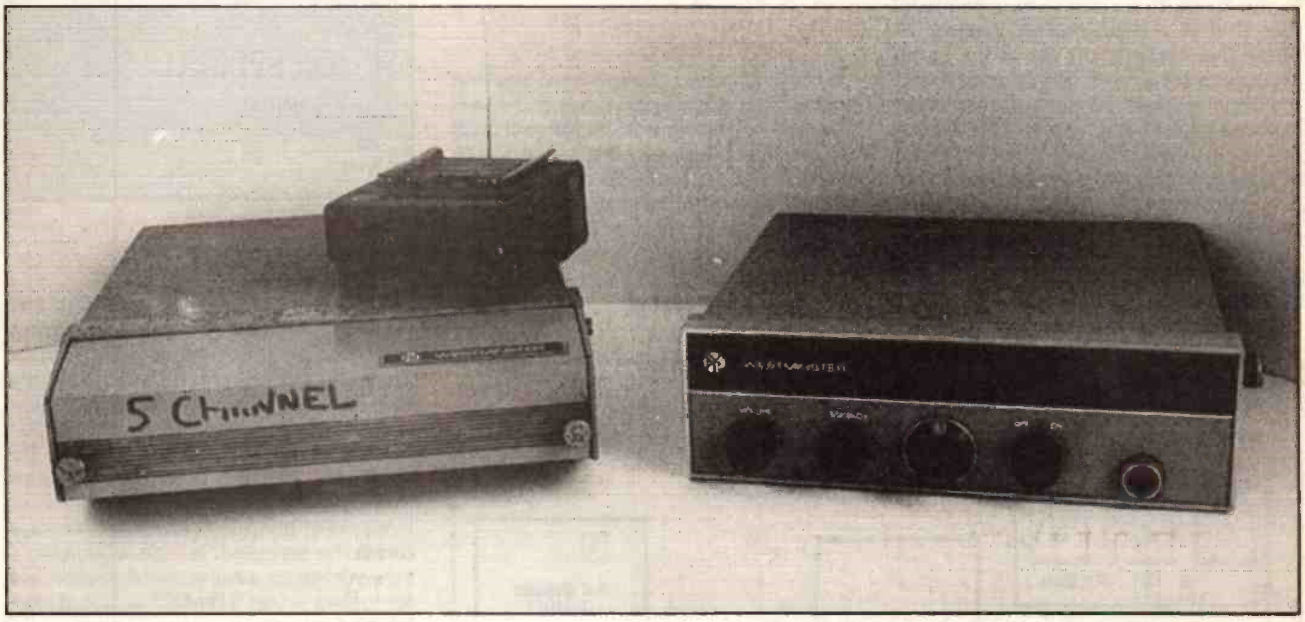
M Band Pye Westminster Conversion



Chris Lorek G4HCL converts the M-Band Pye Westminster onto 2m

The HRT series on converting ex-PMR gear has been very successful, one only needs to listen around the bands and already amateurs are finding that getting on the air needn't be expensive, with many amateurs joining in the 'conversion craze'.

Following re-arrangement of allocations in Broadcast Band II, several public utility services in the UK who previously used the upper section of this, the so called 'Mid' or 'M' band, have been given the order to move onto different frequencies. The result? You've guessed it — a huge number of obsolete two-way radio equipment comes 'up for grabs'. This of course is little use to anyone else in the UK, as the operating band can no longer be used for two-way communication, so the sets become available cheaply on the surplus market.

Some years ago, it was simply not worth the effort in trying to 'convert' sets operating on unsuitable frequencies when other sets, operating on the correct bands, were available at similar prices. However due to the forthcoming flood of these 'M' band sets we thought you'd like to know how to get them going on 2m! The calculator, soldering iron and test gear was quickly put to use in the HRT conversion department, and a well-used Mid Band Westminster soon found a new lease of life on 2m.

Identification

The Mid Band Westminster operates on transmit over the range of 88-108MHz, those coming out of service in the UK normally operating around 107MHz. On receive, the sets usually operated on around 140MHz, having an operational receive range of 132-156MHz. A look at the side-mounted serial number plate will show the equipment 'Cat' number as W15FM, i.e. an FM Westminster of originally around 15W transmitter output, below this the 'Code' designation will show the identification letters of typically 'SDB6', the 'S' standing for 12.5kHz channel spacing ('V' is 25kHz), 'D' signifying 'D' band of 88-108MHz (A and E bands may be used for 2m and 4m without modification — see earlier HRTs or the Argus 2-Way Radio Conversion Handbook for details, P band may be converted to 4m or 6m as per our recent HRT article), 'B' signifying boot mount, i.e. a remote mount unit ('D' is a dash mount), with the '6' signifying 6 channel capability, the sets coming in 1, 3, 6 and 10 channel variants. So make

Remote Mount and Dash Mount Westminsters

sure you know what the set is before you buy it — you may find it operates on a different band!

The receiver can operate on 2m without any circuit modifications whatsoever, just a re-alignment job taking typically a few minutes being all that is required. The transmitter however *does* require a number of circuit modifications to operate on 2m, which I'll detail later on.

Dash and Remote Mounts

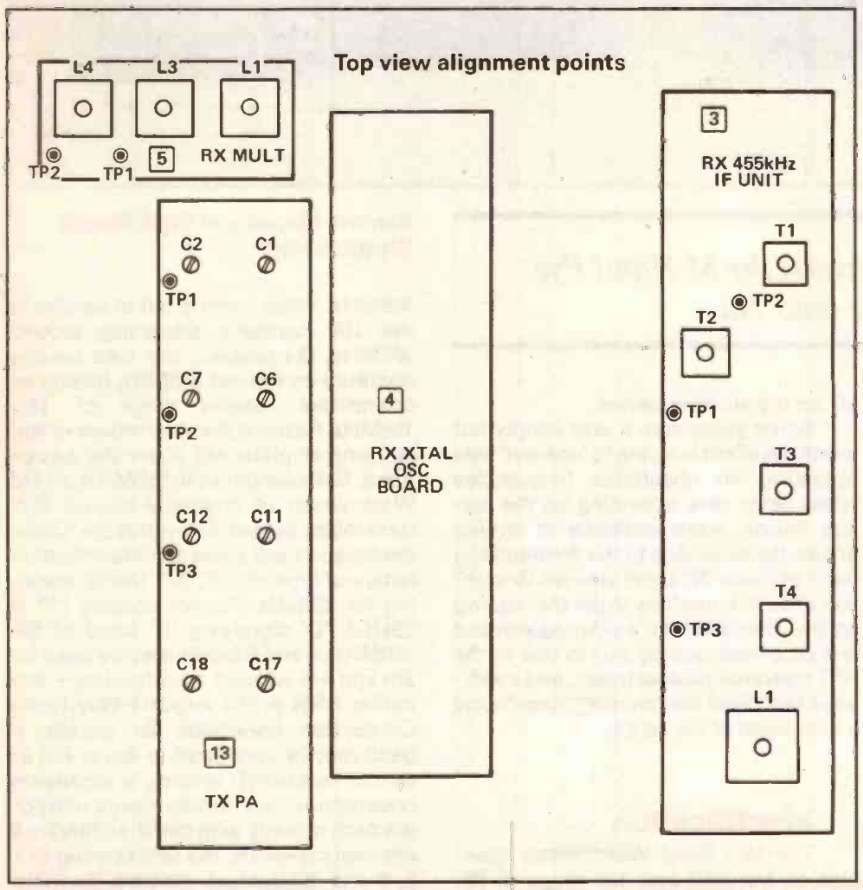
The accompanying photographs show what a Pye Westminster looks like in the flesh, there being two versions. The first is a dash-mount, having its operating controls on the front panel together with a microphone socket and the like, the second is the more common 'remote mount' unit, where a small control box is used via a thick multi-way lead and plug/socket arrangement to control the main transceiver which is normally mounted in the car boot.

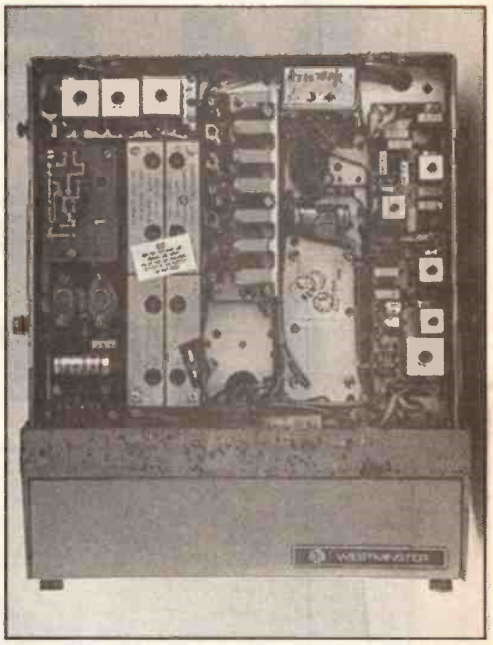
The latter version can be used to good effect if you just want an inconspicuous set in your car for local nattering, alternatively for home use with the main set placed under the table or whatever to give you a degree of extra room on your shack table. The dash-mount version is a little on the large side for today's compact car dashboards, however it *is* more convenient for shack use. If you purchase a remote mount set, ensure you also obtain the control box **and** the connecting cable, unless of course you don't mind making your own. This could be a cheaper option also if you just want to use the set as a packet transceiver, here you don't need frequent access to volume/squelch controls and on/off switches and can be 'hard wired' into the set's case. The accompanying diagram shows the original control box circuit, the connection letters referring to those marked on the remote connector on the transceiver.

Conversion

You have two choices here, the first and easiest is to obtain a set and use it just on receive as a monitor for your local repeater or whatever, the second is to modify it for transmit operation as well. I'll thus start with the simpler option. i.e. the receiver. For this you'll first need to obtain the required crystal for the receive frequency of your choice, the formula for this being;

$$\text{Xtal Freq} = \frac{\text{RX Freq} - 10.7\text{MHz}}{3}$$





The Inside top view

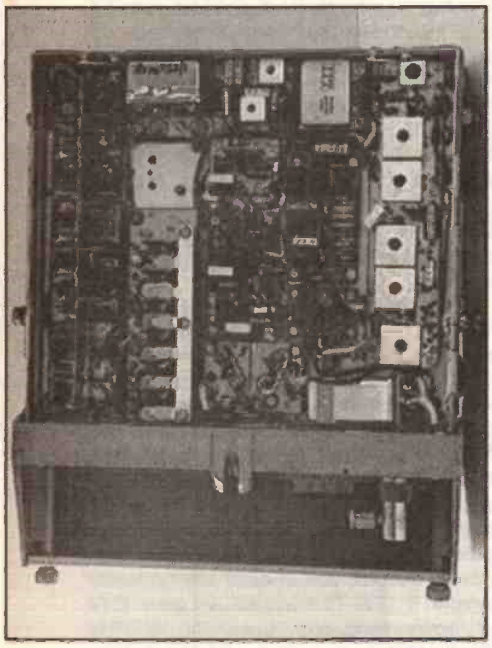
The crystal can size is HC6/u, and you'll find that some crystal companies may carry ex-stock crystals for popular 2m frequencies, remember to state the W15FM Pye Westminster when you order them to ensure the correct circuit loading is obtained. You'll need a DC voltmeter and a non-metallic adjustment tool for the receiver alignment, as I've said in previous conversion articles **never** be tempted to use a jeweller's screwdriver or similar metal implement for tuning — you'll break the delicate ferrite tuning cores. If you don't have a suitable adjuster, you can file down a plastic knitting needle, or even a match stick, to suit the slots in the cores. You'll also need some form of receive signal for the front end alignment, several methods of achieving this without the need for a signal generator having been well documented in the past in HRT (e.g. get a local amateur to put a signal out, or use a local repeater with changes of aerial at your end).

To start with, ensure you have a suitable power lead for the set, if one didn't come with the equipment then on the power plug you'll need to link together pins 2 to 3, and 4 to 5, then connect +ve 12V to pin 1 and -ve to pin 7, the pin numbers being marked inside the set's case. You'll also need a speaker plugged into the lead coming from the rear of the set or the control box, the original version being of 3 ohm impedance although a more common 8 ohm speaker will suffice. Plug your receive crystal in, select the appropriate channel and switch the set on, then make sure you can hear squelch noise from the speaker. If your

set or control box has a 15-way D-type socket mounted, you may find you'll need to link pins 8 and 9 on this to achieve a receive audio path, this socket being used for external tone signalling units.

If the set has come out of service, it will most likely be 'nearly' tuned, so don't touch the front end coil adjusters yet. Connect your DC voltmeter positive lead to TP1 on Board 5, the negative lead to the DC supply negative (not the transceiver chassis, this is not at negative voltage potential), and tune the cores of L1 and L3 for maximum voltage, then transfer to TP2 and tune L4 for maximum, retuning L1, L3 and L4 again for absolute maximum. Now connect your aerial and tune the crystal adjuster core until you start hearing a clear signal, i.e. tune this for minimum distortion. For more accurate 'netting', you can connect a DC voltmeter to pin 3 on the RX IF PCB (Board 3) and tune the crystal adjuster for zero volts on a received signal, this test point providing a centre-zero discriminator output voltage. If your set is a 12.5kHz version ('S' code on the label, or +/- 3.75kHz marked on the large internal crystal filter) then you'll find well deviated signals may introduce distortion on speech peaks, however for packet use with 3-3.5kHz deviation normally used you shouldn't have too many problems receiving signals from correctly adjusted transmitters.

The inside bottom view



Once you've tuned your crystal onto frequency and can hear signals, you can concentrate on the front end. Here you simply tune the five coil adjuster cores for the best received signal, i.e. minimum noise, you shouldn't need to adjust each core more than a turn or two to bring the receiver 'spot on'. The final sensitivity will be in the order of around 0.35uV for 12dB SINAD, if you'd like to improve this you can replace the two front end transistors TR3 and TR5 (2N3819 FETs) with J310 FETs, changing the values of the resistors R6 and R14 to obtain a current of 10mA through them (this being the FET source current) for best performance.

That's it for the receiver, simple wasn't it? Now for the transmitter modifications for the more adventurous amongst us.

TX Driver Modifications

We'll start with the transmitter modulator/driver PCB. First of all to gain easier access, remove the screws securing this to the transceiver chassis, you'll also find it useful to unscrew the adjacent solder tag towards the rear connecting the capacitor to the transceiver chassis to prevent damaging this. Now remove capacitors C12, C15, C17 with its associated resistor, C20, C23, C25, C27 with its associated resistor, C30, C32 with its associated resistor, and C35. You may find it easier to simply cut the capacitor leads off where these are positioned next to the metal screen to avoid damaging the coil formers. Make sure you don't unsolder the coil leads from the former pins when you remove the capacitors, it won't work otherwise! Now replace the capacitors with the values shown in Table 1, but don't replace the resistors associated with C17, C27, and C32. Any normal ceramic capacitor types will suffice, but don't be tempted to use 'near' values from your junk box otherwise you may find you'll be tuning to the wrong frequency multiple when you come to the alignment stage. Where the capacitors are adjacent to the metal screen, you'll find it easier to solder these to the underside of the PCB rather than to the former pins, in either case remember to keep the capacitor lead lengths as short as possible.

The crystal frequency you'll need is given by the formula;

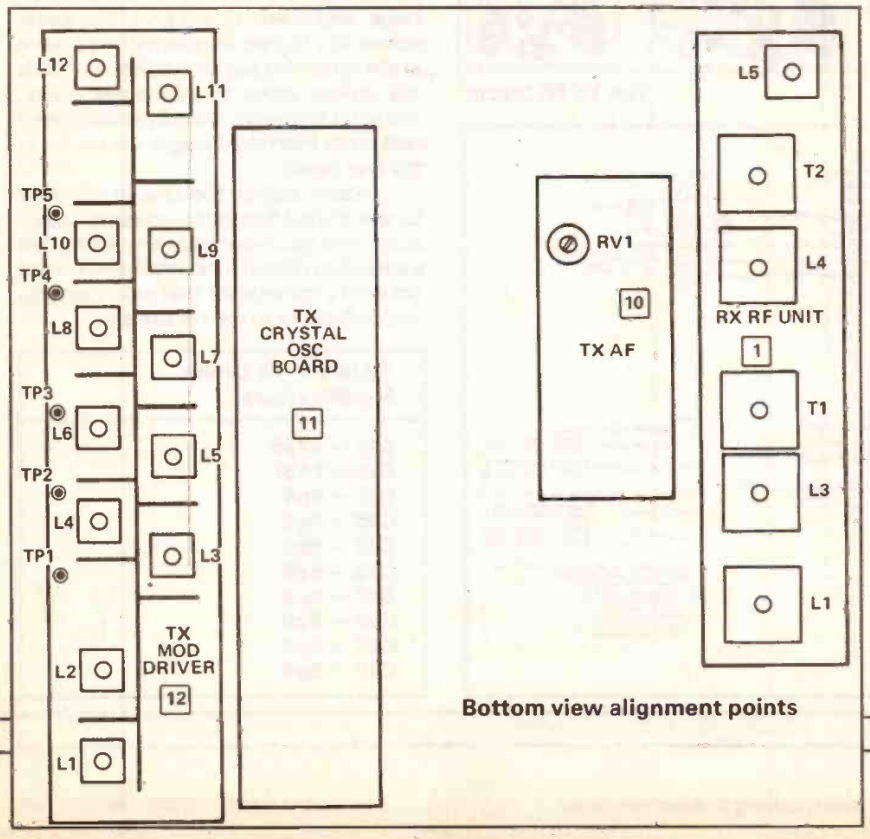
$$\text{Xtal Freq} = \frac{\text{TX Freq}}{36}$$

Again the can size is HC6/u, and remember to state the Pye Westminster when you order your crystals to ensure the correct crystal loading is obtained. If you didn't get a microphone with your set, you'll find the five-way 270 degree DIN socket is wired with the following;

Pin 1 Mic Live
Pin 2 Mic Gnd
Pin 3 PTT
Pin 4 RX Audio
Pin 5 PTT Common

TX Driver Alignment

First disconnect the thin coax lead at the rear of the board, and in its place connect a coax lead to a low power meter/dummy load, you'll need to be able to indicate around 0.25W here. Start by inserting your TX crystal, and connect your DC multimeter positive lead to TP1,



Bottom view alignment points

the negative lead to your DC supply negative connection. Key the transmitter, and tune the cores of L1 and L2 for maximum, then tune L3 for minimum, you should find just a slight 'dip' in reading is obtained when adjusting L3. In each case, you should find two tuning points, one with the core nearly flush with the top of former, the other with the core almost flush with the bottom of the former. Use the lower position in each case for best performance, this giving maximum reading, but avoid any slight peak or dip you find with the core around mid-travel.

Transfer your meter +ve lead to TP2 and tune L4 then L3 for maximum DC voltage reading, then tune L5 for a dip, again choosing the lower core position in each case. Transfer to TP3, and tune L6 then L5 for maximum, then L7 for minimum. Then on to TP4 and tune L8 then L7 for maximum, then L9 for minimum. You may by now be seeing an indication of RF power on your in-line power meter, so tune L10, L11, L12 and L9 in that order for maximum reading, re-tuning again for absolute maximum.

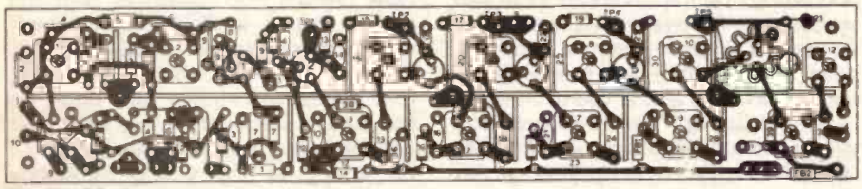
You now have a low-power transmitter, you'll even be able to hear it on a nearby receiver when you talk into the microphone. If you can't hear any audio, then if your set or control box has the 15-way connector previously mentioned fitted, try linking pins 1 and 2 on this, these being the TX audio path for the external tone signalling module. The preset potentiometer RV1 on the TX AF board (Board 10) controls the peak deviation, you'll probably find you get around 3.5kHz without adjustment if the set was originally aligned for 12.5kHz channel spacing (you're now multiplying the crystal frequency by 36 instead of 24).

PA/LPF Modifications

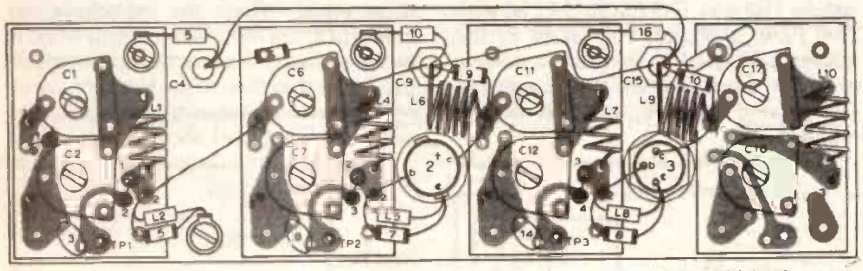
We now come to the 'power' side of the modifications. Re- connect the original coax on the TX driver PCB, then turn the set over. On the Low Pass Filter PCB, you'll see three 39pF capacitors, remove these and replace them with 15pF capacitors, again any ceramic plate type should suffice but ensure you use the correct value and not 'near' value components. The transmitter PA will have a screen fitted, remove this temporarily and take a look at the air-wound coils fitted. You'll need to remove two turns from L1 and L10, the easiest way to do this is to cut off the middle section of each coil from the top, squash the remaining two turns together, then re-solder these. You'll now also need to remove two turns from the link coils L6 and L9, these use enamelled wire so remove the coils and discard the resistor fitted inside the windings, shorten the coils and reconnect them in their original positions taking care to scrape a small amount of enamel from the end to ensure a good solder joint. Don't replace the associated resistor previously fitted inside the turns of each coil. Check your solder connections, then replace the screen.

Connect a power meter/dummy load to the transceiver aerial socket, you'll need to indicate a maximum of around 15W. Key the transmitter and watch carefully for a slight increase in power as you adjust C17 and C18 on the PA board, adjust these for maximum, then carefully go back and tune the capacitor pairs C1 and C2, C6 and C7, then C11 and C12, finally C17 and C18. Repeat this procedure until you can't get any more power output, you should see typically around 8-12W. The original set gave 15W at a lower frequency, but in the 145MHz Westminster a further PA transistor stage was used to achieve the same power at a higher frequency, we'll have to put up with a slightly lower level than this unless some additions are made, (the extra transistor would probably also cost more than you bought the set for in the first place).

Finally, adjust the crystal trimmer for the correct frequency, check the deviation, and you now have a working 2m transceiver! Good luck, and have fun on 2m with a transceiver that won't set you back a fortune to get on the air.



The TX Multiplier layout



The TX PA layout

Control Unit circuitry

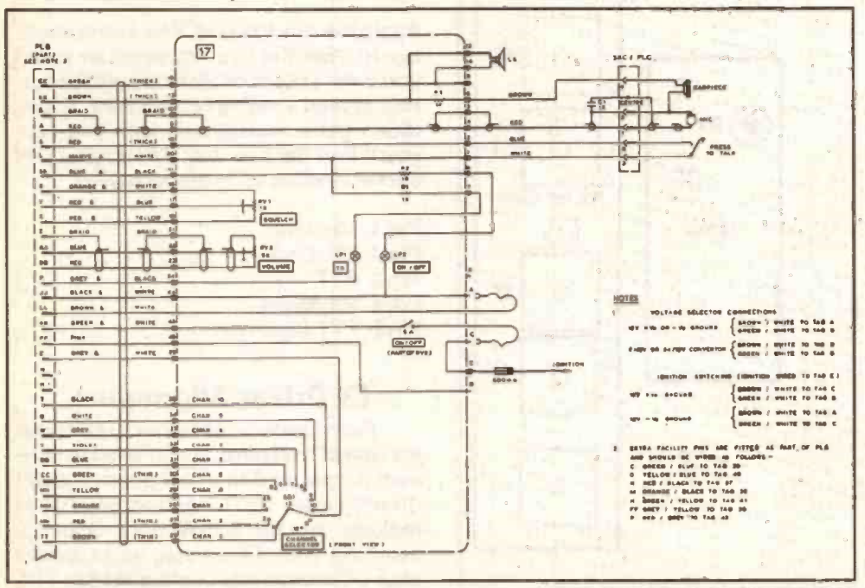


Table 1 — TX Driver Modifications

C12 — 47pF
C15 — 56pF
C17 — 5p6
C20 — 5p6
C23 — 8p2
C25 — 5p6
C27 — 5p6
C30 — 5p6
C32 — 5p6
C35 — 5p6