatively easy task of alignment.

Those of you wishing to duplicate communications receiver performance should appreciate the limitations of a design aimed primarily at broadcast reception. There is no easy way to persuade this type of mask-programmed MPU to do anything it doesn't want to do. But, and the author may come to regret having said this, a fully synthesised section covering 6–9MHz could conceivably be used as a tunable i.f. in a design with a double-conversion approach, using a set of crystal controlled converter front ends to cover the bands shown in Table 1. On the lowest band, you should only expect to track the 1·6–3MHz region with ease, since the 525kHz–1·6MHz range is already covered under m.w.

The limitation of the fixed 5kHz channel spacing need not be a problem, if you are prepared to turn a slightly blind eye to a small readout inaccuracy, since interpolation (fine tuning) of ±2·5kHz can be provided by a varicap trimmer across each of the conversion crystals. Trimming the reference in the p.l.l. of the synthesiser is not

Table 1

Band	Conversion crystal
1–3MHz	6MHz
3–6MHz	3MHz
6–9MHz	Direct
9–12MHz	3MHz
12–15MHz	6MHz
15–18MHz	9MHz
18–21MHz	12MHz
21–24MHz	15MHz
24–27MHz	18MHz
27–30MHz	21MHz

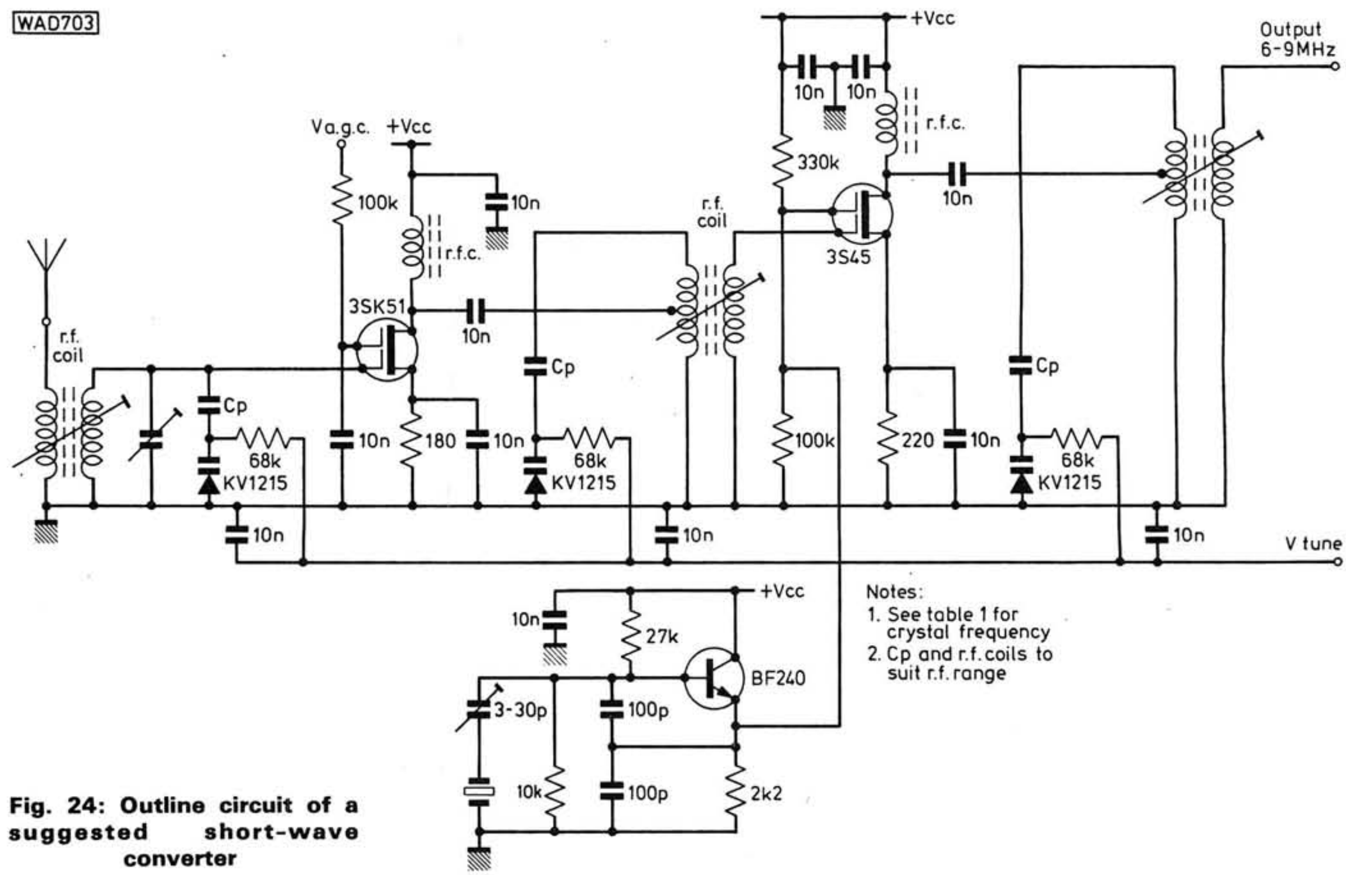


Fig. 24: Outline circuit of a suggested short-wave converter

very successful, since the division from 11·52MHz to 5kHz also reduces the effects of pulling the crystal so that it is not a viable solution. A general circuit for the converter is shown in Fig. 24, but nothing more specific will be entered into in the context of this article.

Long Wave and Medium Wave

A mains-powered tuner is prone to mains-borne interference, and with so many triac control systems in domestic use, it is a severe problem for many users. Such interference is either radiated from the mains wiring adjacent to the a.m. antenna, or it may actually be picked up within the set itself. The latter problem may be tackled with a mains input filter, but the first problem remains. A portable radio frequently gives more acceptable results when used in an area with noisy mains, not only because of the isolation from the mains power, but also because the antenna may be more easily rotated for optimum alignment to the incoming wave fronts. The antenna in the mains-powered set must be externally adjustable, and certainly in the case of a digitally synthesised design, the more space and screening between the antenna and digital sections of the tuner, the better for the avoidance of interference effects.

In all previous approaches to the design of m.w./l.w. radio, the "Hot End" of the tuned circuits is taken from the antenna at the back of the case, to the bandswitch at the front, and then to the tuning capacitor (Fig. 25). The hot end of the antenna circuit acts as an antenna in its own right, although of the electrostatic (*E* field) variety, as opposed to the ferrite rod, which is electromagnetic (*H* field). The hot end also adds stray capacity to the antenna tuned circuit calculations, and is generally unsatisfactory. But the most troublesome aspect is the antenna effect, since it is in this section of the antenna circuit that most stray "image" pick-up occurs, leading to the heterodynes and whistles that affect most m.w./l.w. radio sets after dark.

The hot end is at a very high impedance, being the top of a parallel tuned circuit of Q about 150–200, having an impedance of some 200–300kΩ in many cases. From experience with high-impedance audio inputs, most constructors will have encountered the problems of stray noise pick-up on high-impedance lines, which are greatly reduced if you have a microphone with switchable outputs, and the choice of the lower impedance 600Ω standard. One cure for a microphone is to use screened cable, but the capacitance of the lead is impossibly high for our application. So the answer is to transform to a lower impedance before running the wires around.

The advent of multiple matched varicaps for a.m. tuning has provided the solution for tuners. The use of separate varicaps on each tuned circuit may look extravagant on the face of it, but the problems in switching and tracking are solved by such a technique, used in conjunction with d.c. bandswitching. The principle described is fully expandable to cover another r.f. tuned circuit if so desired, a clearer representation of the technique is shown in Fig. 26. The cost of using a separate varicap is more than economical when compared to the complexities of individual bandswitching, since the varicaps are now cheaper than ever.

This approach also means that no hot end need be switched for the ferrite rod antenna, and the entire high impedance part of the circuit is contained on and around the antenna itself. The antenna simply provides the much lower impedance output from the tapped sides of the coils, down to about 1–2kΩ. This can be reduced still further using a f.e.t. source follower (Fig. 27), which acts as an active transformer down to a 50 or 75Ω line level, which can then be fed over a considerable distance—up to 25–50m has been verified, with the probability of more. So you

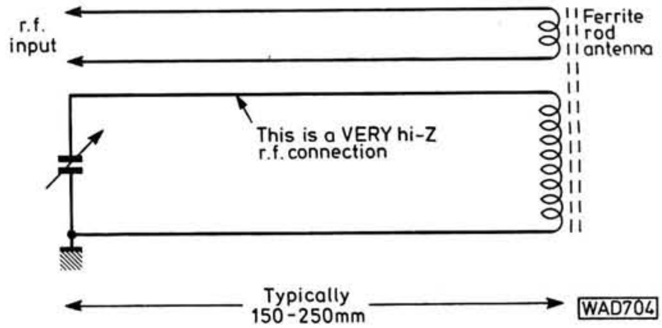


Fig. 25: A conventional ferrite rod antenna circuit

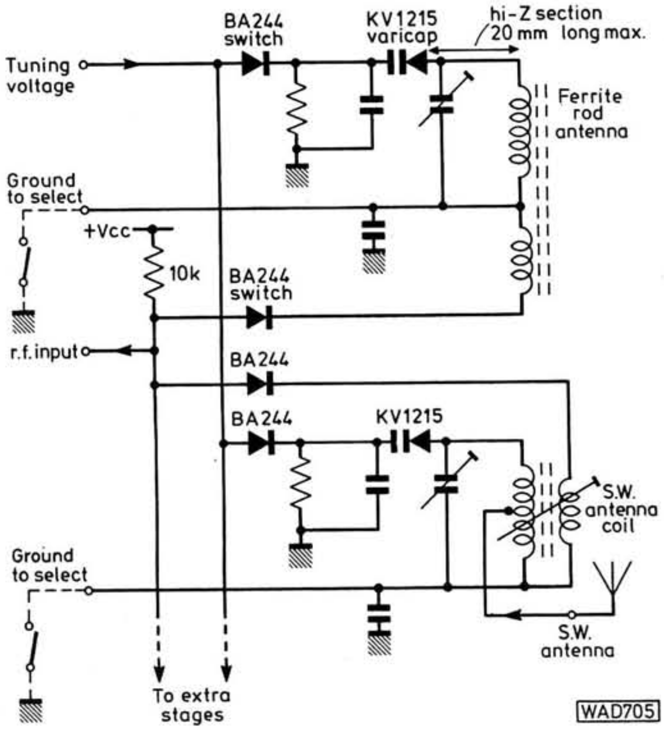


Fig. 26: A d.c. tuned and switched ferrite rod antenna system

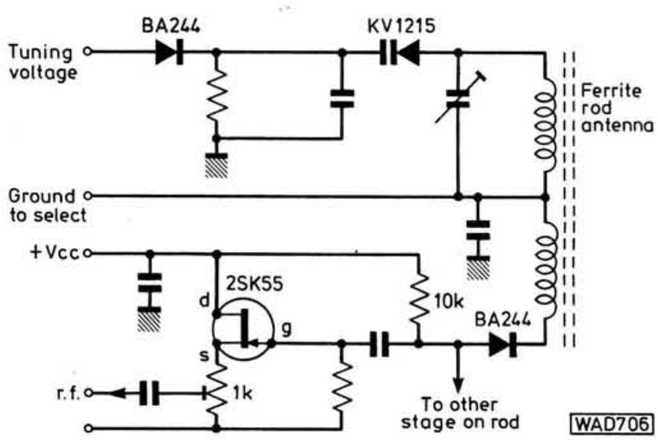


Fig. 27: Adding a f.e.t. source follower to achieve an even lower output impedance

could place the ferrite rod well away from the tuner if required—even to the extent of fitting it to a mast and rotator to get exact alignment on DX. The angle of the rotator could also be driven from the meter output via a form of servo system, so that the antenna was automatically aligned for best results. It is hoped that a reader may be sufficiently moved to try this out and report his findings within these pages. The same idea would also apply to f.m. although the inverted a.g.c. output would have to be used for signal level reference (Fig. 28).

Those of you suspicious of new-fangled things like varicaps may be beginning to see some of the broader reasons why this technique is really so much better than mechanically operated tuning systems.

The diodes used for r.f. switching are specifically designed for the purpose, and whilst the standby 1N4148 will "do", some examples are not satisfactory when operated in this type of circuit, with the relatively low switching currents involved. The currents are purposely kept as low as possible, since the passage of the d.c. switching current through the coil secondary will tend to disturb the characteristics (solenoid effects). In an ideal world, each secondary would be capacitively isolated from the diode, and a choke used for the d.c. path, but the added complication was not found to be necessary in this type of circuit.

Apart from the elegance of the input and switching arrangements, the rest of the a.m. signal path is relatively uncomplicated, being fed into a double-balanced mixer in the i.c. with the local oscillator going into the other side of the mixer. The resultant 468kHz i.f. is selected via a filter block using the CFM2 mechanical resonator, and carefully matched to provide as much bandwidth as possible at the top, without letting too much in at ±5kHz when operating under short-wave conditions. Purists may like to spend more on this part of the circuit, and a 4-element ladder filter, Type SFR468 is available with improved shape factor, and at higher cost. The communications-style 455kHz components cannot be used since the i.f. offset is fixed at 468kHz by the MPU ROM.

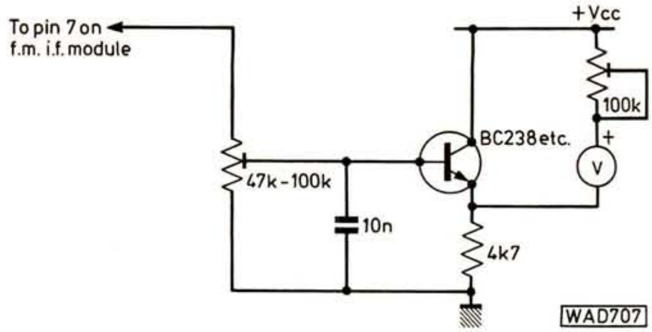


Fig. 28: A signal level meter amplifier

★ components

STEREO DECODER MODULE

Resistors

¼W 5% carbon film

33Ω	1	R16
270Ω	1	R14
560Ω	2	R6,24
680Ω	2	R23,25
820Ω	1	R9
1kΩ	1	R28
1·2kΩ	1	R4
1·8kΩ	2	R21,22
2·2kΩ	1	R3
4·7kΩ	5	R5,10,11,12,15
10kΩ	1	R13
15kΩ	1	R8
27kΩ	5	R17,18,19,20,27
47kΩ	2	R7,26
470kΩ	2	R1,2

0·1W min. horizontal preset

4·7kΩ	1	VR3
25kΩ	1	VR4
47kΩ	1	VR2

(VR1 not used)

Semiconductors

Integrated circuits

KB4437	1	IC1
KB4438	1	IC2

Transistors

2SA1084	1	Tr2
2SC2546	1	Tr1

Diodes

1N4148	1	D1

Capacitors

Polystyrene

470pF	2	C4,8
680pF	1	C3
1·5nF	3	C2,17,18

Sub-min. plate ceramic

180pF	2	C26,27

Low voltage disc ceramic

47nF	1	C7

Electrolytic, p.c. mounting, 10V

47µF	3	C22,23,24

Electrolytic, p.c. mounting, 16V

10µF	1	C10
22µF	1	C32
47µF	2	C29, 31
100µF	2	C28, 30

Electrolytic, p.c. mounting, 35V

4·7µF	5	C1,19,20,21,25

Electrolytic, p.c. mounting, 50V

2·2µF	8	C5,9,11–16

(C6 not used)

Filters & Inductors

FL1, FL2 208BLRC–3315N (2 off)
L1 7mH Can 1980

Miscellaneous

IC sockets, 2 off 16-pin × 0·3in d.i.l. P.c.b. connectors, 0·1in pitch, board/wiring: 2 off 10-way. Printed circuit board. Screening box assembly.

The i.f. amplifier has excellent a.g.c., and the detector (at low level, and thus less likely to contribute to i.f. instability problems) provides exceptionally good quality audio. The audio pin of the i.c. is filtered with a 55kHz low-pass filter (as described in connection with the f.m. and stereo considerations). The audio passes through the stereo decoder, taking advantage of the mono switching facility of the decoder that provides outputs on both Left and Right channels from a single mono input.

Although signal muting does not operate on a.m., the synthesiser sends out a control signal to the muting amplifier after the stereo decoder, muting the audio whilst tuning operations are being carried out. The meter output of the TDA1090 provides an a.m. signal level reference, which is used in the synthesiser scan-detector circuitry. A preset resistor determines the actual threshold value of the signal level before the stop signal is activated.

Layout

So far, the theoretical and conceptual aspects of the project have been considered in some detail. Although references have been made to some of the practical aspects of constructing a multi-band synthesised broadcast tuner, it is most essential to appreciate the more esoteric aspects of the art of merging radio and logic systems in close physical proximity.

If you feel that you have mastered the wiles and subterfuges necessary in the practical "art" of wireless, compared to the comparatively straightforward skills needed to get to grips with simple electronic and digital equipment such as timers and audio amplifiers, then pitching all these very different skills together in one system creates far more potential for problems than might be suggested by the individual complexities of the component parts.

The Synthesiser

The p.c.b. configuration for the main synthesiser unit (Fig. 30) is dictated by the positioning of the input/output pins of the input/output ports of the major i.c.s used. Since the display itself is a static system, an individual connection must be made to each segment from the display decoder, so the best means of achieving this is to mount the display directly above the HA12009 driver, IC3.

The nature of the display enforces the use of a vertical front panel p.c.b., and so this panel has been extended to incorporate all the switching and remaining display arrays for the signal level indicator and memory indicator system. With the complexity of the switching arrays, it is not readily feasible to approach the problem in any other way that can be encompassed within the resources at the disposal of the enthusiast constructor.

A more subtle problem associated with the layout of the switching array is the fact that it is scanned with 20ms pulses, which are—like all pulses—potential sources of radio frequency interference (r.f.i.). Whilst it would be nice to have the array as close to the MPU as possible, the best solution is to be aware of the potential r.f.i. hazard, and screen the synthesiser sections from the radio inputs. The antenna connections for the tuner are kept outside the metal cabinet of the tuner as far as possible.

The noise problem from the f.m. prescaler occurs at and around the prescaler i.c. output—but since the prescaler is inoperative on a.m., the only r.f.i. to watch for is that which falls in the 88–108MHz band coverage of f.m. Part 1 of this article discussed the scope for such interference at some length, with the major practical consideration being the correct earthing and decoupling of the complex v.h.f. signals involved. Even apparently substantial screening is not totally effective, as the screening itself (despite earthing, etc.) may easily be radiating the spurii.

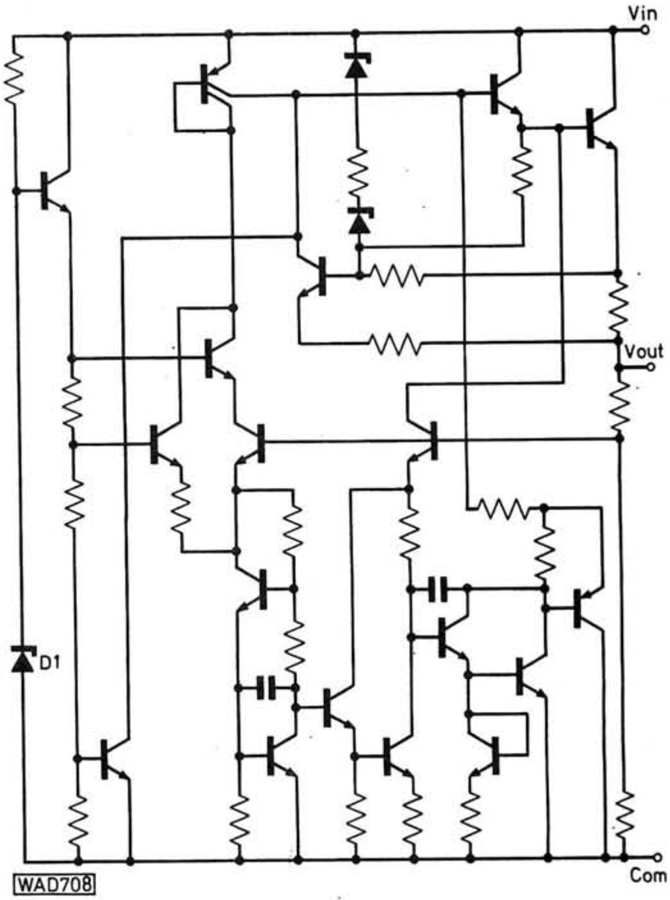
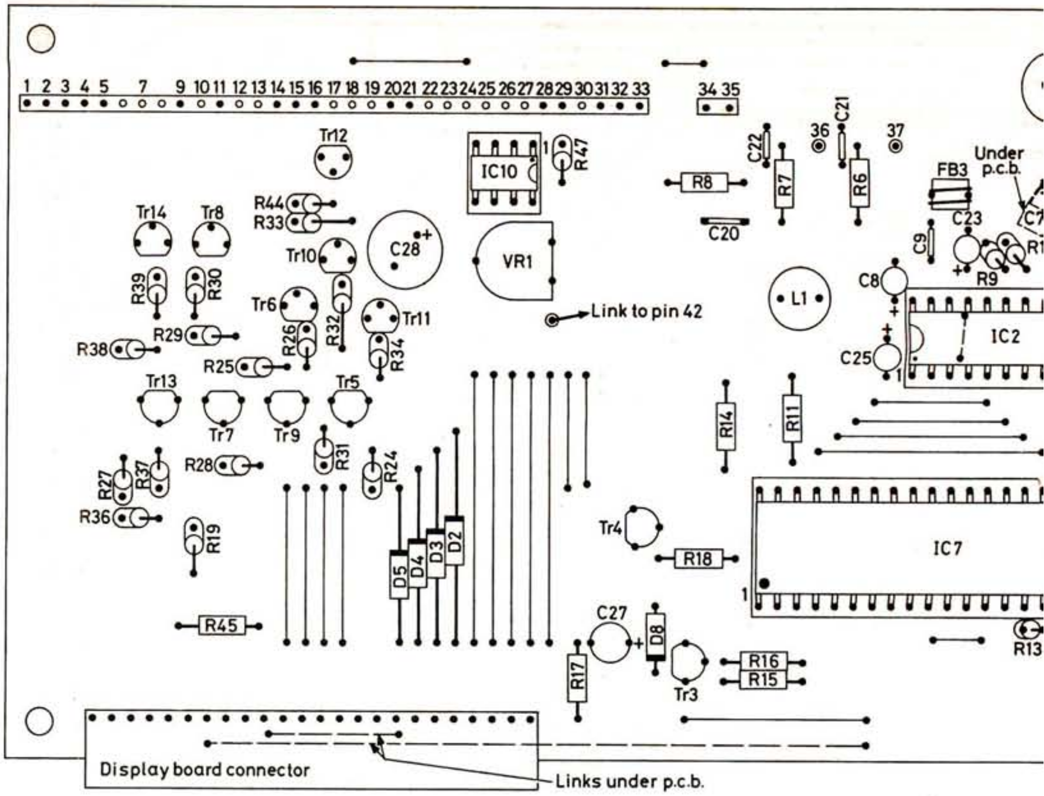


Fig. 29: Internal equivalent circuit of a 78' series voltage regulator

The layout used here, from the point of entry of the f.m. local oscillator to the input of the programmable divider IC2, is quite crucial, and short leads are vital in this area. Good r.f. components must be used to keep decoupling impedances as low as possible. The real solution is to place the entire tuner in a metal cabinet, with all antenna connections fully screened from the adjacent sources of r.f.i.

The programmable divider is itself a source of r.f.i. (digital division again), except that the HD44015 is a much lower power CMOS circuit, with the only major clock output of any significance being the 50Hz derived from the crystal to drive the timekeeping functions of the MPU. Thus the main potential for r.f.i. lies in the supply voltage connection, which is decoupled with a choke and a capacitor L1/C8. It is worth noting that simply taking the capacitor across the supply rails often leads to compounded problems where the earth is not of a sufficiently low impedance, for the earth track then acts as an antenna for the r.f.i.

Finally, the "three-terminal" voltage regulators used are given a very respectful r.f.i. treatment, with toroidal ferrite chokes and multiple capacitive decoupling. The r.f.i. aspects of three-terminal voltage regulators warrant an article in their own right, since very many obscure and difficult noise problems arise from their application in sensitive r.f. environments. Most manufacturers try to pretend the problem doesn't exist, and indeed no specification ever seems to appear on the data sheet for r.f.i. The internal diagram of the device (Fig. 29) reveals the presence of a



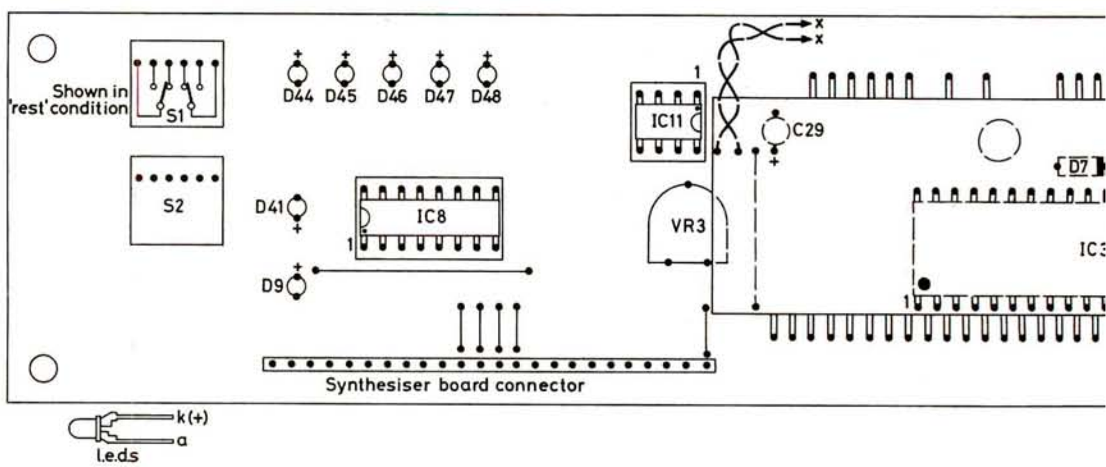


Fig. 30: Component layout of the main synthesiser p.c.b. (top) and its associated display/control p.c.b. (bottom) shown full size. They are joined by two right-angled multi-way connectors. See the wiring diagram Fig. 10 for full details of the links on the main synthesiser board.

Full-size paper prints of these p.c.b.s are available from the Editorial offices at Poole, price £0·45 including post and packing to UK addresses

Please note that the equation at the foot of page 41 in our October issue should, of course, say "Divided by 10 000 = F_{ref} = 1kHz"

completely unbypassed voltage reference source, D1, followed by lots of amplification—hardly textbook design as far as avoidance of wideband noise is concerned.

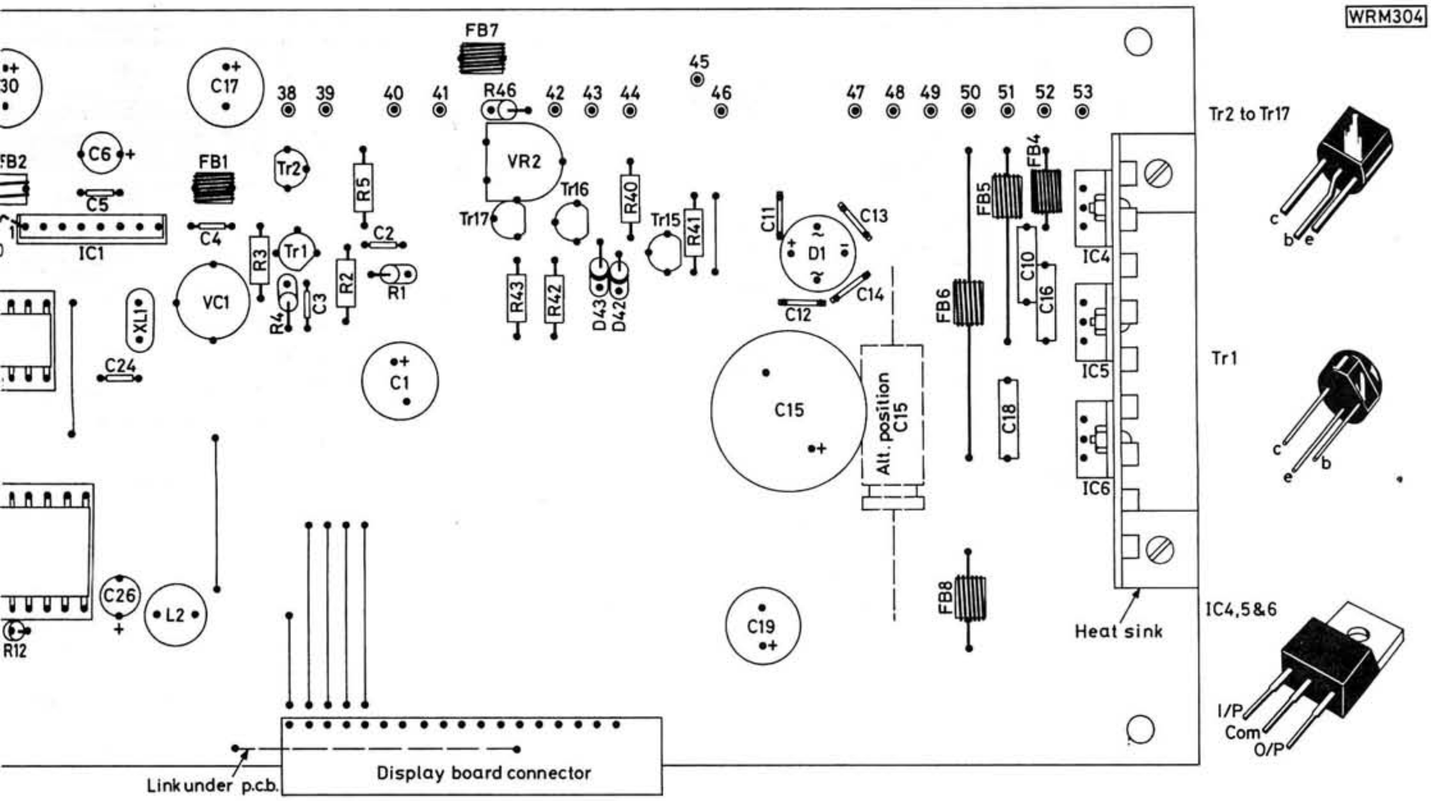
Of all manufacturers' versions of the 78' series voltage regulators, none appears to be any better than any other. They can all be very poor unless treated to the sort of decoupling used here. The output impedance of the three-terminal voltage regulator is very low, making simple capacitive decoupling rather ineffective unless very high values are chosen.

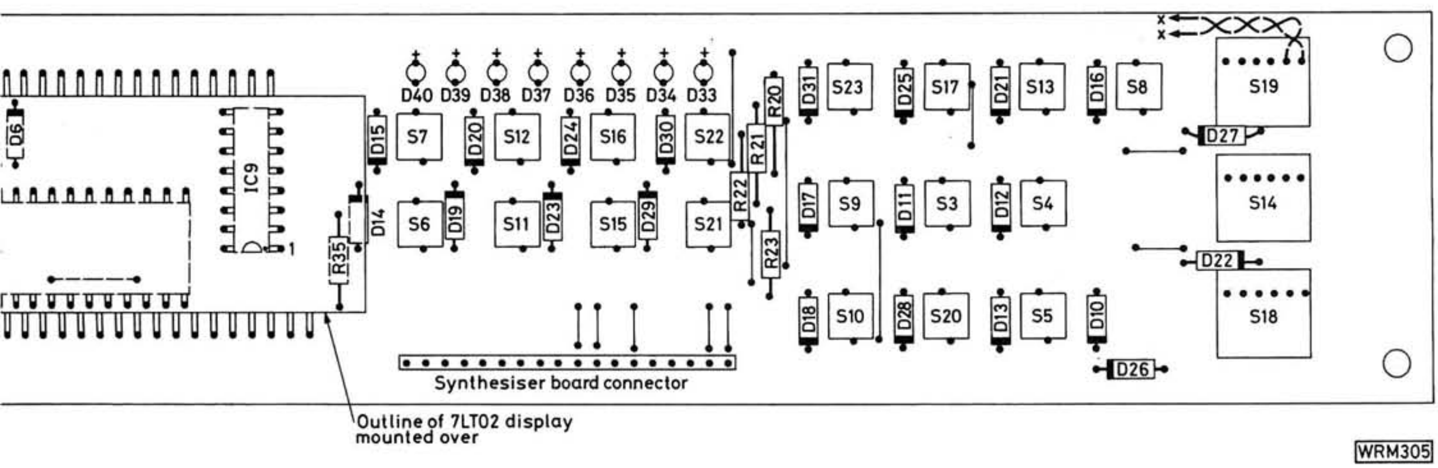
A further point on the subject of three-terminal voltage regulators can be made here, since many constructors appear to be deceived by the beguiling simplicity of the external circuitry required. A three-terminal voltage regulator is in truth a very high gain, wideband linear i.c., and as such requires careful consideration in terms of layout and earthing. Any hum loop in the earth layout between the earth pin and the decoupling components may be reflected in an inexplicable hum on the output—which, by virtue of the low impedance of the device is virtually unpreventable by the addition of extra capacity on the output. Notwithstanding this, once the shortcomings of these regulators are appreciated and catered for, the overall advantages of this approach in the power supply section justifies their implementation.

Synthesiser Construction

The i.c.s may all be fitted into sockets with the exception of display driver IC3 and memory IC9 which must be soldered directly to enable the display to be fitted correctly. Take great care when fitting the HA12009, since desoldering a 42-pin i.c. can be a very tiresome business indeed. The HD44752 MPU IC7 is a 42-pin device and not many 42-pin i.c. sockets exist. The author used a combination of a 40-pin socket, and a piece lopped off the end of another similarly spaced socket.

The remainder of the construction requires little comment, apart from the obvious one that care must be exercised when soldering. This may seem tedious and repetitive to many of you, but the vast majority of constructor problems may be summed up as highly avoidable incorrect





placements of components, or poor soldering. A hot iron (temperature controlled is by far the most satisfactory) and a fine tip are a good start. Experienced constructors may prefer a slightly blunter tip for speed of work, but if in doubt, use a fine tip with 22 gauge (or smaller) solder.

Don't attempt to start the construction of a project of this complexity unless you are already equipped with a decent soldering iron, or are prepared to acquire one. You will waste far too much time and money finding out the hard way that the correct tools are vital.

Setting up the Synthesiser

Once the p.c.b.s are assembled, then setting the synthesiser is sheer simplicity. Only the crystal trimmer VC1 need be adjusted, and then it is doubtful if this will provide any problems, since the 60pF trimmer is approximately 30% enmeshed in virtually all instances examined so far. The adjustment can be fairly coarse, since the tuning accuracy is assured by the multiple division of the reference to provide the channel spacings—and the only effect of mistuning is likely to be a long-term inaccuracy of a few seconds in the clock function of the completed unit.

Careful examination of all the features requires all the various radio tuner sections to be correctly fitted, since most are not available until the p.l.l. sends out a lock-detect signal to the MPU. The scan tuning and memory enable in particular will not work. However, the setting switches can be checked in certain respects.

Using the Manual Tuning Up/Down buttons, the clock can be set after selection of the function on the appropriate selector. The "Enable" key must be pressed to light the "Enable" l.e.d., then simply pressing the Tune Up/Down buttons will respectively set the hours and minutes of the display in a 24-hour time format. Pressing the button briefly will advance the setting one unit, or holding the button down will cause the setting to advance at a much faster rate. There is no timer function available with this system.

Next month, the final part of this series will deal with the remainder of the construction, and setting up of the completed tuner.

the first YL

Ron HAM

No doubt most of us remember the excitement of our first short-wave receiver, and the thrill of hearing radio signals from the far corners of the earth.

About 55 years ago, a young lady, Barbara Mary Dunn, entered the new and exciting world of short-wave radio at a time, when it addition to the names and call-signs of it's own, now famous, founder members, the RSGB call-book listed such names as Capt P. P. Eckersley, 2OO and J. Scott-Taggart, 2LR, along with such firms as British Thomson-Houston, 2ZI, Marconi Wireless Telegraph Co. Ltd., Writtle, 2BO and Metropolitan Vickers Electric Co. Ltd., 2AC.

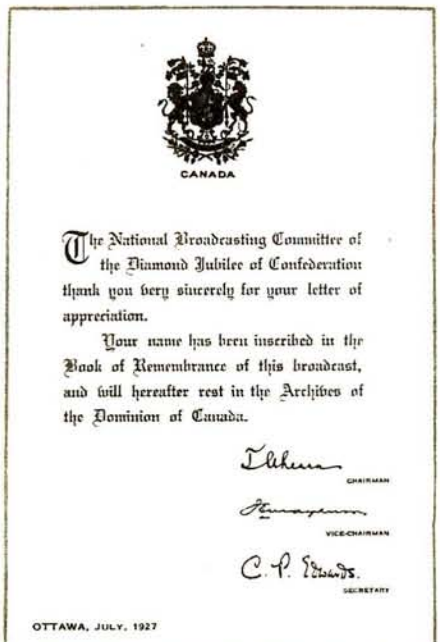
In 1927, the Radio Society of Great Britain and Printing Craft Ltd. jointly produced a foolscap sized *"Annual Diary and Log Book"* which contained the call-book, was well supported by component advertisers and cost three shillings and sixpence (17½p). On 24 August 1926, Guglielmo Marconi wrote to Printing Craft Ltd.

"By combining information, useful tables and data with a practically ruled-and-printed daily logging chart covering the full twelvemonth of the year, the Official Diary and Log Book you are bringing out in conjunction with the Radio Society of Great Britain should prove of great use to the increasing army of investigators and others interested in the Science of Radio Transmission and Reception."

Positive Reporting

This is precisely what fascinated Barbara Dunn because her early log books, now in the author's collection, show extensive reports about signals she received from amateur, aeronautical, broadcasting, experimental and maritime stations, always accompanied by the prevailing atmospheric and weather conditions and any appropriate press cuttings. One of the many historic broadcasts she heard was on 26 metres, between 0330 and 0630 on 2 July 1927, when a programme from Ottawa, celebrating the "Diamond Jubilee of Confederation" was relayed by the Marconi Beam Station, Drummondville, Quebec. At the end of this transmission she heard Drummondville call up stations in Mexico and New Zealand thanking them for reports and asking listeners in general for further reports. True to form, Barbara replied and her extensive report was acknowledged with the official commemoration card and an engineering card.

In those early years interesting things, which we take so much for granted today, were happening all the time. On 6 March 1927 Barbara heard signals from the Norwegian whaler, "Sir James Clark Ross", callsign AQE, at the South Pole. Also on the 19th she read signals from the British warship "Renown" while it was visiting New Zealand as part of a world tour (6 January to 27 June) with the Duke and Duchess of York on board. On the 11th she listened to Dance music from 2LO, London,



CANADA

The National Broadcasting Committee of the Diamond Jubilee of Confederation thank you very sincerely for your letter of appreciation.

Your name has been inscribed in the Book of Remembrance of this broadcast, and will hereafter rest in the Archives of the Dominion of Canada.

CHAIRMAN

VICE-CHAIRMAN

C. P. Edwards.
SECRETARY

OTTAWA, JULY, 1927

Commemoration card received from The National Broadcasting Committee in Canada. Heading photograph courtesy of *Wireless World*

being relayed by Gerry Marcuse, G2NM, from his home in Caterham on 90 metres. Barbara reported on several of these late night transmissions and sometimes Gerry would end his experimental transmissions with: "Hello Barbara, Goodnight, thanks very much for your reports which are very welcome."

Like many other wireless enthusiasts, Barbara took part in the solar eclipse tests between 0526 and 0717 on 29 June and logged 35 amateur and broadcast signals, mainly from the USA.

At 1726 on 9 March Barbara reported on signals from GLYK, the motor yacht "Adventuress", cruising in the English Channel. This yacht was fitted out with short-wave radio by Col Millard and F/lt Durrant, o/c WT, RAF Kidbrooke, who wrote to Barbara, as he had done before: "Thanks again for your lucid reports." Between 0449 and 0555 on the 23rd she heard WGY, the General Electric Co., New York, relaying the Tunney-Dempsey boxing match and on the following day she cut a picture from the Daily Mirror, taken during the first round of the fight and labelled, "transmitted by Marconi Wireless".

During October 1927, she heard a QSO between the British troopship SS "Dorsetshire", callsign GDKB, and Air Ministry, London, callsign GFA. Barbara often monitored the signals between these two stations and her reports to the RAF radio station at Kidbrooke were again, warmly acknowledged.

On 14 November she received a letter of appreciation from the research department of Marconi's Wireless Telegraph Co., Chelmsford, for her reception reports of signals from their Chelmsford station 5SW (used for Empire broadcasting) between noon on 5 November and midnight on the 11th.

The First YL

Among the more familiar amateur radio abbreviations are the letters YL which are instantly recognised as Young Lady, just as XYL means Wife and OM is Old Man. Digging into my archives I found a letter from the late John Clarricoats, G6CL, general secretary of RSGB, to Barbara Dunn, dated 2 May 1961, in which he explained that the first lady to hold a GPO amateur transmitting licence was a Mrs C. E. Ingram, callsign 1XI, of Ilford in 1913. Barbara joined the RSGB in September 1926 and in July 1927 applied for a transmitting licence. On 4 August she received a letter from the GPO saying that the PMG would grant her a transmitting licence for c.w. on 23m, 45m, 90m and 150–200 metres, providing she was able to "satisfy the PMG by examination as to your qualification in Morse working." This was no effort for Barbara and an entry in her log book on 19 August reads: "Did my Morse test at Chelmsford Post Office. Received at over 13 words per minute (sometimes quicker) and sent at 14 words per minute. Examiner said I'd done 'very well indeed.'" Barbara received her licence on 1 September and the callsign 6YL, later G6YL and made her first call to 6HV on 45 metres at 1529 on 16 November and remained a very active c.w. operator for more than 50 years.

Southern Cross

G6YL soon made many friends around the world and was noted for her scientific and meticulous approach to her radio operating and by 24 June 1930 her QSOs numbered 2122. Despite this heavy commitment to consistent contacts she took a break to play her part in the historic flight of the "Southern Cross", fifty years ago.

On 24 June 1930, four men led by an Australian, Captain Kingsford-Smith, a battle veteran of the Royal Flying Corps, set off in a Fokker monoplane named "Southern Cross", powered by three Wright Whirlwind engines, from Portmarnock Strand, near Dublin, for New York. Evidently Portmarnock was finally chosen for the departure because the Strand offered some 4km of runway, which it was felt the aircraft, weighing between eight and nine tonnes fully laden, needed for take off.

Extracts from G6YL's Log

1017 "Been shooting suns and things. Gee! it's icy cold outside. Bet Van and Smithy are feeling it. We are all wrapped up like polar explorers, but it's still pretty nippy."

To Wright Aeronautical Corporation, Peterson, New Jersey. "The good old Whirlwinds are fine and good for thousands of miles yet."

1100 "Our position works out at 53.15N and 16.57W giving an average ground speed since leaving cost of 82 statute mph. This is satisfactory and leaves us a good margin. All aboard safe and cheerful. Revs 1675, airspeed 100, altitude 400ft" . . . Smith.

1136
To Fokker, Amsterdam,
"Cheerio and best wishes, Southern Cross behaving perfectly. Regards from all the boys" . . . Smithy.

1144 "Just been talking to SS George Washington."

1251
To Air Ministry, Den Haag, Holland . . .
"I send my regards to Dutch people, everything OK . . . Kingsford-Smith, Vandyke . . . Atlantic.

1308 VMZAB: "All OK."

1318 "Hope to see you in New York tomorrow PM, Vandyke and Kingsford-Smith."

1825 "About 1800 miles to go."

Wednesday, 25th

0010 "It's getting quite dark now inside the cabin. Cheerful glow of radio tube with its cherry red plate makes cabin look cosy. To complete the effect I think I'll wrap myself around another sandwich. Goodbye."

0022 "Well that was a jolly decent supper I think for this ship. A snappy chicken sandwich and a cup of coffee Royal. Not dark yet but we're fairly high, nearly 4000ft."

0045 "Getting darker now. The outboard motors are shrouded in blue haze and each exhaust port has a faint pink flame feathering from it. Very uncanny . . . The lettering on the starboard wing is embossed in gold as the last radiance from the western sky touches it."

0059 "Must try and get bearing from VCE now." (Cape Race callsign.)

0205 "Position: latitude, 48.12N longtitude 45.5W, true course 254. Distance to go to Cape Race, 250 miles. Everybody happy and all OK . . . Smith."

0245 "Calling VCE, please listen 600m."

0315 "Can't raise VCE yet . . . many thanks but endeavouring to reach American territory before landing, Kingsford-Smith."

0402 "Only 100 miles off Cape Race and the stiff doesn't reply. It doesn't look as if we shall get a bearing just when we want it. We should be over Cape Race in an hour."

0505 "Sorry old boy, been messing about trying to get a bearing. Very dark. Flying blind. Motor ringed with flames. Still 160 miles from Cape Race. Dickens of a struggle to keep awake now. Drone makes us tired."

0509 "A faint streak of approaching dawn."

0519 "Shall have to try for more bearings now."

Captain Kingsford-Smith and his companions, Mr A. Vandyke, second pilot, Mr J. Stannage, wireless operator and Captain J. Saul, navigator, watched by some 10 000 people took off to loud cheers, around 0430 for their east west flight across the Atlantic ocean. Captain Kingsford-Smith made a perfect take off and the aircraft rose after a 2000 metre run.

Wireless Communications

The Southern Cross was equipped with two transmitters, one for 600m and the other for 33·3 metres and her in-flight messages, received by many radio amateurs, were co-ordinated at Magnet House, Kingsway, the London headquarters of the General Electric Company, in co-operation with the Radio Society of Great Britain. According to the *Newcastle Daily Journal,* 25 June 1930, a Dr Gordon Wilson, in London, was one of those picking up the messages and the paper said: "The three-valve set, which was entirely home-made, was working through an amplifier and loudspeaker. The Morse signals came through distinctly on a Ultra-Short wave of 33·3 metres."

"Girl's 30 Hours at Radio Set", was the headline on page 3 of the *Daily Express* newspaper, 27 June 1930, and continued: "The thrilling story of a Northumberland girl's 30-hour vigil at the dials of her wireless set while picking up signals from the Southern Cross during its Atlantic flight is revealed today." The report, referring to Barbara Dunn, described her as "an attractive girl in her early twenties." She told the reporter: "The whole thing was a most exciting experience, directly I received news from the General Electric Company in London that the Southern Cross had taken off, I tuned in my short-wave receiver to the 33-metre wavelength on which Mr Stannage was expected to transmit."

Barbara received her first message from the aircraft, callsign VMZAB, around 1015 when she read:

"To Smith, Longville, Sydney. Love to all, having a good trip but cold and some head winds."

Wonderful Wireless

According to press reports at the time, Ottawa station tried to give bearings to the Southern Cross at 0600 and it seems that the aircraft had been negotiating thickening fog for some time, in addition to their compass trouble, because part of a wireless message at 0945 from Kingsford-Smith said:

"Have been in very bad fog all night and trouble with the compass held us up quite a lot. Afraid we will have to land in Newfoundland or Nova Scotia for petrol after all."

The Southern Cross passed Cape Race and although Captain Kingsford-Smith was eager to push on to the American mainland, circumstances forced the plane to turn back and at 1000, the flyers informed Cape Race that they were hoping to reach Harbour Grace, Newfoundland and at 1013 the Southern Cross flew low over Bay Roberts' cable station, looking for Harbour Grace.

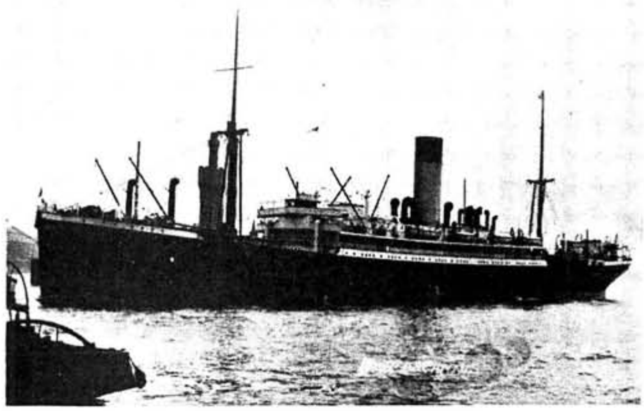
The very dense fog over the airfield prevented the plane from landing unaided and while she circled slowly down a wireless message, picked up by the Institute of Technology beam station at South Dartmouth, Mass, said:

"Please ring up Harbour Grace and ask them to send a pilot plane above the fog."

Very soon an aircraft from Harbour Grace found the Fokker hovering over the aerodrome and escorted her through the fog to a safe landing at 1053 and the completion of an approximately 31-hour trip. On arrival, Captain Kingsford-Smith said: "But for the wonderful wireless apparatus we should never have got out of the fog."

Her First VK

On 24 July she resumed normal DX working and among her contacts were ships' wireless operators, many of whom had their own amateur callsigns. By 12 November 1931 she had made more than 3200 QSOs and began an experiment in propagation with John R. Witty, G5WQ, while he was travelling as a passenger on the Blue Funnel Line, TSS "Ascanius" from Las Palmas, via Capetown, to Melbourne from 13 November to 22 December. John, from Great Crosby, Liverpool, installed a two-valve receiver, known as an OV1, comprising a screened grid detector and one l.f. stage, fed by a half-wave doublet aerial only 1·22m above his cabin roof, to listen for G6YL's signals on 7MHz and 14MHz. At the end of the journey he sent her a detailed log and a special home-made QSL card.



HMS Ascanius—received from John R. Witty G5WQ

According to the list of experimental stations in the RSGB Annual, 1928, ships' stations with amateur calls place an "X" before their usual prefixes. In view of this rule and a study of Barbara's log I can only assume that the callsign of the Ascanius was X1.YJ because on 16 December she worked XX1.YJ, her first in VK6, when the ship was off Cape Leenwin, Western Australia and on the 18th she had her first QSO in VK5 when XX1.YJ was half way across the Great Australian Bight.

RSGB Award

At the 1930 RSGB Convention, Barbara Dunn was awarded the 1930 Committee Cup for outstanding work in the first series of 1·7MHz tests and became the first YL to hold an RSGB trophy.

"My station is c.w. only. I don't like phones," she told me back in 1974 and by then she had made more than 15 000 QSOs and dozens of awards.

I think that it was this fascination she had for c.w. that made Barbara Dunn one of the finest amateur radio operators of this century. ●

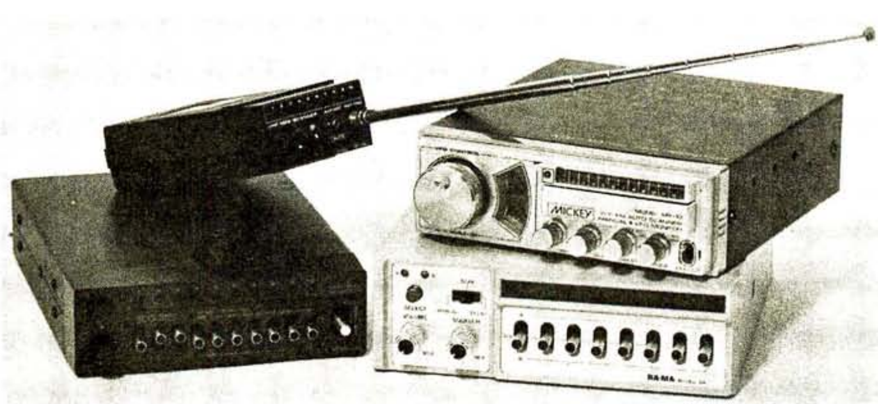
PRODUCTION LINES

ALAN MARTIN G8ZPW

Scanning Receivers

Amateur Radio Exchange inform me that they are able to supply a really competitive range of scanning receivers, all offering top-grade technical specifications.

The four shown in the photograph are, top left, the MR–1000A a hand-held v.h.f. scanning receiver covering 10 channels, and allows automatic scanning or manual tuning across selected crystal-controlled channels. Supplied with NiCad power supply and charger, the price is only £39.



The MR–110, bottom left, is a v.h.f. scanning receiver intended for mobile operation, with 10–channel capability and lock-out facility. Sensitivity is 0·8μV (20dB S/N) and the unit is powered from an external 12V source. Priced at £49 the MR–110 is supplied with crystals fitted for 5-channels ex-stock.

Top right is the MK–10, a mobile v.h.f. scanning receiver covering 144–152MHz. The receiver scans up to 12 crystal-controlled channels either automatically, by manual tuning or via the v.f.o. control on the main dial and incorporates an automatic lock-out facility. Powered by an external 12V power supply, sensitivity is 1μV (25dB S/N) and the basic price is £69.

And last, but by no means least, is the RAMA/8A, a 16-channel capability crystal-controlled air-band scanning receiver, covering 108–136MHz. With a choice of either 8 or 16 channel auto-scanning or manual operation the sensitivity is 1μV (10dB S/N). Powered by an external 12V or a.c. mains supply, the basic price is £79.

Crystals for all the models are available at £2 per channel.

Prices quoted for the receivers include VAT and p&p, and are available from: *Amateur Radio Exchange, 2 Northfield Road, Ealing, London W13 9SY. Tel: 01-579 5311.*

Calculator Plus

Casio, the manufacturers of quality calculators and watches have introduced a new musical calculator with a very novel additional function.

The MG–880 is an eight-digit calculator with the four basic calculations, plus three memory functions and percentage key. It also possesses a musical function with the tune "When The Saints Go Marchin' In" programmed into the machine and the calculator keyboard doubling as the tonic sol-fa plus three octave notes.

The new feature is a nerve-jangling game facility similar to the "Space Invaders" game, in pubs and clubs. Basically, the game presents a randomly selected series of digits, which we shall call spaceships, appearing at the extreme right of the display, these spaceships then advance across the display towards the earth's missile battery, represented by a single figure at the left of the display, which can be advanced, numerically, by depressing the "Aim" key.

The object of each phase of the game is to eliminate 16 separate spaceships with a limit of 30 missiles. This is achieved by depressing the "Fire" key when the same digit shows on both sides, this action eliminates the spaceship and moves the remaining spaceships back a space for each spaceship eliminated.

In each of nine encounters of stage 1 of the game, the earth has three defence lines, indicated by horizontal dashes immediately to the right of the earth's missile battery. If the advancing spaceships reach the defence lines, one of the defences is removed and the game restarts until all three defences are eliminated or the 16 spaceships are destroyed.

Should the player destroy the 16 spaceships, through nine encounters, the game goes on to stage 2, where the spaceships start appearing one space closer for a further nine encounters.

As the player progresses through each stage, the spaceships move across the display faster. Upon completing stage 2, the game returns to the beginning of stage 1, and continues.

Scores are accumulated by destroying spaceships, and the sooner they are destroyed after appearing the higher the score.

Our office champion, the steely-nerved Sharron, has achieved a score of 39 840, so far.

The unit also has an "auto power-off" facility which, should the unit be left on accidentally, automatically switches it off after seven minutes.

The MG–880 has a RRP of £12.95 but Tempus offer the unit at a discounted price of £10.95.

A catalogue giving full information of available Casio products, can be obtained on application to: *Tempus, Dept PW, Beaumont Centre, 164–167 East Road, Cambridge CB1 1DB. Tel: (0223) 312866.*

More on page 57 ▶▶▶

air test

USER REPORTS ON SETS AND SUNDRIES

ICOM IC-2E
2m Hand-held Transceiver

Hand-held f.m. transceivers have been getting smaller and smaller while at the same time offering more and more features for the amateur user. The Icom IC-2E is probably the smallest of the latest bunch of hand-held 2m rigs to appear on the market.

Fully synthesised it covers all the 2m amateur band in 400 steps of 5kHz each together with full repeater shift facilities.

In its standard form, with the normal NiCad battery pack fitted the power output on transmit is 1·5W but this can be increased by fitting optionally available larger battery packs. Furthermore a slide switch on the back of the case reduces the output to 150mW if required to conserve the battery power.

All the controls, with the exception of the power switch, are mounted on the top of the case, as is the b.n.c. aerial socket.

Frequency selection is by a miniature thumbwheel switchbank which proved to be quite easy to use in daylight but could pose a problem in the dark, especially if ones fingers are frozen. However this means of frequency selection does have advantages for a small hand-held rig as it also doubles up as the readout. All the other controls proved easy to use and in general this transceiver was ideal for taking out on the Sunday walk.

The review rig was taken on holiday to Cornwall and used on the GB3NC at St. Austell. (North Cornwall on the south coast of Cornwall!) No problems were experienced and the NiCads were kept charged by plugging in directly to the car battery via the jack provided in the battery pack.

The transceiver was also worked through a Slim Jim aerial which improved the coverage considerably over that obtained with the standard 'rubber duck'.

Battery drain on maximum power transmit was about 550mA and 130mA during receive at maximum audio gain. This is reduced to around 220mA on low transmit power and 20mA on standby receive, giving a useful operating time of several hours on each charge. As the battery pack is easily removable it would be possible to carry spare packs in case of complete discharge in the field. It is also possible to operate from the car battery if required.

The small size of the IC2-E, it measures 156 × 65 × 35mm with the standard 9V battery pack, and light weight (470g complete) make the transceiver ideal for pedestrian use and also as an 'active' microphone for mobile use feeding into a suitable linear amplifier.

As with all Icom rigs the IC2-E is supplied with an excellent instruction manual complete with full maintenance details and circuit diagram and p.c.b. layouts.

The IC2-E costs £159 including VAT from **Thanet Electronics Ltd., 143 Reculver Road, Beltinge, Herne Bay, Kent. Tel: 02273 63859,** to whom we offer our thanks for the loan of the review unit.

SHADOW ELECTRONICS
Tone Burst Kit

Although it is possible to whistle up a repeater it is much simpler to fit a simple toneburst unit to produce an accurate 1750Hz tone for the required half a second or so.

There have been many circuits published for tonebursts, some of them being quite complex, with crystal controlled oscillators and even built in time-out indicators.

However, many people who do not want to go to the trouble of experimenting or even building a unit from scratch would be prepared to put together a simple kit for a toneburst unit.

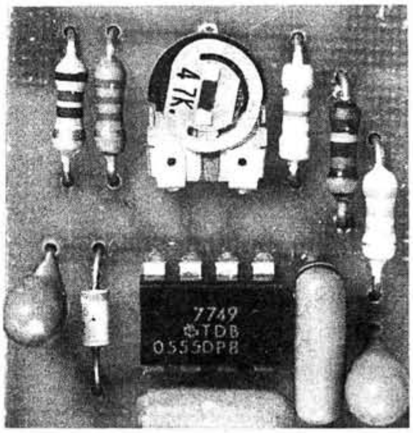
Shadow Electronics produce a *range* of small kits for the amateur radio enthusiast and this includes a simple toneburst encoder.

The kit is supplied with an instruction leaflet and consists of a small p.c.b. about 35mm square together with the components, wire and solder for a simple automatic toneburst unit based on the ubiquitous 555 timer chip.

No problems were encountered with the construction of the unit all the components fitted the board and were of good quality.

Only one preset control is fitted, this being used to set the tone to 1750Hz. Fixed resistors have to be changed to alter the duration of the toneburst and the output level.

The instructions recommend that the tone is set before installing the unit. I found that this was not really feasible as to achieve the required output from the toneburst unit to adequately deviate the Wood & Douglas 70cm transceiver the output series resistor



had to be reduced from 470kΩ to 2·2kΩ and this loaded the toneburst changing the output tone frequency. Setting the tone with the unit installed in the transceiver and working into a dummy load it was simple to adjust the preset tone control to the desired 1750Hz.

The Shadow Electronics Toneburst kit costs £4·28 including VAT and was supplied by **Lowe Electronics, Chesterfield Road, Matlock, Derbyshire. Tel: 0629 2817.** Shadow Electronics address is Structons Heath, Great Witley, Worcestershire.

PRODUCTION LINES

ALAN MARTIN G8ZPW

Coax Feeder Switch

The LAR 1kW feeder switch provides a convenient means of routing a coaxial feeder to any of three outputs. The design is simple and efficient and it may be used equally well for either transmission or reception.

The switch is housed in a robust steel case. Mirror type fixing holes are provided in the back of the case to facilitate mounting on a support. Selection of output is by means of a three-position rotary switch. Input and output connections are u.h.f. connectors type PL-259.

Technical data is as follows: Through power, 1kW p.e.p. (with termination better than 1·2:1 v.s.w.r.); Impedance, 50 ohms; v.s.w.r., better than 1·1:1 at 30MHz; Connectors, u.h.f. sockets type SO-239 PTFE insulated.

The unit measures overall 96 × 85 × 70mm, weighs 305g and costs £16.95 (VAT included), plus £1.50 p&p.

LAR Modules Ltd., 27 Cookridge Street, Leeds LS2 3AG. Tel: (0532) 452657.

Low-cost Multimeter

Armon Products Ltd. have introduced a low-cost analogue multimeter, the model HM-102.

The unit covers d.c. volts up to 1kV over eight ranges, with a sensitivity of 20kΩ/V; a.c. volts up to 1kV over five ranges, with a sensitivity of 10kΩ/V and a dB scale covering −20 to +22dB; resistance up to 6MΩ over four ranges and d.c. current via two μA ranges and three mA ranges up to 500mA.

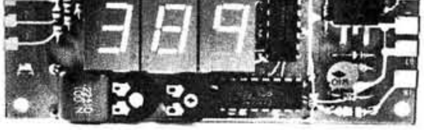
The HM-102 requires 1·5V AA size cell for the ohms ranges, weighs 1lb (including battery) and measures 130 × 90 × 40mm. The unit also employs overload circuitry to protect the meter movement, has a mirror arc to help eliminate parallax errors and the carrying handle doubles as a tilt arm positioner.

Priced at only £11.50 which includes VAT and p&p, the HM-102 is available from: *Armon Products Ltd., Cottrell House, 53–63 Wembley Hill Road, Wembley, Middlesex HA9 8BH. Tel: 01-902 4321.*

Low-cost DPM Module

Riscomp Ltd. offer a low-cost digital panel meter module, featuring a full 3-digit display with 10·9mm digits, known as the DVM314.

The module has a display sensitivity of −99mV to +999mV with an accuracy of 0·1% ±1 digit. A single d.c. supply of between 7 and 12V capable of providing 220mA max. is required to power the unit.



The basic 1V maximum reading may easily be extended by the use of simple resistance attenuators with the required decimal point being selected by grounding the appropriate pad on the module.

Measuring 95 × 41 × 10mm, the unit is supplied with a full instruction sheet which includes suggested values for attenuators, together with instructions for measuring a.c. voltage, current, resistance and temperature.

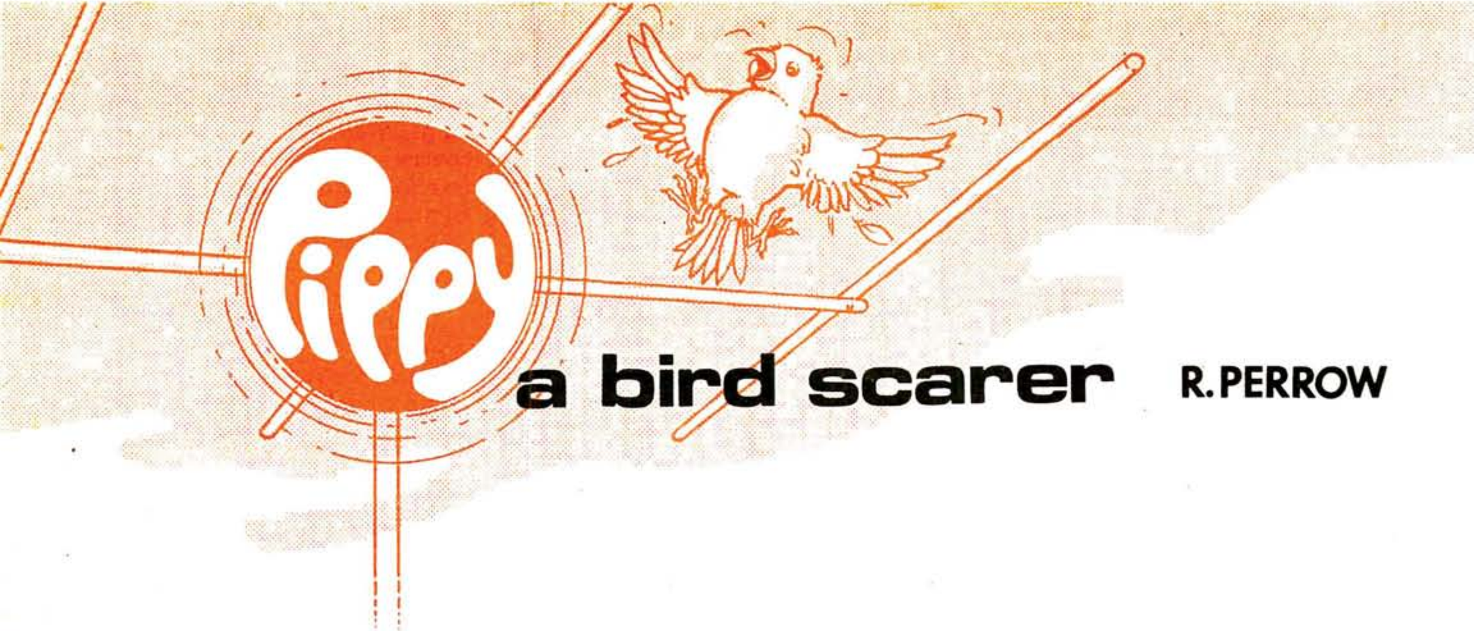
Priced at £11.95 plus VAT and 50p p&p (£14.24), the DVM314 is available ex-stock either by mail order or by calling at the new component shop at: *Riscomp Ltd., 21 Duke Street, Princes Risborough, Bucks. HP17 0AT. Tel: (084 44) 6326.*

VHF Wavemeter

In the "Production Lines" column on page 74 of the November 1980 issue, I mentioned a v.h.f. wavemeter from Packer Communications. Unfortunately, the company has ceased trading for the time being, and customers are having their cheques, etc., returned to them. I understand it is the company's intention to resume trading some time during 1981.

I offer my apologies to those of my readers who have been inconvenienced in ordering the equipment, only to have their money returned.

Alan Martin



Pippy a bird scarer

R. PERROW

Birds, the feathered variety, that is, seem to be attracted to v.h.f. Yagi-type aerials. Whilst this in itself is nothing to lose any sleep about, the mess and droppings they deposit can be unpleasant, especially when sunbathing below!

It was with this in mind that the following simple circuit was devised and built. At first a high audio frequency tone was used, but the birds seemed to become accustomed to this within a very short time. However, when a more rasping tone was used this had the desired effect.

The circuit is split into two sections. The main unit is mounted in a weather-proof box at the mast head, and the power supply unit is in series with the aerial at the tuner end. To save on cable the same coaxial feeder that runs from the aerial to the tuner is used to carry the power to the main unit.

A separate supply was used for the unit, rather than tapping off the tuner supply. The reason for this was that it was originally thought that interference may have been caused to the receiver due to the squarewave content of the oscillator. It was therefore decided that the unit would require a means of being shut off when the receiver was on. Later, it was found that no interference was caused, but as the author lives in a strong signal area it was thought better to stick to the original concept, in case some constructors might find that the unit did actually cause problems with their reception.

CONSTRUCTION RATING: Beginner

BUYING GUIDE

Builders of Pippy should have little difficulty in obtaining the components. Weatherproof enclosures can be found in the Vero Electronics range of moulded polystyrene cases. A suitable speaker is the Maplin Electronics Hi-Z type. Order code no. WF57M.

APPROXIMATE COST £18

★ components . . .

Resistors		
¼W 5%		
22Ω	1	R1*
12kΩ	2	R2,4
100kΩ	1	R3
680kΩ	1	R6
1MΩ	1	R5*
Capacitors		
Polyester		
1nF	4	C1,3,4,6
10nF	2	C7,9
0·1μF	1	C8
Electrolytic, 16V p.c.b. mounting		
100μF	2	C5,10
1000μF	1	C2

Semiconductors		
Transistor		
BC109	1	Tr1
Integrated Circuits		
555	2	IC1,2
Diodes		
1A 50V bridge	1	D1
Inductors		
47μH	2	L1, L2

Miscellaneous

Transformer T1, 3-0-3V 1·2VA (RS 196-268); Fuseholder p.c.b. mounting (RS 413-417); Fuse 20mm 250mA; 8 Pin Sockets (2); 75Ω speaker.

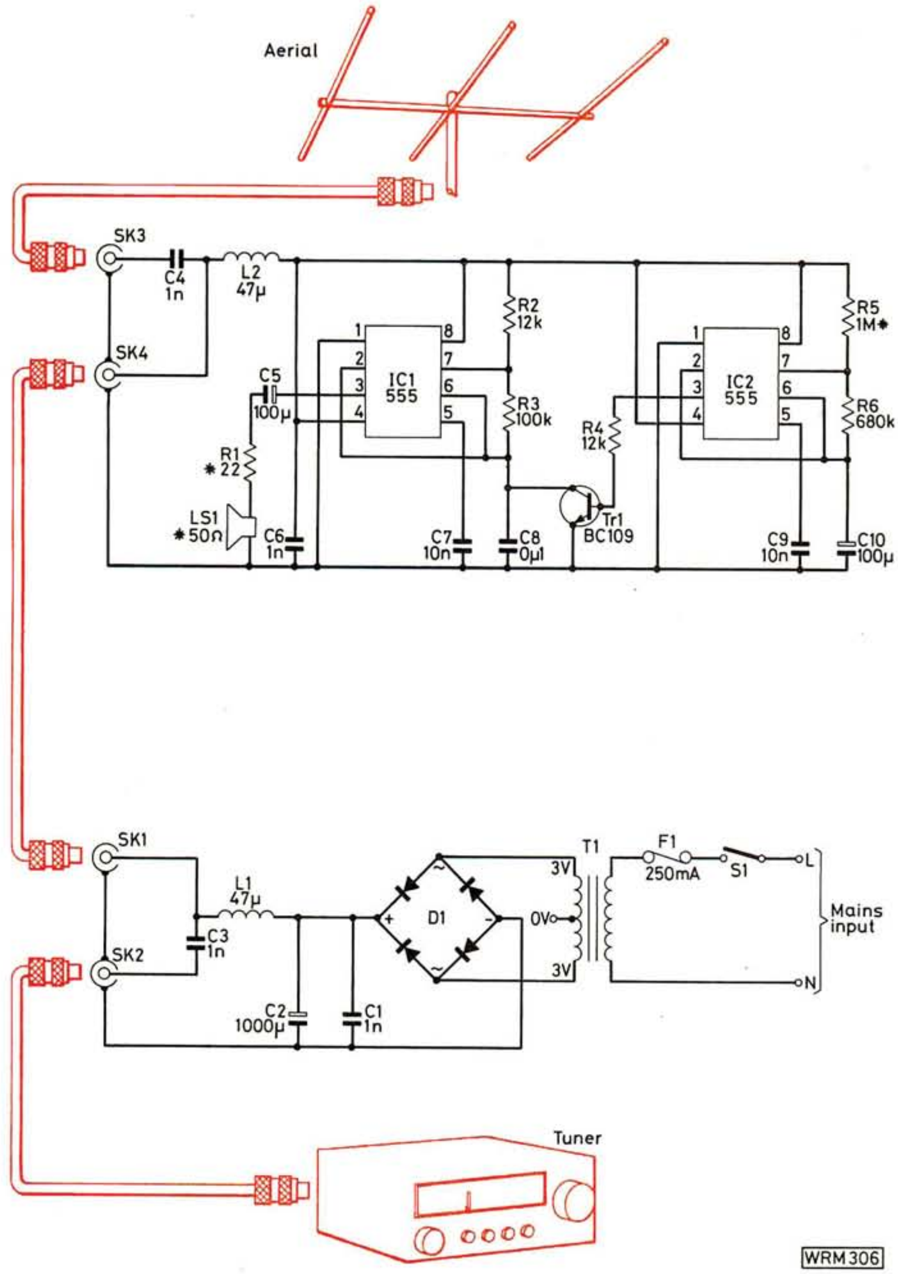


Fig. 1: (Left) Circuit diagram of the main unit and power supply. Interconnections shown utilise existing coaxial cable, which may be directly terminated on the boards in place of the sockets. See text regarding starred components

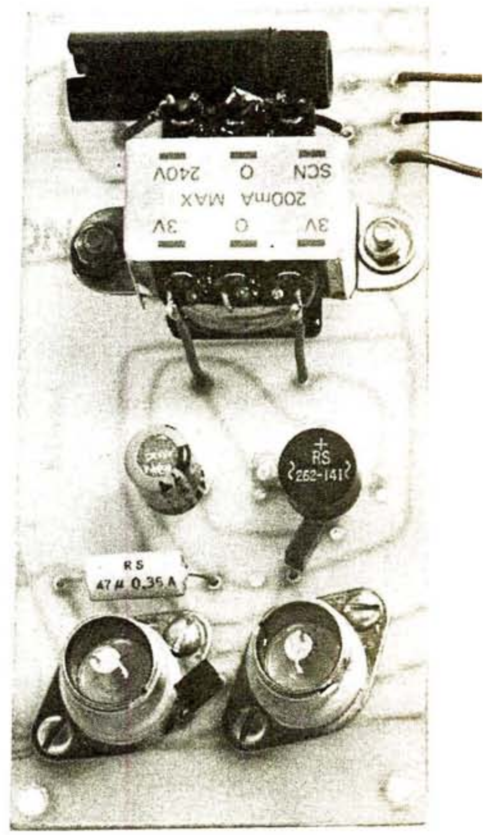


Fig. 2: (Below) The prototype power supply board layout

Circuit Description

The unit is split into two sections as already mentioned. The power supply is straightforward and produces about 9 volts across C2. This is fed to SK1 via L1 which displays a high impedance to the incoming received signal. The d.c. is prevented from reaching the tuner by C3.

The main unit, which is mounted on the mast, uses two 555 timers. IC2 controls the on/off periods of the tone generator IC1. With the values shown the output at IC2 pin 3 is high for about 90 seconds and low for 10 seconds. If the high is too long it can be shortened by reducing R5. Try a value of 470kΩ—this will give a high for about 60 seconds. Transistor Tr1 inverts the output from IC2, which results in the tone generator being keyed on for 10 seconds and then off for 90 seconds. This duty cycle was found to be quite adequate. The tone generator IC1 gives a rasping sound at a frequency of about 200Hz. Again this frequency can be altered by changing R2, R3 and C8.

Maximum output can be obtained by using a 75Ω speaker and shorting out R1. However a 50Ω speaker was on hand and this in series with a 22Ω resistor provides sufficient output. Capacitor C4 passes the r.f. signals, but prevents the d.c. feeding into the aerial. Inductor L2 prevents the r.f. being lost in the oscillator circuit.

Construction

This is very straightforward, providing printed circuit boards are used. Figs. 3 and 6 show the layout of these. The component layouts are shown in Figs. 4 and 5. In the prototype unit the 555s were soldered directly into the p.c.b. but i.c. holders or pins may be used if required. Chassis mounting coaxial sockets were used for all aerial connections.

No housings are shown as this is up to the individual. The mast unit must, or course, be water-tight and should have a clamp for fixing to the mast. A suggestion for the loudspeaker is to wrap it in a thin polythene bag before mounting it. This will protect it from the elements whilst allowing most of the sound out.

Fig. 3: Copper track pattern shown full size, for the power supply

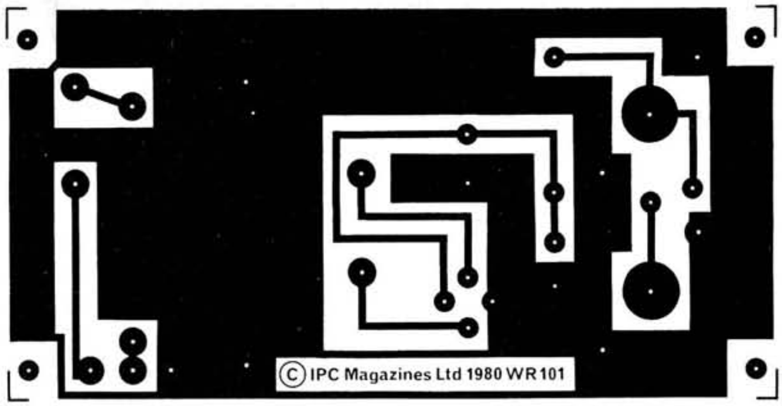


Fig. 4: Component placement details of the power supply board

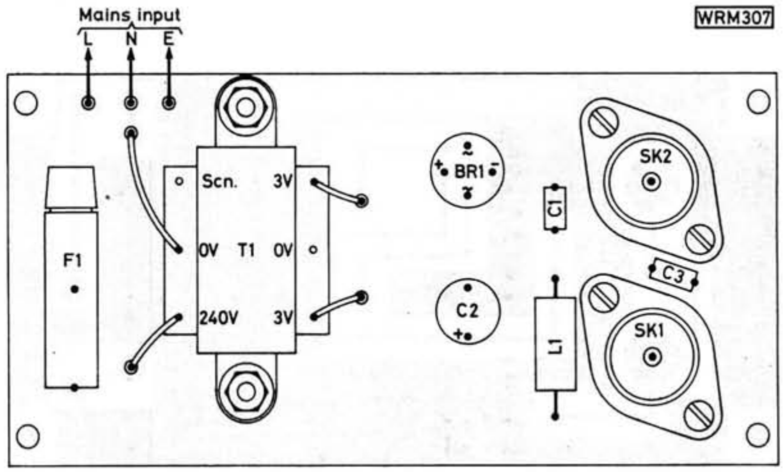
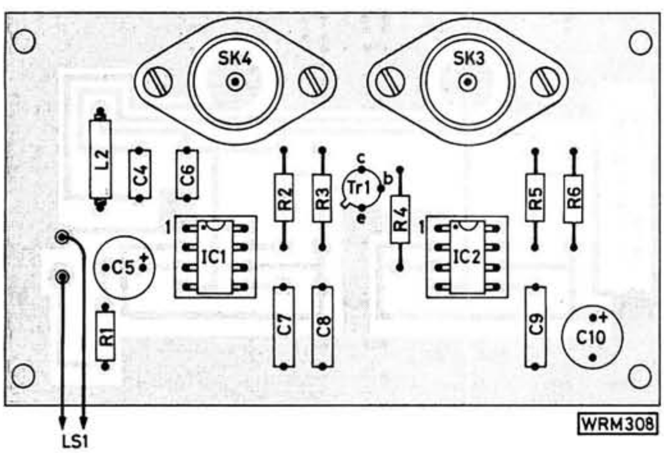
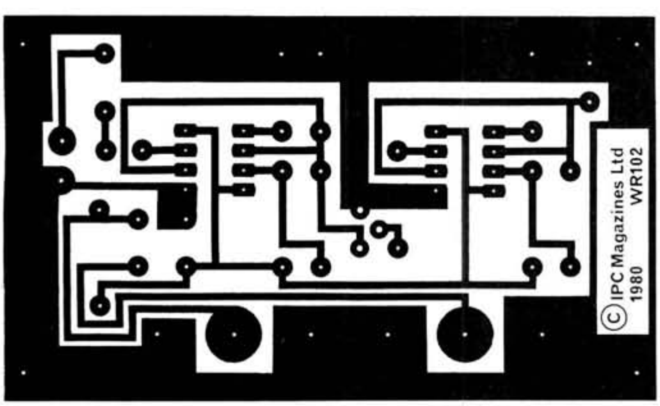
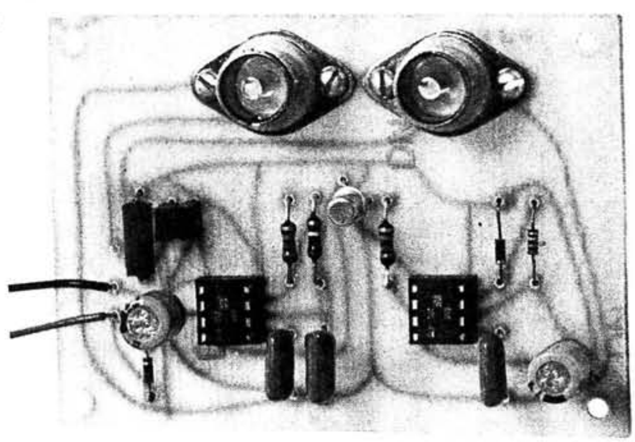


Fig. 5: (Below) Component placement details of the main unit. Fig. 6: (Bottom) Copper track pattern shown full size, for the main unit







Build One for the Garden . . .

It will be found that the unit need not be used continually. Once the birds accept that the unit is there they tend not to plonk themselves on the aerial, and will only gradually drift back to using it as a perch. Then is the time to switch on and give them a dose . . . but don't stand underneath, just in case they feel like revenge! Should they take it out on your peas, why not build another? ●

Visit the Practical Wireless stand at Breadboard '80

Daily appearances of personalities from the world of amateur radio, who will operate the demonstration stations GB2PW and GB8BB and chat to visitors about the hobby on Stand L6/K8.

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We shall also be showing a selection of our projects, past, present and future, and PW staff will be there to chat about them and the magazine.

Opening hours are:

26th Nov — Wednesday, 10am–6pm
27th Nov — Thursday, 10am–8pm
28th Nov — Friday, 10am–6pm
29th Nov — Saturday, 10am–6pm
30th Nov — Sunday, 10am–4pm

The venue is the Royal Horticultural Halls, Elverton Street, Westminster, London SW1, and admission to the exhibition costs £1·50 (£1·00 students/children/OAPs).

kindly note!

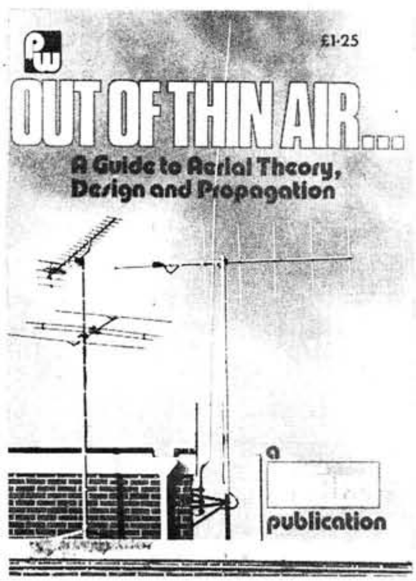
Transceiver Power Unit, September 1980
When switching on for the first time ensure that VR2 is set to maximum resistance not minimum resistance as indicated in the text. It is recommended that for the initial setting up of the supply F2 is replaced with a 2A fuse until the over-voltage trip is properly adjusted.

Some readers have found difficulty in obtaining IC2 and CSR1. IC2 is RS Components stock No. 307–890 and CSR1 is stock No. 262–488. Several advertisers can supply these to order.

Linear Scale Resistance Meter, November 1980
This article was wrongly attributed in the Contents list to R. A. Penfold. We apologise to the author, Mr Robert Goffin, and to Mr Penfold for the mistake and for any embarrassment caused.

Low Cost High Impedance Voltmeter, August 1980
There should be a break in the track between Tr1 base and R6 in Fig. 3. Also in Fig. 3 D1 is shown the wrong way round and should therefore be reversed. The circuit diagram is correct.

Our apologies to readers for omitting any indication of the batteries to be used in this project. Two 9V PP3 or equivalent are suitable.



Aerials and aerial accessories are very definitely among the most popular topics covered in *Practical Wireless*. In response to requests from readers, we've reprinted a selection of articles from the past three years, plus two new features—one by Ron Ham on v.h.f. propagation, the other describing the "Ultra-Slim Jim", a new version of that most popular 2-metre aerial design by Fred Judd.

Out of Thin Air has 80 pages, 295 × 216mm, and is available from W. H. Smith price £1.25, or by post from Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF, price £1.50 including postage and packing to UK addresses, or £1.80 by surface mail overseas. Please ensure that your name and address are clearly legible.

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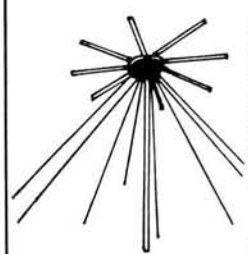

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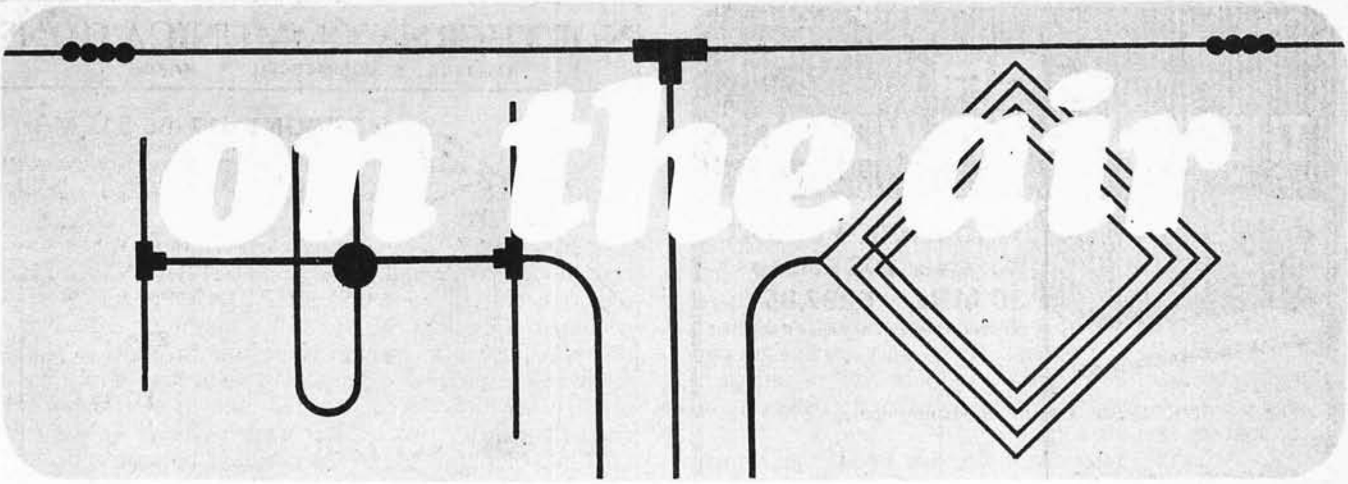

Amateur Bands

by Eric Dowdeswell G4AR

Reports to: Eric Dowdeswell G4AR
Silver Firs, Leatherhead Road,
Ashtead, Surrey KT21 2TW.
Logs by bands in alphabetical order.

Considering the cosmopolitan nature of amateur radio, with enthusiasts in virtually every country in the world, it is a little surprising that we all seem to get on so well together apart from the odd letter to the magazine complaining about too much contest activity! Somehow we all find our own niche in this great hobby. What we all learn is tolerance, the ability to get on with our own small bit of activity in amateur radio without interfering too much with anyone else, and putting up with a bit of interference when it happens to us.

On taking up amateur radio we have a choice of bands from the comparatively low frequency of 1·8MHz up into the gigahertz region, modes from simple a.m., c.w., s.s.b., f.m. and others, including TV, both conventional and slow-scan, while propagation options range from ground wave to ionospheric, meteor scatter and even via the rough surface of the moon, not forgetting repeater operation and the OSCAR satellites.

Yet how many amateurs even sit down and thoroughly consider all the many alternatives before they rush out and buy some expensive equipment as soon as the RAE pass slip arrives? After all, it is virtually impossible to have a go at all the possibilities except over a number of years. Techniques vary considerably from mode to mode and certainly from band to band, techniques that can only be learned by experience and certainly not from books. In some cases amateurs are actively pioneering techniques, as they have always done, that will later be taken up by commercial interests.

Before being licensed, the s.w.l. will probably have fallen into one or other of the very broad categories of v.h.f. or h.f. listening, more likely to s.s.b. or a.m. stations than to c.w., but this is only scratching the surface of amateur radio. It is not expensive to organise a set-up for RTTY reception, which has its own allocations on most amateur bands, both v.h.f and h.f., and it is surprising how cheap secondhand printers can be. Yet at the present time there is not one reader sending in reports of RTTY activity to this column.

The effort required to learn and master c.w. reception is not excessive for the average listener, yet once achieved it opens up yet another exciting facet of amateur radio and represents the learning of another language, universally known among amateurs, even more so than perhaps the English language.

A listener and potential radio amateur is strongly advised to contact and join a local radio club. There, contact can be made with a member willing and able to demonstrate the many ways in which amateur radio can be enjoyed, thus obtaining a much wider view of the subject instead of regarding it as just v.h.f. or h.f. without considering the many alternatives in each field.

Ash Nallawalla VK6KE/ZL4FM of Maylands, W. Australia, has kindly given me some details of the amateur licensing legislation in ZL-land, which would seem to me to be much more sensible than our practice of chucking the new "A" class licensee in at the deep end, with full power and every facility from the word "go". It seems the Grade III licence there is similar to our "B" licence, allowing operation only above 144MHz.

The Grade II licence allows 6m, 80m and 160m operation after a 12 w.p.m. code test, and a full call, like ZL4FM, is issued. Grade I means providing evidence of at least 50 QSOs on 80m and a repeat code test at the same speed at least one year after the Grade II ticket was issued. A pass in this means that the call is retained with operation allowed on all bands. As Ash says, the year's trial on c.w. lets one make mistakes without having an international audience!

An interesting VK licence I didn't know about is the one using "C" as the first letter in the three-letter suffix, for those whose job or profession involves moving around the country from one call area to another. Thus VK2CXX becomes VK4CXX when moving to the new call area, identifying the operator as being the same person. Ash is getting a commission in the RAAF so expects to get such a call soon, presumably VK6CKE initially?

Here and There

I was getting very apprehensive about friend **John Dainty** (West Wickham) who had not written about the RAE he took last May. However I needn't have worried as he passed both parts with credit, but being on holiday in Suffolk had been enjoying himself. John expressed surprise that he had not yet received his ticket although he had sent for it right away. Well I understand that something like 2500 people passed out of the 3700 candidates so it is hardly surprising the Home Office was inundated with licence applications! John had taken some 2m gear to Norfolk but was unable to use it!

Steven Jones of 850 Kingstanding Road, Kingstanding, Birmingham has dumped his valved HAC receiver and acquired a CR100/B28 but says that the "aerial tuner" has been removed. Steve could do with some help or a manual if anyone cares to assist. Another reader, with thoughts of the beginner looking for a s.w. set to start on, has got two suitable receivers he wishes to donate free of charge if picked up. The area is Mansfield so anyone interested contact me in the first instance.

An interesting letter from **Charles Frost,** via Kenya, tells of his intention to get on as an ST0 from the Southern Sudan where he is teaching linguistics. At home Frosty is K5LBU but he has his Dentron HF200A rig with him. He would also consider activating 60-land if funds could be made available.

Elastic Bands

According to the general comments in readers' letters, the h.f. bands have been very variable with 10m showing some sign of life now. I have a feeling that the receivers of some people are not too hot on this band, reporting little activity when it is obvious from other reports that it has been quite good. As I don't listen on 10m I am unable to comment.

However I can speak with knowledge of 20m where it has been good to excellent for a long time now, with plenty of DX going for the asking. Apart from strings of VKs and ZLs, my best catches have been HH2SL and VP8BB. I thought that I knew a bit about propagation, but I wish someone could explain how it is that VKs can be worked for hours on end on 20m long path virtually any morning, whereas other parts of the world come and go in an hour or so. The signals are nearly always extremely steady as one might expect over an all-sea path.

R. Heeley (Notts) now has an FRG-7 with a multiband tuner and a short outside aerial. A home-brew audio filter is used when the QRM gets too bad. Bob lists plenty of VKs and ZLs on 20m s.s.b. with ZL4BO on 40m. Apart from Japs ZP5CPE was the only item of interest on 15m, while 10m produced VP2AZF, 5H3FW, 9J2FC, 9M2GZ and 9X5PP.

Allan Stevens in Crowthorne, Berks, found 15m alive with Pacific signals (some with remarkably low power, a typical characteristic of this band) although Allan is very critical of the many American phone patches on 20m. All quite legal as far as they are concerned I'm afraid, although I usually find they do tend to keep to the top end of the band, where, in case you don't know, there are often VKs and ZLs lurking! On Guam, Allan found KG6NAA and on Midway it was WB6BDG/AH2 both on 20m. He wryly comments that finding VK8DH was a change from VK3MO! The latter it should be noted has stacked cubical quads. Need I say more? The 15m band came up with HS0HS, SV1KP/SV5 (Dodecanese Is), TA1MD, VS5DD, YB0WR and YS9RUE.

The Trio 9R59DS of **Colin Frankland** of Hull did well to catch 4W1JB who said QSL to PO Box 641, Sana which seems genuine enough on the face of it, but from my knowledge of the area I'd wait for the card before ticking it off my countries worked list! Naturally there was a pile-up, and if people weren't working him they were talking about him. This was all on 15m s.s.b. Others caught with Colin's two indoor dipoles were VP2KC on St. Kitts, PZ1BT, and KG4KK on Guantanamo Bay, Cuba.

In Stourbridge (W. Mids), **P. C. Hawkes** is determined to make the next RAE and fits in his listening only when not studying, a very sensible approach. His several dipoles helped his AR88 to find such as JY5NS and 5N9GM on 10m, ZS3TL, P29NRL, YC3BJX, 5H3AA, TU4AT (QSL HB9BTQ), 4S7DJ and VS5SI (QSL JA7SGV) on 15m. On 20m 6Y5DA (QSL VE4JK) and 6W8IA came up, with PS8WCJ and a fine goodie in PY0YCW on Fernando de Noronha and QSL via PY1AA.

David Coggins (Knutsford, Cheshire) collected a damaged thumb in trying to telescope two bits of tubing while in the process of knocking up a new aerial, but it doesn't seem to have deterred him from DXing. He finished up with two quarter-wave verticals on 20m fed 90° out of phase to give a cardioid pattern with "fantastic" results, as I would expect. I used something similar for years, when ST2AR, with switching of delay lines to give a variety of directions at will. David says it also works well on 10m and 15m but it would not be optimum conditions.

I would like to see a lot more readers of this column try something a bit more ambitious than the usual long wires. It can cost next to nothing using odd copper wire and plastics insulators, and can be extremely rewarding. David commented on the remarkable strength of VR6TC of Pitcairn on 20m. Using his regular aerial, the 66ft wire, and a.t.u. the DX in Knutsford was KA6S/3B8, S79GM, VP8PP (Box 224 Port Stanley), YB2AJ, 9X5PP on 10m, and AP2SA, FO8DL, FR0FLO (Reunion), YJ8NPS, AH2E (Guam), VK0KH (QSL VK5NV) and 9X5PP again on 15m. OJ0MA turned up on 40m as did OX3PT, LU9FFA and PJ3DO. Just to complete this tour of the h.f. bands PY1YCW was logged on 80; could be PY0YCW?.

It was a pleasant surprise to get a log of stuff worked from **Adrian Dening** G4JBH located in Yeovil, who sports an FT101 plus DX5V vertical, but "no linear, beam, compressor or filters" he boasts proudly! On 15m s.s.b. C31MK, C5ABK, CT8USA, FR7BE, H44CF, YB0ACL and ZD7SD were worked with ZS4MG and 5N0MAS contacted on c.w. 20m s.s.b produced KH6IJ, KL7HC, OJ0MA, ZB2FX and ZK1AC.

Another one who prefers to work the DX instead of just listening to it is **Paul Barker** G4HPS of Sunderland, whose TS180 and vertical aerial found A35AE on Tonga, KL7HT, N6CUQ/KH2 on Guam, VK8NOO, W7LPF/DU2 and YO0OOO all on c.w. on 15m. I take back all I said about the last station as reported by Bill Rendell of Truro! Seems it was an Olympic station, hence the five circles. Brilliant! The best on c.w. for Paul on 20m was FK8DD, a very nice catch but he did miss out on a 9U5 and a D68.

Mike Howard is now BRS44755 but it doesn't seem to have affected his DXing judging by A35RB, CO6RC, DU1JB, HH2JR, HK0AA (Serrana Bank), J28AZ, VS6DX and 5N0SMF on 20m with his DX160 and 30ft wire. The best on 15m were VR3AH, 4S7CF, 5H3FW, C5ABK and YB5OB.

Basil Woodcock of Leeds has been playing around with counterpoise earths, being located well above earth level, to help his SRX-30 along, fed by a 65ft aerial and a 20m dipole plus a.t.u. He is 400ft a.s.l. on a hill so he should grumble! His log on 10m shows 5H3FW and 9Z7CSJ a Scout Jamboree outfit on Trinidad, he says. Best catch on 15m was undoubtedly the 4W1JB but FP0FXP also showed up, plus XT2AW, 8R1RBF, KC4AAA ("within sight of the South Pole"), VK9ZG and IM0MIE on Magdallena Is. who also created quite a stir in the WAE

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contest recently. Guess he is a good one for the WAE award.

Having bowed my head re YO0OOO to **Bill Rendell** I'd better report some of the other loggings in the Truro area. With his penchant for islands Bill has added CE9AF (QSL Radio Club of Chile, Box 13630 Santiago), W1DDV/C6A on Andros Is. and VP8HA in the Falklands, QSL W3HNK or RSGB, all 20m s.s.b. On 15m CS1BI was on Berlenga Is. (QSL CT1XX), VP8SB Adelaide Is., QSL G3ZMF, WB6PDG/AH2 via KG6JJY was on Guam, and 9M2GZ's QTH is Penang Is. Heard also were D68AP, J3AH, VP1EEC (QSL Box 75 San Ignacio Cayo, Belize), VP2MSG, and ZD8KM who QSLs through G3IFB.

Clubs in Brief

Quite a few reporting for the first time so hopefully improving our coverage of the country.

East Antrim RC. Only been going since April so new members welcome second Tuesday at Carntall Hall, near Mossley at 8pm where an extensive programme is under way. Contact: Jim Welsh GI4JXM, c/o 20 Bryantang Brae, Doagh, Ballyclare, Co Antrim or Ballyclare 40384.

Derby & District ARS. Boasts a paid-up membership of 141 at the moment so it must be good. Two Morse classes are run with great success, while forthcoming events include bring-and-buy sale Nov 5 with Birketts of Lincoln visiting on the 12th, followed by Lowe Electronics giving forth on computers on the 19th, with Ken Burdon G8TUS speaking on aircraft safety on the 26th. Meetings Wednesdays 119 Green Lane at 7.30pm or try Jenny Shardlow G4EYM, 19 Portreath Drive, Darley Abbey, Derby or Derby 556875.

Dover RC. Good to hear from them again. Meet at YMCA, Godwyne Road and club station G3YMD, plus S20 for talk-in. Nov 5 is natter night with G8HNZ talking on technical aids for the blind on the 12th. De-bugging projects ought to interest most people on the 19th, with the 26th devoted to contest planning. Peter Chamberlain G8EGT can help you at the YMCA QTH.

Bournemouth RS. First and third Fridays at 7.30pm Dolphin Hotel, Holdenhurst Road, for 8pm start, with new Hon. Sec Glenn Lloyd G8GTF willing to help with the details from 4 Gorleston Road, Parkstone, Poole, Dorset or ring Bournemouth 769317.

Worcester & District ARC. May be too late to tell you about the meeting on Nov 3 when Jim Cook talks on model radio control, but you will be in time for the annual dinner on the 29th. Meetings Mondays at 8pm at the Old Pheasant, New Street, Worcester with family outings, like picnics, now and again. Mike Tittensor G4EKG, 16 Durcroft Road, Evesham, Worcs is waiting to hear from you, or talk to him on Evesham (0386) 41105.

Plymouth Polytechnic RC. Own shack and station G3TCP at the Poly open to members to 10.30pm daily. Contact: J. P. Key G8VTW, 6 Beverley Gardens, Ashburton, S. Devon.

Waterside SW RC. Breakaway club from Southampton RC for those unable to get to the great port. Meets fourth Tuesday at the Blackfield Community Centre at 7pm, with lectures etc., plus fun with club station G4JNY. More help from Clive Sanders G4KCM, 35 Forest Edge Estate, Fawley, Southampton or Fawley 893200.

Wirral & District ARC. Wednesday 8pm in the Dining Room of the Concourse Sports Centre, W. Kirby with John G8BVE on UK repeaters on Nov 12 and an RSGB tape and slide lecture on the aurora on the 26th. Club call is G8WDC. Excellent pocket-sized newsletter is produced by Ian Brooks G8PMW of 28 Paignton Road, Wallasey who is also Hon. Sec. Telephone is (051) 639 5666. This is a new QTH.

Stevenage & District ARS. First and third Thursdays in Senior Staff canteen, British Aerospace Dynamics Group, Gunnels Wood Road, Stevenage, Herts., at 8pm. Talk on the Royal Observer Corps Nov 6, while the 20th lets loose Pete Hipkin G8KMG on popular music through the ages with audio and visual demos. Contact: Peter Byrne G8MCV, 21 High Plash, Stevenage or 0438 64624 at home or 0462 4231 during working hours. A local net operates on 145·25MHz Tuesdays at 7.30pm, with club calls G3SAD and G8SAD.

Dartford Heath DF Club. Special interest club, meeting at the Scout House, Broomhill Road, Dartford, Kent with club call G4BDF, of course! Details of club events on club net 1930kHz or thereabouts Sunday 10.30am plus v.h.f. net on 145·325MHz (S13) on Tuesday pm. Contact: Alan Burchmore G4BWV at the club QTH for more info.

Crawley ARC. Much reading in club newsletter with plenty of news from members on their activities, normally hard to get! RAE results for club show 24 entrants for May exam with 19 passes, four failures in one part and just one complete failure. Says well for club courses and reflects on high standard of club. Write to editors of CARC, 16 Newmarket Road, Furnace Green, Crawley, W. Sussex, in the absence of a QTH for the Sec.

Edgware & District RS. Second and fourth Thursdays at 8pm at the Watling Community Centre, 145 Orange Hill Road, Burnt Oak, Edgware, Middx with visitors assured of a warm welcome. On Nov 13 Les Sharrock G3BNL ought to be speaking on microwaves, while the 27th is informal. Club net with G3ASR Mondays 10pm 1875kHz with slow Morse practice sessions from G3AGR on Top Band and v.h.f. Morse classes at the club, of course, to suit all speeds. Activity periods on all h.f. bands, telephony and c.w., now embrace neighbouring Harrow and Verulam clubs. PR is Howard Drury G4HMD, 39 Wemborough Road, Stanmore, Middx or (01) 204 7459.

Finally, I have received details from the G-QRP Club of its activity weekends and winter sports events in 1981. Details from Chris Page G4BUE, "Alamosa", The Paddocks, Upper Beeding, Steyning, W. Sussex. The club has activity periods on Sundays 1100 to 1230 and 1400 to 1530 GMT on 3560, 7030, 14060, 21060 and 28060kHz, with anyone interested in QRP working invited to join in. General enquiries to George Dobbs G3RJV, 17 Asoen Drive, Chelmsley Wood, Birmingham.

the things people say

"If you can't get anyone to talk to you on SR, just say that you are calling through BR; there are always 10 stations just waiting to come up and put you right."

Brighton & District RS Newsletter

Have you heard any (printable) comments, funny peculiar or funny ha-ha? If so, why not send them in to our Editorial offices at Poole. We will pay for every one published.

Medium Wave Broadcast Band DX

by Charles Molloy G8BUS

Reports to: Charles Molloy G8BUS
132 Segars Lane, Southport PR8 3JG.

Last month we had a look at medium-wave propagation and the possibility of picking up North America on the medium waves in the UK. Reference was made to station CJYQ which is located at St John's in Newfoundland and is often heard on 930kHz. Why CJYQ? What do those letters mean and why are they used?

Callsigns

High-power transmitters pumping hundreds of kilowatts into their aerials to serve quite large areas, are commonplace in Europe but in North America the emphasis is on local radio. Such high-power broadcasting that exists is limited to 50kW. The United States has some 4500 medium-wave stations, the vast majority operating with powers of 1kW or less. In order to keep track of them, callsigns similar to those given to radio amateurs are allocated, and the stations are compelled to identify frequently by callsigns. Many stations try to make a slogan or word out of it, CJYQ for example calls itself "Q Radio". Others try to obtain call letters that indicate the location or the owners of the station. WNEW (1130kHz) is in New York City, while WCBS (880kHz) belongs to the Columbia Broadcasting System.

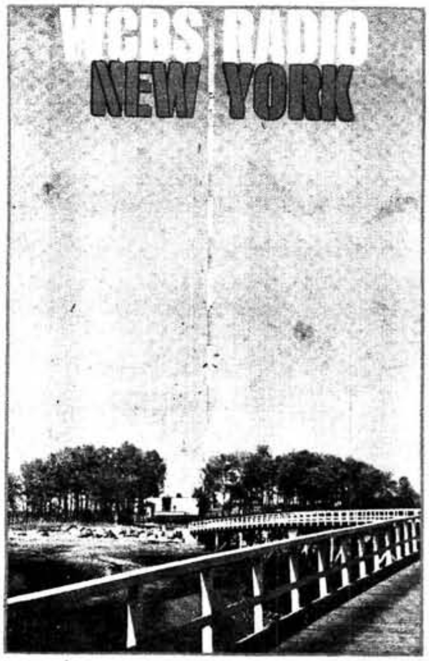
The first letter (prefix) of a callsign allocated in the United States will either be a W for stations east of the Mississippi or a K for those to the west, though there are a few exceptions, anomalies from the early days of radio such as KDKA (1020kHz) in Pittsburg. Canada uses the prefix C except for a handful in Newfoundland who still use the old colonial prefix V. In the United States, callsigns can have either three letters (WBZ in Boston on 1030) or four (WINS in New York City on 1010). In Canada the three-letter calls are used by the CBC (Canadian Broadcasting Corporation), for example CBA in Moncton, New Brunswick on 1070, while four letters are allocated to commercial stations like CJYQ. All the above are heard in the UK when propagation is favourable.

Callsigns are a great help to the DXer. If you hear WQXR on 1560 you know that you are listening to a broadcast from the eastern part of the United States, and if you look up the *World Radio and TV Handbook* you will find that WQXR is located in New York City. Moreover, if you want to write to the station, address the envelope to WQXR Radio, New York City, NY, USA and it will certainly be delivered. Address lists are not generally required for stations in Canada and the USA, provided you know the callsign and location (city or town and State/Province).

Loops

"How do you tune the loop," asks **Peter Eggeman** from Borehamwood. The procedure to follow when using a loop is quite simple provided you do it step-by-step.

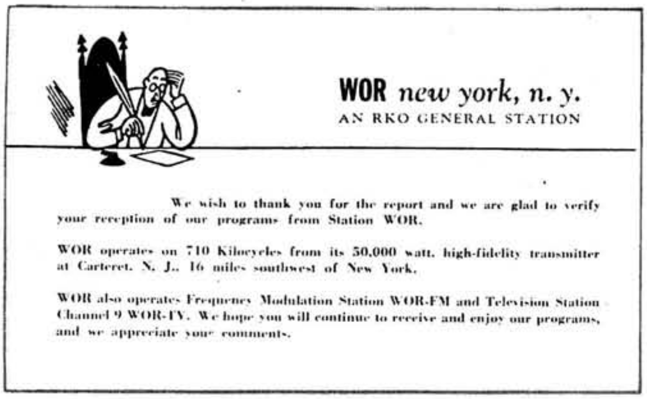
Connect the loop to the receiver aerial and earth



WCBS—Photo of transmitter site on an island in Long Island Sound

WCFL—The voice of Labor, Chicago

KEX—A first from England QSL from Oregon

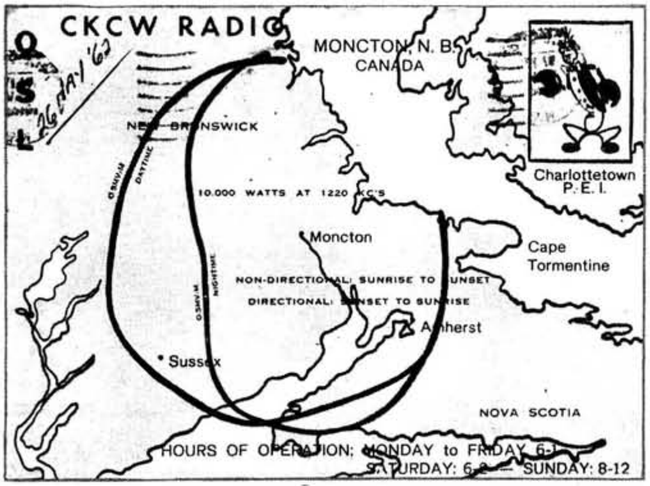

WOR new york, n. y.
AN RKO GENERAL STATION

We wish to thank you for the report and we are glad to verify your reception of our programs from Station WOR.

WOR operates on 710 Kilocycles from its 50,000 watt, high-fidelity transmitter at Carteret, N. J., 16 miles southwest of New York.

WOR also operates Frequency Modulation Station WOR-FM and Television Station Channel 9 WOR-TV. We hope you will continue to receive and enjoy our programs, and we appreciate your comments.

WOR—A real old timer. Callsign issued in Feb 1922



CKCW—Coverage map as QSL card

sockets or to the balanced input A/A1, if provided. Tune the receiver to the desired frequency or station in the ordinary way. Switch off the a.g.c. if this can be done and control the receiver by the r.f. gain control. Peak up the signal with the loop tuning control and finally rotate the loop for optimum results.

A loop is tunable and directional. It can be tuned in to a station just like a receiver, when it will give a boost to that station at the expense of others. In other words it provides a certain amount of selectivity. Its directional properties can be exploited by pointing the null, which is quite sharp, towards interference which may be from another station, or it may be electrical interference or just static (atmospherics).

Receiver Operation

It is usual when tuning around the band to set the r.f. gain control to maximum, switch the a.g.c. (automatic gain control) to ON and adjust the receiver by the audio gain and tuning controls. If there is no a.g.c. switch, this facility is permanently on. What does the a.g.c. do?

It automatically adjusts the gain of the receiver in sympathy with the strength of the incoming signal. When the signal is weak the receiver will be set to maximum gain. When the signal is strong receiver gain will be reduced. Receiver gain varies inversely with incoming signal strength. In answer to **J. Seow** of Penang in Malaysia, it is the a.g.c. that causes a noisy background to disappear when you tune in a strong station. When searching, the gain is high which brings up static. When you tune in a strong station the gain is reduced and the noisy background disappears.

Automatic gain control is intended mainly to combat fading, but it can be useful when tuning round a crowded band as it prevents receiver overloading on strong signals. There are though a couple of snags with a.g.c. when DXing on the medium waves.

Switch Off the AGC

Quite often you will be listening on a channel with more than one occupant. You may be waiting for one of them to fade or you might be trying to null out one with a loop. Although the two will nominally be on the same frequency there will be a slight difference between them, perhaps only a few hertz, which creates a beat which can be observed on the "S" meter. The receiver a.g.c. will respond to this beat and the receiver gain therefore will go up and down in sympathy with it, giving an unpleasant blasting effect at the loudspeaker. The remedy is simple. Switch off the a.g.c. and control the r.f. gain manually.

There is an intended time delay, known as the recovery time, before the a.g.c. permits the receiver gain to return to maximum, once a strong signal is removed. If you are trying to pick up a weak station adjacent to a strong one, then this delay can operate against you and you may not hear the weak one at all. Once again the cure is to do without the a.g.c and adjust the receiver manually.

Short Wave Broadcast Bands

by Charles Molloy G8BUS

Reports: as for medium wave DX, but please keep separate.

"Tuning in to the 13 metre band at 1045 I picked up Dubai Radio broadcasting a test transmission. Can this be termed DX?" writes reader **A. Cross** of Bath, who was using a Lloytron NR-32F1 with a random wire.

The term DX originated from a telegraphic abbreviation which stood for distance, the X replacing the remaining letters of the word. In the early days of wireless it was considered quite an achievement to be able to listen to distant parts of the globe, but nowadays one can pick up stations from all over the world with a portable receiver and a whip aerial.

Personally, I prefer Difficulty to Distance. This definition takes account of the type of receiver, the location (QTH), aerial, level of interference and the experience and ability of the listener.

There is a great deal of fun to be had from short-wave listening/DXing and a sense of achievement too on occasion, so perhaps it is as well to enjoy it without worrying too much about definitions.

Tuning Scales

Reader **Bill Solley** of Bristol only started s.w. listening a few weeks ago. He uses a Vega Spidola and is puzzled by its scale markings which, he says, "Have frequency, reading from high values on the right to low on the left, whereas the supplementary scale on the front reads logically 0 to 100", and he wonders if there is any standard for the calibration of radios.

The trouble is, Bill, that there are two parameters that can be displayed, frequency and wavelength, and one ascends in value as the other decreases. Frequency is measured in kHz where 1MHz = 1000kHz while wavelength is measured in metres. A low wavelength means a high frequency and vice-versa. The international short-wave bands start at 6MHz which is in the 49 metre band, and extend to 26MHz in the 11 metre band. If you put 6MHz at the left hand of the scale you will read, from left to right, a scale that either increases in frequency from 6MHz or decreases in wavelength from 50 metres.

Digital readouts display frequency and consequently the use of metres on the short waves will gradually die out, as it has already on the medium waves in most parts of the world. In the meantime we have to convert from one system to the other on occasion, but fortunately this is easy to do. Frequency in kHz times wavelength in metres equals 300 000, so it follows that:

$$\text{kHz} = \frac{300\,000}{\text{metres}} \qquad \text{and metres} = \frac{300\,000}{\text{kHz}}$$

For example, according to my pocket calculator, 6·02MHz = 6020kHz, so:

$$\frac{300\,000}{6020} = 49{\cdot}83 \text{ metres}$$

As a matter of interest, the 300 000 is the speed of radio waves measured in kilometres per second.

Logging Scales

The scale marked 0 to 100 on Bill Solley's radio is known as a logging scale, and one can be found on a number of domestic sets. If you are listening to a s.w. station and you want to go back to it at a future date, then make a note of the log scale reading. If it is, for example, 67 then next time you want to listen, set the pointer to 67, rock the tuning a little on either side and you should be able to locate the station even if you are not sure of the exact frequency.

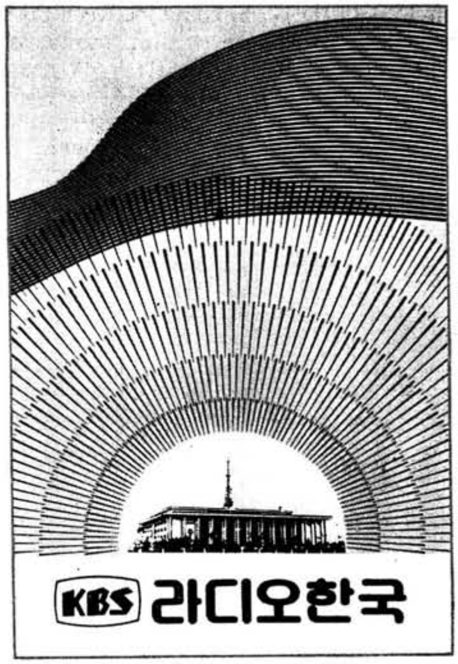
A few receivers have a better arrangement. They have a large tuning knob round which (but attached to the receiver) is an annular scale marked from 0 to 100. For every complete rotation of the tuning knob there are 100 logging points, so if it takes $3\frac{1}{2}$ turns of the knob to cover the band in use then there are 350 logging points. Sounds impressive and there is nothing new about it. Some versions of the wartime R1155 had an arrangement like this.

There are snags. The tuning knob, pointer and tuning capacitor will probably be linked by means of a cord tensioned by springs and there must inevitably be some play in the system which is known as backlash. With most receivers though, backlash is slight and this type of logging scale is really quite a boon with a receiver that does not have digital readout.

Do-It-Yourself Logging Scale

It is not difficult to stick a narrow strip of paper onto the tuning scale or glass cover. Mark 0 where the pointer stops at the left hand end of its travel, and 100 at the other

QSL card from Radio Korea



A recent QSL from AFRTS

end. Then mark out the tens and digits. Crude, but effective.

Better still, fit an annular piece of paper (circular with a hole in it) marked from 0 to 100, to the receiver and around the tuning knob. If possible, fit a larger tuning knob before starting. With the pointer fully to the left, put a spot of paint on the tuning knob next to the 0 on the new logging scale. Put a mark on the main tuning scale corresponding to 100, 200 and 300 on the logging scale. This is quite a simple job if there is space on the receiver and it will provide over 300 logging points.

Readers' Letters

"I have recently acquired a five-valve radio (Grundig 3090WFE) and I sure could use its circuit diagram or manual," writes **Lee Hock Leng.** If any reader can help then please write direct to 44 Jalan Foo Win Yin, Canning Garde, Ipoh, Perak, West Malaysia. The receiver is an interesting one as the short waves (2MHz to 26·15MHz) are covered in four bands each with its own scale measuring over one foot. Some of these old receivers perform very well if they are in good working order, and are a good buy for a beginner who has little funds available.

Andorra is now operating in the 19 metre band. **Roy Patrick** (Derby) reports hearing Radio Andorra in English on 15 030kHz on Sundays between 0900 and 1000. This is in addition to the evening transmission on 6221kHz which now goes out with 10kW. "When is the best time to listen to Radio New Zealand?" is the question posed by **Stuart Perry.** Try very early in the morning. RNZ is on 17 860kHz until 0630, 15 485 until 0815 and 11 945 until 1030 according to the current schedule.

DX Heard

News of Asiatic DX comes from **T. Ambi** (London), who used a Panasonic DR49 to pull in All India Radio in English on 11 620 between 1745 and 2230, and in Hindi/-Tamil on 9912 and 7265 between 2300 and 0045. Sri Lanka was heard in English on 15 425 at 0030 and in Hindi on 7120/11 800 at 0030, while Pakistan came through in Hindi on 17 662/21 655 between 0715 and 1100. **Jonathan Kempster** (Berhamstead) mentions hearing Pakistan on 15 450 at 1715 using his VEF206 and 100ft long wire. Radio Afghanistan on 15 075 at 1945 and Radio Korea at 15 560/1924 are reported by **Ian McLean** (Port Glasgow) who uses two semi-vintage receivers, a Ferguson 461 and a Pye Cambridge R16, along with a PR40 preselector and 100ft long wire.

RNZ was heard on 17 860 at 0430 by **Stephen Haywood** of Barnsley using his FRG-7. Other DX included Haiti on 11 835 at 2230, Zimbabwe 3396/1830, Malawi 3380/1800, Nigeria 3326/0600, Ghana 3366/0629 and 3350/1807. RNZ was also heard on 17 860, this time at 0320, by **K. Lewis** (Pensilva, Cornwall) who also logged VLW15 in Perth, Australia, on 15 425kHz at 0340, the latter being something of a rarity. The tropical bands yielded Iraq 3240kHz/2045, Radio RSA 3250/1905 and Togo 5047/2045. The 90 metre band is really producing the DX these days.

VHF Bands

by Ron Ham BRS15744

Reports to: Ron Ham BRS15744
Faraday, Greyfriars, Storrington,
Sussex RH20 4HE.

I know from my post bag that many of you are experimenting with aerials and equipment in readiness for future events. This is good, because no one can forecast precisely when an atmospheric disturbance will occur, therefore we can only rely on our past experiences for indicators and be ready to chase the DX at, sometimes, very short notice.

Solar

Although the sun was generally quiet between August 20 and September 24, small bursts of radio noise were recorded by **Cmdr Henry Hatfield** and myself at 136 and 143MHz respectively on August 22 and September 1, 2, 6, 7, plus a noise storm on the 14th. During the midday observation on August 31, **Reg Taylor,** Shillington, Herts, 151MHz, Henry and I recorded a large burst of noise lasting 8 minutes, Fig. 1, which was no doubt the result of a flare. "Two very angry-looking plages on the east limb

Fig. 1: An 8-minute solar burst recorded by the author at 143MHz on August 31

and looks complex", said Henry, who had been observing the sun with his spectrohelioscope. On August 30th, **Ted Waring,** Bristol, counted 53 sunspots which increased to 74 by September 2 and reduced to 59 by the 6th.

The 10m Band

Both Ted and I noted that signals were readable almost daily between August 20 and 31 from the International Beacon Project stations in Cyprus 5B4CY, and Germany DL0IGI. After that, these signals were sparse until between September 13 and 22, when again I frequently heard signals from DL0IGI, 5B4CY and Bahrain A9XC, and occasionally from the beacons in Bermuda VP9BA, Mauritius 3B8MS and Norway LA5TEN. Between August 27 and 31, **Harold Brodribb,** St Leonards-on-Sea, Sussex, heard signals from Hungary, Russia, Scandinavia and South America, and during the late afternoon of September 3 he received strong signals from 11 Ws, a VE and a ZS, and several from both North and South America on the 12th and 13th. The band opened up more between the 13th and 24th; this was confirmed by **Gordon Goodyer,** Petworth, Sussex, **Barry Ainsworth** G4GPW, Lancing, Sussex and my own observations. On several occasions we all heard signals from most parts of the world. I heard strong signals from JA around 0800 on the 21st and 22nd, and at 1258 on the 24th Barry worked a WA on 29·6MHz who was using a converted CB rig and running 4 watts to a dipole.

Brief Aurora

When **Alan Baker** G4GNX, Newhaven, began his regular sked on 20m with VK2DGS at 2100 on September 23, the VK's signals were extra strong, "30 over 9" said Alan. At 2145 the distant signals were fading, the band became very noisy and the c.w. from European stations took on an auroral tone, and although by 2210 the band was returning to normal, one Russian station was 58A at 2204.

SSTV

"The 10m SSTV calling channel, 28·680MHz is becoming quite active again" writes **Sam Faulkner,** Burton-on-Trent. Sam received pictures from LU5AN at 1530 on August 24 and from W8IY/TECT at 2000 on the 28th. From 1900 to 2030 on September 11, he had excellent copy from N8AEP and WA1GZY, and watched a QSO between W7KPW and G3NOX. g" tvv hupied most of my log this time", said Sam, "with video on 20m from DK, EA, HA, HB, I, LZ, OE, OH, OK, SM and W3".

VHF at Sea

While on a boat trip to the Isle of Wight in September, I could not resist the chance of talking to Alan Reynolds, Skipper of the *Solent Scene,* one of the Blue Funnel's Solent Leisure Line Fleet.

The *Solent Scene* can carry up to 249 passengers and during our crossing from Southsea to Ryde, the Skipper, having welcomed us aboard with an Eagle PA system, which was extremely clear, pointed out places of interest, such as the buoys marking the wreck of the *Mary Rose,* and invited further questions. On the return journey I took up his offer and asked him about the ship's radio gear. With obvious enthusiasm and love for his ship, Alan invited me onto the bridge to see the Decca 050 Mk II Radar, which has switchable ranges between 0·5 and 12 miles, and the Space Age Electronics depth sounder which can work to a depth of 80 metres but in this case is normally used around 26 metres. The radar scanner is installed in a protective radome on top of the bridge, and the sounder is fed from a transducer in the ship's hull. Alan was full of praise for the friendly and efficient wireless operators who cover his patch at Southampton as he demonstrated his v.h.f. set, a Seavoice RT100, fed from a vertical aerial on the mast, as is the v.h.f. Air Call set used for making ship-shore telephone calls. The engine rev counters and associated controls, both mechanical and electrical, are mounted on a polished desk-top console within easy view from the wheel, and the whole comfortable and spacious bridge, under Alan's watchful eye, just spells efficiency.

VHF Weather

Specified v.h.f. bands are also used for weather satellites and one of the experts on this subject, as we know from his articles in *Wireless World,* is **Gerry Kennedy** G3OGK, who says that readers who want to know more about this subject should write to The Director, Science Research Council, Rutherford and Appleton Laboratories, Ditton Park, Slough, Berks SL3 9JX and Gerry will deal with their enquiries in due course. Gerry is also active with facsimile equipment on the h.f. bands and can often be found for a chat on 2m and 70cm. Gerry and his wife Barbara hold the call-signs VP8LZ and VP8MF respectively.

Tropospheric

We can trace the early September tropospheric opening back to August 30 when the midday atmospheric pressure stood at 29·8in (1009mb) before beginning to rise sharply at 1400. It reached 30·15in (1020mb) at noon on the 31st and 30·35in (1027mb) by 1200 on September 1. Soon after midnight on the 1st, the pressure began a gradual decline until it reached 30·1in (1019mb) at midday on the 3rd. True to form a v.h.f. disturbance took place, during which **Mike Rowe** G8JVE, Chichester, worked an EA through the Brighton repeater GB3SR, R3, and on his way home from Salisbury, he stopped on Portsdown Hill and heard an EA call on S20 and hook up with a GU. On arrival home Mike worked two DJs on 2m s.s.b. At 2256 on the 1st, Alan Baker had a c.w. QSO with a PA0, and around 2200 on the 2nd he worked DK3UZ and F9QE on c.w. and OZ9FW on s.s.b.

Also on the 2nd, **John Cleaton** G4GHA, Wareham, Dorset, contacted a new QRA square for him by working F9NL in AD71b, and then had QSOs with F6FRR, F9ON/P, F6ELI and DJ8PB. At 1925 on the 3rd, John made contact with **Ann Short** G4EYL/A, a DXpedition station in the Scilly Isles. For most of the 1st and around 0730 on the 2nd, I heard strong mobile QSOs through the Birmingham GB3BM, R5, and Bristol Channel GB3BC, R6, repeaters. Later the opening spread to 70cm, because from about 1900 on the 2nd to 0500 on the 3rd, I received 539 signals from the Sutton Coldfield beacon GB3SUT, 432·89MHz, with only a dipole feeding my receiver.

Thuraiappah Ambihairajan, London, using a National Panasonic DR59, received many extra stations in Band II, at good strength, between September 2 and 4 using just the telescopic aerial provided with the set. In the same tone, Harold Brodribb writes: "September 3, an extraordinary day, Band II reception even more marked than on the 2nd." At 1905 on the 2nd, Harold counted 17 French stations between 88 and 100MHz, and there were 21 around 1900 on the 3rd.

A quick up and down in pressure occurred again between the 5th and 7th, and on the 6th Mike Rowe worked an EA, an F0 near the Spanish border, an F6 on the Mediterranean coast and two HB9s. John Cleaton worked DJ, F, G, GJ, GU, GW, HB9, ON and PA0 over the 6th and 7th. During the evening of the 6th, while some u.h.f. TV channels were disturbed, I again heard 539 signals from GB3SUT and received strong pictures from the IBA transmitter at Lichfield on Ch. 8.

Station Reports

On August 25, **Gerry Brownlow** and family once again set up their h.f. demonstration station at the Chalk Pits Museum, Amberley, Sussex and while Gerry G3WMU/A and Peter G4ESC, delighted the museum visitors by working stations in Germany, Italy, Russia and the Shetland Isles, his wife Margaret G8TVN and son Richard G8VEJ, were using their hand portables on 2m. Among the many visitors to the station was **Terry Connell** G3UWI from Fareham, Hants.

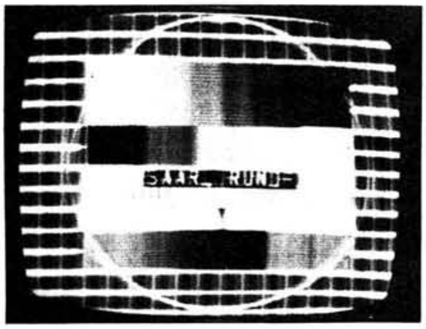
During his holiday, **Dick Grimsdale** G8USF, Brighton, found that operating through the Dublin repeater on R0 was of great assistance when working mobile on 2m in the Welsh valleys.

Guy Stanbury, Chelmsford, while on holiday in Canada, taped a selection of radio stations in Vancouver, visited CHAB, Moosejaw, CKPT/CKQM and CHEX RADIO/TV, in Peterborough, Ontario, and writes: "All engineering and management staff very helpful."

Husband and wife team, **Ed** and **Sheila Watkin,** G8RKI and G8WSG, Southsea, are always looking for contacts through the Hampshire GB3SN, R5 and Brighton repeaters. Ed uses a FDK 700E and a FT-207R and Sheila a KP202. Ed is assistant controller of south-east Hants Raynet and a member of the RNARS.

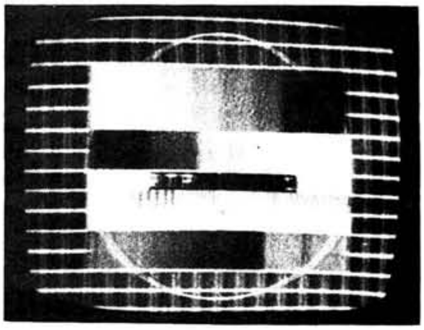
Richard Hope GW8TVX, Swansea, is very interested in 2m s.s.b. and has been active since March using an IC-211E with a Lunar linear giving 80 watts to a 9-element Tonna at 15ft a.g.l. His QTH is 350ft a.s.l. with an excellent take-off to the south and east and reasonable in the other directions. Richard was in on the July sporadic-E when he worked YU1OHK and heard GW4BCF and GW8ELR do the same. All three have now received QSL cards confirming the contacts. Richard has plans for a 16-element Tonna on top of a Versatower.

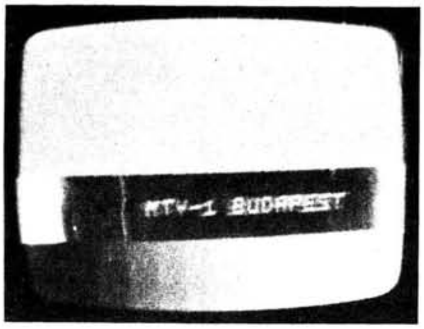
The Amateur Radio Association of Bahrain have installed a v.h.f. repeater on channel R6, accessed by the normal 1750Hz tone burst. The aerial, a single 5dB colinear, is 220ft a.s.l. and the rig runs 20 watts. "Operation and coverage have been excellent over the last year and amateurs sailing on vessels in the Gulf have been working over a distance of 300 miles" writes **S. K. Street** A9XBE Chairman and repeater keeper, and adds. "We welcome any new users to the repeater as currently there



◀ **Fig. 2: A West German station received by Nicholas Brown on Ch. E2 on 7 July 1980**

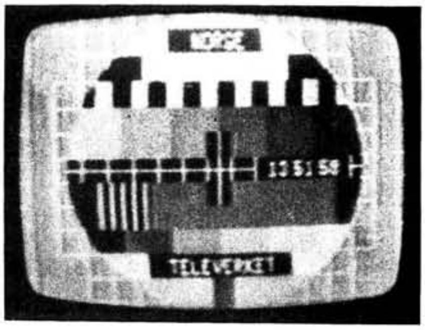
Fig. 3: A test card from Portugal received by Nicholas Brown on Ch. E3 on 16 July 1980





◀ **Fig. 4: A caption card received by Paul Farrigio in Band I during the 1980 sporadic E season**

Fig. 5: A test card received from Norway by Paul Farrigio in Band I during the 1980 Sporadic E season ▶



are only A9XBE, A9XBW, A9XCF and A9XCX active on the system".

DXTV

The u.h.f.s were also affected by the opening on September 2, because around 2200, Thuraiappah Ambihairajan received pictures from the German station DBP-ZDF on Ch. 28, and after 2300 on the 4th he watched some form of transmitter testing from Belgium on Ch. 61, showing a test card made up of squares with "Canal 61" scribed in a centre circle, which periodically disappeared, leaving only the letters flashing on top of the squares.

T. Ambi is making comparisons between the Antiference MH311 and MH473 aerials for Bands I and III to see which suits him best. **Nicholas Brown,** Rugby, also working on aerials writes: "I am about to set to work on improving my omnidirectional crossed dipole array for a, hopefully, good F2 season." There are signs already, Nicholas, because around 0900 on August 23, Gordon Goodyer, using an R208 receiver and a home-brew preamp, heard three weak s.s.b. signals on 50MHz. Nicholas has also ordered a Wolsey "Colour King" u.h.f. aerial for future tropo openings, and is installing an ex-ITV 5-element array for Band III. Back in July he received pictures from West Germany on Ch. E2 (Fig. 2) and Portugal on Ch. E3 (Fig. 3), which were both among the strongest he saw during the 1980 sporadic-E season. The interesting caption and test card from Hungary and Norway, Figs. 4 and 5, were received by **Paul Farrigio,** Cardiff, who, no doubt like us all, is looking forward to the 1981 season.

At 1724 on August 25 I watched a western-type film on Ch. E2 and at 0900 on the 31st a pop group on Ch. R1. Harold Brodribb saw a brief test card on Ch. R1 at 1016 on August 29, a picture for a short period with possible Russian lettering at 0900 on the 30th, a fleeting, but definite test card from Norge-Steigen on Ch. E2 between 1025 and 1030 on September 3 and some bursts of pictures on R1 and E2 during the afternoon of September 13. At 1055 on September 12, **David Appleyard,** Uppsala, Sweden, noted an audio and video mix up between PTT SRG1 Switzerland and SAARL-RUNDF West Germany, on Ch. E2 but by 1130 conditions had returned to normal.

New Repeater

On September 20, **John Fell** G8MCP, Poole, our Technical Editor, received signals from the Cornish 2m repeater at his home in Poole, during its first morning of operation.

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ON THE AIR

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SHOW REPORTS

NEW BOOKS

MISCELLANEOUS

SUPPLEMENT etc

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DTL

930	55p
935	65p
937	55p
944	65p
946	55p
947	55p
962	55p
9099	90p

7400

7400	11p
7401	12p
7402	12p
7403	13p
7404	17p
7409	18p
7410	16p
7412	18p
7513	28p
7420	16p
7430	18p
7432	25p
7440	16p
7442	68p
7448	75p
7473	32p
7474	32p
7475	40p
7476	40p
7490	35p
7492	50p
7493	50p
7496	45p
74121	35p
74123	45p
74154	90p
74157	55p
74122	45p
74125	50p
74195	100p
74196	100p
74283	140p
74290	120p
74365	90p
74366	90p

74LS

74LS00	18p
74LS01	12p
74LS04	15p
74LS08	20p
74LS10	19p
74LS11	30p
74LS12	30p
74LS14	60p
74LS15	38p
74LS20	19p
74LS30	19p
74LS32	25p
74LS40	26p
74LS42	56p
74LS47	78p
74LS48	85p
74LS49	99p
74LS73	30p
74LS74	30p
74LS75	39p
74LS86	39p
74LS90	40p
74LS107	40p
74LS123	69p
74LS125	50p
74LS132	79p
74LS138	69p
74LS151	75p
74LS153	75p
74LS155	65p
74LS161	78p
74LS163	90p
74LS164	90p
74LS168	190p
74LS174	99p
74LS175	99p
74LS195	87p
74LS221	110p
74LS244	175p
74LS245	325p
74LS251	120p
74LS257	110p
74LS290	95p
74LS293	120p
74LS366	57p
74LS373	170p
74LS374	170p
74LS375	140p
74LS377	188p
74LS393	135p
74LS490	140p
74LS670	260p

CMOS

4001	19p
4002	19p
4006	75p
4007	19p
4008	80p
4009	35p
4010	45p
4011	20p
4012	24p
4013	38p
4014	70p
4015	75p
4016	35p
4017	60p
4018	76p
4019	42p
4020	88p
4021	100p
4022	88p
4023	22p
4024	50p
4025	20p
4026	130p
4027	45p
4028	75p
4029	80p
4030	50p
4031	195p
4033	145p
4035	104p
4036	290p
4037	105p
4038	110p
4039	290p
4040	99p
4041	75p
4042	73p
4043	86p
4044	88p
4045	160p
4047	99p
4048	56p
4049	38p
4050	40p
4051	69p
4052	75p
4053	73p
4054	111p
4055	121p
4056	121p
4059	560p
4060	112p
4063	112p
4066	56p
4067	422p
4068	19p
4069	19p
4070	28p
4071	25p
4072	25p
4075	20p
4076	88p
4077	23p
4078	29p
4081	23p
4082	25p
4085	86p
4086	68p
4089	130p
4093	68p
4094	225p
4095	99p
4096	325p
4098	110p
4099	180p
4501	25p
4502	112p
4503	68p
4507	52p
4508	288p
4510	76p
4511	125p
4512	75p
4514	250p
4515	290p
4516	109p
4518	99p
4520	99p
4521	230p
4526	105p
4527	130p
4528	99p
4529	140p
4531	150p
4532	125p
4538	150p
4543	160p
4556	70p
4560	225p
4569	240p
4572	46p
4584	79p
4585	125p

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4116 150 NS	395p
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IM6402 IPL	425p

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RO-3-2513 UC	450p

KEYBOARD ENCODER

AY-5-2376	795p

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FD1771 B-01 S/D Inverted Bus	2995p
FD1791 B-01 D/D Inverted Bus	4995p
FD1792 B-01 S/D Inverted Bus	3495p
FD1793 B-01 D/D True Bus	5495p
FD1794 B-01 S/D True Bus	3495p
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FD1797 B D/D True Bus, side select	5995p

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6520	495p
6522	795p
6532	895p
6551	1095p
6810	375p
6820	425p
6821	425p
6850	425p
6852	425p
8212	395p
8214	450p
8216	395p
8224	395p
8228	395p
8251	495p
8253	1125p
8255	495p
8257	1050p
8259	1325p
MC 144 12VL	797p
Z80 P10	595p
Z80 CTC	595p
Z80A P10	695p
Z80A CTC	695p
Z80 DMA	1995p
Z80A DMA	2495p
Z80 S10/0	2995p
Z80A S10/0	3495p
Z80 S10/1	2995p
Z80A S10/1	3495p
Z80 S10/2	2995p
Z80A S10/2	3495p

LINEAR IC's

AY-3-1350	695p
AY-3-8910	850p
709	30p
723	33p
741	18p
ICL7106	595p
ICL7107	695p
ICL8038	295p
ICM7216A	1875p
ICM7216B	1675p
ICM7555	80p
LM301AM	30p
LM311	50p
LM318	75p
LM324	45p
LM339	45p
LM380	65p
LM1496	65p
LM1871	550p
LM1872	550p
LM3900	50p
LM3914	225p
LM3915	225p
LM13600	125p
NE555	18p
NE556	50p
RC4136	85p
SN76477N	175p
TBA810DAS	85p
TL071	55p
TL074	130p
TL082	75p
TL084	110p
TL490	175p
XR2206	325p
XR2207	375p

INTERFACE LINEAR

MC1488	90p
MC1489	90p
DM8123	125p
75150	125p
75154	125p
75182	195p
75322	250p
75324	325p
75325	325p
75361	350p
75365	295p
75451	50p
75491/2	75p
8T26	175p
8T28	175p
8T95	175p
8T97	175p

LEDs

TIL209	9p
TIL211	13p
TIL212	15p
TIL220	12p
TIL222	15p
TIL224	18p

DISPLAYS

FND500	80p
FND510	80p
FND567	125p
DL704	85p
DL707	85p
MV57164	225p

DIL SWITCHES

4 pole	99p
6 pole	115p
8 pole	140p
10 pole	175p

ISOLATORS

ILD74	120p
ILQ74	325p
MCT6	90p
TIL111	75p

LOW PROFILE SOCKETS BY TEXAS SALE

8 pin	7p	18 pin	15p	24 pin	22p
14 pin	9p	20 pin	18p	28 pin	25p
16 pin	10p	22 pin	22p	40 pin	28p

CPU'S

6502	795p
6504	795p
6505	795p
6800	695p
6802	995p
8080A	525p
8085A	1095p
Z80	795p
Z80A	995p
Z8001	12500p
Z8002	9500p
WD9000B	19900p

VOLTAGE REGULATORS

7805/7812	55p
7905/7912	65p
78HO5SC	575p
78HGKC	625p

BIPOLAR PROMS

93448 512 · 8 40 NS	p.o.a.
93453 1k · 4 40 NS	p.o.a.
93451 1k · 8 45 NS	p.o.a.
93511 2k · 8 50 NS	p.o.a.

74C

74C20	30p
74C76	60p
74C85	145p
74C97	125p
74C98	125p
74C107	100p
74C160	110p
74C161	145p
74C162	145p
74C163	145p
74C192	175p
74C193	175p
74C194	175p
74C195	175p
74C903	45p

NEW

SPECIAL OFFER!

4K CMOS RAM (1K × 4) 450 NS ONLY £6.95 (8 for £45).

The TC 5514P from Toshiba, CMOS equivalent of the 2114!

- Low Power Dissipation
  10pW/BIT (TYP.) "3.0V (STAND BY)
  10uW/BIT (TYP.) "5.0V (OPERATING)
- Data Retention Voltage 2V to 5·5V
- Single 5V Power Supply
- 18 PIN Plastic Package
- Full Static Operation
- Three State Output
- Input/Output TTI Compatible
- Fast Access Time 450NS.

Toshiba's TC5514P (industry type 6514) is a full static read write memory organised as 1024 words by 4 bits using CMOS technology. Ultra low power dissipation means it can be used as battery-operated portable memory system and also as a non-volatile memory with battery back-up. Operates from a single 5V power supply with static operation, hence no refresh periods and a much simplified power supply circuit design. Three state outputs simplify memory expansion for minimum data retention voltage is 2V, the battery back-up system needs only simple circuit. Toshiba's original C²MOS technology also means wide operating and noise margins. The TC 5514P is moulded in a dual-in-line 18 pin plastic package 0·3 inch in width.

STEREO! S100 SOUND COMPUTER BOARD!

At last, an S-100 Board that unleashes the full power of two unbelievable General instrumentsd AY-3-8910 NMOS Computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE etc.

KIT FEATURES

- Two GI Sound computer IC's (AY-3-8910)
- Four parallel I/O ports on Board.
- Uses on Board audio Amps or your STERO.
- On Board proto typing area.
- All sockets, parts and hardware are included.
- PC Board is soldermasked, silk screened with gold contacts.
- Easy, quick and fun to build, with full instructions.
- Uses Programmed I/O for maximum system flexibility.
- Both BASIC and ASSEMBLY language programming examples are included.

COMPLETE KIT . . . Only £59.96 includes 60 page data manual.
BARE BOARD . . . Only £25.00 includes 60 page data manual.
AY-3-8910 chip special price with purchase of BARE BOARD (2 chips) £15.

SOFTWARE

SCL is now available! Our Sound Command language makes writing Sound Effects programs a SNAP! SCL also includes routines for Register-Examine-Modify, Memory-Examine-Modify and Play-Memory. SCL is available on CP/M compatible diskette or 2708/2716. Diskette – £19.95, 2708 – £14.95, 2716 – £24.95. Diskette includes the source. EPROM'S are ORG at EOOOH.

TUNES SYNTHESIZER

The AY3-1350 is a MOS microcomputer synthesizer of preprogrammed tunes for applications in toys, music boxes and door chimes. The standard device has a set of 25 different popular and classical tunes. In addition there are 3 chimes making a total of 25 tunes.

FEATURES

- Minimal external components.
- Automatic switch-off signal at end of tune for power saving.
- Envelope control to give organ or piano quality.
- Sequential tune mode.
- 4 door capability when used as door chime.
- Operation with tunes in external PROM if required (2708).
- Single supply (· 5V) operation.
- Tunes include: STAR WARS, BEETHOVEN'S 9TH AND 5TH, JINGLE BELLS, YANKEE DOODLE, STAR SPANGLED BANNER, CLEMENTINE, GOD SAVE THE QUEEN, O SOLE MIO, WESTMINSTER CHIMES, and DESCENDING OCTAVE CHIME **plus many more!** with detailed specs and instructions.

BOOKS

Please order books by reference no. *and* title, and add 50p post & packing for each book ordered.

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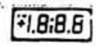
3½-DIGIT LIQUID CRYSTAL DISPLAY with 'low bat' indicator.



- High Contrast Ratio
- Wide Viewing Angle
- 0·5in Digit Height
- ULTRA low Power Consumption LCD 106

£6.45

LED BAR GRAPH AND ANALOG METER DRIVER

New from National LM3914. Drives 10 LED directly for making bar graphs, audio power meters, analog meters, LED Oscillators, etc. Units can be stacked for more LEDs. A super versatile and truly remarkable IC.

Special price.	Only £2.25
12 page data	25p
Matching red bar display MV57164	£2.25
Data	25p

SE 01 Sound Effects Kit

NEW

The SE-01 is a complete kit that contains all the parts to build a programmable effects generator. Designed around the new **Texas Instruments SN 76477** Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noises, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator and Multiplex Oscillator for even more versatility. The 3¼" · 3" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate **Explosion, Phaser Guns, Steam Trains**, or almost, an infinite number of **other sounds**. The unit has a multiple of applications. The low price includes all arts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100MV amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included.)

COMPLETE KIT ONLY £14.99
P&P 67p · VAT

THE NEW ULN-2232A INTEGRATED MOTION DETECTOR
The most SOPHISTICATED MOTION DETECTOR available!

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- Long Range Operation
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- Two Sound Patterns

Combining I²L and Bipolar circuitry, the ULN-2232 A Motion Detector is a complex optolinear IC which includes an on-chip photodiode, high-gain logarithmic and linear amps, extensive digital circuitry for sound generation and timing, and high-current output drivers. Add on five small capacitors, a speaker and power source and you turn this state-of-the-art device into a complete Motion Detector sensitive to small changes in light level as a function of time. DETAILED DEVICE DESCRIPTION AND APPLICATIONS INFORMATION INCLUDED WITH EVERY ULN-2232A. ONLY **£7.60!!**

UNIVERSAL SCR

C106D 400V/5A Sale	30p

AY·3·8910
THE NEW GI COMPUTER SOUND CHIP

The amazing AY-3-8910 is a fantastically powerful sound and music generator, perfect for use with any 8-bit micro processor. Contains 3 tone channels, noise generator, 3 channels of amplitude controls, 16-bit envelope period control, 2 parallel I/O, 3D/A converters plus much more. All in 40 pin DIP. Super easy to interface to the S-100 or other Busses.

ONLY **£8.50** · VAT, including FREE reprint of BYTE '79 article! Also, add £2.25 for 60-page data manual.

"Perhaps the next famous composer will not direct a 150-piece orchestra but, rather, a trio of microcomputers controlling a bank of AY-3-8910s." BYTE July '79.

MUSIC FOR YOUR EARS

Bullet's **Electronic Music Maker TM Kit** has a single **28 Pin Microprocessor Chip with ROM** that has been programmed to play the first 6 to 10 notes of the **25 popular tunes** listed below. Each tune can easily be addressed individually or played sequentially at the push of a button. The 3 chime sequences are activated at any time by separate switch closures, so when used as a doorbell, one door can play songs while two others wll play different chimes. The unit has a **5 watt audio Amp anid will run on either 12 VAC or 12 VDC.** Construction is very simple, works with any 8 or 16 ohm speaker, or horn speaker (not included). Tunes can be remotely programmed using a single rotary switch (not included), if desired.

Complete Kit £9.95. 240V Transformer optional.

Tunes: Toreador ★ William Tell ★ Hallelujah Chorus ★ Star Spangled Banner ★ Yankee Doodle ★ America America ★ Deutschland Leid ★ Wedding March ★ Beethoven's 5th and 9th ★ Hell's Bells ★ La Vien en Rose ★ Stars Wars Theme ★ Clementine ★ Marseillaise ★ O Sole Mio ★ Santa Lucia ★ The End ★ Blue Danube ★ Brahms Lullaby ★ Westminster Chime ★ Simple Chime ★ Descending Octave Chime ★ Augustine ★ Jingle Bells ★ God Save the Queen ★ Colonel Bogie.

The XR2266 Decoder/Sense & Drive Chip for toy cars that DRIVE LIKE REAL!
ONLY **£5.45!** **NEW FROM EXAR**

This versatile 18-pin dual in-line IC combines both the decoder **and** the sense and drive functions to cut remote control circuitry by **at least** a factor of two! Steering, lights, indicators, speed control – all from the new XR2266 at only **£5.45!**

Ordering information. Unless otherwise stated, for orders under £50 add 50p p&p. Add 15% VAT to total (no VAT on books). All devices are brand new, factory prime and full spec and subject to prior sales and availability. Prices subject to change without notice. Minimum telephone order using ACCESS is £10. If ordering by post with ACCESS, include name, address and card no. written clearly. Please allow 4/6 weeks delivery on books.

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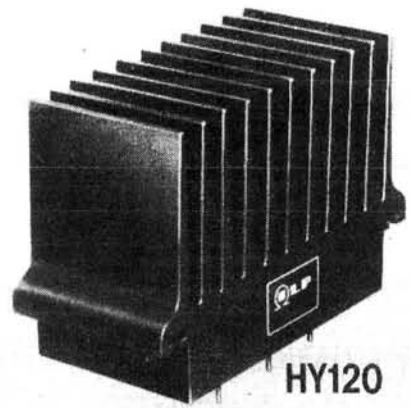


MOSFET

CHOOSE AN I.L.P MOSFET POWER AMP when it is advantageous to have a faster slew rate, lower distortion at higher frequencies, enhanced thermal stability, the ability to work with complex loads without difficulty and complete absence of cross-over distortion. I.L.P's exclusive encapsulation technique within fully adequate heatsinks has been taken a stage further with specially developed computer-verified 'New Profile' extrusions. These ensure optimum operating efficiency from our new MOSFETS, and are easier to mount. Connection is via five pins on the underside. **I.L.P MOSFETS ARE IDENTICAL IN PERFORMANCE TO THE COSTLIEST AMPLIFIERS IN THIS EXCITING NEW CATEGORY BUT ARE ONLY A FRACTION OF PRICES CHARGED ELSEWHERE.**

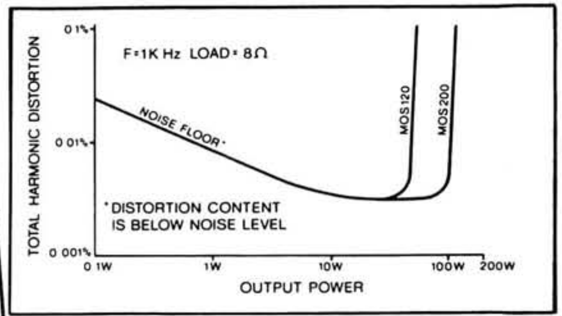
Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
MOS120	60W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£25.88 + £3.88
MOS200	120W into 4-8Ω	0.005%	20V/μs	3μs	100dB	£33.46 + £5.02

BIPOLAR

CHOOSE AN I.L.P BIPOLAR POWER AMP where power and price are first consideration while maintaining optimum performance with hi-fi quality and wide choice of models. From domestic hi-fi to disco and P.A., for instrument amplification, there is an I.L.P Bipolar to fill the bill, and as with our new Mosfets, we have encapsulated Bipolars within our New Profile extrusions with their computer-verified thermal efficiency and improved mounting shoulders. Connections are simple, via five pins on the underside and with our newest pre-amps and power supply units, it becomes easier than ever to have a system layout housed the way you want it.

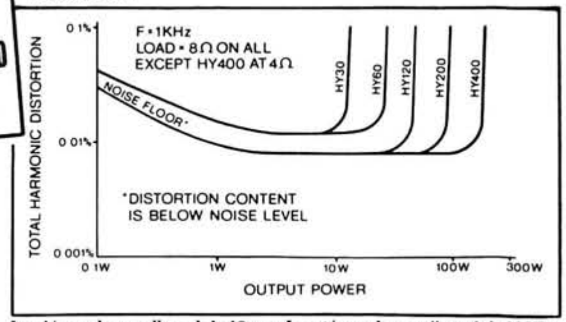
Model	Output Power RMS	Distortion Typical at 1KHz	Slew Rate	Rise Time	Signal/Noise Ratio DIN AUDIO	Price & VAT
HY30	15W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£6.34 + 95p
HY60	30W into 4-8Ω	0.015%	15V/μs	5μs	100dB	£7.24 + £1.09
HY120	60W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£15.20 + £2.28
HY200	120W into 4-8Ω	0.01%	15V/μs	5μs	100dB	£18.44 + £2.77
HY400	240W into 4Ω	0.01%	15V/μs	5μs	100dB	£27.68 + £4.15

ILP POWER AMPS ARE ENCAPSULATED FOR THERMAL STABILITY AND LONGER LIFE



Load impedance both models 4Ω-∞ Input sensitivity both models 500mV

Input impedance both models 100KΩ Frequency response both models 15Hz-100KHz – 3dB

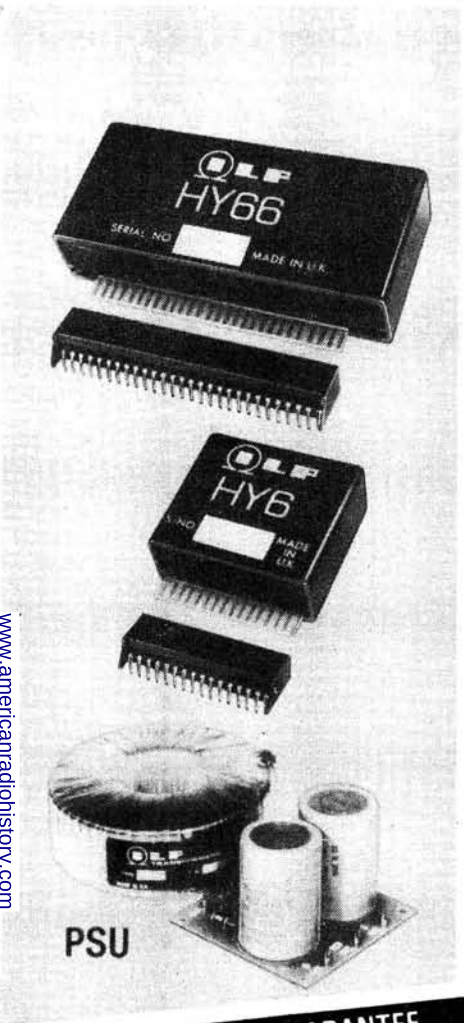


Load impedance all models 4Ω-∞ Input sensitivity all models 500mV

Input impedance all models 100KΩ Frequency response all models 15Hz-50KHz – 3dB

THE NEW PROFILE EXTRUSIONS

The introduction of standard heatsink extrusion for all I.L.P power amplifiers achieves many advantages: – Research shows they provide optimum thermal dissipation and stability. Slotted shoulders allow easy mounting; standardisation enables us to keep our prices competitive. Surfaces are matt black, anodised for lower thermal conductivity. Extrusions vary in size according to module number.



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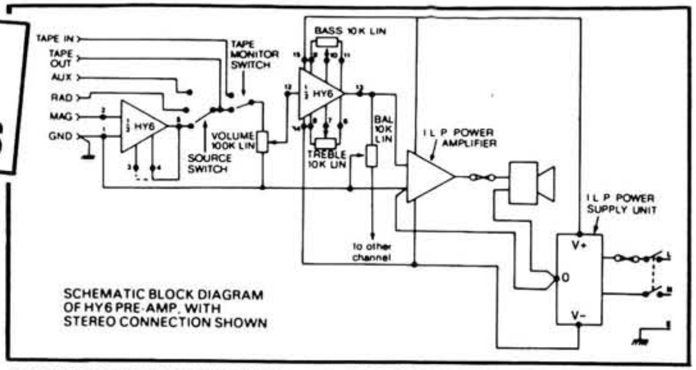
NEW PRE-AMPS

HY6 (mono) and **HY66** (stereo) are new to I.L.P's range of advanced audio modules. Their improved characteristics and styling ensure their being compatible with all I.L.P power-amps both MOSFET and BIPOLAR, giving you chance to get the best possible reproduction from your equipment. HY6 and HY66 pre-amps are protected against short circuit and wrong polarity. Full assembly instructions are provided. Mounting boards are available as below.
Sizes – **HY6** – 45×20×40 mm. **HY66** – 90×20×40 mm.
Active Tone Control circuits provide ±12dB cut and boost.
Inputs Sensitivity – Mag. PU. –3mV: Mic – selectable 1-12mV: All others 100mV. **Tape O/P** – 100mV: **Main O/P** – 500mV: **Frequency response** – D.C. to 100KHz – 3dB.

HY6 mono £5.60 + 84p VAT Connectors included
HY66 stereo £10.60 + £1.59 VAT Connectors included
B6 Mounting Board for one HY6 78p + 12p VAT
B66 Mounting Board for one HY66 99p + 15p VAT

COMPATIBLE WITH ALL ILP MODULES



- **DISTORTION TYPICALLY 0.005%**
- **S/N RATIO – 90dB (Mag. P.U. – 68 dB)**
- **38 dB overload margin on Mag. P.U.**
- **LATEST DESIGN HIGH QUALITY CONNECTORS**
- **ONLY POTS, SWITCHES AND PLUGS/SOCKETS NEED ADDING**
- **NEEDS ONLY UNREGULATED POWER SUPPLY ±15 to ±60v**

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Of the eleven power supply units which comprise our current range, nine have toroidal transformers made in our own factory. Thus these I.L.P power supply units are space-saving, more efficient and their better overall design helps enormously when assembly building. All models in the range are compatible with all I.L.P amps and pre-amps with types to match whatever I.L.P power amps you choose.

PSU30 ±15V at 100mA to drive up to 12 x HY6 or 6 x HY66 — **£4.50** + 0.68p VAT
● *THE FOLLOWING WILL ALSO DRIVE I.L.P PRE-AMPS*
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● *ALL THE FOLLOWING USE TOROIDAL TRANSFORMERS*

PSU50 for use with 1 or 2 HY60's	**£9.75** + £1.46 VAT
PSU60 for use with 1 HY120	**£9.75** + £1.46 VAT
PSU65 for use with 1 MOS120	**£9.75** + £1.46 VAT
PSU70 for use with 1 or 2 HY120's	**£13.61** + £2.04 VAT
PSU75 for use with 1 or 2 **MOS120**	**£13.61** + £2.04 VAT
PSU90 for use with 1 HY200	**£13.61** + £2.04 VAT
PSU95 for use with 1 **MOS200**	**£14.75** + £2.21 VAT
PSU180 for use with 1 HY400 or 2 HY200	**£23.02** + £3.45 VAT
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Analogue. Independent hours and minutes with synchronous digital seconds. Dual time ability.
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Stopwatch. 1/100 second to 12 hours. Net, lap and 1st and 2nd place. Start/stop and 10 minute signals.
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Countdown Alarm. Normal and net times to 1 hour, with amazing "Star Burst" flashing display.
Time signal. Half hourly and hourly chimes. Tone control. Lithium battery. Light. Water Resist. case. 8.65mm thick. Mineral glass (£34.95).

ONLY £29.95
for around 40 functions.

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Countdown alarm. Date memories.

Hours, minutes, seconds, am pm. 12 or 24 hour. Day, date and month auto calendar.
Alarm. 7 melodies, one for each day of the week.
Hourly time signal. With "Big Ben" type tune.
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Countdown alarm. From 1 second to 1 hour. After zero, count continues positively.
Stopwatch. 1/10 second to 1 hour. Net, lap etc.
Picturesque moving display of notes played.
Light. Lithium. Glass. Water Resist. cases.
M-12 resin, s/s trim. **M-1200** all s/s 9.0mm thick.

£24.95 **£29.95**
For around 40 functions

100 METRE WATER RESISTANT

Alarm Chronographs with countdown.

Amazing 5 year lithium battery life. Hours, minutes, seconds, am/pm, day, date and month. 12 or 24 hour. Time is always visible regardless of display mode.
Stopwatch. 1/100 second to 1 hour. Net, lap, 1st and 2nd. Start/stop signal. 10 minute signal.
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W-100. All resin. **W-150B.** All s/s. **W-150C** (not illustrated) s/s case/resin strap **£25.95.**

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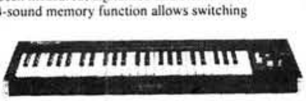
With the amazing new CASIOTONE 201

A remarkable new concept in electronic keyboard instruments using a totally new technology. Pitch, timbre and harmonics of 29 instruments have been measured, digitalised and stored in electronic chip memory for faithful reproduction. A 4-sound memory function allows switching between any 4 pre-selected instruments. This polyphonic instrument can play full chords of up to 8 notes on its 29 white and 20 black keys spanning 4 octaves. Vibrato and tone switches. Foot volume and sustain pedal options. Echo jacks. 3×33½×9¾ inches. Weight 15lbs. Black or woodgrain finish. AC only.



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Four instruments on the move!

Polyphonic playing of piano, organ, violin and flute. 19 white and 13 black keys span 2½ octaves. Vibrato switch. 2×16½×5¾ inches. Weight 3.5lb. Integral speakers. O/p jack. Mains/battery.

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We can now give no assurance of future availability as Toshiba ceased production two years ago and NEC are now refusing further orders. Some of our prices have more than doubled in last six months, but we suspect they will be going up again as the shortage starts to bite.
EQUIVALENTS. The FT101 is designed for use with NEC or Toshiba PA tubes. Many other makes are not satisfactory, e.g. RCA will not bias correctly, won't neutralise, and oscillate continuously on TX and RX (O.K. in TV sets, though – that's what RCA made them for!). 6146B's aren't all identical and some valves will not function in some rigs.
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6JS6C Toshiba unstamped, few only .... £18.00 pair*
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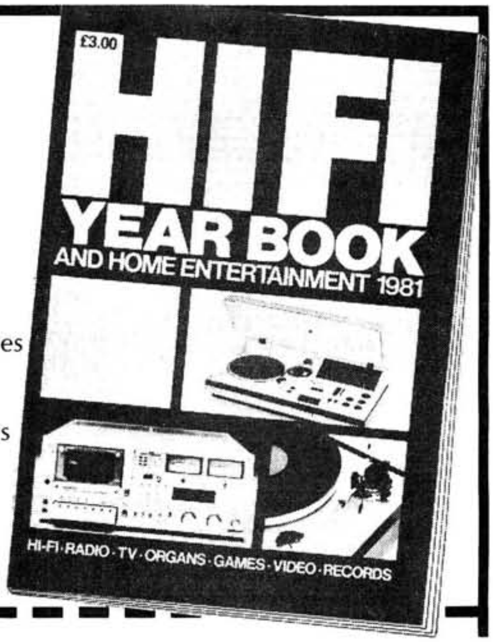

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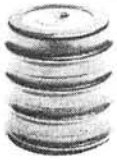

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Continuous Ratings

30 VOLT RANGE (Split Sec)
Sec Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V or 12V-0-12V or 15V-0-15V.

Ref.	Amps			Price	P&P
112	.5	1	15V	**2.90**	0.90
79	1	2	O	**3.93**	1.10
3	2	4	N	**6.35**	1.10
20	3	6	L	**7.39**	1.31
21	4	8	Y	**8.79**	1.31
51	5	10		**10.86**	1.52
117	6	12		**12.29**	1.67
88	8	16		**16.45**	1.89
89	10	20		**18.98**	1.89
90	12	24		**21.09**	2.24
91	15	30		**24.18**	2.39
92	20	40		**32.40**	O.A.

50 VOLT RANGE (Split Sec)
Sec 50V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 20V-0-20V or 25V-0-25V.

Ref.	Amps			Price	P&P
102	.5	1	25V	**3.75**	0.90
103	1	2	O	**4.57**	1.10
104	2	4	N	**7.88**	1.31
105	3	6	L	**9.42**	1.52
106	4	8	Y	**12.82**	1.73
107	6	12		**16.37**	1.89
118	8	16		**22.29**	2.39
119	10	20		**27.48**	O.A.
109	12	24		**32.88**	O.A.

MAINS ISOLATORS (SCREENED)
Pri 0-120: 0-100-120V (120, 220, 240V) Sec 60-55-0-55-60 twice to give 55, 60, 110, 115, 120, 125, 175, 180, 220, 225, 230, 235, 240.

Ref	VA	Price	P & P
*07	20	**4·84**	0·91
149	60	**7·37**	1·10
150	100	**8·38**	1·31
151	200	**12·28**	1·31
152	250	**14·61**	1·73
153	350	**18·07**	2·12
154	500	**22·52**	2·47
155	750	**32·03**	O.A.
156	1000	**40·92**	O.A.
157	1500	**56·52**	O.A.
158	2000	**67·99**	O.A.
159	3000	**95·33**	O.A.

*Pri 0-220-240V Sec 115 or 240V. State sec. volts required.

CASED AUTO TRANSFORMERS
240V cable in 115V USA flat pin outlet

VA	Price	P & P	Ref
20	**6·55**	1·03	56W
75	**8·50**	1·31	64W
150	**11·00**	1·31	4W
250	**13·39**	1·67	69W
500	**20·13**	1·89	67W
1K	**30·67**	2·65	84W
1500VA	**42·82**	O.A.	93W

60 VOLT RANGE (Split Sec)
Pri 220/240V sec 0-24-30-40-48-60V. Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24V-0-24V or 30V-0-30V.

Ref	Amps			Price	P&P
124	.5	1	30V	**4.27**	1.10
126	1	2	O	**6.50**	1.10
127	2	4	N	**8.36**	1.31
125	3	6	L	**12.10**	1.31
123	4	8	Y	**13.77**	2.12
40	5	10		**17.42**	1.89
120	6	12		**19.87**	2.12
121	8	16		**27.92**	O.A.
122	10	20		**32.51**	O.A.
189	12	24			

12 OR 24V OR 12-0-12V
Pri 220-240 volts

Ref	Amps 12V	Amps 24V	Price	P&P
111	0 5	0 25	**2·42**	0·52
213	1 0	0 5	**2·90**	0·90
71	2	1	**3·86**	0·90
18	4	2	**4·46**	1·10
85	0 5	2 5	**6·16**	1·10
70	6	3	**6·99**	1·10
108	8	4	**8·16**	1·31
72	10	5	**8·93**	1·31
116	12	6	**9·89**	1·52
17	16	8	**11·79**	1·52
115	20	10	**15·37**	2·39
187	30	15	**19·72**	2·39
226	60	30	**40·41**	O.A.

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SCREENED MINIATURES

Ref	mA	Volts	£	P&P
238	200	3-0-3	**2·83**	0·63
212	1A, 1A	0-6, 0-6	**3·14**	0·90
13	100	9-0-9	**2·35**	0·44
235	330, 330	0-9, 0-9	**2·19**	0·44
207	500, 500	0-8-9, 0-8-9	**3·05**	0·85
208	1A, 1A	0-8-9, 0-8-9	**3·88**	0·90
236	200, 200	0-15, 0-15	**2·19**	0·44
214	300, 300	0-20, 0-20	**3·08**	0·90
221	700 (DC)	20-12-0-12-20	**3·75**	0·90
206	1A, 1A	0-15-20-0-15-20	**5·09**	1·10
203	500, 500	0-15-27-0-15-27	**4·39**	1·10
204	1A, 1A	0-15-27-0-15-27	**6·54**	1·10
239	50	12-0-12	**2·88**	0·37

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400V	6A	**£1·44**

500V PM7A6 12A **£3·75**

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Ref.	VA (Watts)	£	P&P
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64	80	**4.41**	1.10
4	150	**5.89**	1.10
53	350	**10.08**	1.31
67	500	**12.09**	1.91
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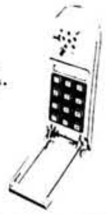

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Intermediate Frequency 1st 10.695MHz; 2nd 455kHz.
Sensitivity Better than 0.3uV for 20dB noise quieting.
Squelch sensitivity – less than 0.3uV.
Squrious response Rejection ratio more than 60dB.
Selectivity More than ± 7.5kHz at -6dB point
Less than ± 15.0kHz at -60dB point
Audio output More than 300mW-8 ohms.
Tone call Crystal controlled.

It will seduce you in it's own way the ICOM IC 251E £479 INCL. only

AFTER YEARS OF SUCCESS THE IC-211E HAS NOW BEEN REPLACED BY THE IC-251E. NOT JUST A FACE-LIFT, BUT A NUMBER OF IMPORTANT DEVELOP-MENTS HAVE BEEN INCORPORATED.

MICROPROCESSOR CONTROL – CPU control with Icom's original programs provides various operating capabilities. No backlast dial controlled by Icom's unique photo-chopper circuit. Band edge detector and Endless System provides out-of-band protection. No variable capacitors or dial gear, giving problem-free use. The IC251E provides FM, USB, LSB, CW coverage in the 144-146 MHz frequency range. Thus the IC251E can be used for mobile, DX, local calls, and satellite work (easily extended to 148 MHz).
MULTI-PURPOSE SCANNING – Memory Scan allows you to monitor three different memory channels. Program Scan provides scanning between two programmed frequencies. Adjustable scanning speed. Auto-stop stops scanning when a signal is received in all modes.
DUAL VFO's – Two separate VFO's can be used either independently or together for simplex operation, and any desired frequency split in duplex operation. Automatic 600kHz shift available on switch-on.

CONTINUOUS TUNING SYSTEM – Icom's new continuous tuning system features a luminescent display that follows the tuning knob movement and provides an extremely accurate readout. Frequencies are displayed in 7 digits representing 100 Mhz to 100 Hz digits.
Automatic re-cycling restarts the tuning at the bottom of the band when the top is reached – and vice versa. Quick tuning at the bottom of the band when the top is reached the SSB and CW modes, and 5 KHz steps and 1 KHz steps in the FM mode, is provided for trouble free use.
EASIER OPERATION AND LIGHTER WEIGHT – The most compact, lightest weight all-mode 144 MHz transceiver. First to use a pulse power supply in communication equip-ment, for lighter weight and cooler running. 50mm-diameter large tuning control knob for smooth and easy tuning. Trouble-free controlling knobs for both receiving and transmitting. LED indicator for transmit and receiving modes.
MOST SUITABLE FOR BOTH FIXED AND PORTABLE STATIONS – Built in 240V AC and DC power supplies. Convenient Dial Lock switch for mobile operation. Easy carry handle. Effective Noise Blanker. IC-SM5 high quality stand microphone is suitable for fixed station operation. Powerful audio output 1.5 Watts at 8 ohm, for easy listening even in noisy surroundings.

OUTSTANDING PERFORMANCE – The RF amplier and first mixer circuits using MOS FETs and other circuits provide excellent Cross Modulation and Two-Signal selectivity characteristics. The IC251E has excellent sensitivity demanded especially for mobile operation, high stability, and with Crystal Filters having high shape factors and exceptional selectivity. The Transmitter uses a balanced mixer in a single conversion system, a band pass filter and a high performance low-pass filter. The system provides distortion-free signals with a minimum spurious radiation level.

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Replacing the IC-245E, the IC-260E offers such extras as full frequency read out, upper and lower sideband, and scanning as well as FM and CW. Thus, it makes an ideal base station, when used with a DC power supply, as well as a mobile. The use of a microprocessor instead of an LSI chip has enabled Icom to offer this at a lower price than the IC-245E.

144MHz ALL-MODE TRANSCEIVER INCORPORATING A MICRO-COMPUTER – CPU control with Icom's original programs provides various operating capabilities. No backlash dial controlled by Icom's unique photo-chopper circuit. Band edge detector and Endless System provides out-of-band protection. No variable capacitors or dial gear, giving problem-free use. The IC-260E provides FM, USB, LSB, CW coverage in the 144-146MHz frequency range. Thus the IC-260E can be used for mobile, DX, local calls and satellite work. Easily extendable to 144-148.
MULTI PURPOSE SCANNING – Memory scan allows you to monitor three different memory channels. Program Scan provides scanning between two programmed frequencies. Adjustable scanning speed. Auto-stop stops scanning when a signal is received, in all modes.
DUAL VFO'S – Two separate VFO's can be used either independently or together for simplex operation, and any desired frequency split in duplex operation.
CONTINUOUS TUNING SYSTEM – Icom's new continuous tuning system features an LED display that follows the tuning knob movement and provides an extremely accurate readout.

Frequencies are displayed in 7 LED digits representing 100MHz to 100Hz digits. When in Duplex and using the tuning-knob the two VFO's track together. Automatic recycling restarts tuning at the top of the band, i.e. 145.999.9 MHz when the dial goes below 144.000.0MHz. Recycling changes 145.999MHz to 144.000.0MHz as well. Quick tuning in 1kHz steps is available, and fine tuning in 100Hz steps in the FM mode, is provided for trouble-free QSO.
OUTSTANDING PERFORMANCE – The RF amplifier and first mixer circuits using MOS FET's and other circuits provide excellent Cross Modulation and Two Signal Selectivity characteristics. The IC-260E has excellent sensitivity demanded especially for mobile operation, high stability and with Crystal Filters having high shape factors and exceptional selectivity. The transmitter uses a balanced mixer in a single conversion system, a band pass filter and a high performance low pass filter. This system provides distortion free signals with a minimum spurious radiation level for an output of 10W or more.
ADDITIONAL CIRCUITS – The IC-260E has a built-in Noise Blanker, CW Break-in CW Monitor, APC and many other circuits for your convenience. The IC-260E has everything you need to really enjoy VHF operation, in an extremely compact rugged transceiver.

AGENTS (PHONE FIRST – All evenings and weekends only, except Barnsley and Burnley)

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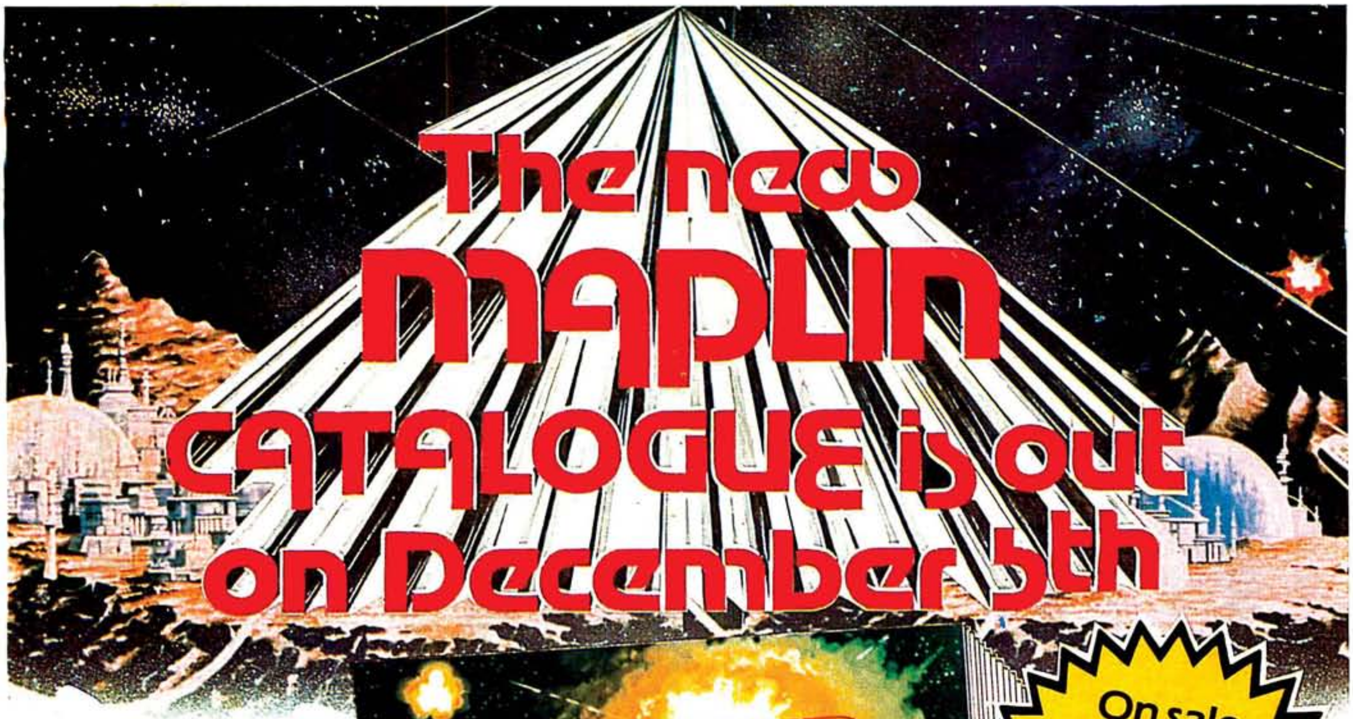

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