Wessies For UHF

UHF Westminsters are ideal 'leave where they are' 70cm rigs for repeater and favourite channel use. Chris Lorek, G4HCL, describes how to set them up and improve the Rx sensitivity if necessary.

Want to join in the fun on 70cm but don't want to spend a fortune? Nowadays 70cm FM black boxes usually cost more than their 2m counterpart, because components and manufacturing standards are that bit more exacting. In the past, few amateurs, bar the very rich, would dream of buying a stand-alone 70cm black box, there was just not the activity to justify it. Home-brew sets and transverters from existing 2m or 10m equipment were used and if you had a contact that was not pre-arranged or during a contest, you were very lucky.

However, with time technology improves and more amateurs get onto the bands. The result is a rather crowded 2m and amateurs start to seek new pastures to have a relaxed natter, the 'next band up' being the most likely choice, of course!

The Advantages of 70cm

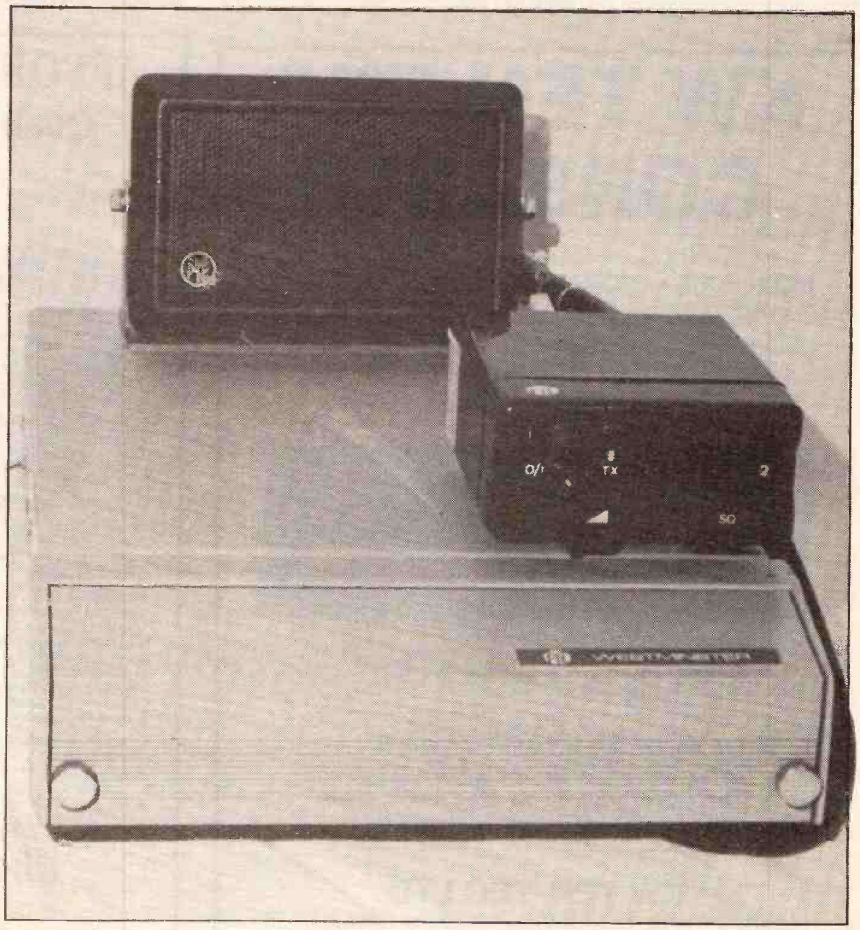
FM activity on '70' started mainly with converted radio-telephone equipment. I was always fascinated by amateurs walking around rallies keeping in touch with their friends with Pye PF1 pocket-phones. Why UHF I thought? Surely it can't get as far as 2m? Due to the shorter wavelength, 70cm propagation can get around built up areas far better than 2m with the majority of communication via reflection from buildings. Just take a look at your local urban policeman and see what he has tucked in his lapel — a UHF rig.

70cm FM operation has become *the* community natter system in many areas of the country. Look at a repeater map and compare the number of boxes on 70cm to those on 2m. The reason for the number of repeaters on 70 is that they are licensed as 'community' repeaters — you won't be chased off for having a long informal QSO. Often everyone knows everyone else and newcomers are met with open arms. Because of the improved penetration in towns, you'll find that you only need a small aerial when mobile to achieve rock solid signals.

Get Some Gear

Having (hopefully) convinced you of the joys of 70cm, let's set you up with some gear. My first 70cm rig was a hand portable, which I also used in the car and at home into external aerials. The limitations soon became apparent and I was always tempted to leave the set connected up in one place. I couldn't justify the enormous cost of a 'Jap' box which did far more than I needed, so I decided to fit a Pye Westminster, working on a couple of channels, in the boot.

'Wessies' are seen at rallies for anything from a fiver upwards, and represent an ideal way to have many pleasant informal chats. It is a remotely mounted rig, with the main unit being fitted wherever convenient and linked to a small control box via an 'umbilical' multi-way control cable. The control box contains the on/off switch, channel



change, volume and squelch controls. Having been designed for mobile use, they operate from a 12V supply, drawing about 2 amps on transmit and commonly give around 4W output, although transmitter circuitry has varied slightly in the past. On receive, expect around 0.5uV for 12dB SINAD, which is not fantastic by today's standards but can easily be improved.

Table 1 70cm FM voice repeater channels

CHANNEL	TX FREQ	TX XTAL	RX FREQ	RX XTAL
RB0	434.600	13.58125	433.000	12.3250
RB2	434.650	13.582812	433.050	12.326388
RB3	434.675	13.583593	433.075	12.327083
RB4	434.700	13.584375	433.100	12.327777
RB5	434.725	13.585156	433.125	12.328472
RB6	434.750	13.585937	433.150	12.329166
RB10	434.850	13.589062	433.250	12.331944
RB11	434.875	13.589843	433.275	12.332638
RB13	434.925	13.591406	433.325	12.334027
RB14	434.950	13.592187	433.350	12.334722
RB15	434.375	13.542968	433.375	12.335416

Tracking Down Your Wessie

As the Westminster is a range of equipment, make sure you get the right type! The UHF Westminster comes, with just one or two rare exceptions, in a remote mount version only and is a few inches longer than the VHF FM box. However, there are some high power VHF AM rigs around that look exactly like the UHF set, so read the small label rivetted to the side of the case. If the set type says 'W15U' then you've found your animal, if it says anything else then look in last month's HRT and see if you can wangle it as a bargain for 2m. If the label has been removed then beware!

The set comes in 1, 3, 6 and 10 channel variants, but all the control box channel switches go up to 10 channels. To check, open up the lids by giving the two end screws on each lid half a turn each, and count the number of crystal sockets there are, two per channel. Although you may not need it for more than one channel at first, you may wish to fit a simplex or club net channel in the future. From your home you may find you can easily get into a further repeater, so keep this in mind. It's a good bargaining point anyway when haggling at the rally stand!

Also make sure you obtain a control box and lead in the deal, these are an absolute necessity. You may fit any 3-8 ohm speaker and a dynamic microphone of around 600 ohms impedance will suit nicely. If these are included in the sale all the better. The power lead invariably gets lost on the way, but ask for one in any case, it will make the installation job easier. You may even be lucky and get a proper mount for the unit to stop it sliding around under the seat or in the boot. I have never used these as they require holes drilling in the car, something I avoid whenever possible. Plug connections for these accessories are common to the Westminster range.

Get Crystallised

Sort out what frequency you want to use by asking around at the local club or by taking a look at a repeater list for your local box. **Table 1** gives the repeater frequencies corresponding to the RB channel numbers as used in this country. Once this is done, calculate the crystal frequencies if necessary according to the formulae

Tx xtal (MHz) = Transmit Frequency (MHz)/32

Rx xtal (MHz) = (Receive Frequency + 10.7MHz)/36

The crystal can size is HC6/u. Quote the UHF Westminster when ordering to ensure the correct loading is supplied. Some crystal firms state they supply the correct crystals 'ex-stock', if purchasing from these firms then *ensure* you quote the correct *crystal* frequencies. The reason for this is that the UHF Westminster is made in two frequency ranges: 402-435MHz and 450-470MHz. The latter usually appears on the surplus market in this country. However, the receiver crystal multiplier is exactly the same between ranges, with the same overall tuning range. On 402-435MHz positive side injection is used; on 450-470MHz negative side injection is used. Trying to pull the many stages of this board down in frequency could possibly lead you to a few problems.

Don't be fobbed off by the supplier saying "Oh yes, your set is 'high UHF band' so you need these crystals," they are talking a load of rubbish! Hopefully, this advice may save you the trouble experienced by many amateurs in the past who tried to make the sets tune to their best performance, and perhaps suppliers will start stocking the correct crystals?

Getting It Transmitting

Readers of my recent articles will be familiar with my approach to getting sets tuned up. If you have a workshop full of test equipment then all well and good, but remarkable results can be achieved with a multimeter, cheap power meter and a filed down matchstick or plastic knitting needle, together with some help from other amateurs on the band or a local repeater.

Connect the set up, plug your crystals in and switch on. Take a look at board 12, the Tx modulator/driver. Set your multimeter to a low voltage range (around 1.5V) and connect the negative lead to the supply negative, positive lead to board 12 TP1. Throughout the transmitter alignment you must keep the Tx keyed of course, you will find a handy push button for this purpose on the front panel of the set. Carefully tune L1 and L2 for maximum voltage reading with your home made adjusting tool. If you have difficulty in getting a 'peak' then try tuning L1 for a maximum diode probe reading at the junction of C1/L1, and L2 for maximum at the junction of C5/L2. Back to TP1 with the multimeter,

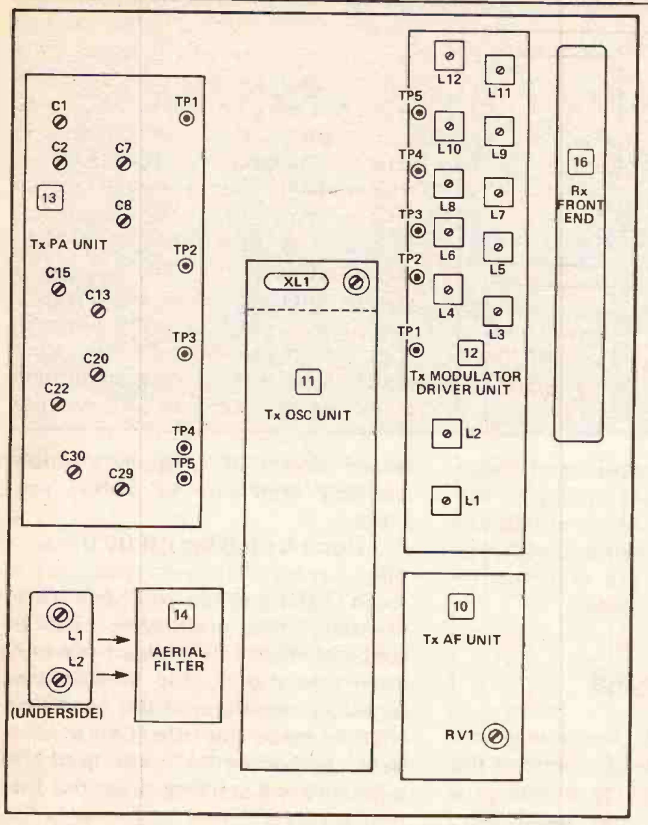


Fig.1 The Tx alignment on a later model PA.

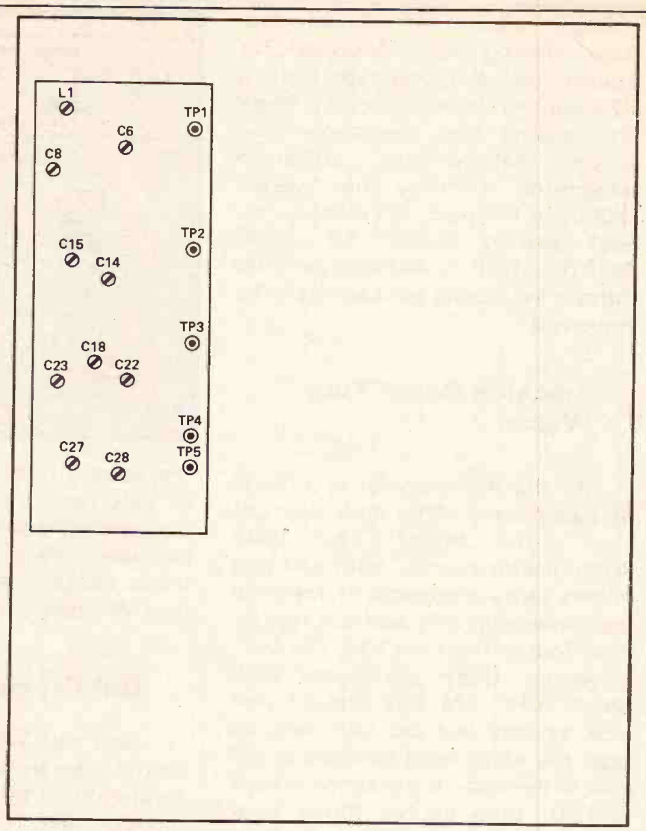


Fig.2 The early model Tx alignment points.

and tune L3 for minimum; retune L1 and L2 for absolute maximum. Move to TP2 and tune L4 for maximum reading, then L3 for maximum, then L5 for minimum.

Transfer to TP3, tune L6 for maximum, then L5 for maximum, and then L7 for minimum. Are you getting the hang of it now? Go to TP4, tune L8 for maximum, L7 for maximum, then L9 for minimum. Easy isn't it? Finally on to TP5, and tune L10 for maximum, L9 for maximum, and L11 for minimum.

By now, you should be able to hear a signal on an adjacent 70cm receiver from your Westminster. Take this opportunity to give the relevant crystal trimmer a 'tweek' to give you the best received signal (least distortion on speech modulation).

There have been two types of PA in common production, an early model with two output transistors and a later one with a single heavier-duty transistor. They can be identified by the number of adjustment holes in the PA screen and both types are shown in **Fig.1**. Fit a 50 ohm load to the aerial socket with some form of power detection in line, this can be a power meter, absorption wavemeter, or loosely-coupled diode probe. For adjustments on the PA board you will need a flat screwdriver blade shaped tool made, again, from a non-metallic material.

Early Model PA

Initially set C14, C18 and C27 to minimum capacity (vanes unmeshed) and C6, C8, C15, C22, C23 and C28 to mid capacity (vanes half-meshed). Set your multimeter to a low DC current setting, preferably around 0.25mA, and connect the positive lead to board 13 (PA stage) TP1. Tune L11 and L12 on board 12 for maximum, then L2 on the PA board for maximum. Moving to TP2, tune C6 and C8 for maximum reading. On TP3, tune C14 for maximum. Transfer to TP4 and tune C18 for maximum. Hopefully by now you should be able to see some indication of output power, so tune L1 and L2 on the aerial filter (module 13) for maximum — you will need a pair of small pliers for these adjusters. You may find a diode probe or adjacent receiver with S meter useful if you cannot get a reading straight away. I have found those cheaper in-line power meters with a sensitivity control to be very useful for initial tuning, they can detect a few milliwatts of power on 70cm at maximum sensitivity. I have lost count of the number of times the needles have hit the end stop at this setting!

Tune C22 and C23 for maximum on TP4 — you will find these both tune at around the same capacitance each. Then retune C18 for maximum. Return to TP3 and tune C15 and C14 for maximum. Back again to TP2 and retune C6 and C8 for maximum. Now we can start tuning for maximum smoke out of the aerial socket. Monitoring the output power, tune C28, then L1 and L2 on the aerial filter, then C28 and C29 for maximum power.

Late Model PA

This one is a bit less tricky! Initially set all trimmers to their mid-capacity setting (vanes half-meshed). Set your multimeter to a low DC current setting, around 0.25mA is ideal, and connect positive to TP1 on the PA (board 13). On board 12, tune L11 and

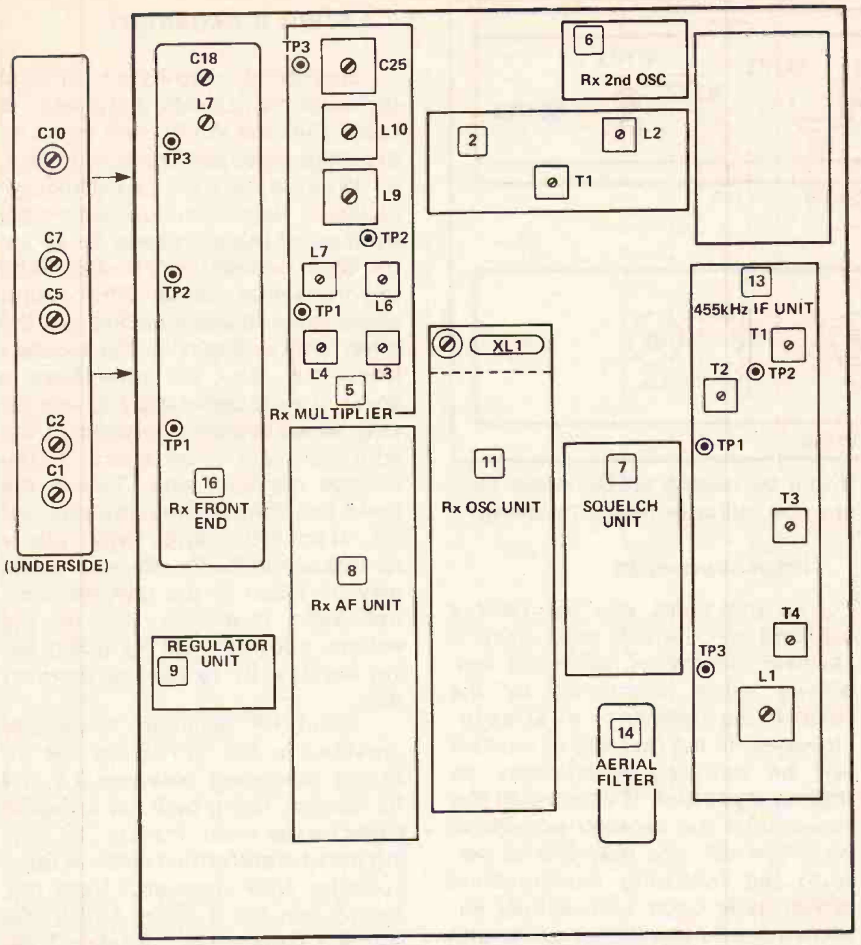


Fig.3 How to align the receiver.

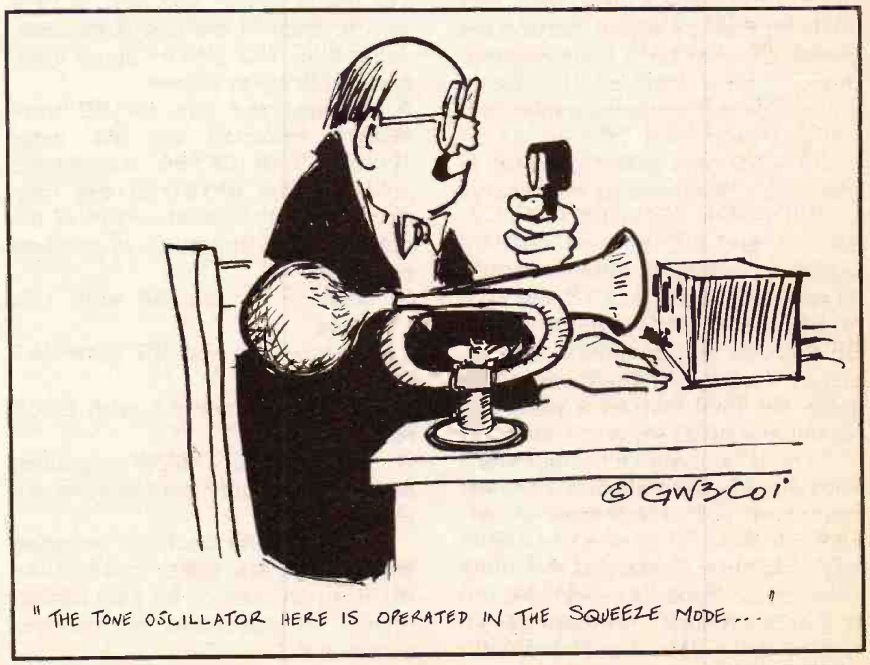
L12 for maximum, then on the PA board tune C1 and C2 again for maximum. Transfer to TP2 and tune C7 and C8 for maximum. On to TP3, tune C13 for maximum and C20 for minimum. On the aerial filter (module 14), using a small pair of pliers, tune L1 and L2 for maximum on the output power meter, (have a look at the early model adjustments for a few hints if in difficulties here). Now tune C20 for maximum output power. Going back to TP3, tune C15, C13, C8 and C7 for maximum current. Retune L1 and L2 on the aerial filter for maximum output, also C22 and C20 again for maximum. You may repeat the PA tuning procedure to get the last possible milliwatt out if desired.

All that now remains is to set up the frequency, if not already done, and the peak deviation. If you have a frequency counter capable of resolution at 70cm then by all means use this; if not an on-the-air check with a friend works wonders. Adjust the trimmer adjacent to the crystal in use for correct frequency, with a non-metallic adjuster. The peak deviation should be set to 5kHz, by adjusting RV1 on board 10. With 25kHz channel spacing ex-commercial sets, this will already be near the required level, but very early (and rare) sets may have been used on 50kHz channel spacing with 15kHz deviation and will sound very distorted unless you turn the deviation down. The best way of setting deviation is with the help of a fellow amateur on a repeater by comparing your 'loudness' with that of the repeater's — your amateur friend quickly switching between repeater output and input frequency. Note that this is a peak deviation adjustment only, mic gain on the Westminsters is fixed.

Receiver Alignment

Set your multimeter to a low voltage range, with the negative lead connected to supply negative. Ensure you have the correct frequency crystals plugged in and if aligning for several channels switch to the one nearest the centre of the total frequency range. Connect the multimeter positive lead to board 5 TP1, and using the tool made for the Tx driver board, tune L3 and L4 for maximum reading. Transfer to TP2, and tune L6 and L7 for maximum. Finally on TP3, tune L9 and L10 for maximum.

Now we go onto the front end module (module 16), the large silver-plated block with several metal adjusters sticking out of it. If you have a diode probe use it on



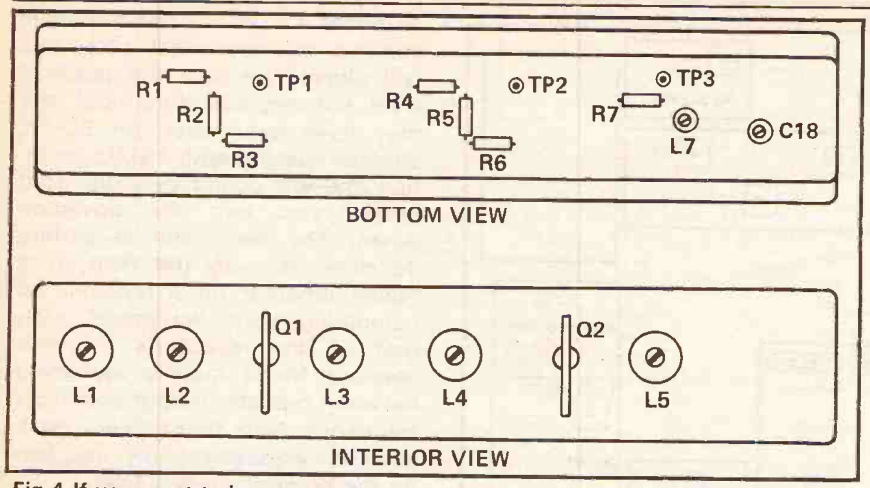


Fig.4 If you want to improve your receiver sensitivity, changing these components on your front end board will help.

the junction board of R7 and C16, and tune C18 on module 16, and C25 on board 5, both for maximum. If not, you will need to tune these later for best received signal.

Find a strongish signal on your crystalled frequency. You will need to be able to reduce this in some way, either by progressively turning a beam off direction, or moving an indoor aerial around for minimum signal. I have found the third harmonic of my 2m rig works very well as a signal for initial tuning. First of all, net your crystal onto frequency by tuning the trimmer adjacent to the appropriate crystal for best reception (least distortion) on a strong signal. You may like to monitor the voltage on board 3 TP3 while receiving a signal, setting the crystal trimmer for 0 volts reading, this will net it precisely. If a diode probe was not available earlier, adjust C18 on module 16 and C25 on board 5 for best quieting signal — reducing signal level as necessary.

On module 16, adjust C10, C7, C2, C1 and L7 for best quieting signal — reducing signal strength as required. Readjust C18 and C25 on board 5 again for best quieting. Go through the procedure again to ensure the best sensitivity possible, doing the final test on a weak off air signal such as a distant repeater.

The IF and squelch stages will have already been aligned if the set has come out of commercial service, so there is no need to adjust anything here. Beware of the idiots who advise 'twiddle everything until you get results', let them get on with it while you align it properly. You'll be having QSOs while they are still trying to hear something.

Improvements

At this point you will have a working set, which may have a receiver somewhat lacking in sensitivity when compared to the latest equipment available. However, in the majority of cases it will be perfectly satisfactory so please, try it first. If you would like to improve the receiver sensitivity by a few dB, you may like to perform the following modifications which have been successfully implemented by the author on several W15U sets in the past. These will improve the receive performance from 0.4/0.5 uV to typically 0.25 dB SINAD.

1. Remove the front end (module 16) metal cover, and add ⅓ of a turn to each of the five large coils, using thick (12 SWG) copper wire, preferably silver plated.
2. Replace the two BF180 transistors mounted on the inner screens with BFY90 transistors, soldering the BFY90 screen connections to the metal screen of the module. Keep the leads as short as possible.
3. Replace R1 and R4 with 12k resistors.
4. Replace R2 and R5 with 4k7 resistors.
5. Replace R3 and R6 with 820R resistors.
6. Add a 2uF2 16VW capacitor across the supply connections adjacent to R7.

Fit the cover back on, ensuring the screws are tight, and re-tune the front end stages for best performance as described in 'receiver alignment'.

Want a Repeater?

Budding repeater group technical whizz-kids may like to know that the W15U will make an excellent repeater! There is, in fact, a Wessie with talk-through facilities. Hence you will see on the front panel there is space for an extra BNC connector. Fit one, wire the transmitter aerial filter output direct to its adjacent socket and the other socket direct to the receiver front end. You will now have a spare coaxial aerial relay to use for your aerial system. Disconnect the wire from pin 7 on board 9, the voltage regulator unit. This is the mute line that inhibits the receiver on transmit, and will allow simultaneous Tx/Rx. Receive audio may be taken to the repeater control logic from the top of the volume control, with Tx audio being fed directly to the mic connection.

Good RF isolation is already provided in the W15U by the inherent screening between Tx and Rx stages, being built on opposite sides of the main chassis. Tx keying may be performed with an open collector NPN transistor from mic connection No 3 down to 0V. Rx squelch output may be taken from pin 9, board 9, which goes to 1.1V on squelch open, and 9.0V when squelch is closed.

And Finally . . .

I have had several letters and calls from amateurs regarding this series. Apart from the compliments which I must thank you for, the main questions asked were ''Where can I get the sets from?''. The best bargains really are from rally and junk sale stands — I sometimes think that price bartering with the stall holder is half the fun. However, for those unable to visit these, the following dealers will, I'm sure, be pleased to help out:

B Bamber Electronics,
5 Station Road,
Littleport,
Cambs. CB6 1QE
Tel. (0353) 860185

Garex Electronics,
7 Norvic Road,
Marsworth,
Tring,
Herts. HP23 4LS
Tel. (0296) 668684