CONVERSION PRO
Burndept UHF Portable

Tony Skaife G4XIV guides us through the innards of the set.

The Burndept portable range of equipment has now been around for about 15 years in one form or another. Operating on UHF, they have been the workhorse of many a PMR system and now they are finding a new life on the amateur bands.

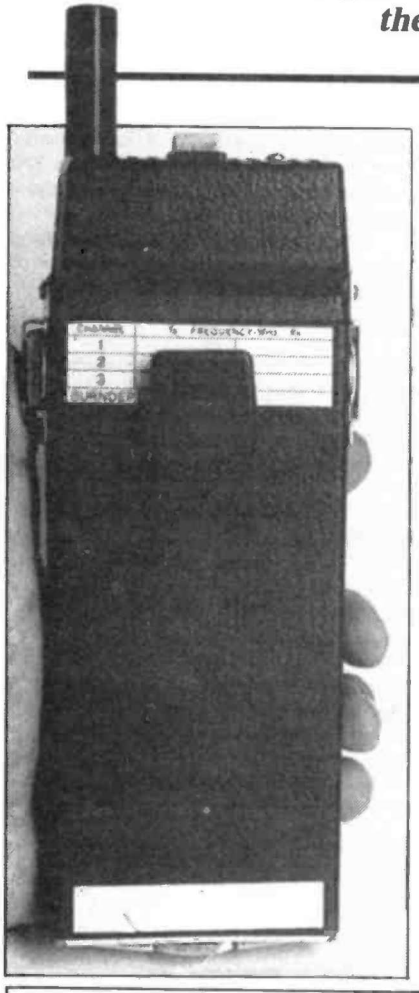
Preliminaries

The UHF transceiver range covers model numbers BE439 to BE470, there are some slight differences to these model types but they basically all operate in the same manner. It must be borne in mind that normally some degree of test equipment will be required to re-tune the set onto a different frequency range. However, this article should also help understanding of the circuitry and allow minor servicing or adjustments to be carried out if required. Additional alignment comments have been added by G4HCL.

Removal of the transceiver chassis from the outer case is done by removing the large rear screw together with both of the side screws below the volume and channel controls, then carefully sliding off the case. On some models, a separate battery base plate will also need to be removed.

Crystals

The easiest process is where the transceiver is fitted with crystals for one channel only and it is to be re-crystalled to another single frequency. It becomes more complex if all three channels are to be installed from scratch, however details of this will be described later.



To calculate crystal frequencies I have reliably used the following method;

For the transmitter, take the final UHF frequency required and subtract 12kHz, call this value 'FT'. Call the TX crystal 'XT' and use the formula;

$$XT = \frac{FT}{9}$$

As an example, the crystal for SU16 (433.400MHz) would be 48.15423MHz, it is a third overtone type that should be ordered.

Similarly for receive, an adapted formula is again used. Take the final 70cm receive frequency and again subtract 12kHz, call this 'FR'. Apply it to the formula using 'XR' as the receive crystal.

$$XR = \frac{FR + 10.7}{9}$$

Again for SU16, this crystal frequency is 49.3433MHz. This formula is not the one quoted in official technical manuals but it is a system that I have always found reliable.

Circuit Operation

Assuming you now have appropriate crystals fitted, I shall explain the circuit arrangement at block level, treating transmit and receive sections separately.

The PTT (push to transmit) switch when pressed serves two functions. As well as acting as an aerial change over switch, it removes the supply voltage (9V) from the receiver and places both 9V batteries in series to generate 18V to power the transmitter units. Therefore, a point to remember is that in transmit mode, both batteries are in use and thus both must be in good order.

Diode D3 is across one of the batteries, so beware of D3 going short circuit. The position of D3 on the circuit board can vary depending on which model is in use, but it can easily be found and tested. D3 incidentally is fitted to provide isolation between the batteries on receive. So far I have mentioned only battery power for use, but a mains power supply unit can be useful for bench testing or battery charging, several designs have of course been published for these. Note that if you use this in place of batteries, you will need either a double output type, or a pair of power supplies, for the transmitter tests.

Transmit

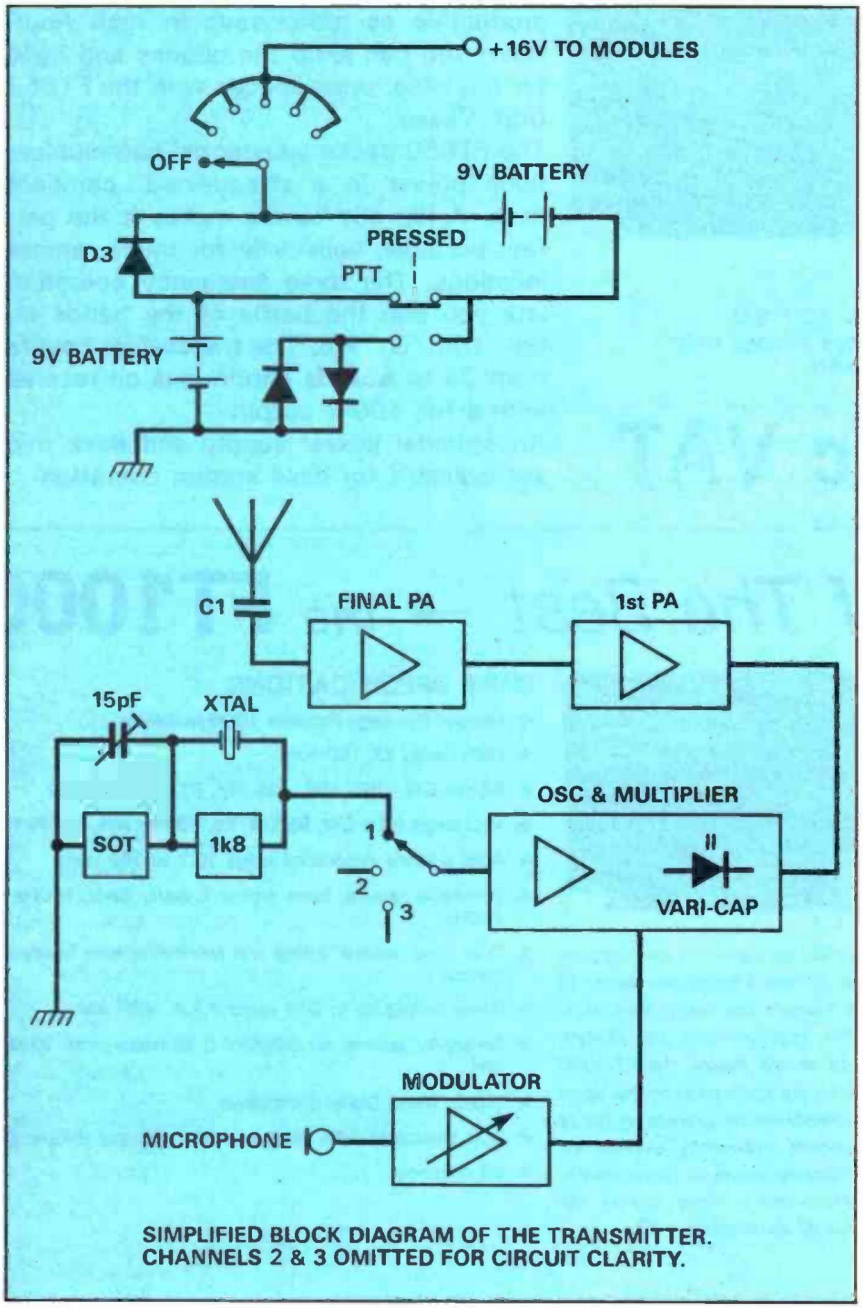
With one of the channels selected, its transmit crystal (approx. 48MHz) is tuned by the associated 15pF trimmer, the output being fed to the TX Osc/Mult unit. Audio from the built-in microphone is amplified in the modulator unit and then fed to the varicap diode in the TX Osc/Mult unit, hence FM is generated and the crystal frequency is given a 9 times

multiplication here. The resulting UHF signal generated is about 8–10mW.

Further amplification takes place in the TX 1st PA stage, this single stage unit producing 50mW. The TX 2nd PA, also a single stage unit, boosts the output to approximately 350mW. The output to the built–in aerial is via C1 (5p6) so it is vital that this capacitor is not damaged or poorly soldered.

TX Alignment

Alignment of the transmitter power consists of carefully adjusting the variable capacitors and coil on the multiplier unit for maximum 70cm signal, an absorption wave meter or frequency counter is useful here. Ensure you use a suitable non–metallic trimming tool, and make sure the core is not broken before you commence this.



SIMPLIFIED BLOCK DIAGRAM OF THE TRANSMITTER. CHANNELS 2 & 3 OMITTED FOR CIRCUIT CLARITY.

After the appropriate crystals have been fitted and the set tuned you'll need to set the deviation on the transmitter. Each crystal will have its own performance characteristics, because of this if a crystal is changed the resultant deviation is likely to differ from the one originally fitted. The deviation is reset by adjusting the potentiometer on the modulator unit, as shown in the accompanying diagram, to suit the new crystal. This can be performed by comparison to other signals such as a repeater, or of course by using a suitable deviation meter if you have access to one.

Where more than one channel is used the solution is a little more difficult. On the circuit side of the board are 3 resistors R17, R18 and R19, these are soldered across each trimmer for the transmit channels. Remove the resistors and check each channel for it's level of deviation, using an adjacent receiver for example and noting which one has the lowest level of audio. The channel with the least deviation should have its resistor replaced by one with the value of 100k. The other channels with their higher deviation levels should then be adjusted to the correct deviation level by using lower resistance values, typically between 12k and 82k. It can be a little daunting at first, but with patience one can set the deviation levels to match, the overall setting is again adjusted with the deviation control on the modulator unit.

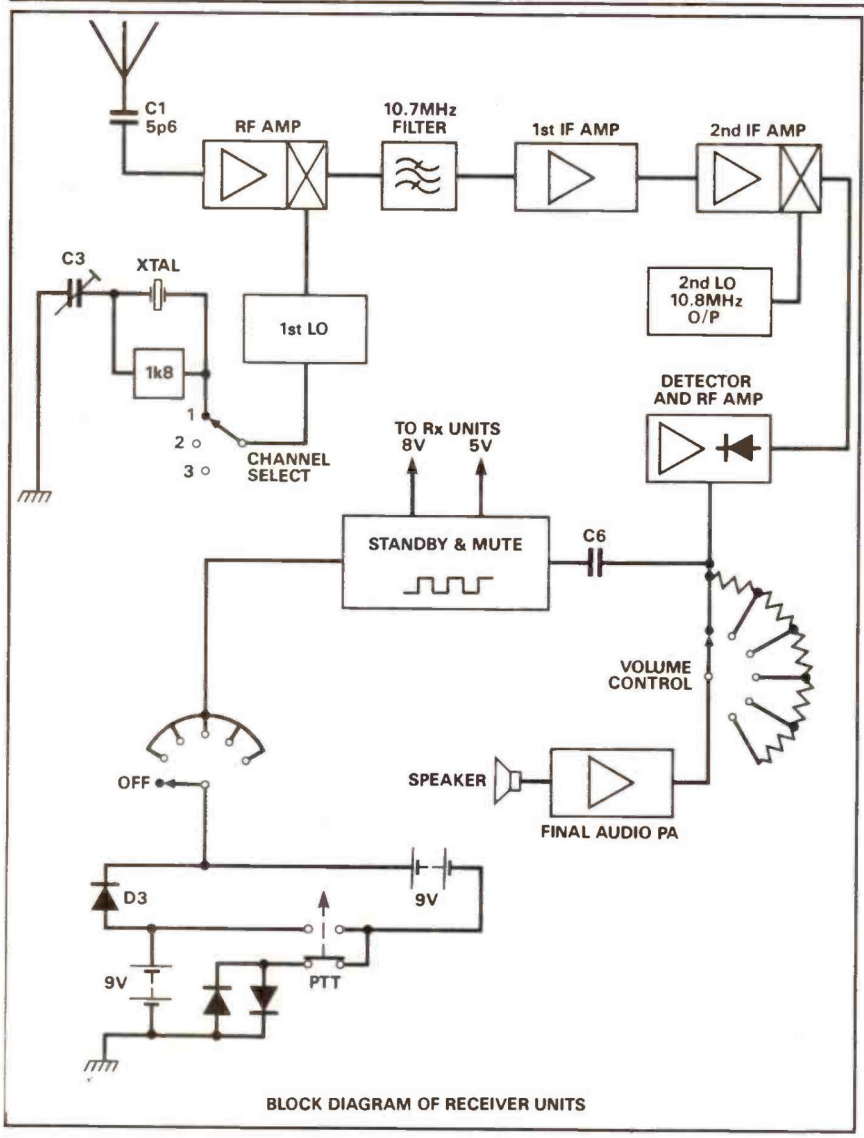
On the TX Osc/Mult unit can be seen a resistor having a 'Select On Test' (SOT) resistance value. By increasing this SOT resistor value, a reduction in battery current drain can take place although the output power is likely to reduce. By reducing the value of this resistor it may increase both power out and battery current. So the final value of this depends on the right balance of power out to power used. It is not much use to increase output power by 10% and your find battery life reduced by over 30%. A typical SOT value would be 180R, the usual range being from 120R to 390R. Selecting the right value should give 350mW out for 120mA or less.

Receive

Releasing the PTT removes the power (18V) from the transmit circuitry and allows 9V to power the RX units. Hence only a single 9V supply is required for receive only test purposes, thus just a single battery or power supply may be used.

Starting again with the crystal, it is tuned by the adjacent trimmer C3, C4, or C5. The first local oscillator multiplies this by a factor of nine and feeds it to a mixer in the RF Amp. Received UHF from the aerial passes through C1 and is amplified in the RF amplifier, then fed to the first mixer to beat with the LO output.

The output here at 10.7MHz is filtered through the crystal filter and is amplified by the first IF amplifier. Further IF gain takes place in the 2nd IF Amp with its final stage being a mixer, into this is fed the 2nd LO which is a crystal controlled



BLOCK DIAGRAM OF RECEIVER UNITS

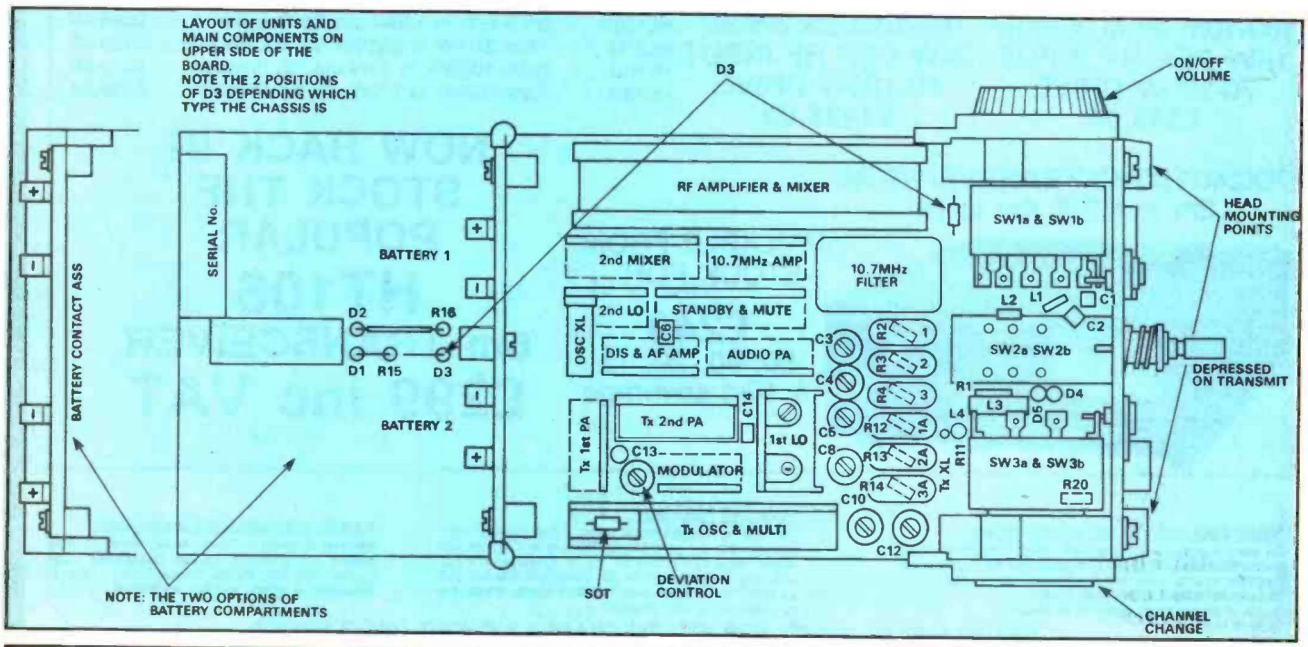
oscillator running at 10.8MHz. This results in a second IF output of 100kHz which is demodulated in the discriminator and AF Amp unit. The resulting audio is fed through the volume control and amplified by the audio PA unit, then fed to the head unit which houses the speaker/microphone.

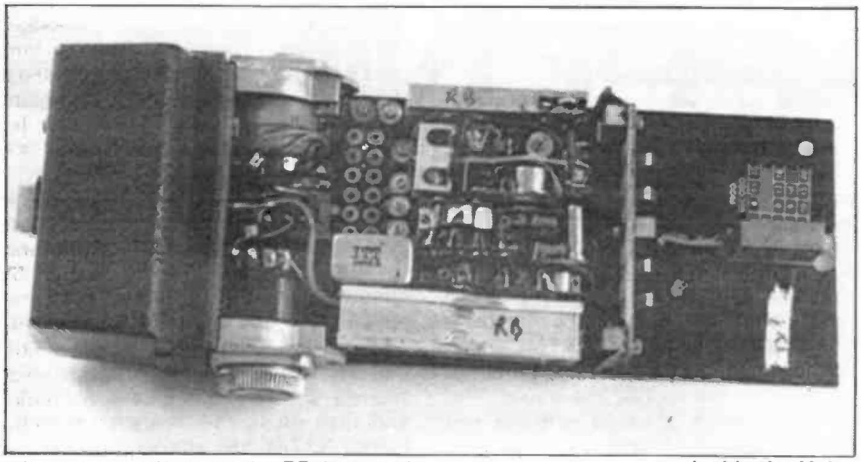
There is still one unit remaining which I have deliberately left until last, this is called the *'Standby and Mute'* unit. One purpose of this unit is to provide 5V and 8V supplies to sections of the receiver circuitry. Another function of this unit is to provide a battery save function. Part of the unit is an oscillator which switches the receiver on and off until a signal is present, and while it's there the receiver stays on. When no signal is present the receiver reverts to its On/Off state thus using less battery power than if it were to be on permanently. On some sets, this oscillator can be heard faintly in the speaker as a ticking sound. The presence or absence of this sound is not important but I think one should know that it could be there.

RX Alignment

Turning the set with its printed circuit uppermost, C6 can easily be identified as it is in the centre of the board. It is the value of C6 that determines the squelch setting and once set it should not need altering again. The value of C6 can range from 56pF to 270pF, and any values significantly outside that range should make one suspect the IF units. Remove C6 to open the squelch while aligning the receiver.

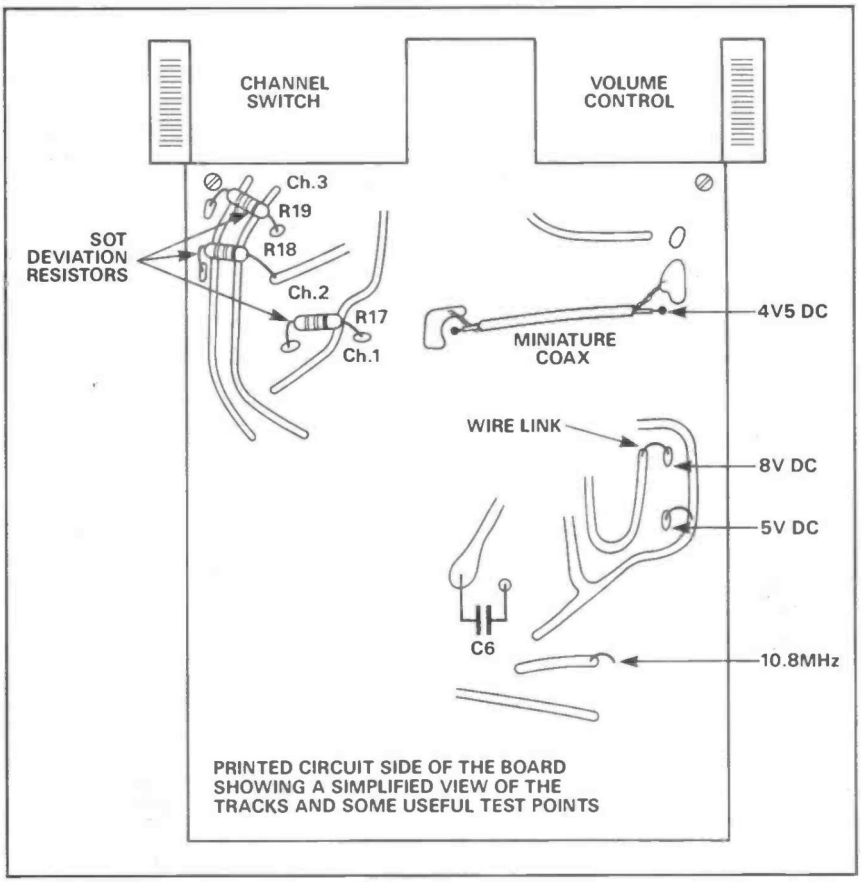
After you have inserted your receive crystal and initially tuned onto frequency using a strong local signal, you will need to adjust the coil and trimmer capacitor on the RX 1st LO unit, followed by the three





Inside the Unit

trimmer capacitors on the RF Amp and Mixer unit for best reception using a 70cm signal source of a variable level. The methods of achieving this have been well documented in previous HRT PMR conversion projects, and thus will not be dwelled on here. You'll find by adjusting the bottom left, bottom right, then the top right trimmers on the RF Amp should eventually provide you with a working set, providing no faults exist.



PRINTED CIRCUIT SIDE OF THE BOARD SHOWING A SIMPLIFIED VIEW OF THE TRACKS AND SOME USEFUL TEST POINTS

Fault Finding

Before I continue, let me stress the importance of cleanliness as many a *'poor receive'* problem has been cured by giving the board a good scrub with a stiff stencil brush and solvent. It's amazing how the board can pick up small pieces of debris after years of use, also I'd recommend placing the chassis on a piece of paper kitchen roll while working on the set to guard against further problems.

As I've briefly explained the circuitry, I'll continue with some useful monitor points and show what to expect. Earlier on, C1 was mentioned and this is found on the component side of the board between a socket in the top frame (aerial) and the central pin of the PTT switch. On the adjacent pin to C6 is the inner of a miniature coax, which being quite stiff can break, thus giving no receive. This may not be apparent as the coax rigidity will hold it close to the pin, so a careful check here could prove useful.

If either of the rotary controls become intermittent, a proprietary switch cleaner may be applied along their shafts, but this cleaner should contain a lubricant or the contacts will soon wear again. If in doubt, a brief spray test on a non-porous surface will determine if yours is the correct type, as an oily residue will be left.

On the inner of the miniature coax running between the local oscillator and the RF amp is a DC voltage of 4.5V, if this value is nearly 8V then there is a good chance the local oscillator has developed an internal short circuit. This may be proved by unsoldering one end of coax inner and measuring the voltage again. Two points further along on the RF Amp are where the 8V and 5V supplies can be found. The two supplies are routed to the RF Amp by small link wires which can break without this being apparent, a careful check with a test meter will soon identify any fault here.

A little further along the board is a length of track that joins the 2nd Local Oscillator and the 2nd IF Amp/Mixer, this carries the 10.8MHz signal. Therefore, a check with a frequency counter will prove if the Local Oscillator unit is working. If an RF voltmeter is available then one should be able to measure something in the order of 125mV RMS here.

Spares

It is a good idea to keep a look out for 'scrap' sets which may be acquired very cheaply, as these may be used for spare parts if needed. Another outer case, even if cracked and marked, can have holes made in it and used as a *'test case'*. With holes in the appropriate places, internal adjustments can be made while the set is in the case with batteries fitted. It is worth mentioning that although the case is plastic there can be a subsequent slight shift in the frequency when a set has been tuned with no case present.

On the subject of spares from scrap sets, the battery terminals from these can be mounted on pieces of wood or the like to hold batteries for charging. If the head unit containing the speaker/microphone and aerial becomes suspect, then a spare head can be swapped with the original to prove the fault.

That's It

The Burndept portable isn't a high power all singing and dancing transceiver, but under the right circumstances it's ideal for working through a local repeater or for locating a lost chum at a rally. (Ed's note – why not give one to your youngster when they've passed their Novice test!).