Trio TK801S Ex-PMR Radio Conversion

Dave Coomber G[illegible]UYZ, Kev Graham G8ZWU and Brian Gallear G8VI[illegible]R get some Trio-Kenwood ex-PMR r[illegible]dios onto 70cm

The Trio TK801S is a synthesized 40W UHF FM transceiver, and this article describes how the set can be converted for use on 70cm with the use of EPROMs to derive the output frequency. (The VHF TK-701S conversion to 2m is planned for a future issue of HRT – Ed).

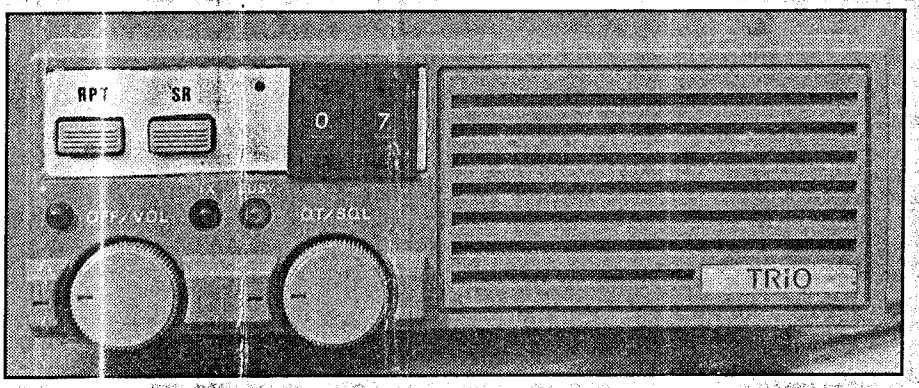
Programming

The EPROM-based conversion offers 240 channels in the band 432.0 to 435.0MHz including the repeaters, simplex and the packet channels in the hexadecimal range 00 – F1 in 12.5kHz steps. It is alternatively possible to arrange a set of 16 small switches or links and have a 'look-up' table to set the simplex frequency of operation. There are two sections to the whole conversion; making sure it works on UHF (it's important that the set is working correctly on the band before starting), and modification of the ROM data source by fitting a pair of EPROMs. The conversion described, whilst straightforward, *can* get a bit difficult especially for those unused to digital work. We cannot stress enough the need for a good standard of work and careful attention to normal safety procedures, including the safe handling of CMOS devices. If you make up a Veroboard, it is absolutely vital that great care is taken with the wiring. All three of us suffered problems which were attributable to wiring problems.

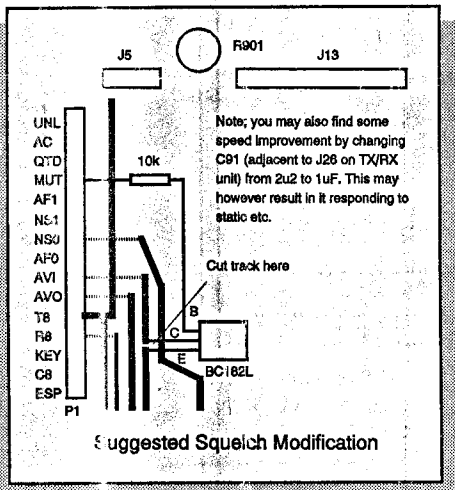
EPROMs

It would be pointless to waste a lot of space with a load of meaningless printed jumble of little use to the average ham who lacks an EPROM programmer, so the authors offer a programming service on your own EPROMs, or can supply suitably programmed EPROMs.

Since a 16-bit pattern is required, two EPROMs are used, 27C64 types are described here. Thumb-wheel BCD switches select a programmed address in the EPROM and the memory constants are put onto the input lines of U18, the first Phase-Locked Loop (PLL), via header cables to U22 & U23.

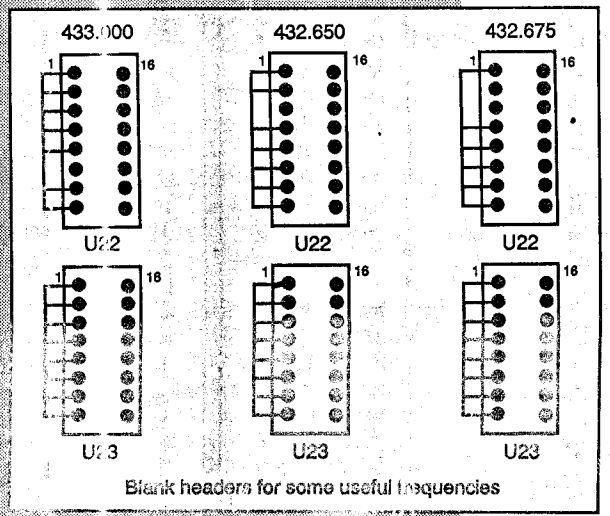


The TK-801S



Suggested Squelch Modification

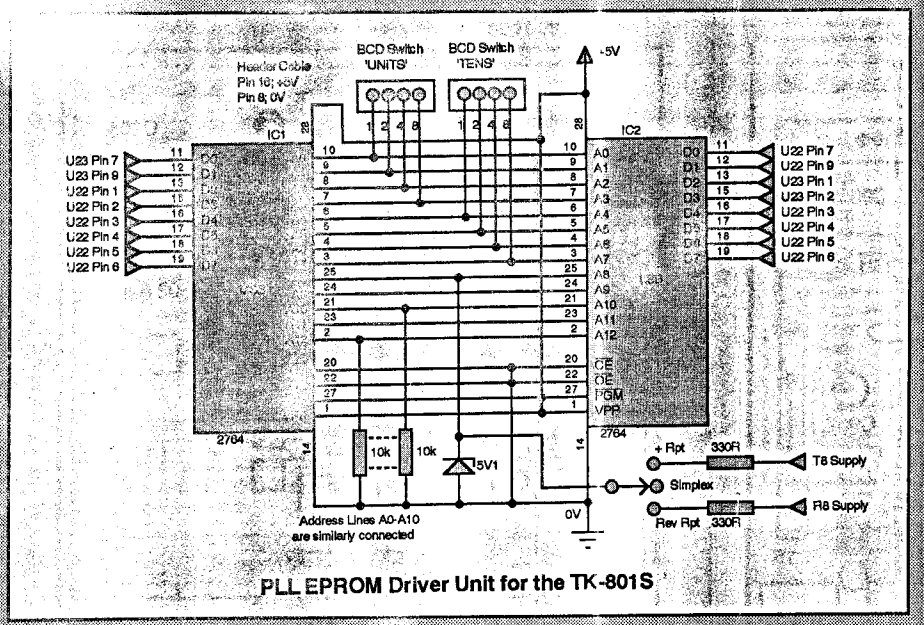
The data on the EPROM address lines A0-A7 is selected by the BCD switches which address data held in the ROMs. The resultant 8+8 data (8 bits from each of the two EPROMs) is sent via the header cables to the PLL in the radio as a 10 bit plus 6 bit. All address lines are held *low* by the 10k pull-down resistors (this is opposite to the PLL U18, which keeps its lines high unless otherwise pulled low). Address line A8 is used to select an offset to store the repeater shifts. This selection is made by using the T8 (+8V Transmit line) via S3a (S3b is used to select the appropriate LED). Reverse repeater is accomplished by selection of R8 (+8v Rx line). The centre-off position ensures that simplex mode is selected. EPROM address line A8 is clamped to +5V by a zener diode.



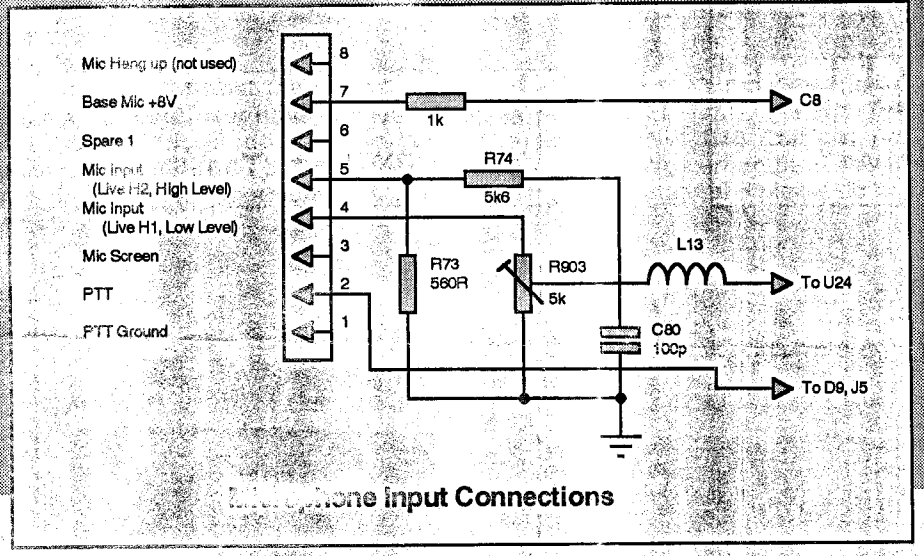
Blank headers for some useful frequencies

No ROM?

If your set does not have any ROM data you will need something to replace them, such as a binary switch assembly which can be used to select frequencies of use (simplex transmission only). The accompanying listing shows typical binary codes to be used on the switch, and a PC



PLL EPROM Driver Unit for the TK-801S



Microphone Input Connections

program is available (see later) to enable you to calculate the codes required for any required frequency range. We used both GWBasic and QBasic for the PC, and the program is simple enough to be easily converted to other BASICs. Alternatively, you will need to make up a pair of header blanks (using a wired pair of headers or IC sockets (turned pins), with some coding on to drive the PLL. In the listing shown here, the binary numbers are in switch order, i.e., lowest value on the left.

Preliminaries

You'll need a 13.8V DC supply, a 15A Ammeter to measure the DC consumption (unless fitted to the supply), an RF Power meter, an AVO or good DVM (10V DC full scale), a 50W UHF dummy load, and normal tuning tools. You will find a simple logic probe of considerable help in diagnosing any problems. (You can also use a multimeter set to the 5V range). Connect a microphone for the PTT, a dummy load to the aerial socket and the 13.8V supply to the set.

If there is a CTCSS tone board fitted in your set, remove it. If there is no CTCSS tone board fitted, check that a plug is fitted to J6 (near the microphone input connector). If this plug is not fitted, solder a lead between pins 3 & 5 (AF1 & AF0) or make sure that link H4-H3 (adjacent to pin 5) is fitted with a jumper connection. (This point is also noteworthy for being an ideal place from which to take AF output (500mV) to a TNC). Solder a second lead between pins 4 & 1 (AC and GND).

PLL Adjustment

Switch on, set the repeater switch to centre (off), the BCD switches to 50 (corresponding to 433.000MHz), or use a programmed blank header. Squelch fully open, volume to a comfortable level. Connect an AVO earth lead to earth, select 10V DC range, apply the positive lead to the 1st RX test point (TP1). Tune capacitor C901 for about +5V. It should not move by more than about 0.5V at the top and bottom edges of the chosen band. Re-adjust for a compromise if necessary. Connect the UHF Frequency Counter to TP6 on J11 pin 3 and tune C902 for (Rx frequency – 21.4MHz)/3. This works out to 137.1MHz for channel 38 (432.700MHz).

For the TX PLL, place the AVO positive lead (10V DC range) on TP4. Press the PTT button. Tune C903 for 2.5V on TX (it should not vary by more than about 0.5V from the bottom to the top of the band).

Receiver Alignment

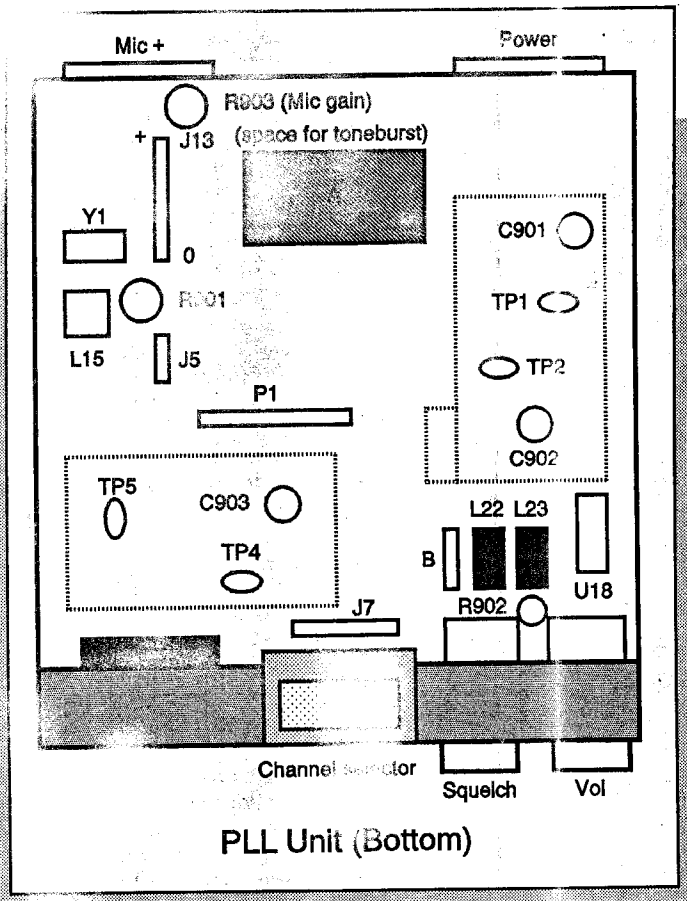
The TK801 uses helical resonators which have brass core slugs. If you lose the core retaining springs, you are in deep trouble as they not only secure the core slugs, but also form an earth connection from the slug to the outer case. They are not easily replaced. You might get away with soldering a piece of wire across the can and in line with the core slot or even solder the slug to the can – but only *after* you have tuned the set up.

If you have been fortunate enough to obtain a 420-440 MHz set, (T band), you will probably not have to do much! If you have a U band set (440-470 MHz), the cores of Z17, 18, 19 & 20 will be about three turns out. It's about the only way of telling the difference! Connect the AVO (or a 'scope) to the loudspeaker connections (set to 2.5V AC range). Inject fundamental RF, modulated 1kHz tone, at a high enough level into the Ae socket to hear *something*. Tune Z17, Z18, Z19 & Z20 for maximum audio output (as read on the 'scope or the AVO connected across the loudspeaker connections), reducing the input signal level as the noise decreases and the signal rises. Repeat until there is no further improvement. The brass cores will be almost fully in on Z17, 18, 19, & 20. Tune L27 to obtain maximum sensitivity (best SINAD). Tune L29 for maximum AF output. Tune L26 & L23 for minimum audio distortion (best SINAD).

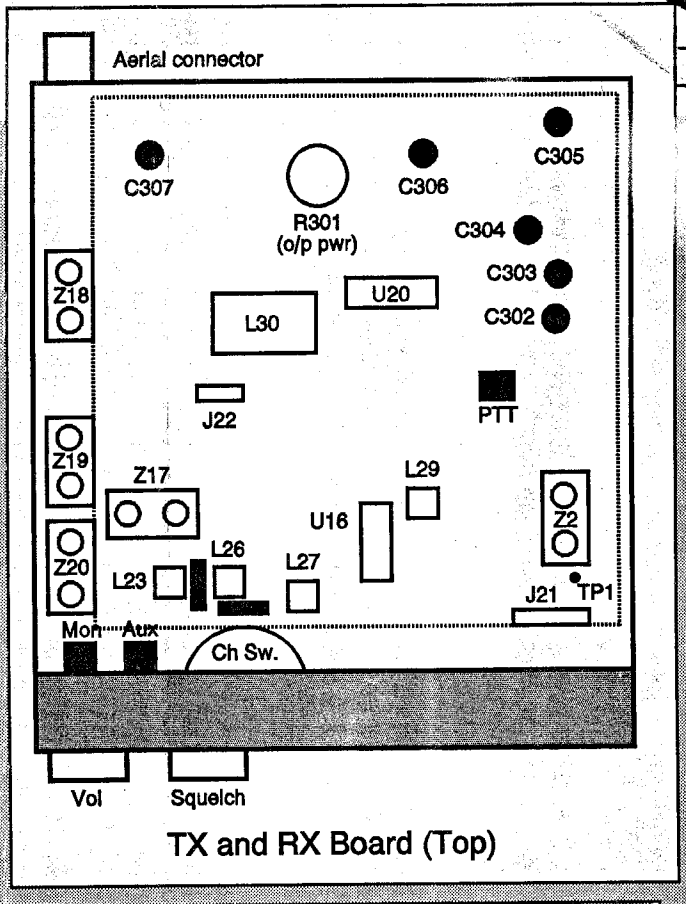
To preset the squelch, turn the front panel squelch control fully anti-clockwise until the switch operates. Set R902 clockwise until the squelch opens (and the green LED light illuminates), then back off R902 until the light just extinguishes. Some users have reported problems with the squelch. A simple modification is possible which requires only a small transistor and a 10k resistor.

TX Alignment

Connect your dummy load and select a channel in the middle of the



PLL Unit (Bottom)



TX and RX Board (Top)

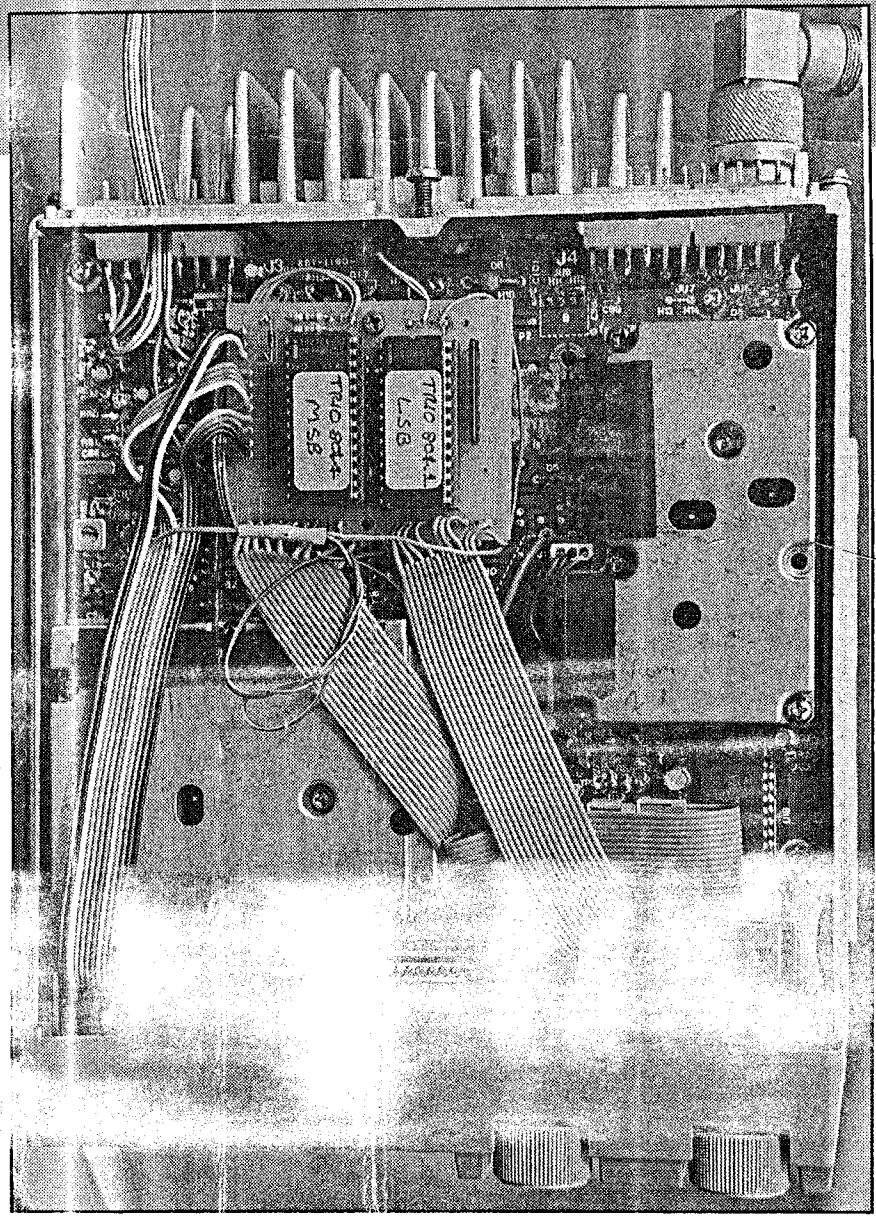
band. Squelch closed, volume to a comfortable level. Put the frequency counter leads to J21. It should read (Tx freq./3) when the PTT line is pressed. Disconnect the counter from J21 and put it near C302. Tune Z2 coils for an RF output at TX final frequency. Tune C302, C303 & C304 for increasing RF output (measured at the aerial socket). If you get none, rotate R301 fully clockwise. Re-tune C302, 303, 304, 305, 306 and 307 for maximum RF output (should be well in excess of 25W – usually 40W). Observe the ammeter for a slight 'dip' as you come up to maximum output power. The core of Z2 should be about one turn out after tuning. Rotate R301 anti clockwise to set desired RF output level (ours all seem to work very well at about 20W (4 – 5A consumption).

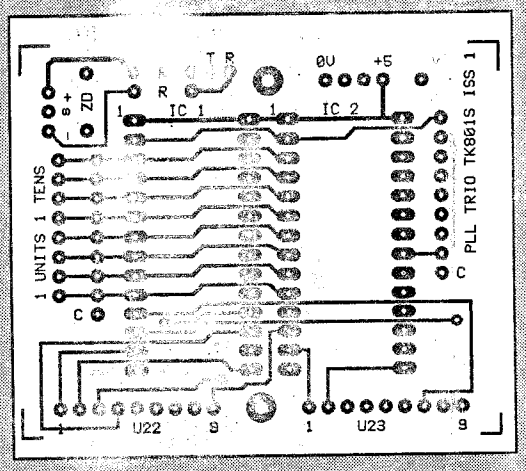
Place the counter lead near the aerial socket (or on the dummy load). Tune L15 for *exact* TX frequency. Re-tune C305, 306 & 307 for maximum RF output commensurate with minimum DC supply current, this ensures that the set will run a bit cooler. This manoeuvre can take a little practice.

For deviation adjustment, set R903 fully clockwise, then set R901 clockwise for your desired deviation, the local repeater signal is usually a good comparison.

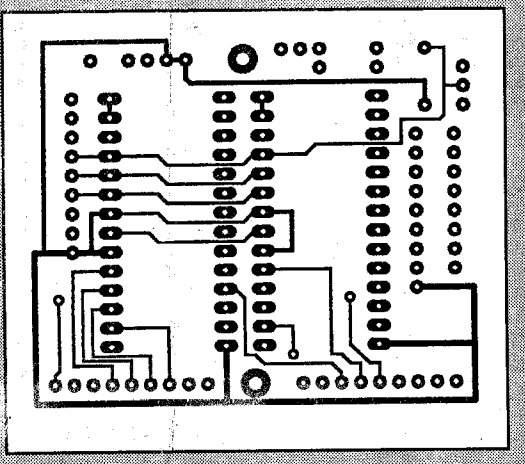
Diagnostics

If you're having problems and you're using the EPROMs, check that the supplies are good to both ICs (on pins 28, 27 & 1) and that the earth is





PCB, component side, full size



PCB, solder side, full size

properly made (pins 14, 20 & 22), and that you have the correct bit positions on the ICs (details available from HRT for an SAE).

If you fail to get the correct frequency of output (or none at all if the PLL is out of lock), double check the header blanks (if used), or that the switch bank (if used) is correctly set. The switches are used with the binary count reversed to the normal method (0 to the left). You might find it easier to wire up the 'cross-overs' of pins 7 & 9 for U22/U23 on the board as it will make for easier construction of the headers. Remember that the switch order is N0–N5, A0–A5, left to right. Check also the setting of the repeater selection (if used).

The lowest simplex channel is 00 (432.000 MHz), highest channel is F0 (435.000 MHz). These simplex channels are in 12.5kHz steps. Using the ready-programmed EPROMs, the repeater channels start at 50, running every other one to 6E (viz., 50, 52, 54, etc..). Note: These transmit *only* in 25kHz steps, although you should be able to receive a station that is 12.5kHz away (51, 53, etc..). The repeater switch should be set to '+' for normal repeater operation, '-' for reverse. The centre position should be *off* for simplex operation.

General Notes & Applications

As noted earlier, there is a 500mV source of audio, which is suitable for feeding a TNC, available at AF0/AF1. Note that the audio output on the rear apron is at 130mV and it is passed via a high-pass filter (Q24, 2SC1815C), which does not seem to be too friendly to packet/data signals.

The PTT line is 'live' and pulled to earth to make the set transmit. Consumption has not been measured, but it work well on our TNCs. The Loudspeaker output is rated at 4 watts into 4 ohms.

PCBs, EPROMs, and More Information

For a programming service on your own EPROMs, or a supply of suitably programmed EPROMs, contact Kev Graham G8ZWU, 670 Stafford Rd, Fordhouses, Wolverhampton WV10 6NW, for full details and please do not forget to enclose an SAE. Thanks to the efforts of G4YTK who designed it, there is a double-sided PCB layout illustrated, there may even be one or two in stock for those who do not want to design their own. A transceiver circuit diagram, 'add-on' details, operational and faultfinding notes, drawings etc. (unfortunately far too many to publish in this magazine article – Ed) are available by sending a large SAE marked "TK801 Information" to the HRT Editor at the usual HRT Head Office address (rear pages). If you'd like a copy of the BASIC program to calculate the channel codes for any 70cm frequency, send a blank, formatted 3.5in PC disk along with your SAE. For any other queries relating to this conversion, please contact the author, Dave Coomber G8UYZ, 14 Francis Green Ln, Penkridge, Staffs ST19 5HF.

Typical EPROM codes

Freq	Dec.	N Binary N0123456789	Dec.	A Binary A012345
			2	010000
432.625	514	0100000001	4	001000
432.650	514	0100000001	6	011000
432.675	514	0100000001	32	000001
433.000	514	0100000001	34	010001
433.025	514	0100000001	36	001001
433.050	514	0100000001	38	011001
433.075	514	0100000001	40	000101
433.100	514	0100000001	42	010101
433.125	514	0100000001	44	001101
433.150	514	0100000001	46	011101
433.175	514	0100000001	48	000011
433.200	514	0100000001	50	010011
433.225	514	0100000001	52	001011
433.250	514	0100000001	54	011011
433.275	514	0100000001	56	000111
433.300	514	0100000001	58	010111
433.325	514	0100000001	60	001111
433.350	514	0100000001	62	011111
433.375	515	1100000001	0	000000
433.400	515	1100000001	2	010000
433.425	515	1100000001	4	001000
433.450	515	1100000001	6	011000
433.475	515	1100000001	8	000100
433.500	515	1100000001	10	010100
433.525	515	1100000001	12	001100
433.550	515	1100000001	14	011100
	515	1100000001	16	000010
	515	1100000001	18	010010
	515	1100000001	20	001010
433.625	515	1100000001	22	011010
433.650	515	1100000001		
433.675	515	1100000001		