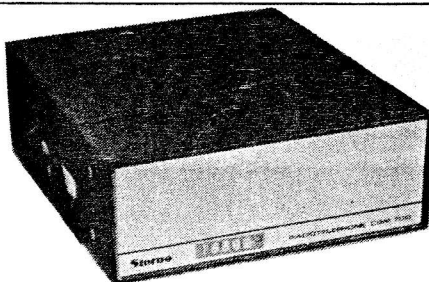


KIT REVIEW

Storno CQM713

Judging by the amount of interest generated from the HRT series on converting surplus PMR gear for use on the amateur bands, it is no surprise that rally stalls are quickly selling out. This was highlighted at the Leicester Exhibition, when a modification kit launched for the Storno CQM713 radiophone was so



natively, the radio may be remote mounted as originally intended, and a tiny control box made up to fit whatever space is available in the car.

The microphone amplifier in the original set is normally fitted into the telephone handset and a balanced 600ohm level is presented to the multiway connector. The modification board incorporates a suitable transistor amplifier interface, allowing a dynamic fist mic or suchlike to be used. Note however that the mic input line is *not* at earth potential, so watch out when wiring your socket.

The channel frequency information is also fed down the multiway socket, in the form of binary logic levels. These control a low-frequency synthesiser, operating between

Psst! Interested in a 20 watt fully synthesized two metre rig for as little as £60? G4HCL gets to grips with the Withers conversion for the Storno CQM 713.

popular that all were sold on the first day, a hurried trip by the dealer to replenish stocks for the second day had the same effect! The HRT exhibition team however managed to get their hands on one and here we reveal all!

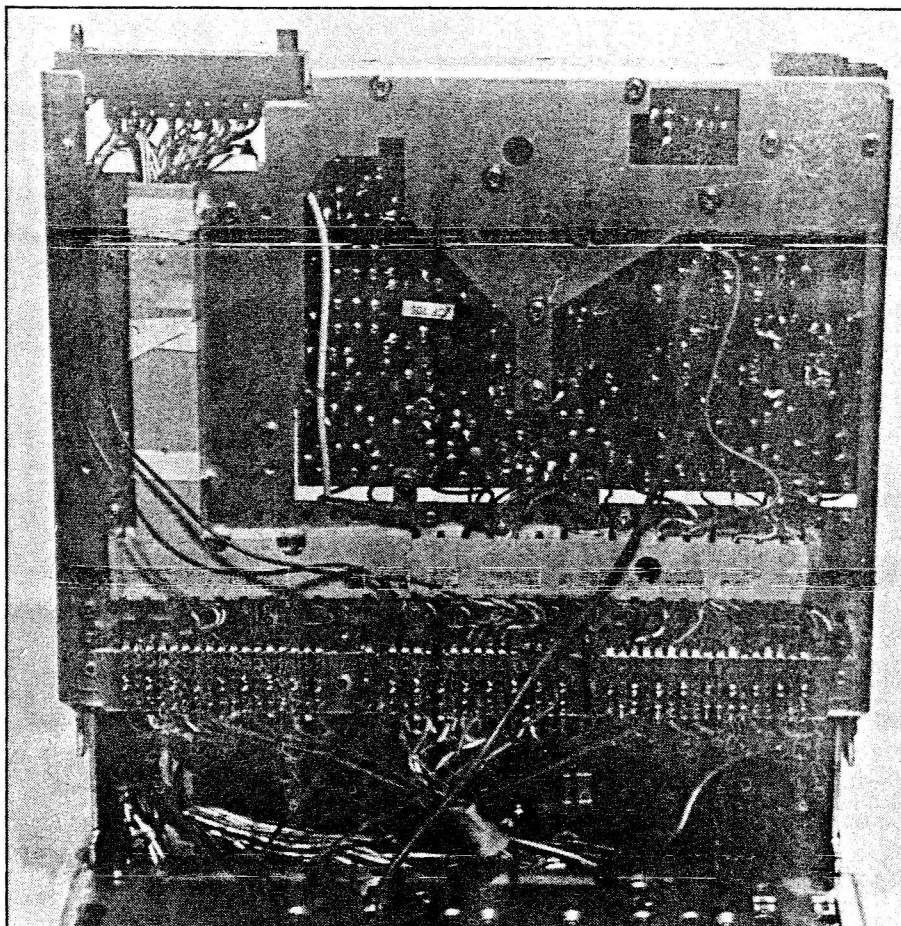
it entirely from the radio unit. This would then allow space for the modification board as well as switches, indicators, and even a small loud-speaker if you wish to convert the set into a stand-alone unit. Alter-

The Box in the Boot

The CQM713 is a unit designed to fit remotely in your car boot or under the seat, linked originally to a control box and handset by a multi-way cable. It was designed to operate on 55, 25kHz spaced channels, between 158.550 and 159.900MHz on transmit, and 163.050 and 164.400MHz on receive. The tuning range of the RF circuits will however go down to 144MHz quite easily without circuit modification. What *is* needed however, is modification of the control system and synthesiser mixer frequency. This has been performed using a small PCB and a pair of specially manufactured crystals, which are marketed as a kit by R. Withers Communications.

Control System

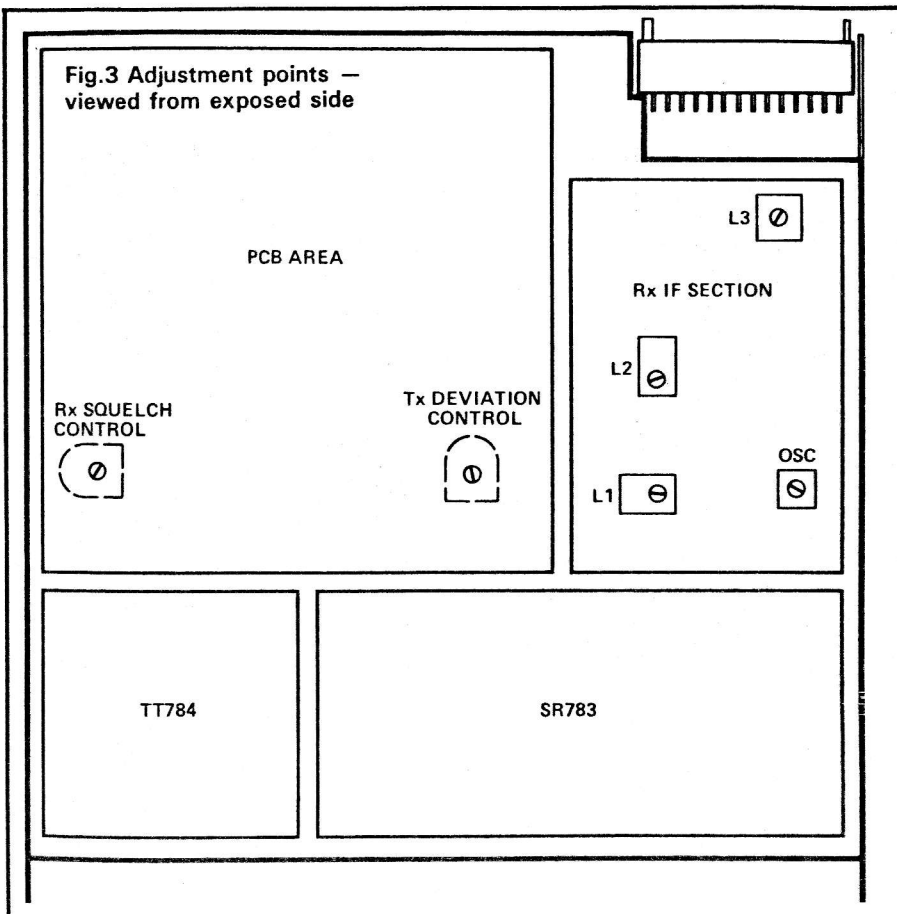
For radiophone usage, a sequential tone encoder/decoder system is needed to interface between the base control giving telephone number and channel, but we can happily bypass this or even remove



16.075 and 17.425MHz on both transmit and receive. The final RF frequency is achieved by mixing the synthesiser output with one of two crystal controlled signals (one for Tx and one for Rx), modification to 2m being simply a matter of changing these crystals and retuning. One complication that may arise is that we amateurs could require such luxuries as automatic repeater shift and a listen-on-input facility, causing crystal switching problems. An alternative to this is to perform binary addition of the logic control lines using simple adder ICs, and it is the latter method that has been incorporated on the mod board.

Transceiver Modifications

Open the chassis of the transceiver by removing all the M3 pozidrive screws on the outer cover of the set and by slackening the two remaining slotted screws at each side of the front panel — the outer case and front panel may now be slid off. Open the inner chassis by unscrewing two slotted screws at the rear underside and hinge open the two halves, just like a book. Firstly, we must provide a 5V rail to the mod board digital ICs, and a further 5V PTT switching line. Locate pins C and H on the rear multiway



socket, cut and discard the wires connecting to these. Connect in their place insulated wires from pin C to terminal 17 group A on the main tagstrip, and from pin H to terminal 11 group B, again on the main tagstrip

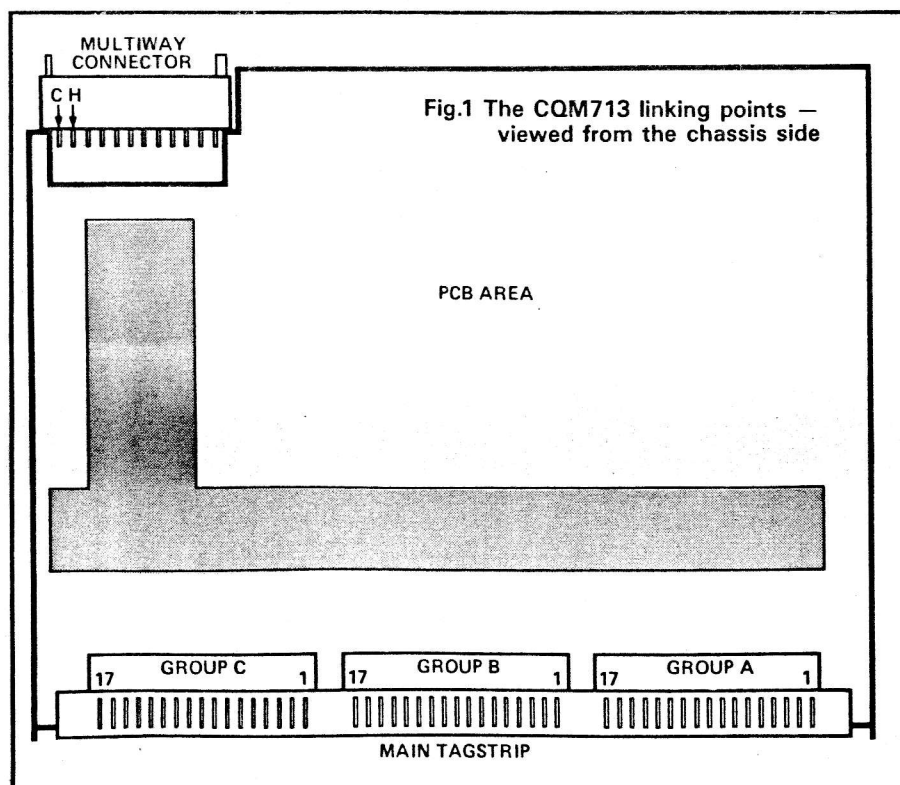
(see Fig.1 and accompanying photographs).

If you know your set is in good working order then fine, if not however the instructions accompanying the modification board suggest you test the transceiver using a good dummy load before ripping it apart. I found by operating the set in its unmodified state with the mod board plugged in and with no channel switches connected, it would correctly receive on 164.450MHz and transmit on 159.950MHz not, as the instructions state, 159.550MHz.

Discarding the old control boards

The RF circuitry is well screened, so to get at it simply prise off the push-on metal panels to expose the boards and adjustment points (Fig.2). Remove the two miniature HC45u crystals using a soldering iron and long nose pliers or tweezers, and in their place solder in the new crystals, marked 'T' and 'R' for Tx and Rx respectively. These are the larger HC18u case size, so you must insulate the cases and lay them horizontally across the board rather than place them back in their clips.

If you'd like to discard the old



control boards completely to make room for your own circuitry, then connect the following links on the main tagstrip;

- 1) Link pin 7 group A to pin 9 group A
- 2) Link pin 12 group A to pin 1 group C
- 3) Remove the three tone logic PCBs, cutting the lacing and insulating the discarded wires, but *do not* cut the wires soldered to the three-terminal 5V regulator mounted on the side of the chassis.

Multiway Cable Wiring

If you wish to use the set as a remote unit as opposed to a dash-mount, then make sure you obtain the matching cable and plug. The radiophone normally uses a 24 way cable which has multi-coloured wires for identification. However not all of these are used and as we need to use new terminals on the multiway connector for the binary control lines etc, the cable connector must be re-wired. I found it easiest to desolder the existing wires rather than cut the cable and re-strip and tin all the wires, but it's up to you as long as a neat job is the end result. **Table 1** shows the connections required, the first colour is the main wire insulator colour and the second is the tracer (the thinner colour strips). You should have four wires left over, these being green, brown/grey, green/grey and red/brown. These may be insulated rather than simply cropped short as you might find a future use for them — in scanning applications perhaps.

Modification Board

This is a small PCB measuring 87mm x 60mm, housing two 4560 CMOS adder ICs, a 600ohm microphone amplifier, connection points for controls and indicators, and a diode matrix fitted to a further sub-board. It enables two methods of frequency control, either by adding a pair of BCD thumbwheel switches to give a numerical readout, or by using the matrix board and wiring in a pair of normal 10-way rotary switches. Toggle switches give logic inputs to the adder ICs to perform 600kHz shifts. The end result is a BCD (Binary Coded Decimal) output corresponding to eighty 25kHz channel steps, covering the 2MHz wide 2m band. The more ambitious

amongst us can no doubt dream up many other control methods such as digital shift registers and displays linked to scanning circuitry, but the

original concept of the conversion was simplicity and low cost. May I suggest that if you have an old broken CB transceiver that uses an

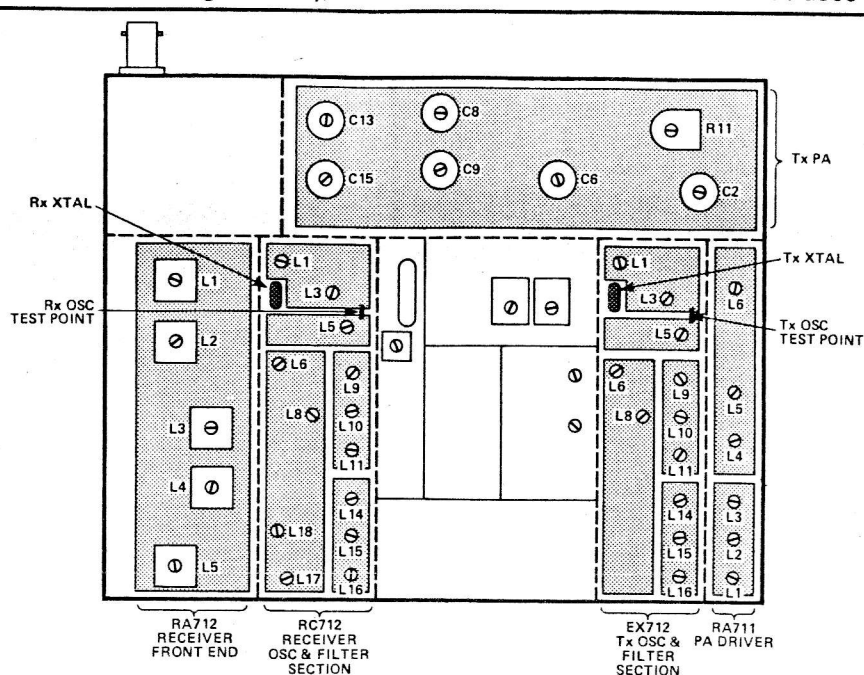
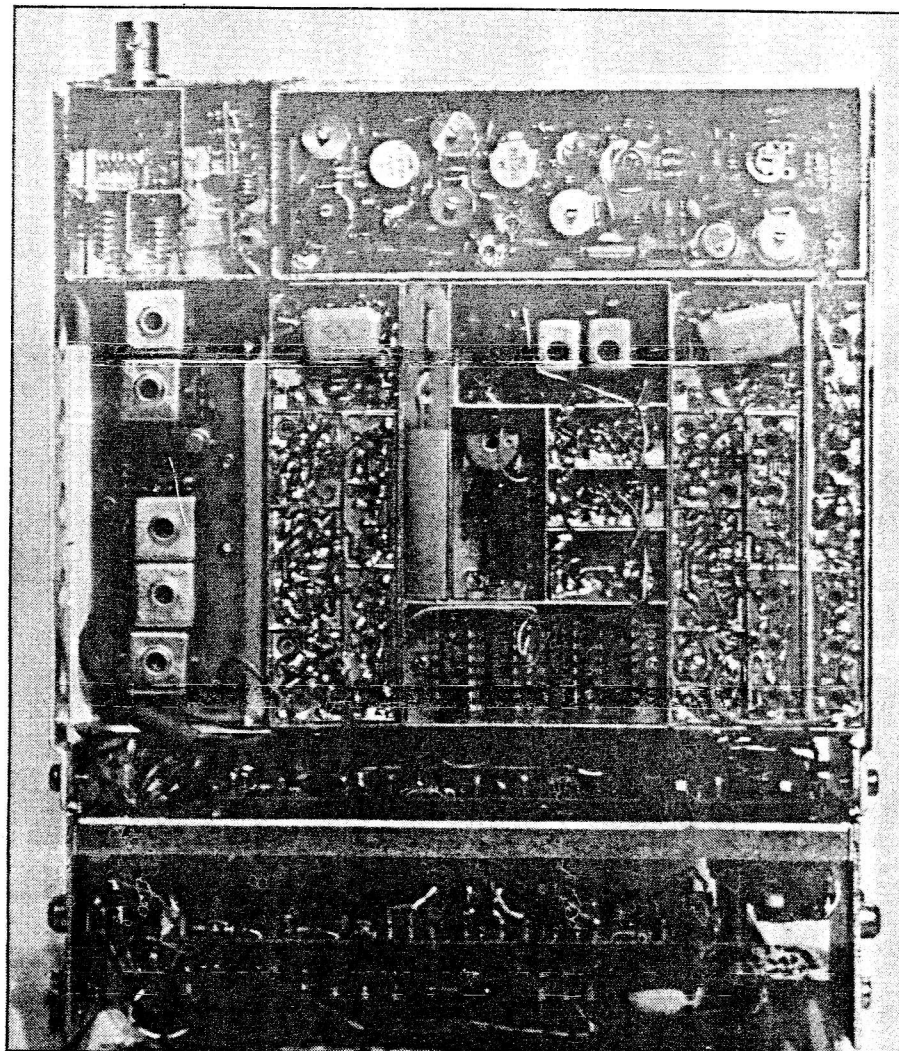
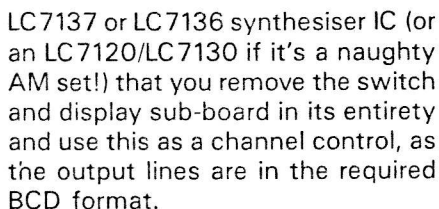


Fig.2 Board location and alignment diagram for the CQM 713



IF UNIT X48-3010-XX RF UNIT X44-3000-01



There is a catch with whatever control method you use, in that the channel numbers are inverted. Due to the original Storno design, the frequency decreases with each increase in channel number, ie. channel 1 is the highest frequency whilst channel 55 is the lowest, this is of course carried over to the 2m modification. However one easily gets used to the fact, and it can be solved by further digital logic if you're really fussy! Table 2 gives the channel/frequency relationship.

The conversion board and multiway wiring detail

First make sure you have a suitable *non-metallic* adjustment tool to tune nylon adjusters visible in the set. *Don't* be tempted to 'make do' with a watchmaker's screwdriver or the like, as disaster will surely strike. I used a Radiospares trimming tool, but if you don't have something suitable to hand then a filed down knitting needle or matchstick works wonders.

You will also need a frequency counter or a diode probe, together with a power meter and a 2m rig with an S-meter. Start by temporarily

linking the yellow/grey squelch defeat control lead (N) to negative; switch on and adjust the volume pot to give a suitable noise level. With your probe or frequency counter on the receive oscillator test point, ie. the short blue insulated wire (see Fig.2), tune L3 on the RC712 section until you get a reading. If you are using a counter, tune L3 and L1 until you get a reading of exactly 134.225MHz, which is the fre-

quency of the 7th overtone Rx mix crystal. If not, then radiate a strong local signal from the working 2m set and tune L1 and L3 for least distorted speech, making sure you have both sets on the same channel. Now that we have the receiver on frequency, we can start to re-align for best performance.

By progressively reducing the off-air 2m signal level, tune L5, L6, L8, L9, L10, L11, L14, L15 and L16 on

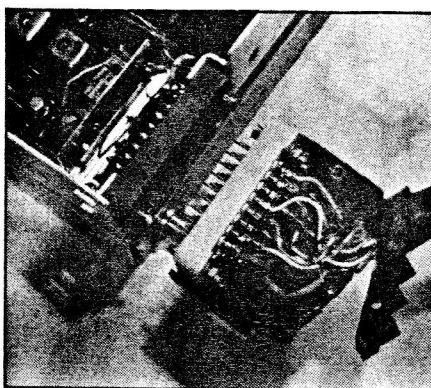
the RC712 section for best quieting of noise. Then go onto the RA712 section, which is the front end, and tune L1, L2, L3, L4 and L5 — again for best signal corresponding with maximum quieting level, reducing the received signal as necessary to aid alignment. By now the set should be capable of receiving off-air signals, so 'fine tune' each coil (including L1 and L3 if originally adjusted without a counter) for absolute best reception of a weak signal. I managed to achieve 0.22uV pd sensitivity for 12dB SINAD which is quite reasonable when compared with the average Japanese box. The IF section should already be aligned, however the squelch control is a pre-set (see Fig.3), and you may adjust this if you wish to give a more sensitive level or even bring the connections out to the front panel for a variable control.

Transmitter Alignment

First connect a suitable load to the aerial connector via an in-line power meter or some other form of level detector. If you must use an aerial rather than a dummy load then

Table 1 Multiway cable wiring details

CODE	DESCRIPTION
A	Not used
B	Not used but also -ve
C	Orange; 5V Tx
D	Grey/red; Binary 8 tens
E	Not used
F	Brown; PTT
G	Not used
H	Green/brown; 5V rail
I	Not used
J	Yellow/green; Binary 4 tens
K	Not used
L	Not used
M	Not used
N	Yellow/grey; Squelch defeat
O	Not used
P	Not used
Q	Not used
R	Black — Link to AA; -Ve Gnd
S	Yellow; Loudspeaker AF
T	Black/yellow; Volume pot
U	Yellow/white; Binary 2 tens
V	Blue/brown; Binary 8 units
W	Not used
X	Yellow/brown; Binary 1 tens
Y	Green/white; Binary 4 units
Z	Not used
AA	Black; -ve Gnd
BB	Not used
CC	Red/yellow; Binary 2 units
DD	Not used but also -ve
EE	Not used
FF	Grey/white; Volume pot
GG	Not used
HH	Green/red; Binary 1 units
II	Not used
JJ	White; Mic input
KK	Thick blue; 12V DC switched
LL	Thick red; 12V DC input
MM	Brown/white; Volume pot slider
NN	Link to KK



Close-up of the multiway plug

please make sure you choose a frequency where you won't be causing interference! Keep the transmitter keyed by grounding the brown PTT line (F) and connect your counter or probe to the transmitter oscillator test point, again a short blue insulated wire (see Fig.2) and tune L3 on the EX712 section for an indication. If you're using a counter, tune L1 and L3 for exactly 128.525MHz, the frequency of the 7th overtone transmit mix crystal. If you have a good airband receiver, this may aid you in the absence of a counter.

Now by using the 2m receiver alongside the set, tune L5, L6, L8, L9, L10, L11, L14, L15 and L16 for maximum received signal strength again making sure that both sets are on the same channel. Then continue onto the RA711 section, tuning L1 through to L6 again for maximum signal, reducing the coupling between the two sets as required. By now, you should be getting some indication of RF power on your meter, so continue tuning the variable capacitors on the PA stage for absolute maximum, then go back

Table 2 Frequency & channel relationships

BCD Input	BCD Tens		BCD Units		FREQ (MHz)
	MSB	LSB	MSB	LSB	
00	0000	0000			146.000
01	0000	0001			145.975
02	0000	0010			145.950
03	0000	0011			145.925
04	0000	0100			145.900
05	0000	0101			145.875
06	0000	0110			145.850
07	0000	0111			145.825
08	0000	1000			145.800
09	0000	1001			145.775
10	0001	0000			145.750
20	0010	0000			145.500
30	0011	0000			145.250
40	0100	0000			145.000
50	0101	0000			144.750
60	0110	0000			144.500
70	0111	0000			144.250
80	1000	0000			144.000

and fine tune all the transmitter stages until the set is completely aligned for maximum power output. You should get around 20W output, I achieved just over this, but you may finally adjust R11 on the TX PA to set your desired output level. I did find a slight problem on L5 and L6 of the RA711 section, where excessive drive caused instability in the PA. This may have been an isolated case, but if you find that the output power jumps quickly in level as you tune, then I would suggest slightly detuning L5 in one direction whilst detuning L6 in the other direction to reduce the overall drive level.

If you originally adjusted L1/L3 with a counter, your set should now be on frequency, if not then set these to give centre frequency from an off-air report. Your deviation should be close to 5kHz already, but Fig.3 shows the position of the deviation control should you wish to vary it. The other unmarked adjustments in Fig.2 are the synthesiser VCO (Voltage Control Oscillator) and reference crystal oscillator adjustments, these should all be spot on and hence will not need adjustment.

Replace the internal screens to the boards, checking to ensure that the performance is not affected when you do this. You may need to very slightly re-tune the adjustments on a trial-and-error basis if you find this happens, although I found no problems occurred in the test set.

Second Rig

So there we are, for around £60 you've got yourself a synthesised 2m rig, either as a first set for the band or possibly as a permanent remote mounted mobile set to save you lugging the FT290 about. A remote mount makes the rig far less prone to theft with the main set being hidden away out of view and just a tiny box under the dash or in the glove compartment. Because PMR equipment such as this is designed to strict professional specifications, it will easily outperform most amateur sets in regard to strong signal handling, adjacent channel rejections and transmitter modulation quality and RF cleanliness and that can't be bad!

My thanks go to R. Withers Communications Ltd for loan of the equipment and conversion kit.