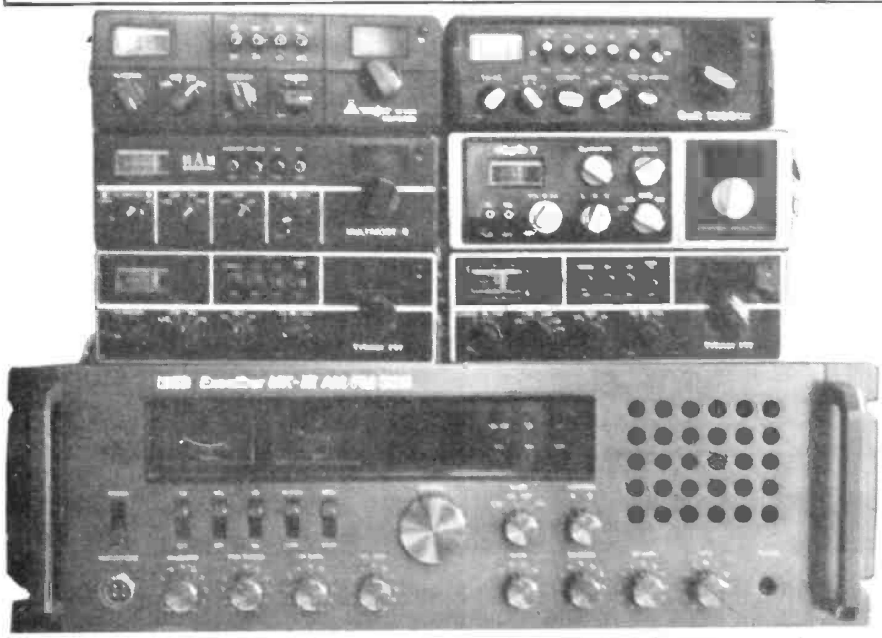
Converting Ham Internationals To 10m PART 2



The Ham International series — a group photo of the infamous seven!

In this second and final part, Roger Alban, GW3SPA, describes how this series of CB rigs can be modified with the aid of an EPROM.

Binary addition can also be used to extend the frequency range of the rig. Using the channel frequency relationship shown in Table 3 (see December '85 HRT), channel 30 on the high band corresponds to the FM calling frequency of 29.6MHz. The required binary code for channel 30 will be 81 (from Table 6, Dec HRT) and the switch logic code is 29 (from Table 5, Dec HRT). Therefore the binary adder will be required to add binary 52 to the programme code.

When the rig is switched to mid band, the working frequency will be 29.20MHz. The required binary number will now be 121 (see Table 7). To obtain the new binary values on the PLL chip programme lines, using the same switch logic code, the binary adder must add binary 92 to the original binary value.

Finally, with the rig switched to low band, channel 30 corresponds to a working frequency of 28.80MHz and from Table 8, the new binary value can be seen to be 161. The binary adder will need to add binary 132 to the original binary value to obtain the required binary value. Therefore, as we switch from one band to another, the binary value on the B inputs to the binary adder will have to be changed.

Table 9 shows the binary codes required on the B inputs together with the corresponding logic levels. Note that B0 and B1 remain at logic level 0 and B2 at logic level 1. The remaining B inputs must have their logic levels changed from band to band in some way. Using the binary adder circuit diagram (Fig.5 Dec HRT) and Fig.6, reconnect the B inputs, to obtain the required logic levels. Using diode switching, B3-7 are connected to the band switch, SW1 which is also connected to Vdd to prevent feedback reaching the other B inputs.

This technique for changing the logic codes on the B inputs uses only 6 diodes. The diode matrix is built on a separate piece of Veroboard and wired to the band change switch on the front panel of the rig and to the Veroboard containing the two binary adder chips with ribbon cable. The rig will of course need to be retuned as described in the first part.

This binary addition method of modification is cheaper than the three crystal approach because one of the original crystals is being used. However, there are disadvantages in the two methods so far described. Firstly, on looking closely at Table 3 you will see that some frequencies on the upper channels of the lower bands are repeated on the lower channels of the upper bands. For example, channel 40 on

CHANNEL	P8	P7	P6	P5	P4	P3	P2	P1	P0	BINARY NUMBER
CHAN 1	0	1	0	0	1	1	0	1	1	155
CHAN 30	0	0	1	1	1	1	0	0	1	121
CHAN 40	0	0	1	1	0	1	1	1	1	111

Table 7 The required programme code for mid band.

CHANNEL	P8	P7	P6	P5	P4	P3	P2	P1	P0	BINARY NUMBER
CHAN 1	0	1	0	0	0	0	0	1	1	195
CHAN 30	0	1	0	1	0	0	0	0	1	161
CHAN 40	0	1	0	0	1	0	1	1	1	151

Table 8 The required programme code for low band.

BAND	B7	B6	B5	B4	B3	B2	B1	B0	BINARY NUMBER
HIGH	0	0	1	1	0	1	0	0	52
MID	0	1	0	1	1	1	0	0	92
LOW	1	0	0	0	0	1	0	0	132

Table 9 The required 'B' input logic codes for multi band use.

low has the same operating frequency as channel 4 on mid band. This can be overcome by adjusting either the band crystal frequency or the divide by N number but it will result in certain frequencies being lost.

Another disadvantage is that the logic code produced by the channel switch is designed to FCC frequency specification (ie frequencies are missed and there is a strange jump back between two of the upper channels). This non sequential code would have to be intercepted before it reached the PLL programme lines and converted to an acceptable logic code which will increment the operating frequency in sequential 10kHz steps.

The Solution — An EPROM

The device that can easily generate a new logic code is a suitably programmed ultra violet Erasable electrically Programmed Read Only Memory (EPROM). This memory device can store the required logic codes in various address locations, which can be selected by applying separate logic levels on the address lines of the EPROM. The address logic levels can be produced by the existing channel control and band change switches as different programme levels will be required for each band. The memory output of the EPROM can be fed directly to the programme lines of the PLL chip.

The contents of the memory can be so arranged that it will ensure that the logic output produced by the various non sequential addresses will be sequential. The EPROM can be programmed at home using an inexpensive manual 'programmer', inputting eight bits of data at a time using a series of switches connected to a power supply. The author can supply a readily 'blown' EPROM at a modest cost for those who do not wish to do this, see the box at the end of the article.

The INTEL 2716

The EPROM chosen for this application is the 2716 because it only requires a single 5 volt supply. Other EPROMs require a minimum of two different operating voltages, one of which is normally in excess of 12 volts. The 2716 draws an operating current of approximately 100mA and therefore a separate stabilised voltage supply is needed to drive the 2716 from the 13.8 volt supply.

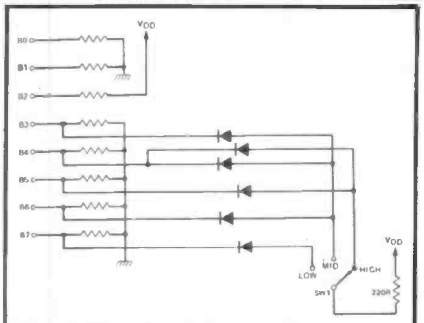


Fig. 6 The circuit for the diode switching which provides the required logic code for the B inputs for each band.

Fig.7 shows how the 2716 EPROM is inserted between the channel switch and the PLL chip programme lines. The programme lines from the channel select switch P0-5 are connected to the 2716 address inputs A0-5. The 4.7k ohm pull down resistors are also connected to the address line inputs to ensure that they are maintained at logic level 0 when the channel switch has no output on any of its programme lines.

Address lines A6, A7 and A8 are connected to the band switch to alter the input address of the 2716 between each individual band. Repeater shift is taken from the rig's transmit line which is +9V on transmit and 0V on receive. A 4.7V zener diode ensures that the logic level fed to address input A9 is held below 5V when the repeater switch is closed on transmit. Address line A10 is not used and its input is grounded to ensure that it remains at logic level 0.

The outputs from the 2716 are fed directly to the input programme lines of the PLL chip as shown. You will observe that programme line P8 is not required and is grounded to remain at logic level 0. Pins 18 and 20 on the 2716 are only used when the 2716 is being programmed so they are also grounded.

The 2716 is fed from a stabilised 5V supply produced by a TIP 3055 pass transistor and a 5.6V zener diode. The pass transistor is attached to the side of the rig via a mica washer. The stabilised 5V supply is also fed to the centre wiper of the band and channel select switches. Previously, these two switches have been fed from the 9V chip supply. You will have to locate the 9V supply wires and disconnect them before connecting

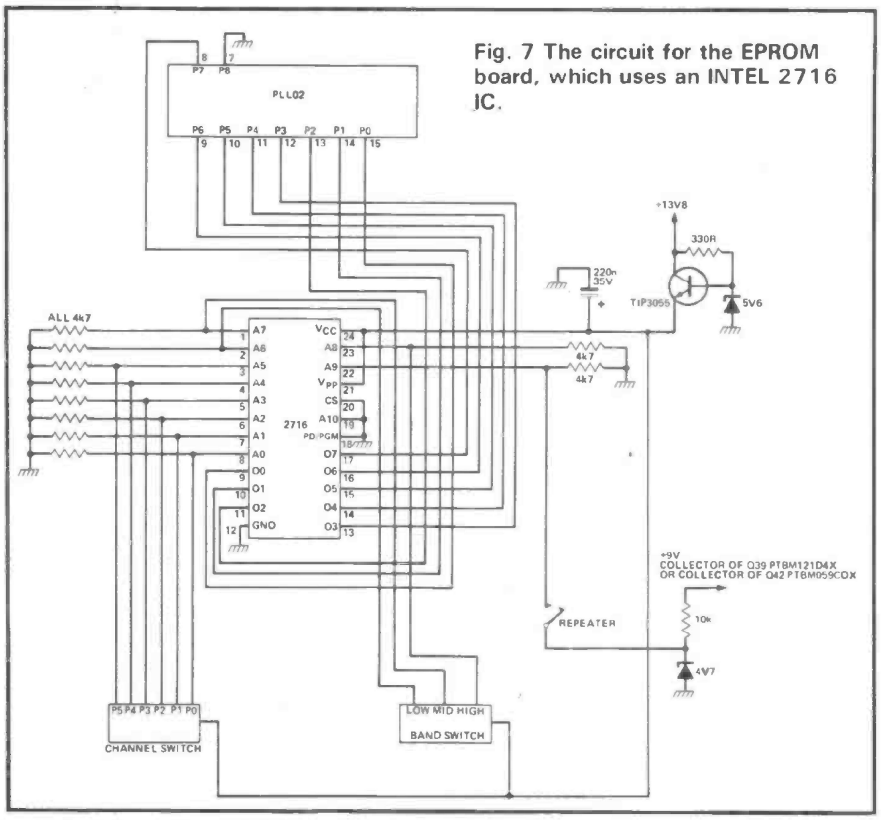


Fig. 7 The circuit for the EPROM board, which uses an INTEL 2716 IC.

up the 5V supply.

The original band crystals were switched by feeding the 9V supply to the crystal oscillator, where diode switching selected the required operating crystal. The contents of the EPROM memory have been selected to operate with the 20.555MHz crystal operating at 20.5525MHz. Therefore, the two other crystals will not be required, and the 9V supply should now be permanently connected to the 20.5525MHz crystal. On high band, a front panel lamp is switched on using the 9V supply through the band switch. If you want to retain this facility, you will have to change the value of R179 from 150 ohms down to 100 ohms since the band switch is now being fed with only 5V.

The 2716 contains 2k of memory which is more than enough to supply the various logic levels required for each of the 40 channels on the three operating bands. Therefore, additional information can be stored increasing the facilities offered by the rig such as having repeater shift.

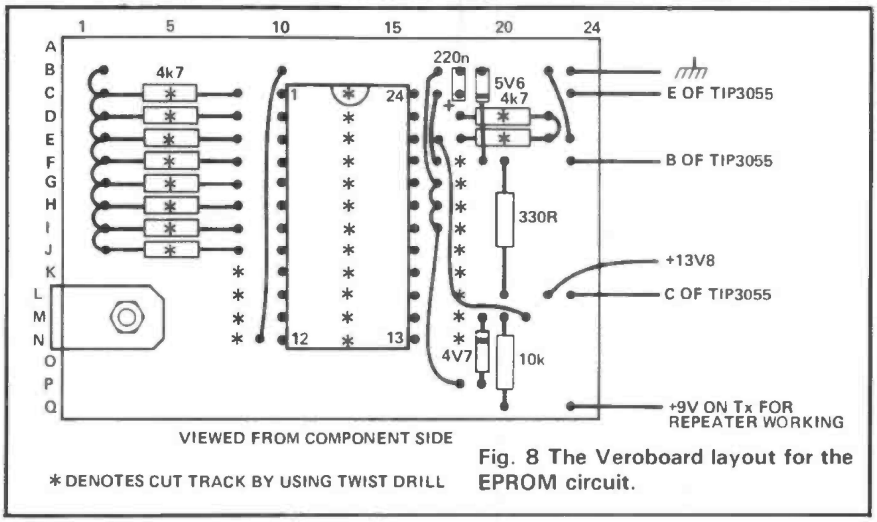


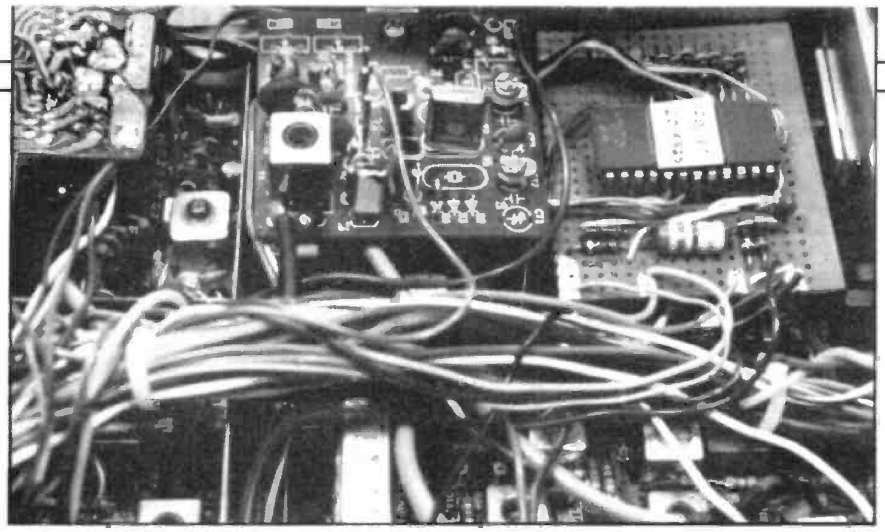
Fig. 8 The Veroboard layout for the EPROM circuit.

Repeater Shift

To work through a 10m repeater the transmitter frequency should be 100kHz below the receiver frequency. This can be done by changing the 2716 address lines so that under transmit conditions, the divide by N number is suitably different. When the repeater facility is not required, the

Table 10 The EPROM memory address/data codes needed if you want to blow your own EPROM and have a Ham International 120 channel rig.

	LOW BAND		MID BAND		HIGH BAND		LOW BAND REPEATER		MID BAND REPEATER		HIGH BAND REPEATER	
CHANNEL	ADDRESS	DATA	ADDRESS	DATA	ADDRESS	DATA	ADDRESS	DATA	ADDRESS	DATA	ADDRESS	DATA
1	07F	BE	0BF	96	13F	6E	27F	C8	2BF	A0	33F	78
2	07E	BD	0BE	95	13E	6D	27E	C7	2BE	9F	33E	77
3	07D	BC	0BD	94	13D	6C	27D	C6	2BD	9E	33D	76
4	07B	BB	0BB	93	13B	6B	27B	C5	2BB	9D	33B	75
5	07A	BA	0BA	92	13A	6A	27A	C4	2BA	9C	33A	74
6	079	B9	0B9	91	139	69	279	C3	2B9	9B	339	73
7	078	B8	0B8	90	138	68	278	C2	2B8	9A	338	72
8	076	B7	0B6	8F	136	67	276	C1	2B6	99	336	71
9	075	B6	0B5	8E	135	66	275	C0	2B5	98	335	70
10	074	B5	0B4	8D	134	65	274	BF	2B4	97	334	6F
11	073	B4	0B3	8C	133	64	273	BE	2B3	96	333	6E
12	071	B3	0B1	8B	131	63	271	BD	2B1	95	331	6D
13	070	B2	0B0	8A	130	62	270	BC	2B0	94	330	6C
14	06F	B1	0AF	89	12F	61	26F	BB	2AF	93	32F	6B
15	06E	B0	0AE	88	12E	60	26E	BA	2AE	92	32E	6A
16	06C	AF	0AC	87	12C	5F	26C	B9	2AC	91	32C	69
17	06B	AE	0AB	86	12B	5E	26B	B8	2AB	90	32B	68
18	06A	AD	0AA	85	12A	5D	26A	B7	2AA	BF	32A	67
19	069	AC	0A9	84	129	5C	269	B6	2A9	8E	329	66
20	067	AB	0A7	83	127	5B	267	B5	2A7	8D	327	65
21	066	AA	0A6	82	126	5A	266	B4	2A6	8C	326	64
22	065	A9	0A5	81	125	59	265	B3	2A5	8B	325	63
23	062	A8	0A2	80	122	58	262	B2	2A2	8A	322	62
24	064	A7	0A4	7F	124	57	264	B1	2A4	89	324	61
25	063	A6	0A3	7E	123	56	263	B0	2A3	88	323	60
26	061	A5	0A1	7D	121	55	261	AF	2A1	87	321	5F
27	060	A4	0A0	7C	120	54	260	AE	2A0	86	320	5E
28	05F	A3	09F	7B	11F	53	25F	AD	29F	85	31F	5D
29	05E	A2	09E	7A	11E	52	25E	AC	29E	84	31E	5C
30	05D	A1	09D	79	11D	51	25D	AB	29D	83	31D	5B
31	05C	A0	09C	78	11C	50	25C	AA	29C	82	31C	5A
32	05B	9F	09B	77	11B	4F	25B	A9	29B	81	31B	59
33	05A	9E	09A	76	11A	4E	25A	A8	29A	80	31A	58
34	059	9D	099	75	119	4D	259	A7	299	7F	319	57
35	058	9C	098	74	118	4C	258	A6	298	7F	318	56
36	057	9B	097	73	117	4B	257	A5	297	7D	317	55
37	056	9A	096	72	116	4A	256	A4	296	7C	316	54
38	055	99	095	71	115	49	255	A3	295	7B	315	53
39	054	98	094	70	114	48	254	A2	294	7A	314	52
40	053	97	093	6F	113	47	253	A1	293	79	313	51



The Marco 747 with its new VCO board and the EPROM.

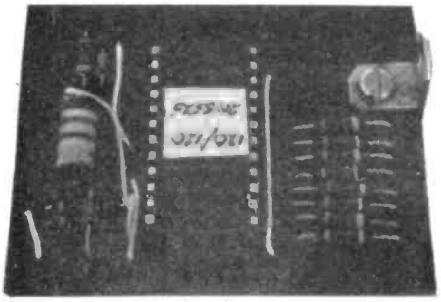
repeater switch is open circuited and address line A9 remains at logic level 0. The noise blanker switch on the front panel was selected to become the repeater switch. The noise blanker wires were disconnected and open circuited to ensure that it operates continuously.

The EPROM Board

The EPROM circuit is built on Veroboard and the component layout is shown in **Fig.8**. The cable connections from the board to the channel and band switches are made with ribbon cable. A right angle bracket was made so that the Veroboard could be attached to the metal chassis of the rig. It is wise to insert the EPROM in a socket only after all the soldering has been completed and a voltage check of the various pins of the IC holder carried out to ensure that there are no crossed wires and that the stabilised voltage regulator is working correctly.

For those of you who are thinking of modifying a Ham International 120 channel rig using an EPROM, the required address and data contents is shown in **Table 10**. The information has been displayed in hex decimal form for convenience. The total cost of the EPROM modification will be approximately £10 with the advantage that the operating frequency of the rig will now stay in step with the channel selected. Also there will be no gaps in the frequency coverage of the set. The new operating frequency of the rig for each channel is in **Table 11**. The EPROM approach also offers the flexibility of being able to introduce the repeater shift facility at no extra cost.

The completed EPROM board showing the chip and the companion eight 4k7 resistors.



And Finally . . .

When modifying CB sets for use on 10m, the minimum amount of test gear is essential to carry out the necessary tuning adjustments; to ensure that the performance of the modified equipment is not impaired; and unwanted spurious signals radiated. The test equipment required must include a digital frequency meter, RF voltmeter or good oscilloscope, and a digital voltmeter.

The three methods described enable the enthusiastic owner of the Ham International series of CB rigs to choose one that suits his own capabilities. Furthermore, I have so far identified seven different models containing the PCBs listed in Table 1 (see Dec HRT). There must be many other models containing these boards yet to be discovered. It is worthwhile removing the lid from the unknown CB to inspect the PCB number to establish the true identity of the rig.

Little has been said here concerning the Colt 1600DX which is listed earlier. This model has a band crystal oscillator similar to the PT0S110A0X PCB, but containing four band crystals. The 20.55MHz can be successfully pulled down to 20.5525MHz using the method described. The band oscillator circuit forms part of the main PCB for the rig. The components contained within the VCO plastic block have been altered in value to permit the rig to cover four consecutive groups of 40 channels between 26.515MHz and 28.305MHz. However, if you wish to convert the rig for use on 10m, you will have to replace the original VCO tuned circuit for the circuit shown in Fig.3 and tune the other circuits as described.

CHANNEL	LOW	MID	HIGH
1	28.51	28.91	29.31
2	28.52	28.92	29.32
3	28.53	28.93	29.33
4	28.54	28.94	29.34
5	28.55	28.95	29.35
6	28.56	28.96	29.36
7	28.57	28.97	29.37
8	28.58	28.98	29.38
9	28.59	28.99	29.39
10	28.60	29.00	29.40
11	28.61	29.01	29.41
12	28.62	29.02	29.42
13	28.63	29.03	29.43
14	28.64	29.04	29.44
15	28.65	29.05	29.45
16	28.66	29.06	29.46
17	28.67	29.07	29.47
18	28.68	29.08	29.48
19	28.69	29.09	29.49
20	28.70	29.10	29.50
21	28.71	29.11	29.51
22	28.72	29.12	29.52
23	28.73	29.13	29.53
24	28.74	29.14	29.54
25	28.75	29.15	29.55
26	28.76	29.16	29.56
27	28.77	29.17	29.57
28	28.78	29.18	29.58
29	28.79	29.19	29.59
30	28.80	29.20	29.60
31	28.81	29.21	29.61
32	28.82	29.22	29.62
33	28.83	29.23	29.63
34	28.84	29.24	29.64
35	28.85	29.25	29.65
36	28.86	29.26	29.66
37	28.87	29.27	29.67
38	28.88	29.28	29.68
39	28.89	29.29	29.69
40	28.90	29.30	29.70

Table 11 The revised channel/frequency allocation after modification with the EPROM.

The EPROM is available at a cost of £8.50 including recorded delivery. When ordering, please make your cheque or postal order out to C B Alban and write your name and address clearly. Post your order to Roger Alban, Ham Radio Today, 1 Golden Square, London W1R 3AB. Please allow 28 days for delivery.