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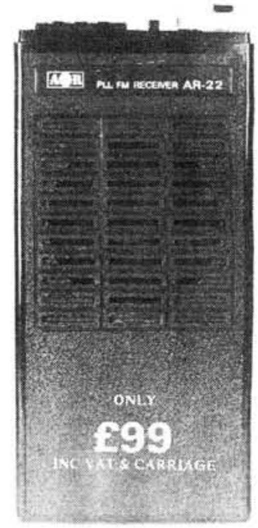

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OCTOBER 1980
VOLUME 56
NUMBER 9
ISSUE 883

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☐ NEWS & VIEWS

☐ FOR OUR CONSTRUCTORS

☐ GENERAL INTEREST

Due to pressure on space, we regret that Part 2 of Audio Power Amplifiers has had to be held over

Our November issue will be published about 3 October
(for details see page 35)

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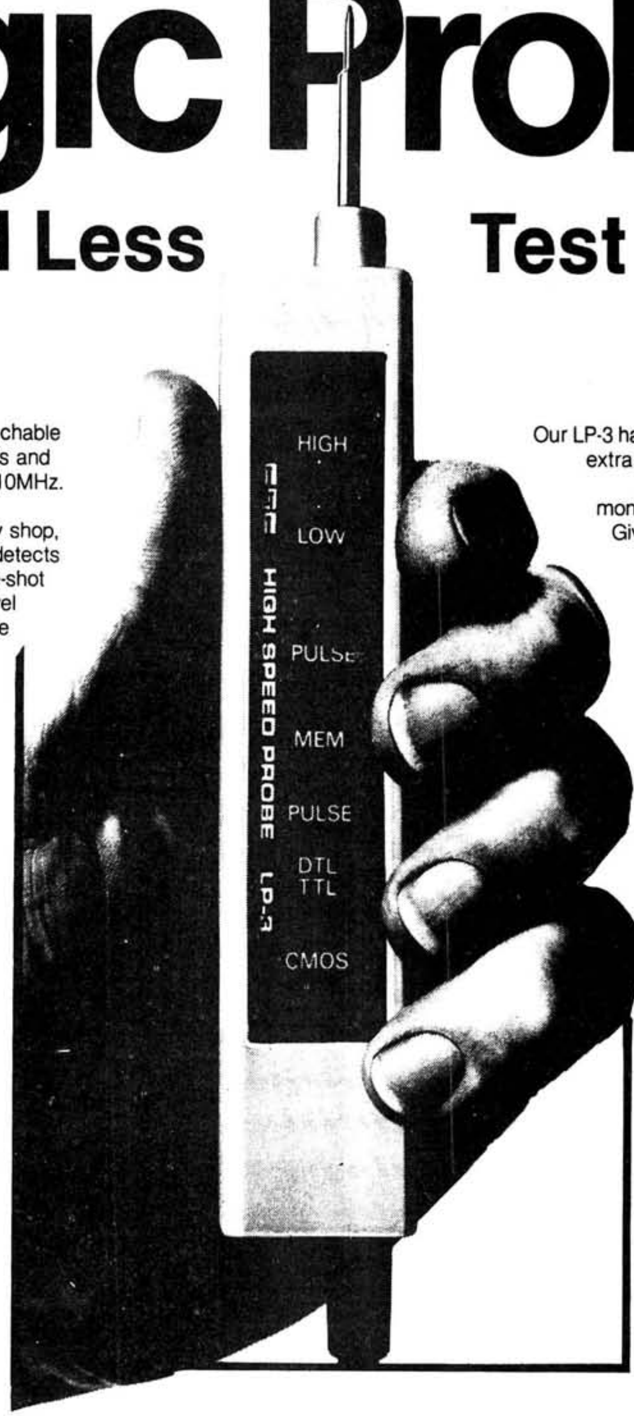

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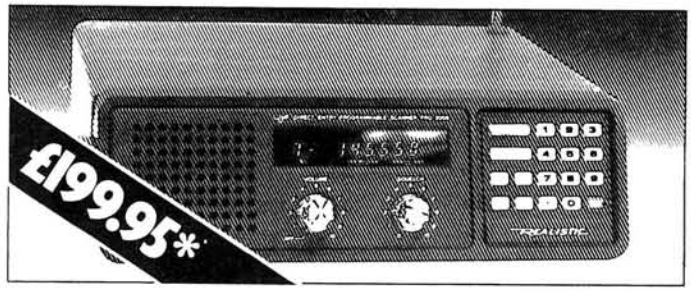

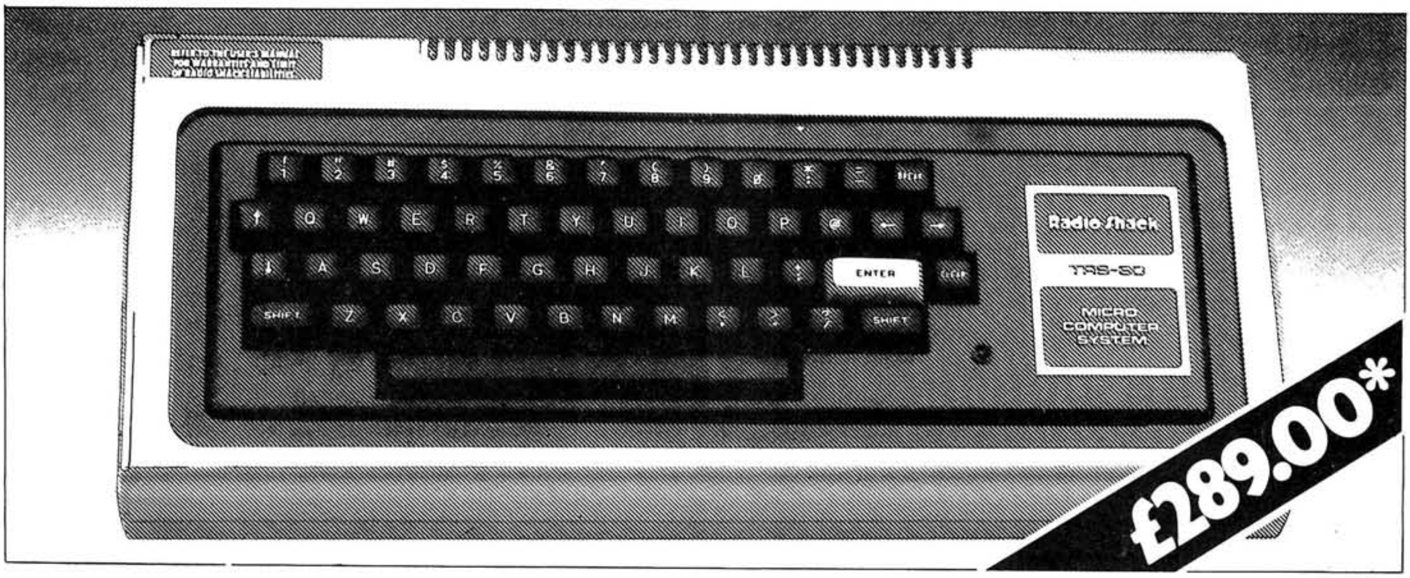

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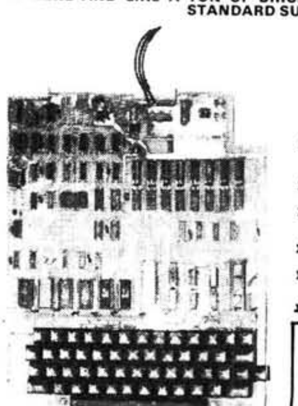

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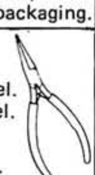

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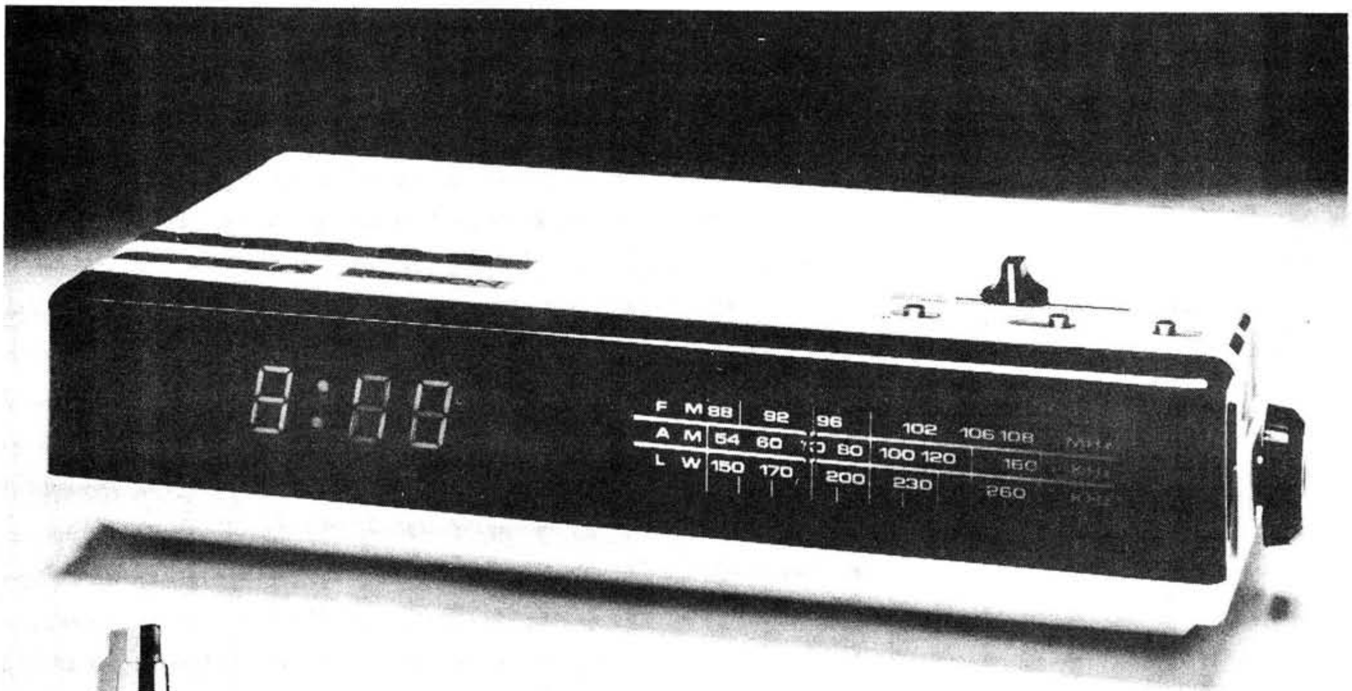

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20	3·0	**7·39**	1·31
21	4·0	**8·79**	1·31
51	5·0	**10·86**	1·52
117	6·0	**12·29**	1·67
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Ref	Amps	Price	P & P
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103	1·0	**4·57**	1·10
104	2·0	**7·88**	1·31
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154	500	**22·52**	2·47
155	750	**32·03**	O.A.
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126	1·0	**6·50**	1·10
127	2·0	**8·36**	1·31
125	3·0	**12·10**	1·31
123	4·0	**13·77**	2·12
40	5·0	**17·42**	1·89
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71	2	1	**3·86**	0·90
18	4	2	**4·46**	1·10
85	0·5	2·5	**6·16**	1·10
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72	10	5	**8·93**	1·31
116	12	6	**9·89**	1·52
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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
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Chips with Everything

WELL, not quite everything, though looking at current advertisements it seems that radio amateurs are probably more exposed to the effects of the microprocessor than any other group outside industry. A quick scan (no pun intended) of current advertisements reveals over a dozen different MPU-based rigs and scanning receivers on offer, and there are more on the way. When microprocessor applications in RTTY and station management are added, it is pretty obvious that the amateur is now, as always, in the forefront of technology.

Our editorial policy on *Practical Wireless* has been not to get involved in microprocessor basics or computing applications. For those that are interested, there are plenty of publications covering that field in depth, including our sister magazine *Practical Electronics*. We shall, though, be dealing with radio-related applications of the microprocessor, as suitable articles become available, and our current series on RTTY will include information on MPU-based terminals.

This month we begin what is, so far as we are aware, the first published home-constructor project incorporating a microprocessor as the control element. Here, we discount things such as musical doorbells and TV games which have, to a great extent, been invented to make use of the power and versatility of the "silicon chip", as it has come to be known outside the electronics industry. It is a pity that this title has been latched on to with such vigour by the popular press, and others who should know better. Its use unfortunately gives rise to such nonsenses as a recent statement by a motor industry spokesman, on the subject of in-car computers, in which he forecast that all new vehicles would soon be controlled by printed circuit boards, carrying silicon chips *and integrated circuits* (my italics).

Our first microprocessor project is the *PW* "Sherborne", a four-band broadcast tuner based on a dedicated MPU, which takes over many traditional functions and also allows several new ones which were previously impossible, or at best impractical. We hope that many of you will enjoy building it, or at least learning about the techniques involved.

★ ★ ★ ★ ★

On a sadder note, I have to announce our increased cover-price this month. I know only too well the effects that increases in prices have on us all, but hope that you will find that *Practical Wireless* continues to represent good value for money.

Geoff Arnold

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NEWS... NEWS...

Licence Changes Coming

In the House of Commons on 14 July 1980, Mr Wheeler MP, asked Mr Whitelaw, the Home Secretary, if he considers it necessary for all low power radio devices to be licensed; and if he will make a statement.

In a written reply, Mr Whitelaw said: "While licensing must remain the main regulatory control over the use of radio equipment, I have concluded that a simpler system would be appropriate in the case of certain low-powered devices. As a first step, I propose to bring forward in the next few months regulations under the Wireless Telegraphy Act 1949, exempting model control equipment and metal detectors from licensing. Broadly speaking, it is my intention that the conditions of exemption will reflect the simple licensing conditions at present in force in respect of these devices, with the result that existing licence holders will be able to pursue their hobbies exactly as now."

Mr Whitelaw concluded by saying: "My proposals will help reduce the work of my Department, and will lead to less bureaucratic control and to greater freedom for individuals. At a later stage I hope to identify other limited categories of radio device which can be dealt with similarly."

But be warned, I am advised by the Home Office that until the Act is modified users will be required to apply for licences in the usual way.

PW 'TAMAR' Part 3

28 MHz TRANSVERTER DRIVER

R. S. HEWES FSERT G3TDR

Readers who intend to operate the *PW* Tamar 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.

When the construction of the transceiver is complete and all sections functioning correctly, the alignment can be carried out. The alignment process is basically simple and provided that each step is followed carefully and use of the necessary equipment can be obtained, then no great problems should arise. A word of caution though; dust cores in the coils are very easily broken, so use only the correct trimming tool for the core to be adjusted.

General Requirements

The alignment can be carried out with the aid of a good, stable signal generator covering 9MHz and 28–30MHz, and a sensitive millivoltmeter fitted with a r.f. probe. A digital frequency meter would greatly facilitate the setting up of the oscillators, and an oscilloscope would prove useful in monitoring waveforms generated in the transceiver.

The millivoltmeter can be terminated by a 50Ω 2W carbon resistor for output power measurements using the familiar formula:

$$P_{out} = \frac{E^2}{R}$$

An a.c./d.c. multimeter is invaluable for checking initially for short-circuits and thence for d.c. voltage conditions, and can also serve as an audio wattmeter if it is terminated with an 8Ω 2W wire-wound resistor. This will be useful for measurement of audio output and for aligning the receiver section of the transceiver in conjunction with the meter M1.

Receiver Alignment

Commence by aligning the receiver section. Inject a 9MHz signal into pin 4 of IC1 via C84 (across R81) and align T4 for maximum output on the "S" meter. Transfer the 9MHz signal to gate 1 of Tr3 and align T2 and T1 for maximum output on the meter, carefully setting the generator to the crystal filter centre frequency. Adjust T3 for maximum output across D7 using the millivoltmeter.

Next, check that the c.i.o. is operating at 8998·5kHz by monitoring the output at T8 secondary and check that the output level is between 400–500mV. Set to the correct frequency by careful adjustment of VC14, then check that the b.c.o. is operating at 15·666MHz and 16·666MHz by monitoring the output at T13 secondary whilst switching S5. Set to the correct frequencies by adjustment of VC15 and VC16 respectively and check that the output level is approximately 150mV.

Next, set the v.f.o. frequency range to 3·333MHz–4·333MHz exactly by monitoring the output at Tr11 source (across R120). Adjust L7 at the l.f. end and VC7 at the h.f. end respectively until the correct range is obtained, checking that the output level is approximately 100mV. The value of R188 affects the "law" of VR14, the main tuning potentiometer, and may be varied from the value shown in Fig. 5 to achieve the best linearity of the tuning scale.

Set VR11 for minimum b.c.o. output. Transfer the millivoltmeter to the junction of R140, L10, and chassis, setting S5 to the 28–29MHz range. Adjust T11 and T12 at the l.f. end and VC8 and VC9 at the h.f. end of the band for maximum output. Repeat these operations until no further output can be obtained, then set S5 to the 29–30MHz range.

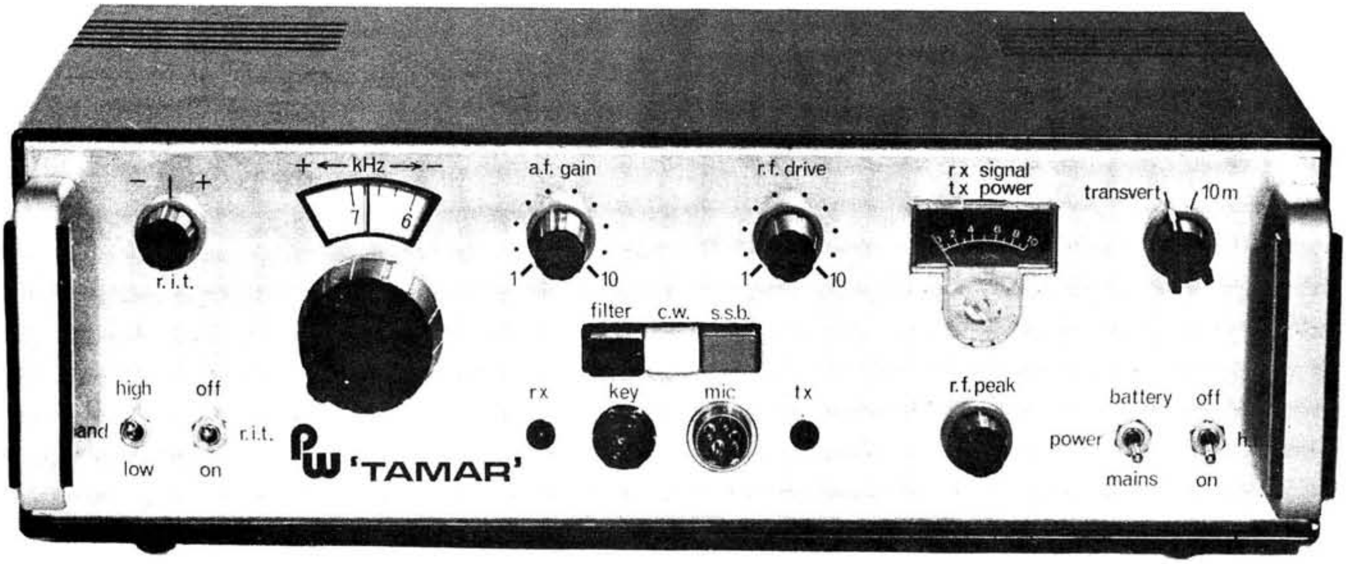
Check that the output level is approximately the same on 29–30MHz as on 28–29MHz, bearing in mind minor variations in output over the two ranges can be ignored and the output level should be approximately 1·5V r.m.s. The d.f.m. can be used to check the output frequencies which will be 19–20MHz and 20–21MHz respectively. Transfer the signal generator to SK1 and set S5 to 28–29MHz. Adjust L2 and L3 for maximum output at 28MHz, then set S5 to 29–30MHz and adjust VC3 and VC4 for maximum output at 30MHz.

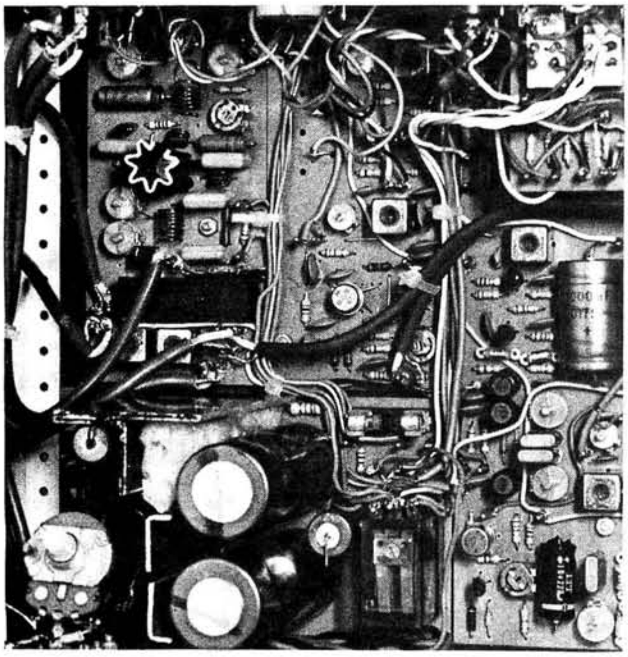
Repeat these operations until no further increase in output is obtained, the transceiver being tuned over each band to check for equal sensitivity levels. This completes the alignment of the receiver section and the setting up of the oscillators.

Transmitter Alignment

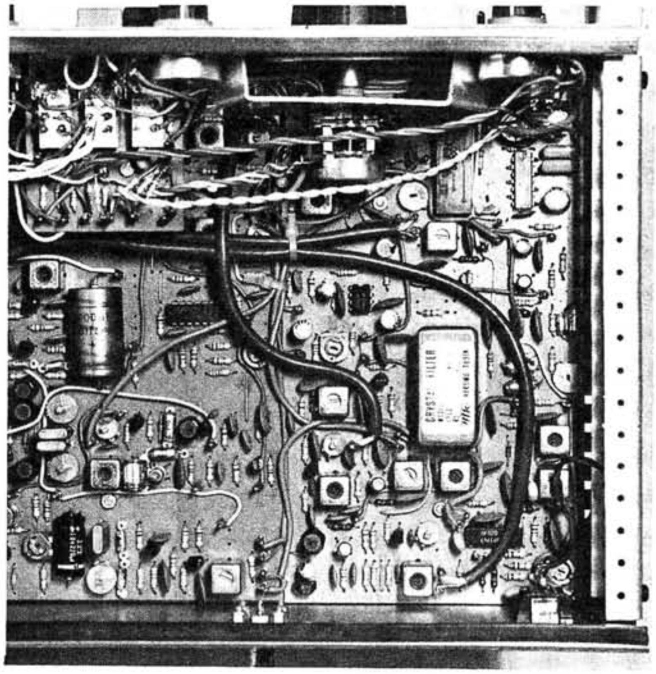
To align the transmitter section, plug in a shorting type c.w. key and set VR7 (RF Drive) for minimum r.f. drive level. Set S2 to c.w. and depress the key to obtain the transmit function. Set VR12 to give 300mV at pin 4 of IC5. Using the millivoltmeter and/or oscilloscope, align T6 and T5 for maximum output using the monitoring point across R78. Transfer the monitoring point to T7 secondary and adjust T7 for maximum output which should be approximately 100mV. Now adjust VR12 for zero audio output from IC4a, then adjust VR5 for optimum carrier rejection. Reset VR12 to give 300mV at pin 4 of IC5.

Transfer the monitoring point to T9 secondary and set S5 to 28–29MHz. With VC1 and VC2 set to maximum

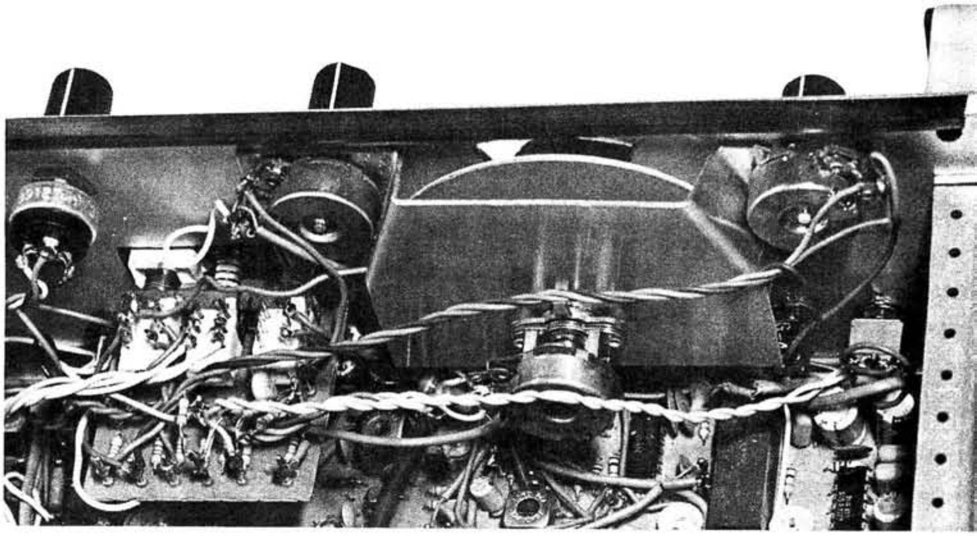




Board 2, with boards 3 and 4 above, with part of boards 1 and 6 on the right of the picture

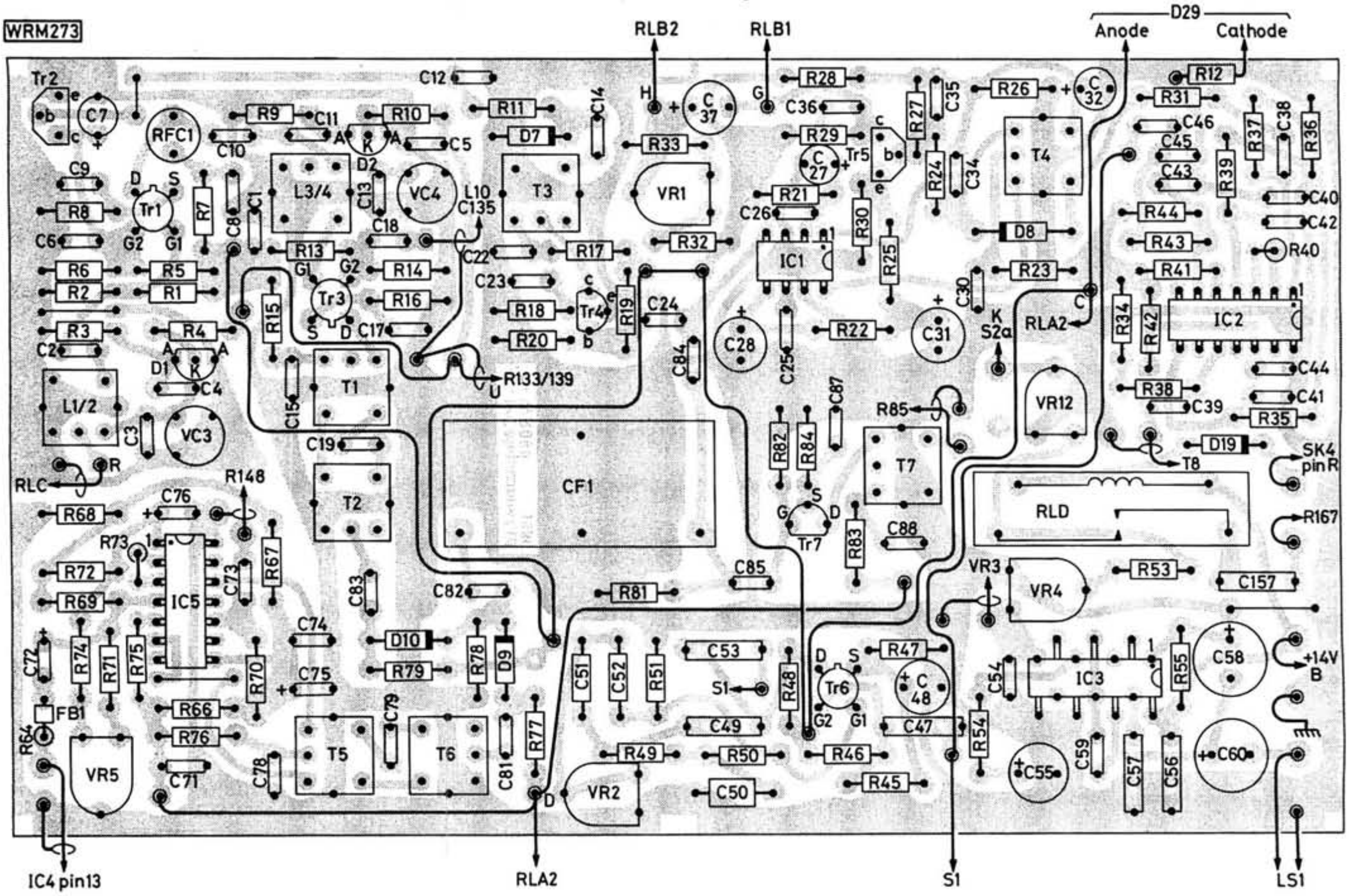


Board 1 and part of board 6 on the left, and board 5 on the right of the picture

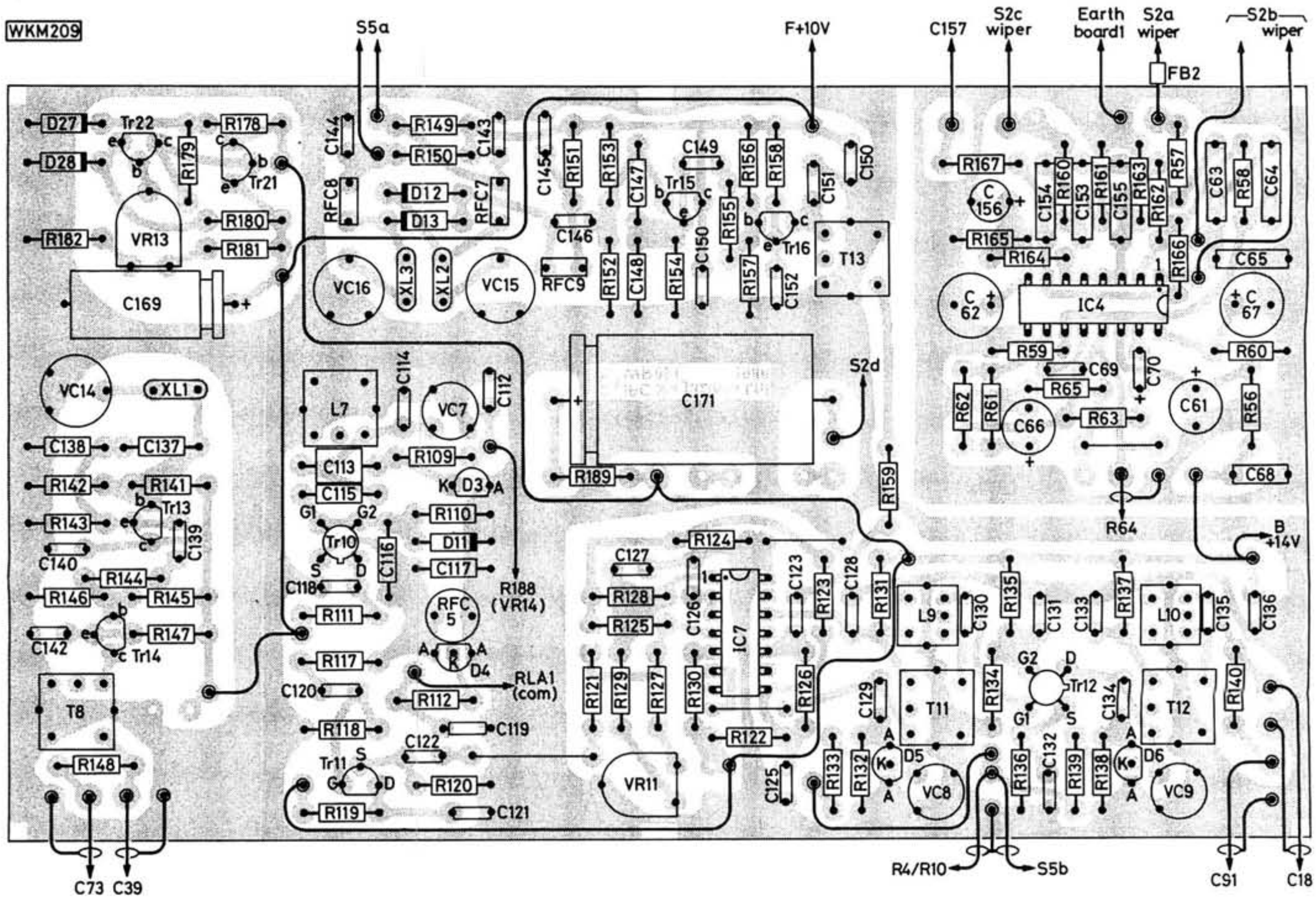


A close-up of board 1 and of the mounting for VR14, which had an integral 10:1 slow motion drive on the prototype unit. A separate s.m.d. with dial drive facilities can be used instead

WRM273



WKM209



capacity, adjust T9 for maximum output at 28MHz. Now switch S5 to 29–30MHz and set VC1 and VC2 to one third of maximum capacity, adjusting VC5 for maximum output at 30MHz. Repeat these operations for maximum output at each frequency.

Transfer the monitoring point to T10 secondary, resetting VR7 to mid-point. Repeat the operations above by adjusting T10 and VC6 for maximum output at 28MHz and 30MHz checking that VR7 varies the output level correctly. Terminate the millivoltmeter probe with a 50Ω 2W carbon resistor and connect it across SK1. Tune the transceiver to 29MHz, adjusting VR8 to give 10mA quiescent current through Tr9. Advance VR7 to register an output on M1 and the millivoltmeter.

Adjust VC13, VC12, VC11 and VC10 in that order for maximum power output, readjusting each trimmer until maximum output is registered. Further advance VR7 until full scale deflection of M1 is obtained; the millivoltmeter should now be reading 7V r.m.s. corresponding to 1W average (single tone) output power. Retune the transceiver to 28MHz and 30MHz and check that the output power falls only minimally at the band edges.

Transfer the millivoltmeter to SK2 and switch S3 to "Transverter". Adjust VR9, transverter drive level, for 250mW r.m.s. output power. This completes the alignment of the transceiver and it is now ready for an "on air" test with a transverter or linear amplifier. Switch S2 to "Mic" and check that when the microphone p.t.t. switch is depressed for transmit, a varying output is registered on M1. Connect an appropriate aerial and an "on air" test can begin, bearing in mind that maximum output is equivalent to half the f.s.d. on M1 when using a microphone.

The author uses, at present, a transverter using a QQV06–40A in the p.a. for 2m operation, the receiver converter employing dual gate MOSFETs in the r.f. amplifier and mixer stages. The 10m linear also uses a QQV06–40A driven by a QQV02–6. Both transverter and 10m linear produce 100W p.e.p. output using mains-driven power supply units, a transistor version of the 10m linear being at present under development for use with the transceiver for mobile operation.

Operation of a Transverter with the Transceiver

It is desirable for the transverter to be switched from receive to transmit and vice-versa by operation of the microphone p.t.t. switch or the c.w. key, connected to the appropriate transceiver socket, this facility being provided by a socket, SK5, and diode D15 for interconnecting the two units. Provided the transverter transmit/receive relay requires its solenoid winding to be grounded on transmit, this condition is satisfied by connection to the transceiver transmit/receive switching line. On receive, D15 prevents operation of the transverter transmit/receive relay to "transmit" should its operating voltage be 13V or less. Similarly, D18 and D19 prevent the transceiver transmit/receive relays being operated by the transverter transmit/receive relay h.t. line on receive should this voltage exceed 14V.

Signal leads using good quality coaxial cable must be used to connect the transverter receive output at 28MHz to SK1 and the transverter drive on transmit, also at 28MHz, is taken from SK2. Filter FL1a and b form a band-pass filter to give additional filtering of the transceiver output, minimising the harmonic and non-harmonic component of the linear amplifier output at the transverter mixer. The filter is broadly centred on 28·5MHz as s.s.b. and c.w. operation on 2 metres and 70 centimetres is at the l.f. end of these bands.

◀ **Fig. 10 (top): The transmitter and receiver exciter board layout (Board 5)**

◀ **Fig. 11 (bottom): The 10V stabiliser, local oscillator and speech processor board layout (Board 6)**

Operation with a 10m Linear Amplifier

The transceiver can drive a transistorised or valved amplifier which requires 2W p.e.p. drive input for maximum p.e.p. output. Two transmit/receive aerial changeover relays are required in the linear amplifier input and output networks which are operated by connection to SK5 and hence the microphone p.t.t. switch or the c.w. key. Signal input/output from SK1 only is routed to the amplifier input diode D24, a BAX13, providing protection for the r.f. amplifier, Tr1, should the amplifier output on transmit exceed 0·7V at SK1.

This now completes the construction and alignment of the *PW* "Tamar" and many happy hours on the air should be achieved, the unit providing a good, clean, drift-free signal which should make the operation of this transceiver a delight.

Errata

1. In Fig. 2 (page 22, August), the secondary of T4 goes to D8, not D2 as marked.
2. In Fig. 3 (page 23, August), the c.w. audio filter supply (junction of R46/R48) should be connected to supply line "C" (switched +14V). IC3 supply and C56 are connected to supply line "B" (unswitched +14V), as shown.

Resistor R54 is connected to pin 5 on IC3, not pin 9 as marked.

The value of VR8 is 100Ω, as shown in the components list.
3. In Fig. 4 (September), the output pin numbers on IC7 have been transposed. The pin connected to R131, etc., should be marked 12; the pin connected to VC8, etc., should be marked 6.

Also in Fig. 4, three pairs of components have been reversed, compared with the p.c.b. layouts shown in this issue. These are: C120/R117, C122/R121 and VC14/XL1. The two arrangements are, of course, electrically similar.
4. In Fig. 5 (September), the junction of D18/D19 goes to SK4 pin "R", not as marked.
5. Under the heading "Mechanical Features" (September), relay RLD should be listed as part of board 5, not board 6 as shown.

Notes

1. The following capacitors are supplied already fitted inside the cans of their associated transformers:

C16, 20, 21, 29, 77, 80, 86 and 141.

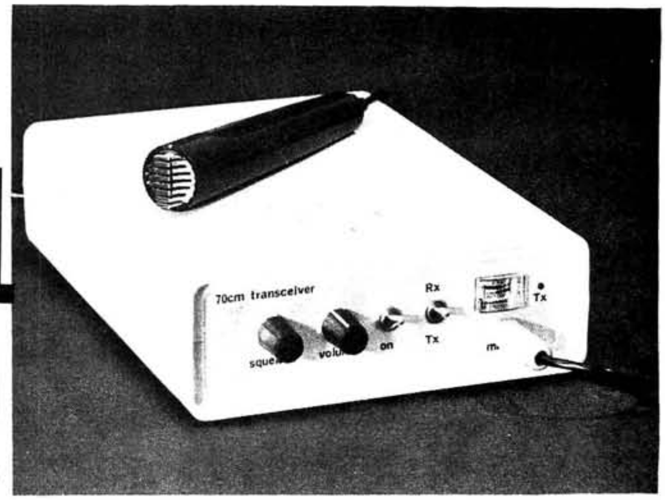
We apologise for not making this point clear in the components list.

The Toko coils for this project are available from Ambit International (see Advertisers' Index).
2. Decoupling capacitor C158 is fitted at the microphone socket SK4.
3. Full-size paper prints of all the "Tamar" p.c.b. track patterns are available from the Editorial offices at Poole. Please send a large (10 × 8in) s.a.e. ●

RADIO SPECIAL PRODUCT REPORT

WOOD & DOUGLAS

70cm SINGLE-CHANNEL FM TRANSCEIVER



This review is rather different in nature to our usual ones in that it looks closely at not just the product but also the thinking behind the product as well as suggesting the reviewer's interpretation of the product in use.

Wood & Douglas is a small company set up by three enthusiastic radio amateurs who believe that the current trend towards "black boxes" at the expense of traditional "home-brew" equipment is not necessarily in the best interests of the amateur radio hobby.

Their solution is to offer kits of high quality parts for the "electronic" side of a range of transceivers. These cover 2m and 70cm f.m. single channel, multi-channel and synthesised transmitters and receivers, and some microwave units. Their list makes very interesting reading indeed.

We decided to review the 70cm single channel f.m. transceiver module in its most basic form, pushing out a nominal 500mW.

In order to keep the costs of their "kits" as low as possible, Wood & Douglas only supply those components actually mounted on the p.c.b.s and leave the constructor to find the controls, crystals and casework himself. This also allows the builder some degree of flexibility in what he can use, and of course if he is a "biscuit-tin" man then he can give full vent to his ideas.

The 70cm transceiver is, in fact, a two-board project, one p.c.b. being the receiver and the other the transmitter. Automatic r.f. switching is carried out by p.i.n. diodes on the receiver board. Each board "kit" is supplied in a plastic bag and full constructional and alignment instructions are supplied.

The components were all of first class quality and it was interesting to note that the instructions also contained a component check list which informed the builder of any changes or substitutions from the types shown. This is very welcome since most of the technical queries received about *PW* projects are as a direct result of component substitutions leaving the reader in doubt. Also in the instructions was a list of the minimum extra components required to complete the transceiver.

The two boards were completed with no problems at all and after a thorough visual inspection a pair of PF1 crystals for RB14 were inserted. Power was applied to the receiver board first and no problems were encountered in aligning this using GB3SD at Weymouth.

The transmitter board proved a bit more troublesome. There was not enough adjustment using the frequency adjust preset to net the crystal onto SD's input frequency. Also the power output was rather lower than the 500mW minimum expected. The board was rechecked and the alignment instructions followed exactly, but still not much output and still off frequency. A study of the circuit diagram showed that the p.a. was driven via a loose coupling of two air-spaced coils and these were indicated by an arrowed coupling line on the circuit. A slight bending of these two coils to bring them closer together resulted in the output power leaping up to around 800mW at 13·8V. This left the frequency adjustment problem. A check in the various catalogues showed that the varicap diode used for tuning the transmitter was in fact at maximum capacitance with the frequency set control at maximum travel. Fortunately there were two pads on the p.c.b. in parallel with the varicap and the circuit showed a capacitor in this position. The components check list however merely stated "if required to net crystal." In the end I opted for an extra 10pF and this did the trick. Once aligned the transceiver proved to be quite stable.

The actual manner in which the two boards are used to form a usable transceiver is left to the builder himself. The instructions do give some outline instructions on mounting the boards but these are only very sketchy. On their stand at Ally Pally in May, Wood & Douglas showed several different ideas for using these boards and this indicated the many different ideas that amateurs have on how to build projects of this nature.

With the upsurge in interest in 70cm, particularly the repeater network, it was decided to use the Wood & Douglas boards to build a simple, low-cost, 70cm "local repeater worker."

The two boards were mounted onto an aluminium plate

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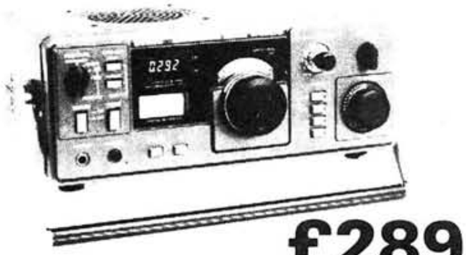

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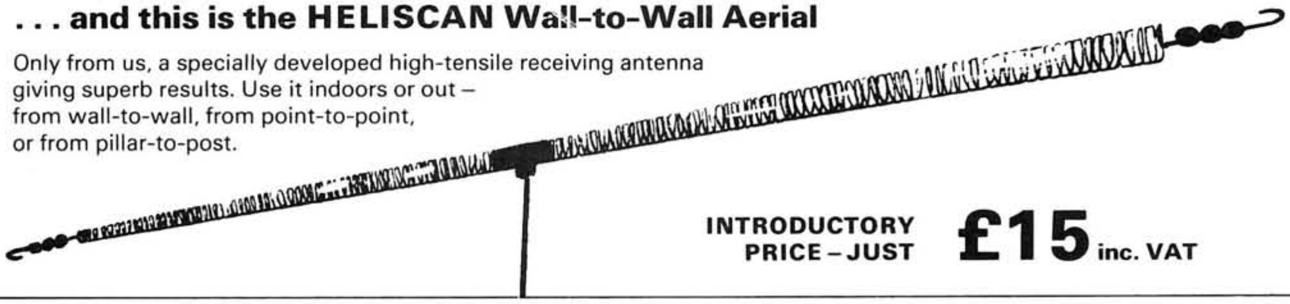

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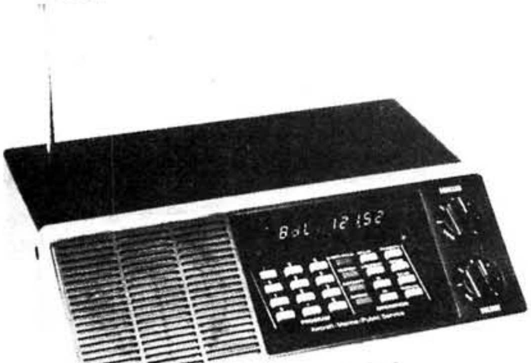

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as suggested in the instructions and this unit was then fitted into a Verobox (65-2066-A) with the controls mounted on the aluminium front panel. The p.t.t. switch was also mounted on the front allowing the use of a simple cheap microphone. This switch also changes the small meter from "S" meter to battery voltage monitor on transmit. A small 8Ω loudspeaker was fitted into the top of the Verobox.

Power is provided by two 6V NiCad battery packs which fit neatly into the case alongside the transmitter board.

Wiring follows the layout given in the Wood & Douglas instructions and the only essential remaining to be fitted is the toneburst unit, the repeater having to be whistled up at present. Wood & Douglas can supply a kit for the toneburst.

The performance of the complete "local repeater worker" is good. The transmitter side works exceedingly well, pushing 800mW up to the aerial on 13·8V. The audio is reported to be bassy with the microphone currently being used and the only other microphone tried so far (a rather expensive unit) has not proved to be at all well matched. The audio gain can be varied simply, using a preset control on the transmitter board, as can the deviation.

The receiver is adequate if a trifle hissy. The hiss can be reduced simply by putting a suitable capacitor across the output of the CA3089E. A 22nF capacitor was used as a larger value reduced the audio output too much. Keeping in mind the fact that the repeater is some 35 miles away from the reviewer's QTH the performance is good.

The kit constitutes a good low-cost means of getting started on 70cm f.m. Various r.f. amplifiers are available to boost the output if required for, say, mobile use as well as several interesting and useful modules designed to improve the project.

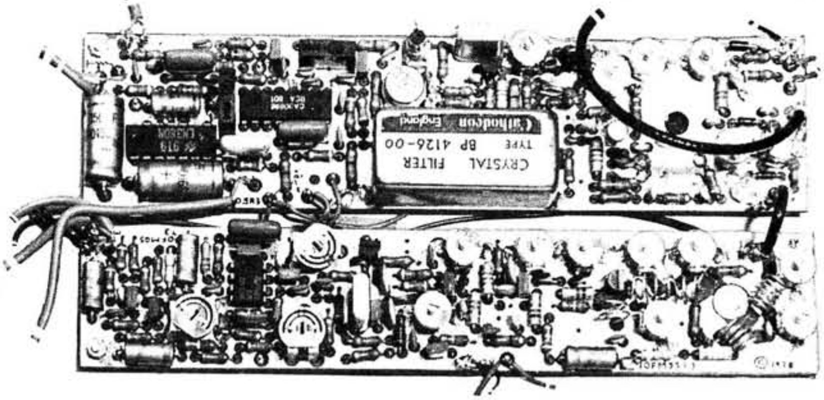
For those who do not feel up to putting the kits together, Wood & Douglas can supply ready built units. Again these do not include crystals or external controls and boxes, and the constructor should be prepared to spend another £10 or so on these.

Prices

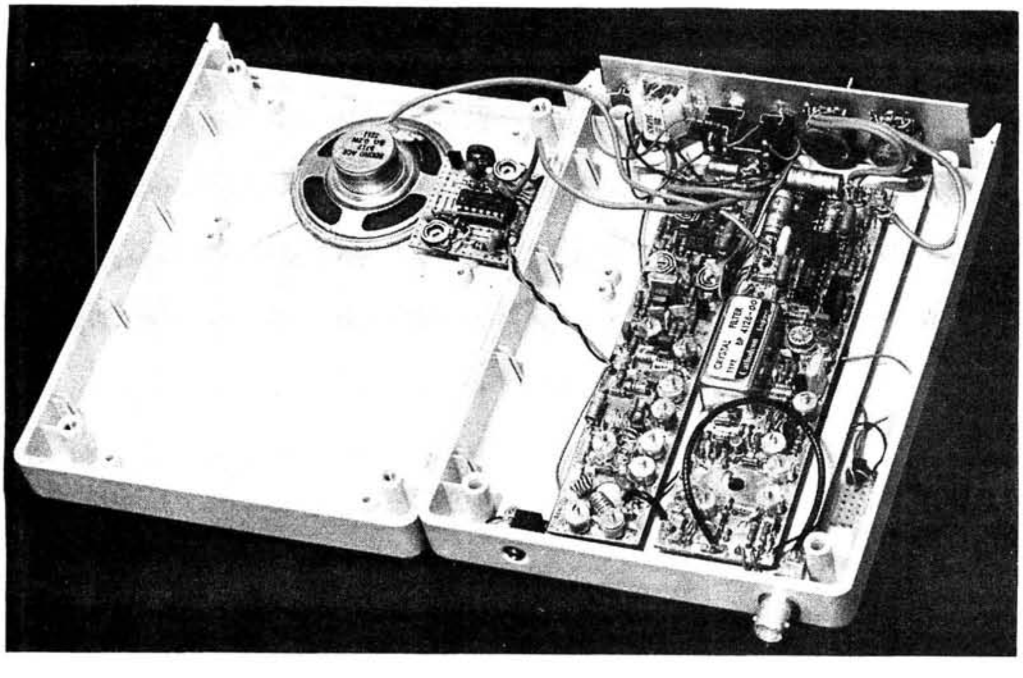
The basic kit for the 70cm f.m. transceiver costs £48.10 inc. VAT. A toneburst kit costs £2.81. Post and packing is 50p. From **Wood & Douglas, 9 Hillcrest, Tadley, Basingstoke, Hants RG26 6JB. Tel: Tadley 5324.**

★ specifications

	RECEIVER
Type:	Single channel, single conversion superhet
Sensitivity:	0·5µV for 12dB SINAD (typ) at 5kHz deviation and 1kHz modulation
Intermediate frequency:	10·7MHz at 30kHz bandwidth
Crystal:	84MHz range as used in PF1
Audio output:	1W into 8Ω
Power:	12V 60 to 70mA at low volume
Size:	38 × 154 × 19mm
	TRANSMITTER
RF output:	500mW nominal into 50Ω
RF switching:	By p.i.n. diodes on the Rx board
Spectrum:	Spurious outputs >40dB down on 500mW
Microphone:	2·5mV basic sensitivity
Input impedance:	100kΩ adjustable
Crystal:	12MHz range as used in PF1
AF stage:	Includes limiter and low-pass filter
Power:	12V 160mA (crystal oscillator stabilised down to 10·5V)
Size:	31 × 154 × 14mm (PA transistor stud is 15mm below p.c.b. but may be carefully sawn off)



The two p.c.b.s forming the Wood & Douglas 70cm single channel transceiver. The receiver board is the top one. Although both boards are tightly packed with components, and double-sided, no problems were found during assembly



The transceiver fits neatly into a medium size Verobox to form a useful "local repeater worker" at reasonable cost. The Ni-Cads have yet to fitted

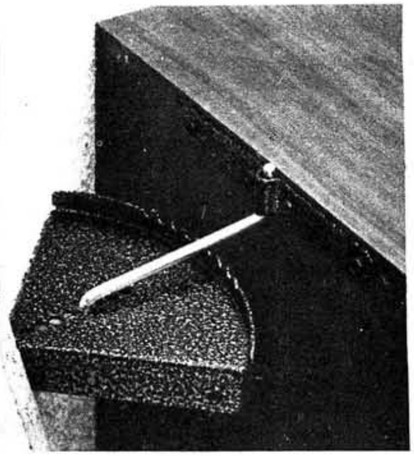
PRODUCTION LINES

alan martin

Versatile Brackets

Quite often, when you've bought a stereo system, the problem arises of where to put the speakers. If you don't have handy shelves in the appropriate corners of the room, the speakers can end up perched on the edge of furniture, or standing on the floor. A product which may solve this problem is Wallangle Speaker Brackets.

The brackets can be fitted easily into any corner of the room and will take speakers up to 290mm (11½ inches) wide, weighing up to 50lb. The brackets are concealed behind the speakers and allow for swivel and adjustment to almost any angle.



Retailing at around £6 per pair, Wallangle Speaker Brackets come complete with screws, wall plugs and step-by-step fixing instructions. Available from many Hi-Fi retailers or multiple department stores, the brackets are manufactured by: *A. E. Arthur Ltd., Ardis House, Rollesby Road, King's Lynn, Norfolk.*

2m Whip

PAL "Firestik", the well known American CB antenna manufacturers, have branched out into the 2-metre amateur market. They have introduced the KW4, a pre-tuned 5λ/8 2m whip that is compatible with their range of accessories, quick disconnect mount, boot mount, magnetic mount, etc. The KW4 measures approximately 4ft long, has a gain of 3·5dB, is constructed of sturdy fibreglass and costs £9.20 plus VAT.

Further details from: *Wintjoy Ltd., 103 High Street, Shepperton, Middlesex TW17 9BL. Tel: Walton-on-Thames (09322) 48145.*

Time Module

A versatile l.c.d. Clock Module, the MA1032 by National Semiconductor, offers 12- or 24-hour display on 0·5in digits, with 24-hour alarm, 59-minute sleep timer, 7-minute snooze timer and a seconds display mode, all in a unit 82 × 46 × 22mm overall. A single supply of just 1·5V is required to power the whole thing, including a back-light, the consumption being typically 8μA without the back-light on. The data sheet supplied gives full specification and connections for the setting switches, alarm, etc.

The MA1032 module costs £13.23 plus 60p P & P from: *A. Marshall (London) Ltd., Kingsgate House, Kingsgate Place, London NW6.*

Home-Brewers' Aerial Bits

If you delight in making the aerials so frequently described in the pages of *Practical Wireless* then the latest lists from Aerial Contractors (Southern) will interest you.

The list covers not only complete aerial systems but also those hard-to-get little components such as terminal covers, element clips, half-round alloy rods, and plastic "X" type insulators.

Various sizes of round alloy tube and rod for making elements as well as square tube for booms are stocked, and for the fainter-hearted constructor Aerial Contractors will even bend the rods for dipole matching and cut rods to length provided full details are given with the order.

For the lists no aerial buff should be without, send 40p in stamps to: *Aerial Contractors (Southern), 28 Caulfield Road, Shoeburyness, Essex. Tel: (037 08) 3717.*

RTTY/Morse Reader

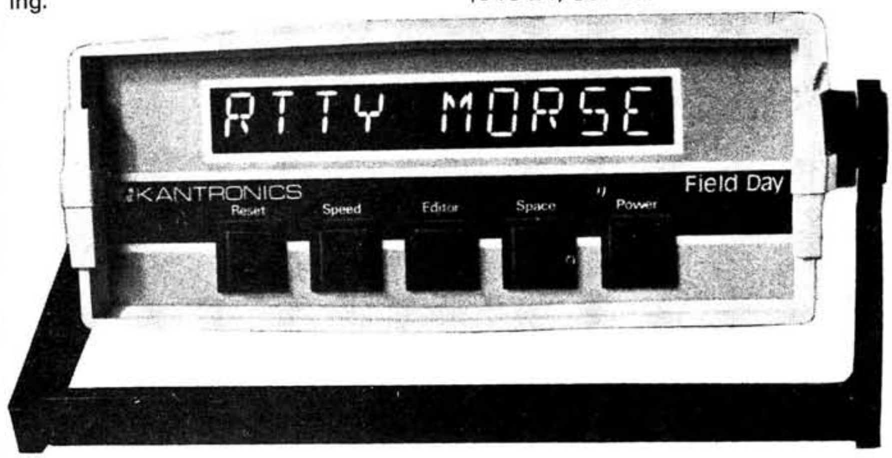
The Kantronics Field Day is a radioteletype and Morse code reader controlled by an Intel 8035 microcomputer with a special c.w. decoding program.

Features include: ten 0·5in high 12 segment alphanumeric displays; internal power supply; 200Hz bandwidth input filter; l.e.d. tuning indicator; code editor, which compensates for sloppy character timing; internal speaker and automatic c.w. speed display, which is a switchable option.

Installation is very simple, the unit is powered by a.c. mains and the only other connection required is a suitable lead between the receiver headphone socket and the audio input terminal on the unit.

The Field Day is compact, measuring 210mm wide × 87mm high × 230mm deep with a tilt handle that allows the unit to be adjusted for optimum viewing.

Costing £295 which includes VAT, the Field Day is available from: *Constellation Radio, 65 Cecil Avenue, Hornchurch, Essex RM11 2NA. Tel: (040 24) 55733.*



NIMBUS

Modular 2m Transceiver System

PSU/Charger

(Part 7)

Michael TOOLEY BA G8CKT
&
David WHITFIELD BA MSc G8FTB

Rechargeable nickel-cadmium batteries have, in recent years, become readily available at very reasonable prices. Owners of the *PW* Nimbus, or similar portable equipment, may therefore, wish to consider the economics of installing a rechargeable battery pack to replace the dry cell originally specified for the transceiver.

In order to re-charge nickel-cadmium cells a constant current charger is required rather than the more conventional constant voltage type associated with lead-acid batteries.

The unit described provides a constant current charging source and is capable of charging up to twelve series-connected nickel-cadmium cells. In addition, the power supply can provide a regulated 12V d.c. output at up to 500mA which will provide power for the Nimbus whilst the battery pack is being charged.

The unit is constructed using readily available components including a monolithic fixed voltage regulator. The regulator incorporates internal fold-back overload, thermal and short-circuit protection. The constant current output is also short-circuit proof and the current output can be programmed to suit the type of cells fitted in the transceiver.

Leclanche cells are suitable for use in applications where there is either a continuous low value of current drain or where there are intermittent periods of high current drain interspersed with periods of no current drain. Nickel-cadmium cells, on the other hand, are more suited to applications where a sustained high current is required over a relatively long period. The additional advantage of this type of cell is that, provided reasonable care is taken, they may be recharged for use over typically some 1000 charge/discharge cycles.

The Nimbus was originally designed for operation from two series connected 6V battery packs, each consisting of four 1·5V Leclanche cells of HP7, or similar type. The nominal on-load voltage provided by a single nickel-cadmium cell is 1·25V and hence eight series connected nickel-cadmium cells will only provide around 10V compared with 12V from a similar number of Leclanche cells. Thus it is recommended that an additional two nickel-cadmium cells be incorporated in order that the total battery pack voltage is approximately 12·5V.

The manufacturer's recommended charge rate for nickel-cadmium cells equivalent to an HP7 battery is 45mA at the 16 hour rate and the cell has a fully charged capacity of approximately 500mAh. The normal pattern of battery usage in a portable transceiver usually takes the form of some 2 to 4 hours discharge and 20 to 22 hours charge in any 24 hour period. Thus a more appropriate charge rate is 30mA and this lower value also helps to reduce the possibility of damaging the cells by prolonged overcharging.

Readers who intend to operate the *PW* Nimbus 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.

Circuit Description

The complete circuit diagram of the power supply unit is shown in Fig. 1. The 12V secondary output from T1 is rectified using a full-wave bridge rectifier, BR1. C1 acts as a reservoir capacitor and IC1 provides series regulation of the d.c. output. C2 and C3 provide de-coupling and prevent high-frequency instability which may otherwise arise from IC1.

Tr1 and its associated components form the constant current source. The base voltage is held constant by means of the two forward biased diodes, D1 and D2. The output current is determined by the value of R1 and D4 is included in order to protect Tr1 against inadvertent polarity reversal of the battery pack. A red l.e.d., D3, acts as an output indicator.

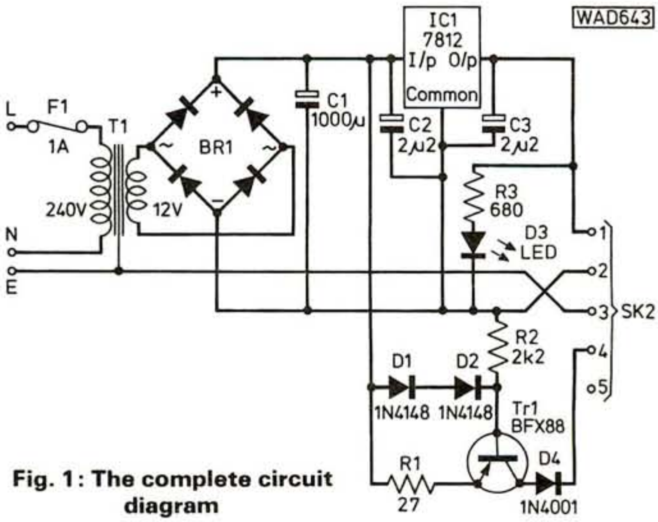
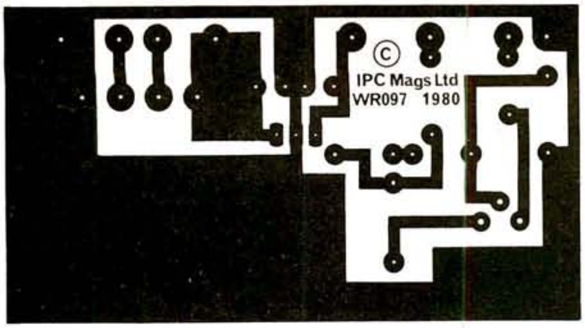
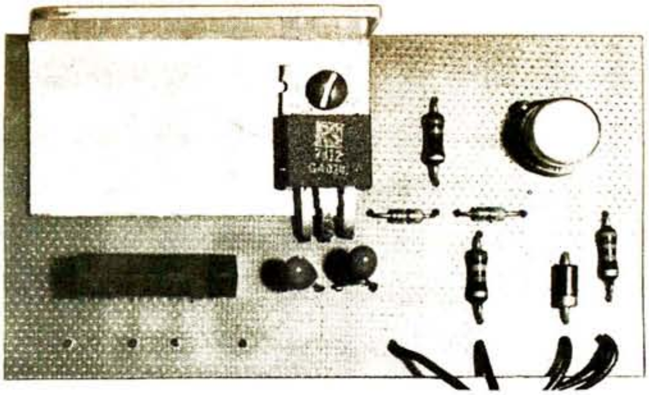


Fig. 1: The complete circuit diagram





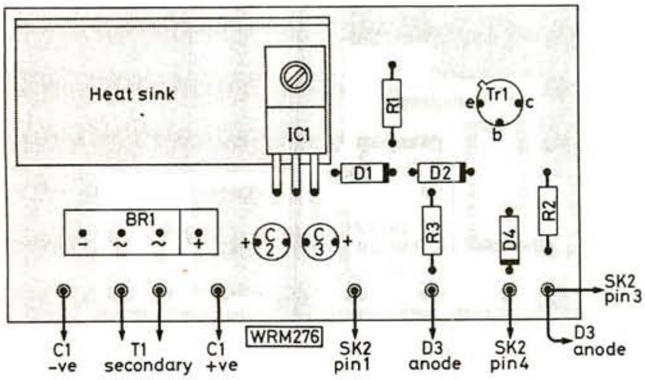
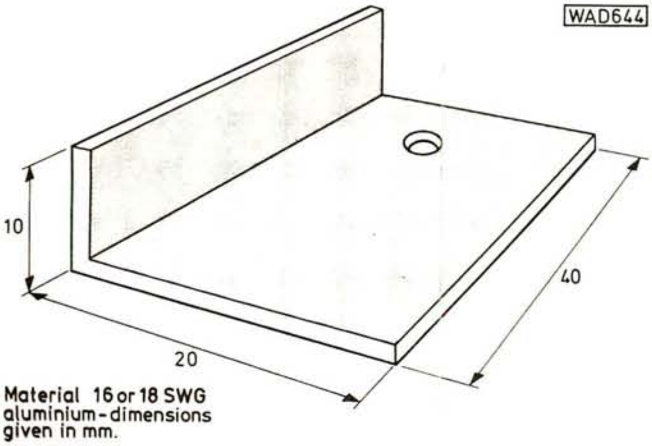


Fig. 2 (top): The copper track pattern of the p.c.b. shown full size

Fig. 3 (above): The component layout for the p.c.b.

Fig. 4 (below): The details of the heatsink for IC1



Construction

The majority of the components are mounted on a single printed circuit board measuring approximately 75 × 40mm. The foil pattern of the p.c.b. is shown in Fig. 2 with the corresponding component overlay shown in Fig. 3. The series regulator, IC1, must be fitted with an adequate heatsink. This may conveniently consist of an L-shaped piece of 16 or 18 s.w.g. aluminium, as shown in Fig. 4. Tr1 should also be fitted with a heatsink of the TO5 "push-on" type. Care should be taken to ensure that there is adequate clearance around both heatsinks and also around the mains transformer.

The entire assembly is housed in a small plastic or metal case which should have sufficient mechanical strength to support the transformer. The reservoir capacitor is retained by means of a suitable mounting clip and a 5-pin DIN socket is used for connecting to the transceiver. A suitable layout and wiring diagram is shown in Fig. 5.

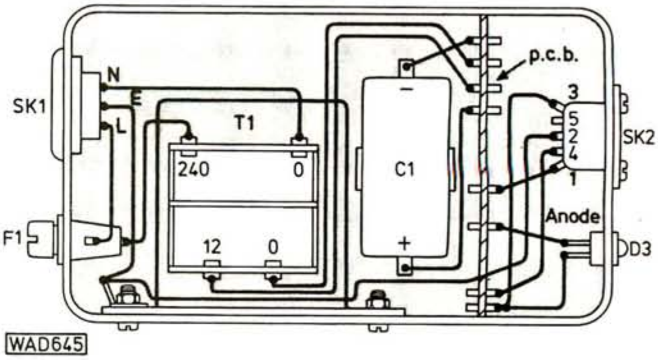
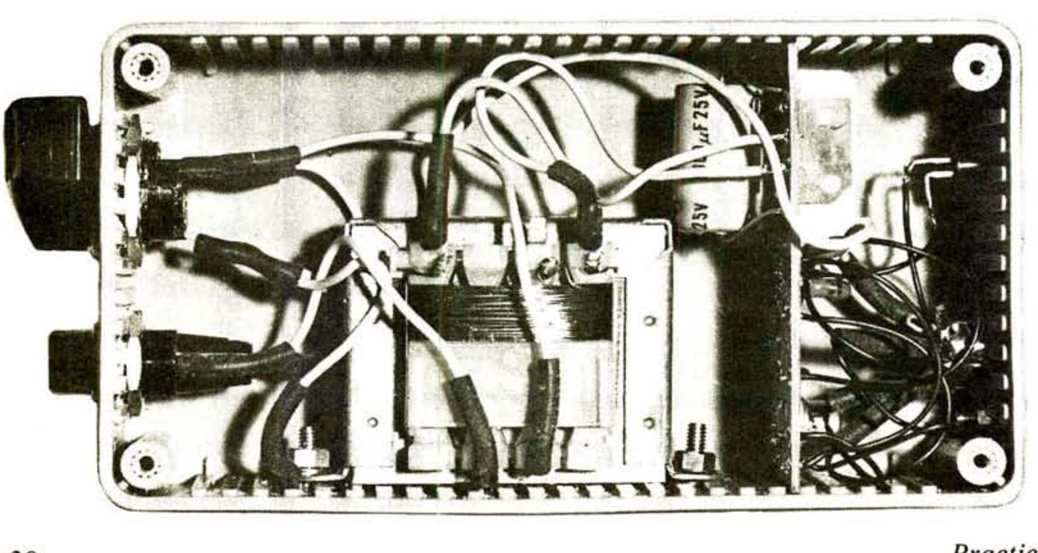


Fig. 5 (above): The general wiring details and layout of components in the plastic box



The Nimbus power supply and battery charger with the lid removed

RADIO SHACK for BEARCAT 220

THE VERSATILE

BEARCAT 220FB

Bearcat® 220FB

Price:–

£258.75

With 4m, 2m & 70cm FM Amateur Bands

Features

- **20 Channels/2 banks** – Scan up to 20 frequencies at once or either of two banks of 10 channels.
- **7 Band Coverage** – Includes Low, High, UHF, UHF-Gov't and UHF-T public service bands, the 2-meter amateur (Ham) band, plus the aircraft band.
- **Automatic Search** – Seek and find new, exciting frequencies.
- **Aircraft Search** – Automatically search the entire Aircraft Band.
- **Marine Search** – Automatically search Marine frequencies by pressing one button.
- **Priority** – Samples designated priority frequency on channel 1 every 2 seconds.
- **Limit** – Sets upper and lower frequencies of search range.
- **Speed** – Choice of either 5 or 15 channels per second scan and search speed for closer monitoring of desired frequencies.
- **Automatic Lockout** – Locks out channels and "skips" frequencies not of current interest.
- **Selective Scan Delay** – Adds a two-second delay on desired channels to prevent missing transmissions when "calls" and "answers" are on the same frequency. Patented by Electra.
- **Simple Programming** – Simply punch in the frequency you wish to monitor.
- **Decimal Display** – The large decimal display shows channels and frequency as well as features selected.
- **Patented Track Tuning** – Receive frequencies across the full band without adjustment. Circuitry is automatically aligned to each frequency monitored.
- **Crystalless** – Without ever buying a crystal you can select from all local frequencies.
- **Automatic Search** – Factory-set squelch automatically blocks out unwanted noise.
- **Direct Channel Access** – Move directly to desired channel without stepping through all channels.
- **Deluxe Keyboard** – Makes frequency and feature selection easy for simple programming.
- **Space age Circuitry** – Custom integrated circuits . . . a *Bearcat* tradition in scanning radios.
- **Rolling Zeros** – This *Bearcat* exclusive tells you which channels your scanner is monitoring.
- **AC/DC** – Operates at home or in authorised vehicle.
- **UL Listed/FCC Certified** – Tested for sale, quality design and manufacture.

Bearcat® 220FB
Specifications

Frequency Range:

Low Band Mobile	66- 88MHz
Aircraft	118-136MHz
Amateur Band	144-148MHz
Public Services & Marine	148-174MHz
UHF Amateur	420-450MHz
UHF Band	450-470MHz
UHF Band	470-512MHz

Size:
$10\frac{5}{8}$" W x 3" H x $7\frac{5}{8}$ D

Weight:
5 lbs.

Power Requirements:
240V AC, 50 Hz.
12-15V DC, 8 Watts.

Audio Output:
2.0 W rms.

Antenna:
Telescoping (Supplied)

Sensitivity:
0.6 μv for 12dB Sinad on L and H bands
μ bands slightly less
1.0 μv for 10dB S/N on aircraft

Scan Rate:
5 or 15 channels per second

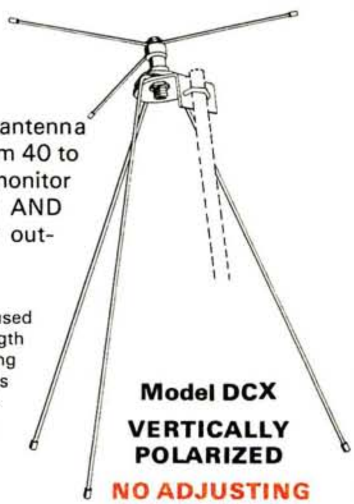
Connectors:
External antenna; external speaker; AC power, DC power

Accessories (included):
Mounting bracket and hardware; DC cord

Hear It All With One Antenna
Total Frequency Coverage
–40 To 700 MHz

DISCONE

The Hustler Discone Model DCX is a wide band antenna and has complete coverage of all frequencies from 40 to 700 MHz. This design is especially suited for monitor radio reception of LOW-BAND, HIGH-BAND AND UHF. As a plus feature, use the Discone for outstanding 88-108 MHz. FM stereo reception.



The Discone is easy to assemble and install and may be used with any length coax cable. Manufactured from high strength solid aluminium rod, zinc plated hardware and mounting assembly, complete with SO-239 connector. Antenna mounts on vertical support up to $1\frac{1}{4}$" O.D. or on a flat surface. Cone elements, 55" in length. Disc elements, 20" in length. Shipping Wt. 2.5 lbs.

£13.80

Discone With Cable

Discone antenna supplied with 50' coax and factory installed connectors, PL-259 one end and monitor pin plug type on the other. Shipping Wt. 4.5 lbs.

£20.70

Model DCX

VERTICALLY POLARIZED

NO ADJUSTING
NO TRIMMING

Securicor Delivery
£5.00

RADIO SHACK LIMITED
TELEX 23718

188 BROADHURST GARDENS, LONDON, NW6 3AY
TELEPHONE 01-624 7174

★ components

Resistors

¼W 5% carbon

27Ω	1	R1
680Ω	1	R3
2·2kΩ	1	R2

Capacitors

Tantalum

2·2µF 35V	2	C2,3

Electrolytic

1000µF 63V	1	C1

Semiconductors

Diodes

1N4001	1	D4
1N4148	2	D1,2
BY164	1	BR1
Red l.e.d.	1	D3

Transistors

BFX 88	1	Tr1

Integrated Circuits

7812	1	IC1

Miscellaneous

Mains Transformer, 12V 20VA; 5-way 180° DIN socket; 1A fuse and holder; Printed circuit board; Case 150 × 80 × 50mm; Heatsink TO5 clip-on; Aluminium for heatsink; Clip for C1.

★ specifications

CONSTANT VOLTAGE OUTPUT

Output voltage (nominal):	12V ± 0·5V
Maximum continuous load current:	500mA
Maximum short duration load current:	850mA
Short-circuit current:	350mA
Output resistance:	0·08Ω typical
Output noise voltage:	less than 100µV (10Hz to 100kHz)
Load regulation:	less than 0·5%
Supply regulation:	less than 0·5%
Mains supply input:	220 to 240V 50Hz

CONSTANT CURRENT OUTPUT

Output current (nominal):	30mA ± 5mA
Output current (short-circuit):	30mA ± 5mA
Output resistance:	70kΩ typical
Open-circuit output voltage:	16V
Maximum number of charging cells:	12 (at 1·25V per cell)
Minimum number of charging cells:	1 (at 1·25V per cell)

Connecting to the Nimbus

Two possible arrangements for connecting the power supply to the Nimbus are shown in Fig. 6 and 7. In Fig. 6 a miniature slide switch is incorporated within the Nimbus to effect the changeover from internal to external supply and to isolate the internal battery pack supply for charging. An automatic changeover system is shown in Fig. 7. A miniature 12V relay having one set of changeover contacts is used to automatically disconnect the internal battery pack whenever the supply unit is in operation. It is important to note that no attempt should ever be made to recharge dry Leclanche cells, and, where nickel-cadmium batteries are not fitted, the connection marked X-X should be broken to disable the charge facility.

continued on page 63 ▶▶▶

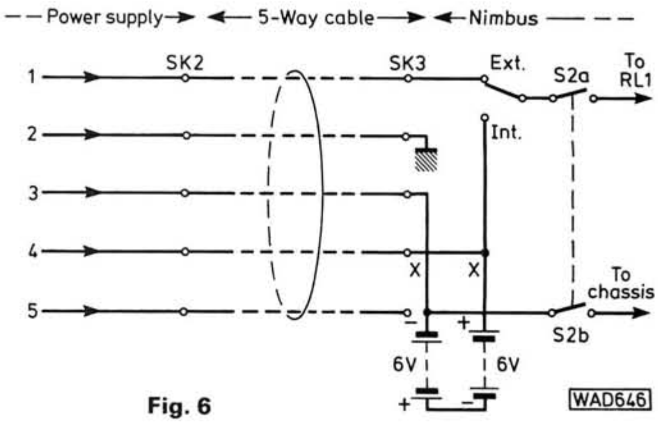


Fig. 6

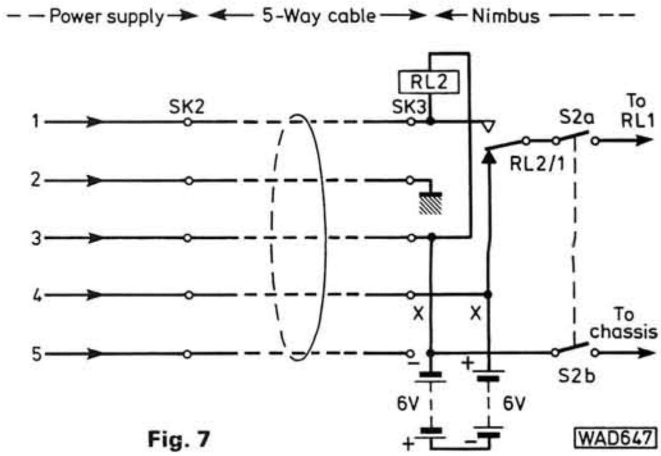


Fig. 7

NEWS... NEWS... NEWS...

RAE Refresher Course

A course designed especially for candidates who have sat the RAE and failed, and do not wish to start again at "square one", has been organised at the De Beauvoir School, London N1.

The course starts on Wednesday, 17 September 1980, and enrolment will be on Monday, 8 September, at the school.

Classes are available on Monday, Tuesday, Wednesday and Thursday evenings between 1930 and 2130hrs. The school has a fully equipped workshop, an amateur transmitting station, and is attended by two tutors and a Morse code instructor.

Details from: *Senior Tutor, F. Barns G3AGP, Highbury Manor Adult Education Institute, De Beauvoir School, Tottenham Road, London N1 4BW.*

Special Event

A Wireless Communications day has been organised for Sunday, 5 October 1980, at the Chalk Pits Museum, West Sussex.

As well as the museum's own vintage wireless collection, it is hoped to feature exhibits from local radio clubs, repeater groups, Raynet, Air Training Corps, Police and marine communications firms. In addition there will be a working h.f. station and a bring-and-buy stall.

Chalk Pits Museum is situated in 36-acres of West Sussex countryside and has many other attractions to interest the whole family, there is also a picnic area, free parking and good local pubs and tearooms.

Along with Ron Ham, a regular *PW* contributor, members of *Practical Wireless* will be attending and look forward to meeting our readers and friends, on the day, at: *Chalk Pits Museum, Houghton Bridge, Amberley, Nr Arundel, West Sussex. Tel: Bury (079 881) 370.*

RAE Courses

Classes to prepare students for the City and Guilds Radio Amateurs' Examination, Course No. 765-02 are offered at the following locations:

Sarah Robinson School, Ifield, Crawley, West Sussex. Enrolment; 8 and 9 September. Starting; Thursday, 25 September, between 1900 and 2100hrs. Further details; R. Scrivens G3LNM, telephone Crawley (0293) 22540.

Canterbury College of Technology, New Dover Road, Canterbury, Kent. Starting; Autumn 1980, Course Tutor; G3LCK. Further details from the college.

Dacorum College, Marlowes, Hemel Hempstead, Herts. Enrolment; 8 September. Starting; Wednesday, 24 September. Further details from the course organiser: C. B. Burke G3VOZ, telephone Hemel Hempstead (0442) 833300.

Paddington Evening Institute, Amberly Road, Paddington. Enrolment between 8 and 12 September. Starting; Monday, 15 September, Monday and Thursday evenings between 1900 and 2100hrs. Course Lecturer; D. T. Busby G4HFL.

Harrow College of Further Education, Hatch End High, Headstone Lane, Harrow. Enrolment; Saturday, 27 September between 1000 and 1500hrs at Nower Hill School, Harrow. Starting; Wednesday, 8 October, between 1900 and 2200hrs. Course Lecturer; D. T. Busby G4HFL.

East Herts College, Turnford, Hertfordshire. Enrolment; 8 September. Starting; Monday, 22 September, between 1900 and 2100hrs. Further details; Jim Sleight G3OJI, telephone Ware (0920) 4316 or Mr J. France at the College, telephone Hoddesdon (099 24) 66451.

The Hucknall College of Further Education, Portland Road, Hucknall, Nottingham. To be held on Mondays at 1900hrs.

The Arnold and Carlton College of Further Education, Digby Avenue, Nottingham. To be held on Wednesdays at 1900hrs.

Further details of both the courses at Nottingham, can be obtained from the Course Lecturer; Alan Lake G4DVW, telephone Nottingham (0602) 382509.

Rallies and Events

This year's Welsh Amateur Radio Convention, organised by the Blackwood and District Amateur Radio Society GW6GW, will be held at Oakdale Community College, Blackwood, Gwent, on Sunday, 18 September 1980. Opening at 10.00am the convention will be officially opened by Mr P. Balestrini G3BPT, President of the RSGB, at 11.00am. Further details from: *B. Davies GW3KYA, telephone Blackwood (0495) 225825.*

The Great Lumley Amateur Radio and Electronics Society G4EUZ, will be holding their annual Mobile Rally on Sunday, 5 October 1980, at the Community Centre, Great Lumley, Nr Chester-le-Street, Co Durham. Further details from: *M. Hanaghan G8HPW, 58 Pickhurst Road, Pennywell, Sunderland, Tyne and Wear SR4 9HH, telephone Aylton (078324) 3946.*

Harlow and District Amateur Radio Society will be holding their annual Mobile Rally on Sunday, 28 September 1980, at Netteswell Comprehensive School, Harlow, Essex. Further details from: *T. M. White G8LXB, 79 Elmbridge, Old Harlow, Essex.*

ZX80 Users Club

The ZX80 Users Club is an independent group run by enthusiasts of the Science of Cambridge ZX80 microcomputer.

Catering for all types of user, from the beginner to the more experienced object coder wishing to expand his system, the club produces a bi-monthly newsletter, has set up a software bank to provide members with software at minimal cost, and provides a technical support scheme.

The annual membership fee, which includes the cost of the newsletter and software bank index, is £6.00 for UK members and £10.00 for overseas members.

For further information, send an SAE to: *ZX80 Users Club, PO Box 159, Kingston-upon-Thames, Surrey KT2 5UQ.*

Sorry!

In the Catronics Ltd. advertisement on page 54 of the September issue of *Practical Wireless,* three pieces of equipment were incorrectly priced.

Catronics have managed to make substantial reductions on the equipment and the prices should have read as follows:

Lowe SRX–30 Receiver, now **£158** not £178; Regency Digital Flight Scan Receiver, now **£215** not £230; Regency M100 Receiver, now **£168** not £192.

Catronics Ltd., Communications House (Dept. 88), 20 Wallington Square, Wallington, Surrey SM6 8RG, telephone 01-669 6700.

NEXT MONTH

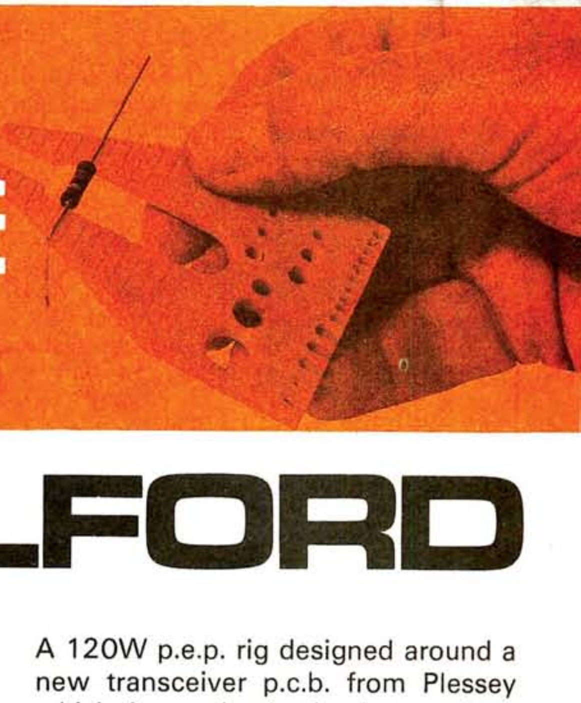
SEE THE NEW STYLE...

FOR THE RADIO ENTHUSIAST...

Practical Wireless

FREE GIFT
LEAD BENDING GAUGE

This useful gadget takes the guesswork out of bending component leads at 0·3–2in pitch for p.c.b. insertion, and also gauges popular drill sizes from "p.c.b." to ⅜in and wires from 16 to 44 s.w.g.



and featuring- PW HELFORD

A 120W p.e.p. rig designed around a new transceiver p.c.b. from Plessey which is surely destined to replace the famous G3ZVC board. The initial design is for 80 and 20m, and a further module will be ready shortly to add 40, 15 and 10m too. If you don't need so much power just omit the p.a.—the driver will give up to 25W

HF SSB TRANSCEIVER

PLUS SURVEY of 2m MULTI-MODES

introducing RTTY part 2

Jeff MAYNARD G4EJA

To convert the output from a receiver loudspeaker to a form suitable for driving a terminal and (on transmission) to convert the output of the terminal into an AFSK signal, requires what is known as a terminal unit. Fig. 8 shows a block diagram of such a unit for reception only (transmission is dealt with later).

The first and last blocks (limiter and terminal unit) are largely incidental to the main process of mark/space detection and are therefore dealt with first. Unless stated otherwise, the reader can use the circuit ideas given with any of the discriminators/tone detectors shown later.

The limiter in its simplest form consists just of two back-to-back diodes across the input (Fig. 9). This literally limits the input voltage swing to 0·6V. Following the limiting diodes, it is quite usual to see some form of band-pass filter to eliminate some of the inevitable QRM associated with RTTY reception. With the ready availability of i.c.s, it is simplest today to opt for an active filter whose centre frequency is set mid-way between the mark and space frequencies (i.e., at 1360Hz). The National Semiconductor publication *Linear Applications, Volume 1* suggests a two-stage active band-pass filter, which is shown in Fig. 10 with suitable values for this requirement. The gain is approximately 15 (23dB) and the Q about 25. This filter can be inserted between the limiting diodes and the next stage (some type of discriminator or tone detector). A bypass switch to take the filter out of circuit is a useful addition to any terminal unit.

The LM3900 used in this circuit contains a further two op. amps. which could be used for another band-pass filter if a two-shift terminal unit is required, or as part of an active filter tone detector (as described later).

Interface

One of the most difficult areas of RTTY for the newcomer to grasp is that of terminal interfaces or magnet drivers. The latter name comes about because the older electro-mechanical types of terminal require the terminal unit to activate some form of selector magnet. It is the need to drive this magnet coil, with an inductance of perhaps 4 henries, that necessitates the use of an 80 volt signal. The large inductance coupled with a resistance of about 250 ohms gives a time constant (L/R) of 16ms (assuming the magnet pulls in at about 12·5mA). Since each RTTY element is only 22ms long this is clearly unacceptable. To reduce this time the inductance can be reduced (impractical) or the resistance increased. For a time constant of 1ms the resistance must be 4kΩ. At this figure the applied voltage required to maintain the magnet holding current of 20mA is (from Ohm's Law) 80 volts.

Driving Systems

Two types of magnet driving systems are used—single current or unipolar, and double current or polar. A single current system, generally operating at 120 volts, allows current to flow, at about 60mA, through the selector magnet for the mark condition. The space condition is when no current flows.

In a polar system (also known as 80-0-80V) it is the direction of current flow that represents the RTTY signal. When the terminal input is negative with respect to earth it is in the mark condition; when it is positive with respect to earth it is in the space condition.

These two types of signalling are illustrated in Figs. 11(a) and 11(b) respectively. Some of the more modern terminals available have added to this confusion with requirements such as ±12V, 12V single current, ±6V and of course TTL.

To minimise the reader's difficulty in understanding the prime function of a terminal unit of demodulation, all the circuits that follow are given with TTL compatible output. In order that the user may use these circuits with his own particular terminal a number of conversion circuits are shown as follows:

Fig. 12: TTL to 120V single current
Fig. 13: TTL to 80-0-80V double current
Fig. 14: TTL to ±12V

Note that in Fig. 13 the double current or polar signalling is achieved by reversing the flow from a single polarity supply. The convention for TTL compatible RTTY is that a mark is represented by 1 (+5V) and a space by 0 (0V or ground).

Demodulator

Now we have an input limiter with optional band-pass filter that can be connected directly to a receiver loudspeaker, and a method of driving any of the current popular terminals. All that is now necessary is to demodulate the incoming tones to a TTL compatible signal (mark = 1, space = 0). When received on a correctly tuned receiver the loudspeaker output for an RTTY signal will be a mixture of 1275 and 1445Hz tones (assuming an amateur transmission).

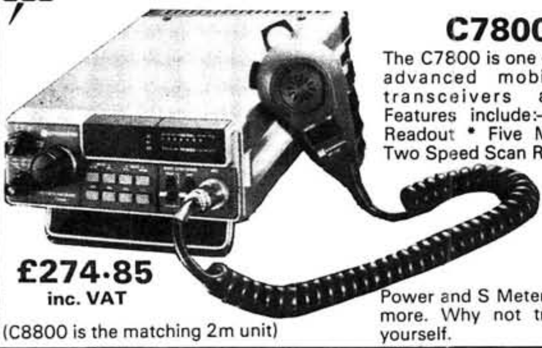
The two-tone method of demodulation uses a pair of filters, one for each tone. In many earlier units these were LC filters as shown in Fig. 15. The coils employed are standard 88mH centre-tapped loading coils as used by the Post Office and obtainable from a number of sources. This type of demodulator is aligned by selecting an appropriate capacitor or combination of capacitors to tune each coil whilst an accurate tone is fed to the input.

The output of the op. amp. will swing between the positive and negative rails as a signal is present within the passband of the respective filters. This circuit has been used by many amateurs throughout the world after reading *RTTY The Easy Way* published by the British Amateur Radio Teleprinter Group (BARTG).

The availability of op. amps. at low prices makes an active filter two-tone demodulator an attractive proposition.

Lee Electronics Ltd

LEE



C7800

The C7800 is one of the most advanced mobile 70cm transceivers available. Features include:– • Digital Readout • Five Memories • Two Speed Scan Rate • L.E.D. Power and S Meter and many more. Why not try one for yourself.

£274·85
inc. VAT

(C8800 is the matching 2m unit)

LEE

NEW LOW PRICE
FRG 7 £199·00

TRIO R1000

BEAT THIS PRICE!! £289 inc. VAT
FREE HEADPHONES WITH THIS SET AND WITH FRG7

THE NEW C800

This 10 channel scanner out performs many of its rivals due to its highly sensitive front end and excellent filtering. A one channel 50MW transmitter is incorporated and is ideal for local use. Controls include squelch, volume, auto scan and manual channel stepping. The unit comes complete with channels S20, R1, R2, R7, Nicads, Charger, helical antenna and wire antenna.

PRICE £69·95 + VAT
CARRIAGE FREE

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SRX30 SWL RECEIVER £158

TRIO EQUIPMENT

		Price inc. VAT £
R1000 SWL	PLL Receiver 200KHz to 30MHz	**297.85**
R820	The ultimate SWL receiver	**690.00**
YG455C	CW filter 500Hz	**58.65**
YG455CN	CW filter 250Hz	**60.95**
SP820	Speaker	**37.95**
HS5	Communications headphones, tailored response	**21.85**
HS4	Communications headphones, tailored response	**10.35**
VHF AMATEUR RECEIVERS		
SR9	Tuneable/crystal 2m FM receiver 144-146MHz	**46.00**
AMR217B	Scanner with 8 crystals. Mains/battery	**120.75**
ROTATORS, TUNERS & SWITCHES		
AR40	(5 core cable required)	**54.63**
FU200	For lightweight 2m beams	**40.39**
KX2	AK Antenna Tuner 0.5-30MHz	**29.90**
CX3	SWL 3-way Antenna Switch	**7.20**
DAIWA	CS201. 2-way Antenna Switch	**11.98**
KW SWL	3-way Antenna Switch	**14.80**
AIR BAND RECEIVERS		
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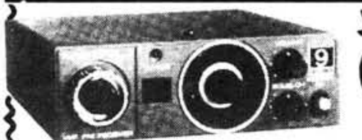

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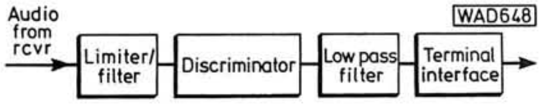


Fig. 8: Receiving terminal unit block diagram

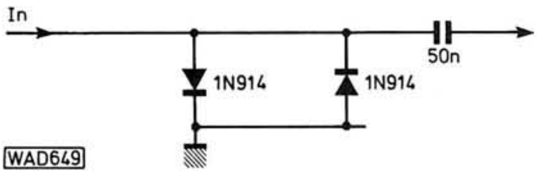


Fig. 9: Terminal unit input limiting

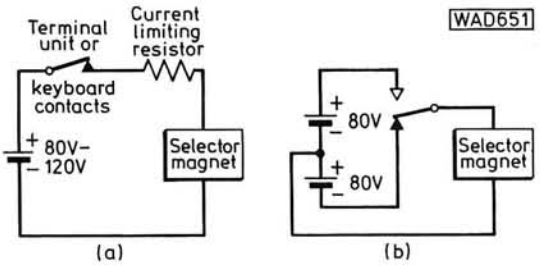


Fig. 11: (a) Single current signalling. (b) Polar or double current signalling

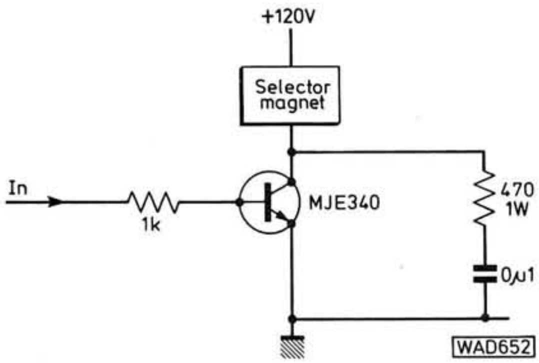


Fig. 12: A TTL to single current interface

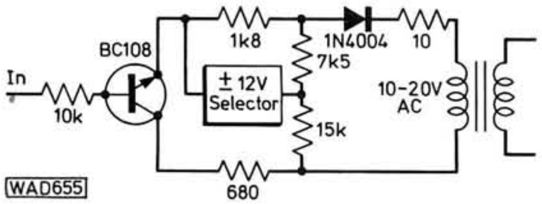


Fig. 14: A TTL to ±12V interface

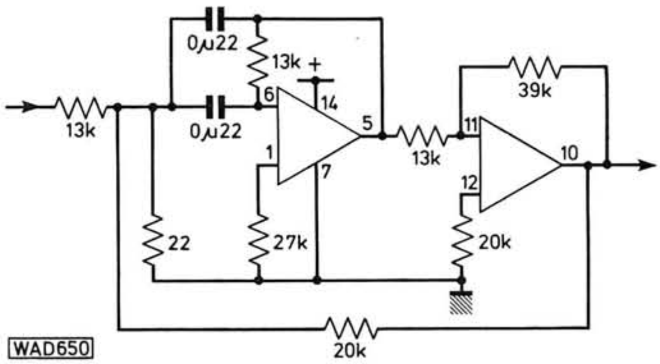


Fig. 10: Active band-pass filter

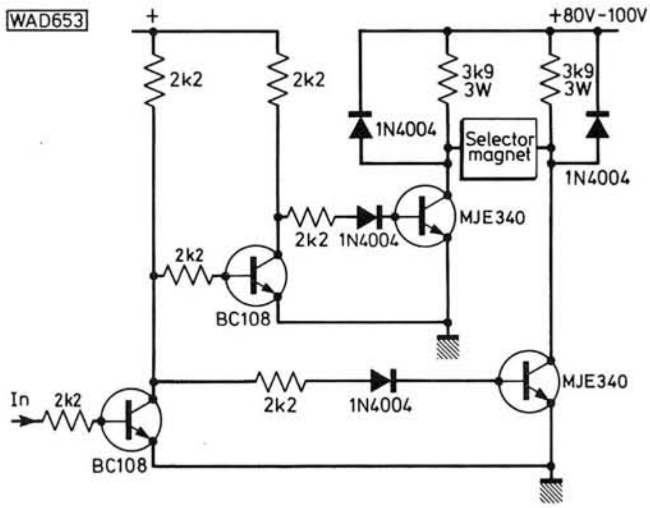
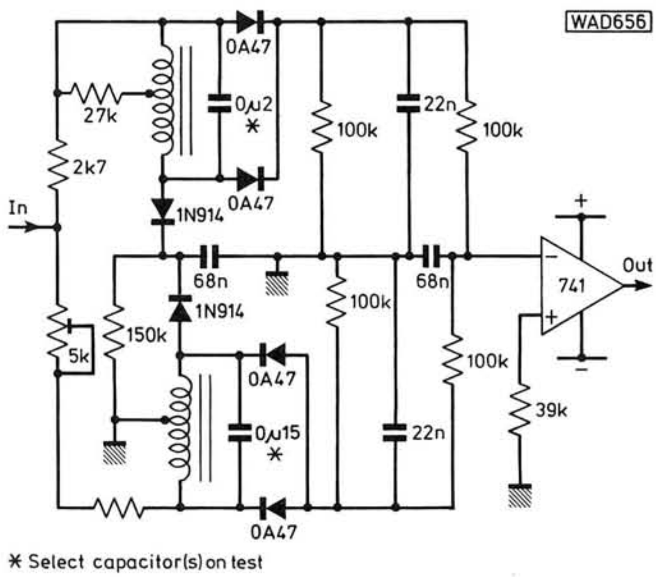
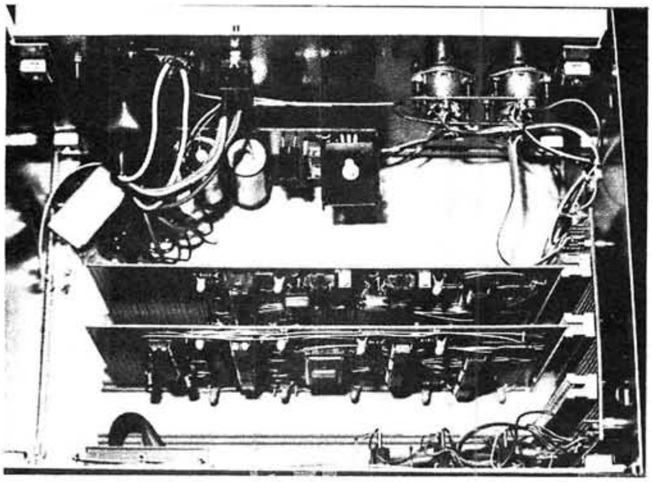


Fig. 13: A TTL to double current interface



* Select capacitor(s) on test

Fig. 15: A passive filter demodulator



Interior of the author's terminal unit, showing the way in which plug-in boards are used to facilitate experimental work

Fig. 16 shows such a circuit as breadboarded by the author. The frequency for each filter (mark and space) is adjusted by means of the 4·7kΩ preset with an accurate input tone.

Phase Locked Loop

The simplest type of demodulator is constructed with the aid of a phase locked loop (p.l.l.), with the NE567 being the most popular. This particular circuit will change output state when a frequency within its capture range is applied to the input. The centre frequency and bandwidth of the capture range are set by a few external components.

If a p.l.l. is set to detect the mark frequency (1445Hz), then at any other time it will output a space condition. Thus a simple unit can be constructed that requires to detect only one tone (its absence being assumed to indicate the other tone). Fig. 17 shows a simple p.l.l.-based demodulator developed by the author. The reader should note that with the addition of input protection diodes and power supply, this circuit provides a complete RTTY demodulator. The centre frequency of the p.l.l. is set by the 25kΩ preset potentiometer, which should be of the multi-turn type.

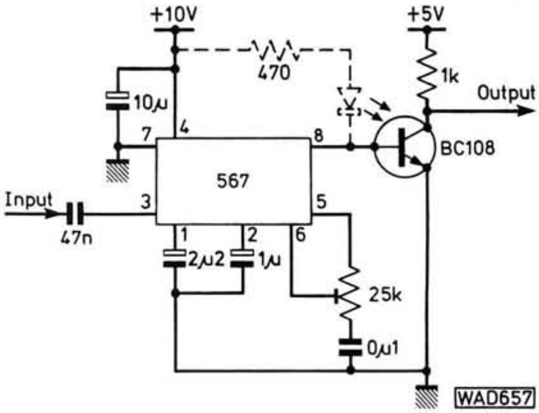


Fig. 17: A phase-locked loop demodulator

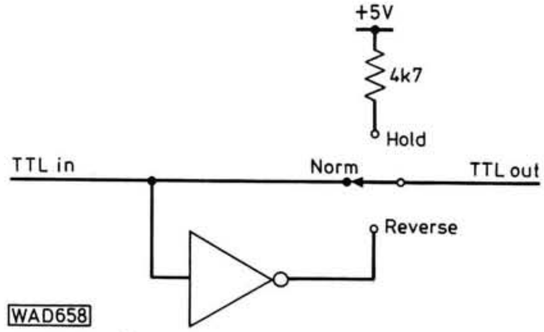


Fig. 18: Hold—Normal—Reverse switching

If the terminal unit is to be used to copy different shifts then it is only necessary to switch in another preset tuned to the new frequency (mark tones for 850Hz shift signals are at 2120Hz).

Adjustment is quite simple and can be accomplished in one of two ways. If a frequency counter is available, the free running frequency of the p.l.l. is set to 1445Hz (with no input and the counter connected to pin 5). Alternatively, feed a 1445Hz signal into the p.l.l. and adjust the preset until the optional mark-indicating l.e.d. (shown dotted) illuminates. Continue adjusting until the l.e.d. extinguishes, then set the preset midway between these points. The p.l.l. should now be free running at 1445Hz.

The measured bandwidth of the prototype unit was 160Hz at 1445Hz centre frequency. Thus the output will be mark for an input frequency in the range 1365–1525Hz. Any other input frequency will cause a space condition on the output, so that some older terminals will "clatter" when tuning across the band. The simplest way to avoid this is to include a mark-hold switch somewhere in the system; this can usefully be combined with a reversal switch (to copy the transmission of a station sending mark for space and vice-versa) as shown in Fig. 18.

To avoid this "clattering" (which can be very annoying in the presence of c.w. signals) two approaches are possible. The first is the introduction of an "anti-space" circuit between the p.l.l. output and the voltage converting tran-

continued on page 76 ▶▶▶

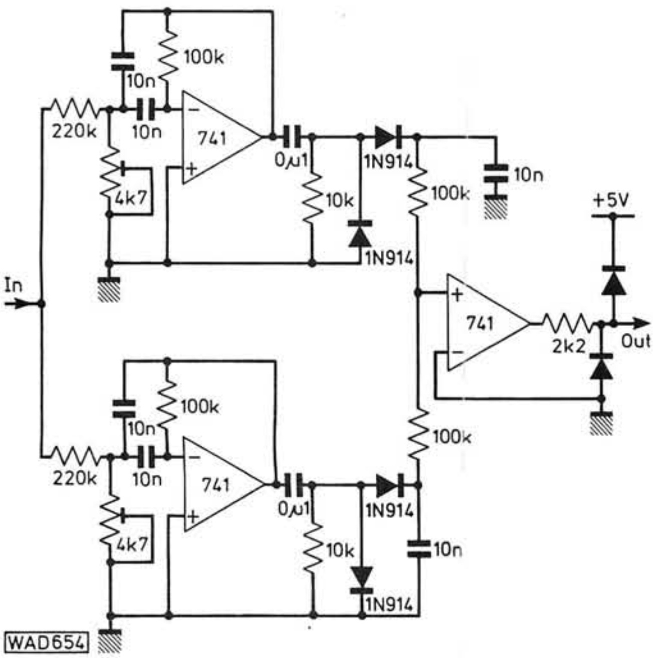


Fig. 16: Active filter demodulator

THE PW 'SHERBORNE' PART 1

SYNTHESISED AM/FM TUNER

W. S. POEL

This series of articles describes a 4-waveband broadcast tuner based on a microprocessor-controlled digital frequency synthesiser. Details will be given of suitable tuner and stereo decoder modules, but it is possible to use the synthesiser with other modules, or to incorporate it into existing tuner or receiver systems, providing the necessary inputs and outputs are available. Advice on such adaptations will be given during the series.

Digital frequency synthesis is beginning to appear at all levels of the radio industry. From early appearances in strictly "money-no-object" military and aerospace applications, the synthesiser has now progressed into consumer broadcast radio systems, and has at last emerged in a form that enables the enthusiast to get to grips with a d.i.y. version of a very sophisticated broadcast tuner. Not only have the technical complexities been drastically reduced, but the cost is on a par with non-synthesised systems offering far fewer features and facilities. Many of the facilities and features in the unit described here are simply not attainable in any other approach—so a direct comparison is not possible.

Principles

The basic operating principle of a digital frequency synthesiser, operating on the phase-locked-loop principle, is shown in Fig. 1. Another meaning of the term "digital synthesis" is the building up of a waveform by adding together various digital signals, but this is certainly not the type of system employed when the term is used in the context of radio applications.

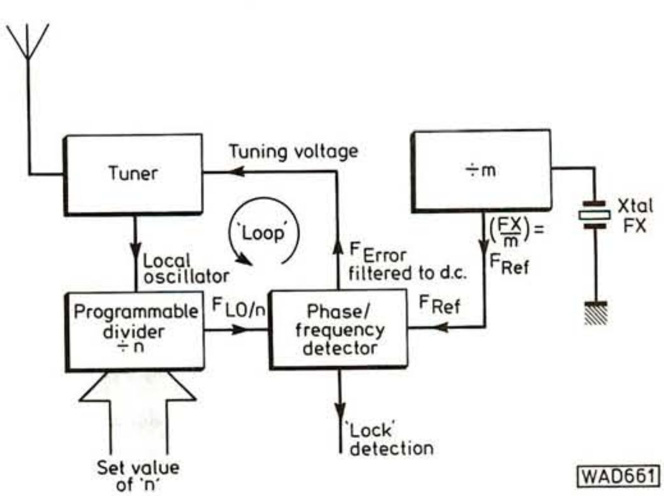
The operational principles are deceptively simple: a crystal oscillator is divided down to derive an ultra-stable frequency reference, $F_{ref} = Fx \div m$, which is then compared in a phase detector with the frequency of the receiver's local oscillator—after the local oscillator frequency has been divided down through a programmable divider system to produce $F_{lo} \div n$. When these two frequencies are the same, the system is said to be locked, but when there is any difference, the phase detector provides an output which then drives the local oscillator frequency either higher or lower, so the signal after division gets closer to the reference frequency until a state of frequency lock is achieved.

The division ratio "n" set for the programmable divider determines the frequency of local oscillator as being $F_{ref} \times n$. For example:

Frequency of crystal = 10MHz
Divided by 1000 = F_{ref} = 1kHz

If the receiver needs to be tuned to 909kHz, then the frequency of the l.o. will be 909 + 468 = 1377kHz (468kHz is the i.f. offset, with oscillator high). So "n" for the programmable divider should be set to 1377, to give the l.o. frequency of $1377 \times F_{ref}$ = 1377kHz.

If the l.o. is initially running at 900kHz, the phase comparator will be fed by 1kHz from F_{ref}, and $900 \div 1377 =$ 0·65359kHz from the l.o. section. The result is an output from the phase detector that drives the tuning voltage higher to close the gap between F_{ref} and $F_{lo} \div 1377$. In other words, the output from the phase detector is the source of the tuning voltage.



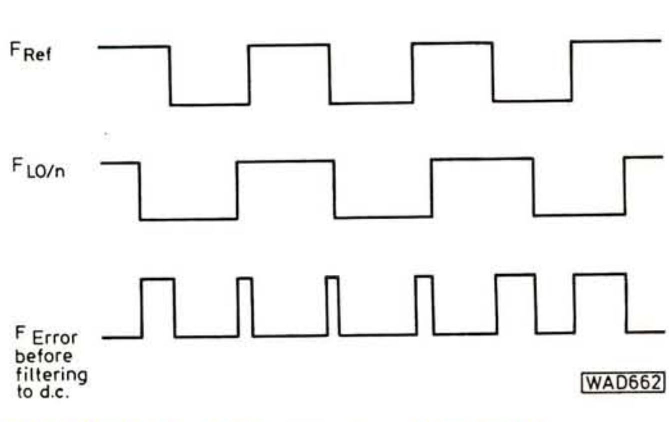


Fig. 1: Basic block diagram of a p.l.l. digital frequency synthesiser, plus derivation of the tuning voltage from the F_{error} signal

The output of the phase detector continues to change while the tuning voltage is driving F_{lo} towards the desired frequency of 1377kHz—but when it reaches 1377kHz, the output from the phase detector is a constant voltage, representing the value necessary to hold F_{lo} at the "locked" value. Occasional phase errors may occur if the l.o. should drift fractionally off tune, and these pulses will occur at the reference frequency—although the duty cycle will vary considerably according to the size of the error.

All this is fairly straightforward stuff, and can be accomplished in standard logic families (CMOS, TTL, etc.) of an appropriate speed—several articles covering such topics have appeared in the enthusiast press over the past few years. But such designs require at least 10–15 i.c.s, plus more for the display driver section, and i.f. offset computation. A lash-up on Veroboard could be made to work—but the sharp edges of the multitude of logic transitions will create a huge amount of radio frequency interference—requiring very long-winded efforts at decoupling and screening to prevent the synthesiser producing so much background noise as to make the whole receiver system unusable. Place a common-or-garden calculator alongside a radio set and see just how much noise results. The more recent l.c.d. calculators are far better than early l.e.d. types, but they all demonstrate the potential for r.f.i. that exists within any logic circuit not specifically restrained by a radio engineer.

Enter the Microprocessor

Whereas discrete logic approaches have always tended to be "parallel" programmed, requiring a proliferation of interconnections—since the data is transferred through the system by a separate line for each BCD digit—the MPU is essentially a serially controlled processor, where data is carried around in "words." In the case of the MPU used here, the Hitachi CMOS HD44752, the words are 4-bit "wide", with a separate clock and enable line to make certain the timing sequence is correct to place the data into the correct data registers when the enable line permits. When the enable line is not active, then the data on the input lines is simply ignored, so that the same set of data lines may be connected in parallel with another device on the same "bus". A separate data enable line to the next device on the bus permits it to read data off the bus when activated.

A reasonable analogy of the differences between a parallel synthesis system, and a modern MPU serial concept would be to consider the difference between two sets of teleprinter links: one where each key on one unit was hard wired to each key on the other unit; the other the usual RTTY code system, where a single data line is used with characters represented by streams of serial word codes that correspond to different keys being pressed.

The MPU must of course be programmed to perform the necessary data manipulations, including:

- Reading the keyboard instruction entry system.
- Computing the correct data to send to the programmable divider.
- Timing the transfer of data to coincide with all the necessary clock and enable periods.
- Taking into account any additional external inputs directing/overriding the keyboard functions.

Fortunately, the HD44752 comes complete with a 1K read only memory (ROM) ready masked on chip, containing the necessary computer program information to enable users to treat the i.c. as the proverbial "black box". Or if you prefer, as a dedicated synthesiser function i.c.—albeit a different ROM program would turn exactly the same i.c.

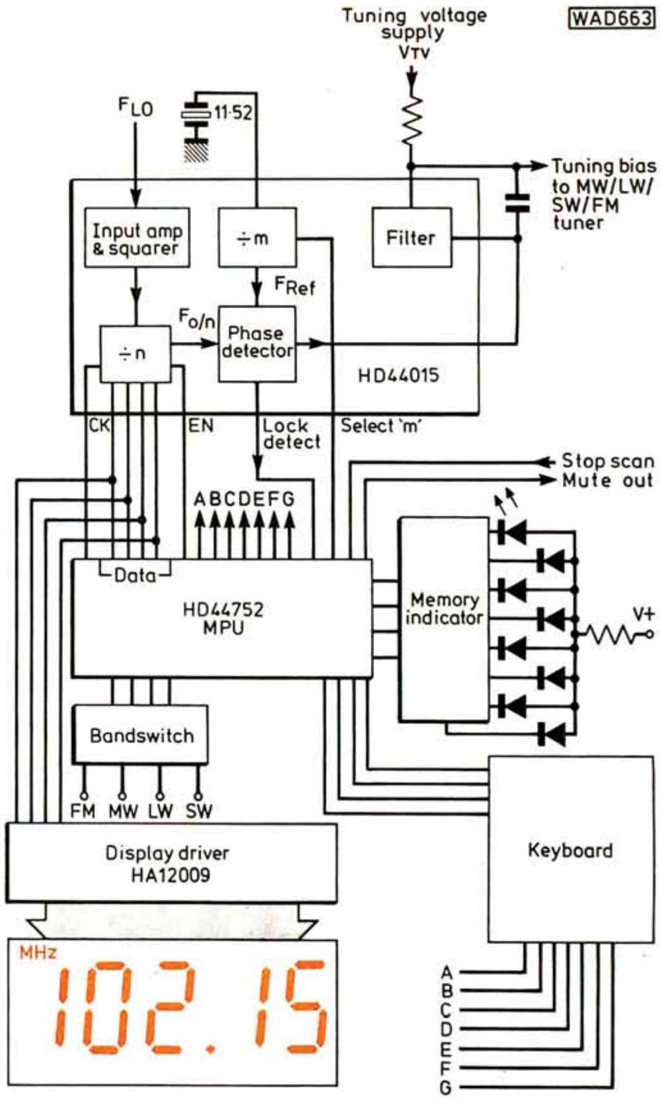


Fig. 2: Block diagram of the Hitachi HD44752 frequency synthesis system

into a multiple stack timer, drinks vending machine controller or a sophisticated TV game controller.

A block chart of the Hitachi HD44752 synthesis system appears in Fig. 2, and reveals that the MPU converts the keyboard information into the data necessary to set the phase-locked loop—and then displays this information (using the same output data line) via a display decoder/driver (HA12009), with a separate indication of the actual frequency band in use. If the frequency has been selected from the memory, then the actual memory location used is displayed on one of eight l.e.d.s (one per memory location).

The keypad does not offer direct entry of frequency, but steps the frequency along in channel-wide units (that correspond to the reference frequency, F_{ref}). Direct frequency entry is desirable in some instances, but it is wasteful of program space. And in the cramped space offered by 1K of ROM the available space is better occupied by some of the other functions described later.

The Complete Circuit

Reference to the complete circuit (Fig. 3) reveals a few more function switches and connections than discussed so far—apart, that is, from those associated with providing a simpler and more effective means of driving the phase-

★ components

SYNTHESISER

Resistors

¼W 5% Carbon film

100Ω	1	R4
180Ω	1	R35
470Ω	2	R3,19
680Ω	4	R24,28,31,37
1kΩ	3	R27,36,45
2·7kΩ	4	R26,30,34,39
4·7kΩ	3	R25,29,38
10kΩ	13	R2,5,8,11,17,32,33,40, 41,42,43,44,48
22kΩ	5	R1,7,9,10,18
27kΩ	1	R16
47kΩ	6	R14,15,20,21,22,23
56kΩ	1	R12
100kΩ	3	R6,13,46
120kΩ	1	R47

Capacitors

Sub-min. ceramic plate		
27pF	3	C2,4,24
150pF	1	C7
Ceramic disc		
1nF	2	C3,9
0·1µF	4	C11,12,13,14
0·22µF	3	C10,16,18
Monolithic ceramic		
10nF	3	C5,21,22
22nF	1	C20
Tantalum bead, 16V		
4·7µF	4	C8,23,25,29
10µF	2	C6,26
22µF	1	C27
Electrolytic, p.c. mounting, 16V		
100µF	5	C1,17,19,28,30
Electrolytic, p.c. mounting or d/e, 40V		
2200µF	1	C15
Variable, preset		
5–60pF	1	VC1

Inductors

RF Chokes		
4·7mH	2	L1,2 (Toko 8RB)
Ferrite bead chokes		
2T	2	FB2,3
10T	6	FB1,4–8

Stated number of turns of 0·25mm dia. insulated copper wire wound on Mullard FX1115 ferrite bead.

Semiconductors

Transistors		
BC237	13	Tr2,5–8,10–17
BC307	3	Tr3,4,9
BF274	1	Tr1
Integrated circuits		
HA12009	1	IC3 (Hitachi)
HD10551	1	IC1 (Hitachi)
HD44015	1	IC2 (Hitachi)
HD44752	1	IC7 (Hitachi)
U237B	1	IC11
741	1	IC10
7442	1	IC9
7805	1	IC6
7808	1	IC5
7815	1	IC4
74156	1	IC8
Diodes		
OA91	1	D8
W0-005	1	D1 (50V 1A bridge)
1N4148	31	D2–7,10–32,42,43
3mm l.e.d.s		
Red	11	D9,33–40,47,48
Yellow	3	D41,45,46
Green	1	D46

Potentiometers

Min. preset, horizontal mounting

100kΩ	2	VR2,3
470kΩ	1	VR1

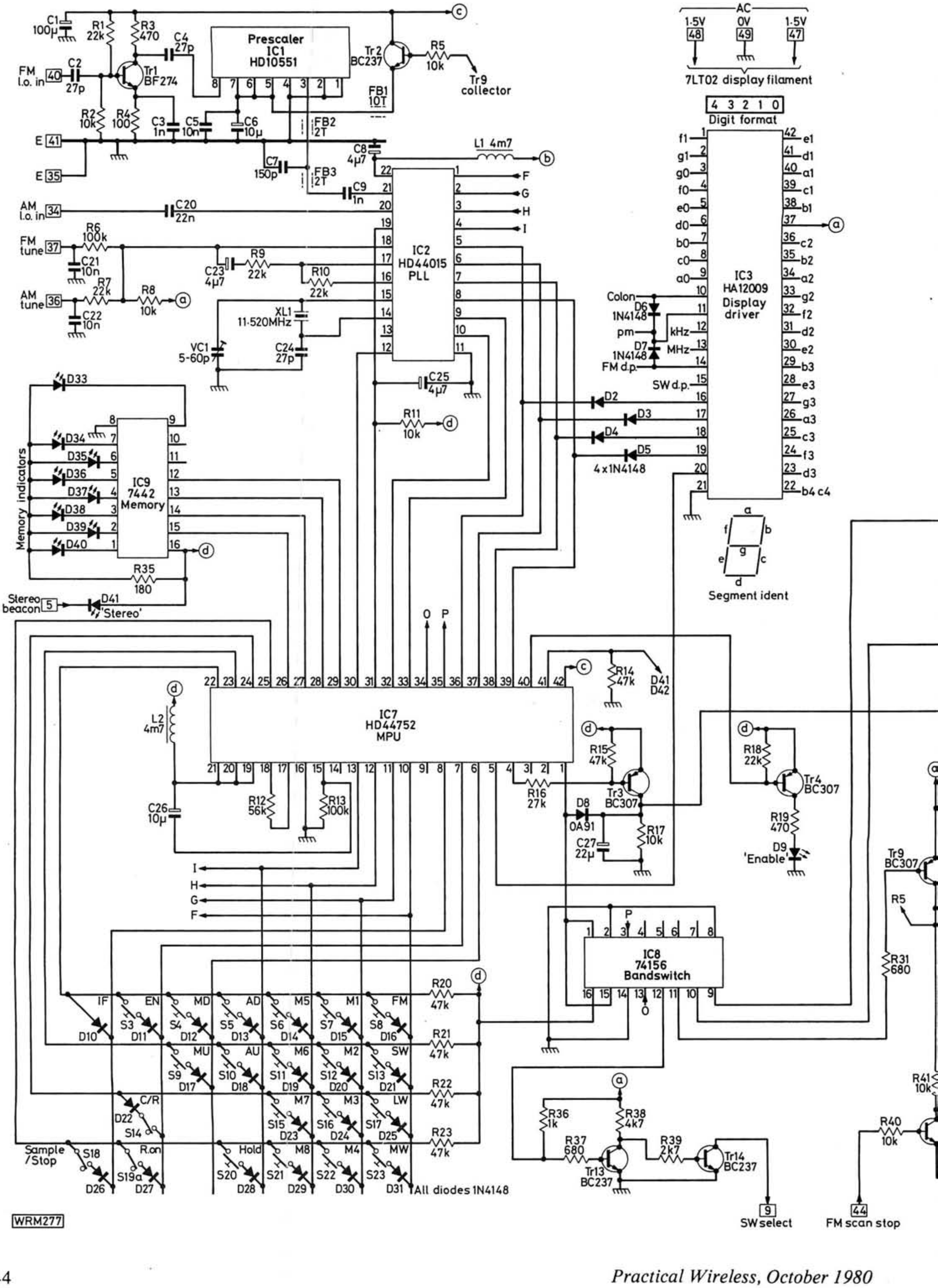
Switches

Push-button, p.c.b. mounting

SPST momentary	18	S3–13,15–17, 20–23 (ALPS KEF series)
DPCO latching	5	S1,2,14,18,19 (ALPS SUT series)

Miscellaneous

T1 10VA Toroidal, Pri: 240V, Sec 1: 15V 150mA Sec 2: 1·5-0-1·5V 100mA; XL1 11·520MHz; 7LT02 Fluorescent display (Futaba); IC sockets: 8-pin s.i.l., 8-pin × 0·3in d.i.l., 22-pin × 0·4in d.i.l., 42-pin × 0·6in d.i.l., one off each, or socket strips to make; PCB connectors 0·1in pitch: board/board, 1 each 20-way and 24-way; board/wiring, 1 each 2-way and 33-way; Heatsink for IC4,5,6; PCB pins, 15 off; Printed circuit boards.


Prescaler
IC1
HD10551
C1 100µ
R1 22k
R3 470
C4 27p
Tr1 BF274
Tr2 BC237
R5 10k
Tr9 collector
FM l.o. in 40
C2 27p
R2 10k
R4 100
C3 1n
C5 10n
C6 10µ
FB1 10T
FB2 2T
FB3 2T
E 41
E 35
C7 150p
C8 4µ7
C9 1n
L1 4m7
AM l.o. in 34
C20 22n
FM tune 37
R6 100k
C21 10n
AM tune 36
R7 22k
R8 10k
C22 10n
C23 4µ7
R9 22k
R10 22k
XL1 11.520MHz
VC1 5-60p
C24 27p
IC2
HD44015
PLL
C25 4µ7
R11 10k
AC
1.5V 48
0V 49
1.5V 47
7LT02 display filament
4 3 2 1 0
Digit format
IC3
HA12009
Display driver
Colon
D6 1N4148
pm
kHz
D7 1N4148
MHz
FM d.p.
SW d.p.
D2
D3
D4
D5
4 x 1N4148
Segment ident
Memory indicators
D33
D34
D35
D36
D37
D38
D39
D40
IC9
7442
Memory
R35 180
Stereo beacon 5
D41 'Stereo'
O P
R14 47k
D41 D42
L2 4m7
C26 10µ
IC7
HD44752
MPU
R12 56k
R13 100k
R15 47k
Tr3 BC307
R16 27k
D8 OA91
C27 22µ
R17 10k
R18 22k
Tr4 BC307
R19 470
D9 'Enable'
Tr9 BC307
R5
IC8
74156
Bandswitch
R31 680
R20 47k
R21 47k
R22 47k
R23 47k
IF EN MD AD M5 M1 FM
D10 S3 D11 S4 D12 S5 D13 S6 D14 S7 D15 S8 D16
MU AU M6 M2 SW
S9 D17 S10 D18 S11 D19 S12 D20 S13 D21
C/R M7 M3 LW
D22 S14 S15 D23 S16 D24 S17 D25
Sample /Stop R.on Hold M8 M4 MW
S18 D26 S19a D27 S20 D28 S21 D29 S22 D30 S23 D31
All diodes 1N4148
R36 1k
R38 4k7
R37 680
Tr13 BC237
R39 2k7
Tr14 BC237
9 SW select
R41 10k
R40 10k
44 FM scan stop
WRM277

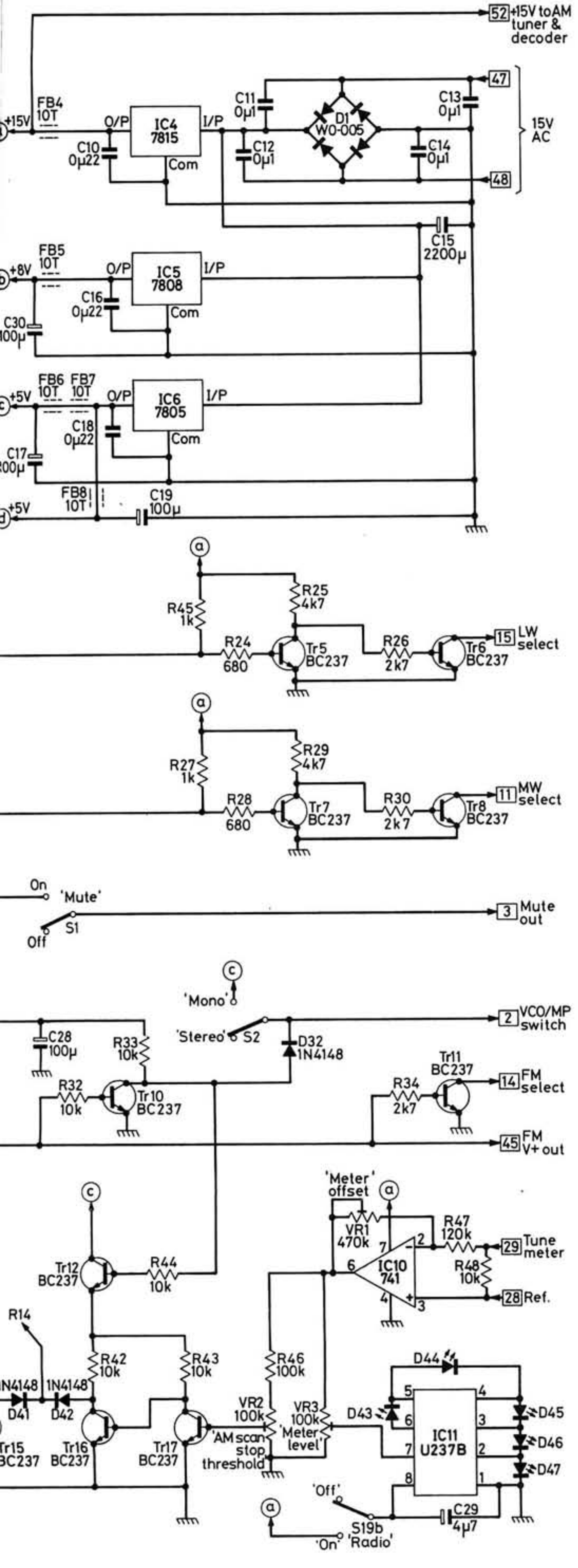


Fig. 3: Complete circuit diagram of the synthesiser unit. The boxed numbers indicate off-board connections to tuner and stereo decoder modules and mains transformer. Output pins on IC3 go directly to the 7LT02 fluorescent display. Layouts for the two p.c.b.s will be given later in the series

locked loop. Taking advantage of the flexibility of the MPU approach, the complete system performs a multiplicity of tasks:

1. To synthesise four broadcast bands:

LW from 146 to 353kHz in 9kHz channel steps
MW from 513 to 1620kHz in 9kHz steps
SW from 5·95 to 9·775MHz in 5kHz steps
FM from 87·5 to 108·1MHz in 50kHz steps

Purists may argue that this is not a sufficiently fine degree of resolution—but this is not so, since the spacing adopted is that now used as the standard spacing for broadcasting—making 1kHz a.m. resolution not only unnecessary, but a positive encumbrance when it comes to designing parts of the circuit associated with automatic tuning facilities. With 9kHz channel steps, the a.m. tuner can provide a simple signal via the signal strength indicator line to tell the synthesiser that it has acquired a signal of suitable level to warrant stopping the scanning sequence, so that the listener can sample the programme material to see if he wants to stay tuned to that spot.

With the purist's 1kHz steps, the signal level control cannot be regarded as an accurate representation of the optimum tuning point, since on a strong signal, the output would be enough to stop scanning when as much as 3kHz off centre frequency. For technical reasons, it is also more satisfactory to design a synthesiser with as high a reference frequency as possible, since it considerably speeds up the time taken to acquire lock when changing frequency.

2. To select frequencies via the keypad as follows:

2.1 Manual Tune. Press once to change the tuned frequency by a single channel spacing; hold down for fast tuning. Separate buttons are provided to go either up or down in frequency from the initial starting point.

2.2 Automatic frequency scan. This may be provided on either a sampling basis—where a detected signal is held for approximately three seconds before the radio tunes to the next detectable signal—or the synthesiser may be set to simply stop at the first signal it locates—until instructed via the keypad to perform another function.

3. To store up to eight sets of frequency/band information in RAM on the MPU, entered by first pressing the memory enable button (whereupon the l.e.d. labelled "Enable" lights up), and then pressing the button for the desired memory location to store the band/frequency information currently displayed, whereupon the "Enable" l.e.d. extinguishes. In fact, pressing any other button whilst "Enable" is lit will cause it to extinguish, without affecting the contents of any of the memory locations. Recall is accomplished by pressing the diesired memory location button (without first pressing "Enable"). The preset frequency and band will then be entered and selected.

4. When changing bands via the bandswitch push-buttons, the last station selected on that band is automatically recalled until updated.

5. The operation of both the auto scan feature, and the

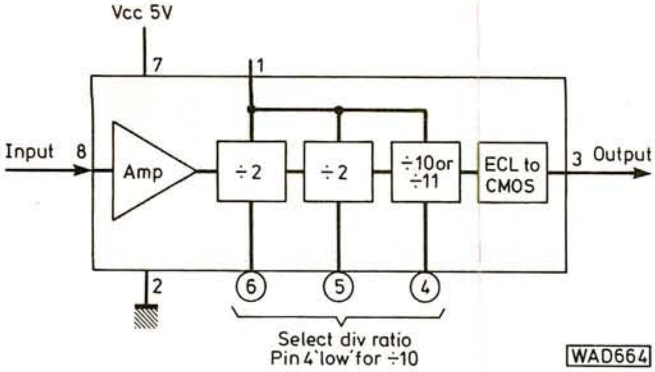


Fig. 4: The HD10551 prescaler

memory enable feature is conditional on the system being phase locked. The combined programmable divider/phase detector i.c. (HD44015) gives an output at pin 19 which changes state when the loop is locked. This signal also inhibits the release of the muting signal at pin 4 of the MPU, which is used to silence the tuner sections whilst the synthesiser is changing frequency, or is otherwise doing things liable to cause undesirable crashes, buzzes and bangs in the audio path—such as being unlocked due to an l.o. connection being loose.

6. When the radio is "deselected" (a quaint piece of computerese meaning switched off)—the display reverts to showing the time in hours and minutes on a 24-hour cycle. The setting of the clock (which incidentally uses the same basic quartz crystal reference as the rest of the synthesiser section) is accomplished by again pressing "Enable" and getting the l.e.d. to light, then updating the hours by pressing the "Manual up" tuning button, and the minutes by pressing the "Manual down" tuning button.

It is necessary to leave the power on at all times (at least the 5V to the MPU and the 8V to the p.l.l. master clock) since this retains both the time information, and the station memory information. A separate battery back-up facility may be provided to keep the MPU RAM alive, but it is simpler just to treat the system as a clock and leave it permanently "on".

The reset on condition is always to settle at 87·5MHz in the f.m. band, and if you find your tuner in this state one morning, then you can be fairly certain that you have suffered a power cut in the night! The clock resets to 00·00.

Detailed Circuit Analysis: The Prescaler—HD10551 (Fig. 4)

The Prescaler is an ECL device, with various selectable division ratios: ÷ 10, ÷ 11, ÷ 20, ÷ 22, ÷ 40, ÷ 44—but for simplicity, it is used here as a fixed ÷ 10, which means that when dividing the f.m. l.o. (ranging from 98·2MHz to 118·8MHz), the outputs are in the range 9·82MHz to 11·88MHz. This is potentially a bad state of affairs, since not only does 10·7MHz (the f.m. i.f.) occur in the middle of that (when the l.o. is tuned to 107·00MHz, receiving an input frequency of 96·3MHz)—but nine times the output of the prescaler also passes through Band II. Nine times the output covers the range 88·38MHz to 106·92MHz—but do not despair, since the points at which the actual tuned frequency of the receiver coincides with the prescaler output ×9 are fairly few and far between.

To minimise the harmonic content from the HD10551 prescaler, the supply voltage must be well decoupled—but the point on earth at which it is decoupled must be carefully chosen to possess low impedance. This is really the art of radio design, since very short pieces of track can adopt very high r.f. impedances, making capacitive decoupling worse than useless—since the path to ground actually resonates at some v.h.f. frequency, considerably increasing the dangers of radiation of unwanted spurii. For example, taking the prescaler decoupling to earth via the earth screen of the l.o. feed would be asking for trouble—since the whole of the cable screen would be a potential source of harmonic radiation. Simply earthing it again somewhere else might help—but on the other hand it might not—since the "networks" thus derived are virtually impossible to analyse except with the most expensive diagnostic equipment—and then very much on the basis of trial and error.

Having coped with the supply to the HD10551, the output of the prescaler must not be overlooked, since although fed with a sinewave, the ÷ 10 output is a fairly ragged squarewave guaranteed to be rich in harmonic energy that must be kept away from the input to the f.m. tuner. Simple capacitive decoupling will help, but then the decoupling capacitor will be shunting a lot of harmonic energy into the earth plane of the p.c.b. with the same problems arising as with supply decoupling. A choke arrangement is used instead, as this does not shunt any signal into the earth plane, but tends to reflect it back into the prescaler—as well as dissipating it as heat in the choke itself. A toroidal choke on a ferrite bead is essential, as an open-field choke will re-radiate the energy like a miniature antenna.

Whilst all this may sound like scientific planning, the practical application of this type of theory is a very different thing—and the final results are the fruit of some six or seven prototype stages that were developed to achieve the best solution.

The Programmable Divider—HD44015 (Fig. 5)

The HD44015 is a CMOS device, thus working at much lower power levels than the ECL prescaler. Most potential r.f.i. may be solved with simple supply line decoupling. The division ratio is entered in the form of 4 × 4-bit data words, which are then latched until updated—so that once a frequency is entered, the MPU can be used for other function control, such as displaying the time. Some forms of p.l.l. system rely on entirely serial data streams, but the HD44015 may be regarded as a 4-bit multiplexed input arrangement, where the BCD input data on pins 5–8 is loaded according to the state of the "multiplexer" pins 1–4. This also means that the p.l.l. may be used in other applications for a 4-decade synthesiser—as the data on pins 5–8 may be set using a BCD thumbwheel, and sequentially entered in conjunction with an enabling sequencer on pins 1–4.

The input signal from the l.o. of the receiver is a sinewave (or should be), and is first amplified and squared to provide a logic-compatible drive for the internal counters. The output of the programmable divider is then compared in the phase detector with a reference signal derived from the external crystal via the internal reference divider chain, which is selected by the MPU to give the correct channel spacing for the band being used.

The output of the phase detector is a stream of variable-duty-cycle pulses at the reference frequency—and these must be integrated to provide a smooth d.c. level for the tunerhead. Almost any disturbance of the final tuning voltage will result in noise at the output of the tuner—and so great care must be taken to filter this voltage. The HD44015 uses a m.o.s. transistor to provide the basis of an active low-pass filter, with external CR values to determine the actual characteristics so that the pulses are con-

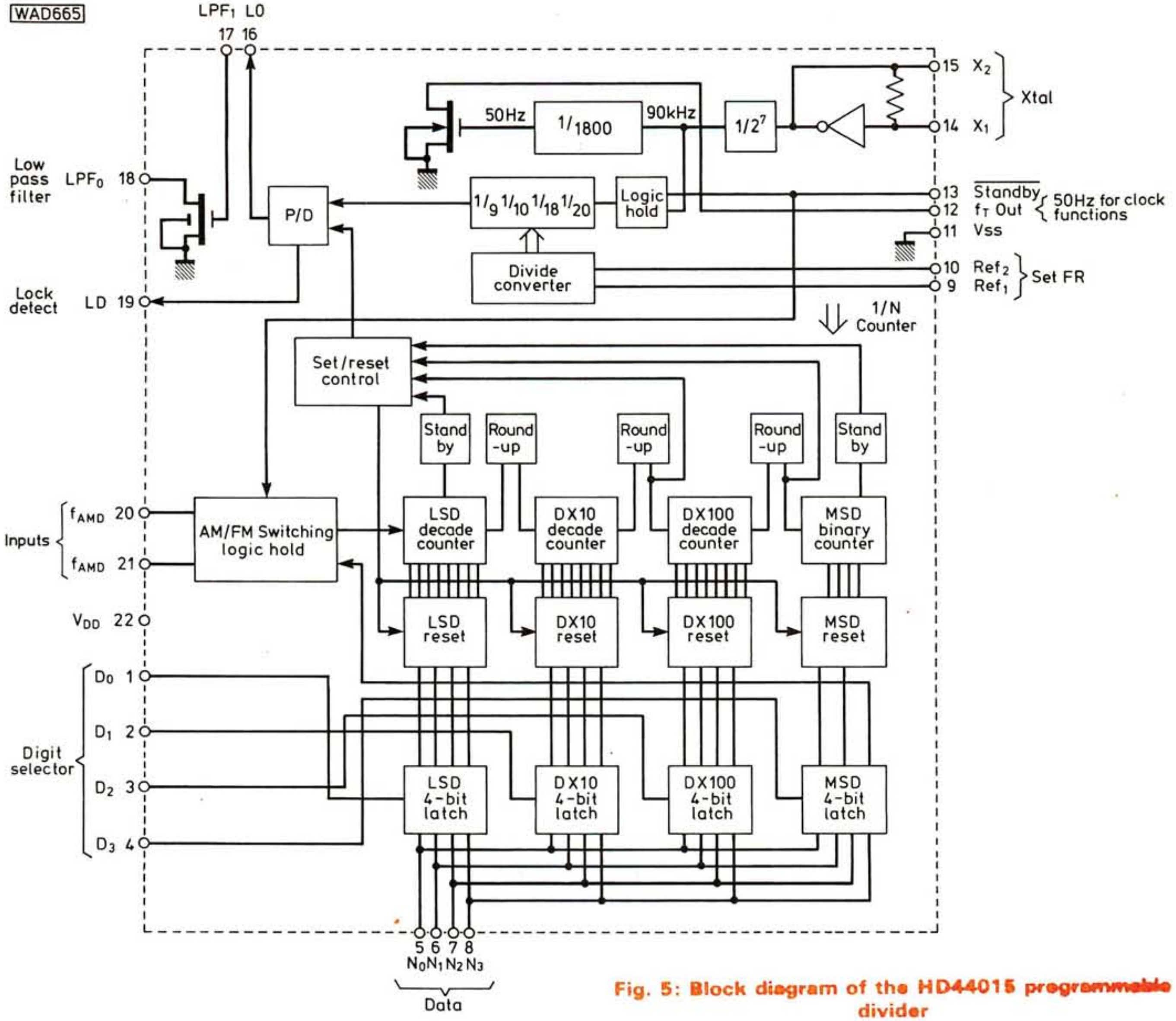


Fig. 5: Block diagram of the HD44015 programmable divider

verted into a d.c. level that can change just quickly enough to keep up with the synthesiser operation.

If this filter has too large a time constant (overdamped), then a condition known as overshoot will occur, causing the tuning voltage to swing back and forth about the selected channel, since the capacity of the filter builds up too much momentum for the tuning voltage to stop precisely when required. The effect is illustrated in Fig. 6, which plots the three possible filter conditions: underdamping, critical damping and overdamping.

There are only two basic reference frequencies used here, since the f.m. output channel of 50kHz is in fact prescaled by 10, down to 5kHz (the same as short wave). So the same basic filter values will be suitable for coarse filtering of both the a.m. and f.m. outputs from the phase detector. It must also be borne in mind that any capacity subsequently added to the tuning voltage line in the form of decoupling, will have an interactive effect—so beware! Two tuning voltage outputs are provided at the final pole of the filter, as the a.m. and f.m. tuning voltages are liable to be independently decoupled and routed within the radio tuner itself.

The output voltage range of the filter is determined largely by the tuning voltage fed via resistor R8 to pin 18 of the HD44015. The maximum voltage that may safely be applied at this point is 15V—leaving a possible range of about 0·5V to 12V for the actual tuning bias at the far side of R8. Depending on the impedance of the tuner tuning

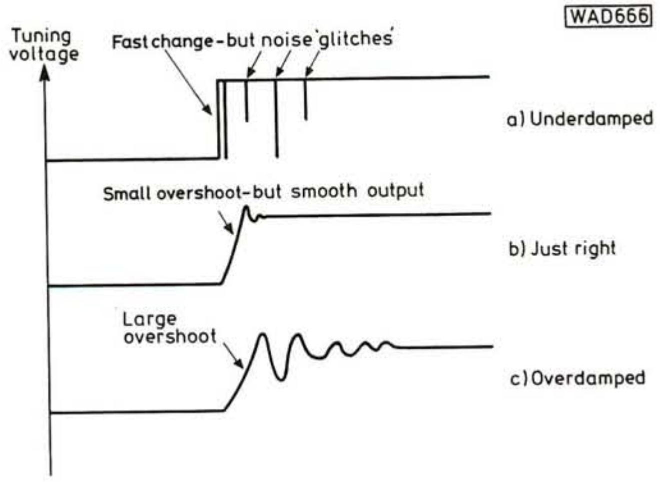


Fig. 6: Effect of filter time-constant on tuning action

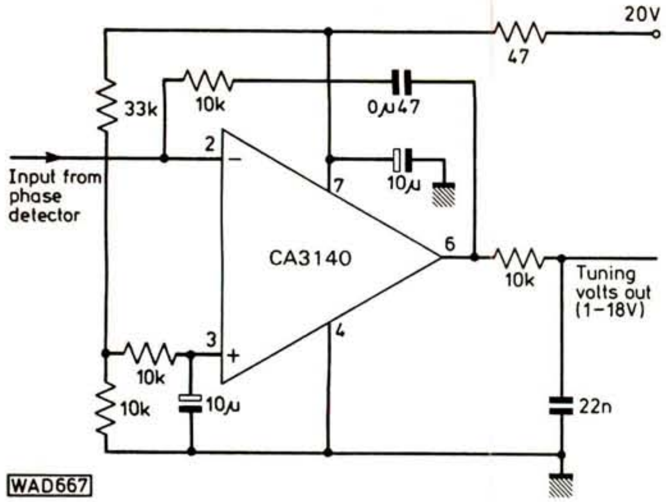


Fig. 7: An alternative form of filter-integrator suitable for driving high-voltage tuning lines

Fig. 8: Block diagram of the HA12009 display driver. Different versions are produced for the European market and Japan/USA, hence the alternative functions shown against three of the output lines

voltage lines, this is sufficient for tuning both a.m. and f.m. systems, although the output of the phase detector can be taken to an external form of filter—using a CA3140E for example—where a maximum 30V can be applied if a wider output voltage range is required for complete tuning of the system. A possible circuit is shown in Fig. 7.

The Display Driver—HA12009 (Fig. 8)

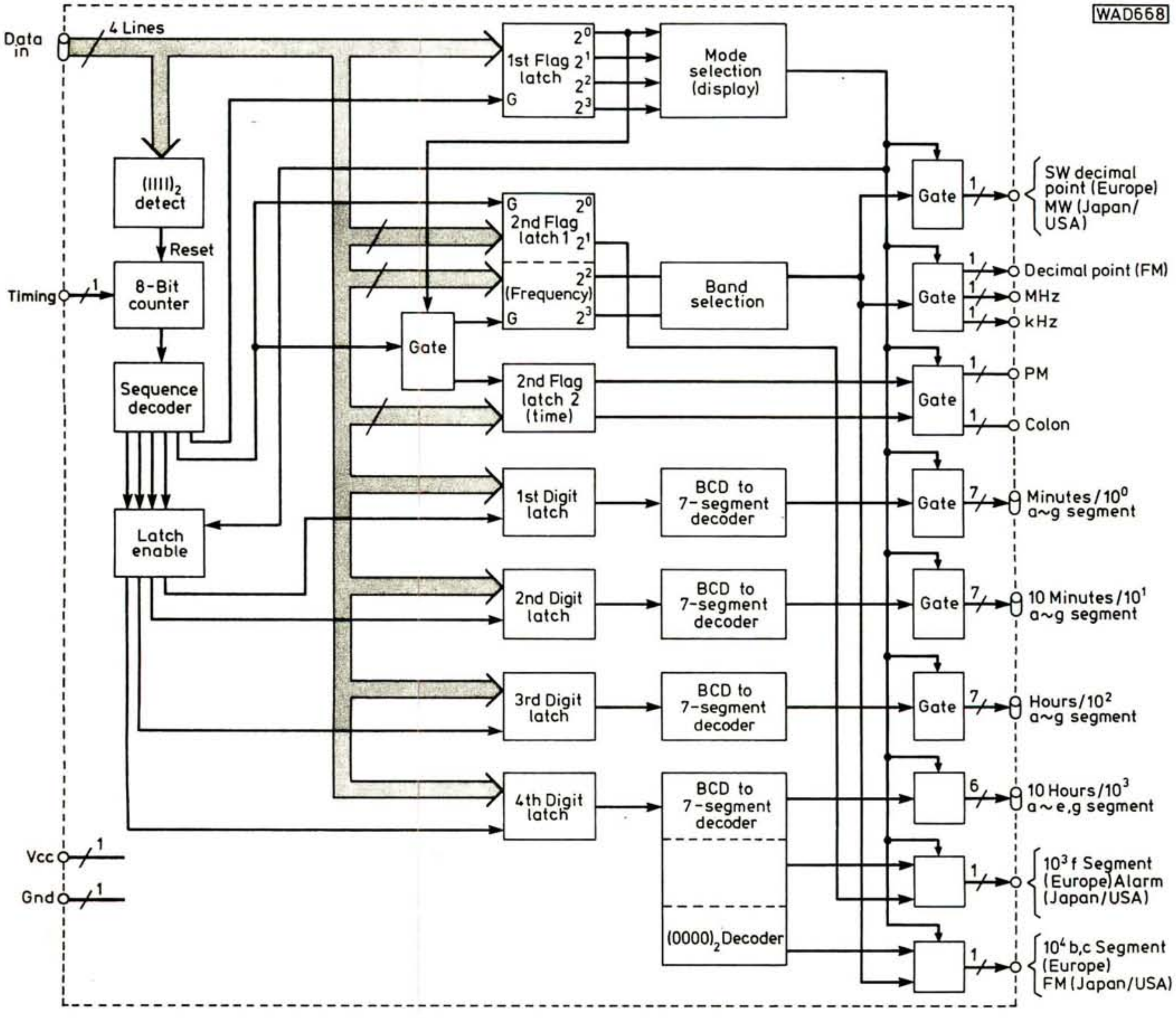
The output data lines to the HD44015 p.l.l. (described earlier) are also used in conjunction with a separate timing signal to drive the display decoder and driver. This data is not the same as that supplied to the p.l.l. i.c. and occurs in a sequence of seven frames that contain the necessary start/stop and indicator "flag" output information.

The HA 12009 is an I²L device—capable of static drive to both l.e.d.s and vacuum fluorescent displays, such as the Futaba 7LT02 used in this feature.

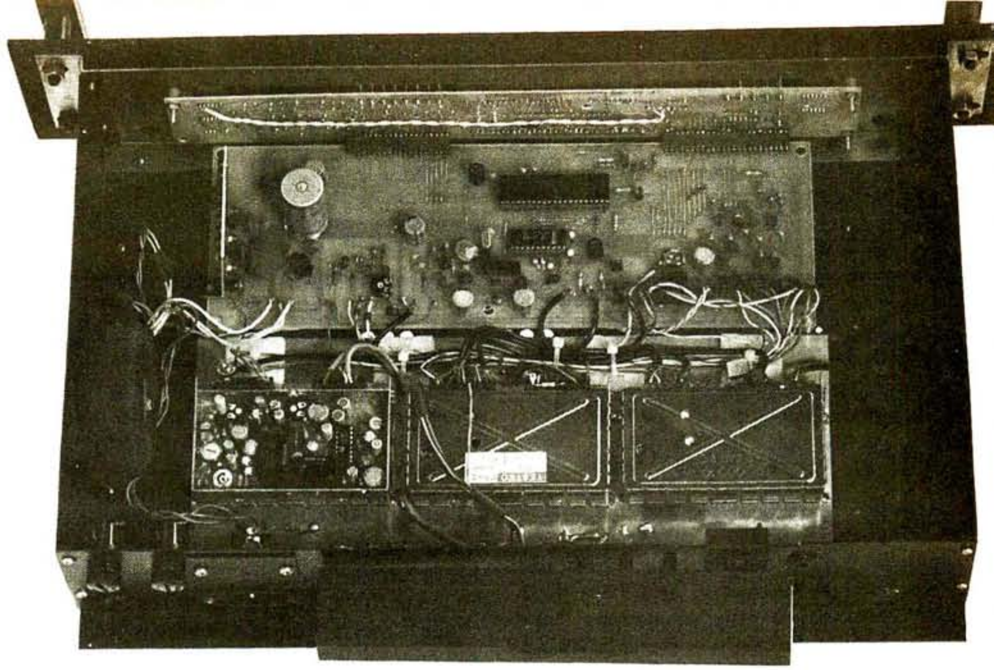
The MPU—HD44752

It is not possible to give an internal structure of the MPU within the scope of this article, so discussion will be restricted to its practical functions.

The user control information is supplied by a matrixed keypad using mainly momentary-contact switches—



Internal view of the *PW* "Sherborne". The two p.c.b.s at the top are linked via right-angled connectors, and together form the synthesiser unit. The three modules are (left to right): stereo decoder; a.m. tuner and f.m. i.f. amplifier; f.m. tuner. At the bottom (boxed) is a remote-tuned/switched ferrite rod aerial for m.w./l.w.



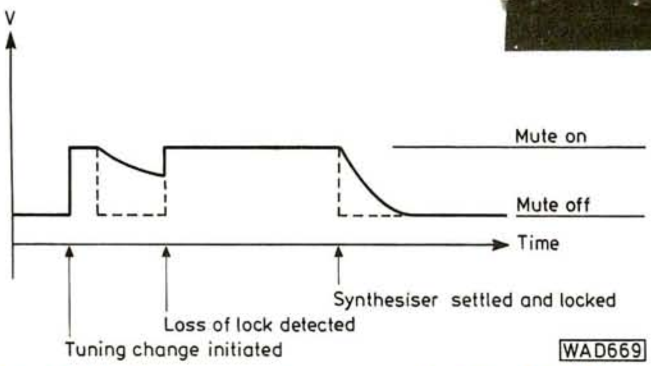


Fig. 9: Muting output after processing. The dotted line shows the actual MPU output pulses before stretching

although with some fixed push-on/push-off types as well. Other control information is supplied for stopping the automatic scan sequence, where an output from the a.m. or f.m. tuner is used to indicate the presence of a usable signal, and thereby cause the scanning either to stop completely—or pause to sample, depending on whether or not the "Sample/Scan" push-button has been depressed. This information is entered on pin 41 of the MPU, and must be positive-going in order to activate the scan stop function. Pin 42 performs a similar function, and may be either held high or ignored, or it may be driven from the stereo beacon, or some other type of signal derived from programme material (it was in fact designed to spot ARI traffic information in countries where the system is in use). The pin 42 function is then "ANDed" with pin 41, so that the tuner can be arranged to stop only on receipt, for example, of a verified stereo f.m. signal.

The tuner outputs are not in the correct form to operate the scanning stop function without a form of interface. So they must be tailored with a simple transistor inverter (Tr15) in the case of the f.m. signal (derived from the muting line), and an adjustable threshold trigger (Tr16/17) in the case of a.m. where the prime information is derived from the signal level output. (It is useful to be able to set the scan to stop at signals above a certain signal/noise threshold.)

The MPU produces all the muting signals necessary whilst tuning and bandswitching is going on—initially in the form of a brief pulse at pin 4 of the HD44752, delivered at the instant when tuning information is being changed—but later taken up again as the out-of-lock detector on the p.l.l. (pin 19 of the HD44015) "catches up" and holds the mute shut until the tuning has settled and lock been stabilised to ensure noise-free reception. See Fig. 9.

A substantial capacitor (C27) is used in a fast attack/slow decay configuration after the transistor switch Tr3 on the MPU mute output, to make certain that there is no "plop" between the initial pulse and subsequent "out-of-lock" signal.

The speed of scanning employed in the synthesiser means that the slow time-constants usually favoured in tuner design will cause unacceptable delays to the mute signal used to control the f.m. side of the auto scan-stop facility. The "slugging" capacitors used in the tuner's own mute detector are removed and replaced with 0·02μF disc ceramics—performing a r.f. decoupling function. The subsequent noise of the muting gate snapping in and out, and the possible chatter on marginal signals are silenced due to the MPU mute signal operating upon the very last stage of the tuner (of a low distortion mutable pre-amplifier), and then using time constants derived from timing signals rather than gates opened by noisy signals.

In order to be certain of stopping the scanning exactly on channel, it is necessary to derive a signal that is at least as narrow as the 50kHz channel spacing—or there will be a danger of stopping too soon on strong signals that cause the mute to operate over a 200–300kHz bandwidth. The answer is readily available with any f.m. amplifier/detector i.c. possessing deviation mute (and many of the good ones do these days). The muting bandwidth must first be narrowed to 50kHz, however, by increasing the value of a single resistor that develops a voltage for the deviation muting in the same way as conventional a.f.c. operates.

Power Supplies

The power for the entire tuner is fed from the synthesiser control board, using three-terminal regulators for simplicity—but it must be noted that nearly all the devices on the market produce a large amount of unwanted r.f. noise (another case of semiconductor designers not thinking about the r.f. consequences of their circuits), and so steps are taken to prevent it escaping into the tuner circuit, by using torodial chokes wound on ferrite beads at the output of each regulator. Central earthing of all parts of the p.s.u. is also necessary to avoid annoying hum loops.

Next month, in Part 2, we shall describe the tuner and stereo decoder modules used in the prototype units.

air test

USER REPORTS ON SETS AND SUNDRIES

STANDARD C800 VHF FM Scanner

This is a hand-held, 10-channel, scanning receiver with a difference—it incorporates a single-channel 50mW transmitter! Measuring just 70 × 120 × 37mm excluding projections, and weighing only 290g including NiCad batteries, it fits neatly in the hand, with its positive-action p.t.t. button in exactly the right place for right- or left-handed operation.

The receiver section is a crystal-controlled double superhet (11·7MHz and 455kHz i.f.s) with a quoted sensitivity for 12dB SINAD of −6dB or better, presumably relative to 1µV although the reference is not stated. Audio output is 100mW to an internal 8Ω loudspeaker, with provision for an external earphone. Push-buttons control manual channel-stepping and auto-scanning, and there are thumbwheels for volume/on-off and squelch.

The transmitter, also crystal-controlled, with a maximum deviation of ±5kHz, has a power of 50mW, although it is understood that this can be simply modified for 100mW, with a penalty on battery life. Pressing the p.t.t. also reverts the receiver to channel 1, which carries the corresponding receive frequency. The microphone is inbuilt at the top of the case.

All operating frequencies must lie within a 4MHz span of the range 138–174MHz.

Results

The stated range of the C800 transmitter is "approximately 100m in open field." In our tests, over heathland with undulations not exceeding about two metres in height, maximum range was found to be around four times this figure, with an Icom IC-2E hand-held in a first-floor window overlooking the heath as the other end of the link. I don't believe that the unidentified station in Bournemouth who told me off for conducting tests on the calling channel could really hear me several miles away, though!

This does show up one problem, however, and that is deciding the best channel for the transmitter. As it comes from Lee Electronics, the set is normally fitted with S20 (Tx/Rx), and R1, R2 and R7 (Rx only). Because of its limited transmit range, the C800 is most likely to be used during things like aerial erection and adjustment, or at rallys, exhibitions, etc., for keeping in touch with a base. It might therefore be argued that a little-used simplex working channel would be a better choice.

Transmitted speech quality is superb, as seems to be the norm for Standard sets, if our recent tests on the C7800 70cm rig are anything to go by. One wonders if Standard's connection with the hi-fi firm of Marantz has any bearing on this.

Receiver sensitivity and quality also proved more than adequate in extended listening tests. Channel-in-use is indicated on a row of ten l.e.d.s and scanning takes place at around five channels per second. If left to its own devices, the receiver resumes scanning after an incoming signal ceases. To restart scanning before the signal ceases, you have to press the "Channel" button, then the "Scan" button. If you inadvertently press "Scan" first, the whole thing locks up until you press "Scan" yet again (or the signal ceases). I suppose it's the sort of thing you get used to in time; personally, I was driven to switching the set off in frustration on occasions!

The finish of the C800 is good, both inside and out, and attention has obviously been given to fine points like the p.t.t. (mentioned earlier) and the captive rubber bung which is provided to stop dust falling into the 2·5mm earphone jack when not in use.

The C800 comes fitted with four channels (extra crystals £3.00 each including VAT, trimming required on installation). Also provided is an a.c. mains charger, capable of bringing the batteries up to a fully-charged state in 10–14 hours. Battery life obviously depends on the pattern of use—consumption is quoted as 18mA on stand-by, 50mA on receive or transmit, and recharging after eight hours use (earlier if the battery indicator starts flashing red) is recommended. Both helical ("rubber duck") and wire aerials are included.

The instruction leaflet is brief but

adequate, though no circuit description is included. A separate sheet carries circuit and block diagrams.

The Standard C800, with the listed accessories, costs £80.44 including VAT, and is available from **Lee Electronics Limited, 400 Edgware Road, London W2, telephone 01-723 5521,** to whom we offer our thanks for the loan of the review unit.

KDK FM-2025E 2m Mobile

At a time when the general trend in amateur transceivers seems to be towards the "all bells and whistles" rig, with so many features that you almost need to go on a course to learn how to operate it, it is interesting to find a manufacturer who has taken advantage of experience (and of technological advances) to produce a rig which is more flexible and yet easier to operate.

We reviewed the FM-2016, which was the 2025's predecessor, in our January 1980 issue, and several of its features have been retained in the current model. These include the High/Off/Low Power switch, the Tone/Off/R.F. Att. (attenuator) switch, and the Close/Off/Open Scan switch, which allows the rig to look for a busy or vacant channel at will. The main tuning dial, which uses a photo-interruptor, now operates in 12·5kHz or 25kHz steps (internally selectable) with the option of "instant QSY" at 125kHz per step available at the touch of a button.

The memory has been expanded to ten channels, arranged in two banks of

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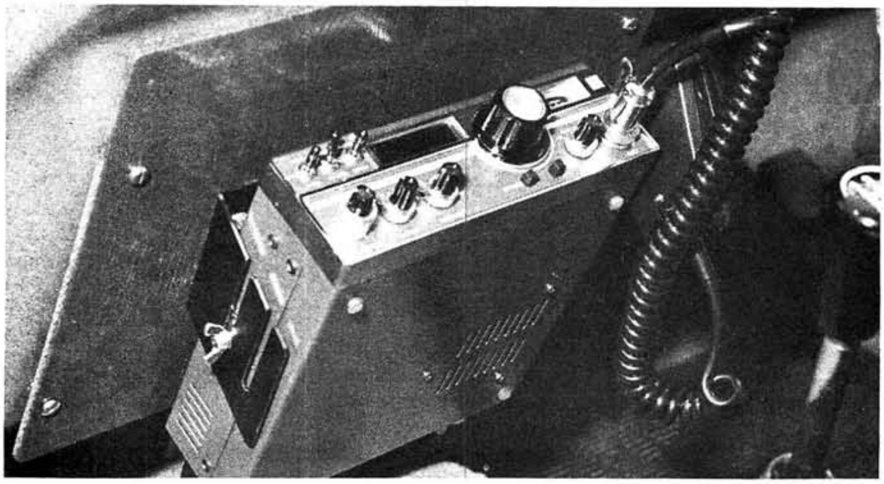


five, so that non-standard frequency offsets can be programmed if required. Two forms of scanning are provided: Memory scanning, in which the contents of either memory bank are scanned, and Band scanning which looks at the spectrum between the frequency programmed into memory channel A5 and that in channel B5.

Pressing the "Write" button takes whatever frequency is indicated on the display and programmes it into the selected memory channel, or, if no particular channel is selected, into channel A1. This "priority" feature is useful for quickly storing, for example, a local "natter" channel when operating mobile in a strange district, but it does mean that you must remember to put your **least** favourite channel in A1, as it is the most likely to be over-written.

An internal NiCad battery provides back-up power for the memory, so that you can shift the rig from home to car, etc., without losing all the programmed channels. The capacity of this battery, which is float-charged as long as a 12V supply is connected, is not stated, but it certainly runs to several weeks.

The FM-2025 has a specified transmitter output of 25W, or 3W in the low power position, while the receiver sensitivity is quoted as 0·3μV for 20dB quieting. Power requirements are given as 0·3A on receiver, rising to 0·6A at full volume, and 6A on full power transmit. The dimensions overall are 65 × 186 × 242mm, and the total weight around 3·2kg.

Results

The rig was first tested as a base station, where it was found to push out around 33 watts in the high power condition. Many contacts were made using a Ringo Ranger at 20ft above ground, and this pattern was repeated during an extensive period of mobile operation, both simplex and via repeaters, with a $\frac{5}{8}\lambda$ gutter-mounted whip. The receiver is very sensitive and is well-matched to the transmitter's power, so that it was always found that "if you can hear them, you can work them." Audio power output was found a little lacking in heavy traffic, though otherwise generally adequate.

The arrangement of controls, plus the facilities of the custom microprocessor used, really go a long way towards making this an "eyes-on-the-road" rig for safe mobile operation. The rig has an air of stylish ruggedness about it, which extends to the mobile mounting bracket. The one exception is the microphone mounting clip, which is very flimsy and bends all too easily.

The heatsink at the rear of the case gets fairly hot quite quickly, but the set's performance did not deteriorate in any way even during a "4-hour" QSO. The famous KDK claim of ability to withstand an infinite v.s.w.r. was well substantiated in a test lasting over an hour.

Brief test runs by five other amateurs ranging from old hands to brand new, brought universal approval, and I thank them for their constructive comments. None of them wanted to give the set back, and all thought it a very professional piece of amateur equipment.

The handbook is quite comprehensive, including a full circuit description, and instructions on basic adjustments, but without component layouts or lists.

The KDK FM-2025E has recently been reduced in price to £225.00 including VAT, and is available from **South Midlands Communications Limited, S. M. House, Osborne Road, Totton, Southampton SO4 4DN, telephone Totton (0703) 867333.** We thank them for their co-operation in the loan of the review unit.

PRODUCTION LINES

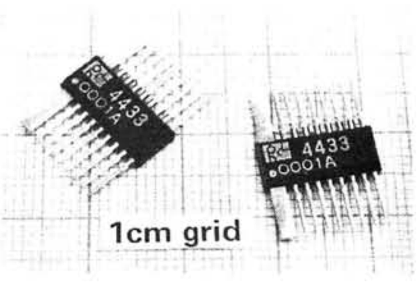
alan martin

Mini Iron

The new Weller WM12D mini iron is designed to meet the needs of the electronics enthusiast or engineer wishing to solder the latest miniature components and i.c.s into tightly packed printed circuit boards.

Rated at 12W 240V, the iron is extremely light and easy to use. The cool handle and stainless steel shaft are designed to the same standards as the industrial Weller irons. A range of slide-in miniature tips is also available.

The new iron costs £4·50 plus VAT and is available from: *Toolrange Ltd., Upton Road, Reading RG3 2JA. Tel: (0734) 29446 or 22245.*



Miniature Radio i.c.s

The continuing trend towards miniaturisation in consumer and communications radio equipment has lead to Toko producing a series of exactly half-size i.c.s for application in f.m. radio i.f. strips with muting (KB4432), complete a.m. radios with r.f. stage, mixer, oscillator, i.f. amplifier (KB4431)—and 140mW audio (KB4433). The a.m. and f.m. systems both incorporate a flashing l.e.d. tuning indicator. Power requirements for this family of devices is 1·8V to 3·5V.

The KB4431 and KB4432 cost £1.95 each and the KB4433 £1.52, there is also a P&P charge of 35p per order.

The devices are available from: *Ambit International, 200 North Service Road, Brentwood, Essex CM14 4SG. Tel: (0277) 230909.*

RECHARGEABLE HANDLAMP

B.V. Cordingley

No doubt you will have noticed how the price of disposable dry batteries has risen over the last few years. Also you may well have been irritated at the way conventional torches seem only to be bright with a new battery and spend much of their life emitting an inefficient, somewhat reddish light. If you use a torch fairly regularly then you may well be impressed by the performance and cost effectiveness of a rechargeable handlamp.

The rechargeable lamp described in this article is based on the conversion of a readily-available dry-battery lantern. A simple circuit, incorporated in the lamp, is used to charge its nickel-cadmium (NiCad) cells. Its cost of construction and its performance compare favourably with commercially available rechargeable torches. The use of NiCad cells ensures a constantly bright light output for virtually the whole of the lamp's discharge period and it should have a trouble-free operating life of many years. The prototype was built some four years ago. It has been used regularly since and still operates to its full specification.

The lamp is based on the Ever Ready Solar 5000 lantern, or equivalent, readily available from most electrical retailers or large department stores. The batteries may be recharged from a mains supply for the cost of a fraction of a penny. Alternatively, it may be charged from a car with a 12V battery—a feature that may well appeal to campers and others without ready access to a mains electricity supply. The lamp can be stored in any state of charge and will not be damaged if accidentally left switched on or left on charge for considerable periods.

Performance

When fitted with a standard 5V, 0·5A torch bulb, the fully-charged handlamp will give a bright light output continuously for over two hours.

When completely discharged the lamp may be fully charged from the mains (200/250V, 50Hz) in a period of 24 hours. Alternatively, it may be charged in a similar period from a 12V car battery.

The mean charging current is 70mA and the mean power consumption when being charged from the mains is less than 2W.

Nickel-Cadmium Cells

Fully-sealed cylindrical NiCad cells are particularly suitable for use in this type of application; they are entirely maintenance free and are electrically and mechanically robust. They may be charged and discharged hundreds of times without deterioration. They are not damaged by overcharging at the rates found in this circuit and their output voltage remains substantially constant throughout the major part of their discharge cycle. In addition NiCad cells may be stored when completely discharged—a considerable advantage if one considers that a torch may be switched on accidentally or neglected for long periods. Other rechargeable cells such as lead-acid accumulators or maintenance-free batteries based on other materials can be permanently damaged if left in a discharged state for any length of time.

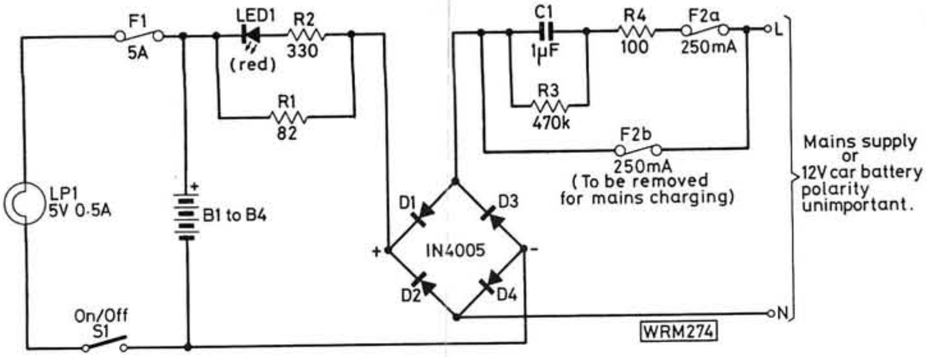


Fig. 1: The circuit diagram of the rechargeable handlamp

NiCad cells are conveniently recharged from a constant-current source, when flat, a total input charge of about 1·4 times their rated amp-hour capacity restores them to the fully-charged state. Excess charging beyond this factor does not add to the electrical energy stored within the cell but causes energy to be dissipated as heat with no permanent loss of electrolyte. The cylindrical NiCad cells can withstand moderate rates of overcharge indefinitely.

Circuit Operation

Fig. 1 shows the complete circuit. The circuit may be considered in three parts; the discharge circuit; the portion of the circuit required for mains charging and that portion of the circuit employed for charging the torch from a car battery.

Discharge Circuit

Four 1·2Ah, 1·25V cylindrical NiCad cells are series-connected to provide a nominal output voltage of 5V. The 5A fuse is used as protection in case of accidental short-circuit of the bulb terminals. Because of the low internal resistance of NiCad cells a substantial current would flow if, say, a ring or watch were accidentally to short-circuit the bulb terminals during a bulb change if the torch were left switched on. This could cause a burn or damage to the jewellery or even the circuit without the protection afforded by the fuse.

The switch and a suitable bulb is supplied with the handlamp. It will be noticed that the standard disposable lantern battery is rated at 6V nominal, but due to the high internal resistance of the dry battery together with polarisation effects, its voltage quickly falls to around 5V in use, which is the nominal working voltage of the NiCad conversion.

The use of a 4·5V bulb will give a very bright and efficient light output but its life will be relatively short. On the other hand a 6V bulb will have an almost indefinite life but will have a relatively poor light output. I have found that a 5V bulb gives the best overall results but the constructor may care to experiment.

The discharge circuit is connected to the torch by soldering wires to the terminals provided for the disposable lantern battery.

Mains Charging

The 250mA fuse should be connected to the line tag on the mains socket obtained. This fuse protects the circuit in case of capacitor failure or accidental use of the car-battery link (when the fuse is in holder 2b) during mains charging. I have found that this value of fuse is capable of protecting the components though it is worth mentioning that it is possible that the l.e.d. charge indicator could be damaged by any fault which is sufficient to cause this 250mA fuse to fail.

Resistor R4 limits the initial mains surge current which flows when the circuit is first connected to the mains (that is when C1 is discharged). C1 controls the charging current and supports the major part of the mains voltage during charging, only a small fraction of the mains voltage being dropped across the cells and resistors. C1 can be considered to act in this respect like a 3kΩ resistor, but unlike a resistor, it dissipates virtually no power. R3 rapidly eliminates any residual charge on the capacitor when the mains is switched off.

C1 is a 1μF capacitor which should be rated for at least 250V a.c. working. A mains interference suppressor capacitor or other capacitor designed to be connected directly across the mains is the type required. A capacitor with a high d.c. working voltage will not necessarily be suitable.

Diodes D1, D2, D3 and D4 form a full-wave bridge. Low-voltage, low-current diodes would suffice here though if the battery were, through any cause, to become open-

★ components

Resistors		
5W wirewound 10%		
82Ω	1	R1
1W 10%		
100Ω	1	R4
330Ω	1	R2
½W 10%		
470kΩ	1	R3
Capacitors		
Polypropylene 250V a.c.		
1μF	1	C1
Semiconductors		
Diodes		
Red l.e.d.	1	LED1
1N4005	4	D1,2,3,4

Miscellaneous
NiCad cells 1·2Ah Berec NCC120HH (4); Fuse holders (3); Handlamp Berec 5000, Chloride HL1505 or similar; 6-way group board; 2BA bolt 63mm long; 2BA spacer 25mm long; 250mA fuse; 5A fuse.

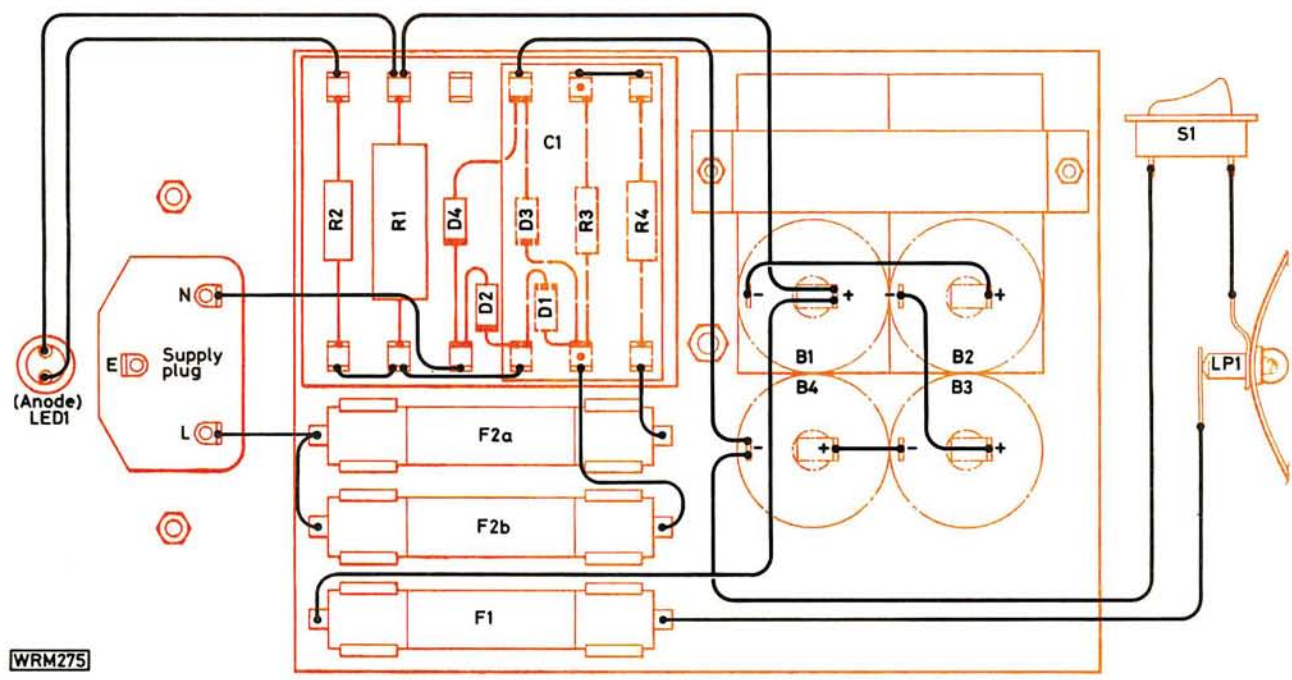


Fig. 2: Constructional details of the charging circuits and NiCad battery positioning together with wiring

circuited the bridge would be required to support the full mains voltage. For this reason it is best to use at least 600V diodes, such as 1N4005, as their extra cost is negligible. The use of high-voltage diodes also ensures that the bridge has an extremely low reverse-leakage current which prevents the NiCad battery being significantly discharged through the diodes over a long period of storage.

Resistors R1 and R2 are arranged to pass a portion of the charging current through the charge indicator l.e.d. to give a visual indication that the batteries are being charged.

Danger

This charging circuit is not isolated from the mains and consequently it should not be used in other applications where any part of the circuit is normally accessible, i.e., it should not be used as a general-purpose charging circuit, or in torches with metal cases, or to convert a torch where exposed metal parts are connected to any part of the circuit.

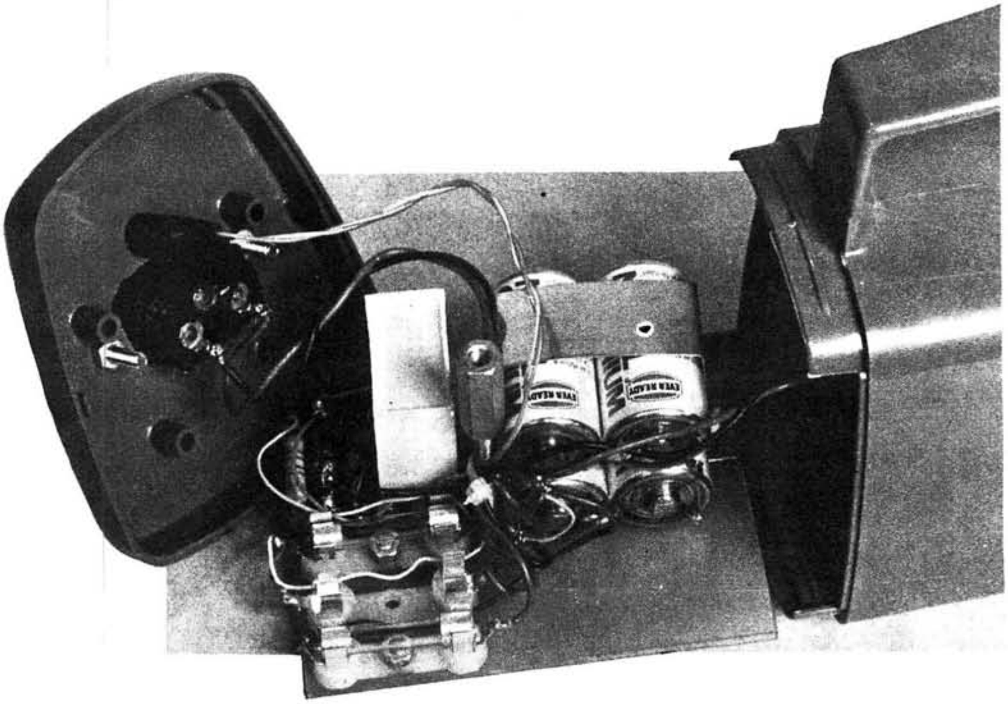
Similarly, bulb replacement should not be attempted while the torch is on charge. When wiring the mains socket ensure that the live (or line) wire from the mains goes to the junction of fuse holders 2a and 2b. This makes certain that the major part of the circuit is at near-earth potential.

Car-battery Charging

With the 250mA fuse placed in fuse holder 2b the lamp may be charged from a car battery. Instead of a mains plug on the end of the charging lead, the lead may be terminated by a pair of crocodile clips or a plug capable of drawing power from a car's cigarette-lighter socket. With the fuse in position 2b, fuse holder 2a, R3, R4 and C1 are effectively short-circuited. D1, D2, D3 and D4 ensure that the charging current flows in the correct direction irrespective of the polarity of the connections to the car battery. The charging current is limited by R1, R2 and LED1 in this case. Remember to remove the fuse from holder 2b and replace it in holder 2a before again charging from the mains.

General

If it is intended to charge from both the mains and from a car battery then the constructor may find it useful to have two leads for charging the lantern; one with a termination suitable for a mains wall socket and the other terminated for the car.



If there is no likelihood of charging from a car battery then fuse holder 2b need not be incorporated and the rating of R1 may be reduced to 1W. Similarly, if a car battery is to be the sole source of charge, fuse holder 2a, R4, C1 and R3 need not be provided.

Construction

The charge indicator and mains socket are contained in the back battery cover of the lamp. The positions and sizes of the drill holes in the cover will be governed by the shape and type of socket and l.e.d. used. However, these components should be placed such that they are not obstructed by the circuit contained in the body of the lamp when the battery cover is in position.

The positions of the other components are not critical. A wire-ended 1μF capacitor was used in the original circuit construction, but if the capacitor obtained has a larger physical size than the one shown, then it may be necessary to clamp it to the circuit board. Some rearrangement of the board layout may be required, but there is plenty of space available in the lamp's battery compartment. A 6-way group board is sufficient to hold the circuit components.

The system was built on a piece of insulating material 68 × 102 × 3mm which neatly fitted into the body of the lamp.

The four NiCad cells are clamped to the board by a piece of aluminium strip 20mm wide. When soldering take care to avoid short-circuiting the NiCad cells, as the cells are likely to contain some residual charge. It is a good idea to leave one of the cell connections until all other work is finished so that the likelihood of accidentally short-circuiting the battery system with the soldering iron is reduced. Label the fuse holders appropriately if it is intended to incorporate both car battery and mains charging facilities.

Wire the circuit to the torch's original battery terminals as shown. Take care not to apply heat for too long to these terminals as there is a danger of melting their plastic supports.

A long 2BA bolt and a spacer are used to hold the circuit board firmly in position in the body of the torch. The positioning of the bolt is not too important but make sure that there is sufficient room between the cells and the spacer to enable the spacer to be lowered far enough for the circuit board to be inserted into the battery compartment.

After testing the circuit place the circuit board into the body of the torch and adjust the spacer so that it presses against the roof of the body. Moderate pressure only is required to hold the board firmly in position—excess pressure may distort the body of the lamp.

The 2BA bolt and its spacer should be chosen together bearing in mind their function. As a guide the prototype employed a length of threaded rod 63mm long and a 25mm long spacer. A piece of thick rubber should be positioned on top of the spacer to prevent it cutting into the roof of the lamp.

Testing

Check that the 250mA fuse is in holder 2a and connect the circuit to the mains. The l.e.d. charge indicator should glow indicating that a charging current is flowing into the NiCad cells. Leave the mains connected for about five minutes and then switch on the lamp. Sufficient charge should have been delivered to cause the bulb to glow brightly for a few seconds. Switch off the bulb and leave the torch on charge for 24 hours. At the end of this period disconnect from the mains and switch on the lamp. It should give a bright light output for over two hours.

To check the lantern's ability to charge from a car battery, the 250mA fuse should be placed in holder 2b and a similar test procedure adopted, using a car battery in place of the mains supply. ●

DIRECT CONVERSION RECEIVER

R.A.PENFOLD

Many direct conversion receiver designs have been published over the past few years, and these have almost invariably been designed for use on the 80 metre amateur band. With the decline of Government surplus receivers and the rather high cost of commercially-produced sets, such a receiver represents an excellent (and just about the only) way for a beginner to commence amateur band reception for a modest outlay.

It is no coincidence that most sets of this type operate on the 80 metre band, and it is the obvious choice for a simple single-band set since it will provide a number of signals at virtually any time of the day. The reason for this is that on the low frequency (l.f.) bands such as 80m, local stations of up to about 200 miles away can be received via the "ground wave", in which case the signal from the transmitter travels more or less straight to the receiver. Reception by this means is still possible after dark, and is then augmented by reception via the "sky wave". This is where the part of the transmitted signal which is radiated upwards at an angle intercepts the ionosphere, and is then reflected back to earth. Communication over great distances is thus possible, as a multi-hop transmission path enables reception from any part of the globe.

HF Receiver

Although DX reception is possible on the l.f. bands, it is rather difficult, particularly if a relatively unsophisticated receiver is being used. The high frequency (h.f.) bands, and in particular the 20m band, offer far better prospects for the DXer.

There are two reasons for this. Firstly, reception via the ground wave does not occur as the h.f. signal is absorbed by the earth and interference from nearby stations is eliminated. Secondly, the sky wave is reflected from a higher layer of the atmosphere than is the case with the l.f. bands, enabling far greater distances to be covered on each "hop". Note, however, that on the h.f. bands, it is mainly during daylight hours and not during darkness that sky wave reception occurs.

The receiver which forms the subject of this article was designed to see if a simple h.f. receiver could pick up stations from any part of the world which, indeed, it seems to do. As a test of the receiver it was decided that an attempt should be made to receive stations in all six continents in the shortest possible time—after being finished at about 7pm the task was finally completed at 9.30 the following morning when ZK1DR was received!

Considering the band used, the prevailing conditions, the aerial employed (a 100ft wire at a height of about 25ft) this is not particularly exceptional—but it is not at all bad for a receiver which utilises just four active devices, and has only two tuned circuits!

There is, of course, a drawback to a set such as this and it is that, due to the absence of ground-wave communication, nothing at all can be received when propagation conditions are indifferent! Conditions of this type occur frequently during the dark winter nights but during the other seasons, despite the band sometimes going "dead" in the middle of the night, there will usually be an abundance of signals.

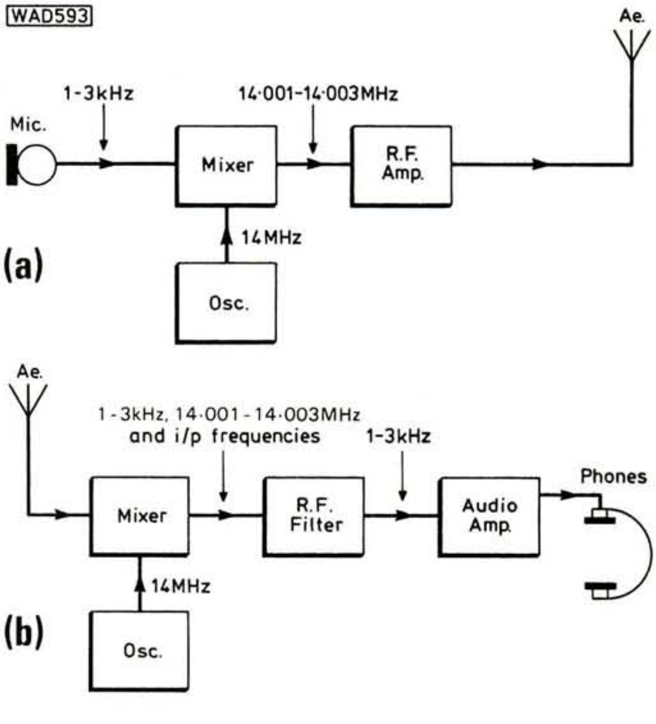


Fig. 1: Block diagrams of a simple u.s.b. transmitter (a) and receiver (b)

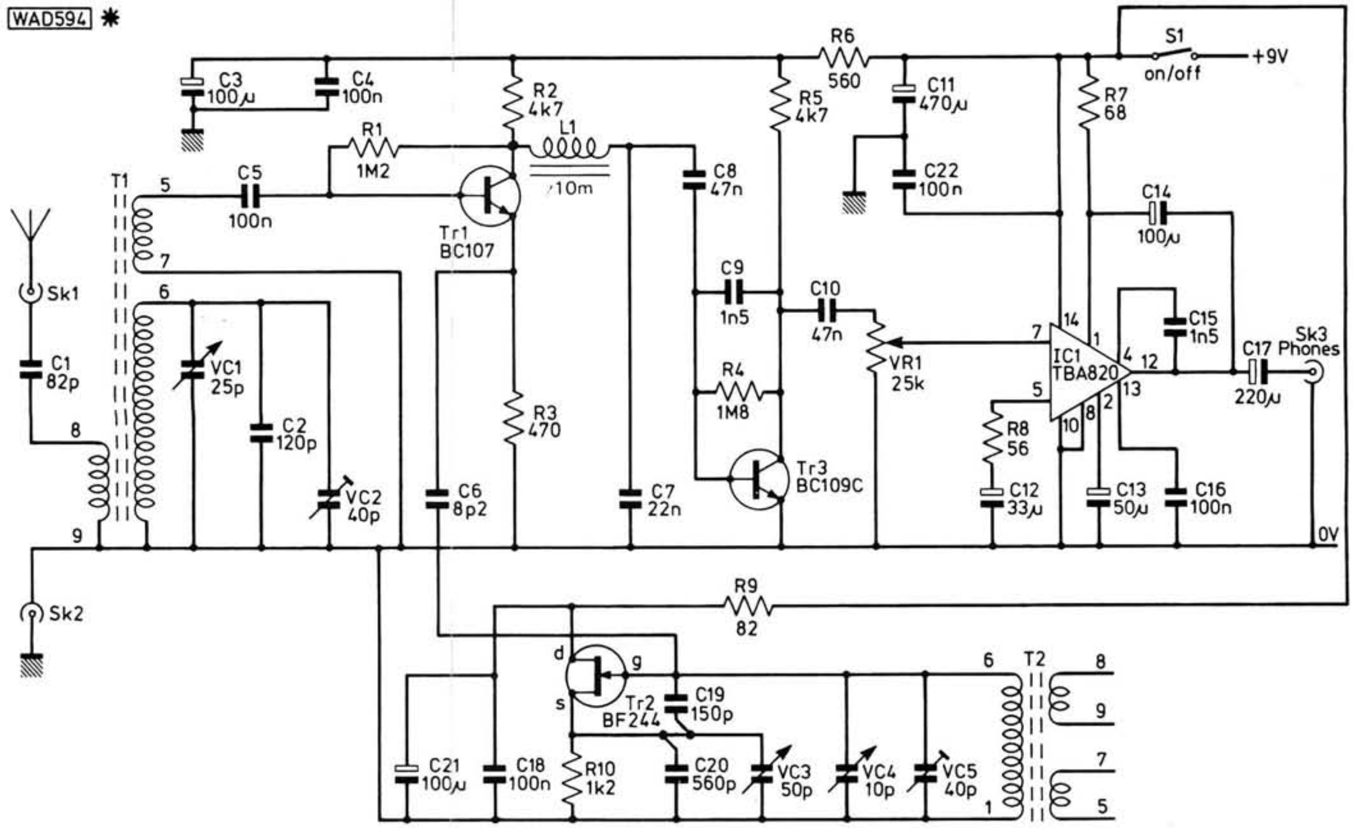


Fig. 2: The circuit diagram of the Direct Conversion Receiver

Single-Sideband

The two transmitting modes which are used most on the s.w. amateur bands are single-sideband (s.s.b.) and continuous wave (c.w.). Single-sideband is used for the transmission of speech and c.w. provides a medium for transmitting the Morse code. While these are both forms of amplitude modulation (a.m.), they are not the usual type of a.m. which is employed by broadcast stations.

The purpose of the radio transmitter is to take the a.f. signals generated by the microphone, and raise them in frequency by some predetermined amount (See Fig. 1(a)). For example, if the transmitter is to operate at a nominal frequency of 14MHz, and there are three audio input frequencies of 1, 2 and 3kHz, then the transmitter will produce output frequencies at 14·001, 14·002, and 14·003MHz. This form of s.s.b. is known as "upper sideband", and is the type which is normally used on the h.f. bands.

"Lower sideband" is much the same, except that the transmitter output frequencies lie *below* the oscillator frequency and thus the l.s.b. equivalent of the u.s.b. example given above would be output frequencies of 13·999, 13·998 and 13·997MHz respectively. This form of s.s.b. is the type which is usually used on the l.f. bands.

At the receiver, the oscillator must be tuned to the same frequency as the oscillator at the transmitter—the difference output from its mixer then provides a reproduction of the original audio signal which was fed to the transmitter. It is this difference signal which provides the audio output whether it is an l.s.b. signal which is being received, or a u.s.b. signal (See Fig. 1 (b)); the u.s.b. signal is demodulated by placing the oscillator *below* the signal whereas the l.s.b. signal is demodulated by placing the oscillator *above* the incoming signal. Placing the oscillator frequency, which must be accurately tuned to the correct nominal frequency, on the wrong side of the signal will produce an audio output, but this will have the high and low frequencies transposed and will therefore be completely unintelligible! Tuning to an s.s.b. signal is far more critical than tuning to an ordinary a.m. transmission!

Circuit

The complete circuit diagram of the Direct Conversion Receiver is shown in Fig. 2. The aerial signal is coupled to the primary winding of the input transformer via C1, which is used to attenuate very strong l.f. radio-signals which would otherwise "breakthrough" to the output. The secondary winding of T1 is tuned over the correct range of frequencies by VC2, C2 and VC1, the latter being the aerial trimmer control. There is a third winding on T1 which is used to couple the aerial signal to the base of Tr1 by way of C5, a d.c. blocking capacitor.

Transistor Tr1 is biased so as to amplify the input signal with good linearity, and the negative feedback which is introduced via R3 helps in this respect. Good linearity is necessary in order to minimise both distortion in the audio output and "breakthrough" from unwanted transmissions.

The local oscillator (l.o.) uses a JUGFET (Tr2) in the grounded-drain Colpitts configuration. Variable capacitor VC4 enables this circuit to be tuned over slightly more than the required frequency range of 14·00 to 14·35MHz; this is the BANDSET control. Variable capacitor VC3 is shunted across C20 rather than across both C19 and C20, and this gives it an effective value of only about 2pF; it

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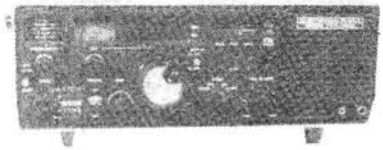

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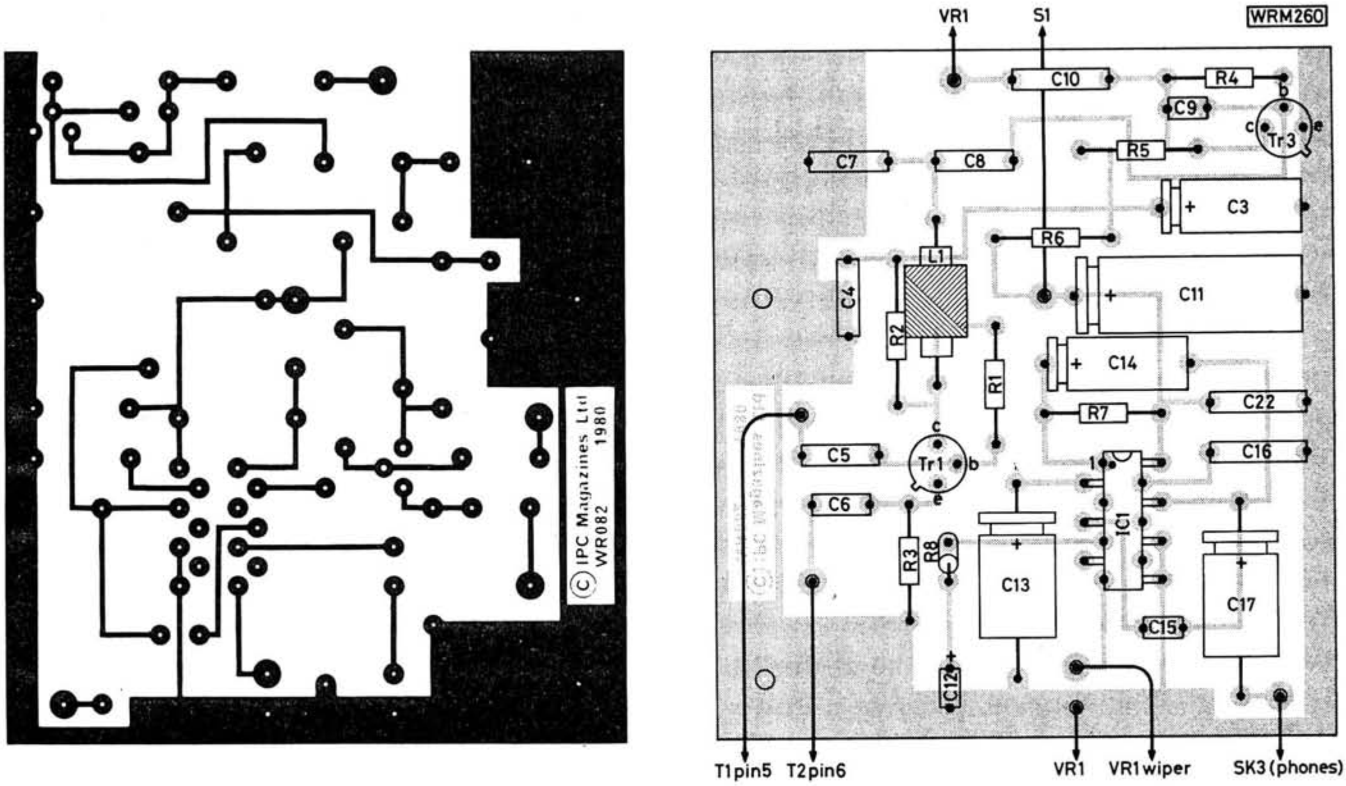


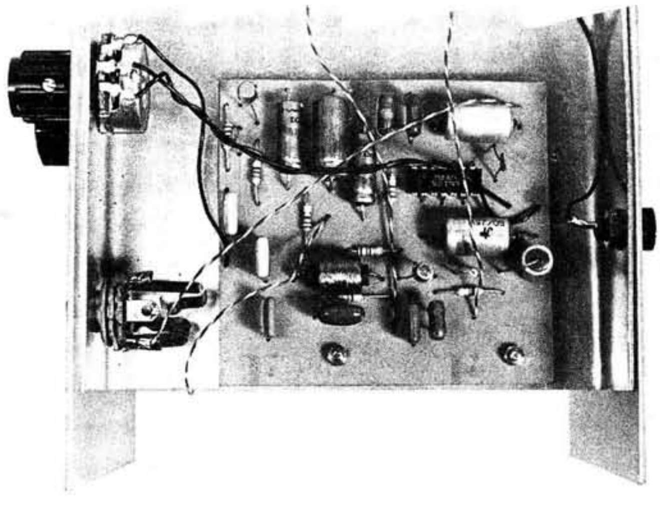
Fig. 3: The foil pattern and component layout (full size)

therefore only provides coverage of part of the band, and acts as the BANDSPREAD control.

The l.o. signal is fed via C6 to the emitter of Tr1 whose operating current varies widely in sympathy with the oscillator signal: this produces variations in the gain of Tr1 and so provides the necessary mixing action. Incidentally, when a mixer of this type is used as an s.s.b. demodulator it is called a "product detector".

The audio output signal appears at the collector of Tr1. Inductor L1 and capacitor C7 filter out the unwanted r.f. signals and the remaining audio signals are fed to a two-stage audio amplifier, which uses a common-emitter amplifier (Tr3) and an i.c. output stage, both of which provide high gain. In order to provide an improved signal-to-noise ratio the high frequencies are "rolled off" by C9 and C15 and the bass frequencies are attenuated by using fairly low value interstage coupling capacitors.

Potentiometer VR1 is an ordinary volume control and S1 is the separate on/off switch.



A view of the p.c.b. mounted on the underside of the chassis

Construction

The prototype is housed in a Verobox to which a home-made chassis has been added. The general layout and arrangement of the unit can be seen from the photographs—if the Verobox is used, the chassis can consist of a 190 × 153mm piece of 18 s.w.g. aluminium with 32mm deep flanges along its shorter sides. Any similar case and chassis should be suitable, of course.

Both r.f. transformers are ready-made components which are mounted on the extreme right-hand side of the chassis in B9A valveholders—these holders each require a 19mm dia. cut-out. The two smaller holes are drilled for 6BA clearance using a No. 31 drill; the valveholders make a handy template for the job! A solder tag is mounted on the underside of each chassis on one of the short 6BA mounting bolts of each holder (See Fig. 4)—T1 is plugged into the front holder and T2 into the rear one.

The components are assembled onto a p.c.b. (the details of which are shown in Fig. 3). When completed, this assembly is wired up to the rest of the unit before it is mounted on the underside of the chassis on the extreme left-hand side. Spacers are used over the 6BA mounting bolts so that the connections to the underside of the board are held clear of the metal chassis. The remaining point-to-point wiring is all shown in Fig. 4; keep it as short and direct as possible.

There is plenty of space for either a PP3 or a PP6 battery to the rear of the on/off switch, and it can be held in place using Blu-tack or, alternatively, a suitable bracket can be constructed. The current consumption of the set is about 8 to 10mA—so if it is to be used extensively a PP6 battery will prove the more economical of the two types.

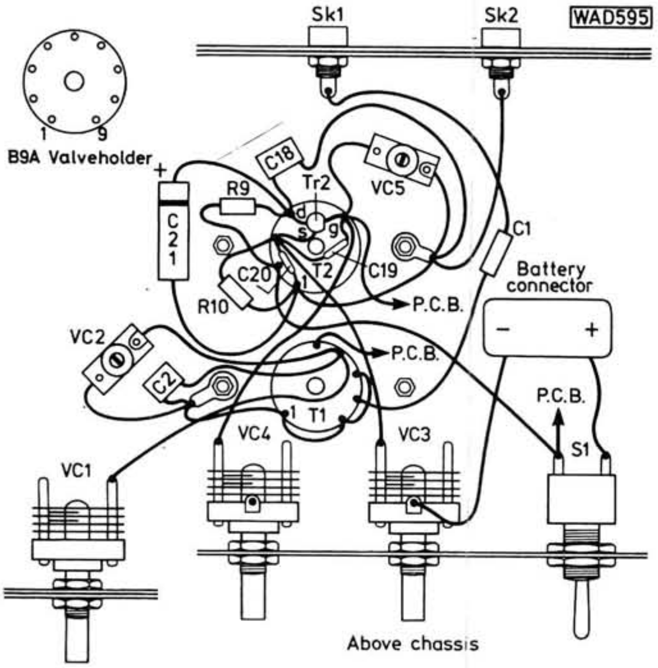


Fig. 4: Chassis wiring diagram. Note that VC1 (ANT. TRIM) and VR1 are both mounted below the chassis. Do not forget to check that the negative battery connection is properly made to both the chassis and the printed circuit board

Adjustment

Assuming that no test gear is available, the setting-up procedure is largely a matter of trial and error. As supplied, the coils have their cores fully screwed in and these should be unscrewed until about 5mm of thread protrudes from the top of each coil. Initially, VC2 and VC3 are adjusted for about half maximum capacitance.

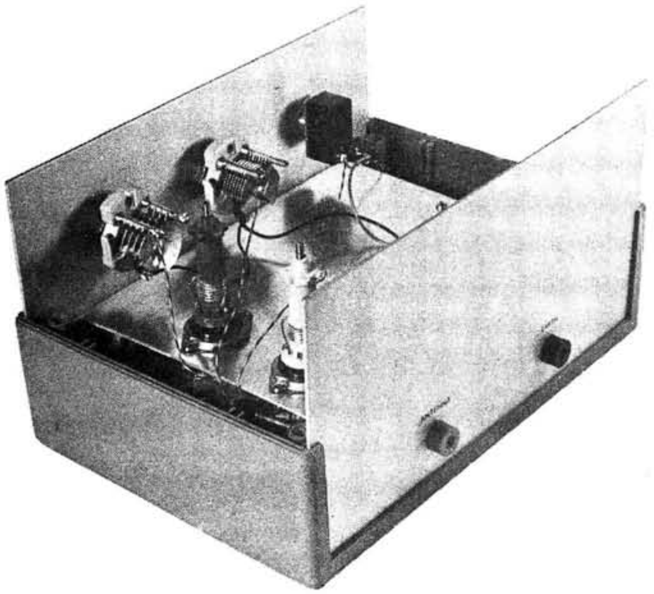
An aerial must obviously be connected to SK1, which is intended to accept an ordinary long wire antenna; this should be as long as possible (20m or more) and located as high as possible above the ground. A short indoor aerial will provide reception of a great many stations, but results using such an aerial will be comparatively poor. If an earth connection is available this is connected to SK2; at the frequencies involved here, however, an earth is likely to be of little benefit!

Probably the best type of phones to use with the unit are inexpensive 8Ω stereo ones, which have been rewired for 16Ω mono operation, but any normal type of headphones can be used if this type is not available. Microphony (vibration of the receiver causing a clanging sound from the phones) tends to be a slight nuisance with sets of this kind, and problems with feedback would almost certainly occur if a loudspeaker is used.

★ components

Resistors		
¼W 5%		
56Ω	1	R8
68Ω	1	R7
82Ω	1	R9
470Ω	1	R3
560Ω	1	R6
1·2kΩ	1	R10
4·7kΩ	2	R2,5
1·2MΩ	1	R1
1·8MΩ	1	R4
Capacitors		
Ceramic		
8·2pF	1	C6
82pF	1	C1
120pF	1	C2
150pF	1	C19
560pF	1	C20
1·5nF	2	C9,15
Polyester (Type C280)		
22nF	1	C7
47nF	2	C8,10
100nF	5	C4,5,16,18,22
Electrolytic		
33μF 10V	1	C12 Tantalum
50μF 50V	1	C13
100μF 10V	3	C3,14,21
220μF 10V	1	C17
470μF 10V	1	C11
Air-spaced (Jackson Type C804 or similar)		
10pF	1	VC4
25pF	1	VC1
50pF	1	VC3
Compression trimmers		
3–40pF	2	VC2,5
Inductors		
Denco (Range 5/T)		
Blue	1	T1
Yellow	1	T2
Ferrite-cored choke		
10mH	1	L1
Semiconductors		
Transistors		
BC107	1	Tr1
BC109C	1	Tr3
BF244	1	Tr2
Integrated circuit		
TBA820	1	IC1

Miscellaneous
Printed circuit board; Verobox 75-1412-K or similar case; 18 s.w.g. aluminium for chassis; miniature toggle switch s.p.d.t. (S1); B9A valveholders (2); knobs; PP3 or PP6 battery; headphones with plug (see text); wander plugs and sockets (2 of each); ¼in jack socket (SK3); equipment wire, fixings, etc.



A view of the receiver with the top of the Verobox removed showing the location of the chassis sub-assembly within the case

With reasonably good propagation conditions, when first turned on, the receiver should receive a few signals of some sort with the volume turned up and VC1 adjusted to peak sensitivity. The setting of VC1 does have some effect on the tuning as no buffer stage is used between the oscillator and mixer stages, but the correct setting of VC1 is usually pretty obvious. If VC1 cannot be used to peak received signals, or this peak coincides with its maximum or minimum setting, then some adjustment of VC2 should improve matters.

Variable capacitor VC5 is then adjusted so that VC4 provides coverage of the entire 20m band. Probably the best time to adjust VC5 is at a weekend during daylight when the band is usually crowded from end-to-end. Morse (c.w.) signals will be found at the l.f. end of the band (VC4 vanes well meshed together), and s.s.b. signals will be located at the h.f. end.

It is not easy to tune an s.s.b. signal properly using VC4 as the tuning is very sharp using this control. The tuning must be carried out very accurately in order to produce an acceptable signal and therefore VC4 is used only to tune to the part of the band which is to be searched; the fine tuning is accomplished using VC3. This only provides coverage of part of the band, and thus the tuning is less sharp using this control. VC3 should be set to its mid-point when coarse tuning with VCA, otherwise you will find that you are limited in fine tuning range with VC3. ●

PW NIMBUS—7 PSU/CHARGER

▶▶▶ *continued from page 32*

When recharging a nickel-cadmium battery pack care should be taken to ensure that it is, in fact, fully discharged before allowing it to charge for a full 20 to 22 hour period. Prolonged periods of charging without periodic discharging should be avoided. The cells will remain in better condition if they are periodically cycled through charge and discharge than if maintained in a fully charged condition. It is also inadvisable to store nickel-cadmium batteries for any length of time in a fully charged condition.

Table 1

Charging current (mA)	R1 (Ω)	Hours to achieve full charge of HP7 equivalent nickel-cadmium battery
8	82	75
15	47	40
40	18	15
90	8·2	7
150(1)	4·7	4(2)

(1) In this case a heatsink of 50°C/W or better MUST be fitted to Tr1.

(2) It is inadvisable to charge HP7 equivalent nickel-cadmium cells at this rate. In an emergency a rapid charge at this rate is permissible.

Table 2

Battery type equivalent	Nominal capacity (Ah)	Charging current for 20 hour rate (mA)
PP3	0·11	8
PP9	1·2	90
HP7 (AA)	0·5	40
HP11 (C)	2·0	150
HP16 (AAA)	0·18	15

If desired, alternative charging currents may be obtained by changing the value of R1 as shown in Table 1. Typical charging currents for various types of nickel-cadmium batteries are shown in Table 2. The table is constructed on the assumption that the total period of charge is to be 20 hours.

Caution

The charging current selected should always be appropriate to the type of cell used. **Under no circumstances should excessive charging currents be used; not only is this potentially dangerous, but it may also result in damage to individual cells and will certainly curtail the overall life of the battery pack.** ●

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

The question of the reporting of amateur signals is constantly being brought up by readers and seems to arise from the idea that a signal strength meter, or "S" meter, is somehow infallible. Someone new to the hobby spends a fair sum on a new receiver, sets up the "S" meter according to the manual and henceforth has complete faith in its readings.

Then a local amateur is heard working a DX station and giving it S9 whereas our newcomer can hardly hear the DX and starts to doubt his "S" meter. Maybe G4XXX is just giving S9 in order to encourage the DX to send a QSL, a practice not entirely unknown, perhaps the "S" meter is wrong or, even worse, is there something wrong with the receiver?

So let us look at all the many links in the chain with the signal arriving at a particular location, coming via a bounce or two from the ionosphere and measuring something of the order of a few millionths of a volt (μV), picked up on an odd length of wire which is probably non-resonant if no aerial tuning unit is being used. But the local amateur has a three-element beam 60ft in the air, resonant, with a considerable gain and properly matched to the receiver. The two receivers may be quite different in gain and signal-to-noise ratio.

The "S" meter frequently operates from one of the i.f. stages controlled by a voltage from the automatic gain control circuit, the voltage being related to the input signal or carrier level, the subsequent detection and audio amplification having no effect on the "S" meter. However, with s.s.b. signals there is no carrier as such, so the a.g.c. voltage is often derived from the audio signal after detection, with a delay introduced to prevent too rapid fluctuations of the a.g.c. voltage.

The main use of an "S" meter is to compare signals or note signal changes, rather than to make absolute measurements of the signal level. Decibels (dB), often used so glibly by amateurs, compare levels whether it be audio, r.f. or sound, and if the reference level of the comparison is not known then using decibels is meaningless. "S9 plus 10dB OM" we hear on the air but what is the S9 level? We don't have the faintest idea!

Look at all the variables in the chain; r.f. gain control, a.t.u. tuning, variations of the set's sensitivity on different bands and even between the ends of bands, different aerials, different i.f. bandwidths affecting signal-to-noise ratio and so on. What about the local noise level that gives a permanent S3 on the meter? Frankly, the best way is to take what **you** would call a "loud" signal and set the "S" meter to read S9, perhaps taking the average of a number of signals over a period of listening. You will often find very weak s.s.b. signals that don't even move the needle but which are perfectly readable, so don't be surprised if you hear a "50" report!

So, don't develop an inferiority complex when you hear that S9 plus 20dB report. What he means is that the signal is loud at that location, at that time, at that frequency, with that aerial and with that receiver, and no more!

I frequently get letters which ask, in effect, tell me all about amateur radio, a tall order, but I do have a standard letter in reply for these occasions. In future I think I'll refer the writers to Fred Judd's (G2BCX) new book *Amateur Radio* in the Questions and Answers series from Newnes Technical Books.

The 120 pages for a mere £1.75 is astounding value for this day and age, apart from being good value for the reader from the technical aspect. It would be hard to frame a question that isn't answered here and it also deals with the new format RAE. I imagine the book is available at or through any large bookshop or see the ads in *PW*! Unfortunately in the table of electrical units on page 37 the prefix kilo ("most commonly used in radio") is shown as "Milo". Sounds like someone getting a quick ad in on the cheap!

So on to our general news which is really a condensation of two months to make up for the missed July issue of *PW*.

Like so many readers, **Arthur White,** of Grantham, Lincs, awaits his result of the May RAE with much impatience, expecting that the computerisation of the exam results would have speeded matters up a little. But by the time this appears I'm sure his waiting will be over, successfully we all hope. Morse practice with neighbour G3ZOA is bearing fruit.

Ray Howes (Weymouth) joins the column for the first time, with a Trio JR599CS plus AR88 and a.t.u. fed from a 132ft wire at 30ft. He has heard plenty of DX but doesn't "bust a gut" trying to get some of the rarer, weak signals. The RAE in December is the present target, but he finds the current controversy over the new format somewhat "off-putting", a sentiment echoed by several readers every month.

D. W. Parsonage of 52 Bramble Lane, Morsfield, Notts, says he is mainly interested in renovating old radios, but does use a Hallicrafters S32 for which a manual would be most useful if any reader can help him. **Raymond Benitez** BRS39613 of Ealing, London, is also a candidate for the next RAE and keen on c.w. operation. Good lad! He is working on a change-over system to use with his anticipated R-1000 receiver.

Also waiting with high hopes for the RAE is **John Dainty** in West Wickham, Kent, who has already got a v.h.f. rig while he gets down to the code, presuming he will not desert the h.f. bands after all this! John, too, has now been able to

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(Netherlands Branch – De Ruyterstraat 3, 3134 XN, Vlaardingen, Holland) get back to the bands for a good listen. Young reader **Noel Cosgrave** in Dublin writes to express his very keen interest in s.w. listening, particularly the amateur bands, but so far can't afford a set of his own, other than an old valved job. If anyone in the area feels able to assist Noel it would be much appreciated all round. Drop me a line in the first instance.

Mike Stollov G4HWB still finds time to drop me a line on his activities which have crystallised around rag-chewing on 80m rather than DXing, but there, everyone to his own taste. That's what amateur radio is all about. His 2m rig looks like it will be sold off with his FT-200 in favour of something more up to date for the h.f. bands. Main problem however is getting a decent skywire up in the restricted space available. Another to sit the May RAE was **Rod Williams** in Talgarth, Brecon, who is passing the time waiting for results by house decorating and like chores. Now BRS43353, Rod reckons he did well enough to pass, but if he didn't he is ready to try again in December.

Near Truro, Cornwall, **Bill Rendell** has been overhauling his newly-acquired HRO and enjoying himself in the process, with the AR3, in temporary retirement.

On to the Bands

First ever report from **Colin Frankland** of Hull who uses a Trio 9R59DS plus PR30 preselector and two indoor dipoles but still managed to log 8P6CS among others on 14MHz, with 3D6BB, 5N0DOG, HM2JN, W1DDV/C6A, VU2USE (US Embassy, New Delhi), TU2HG, JR6RYU on Okinawa, all on favourite band 21MHz. John Dainty, previously mentioned, logged 9T1WA in Zaire for an unusual prefix, CR9MM, HS1ABD, XP9LH in Greenland, YB8HOD and ZE8JD on 15m plus 8Q7AZ for a good one on 20m, making country total of 166 to date.

Good news from long-time correspondent **Philip Charlesworth** of Southport, who has just got his BSc in Electrical and Electronic Engineering, thus giving him some well-earned rest and time to get back to the receiver where he stuck to 80m s.s.b. copying CP5HH, EL2AR, HP9AWW, OR7BW (Belgium), OY6FRA and PY2SOB on his Eagle RX6ON receiver. The Drake R4C of **Bernard Hughes** had been working overtime in Worcester covering 3·5 to 28MHz, finding CE5BYZ and VP9AD on 80m, FM0FJE, TR8CR, VK3VO and XE1DO on 40m, with FO8AK, FW0DD, VK9ZG on Willis Is, VK0DB on McQuarrie Is, VR6TC, 6W8HL and 3B9AE for 20m. The spoils on 15m included KX6PJ, K7SE/PJ5, VS5DD, S79RD and YS1ECA with 10m coming up with FK8DJ, J28CC, VS5MM, VK9XT, VP8SB, 5T5ZR and 8Q7AY, all loggings being on s.s.b.

Mike Howard, also new to our column, is 15 years old and runs a DX-160, a.t.u. and ground plane for 14MHz plus 33ft wire for general use. He listens most between 0400 and 0830GMT, when he finds things like A35RB (Tonga), D4CBC, D68AIA (Comoro Is), FR7ZN, HS5AID, J28AZ (Djibouti), J3NPP, J6LNP, TL8CR and ZM7AA on Tokelau Is, all on 20m. 15m came up with HH2V, HS4MI, HM2ACE and HR1X while on 10m stations logged included ZD7SD, 5H3AA, C5AAS (QSL via G3LQP) and D4CBC.

Bill Rendell, again (near Truro), sends his usual list of goodies like C5ACC (QSL KB4GQ), C31TT (QSL EA2TV), VR6TC (QSL W6HS) or direct to Box 1 (where else!) Pitcairn, South Pacific, all on 20m, plus, on 15m, S79MC (Box 4901, Seychelles, Indian Ocean), TA3DX/1 with cards via W3HNK, VP2MGR (QSL KA5GRU), ZD7HH, ZD8KM (QSL G3IFB), ZF1GC (QSL VE4XN), 5N0DOG (QSL W4FRU) and 6T1YP operated by OH2BH apparently, in the Sudan.

P. G. Hawks of Stourbridge, W. Midlands, is now the proud owner of an AR88 got from a TV service engineer who turned out to be a G8! Dipoles at 20ft are in use to get such items as ZB2FK, ZD8MH (QSL G4DDH, home call), YB0ACL, SU1BA (PO Box 2104 Cairo), 8R1JY on 10m, M1C, H44CF, 9V1UH, C5AAS, VS5DD, C31TI, 5W1BZ (QSL PO Box 109, Apia), and YJ8NPS of PO Box 27, Port Vila in the New Hebrides using only 10W. The 80m band produced CT3AB, C31PA and PY2YFO.

In Crowthorne, Berks, **Allan Stevens** has been improving his 9R59DS with a series-tuned trap in the aerial lead, tuned to the image frequency of the 20m band with surprisingly good results, sorting out HM3UJ and VS5DD on 15m and HZ1TC and ZB2FA on the 20m band. Interesting letter from **F. G. Garraway** of Keynsham, Bristol, who admits to learning c.w. in 1930! He still copies it OK, and why not, on his Eddystone EA12 with a Datong active aerial under the roof, with the following results, all on c.w.; ZL4IE, TF3JO, S7ECD, OR4TA (Belgium, now), all on 14MHz, and HI3PC, 6W8JA, HH2V, SV0AU, FC6ETS, HM1KY, all on 21MHz. Other c.w. logs are always welcome with the low ends of the bands coming up with some real goodies at times.

Also working on c.w., **Paul Barker** G4HPS had time to tell me about VP5JAX, VP8AI, WP2AAP (Virgin Is), 6W8IH and 9J2KL worked from his Sunderland QTH with a TS-180 transceiver and vertical aerial system on 15m. A good one on 20m was 6T1YP, old friend OH2BH again in the Sudan. From Dave Coggins in Knutsford, Cheshire, comes news of another one in the Sudan DF3NZ/ST on 15m s.s.b., plus HS1ABD, TU2DP, FO0RS, HH2W, H44JB, P29JS, YJ8NPS with 10W, 3D2CC, 5W1RP and J27AA in Djibouti, all on 15m with an FRG-7, 66ft inverted-"V" plus a.t.u. and rotary dipole for 10m and 15m.

Another newcomer to this column is **C. Griffiths** of Northam, N. Devon, who employs a CR150 receiver with 40ft wire and PM11 a.t.u. to get such as HS1ABD on 15m and M1C, SJ9WL, OY5J, VP2AZG and JY5RBM on 20m, all s.s.b. **Guy Dean** in Ringwood, Hants, mentions a good source of DX by listening to the Round Table Net on 14 175kHz every evening between about 2030GMT and 2215GMT with control station VP2MH on Montserrat, and alternatives F6EWE, FP8HL and 5T5AY, with as many as 60 DX stations calling in during an evening. **Paul Burgess** BRS42818 from Lowestoft has been busy for the RAE, now taken, with the code exam to follow later in the year. This hasn't stopped him copying KP3KNX (Roncador Cay), 9Y4GLM, EA8XS and OY7Z on 14MHz with HV2VO, EA8RY, PJ2FR and HS1AMT on 21MHz band, all on s.s.b.

Finally a pleasant letter from **C. K. Chan,** Manchester, who is from 9M2-land, at present studying for a degree in engineering. Current receiver is a National Panasonic DR28 with indoor aerial in college. Log looks like HI8RCD, ZP9AH and 4S7DJ on 15m plus HI8RCD, again, on 20m with HK3DD, ZP5CF and 6Y8AK. He expects to go to Darlington in September and to join a club there in due course.

Club Round-up

It is a pity that a lot of information sent in on club events has had to be scrapped because of the IPC pay dispute but nonetheless club secretaries have kindly continued to keep me in the picture, so here goes on future events.

Exeter ARS. After a period in the doldrums the club is now on the up and up with a well-organised programme running into the autumn of 1981! Monthly meetings at the Community Centre, St David's Hill, Exeter at 7pm, next being Sept 8 with the principles of f.m. transmission and reception being expounded by D. Munro G3OFY. RAE classes start on Sept 30, which is also enrolment day, at 3 Palace Gate, South Street, Exeter at 7pm. More news on the club from PRO Geoff Draper BRS44198, 1 Carlyon Close, Heavitree, Exeter EX1 3AZ.

Yeovil ARC. Meets Thursdays 7.30pm at Building 101, Houndstone Camp, Yeovil, with lectures by club members, Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:

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

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

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

Morse and RAE classes, an amateur radio library and a net on 2 and 80m via club station G3CMH. Contact: D. L. McLean G3NOF, 9 Cedar Grove, Yeovil or ring 0935 24956.

Worcester & District ARC. Gathers at the Old Pheasant, New Street, Worcester, first Monday monthly at 8pm, with a warm welcome for visitors and potential members alike, so don't be shy! An interesting newsletter keeps members in touch, with a long list of events to come, like competing in the RSGB HF SSB field day on Sept 6/7 and the 2m portable contest at the same time. Mike Tittensor G4EKG at 16 Durcott Road, Evesham, Worcs will be glad to fill in the details.

Bury RS. RAE classes have been arranged at Bury Tech on Thursday evenings 7 to 9pm beginning first week of Sept. Those wishing to enrol contact the College or Chris Marcroft G4JAG at 24 Lancaster Avenue, Ramsbottom, Bury which is 070682 2168, all designed to pass the May 1981 RAE paper. On Sept 9 G8TMS deals with commercial MPUs and basic programming. Meetings second Tuesday monthly are main ones with others on remaining Tuesdays at the Mosses Youth & Community Centre, Cecil Street, Bury. A steady influx of new young and not-so-young members is reported.

Crawley ARC. Events to come include 21st birthday party on the air on Sept 21 and a junk sale on the 24th but more info from Dot and Vernon Davis, G3MER and G3MSK respectively at 16 Newmarket Road, Crawley, W. Sussex, in the absence of any other contact information in the newsletter.

Barking Radio & Electronics Society. Club reopens beginning of Sept with meetings at Westbury School, Ripple Road Barking, starting around 7.30pm, on Thursdays for main meetings with a talk by the RSGB Contest Committee on Sept 18 at 7.45pm. The club is also open on Tuesdays for code classes and for general work on Mondays, Wednesdays and Fridays. Forthcoming plans include a visit to London Weekend TV and to the ITV transmitter at Crystal Palace, Secretary Alan Sammons G8IZN on 01-594 2471 can give you further information.

Cheshunt & District RC. RAE course at the East Herts College at Turnford with registration on Sept 8 and first class on Sept 22 at 7pm. Fee is £20 for full tuition up to week before the May 1981 exam. More details from Jim Sleight G3OJI, 18 Coltsfoot Road, Ware, Herts or on 0920 4316. The club meets Wednesdays 8pm in the Church Rooms, Church Lane, Wormley not far from the college, with a hearty welcome for one and all. Sept 10 sees Mr Parker of the Herts Fire Service chatting on fire Communications, with Derek Bastin speaking on audio modules on the 24th. In between its natter time and code practice.

West of Scotland RS. Don't forget Scottish AR Convention, Sept 13, in the Palace of Arts, Bellahouston Park, Glasgow from 11am to 5.30pm with RSGB Region 14 ORM in the afternoon, then dinner and dance in the Dean Park Hotel. Bet the bands will be quiet that day around Glasgow! Details, etc., from Ian McGarvie GM4JDU, 3 Kelso Avenue, Paisley.

Edgware & District RS. Seems a mention of the club in *PW* has led to several new recruits and to a visit by WB2BFE while over here! Club meets second and fourth Thursdays at 8pm at the Watling Community Centre, 145 Orange Hill Road, Burnt Oak, Edgware with any visitors more than welcome. To come is Mobile Working by Fred Barnes G3AGP on Sept 11 and a Sunday afternoon DF hunt on the 28th. More on the club from Howard Drury G4HMD, 39 Wemborough Road, Stanmore, Middx or 01-952 6462.

St Neots & District ARS. A newly-formed club for Cambridgeshire deserving of your support. Meetings "alternate Mondays," which doesn't convey much without a datum point, 7.30pm at the Ernulf Community School, Barford Road, Eynesbury, St Neots, Cambs, or contact: Sec Dave Wright G8BKG, 61 Potton Road, Eynesbury, St Neots, Cambs, telephone Huntingdon 73702.

West Kent ARS. Out and about with a visit to beacon site of GB3WHA on Sept 12 for those booking in advance or 2m Fox Hunt for others. Sept 26 is an Open evening especially to interest newcomers to the hobby! Display of equipment, talks, sale of RSGB publications, so anyone in the area get along there! Alternatively try Brian Castle G4DYF for more info at 6 Pinewood Avenue, Sevenoaks, Kent, or 01-432 2256 in the day, or 0732 56708 otherwise. Meetings normally held at Adult Education Centre, Monson Road, Tunbridge Wells.

Wirral & District ARC. Committee Room, Concourse Sports Centre, West Kirby at 8pm. Be there Sept 10 for chat on satellite operation for the beginner by J. Branegan GM4IHJ. Newsletter is newsy and full of useful gen so contact: Hon Sec Ian Brooks G8PMW at 59 Mosslands Drive, Wallasey.

Liverpool & District ARS. Sale of surplus gear on Sept 9 with talk on c.w. operating techniques by G3XSN on the 16th. On the 23rd W1PFA/FP8BH recounts the expedition to FP8-land by means of RSGB tape/slide lecture. All at the Conservative Rooms, Church Road, Wavertree at 8pm, and every Tuesday. NFD this year produced double number of QSOs of 1979 so, as Hon Sec Al Neilson G4CVZ says, "we are beginning to learn from our mistakes". Write to him at 78 Ackers Hall Avenue, Liverpool L14 2EA, or 051-220 5470.

North Bristol ARC. Weekly meetings Fridays at 7.30pm with RAE and Morse code classes at the Self-Help Enterprise, 7 Braemar Crescent, Northville, Bristol 7, but G. Taylor G2HDG at 66 Burley Crest, Downend, Bristol BS16 5PW will tell you more of the club's activities.

Hope we can get back on schedule now so please continue to send in logs and letters and club news to reach me by the 15th of the month, or earlier of course, unless it relates to DX heard, which should be as recent as possible.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

A number of readers have complained about the noise on the medium waves and ask what can be done about it. There are unfortunately a number of sources of noise, so it might help to identify some of them before proposing any remedies.

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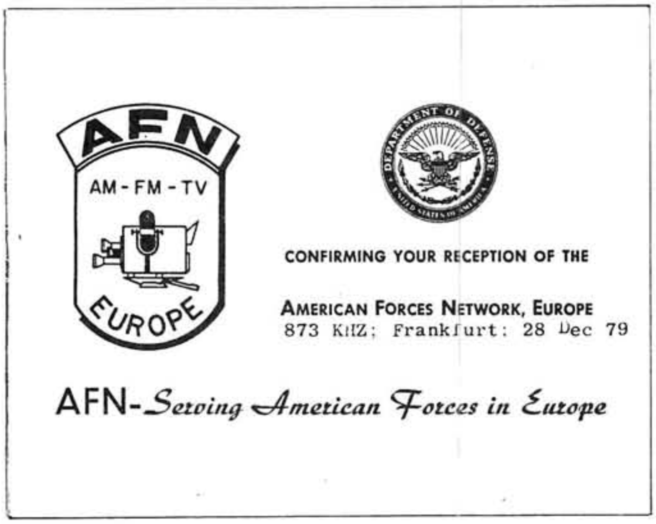


Receiver Noise

As the name suggests, this type of noise is produced inside the receiver and is caused by the passage of electricity along wires and through components. It should not be a problem with commercially-designed receivers, but it can occur with home-brewed equipment. Noise produced in the early stages of a receiver limits the amount of gain that can follow. Once you obtain a noisy background with the aerial disconnected then you have reached this limit. Receiver specifications usually refer to sensitivity as the number of microvolts at the aerial socket to give a signal-to-noise ratio of 10dB, and the noise they are talking about is receiver noise.

Atmospherics (QRN)

Static and atmospherics are the same thing and the cause is distant thunderstorms, where the lightning flashes produce a rustling type of noise when static is slight and frying when strong. Usually it is spread evenly across the spectrum, so that the amount picked up and hence its volume at the loudspeaker is proportional to the receiver bandwidth in use. The wider your window into the spectrum the more noise you will collect, so by increasing selectivity you will improve the signal-to-noise ratio but at the expense of audio quality.

During the summer, thunderstorms in tropical regions are the main cause of atmospherics, and in the UK a loop aerial with its null pointing south can often eliminate them. Very useful if you are DXing stations to the East (Europe) or the West (North America) but not so helpful if you are trying to pick up South America. At other times of the year, static may come from other directions but the loop can usually help unless the storms are local.

Man-made QRN

Man-made electrical interference is produced by both mains- and battery-operated equipment, the chief offender (though not the only one) being the domestic TV set. It generates a buzz at intervals of approximately 15kHz across the spectrum, the strength decreasing with increase in frequency. It is most troublesome on the long waves, less so on the medium waves, and does cause problems on occasion on the short waves as well. It is radiated direct from the TV and often from house wiring. It will, of course, be absent outside normal viewing hours.

To reduce or eliminate this type of noise, use an outdoor aerial, even a whip on the window ledge may help. Position the receiver as far away from the TV and as near the window as possible, and use a screened lead such as coaxial cable from aerial to receiver. Sometimes a loop will eliminate this type of QRN. Outdoor aerials too can pick up QRN from defective street lighting, etc. Try using the TV aerial, when it is not in use of course, the inner of the coaxial lead going to the aerial socket and the outer (screen) going to the earth socket on the receiver. The TV aerial is equivalent to a whip mounted on the roof and should be less prone to outdoor QRN than a long wire.

Noise Limiters

Some receivers have a noise limiter and associated on/off switch, but I have yet to use one that is really effective. They can be useful when dealing with the spikey type of noise that comes from an electric motor, but even then speech is clipped as well and the overall effect may not be all that good.

American Forces Network

The American Forces Network in Germany has a number of outlets on the medium wave which are easily picked up in the UK. **Bradley Wilson** (Bristol) heard AFN on approximately 1150kHz at 0200, which was probably the 10kW outlet at Stuttgart on 1143kHz. **Colin Frankland** (Hull) received a QSL card from AFN Frankfurt 873kHz, much to his surprise after reading my remarks about AFN's QSL policy in the May issue of *PW*. A non-verifier can suddenly start issuing QSLs, perhaps the result of a change in station personnel, to give the enterprising DXer a welcome QSL.

A Tiny Loop

Local Radio DXer **Dilip Kapur** of Newcastle-under-Lyme was dissatisfied with the performance of his Spidola portable on the medium waves. When used with a 120ft long wire and an a.t.u. it brought in nothing but lawn-mowers, fluorescent lights and ignition interference, so he set about making a very small loop which would be inductively coupled to the internal aerial of the portable.

The arrangement is shown in Fig. 1. The single winding, which consists of 23 turns, is wound round an orange crate (no dimensions given, but the winding would probably be about 380 by 130mm), the two ends of the winding being terminated on a 500pF variable capacitor which is the tuning control. The receiver is placed inside the crate so that receiver and crate are rotated simultaneously. "The increase in pickup is, to put it mildly, incredible," writes our enthusiast, who goes on to say that as well as hearing Manx

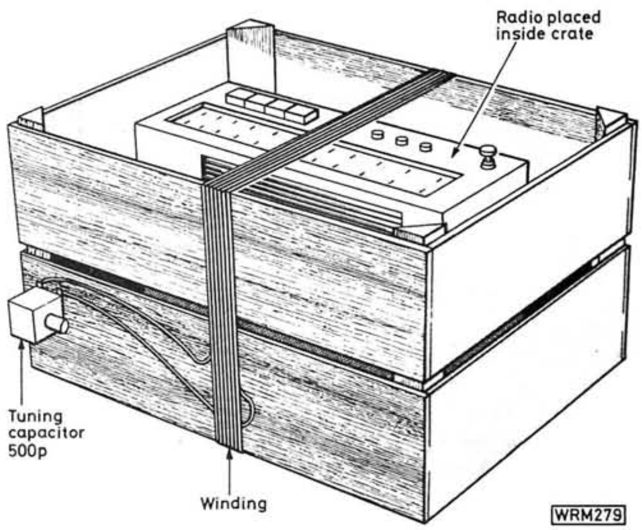


Fig. 1: The Tiny Loop, as designed by Dilip Kapur

Radio on 1368kHz, Radio Forth on 1548kHz, and Redruth and Carlisle on 756, a number of Spanish- and Arabic-speaking stations were picked up as well.

It is important to ensure that the nulls of the loop and the internal ferrite rod aerial belonging to the receiver, coincide, otherwise it will be impossible to null out anything. Tune in a station, peak it up with the loop tuner, rotate the loop for minimum signal and now move the receiver slightly to see if the null can be improved. When correctly adjusted, the loop and receiver are rotated together to null out interference. Signal pickup will be enhanced when a station is not being nulled out, but it would be a shame not to make use of the null as well.

DX Heard

Reader **K. Lewis** of Pensilva in Cornwall picked up an unidentified Portuguese-speaking station on 1300kHz at 0135, using his Realistic DX160 receiver with m.w. converter and m.w. loop aerial. He made a recording of the broadcast which turned out to be from Radio Iracema at Fortaleza in Brazil. "The tape recorder and *World Radio TV Handbook* were indispensable," he writes, and he also recommends this station to anyone who has not yet logged Brazil on the medium waves. Two other broadcasts, both from Venezuela, were heard on 1300 and they turned out to be from Radio Reloj in Maracaibo and Radio Trece at Petare.

Another Venezuelan is reported by **David Hyams** of Finchley, who picked up Radio Margarita on 1020kHz at 0030. This station is probably the most consistent South American on the band and can often be heard before midnight during the winter.

David too, uses a DX160 but he has to use a long wire as it is not feasible to use a medium-wave loop directly with this receiver since it has an internal ferrite rod aerial. In the November 1977 edition of *Practical Wireless* there was a project for building a 10–60 metre converter with an output of 5·5MHz, and David hopes to build one soon and modify it to work on the medium waves. Let's hear if you are successful David!

With this arrangement, the loop aerial will be connected to the modified converter which now tunes over the medium waves. The output of the converter is connected to the aerial and earth sockets of the DX160 which is tuned to 5·5MHz, the whole arrangement forming a double superhet with a first i.f. of 5·5MHz and a second of 455kHz which is the i.f. of the DX160.

Long Waves

Did you notice the temporary move away from 185kHz at the end of May? Europe No. 1 shifted to 185kHz and the Voice of the GDR went to 179kHz, both for a period of three days to enable propagation checks to be made. Anyone listening at the time on 185kHz had a marvellous opportunity to pick up the 1200kW Turkish station at Ankara which is normally the third occupant of the channel.

Sunspots

"What is expected in the future?" asks Bradley Wilson, who is referring to sunspots and their effect on DXing. Solar activity varies in a regular way over a period of some eleven years and the number of sunspots visible is a measure of it. There is a maximum and a minimum during what is known as the sunspot cycle. At the maximum, solar activity will be high and propagation will be good on high frequencies such as the 11m band, and poor on low frequencies such as the medium waves. The reverse occurs at the sunspot minimum.

Last year saw the maximum of the current SS cycle, and as solar activity and radiation diminishes we can look forward to improved DXing on the medium waves. Quite remarkable results are obtained at the time of the minimum, and on the last occasion I logged a number of North Americans on my Vega 204 using its internal ferrite rod aerial.

BROADCAST BANDS

SHORT-WAVE BROADCASTS

by Charles Molloy G8BUS

Broadcasting stations do occasionally pop up at quite unexpected places on the dial, causing surprise and bewilderment among listeners. For example, **Vernon Graham** (Brussels) picked up broadcasts from the 19 metre band (15MHz) while tuning across the 20 metre amateur band (14MHz) which he rightly ascribed to images. **Dr Ian Longshaw** (Libya) is puzzled by the appearance of the BBC World Service on approximately 24·5MHz which is probably an image of their transmission on 25·65MHz. What are these images and how to they occur?

How Good is Your Image

Unlike harmonics, which are real but unwanted signals coming from the transmitter, images are unreal and do not exist! They are simply due to shortcomings within the receiver which sometimes cause a station to appear at two points on the dial.

Modern receivers (superhets) convert the incoming signal to a fixed frequency called the intermediate frequency (i.f.) for ease in providing selectivity and amplification. This is done by generating a frequency in the "local oscillator", which is mixed with the incoming signal from the aerial at the "mixer", which in turn generates the appropriate intermediate frequency. If a receiver with a 465kHz i.f. is tuned to 20MHz (20 000kHz) then the local oscillator will be generating 20 000 + 465 which is 20 465kHz, and the difference frequency of 465kHz will appear at the output of the mixer. It will then be fed to the i.f. stages for processing.

A station transmitting on 20 930kHz will also mix with the local oscillator's 20 465kHz to produce a 465kHz difference signal, and this too will be applied to the i.f. stages. This is the image of the 20 930 station, and it appears when the receiver is tuned to 20 000kHz. The separation between image and true signal is 930kHz which is twice the value of the i.f. Some receivers use 455kHz for the i.f. and the separation in this case would be 910kHz.

It is interesting to note that if the receiver is now re-tuned to 19 070kHz, then the oscillator will be set to 19 535kHz and an image of the station on 20MHz will appear at this point on the scale. In brief, any station may appear at two points on the dial which are separated by twice the value of the i.f.

Image Rejection

It is clearly undesirable that a station should appear at two different points on the tuning scale, so receiver designers attempt to suppress or reduce the strength of the image. This is done by providing selectivity between the aerial socket and the mixer. A simple receiver without an r.f. stage will have a single tuned circuit controlled by the tuning knob, so that it is always tuned to a frequency 465kHz lower than the local oscillator. A receiver with a tuned r.f. stage will have two tuned circuits and greater selectivity. However, it becomes progressively more difficult to suppress images towards the high-frequency end of the spectrum, and 465kHz is really too low a frequency to use as an i.f. in a receiver intended for use much above 10MHz.

What can you do about images? A preselector (which is only a tuned r.f. stage in a separate box), placed between aerial and receiver aerial socket, will bring an improvement and should be of particular value with the simpler type of receiver which is more likely to produce images. There is a paradox here, as it is the simpler receiver which appears more lively than its more complicated big brother, but the reason of course is that signals, including commercial traffic such as Morse, appear twice on the scale.

Multi-conversion

The real solution to the problem is to use a higher value of i.f. on the short waves than on the medium and long waves; 1600kHz was popular at one time. The modern trend is to use double or even triple conversion, where the first i.f. is very high to give good image rejection, while the second or final i.f. is a low frequency making it easier to obtain good adjacent-channel selectivity.

Don Hastings, one of HCJB's engineers in Ecuador and a model of the steerable antenna

Grønlands Radio

"Greenland broadcasts on 3999, 5980 and 9575kHz. They sign on at 1015, but the best time to listen for them here in NW Europe is after 2300," writes **Brian O'Flynn** who uses a Pye domestic receiver and 90ft long wire. He goes on to say that the address for reports is PO Box 607, DK3900, Godthab, via Denmark. Brian would like to get in touch with other DXers in his area, his address is 7 Woodlands Grange, Douglas, Cork, Eire.

Has anyone had a QSL from Greenland? It is part of the North American continent and counts as a NA country. Incidentally, place names have changed recently as a result of semi-independence from Denmark. Greenland is now called Kalatdlitnunat (the land of the people) and the capital Godthab is known as Nuk.

Harmonics

"Could you possibly explain Harmonics in non-technical language?" asks fourteen-year-old **Alistair Dupres.**

Any radio transmitter, if it is allowed to do so, will not only transmit on its assigned frequency but also on multiples of it as well. A transmission on 6010kHz (the fundamental) will also have a small output on twice that frequency, which is 12 020kHz and is called the second harmonic; on three times the fundamental which is 18 030, the third harmonic and so on. There is no first harmonic!

Transmitting engineers are usually very successful in suppressing harmonics, but if you consider a transmitter of 500kW feeding a directional aerial array, then the effective power radiated towards the target area will be several megawatts and it is hardly surprising if a few watts of harmonics are radiated as well. Normally this does not matter, since broadcasters choose operating frequencies near to the critical (penetration) frequency of the ionosphere for maximum efficiency, and harmonics simply pass off into space.

At the moment, a time of high solar activity, the critical frequency is much higher than usual and consequently many harmonics are to be heard from 22MHz to well beyond 30MHz. Look for the BBC (Cyprus) on 23 520kHz (twice 11 760), or Cairo on 28 860 (3 × 9620), and there are many others. If you can measure the frequency of a suspected harmonic then try dividing it by any whole number between two and five and see if the answer corresponds with a known fundamental. You may not be able to hear the fundamental as propagation may be quite different on each of the two frequencies, but frequently both fundamental and harmonic are audible.

Listening beyond 22MHz is quite interesting these days, what with broadcasting on the 11m band (25 600kHz to 26 100kHz), some out-of-band transmissions, harmonics, plus of course, any images of these produced by the receiver.

A pennant, now being issued by Radio Canada International

Voices

At the time of writing the first issue of *Voices* is to hand. It is a glossy magazine, in colour, which calls itself *The Guide to International Radio.* There is a section covering the pick of s.w. programming for each day of the month, and another with countries listed in alphabetical order giving times and frequencies of broadcasts in English to four separate parts of the world including Western Europe. There are also several articles of general interest to the SWL. I liked the humorous "Incomplete guide to regional news bulletins" which rather unkindly referred to one station's output as a triumph of boredom over brevity. It isn't the one you would think of either! Further information about this new publication, which is in English, can be obtained from Voices, PL 226, SF-00171, Helsinki 17, Finland.

European DX Council

The EDXC now has its own programme, presented by Jonathan Marks as part of Radio Nederland's *DX Juke Box* on a Thursday. It can be heard on 11 September, 30 October and 13 November 1980. A competition, with records and tee-shirts as prizes, is being run during September. The address of the EDXC is PO Box 4, St Ives, Huntingdon, England PE17 4FE, and do not forget to enclose an s.a.e. (or an IRC if writing from abroad). Better still, listen to *DX Juke Box* on Thursdays. Their address, for an up-to-date schedule, is Postbus 222 Hilversum, Holland.

The Voice of the Andes

As a contrast to the August issue when I included a photograph of HCJB's 100 watt, 11 metre-band transmitter, here is one of a model of their new steerable aerial which is intended for use with their 500kW transmitter. It will focus the output into a narrow beam which can be aimed at Europe, Africa, North America as well as to other parts of the World.

VHF Bands

by Ron Ham BRS15744

Although in this issue we are making up for lost time by covering a double period, from May 17 to July 20, it has enabled me to emphasise, by illustration (Fig. 2), the value of your consistent reports, both to posterity and the better understanding of v.h.f. propagation.

Solar

During the 63-day period from May 20 to July 20, radio waves from the active sun, at 136, 143 and 151MHz, were received by **Cmdr Henry Hatfield** (Sevenoaks), **Reg Taylor** (Shillington, Herts) and me on 32 days, and although on most of them there were individual bursts of varying intensities (Fig. 1), noise storms did occur from May 24–30 and July 17–20. Despite the bad weather, which hampered visual observations, **Ted Waring** (Bristol) counted between 95 and 112 sunspots during the May solar storm, and numbers ranging between 16 and 80 from 14 days interrupted observation between June 1 and July 11.

Aurora

In view of the solar storm, I was not a bit surprised when **John Branegan** GM4IHJ (Saline, Fife), told me that on May 27 he had seen auroral TV signals from Poland and Sweden in Band I at 1405, and between 1405 and 1530 he heard tone "A" signals from the 2m beacons in Northern Ireland GB3GI, Germany DL0PR, plus stations in EI, GM, LA, OZ, PA and SM.

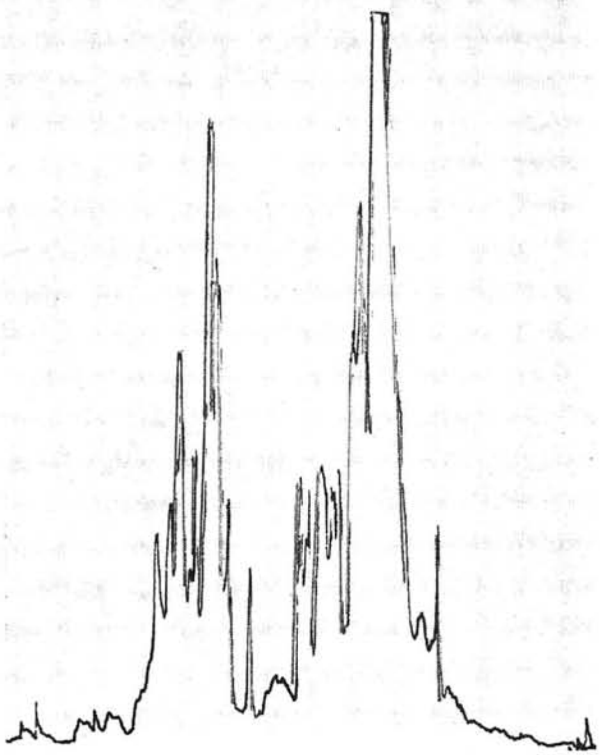


Fig. 1: A 4-minute solar burst, recorded by the author at 136MHz around midday on July 20

The 10m Band

Without the solar activity which can often upset 10m, the band has been generally quiet throughout the period, but this did not deter my readers from listening around. **P. C. Hawkes** (Stourbridge), using an AR88D and a 10m dipole at 20ft, frequently listens for the International Beacon Project stations, and so far has heard signals from the beacons in Cyprus 5B4CY, Germany DK0TE and DL0IGI, and South Africa ZS6DN. Between May 16 and July 14, Ted Waring heard DL0IGI on 44 of the 60 days, DK0TE on 24 days, 5B4CY on 27 days, and ZS6PW on 21 days. My own obser-

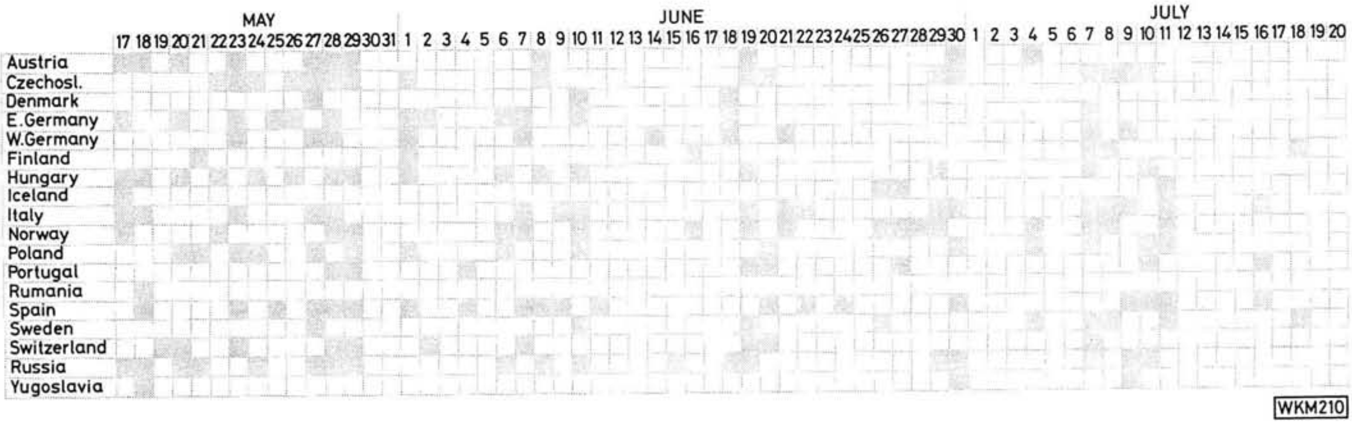


Fig. 2: Days when TV pictures were positively identified, by test card or caption, in Band I by my readers

vations of these beacons are similar to Ted's, and like me, Ted occasionally hears the beacons in Norway LA5TEN and Mauritius 3B8MS. I hope that **Arthur White** (Grantham), who is building a 10/15m beam to feed his AR88, will find these beacon signals a good propagation indicator for his future amateur radio activity.

I did hear good signals from VK during the early mornings of June 16 and July 6, 15 and 18, and noticed on several days that although 10m was dead, DL0IGI and LA5TEN were pounding in due to sporadic-E disturbance. The band was completely dead on several occasions during the May solar storm and **Ken Smith** BRS20001, phoned me early on July 19 (solar storm again) to say that both 10m and 15m were completely dead.

Sporadic-E

It is now well-known that during the larger sporadic-E events, up to about fifty east-European f.m. broadcast stations can be heard in the UK, at amazing strength, between 65MHz and 73MHz. During the SpE season I pay particular attention to the numbers of these, carefully tuning through the range with my R216 fed by a dipole, because this gives an idea of the extent of each event. My individual counts are indicated in Fig. 3 which has been backed up by John Branegan, **Harold Brodribb** (St Leonards-on-Sea, Sussex), **Guy Stanbury** (Chelmsford) and **Barry Ainsworth** G4GPW (Lancing). John, Guy, **Mark Lynn** (Hinckley, Leics), and I also heard Italian and Spanish signals in Band II, and Mark, using a Sony CF560s with its own rod aerial, sometimes heard these in stereo. A good observation Mark, keep listening.

Between 1900 and 2100 on July 12, **John Cooper** (Cowfold, Sussex) heard four EAs and 9C1JX/EA5, and around 1730 on the 13th he heard four Italian stations and worked I2KSX/A, on 2m s.s.b. John also heard Italian and Spanish broadcast stations in Band II. **Harold Goble** G4FDQ, and his son **David** G8HDF (Lancing), using a Liner 2, giving 10W to a 4-element loft beam, had strong two-way contacts with IT9TDN and an Italian station on 2m s.s.b. on the 13th. **Neil Clarke** (Knottingley), said that sporadic-E was affecting Band II on July 7, 9, 11 and 13, and on 13th he also heard an IT9 and an Italian station on 2m. On July 12, **John Cleaton** G4GHA (Wareham), heard a local G8IKP work 9H1BT, and on the 13th John worked I0CMD and heard IT9 and IC8.

Tropospheric

At 2106 on May 19, **Arthur Tait** GM8TLO (Lerwick), accessed the German repeater near Cuxhaven, DB0XA, R0 and worked 10 stations spread across DF, DL, PE and OZ. Later he worked a further 21 German stations on 2m s.s.b., getting as far as DJ3JP near Hanover, about 1159km from Shetland. One of the German stations, DK3UZ, later told Arthur: "Your signal was the only one on 2m from all over Great Britain this particular night." DK3UZ is keen to get Arthur's QSL card which will confirm his first QSO with Shetland and his 47th, WAE (Worked all Europe) country.

On May 18 and 20, **George Grzebieniak** RS41733 (London), heard PE0 and ON stations on 2m, and on the 19th he heard GW and OR on 70cm. **Dennis Sheppard** (Sheerness), using a Microwave Modules converter into a Lafayette HA350 receiver, fed by a home-brew 14-element Yagi for 70cm, heard stations in DL and LA on May 17, two SMs and three OZs on the 18th and four OZs and six German stations on the 19th.

"On May 10, a large anti-cyclone covered eastern Britain and far into the continent," writes **Michael Thomson** GM4JGJ (Dundee). At 2130 he received a 589 signal from the German beacon DL0PR, 144·910MHz, and during the day local u.h.f. TV channels were disturbed and he

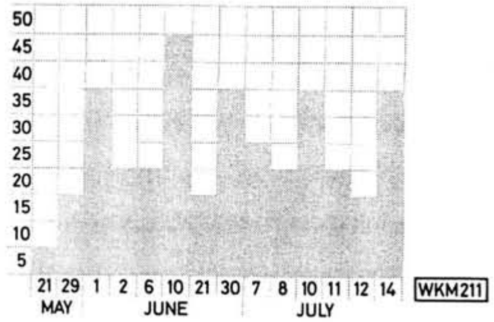


Fig. 3: Rounded numbers of East European broadcast stations heard during a SpE event between 65–73MHz

worked seven very strong German stations. Around 2330 he worked three OZs and at 2100 on the 21st he made a c.w. contact with PA0NIE/A. Michael hopes to be working through OSCAR 7 in due course. Around 1230 on May 11, **Terry Thring** (Chippenham, Wilts), using an 8-element rotatable Yagi feeding a KT1000A tuner, was listening to BRMB, Birmingham on Band II, with his aerial pointing north. This station began to fade and while trying to retune he heard and tape recorded:

> "Hey you guys, you're listening to Don Hurst on Radio W1DN 94·5 f.m. in Rome, so don't touch that dial, OK?"

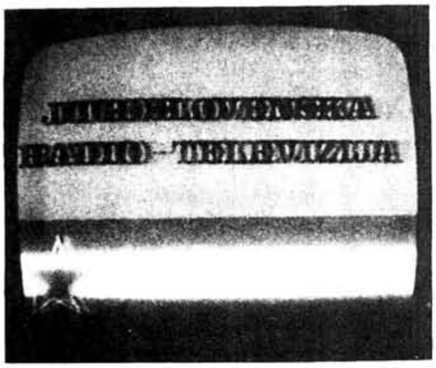
Terry would like to know more about this station, which is not listed in the *WRTVH*, so, if anyone can help, please let me know.

The atmospheric pressure had been below 30·0in (1015mb) for about six days when suddenly it rose sharply from 29·7in (1005mb) at midday on May 31 to 30·3in (1026mb) at midday on June 2. During the evening of the 3rd, it began to fall and continued this way until midnight on the 5th. True to form, a tropospheric opening occurred and during the peak, on the 3rd, signals from the Brighton 2m repeater GB3SR were heard by **Dermot Cronin** EI9DC, in Dublin.

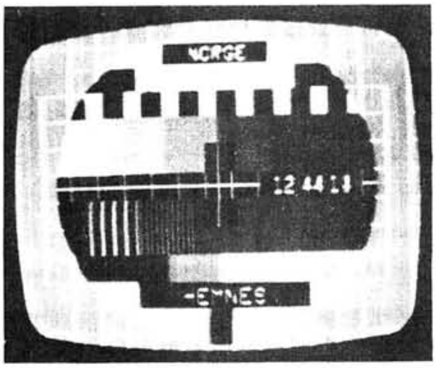
At 2230 on June 3, George Grzebieniak heard seven stations in Bristol, a GW and two ONs, all on 70cm. Also on the 3rd, John Cleaton, using his TS700s to a 6-element 2m quad, worked OR6CP direct, and then two stations via the Brighton repeater, R3. John also worked five French stations on the 7th and four ONs and a PA on the 8th. At midday on the 3rd, I heard GW mobiles working through the Bristol Channel repeater GB3BC, R6, and during the evening I received strong pictures from Lichfield on Channel 8, 189MHz, heard GU and GW stations working through the Hampshire repeater GB3SN, R5, and signals through the Birmingham GB3BM, R5 and Kent GB3KR, R4, repeaters. Conditions were so good I heard G3NRC/M (Crawley, Sussex), and G4IWB, who was using 1 watt in Southampton, in QSO via GB3BC. Around 2220 there was some co-channel interference on u.h.f. TV and I received a 559 signal, on a dipole, from the Sutton Coldfield beacon GB3SU, on 70cm.

Between 0015 and 0045 on the 4th, I watched the end of *Take the Mick* followed by weather, clock and close-down from HTV Cymru/Wales on Ch. 41, again with a dipole. Looking the other way, at 2130 on June 4, **Sam Faulkner** (Burton-on-Trent), watched, with "armchair copy", BBC South on Ch. 39 and Southern ITV on Ch. 42.

"Conditions were very good on 23cm for VHF NFD, July 5/6," writes **John Tye** G3BYV, from Dereham, who worked 17 stations from DK2UO and DK3ZU in the east to GW3BRT/P in the west. John also worked PE0MAR/P on 70, 23 and 13cm. Incidentally, John notched up his best, 869km, on 13cm by working SM6ESG on May 18. Another u.h.f. enthusiast, George Grzebieniak, along with RS42236,



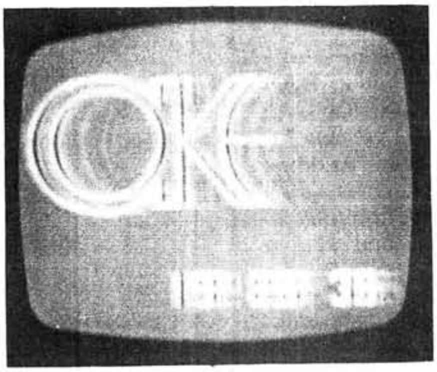
1. Jugoslavia, 0930GMT, 10 May 1980 on Ch. E4



2. Norway, test card, 1030GMT, 10 May 1980 on Ch. E3

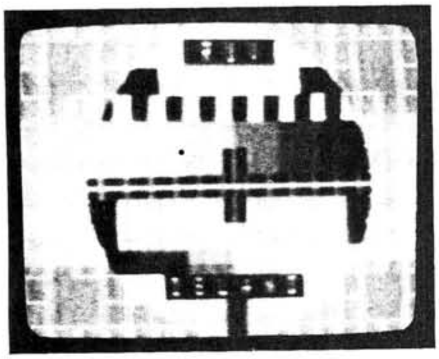
3. RAI Italy, 1020GMT, 18 May 1980 on Ch. 1A

4. ORF Austria, news, 1700GMT, 30 June 1980, on Ch. E2

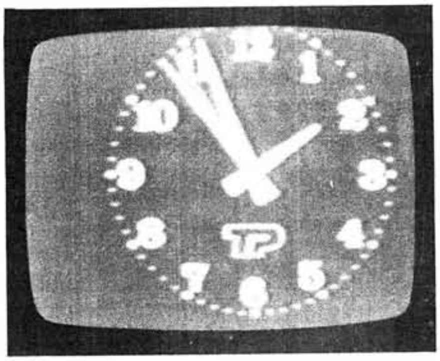


5. DDR1 East Germany, news caption, 1730GMT, 7 July 1980, on Ch. E4

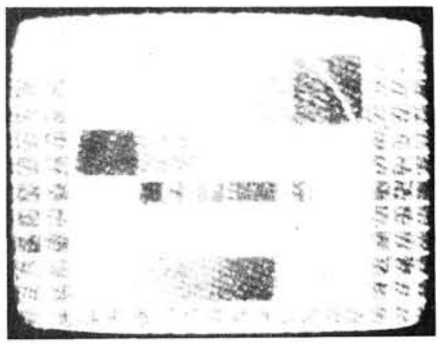
6. ARD West Germany, news, 1800GMT, 7 July 1980, on Ch. E2



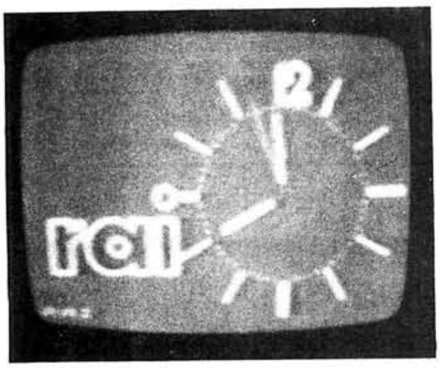
7. Iceland, test card, 1839GMT, 11 July 1980



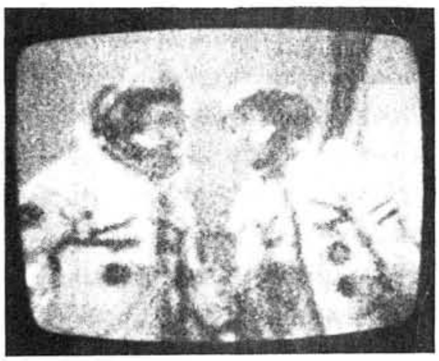
8. Poland, clock card



9. Czechoslovakia, 0640GMT, 19 June 1980, on Ch. R1



10. RAI Italy, clock card, 1800GMT, 23 May 1980, on Ch. E4 via SpE



11. MTV1 Russia, astronauts, 2023GMT, 27 May 1980, on Ch. R1 via SpE

Fig. 4: Examples of TV pictures received in Band I during May–July 1980 by my readers:

1–6: Mike Hahn
7: The author
8: Sam Faulkner
9: David Appleyard
10–11: John Branegan

took his gear portable on July 6 and heard the Sutton Coldfield beacon GB3SU on 70cm and the Dunstable Downs beacon GB3DUN on 23cm, as well as signals on 23cm from Kent G3TOG, London G3JXN, Hampshire G8HHI and Wiltshire G3SOU/P. From home on July 5, George heard three PEs and a GD on 2m. **Alan Baker** G4GNX (Newhaven), told me that the Brighton and District Radio Society's NFD station worked 699km to F6BYJ on 70cm and 874km to F1DSQ/P on 2m. There was a brief lift on July 11 when at 1340, **Adrian Boyd** G8NNY (Horsham), worked F1ELT/M via the French repeater FZ2THF. During NFD John Cleaton made contacts in EI, F, GI, GJ, GU, GW, ON and PA0.

DXTV

While the sporadic-E season was well under way, my readers really enjoyed themselves sorting out the many different stations which appeared on their screens in Band I, some of their handiwork makes the composite picture Fig. 4. Throughout this period I had the usual lucid reports from **Nicholas Brown** (Rugby), John Branegan, Adrian Boyd using a JVC 3040 and its own rod aerial, Sam Faulkner, **Michael Hahn** G4JRB (Rainham), using a Kennex RP 2063X receiver which he purchased in Sweden, **Andrew Rogers** (Bristol), **Steve Scott** G4CKR (Stockport), using a converted Murphy V1913 receiver and rooftop dipole, **David Appleyard** from Uppsala, Sweden, and Harold Brodribb from the south coast.

From their letters and from my own observations, some familiar programmes came from foreign parts, sometimes in English with sub-titles. These included *The Muppets,* Trevor Howard in *Mutiny on the Bounty,* cartoons, *The Crazy World of Sport,* News-Novosti-HOBOCTN, *Lassie, Popeye,* Russian war film, commercials, European Cup-Final (Nottingham v Hamburg SV), musical film *Oliver,* oriental dancing, the start of the Monaco Grand Prix, Country Music, an unidentified English language programme on Ch. E3 about Bristol, Tony Benn and the Labour Party, High Mass followed by an interview with the priest, tennis at Wimbledon, YL announcers, quiz programmes and a variety of test cards spread across the stations indicated in Fig. 2.

Amateur TV

Between May 14 and June 11, Sam Faulkner received good video on 70cm from G4DYP/T Cannock, G5KS/T Birmingham, G8BWC/T Nottingham, G8DIR/T Shrewsbury, G8GUN/T Birmingham and G8VBC/T Shrewsbury.

News Items

Congratulations to Neil Clarke (Knottingley) on passing the RAE. With his new callsign, G8VFV, he has been on 2m with a Trio 2300 feeding a Slim Jim aerial on the roof, and has recently installed a 12-element ZL Special for s.s.b. and a 6-element vertical beam for f.m.

George Grzebieniak has added a Microwave Modules 4m converter and a dipole to his already extensive listening station, and like many others is hoping for a revival of activity on 4m.

Over 3000 visitors attended the Sussex Mobile Rally in Brighton on June 1, and the talk-in station, GB2SMR, worked so many people, that extra QSL cards have been ordered. The first prize in the lucky ticket draw, an FT202, was won by G4HVY from London.

The Horsham, Sussex, 70cm repeater, GB3HO, RB14 is working well from its new site and has two separate colinear arrays. The 2m repeater, GB3BP, R6 with an omnidirectional aerial and a beam pointing west, is now operational. In both cases, reports will be welcomed by Mick Senior G4EFO, QTHR.

INTRODUCING RTTY—Part 2

▶▶▶ *continued from page 40*

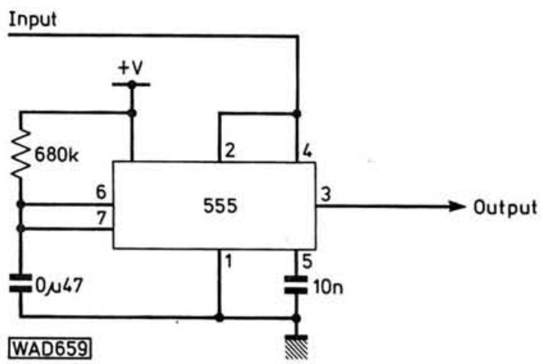


Fig. 19: An "anti-space" circuit

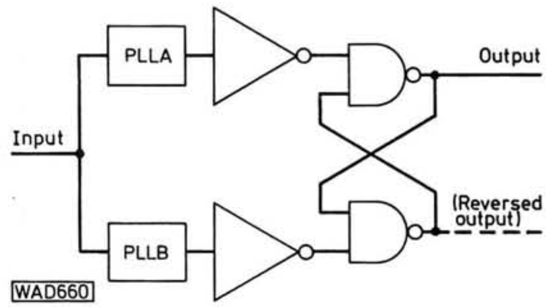


Fig. 20: A twin p.l.l. demodulator

sistor of Fig. 18. Such a circuit, based on a 555 timer, is shown in Fig. 19. This circuit (first suggested by VE4CM) passes normal RTTY signals, but if a space longer than about 300ms appears at the input the output will switch to mark and prevent further "clattering".

The second solution is the provision of a second p.l.l. decoder tuned to the space frequency. The output of the decoders is used to set and reset a flip-flop (Fig. 20). After a mark condition is encountered the unit will only revert to space if the second p.l.l. (identical with Fig. 17 but tuned to 1275Hz) detects a tone within its passband.

Using the circuits described above, the reader can put together a useful terminal unit. It is quite a good idea to develop the unit in stages; starting with the p.l.l. demodulator and progressing to the input filter and then the anti-space features.

The author's terminal unit is built using plug-in boards to a multi-way bus so that new ideas, for say a filter, can be breadboarded and tested within the total system without building a complete unit.

NEXT MONTH

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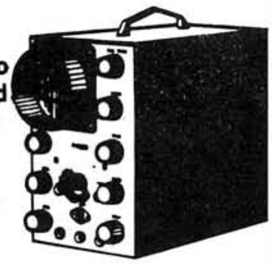
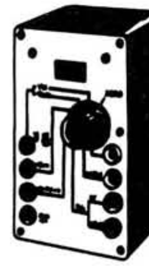


Solid state circuitry; D.C. coupled; 7 cm. dia. tube; Y input 0.3 v/cm.to 50 v/cm.; X input 1 volt/cm.; 1v. and 10v. cal. signals; response to 1MHz; Time base ranges to 8μS per cm.; Size 230 x 130 x 190mm. Wt. 2 Kg. Operates from 110 volt or 220/240 volt A.C. High quality kit complete with carrying case.

£130.00

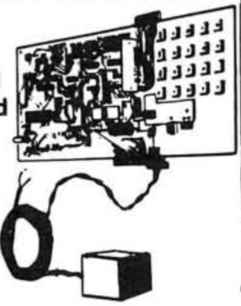
LK2 DIGITAL MULTIMETER



Solid state circuitry with large digital display. Ranges are up to 1000v. D.C. and A.C. and current D.C. to 100mA. Resistance ranges 100K ohms. Battery operated. Size 185 x 110 x 60mm. Digital display : 37 x 16mm

£40.00

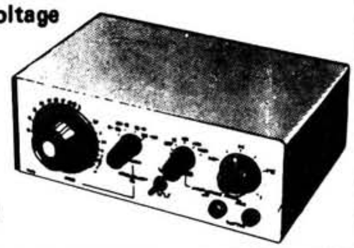
LK3 HOME COMPUTER



Ideal simple computer for beginners. Microprocessor has 8 bit data bus and 12 bit address bus. Ready programmed ROM has 4K bits. RAM of 0.5 x 8k bits fully addressable. 8 digit LED display. Hexadecimal read out. Hexadecimal keyboard. Re-set switch and single shot facility. Power supply kit included. Provision for cassette and V.D.U. operation.

£190.00

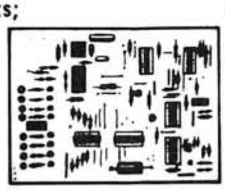
LK4 AUDIO GENERATOR



Covers 10Hz to 100kHz in four switched stages. Variable voltage output. Distortion below 0.02%. Sine and square wave output. Ideal for HI-FI work and as signal tracer.

£40.00

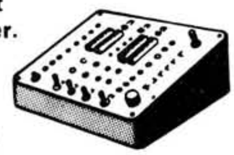
LK5 DIGITAL ELECTRONIC TECHNIQUES



Experiments carried out on a P.C. board, size 190 x 150mm covering operational amplifiers; integrators; basic logic circuits; NAND, NOR gates; Flip-Flops; Multi-vibrators; clock generator; 4 bit comparitor feed back; analoque switching; building simple digital meter circuits; Timer.
Note:— for full benefit with this kit a C.R.O. is desirable although circuits can be built without one.

£35.00

LK6 LOGIC DEMONSTRATION PANEL



Basic introduction to computer technology; AND and OR gates; NOR and NAND; Data line selector; Truth tables; AND and INVERT gate; Half and Full Adder; Latches; Flip-Flops; Shift register; Binary coded decimal counter. Over 16 experiments are performed with panel. Battery operated.

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LK7 ANALOGUE TEST METER

Basic multi range test meter kit with 20,000 ohm/volt sensitivity. Ranges Ranges: D.C. and A.C. volts 0-5, 0-25, 0-100, 0-500; 2.5kV.
D.C. 0-5mA, 0-500mA, 0-50μA
Resistance 0-50K; 0-5M. Size 150 x 75 x 50mm.

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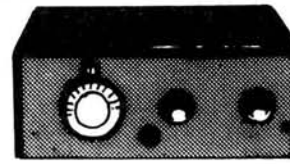
LK8 SHORT WAVE RECEIVER



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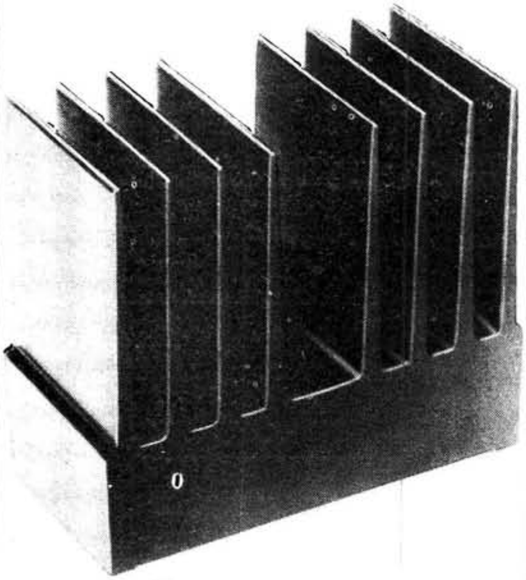

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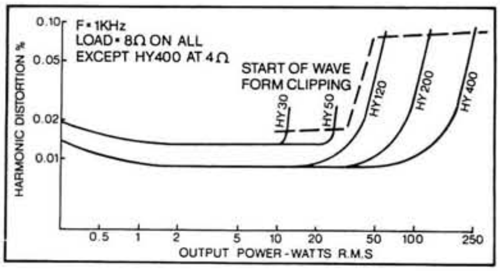
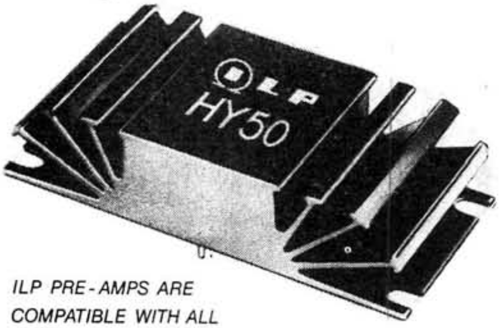


Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/ Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	100 dB	-20 -0- +20	105x50x25	155	**£6.34** + 95p
HY50	30 W into 8 Ω	0.02%	100 dB	-25 -0- +25	105x50x25	155	**£7.24** + £1.09
HY120	60 W into 8 Ω	0.01%	100 dB	-35 -0- +35	114x50x85	575	**£15.20** + £2.28
HY200	120 W into 8 Ω	0.01%	100 dB	-45 -0- +45	114x50x85	575	**£18.44** + £2.77
HY400	240 W into 4 Ω	0.01%	100 dB	-45 -0- +45	114x100x85	1.15Kg	**£27.68** + £4.15



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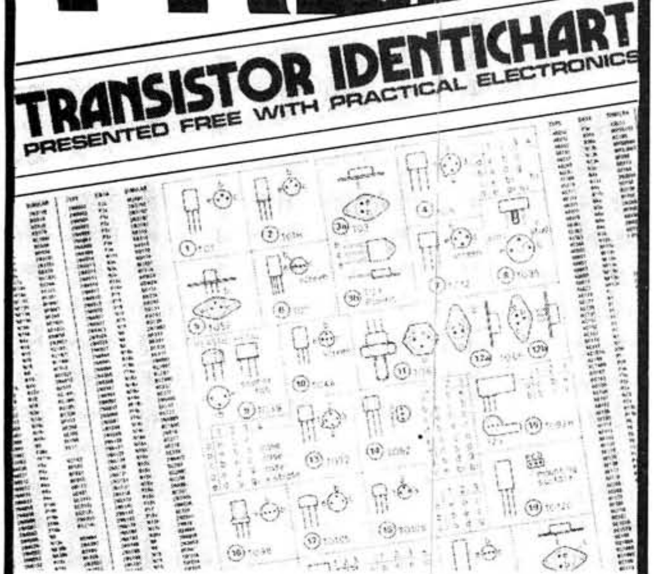

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EC92	0.85
ECC81	0.65
ECC82	0.60
ECC83	0.65
ECC84	0.60
ECC85	0.60
ECC86	1.40
ECC88	0.80
ECC189	0.95
ECC804	0.90
ECF80	0.85
ECF82	0.65
ECF801	1.05
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ECH84	0.80
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ECL82	0.75
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ECL85	0.80
ECL86	0.90
EF37A	1.50
EF39	1.25
EF40	1.25
EF41	1.30
EF80	0.65
EF83	1.75
EF85	0.60
EF86	0.75
EF91	1.50
EF92	2.90
EF95	0.65
EF96	0.60
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EF812	0.75
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EH90	0.85
EL32	1.10
EL34	1.80
	2.90
EL37	4.40
EL38	4.60
EL41	1.40
EL81	0.95
EL82	0.70
EL84	0.80
EL86	0.95
EL90	1.00
EL91	4.20
EL95	0.80
EL504	1.70
EL509	2.70
EL802	1.70
EL821	8.20
EL822	9.90
EM31	1.60
EM80	0.85
EM81	0.85
EM84	0.85
EM87	1.15
EY51	0.95
EY81	0.65
EY86/87	0.60
EY88	0.65
EZ80	0.70
EZ81	0.70
GY501	1.30
GZ32	1.05
GZ33	4.20
GZ34	2.30
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PCC84	0.50
PCC89	0.85
PCC189	1.05
PCF80	0.80
PCF82	0.70
PCF84	0.75
PCF86	1.50
PCF87	0.50
PCF200	1.60
PCF201	1.65
PCF800	0.50
PCF801	1.75
PCF802	0.85
PCF805	2.45
PCF806	1.20
PCF808	2.05
PCH200	1.35
PCL81	0.75
PCL82	0.95
PCL84	0.90
PCL86	1.05
PCL805/85	1.25
PD500/510	4.30
PFL200	1.10
	2.80
PL36	1.25
PL81	0.85
PL82	0.70
PL83	0.60
PL84	0.95
PL504	1.45
PL508	1.95
PL509	2.90
PL519	3.20
PL802	3.20
PY33	0.70
PY80	0.70
PY81/800	0.80
PY82	0.65
PY83	0.80
PY88	0.85
PY500	1.70
PY809	6.45
PY801	0.80
QQV03/10	2.85
QQV03/20A	14.40
QQV03/25A	21.20
QQV06/40A	16.10
QV03-12	4.20
SC1/400	4.50
SC1/600	4.50
SP61	1.80
TT21	16.50
U25	1.15
U26	1.15
U27	1.15
U191	0.85
U281	0.70
U301	0.65
U600	11.50
U801	0.90
UBC41	1.20
UABC80	0.75
UAF42	1.20
UBF80	0.70
UBF89	0.70
UBL1	1.25
UBL21	1.75
UCC84	0.85
UCC85	0.70
UCF80	1.30
UCH81	0.75
UCL82	0.95
UF41	1.25
UF80	0.95
UF85	0.95
UL41	1.50
UL84	0.95
UM80	0.90
UM84	0.70
UY82	0.70
UY85	0.85
VR105/30	1.25
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X66	0.95
X61M	1.70
XR1-6400A	82.90
Z759	9.00
Z749	0.75
Z800U	3.45
Z801U	3.75
Z803U	3.95
Z900T	2.45
1A3	0.85
1L4	0.50
1R5	0.60
1S4	0.45
1S5	0.45
1T4	0.45
1U4	0.80
1X2B	1.40
2D21	0.90
2K25	11.90
2X2	1.15
3A4	0.70
3D6	0.50
3D22	23.00
3E29	10.00
3S4	0.60
5B/254M	14.00
5B/255M	11.50
5B/258M	8.80
5R4GY	1.30
5U4G	0.75
5V4G	0.75
5Y3GT	0.80
5Z3	1.50
5Z4G	0.75
5Z4GT	1.05
6/30L2	0.90
6AB7	0.70
6AC7	1.15
6AG5	0.60
6AH6	1.15
6AK5	0.65
6AK8	0.60
6AL5	0.60
6AL5W	0.85
6AM5	4.20
6AM6	1.50
6AN8A	2.50
6AQ4	3.40
6AQ5	1.00
6AQ5W	1.80
6AS6	1.15
6AT6	0.90
6AU6	0.60
6AV6	0.85
6AX4GT	1.30
6AX5GT	1.30
6B8G	0.40
6BA6	0.55
6BE6	0.60
6BG6G	1.60
6BJ6	1.30
6BQ7A	0.85
6BR7	4.40
6BW6	5.20
6BW7	0.90
6C4	0.50
6C6	0.55
6CH6	8.20
6CL6	1.70
6CY5	1.15
6D6	0.70
6EA8	3.20
6F6	1.60
6F6GB	1.10
6F7	2.80
6F8G	0.85
6F12	1.50
6F14	1.15
6F15	1.30
6F17	1.15
6F23	0.75
6F24	1.75
6F33	10.50
6GA8	0.90
6GH8A	0.95
6H6	1.60
6J4	1.35
6J4WA	2.00
6J5	2.30
6J5GT	0.90
6J6	0.65
6J6W	0.90
6J7	1.20
6JE6C	2.95
6K7	0.80
6K7G	0.50
6K8G	0.65
6L6M	2.80
6L6G	2.50
6L6GC	2.10
6L6GT	1.25
6L7G	0.65
6L18	0.70
6LQ6	2.95
6LD20	0.70
6Q7G	1.30
6SA7	1.00
6SG7	1.15
6SJ7	1.05
6SK7	0.95
6SL7GT	0.85
6SN7GT	0.80
6SR7	1.10
6SQ7	0.95
6V6G	1.50
6V6GT	0.95
6X4	0.75
6X4WA	2.10
6X5GT	0.65
6Y6G	0.90
6Z4	0.70
7B7	1.15
7Y4	1.00
9D2	0.70
9D6	2.90
10C2	0.85
10F18	0.70
10P13	1.20

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With aluminium presence dome.

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8 or 16 ohms.

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With tweeter. And crossover. 10W. State 3 or 8 ohm. *Illustrated* £9·95 Post £1

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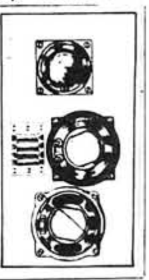

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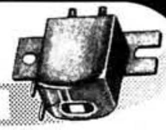

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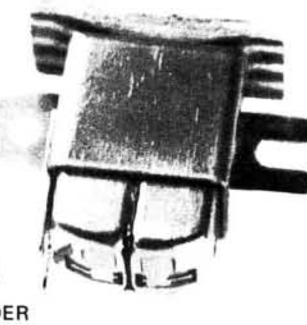

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