SERVICE MANUAL

DNT 40FM

radiotechnic RT852

ICOM ICB 1050

JWR M2

CB to 10mtr

CONVERSION DETAILS

Icom ICB1050 and JWR M2

These rigs use an MC145106P programmable PLL frequency synthesis IC to control the VCO frequency. A 10.24 crystal feeds the IC to provide a reference frequency of 10 kHz. Two more crystals provide references of 16.50625 MHz for RX and 16.96125 for TX.

The VCO output is divided in the IC according to the binary code supplied by the channel switch (see chart). It is a relatively simple matter to convert the operating frequencies of the rig once you know that each increment of "1" in the code will increase the frequency by 10 kHz.

If you compare the standard binary codes with those required to produce the range 29.30 to 29.69 MHz you will note that pins 10 and 11 must be held high: pin 17 is unchanged and can remain connected to the channel switch: pin 16 requires an invertor in the line from the channel switch (except when repeater shift during TX is required). Finally, pins 12, 13, 14 and 15 bear no obvious relationship but, in fact, there is an increase of 1 0 1 0 for 10 metre operation (or an increase of 1 0 0 0 for repeater shift).

Incrementing by this amount can be performed by a "4008" 4 bit binary adder IC. The inversion of pin 16 can be done with a "4077" quad exclusive NOR IC, with gates left over for additional functions.

Since repeater shift will be required only on the top channels, we can prevent accidental out-of-band TX by reverting to normal operation (even if repeater shift is switched on) by detecting the switch codes on the green and blue wires. If either of these is high, repeater shift is inhibited.

As an aid to setting-up, a spare gate can be used to drive an LED when the Lock Detect output from the PLL IC is high. This gives a visual indication that the VCO adjustment is correct. Once the VCO has been adjusted, the LED gate connection can be removed from pin 8 of the PLL IC and connected to point "X" to indicate when repeater shift is actually happening. The LED can be fitted permanently in the front panel of the rig.

The repeater shift wire is taken from point "S", via a switch, to pin 4 on the mic socket.

Note that the violet wire from the channel switch must be disconnected and pins 10 and 11 linked to pin 1 of the PLL IC. The brown and the pink wires are left in place.

T202, the VCO coil, is adjacent to the PLL IC and its core must be freed from wax (carefully !) and unscrewed until the VCO locks on RX (pin 8 will be high). Adjust the VCO similarly for TX and ensure that it remains in lock for channels 1 and 40 on TX and RX. The VCO core can then be rewaxed. Little or no output will be evident on TX until you adjust T209, T301, T303 and T307. To optimise RX sensitivity adjust T101 and T102.

If you check the frequency you will find an error which can be corrected by adjusting CT202 for TX and CT201 on RX. To increase the deviation, rotate RV303 clockwise.

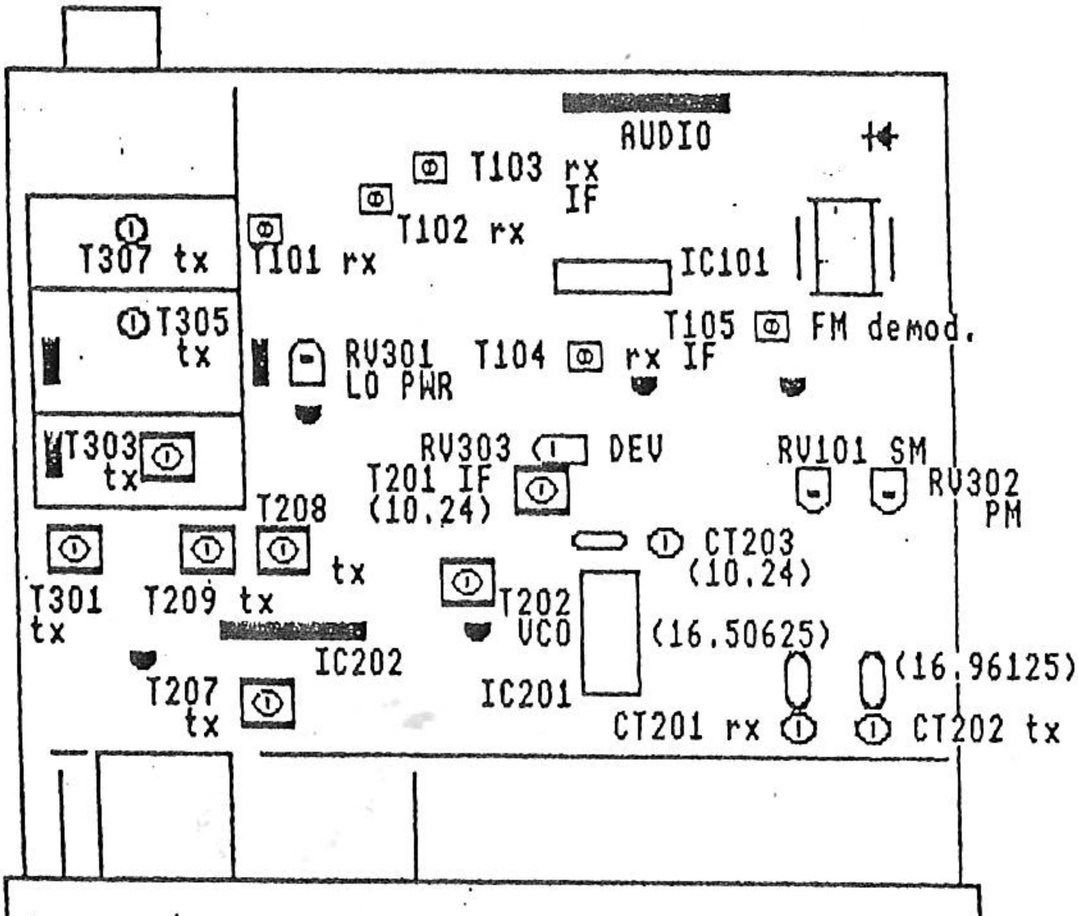
NOTES:

The RF gain varies with the squelch setting. If you remove the diode from beneath the board you might find operation more satisfactory.

T101 has a nasty habit of going open-circuit, making the rig extremely deaf, to say the least! Replace it with a Toko 113CN2K159DZ from CIRKIT.

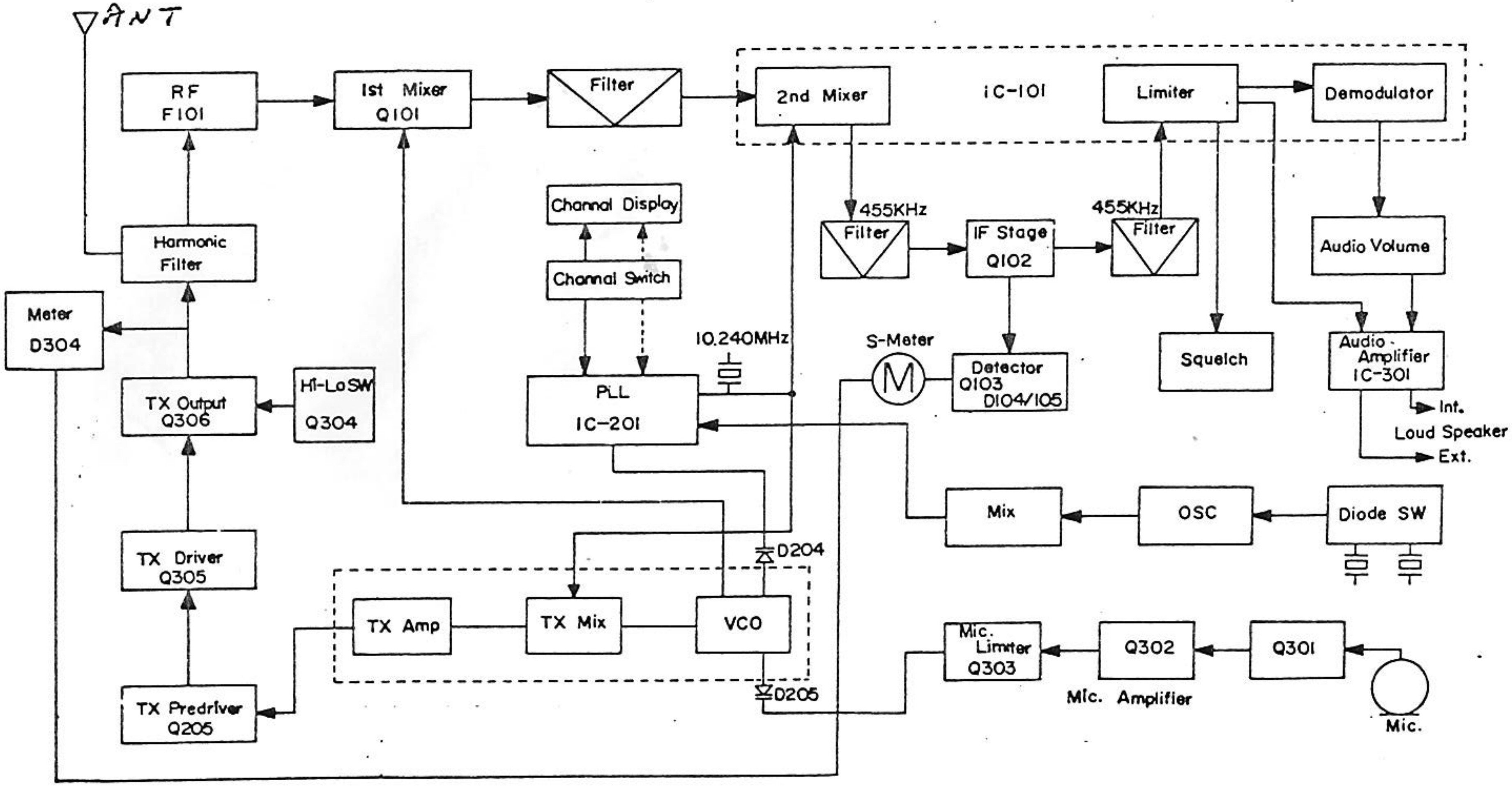
Replace C103 (100pF) with 33pF and C106 (22pF) with 10pF and retune to improve receiver performance.

Replace CF101 with a 10.695 crystal filter from P.R. Golledge to improve I.F. selectivity.



ICOM ICB1050 / JWR M2 CHASSIS LAYOUT

BLOCK DIAGRAM



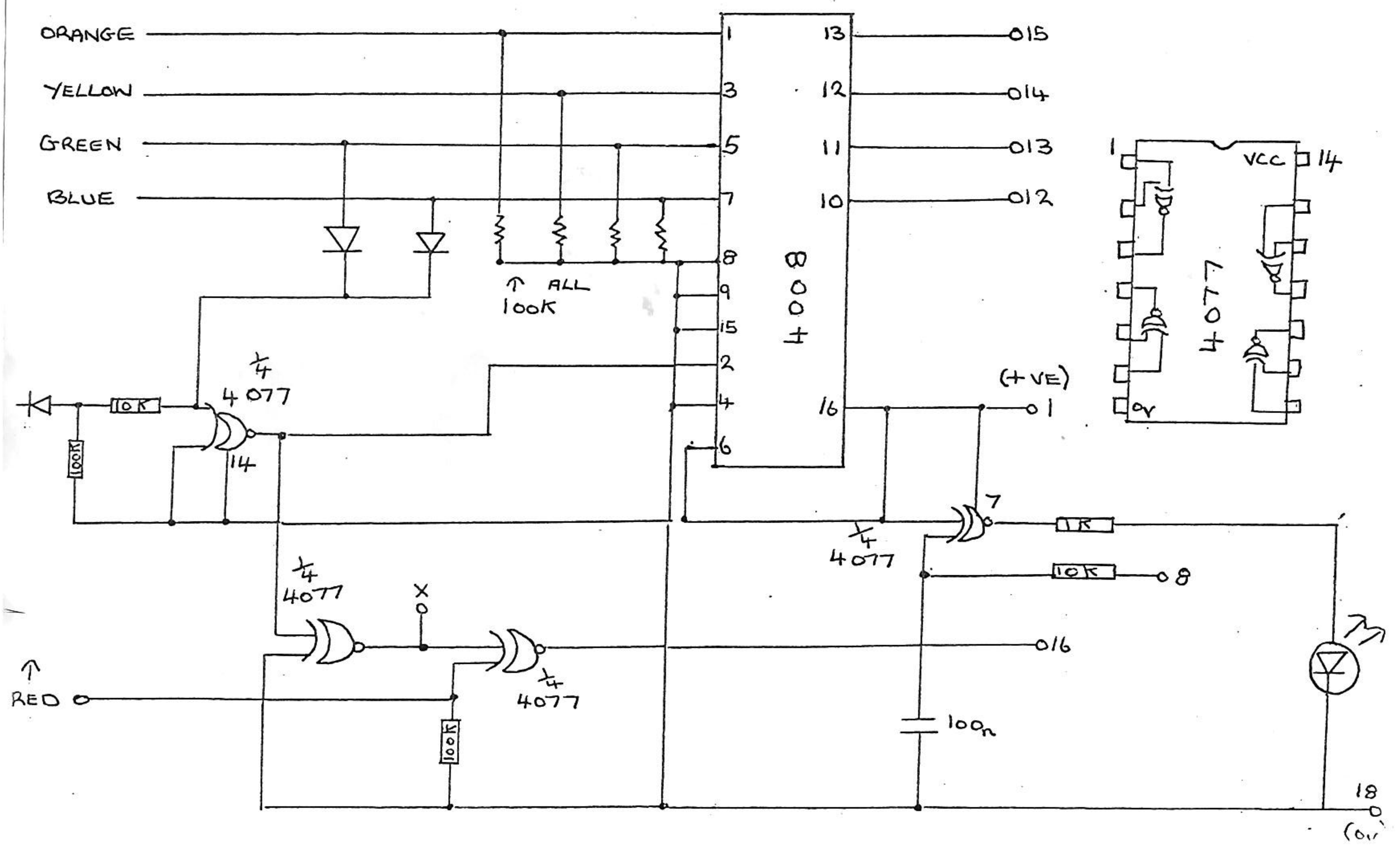
CHAN	Standard			10 metre			TX only	Repeater	
40	79	001001111	27.99125	249	011111001	29.69	239	011101111	29.59
39	78	001001110	27.98125	248	011111000	29.68	238	011101110	29.58
38	77	001001101	27.97125	247	011110111	29.67	237	011101101	29.57
37	76	001001100	27.96125	246	011110110	29.66	236	011101100	29.56
36	75	001001011	27.95125	245	011110101	29.65	235	011101011	29.55
35	74	001001010	27.94125	244	011110100	29.64	234	011101010	29.54
34	73	001001001	27.93125	243	011110011	29.63	233	011101001	29.53
33	72	001001000	27.92125	242	011110010	29.62	232	011101000	29.52
32	71	001000111	27.91125	241	011110001	29.61	231	011100111	29.51
31	70	001000110	27.90125	240	011110000	29.6	230	011100110	29.5
30	69	001000101	27.89125	239	011101111	29.59	229	011100101	29.49
29	68	001000100	27.88125	238	011101110	29.58	228	011100100	29.48
28	67	001000011	27.87125	237	011101101	29.57	227	011100011	29.47
27	66	001000010	27.86125	236	011101100	29.56	226	011100010	29.46
26	65	001000001	27.85125	235	011101011	29.55	225	011100001	29.45
25	64	001000000	27.84125	234	011101010	29.54	224	011100000	29.44
24	63	000111111	27.83125	233	011101001	29.53			
23	62	000111110	27.82125	232	011101000	29.52			
22	61	000111101	27.81125	231	011100111	29.51			
21	60	000111100	27.80125	230	011100110	29.5			
20	59	000111011	27.79125	229	011100101	29.49			
19	58	000111010	27.78125	228	011100100	29.48			
18	57	000111001	27.77125	227	011100011	29.47			
17	56	000111000	27.76125	226	011100010	29.46			
16	55	000110111	27.75125	225	011100001	29.45			
15	54	000110110	27.74125	224	011100000	29.44			
14	53	000110101	27.73125	223	011011111	29.43			
13	52	000110100	27.72125	222	011011110	29.42			
12	51	000110011	27.71125	221	011011101	29.41			
11	50	000110010	27.70125	220	011011100	29.40			
10	49	000110001	27.69125	219	011011011	29.39			
9	48	000110000	27.68125	218	011011010	29.38			
8	47	000101111	27.67125	217	011011001	29.37			
7	46	000101110	27.66125	216	011011000	29.36			
6	45	000101101	27.65125	215	011010111	29.35			
5	44	000101100	27.64125	214	011010110	29.34			
4	43	000101011	27.63125	213	011010101	29.33			
3	42	000101010	27.62125	212	011010100	29.32			
2	41	000101001	27.61125	211	011010011	29.31			
1	40	000101000	27.60125	210	011010010	29.30			

Pins 9 10 11 12 13 14 15 16 17

Tie High
Invert
Convert
Leave

Icom ICB1050 and JWR M2

10M CONVERSION FOR ICOM ICB 1050 / JWR M2



THE SIMPLE METHOD

CONNECT TOGETHER THE SOLDER PADS OF PINS 10,11,12 ON THE MC 145106 PLL IC,VIA A 10K RESISTOR CONNECT THE COMBINED PINS TO PIN 1 OF THE SAME CHIP WHICH HAS A PERMANENT VOLTAGE. THIS WILL NOW ALLOW THE SET TO BE RETUNED TO OPERATE IN THE 29MHz RANGE. WITH CHANNEL 25 BEING 29.600.

TO INCREASE COVERAGE DOWNWARDS FROM CHANNEL 25 THE GREEN LEAD FROM PIN 13 MUST BE DISCONNECTED AND DISCARDED, UNSOLDER THE VIOLET LEAD FROM PIN 11 AND TRANSFER TO VACANT HOLE AT PIN 13.THIS WILL ALLOW 10KHz STEPS FROM CHANNEL 40 TO 9, BETWEEN 1 AND 9 THE CHANNELS WILL DUPLICATE AND CAN BE IGNORED AS THEY ARE ALREADY COVERED.

RETUNING OF THE SET WILL BE NEEDED.T202 IS THE VCO CAN,T209,301,303 AND 307 OPERATE THE TX STRIP WHILE T101 AND T102 COVER RECEIVE.SLIGHT OFFSET ON THE FREQUENCY CAN BE CURED BY CT202 ON TX AND CT201 ON RX.

REPEATER SHIFT CAN BE OBTAINED BY SWITCHING A 16.861 CRYSTAL IN PLACE OF THE 16.961 IN THE TX MODE.

DNT Circuit Description

The circuit of the DNT (also Radiotechnic RT852) rig and the component layout is provided.

The heart of any modern multi-channel CB radio is the voltage controlled oscillator (VCO). An unusual feature of the DNT is that it has TWO VCOs, one for RX and one for TX operation. Another unusual feature is its use of an MC145106P PLL synthesiser IC instead of a modern fixed N-code type. Consequently there is some scope for adding extra channels, albeit with some difficulty.

The TX VCO comprises Q5, L6, C34 and C36, plus bias resistors and decoupling capacitors. D6 is a variable capacitor diode whose capacitance is controlled by the voltage from pin 7 of the IC. As with all VCOs of this basic design, the frequency range can be extended by decreasing the value of the coupling capacitor C36. It would also be necessary to decrease the value of C119 in the RX VCO circuit.

The TX VCO output is taken directly from Q5 emitter to the RF preamp, Q23, where the frequency is doubled then amplified by the RF driver and output stages. The TX VCO runs at around 13.9 MHz. Its output also feeds Q6, Q7 then Q8 where it mixes with the output from the TX crystal oscillator. One of the frequencies resulting from this mixing is around 2.3 MHz (13.9-11.68) and returns via Q9 buffer stage to pin 2 of the IC. If this frequency matches the internally generated reference frequency in the IC (determined by the "N" codes selected by the channel switch) pin 8 goes high and transmission is allowed. Should the frequencies not match, the IC will alter the voltage supplied to D5 by pin 7 until the downmix frequency is correct. (Note that testing the voltage on pin 8 provides a simple means of determining whether the VCO frequency is correct.)

The RX VCO works in exactly the same manner but, because the RX crystal is 15.23 MHz, the output frequency of the VCO must be higher for the Downmix frequency to remain the same as that for TX. The RX VCO frequency will be around 17.1 MHz (27.8-10.695) and feeds the RX mixer transistor, Q2. The VCO frequency mixes with the received frequency to produce 10.695 which is allowed through the filter and passed through the Intermediate Frequency and demodulator IC. Note that a 10.695 oscillator held near to the rig would pass a signal through the I.F. stages to give a reading on the "S" meter, even if the VCO were not working - this is an extremely useful check to make on any rig which is not receiving since it can either eliminate or disclose a fault in the I.F. stages. Another useful check to make is to measure the voltage on pin 7 of the MC145106P. This voltage should alter in steps of about 0.06v as the channel selector is turned. If it does and if pin 8 is "high", then the VCO section is definitely working properly and the fault lies elsewhere. Do these checks for both RX and TX. Note that it is possible to make the rig transmit (albeit off-frequency) by connecting the junction of R57 and R58 to positive. This "enables" the Lock-Detect circuit. If the VCO is working at all, then an output should be produced, provided that the RF stages are adjusted correctly.

With any "dead" rig (lights up but nothing else) it is wise to check the supply voltages (Q13 and D11 form an AVR in the DNT) and the crystal oscillator(s). In the DNT, the RX oscillator is powered only during RX and the TX oscillator receives power only when the TX line is held low. The 10.24 works all the time, of course.

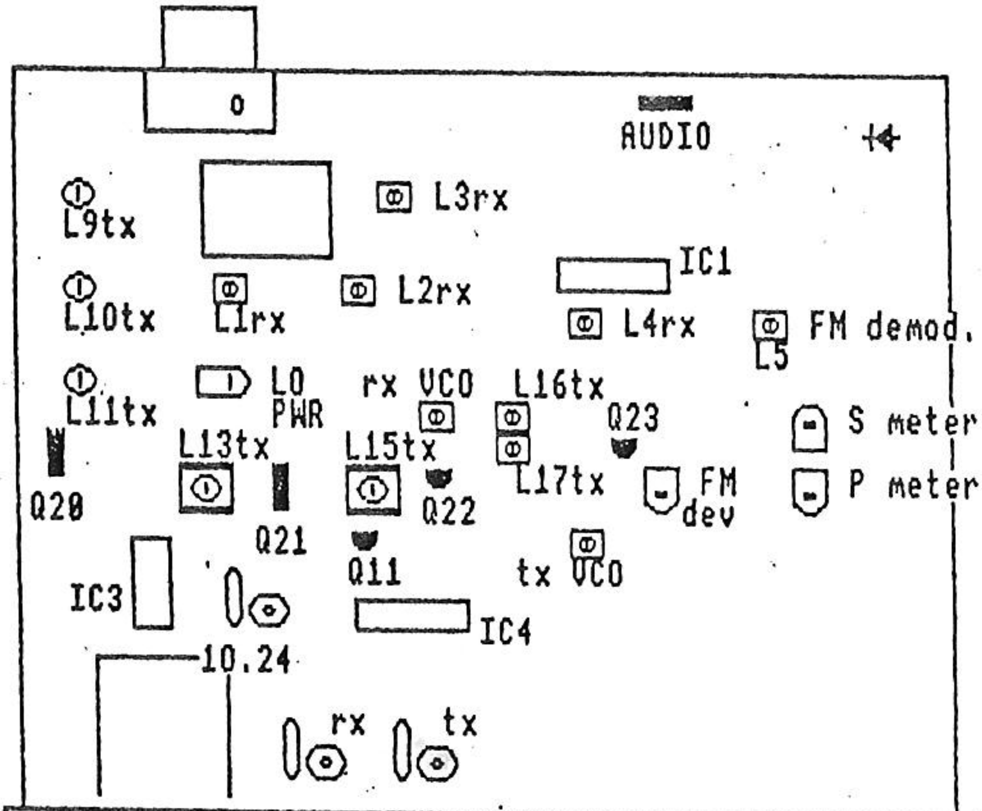
You will notice that there is a third varactor diode, D6. This diode capacitance is varied by a voltage from the microphone amplifier transistors, Q17, 18 and 19 to produce frequency modulation during TX. D12 and 13 perform a clipping operation to limit the maximum deviation which is set by R84.

For those of you who are interested in modification I had better mention that my explanation of the VCO operation was oversimplified. In fact the downmix frequency for TX is NOT the same as that for RX. To achieve the correct frequencies pin 9 is pulled high during TX and pin 6 is pulled low. Pin 9, high, adds 128 to the "N" code and pin 6 low changes the reference frequency from 10kHz to 5kHz. This has to be done because, you will remember, the TX VCO output is doubled. The 5kHz steps thus become 10kHz steps in the RF output to give the correct channel spacing. Just for the record, the N codes for channel 1 are 168 RX and 168+256 TX. This is an extremely complicated way to use the MC145106P. Other rigs achieve the same object more simply.

A very interesting effect is obtained by swapping the tracks to pins 11 and 12. Put a frequency counter on and try it !

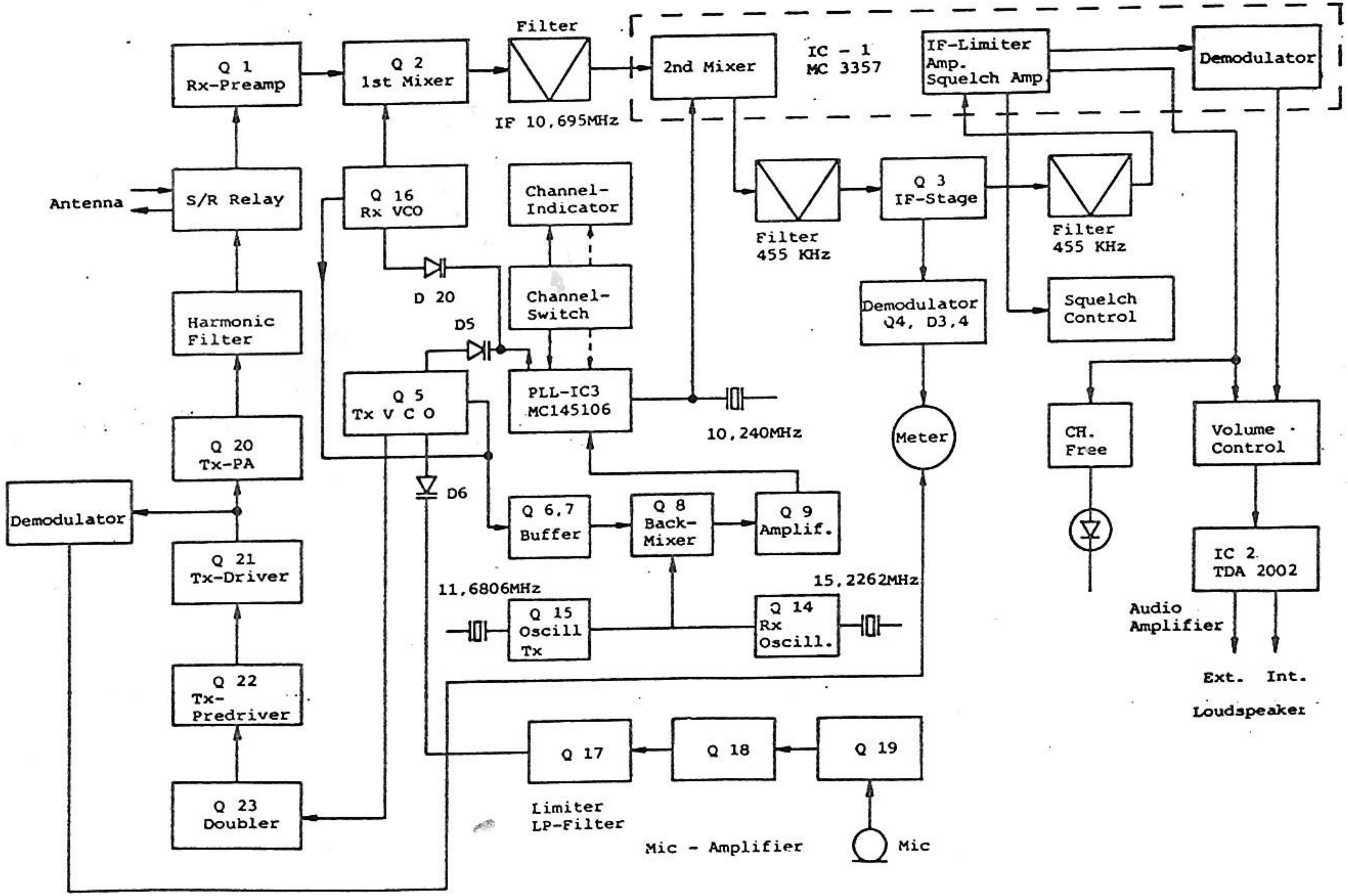
The DNT suffers from odd effects, often caused by maladjustment of the screwcores. It is particularly sensitive to the settings of the tx VCO inductor, L16 and L17. Effects such as reported "breaking up of transmission" on the top or bottom channels: transmit relay clacking in and out, and similar. It is important to ensure that the VCO is stable during TX (use low power) before tuning the TX coils. A high SWR can show up wrong adjustment where the rig might work OK on a dummy load.

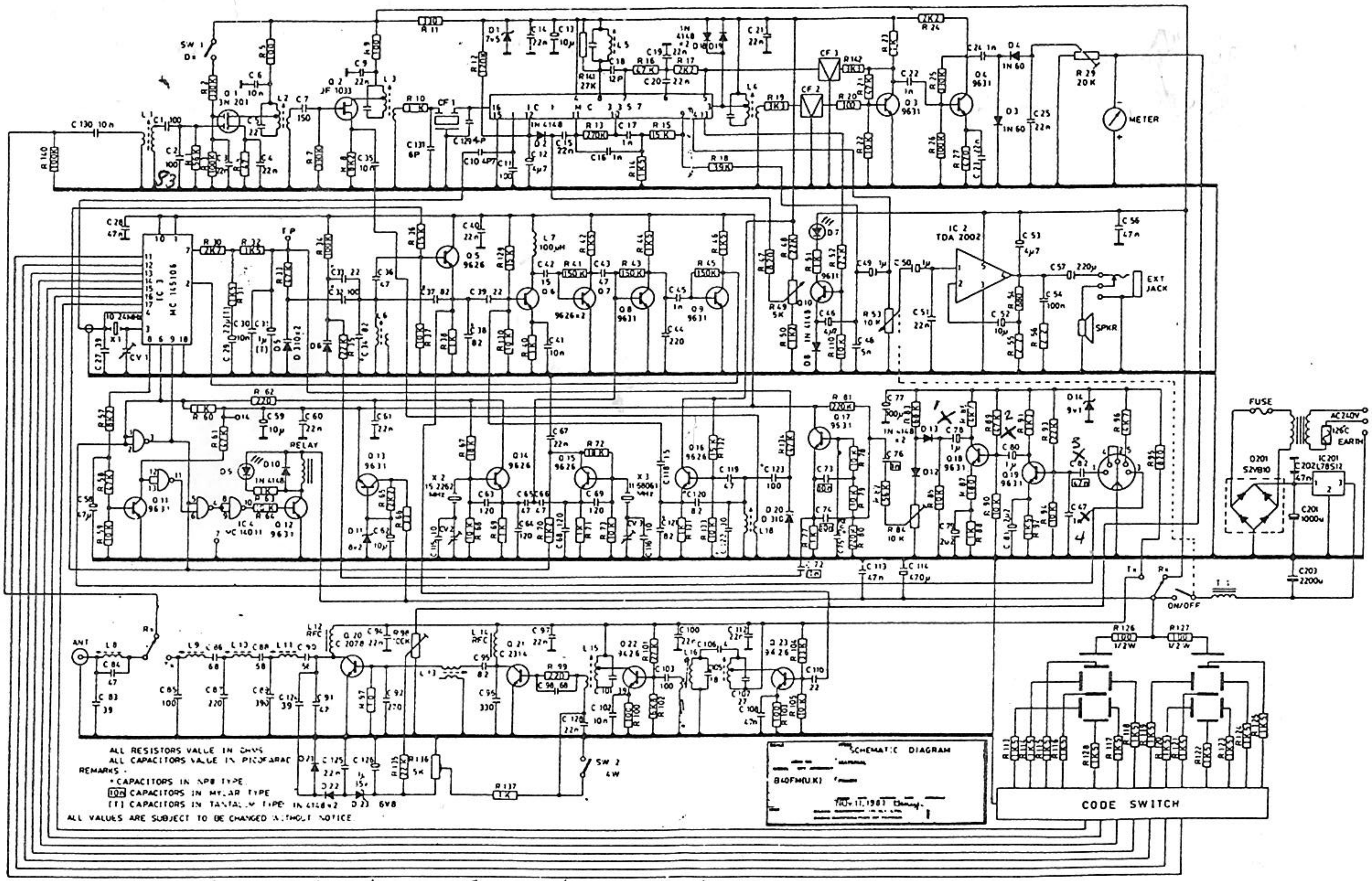
Finally, note that the DNT board suffers badly from dry joints. Most of the faults you will come across will be caused by poor soldering but note, also, that ALL the RF transistors Q20, 21, 22 and 23 tend to go faulty. The audio IC, too, is poorly "heatsinked" and tends to blow.



DNT M40 FM CHASSIS LAYOUT

BLOCK DIAGRAM





Change C2 to 33pF
Change C5 to 10pF-
Change C1 68pF
Change. 1X & 2X To .22 C78 C80
Remove X4 C47
Remove 3X. Change. To ·1 & 3K9. C82.

SCHEMATIC DIAGRAM B 40 FM

PARTS SUBJECT TO CHANGE WITHOUT NOTICE

DNT frequency calculations

TX Switched pins		Fixed pin	channel switch codes							divide ratio	
*	256	128	64	32	16	8	4	2	1		← Binary Multipli
6	9	10	11	12	13	14	15	16	17		← MC145106P pin N
1	0	1	0	1	0	1	0	0	0	=168	- channel 1 RX
0	1	1	0	1	0	1	0	0	0	=424	- channel 1 TX

* Pin 6 determines internal reference frequency. 1= 0.01 MHz for RX
2= 0.005 MHz for TX

These are derived by dividing the 10.24 MHz crystal input by 1024 or by 2048 inside the MC145106P.

RX crystal (Fxrx) = 15.2262 MHz
TX crystal (Fxtx) = 11.68061 MHz
IF frequency (FI) = 10.695 MHz

The difference between the crystal and the VCO frequency is the Difference frequency (Fdrx, Fdtx), = divide ratio x internal reference.

Fdrx = 168 x 0.01 = 1.68 MHz
Fdtx = 424 x 0.005 = 2.12 MHz

chan 1 RX = Fxrx + Fdrx + FI
= 15.2262 + 1.68 + 10.695
= 27.60121 (VCO = 16.9062)

chan 1 TX = 2x(Fxtx + Fdtx)
= 2x(11.68061 + 2.12)
= 27.60122 (VCO = 13.8006)

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10 metre Conversion

We want chan 1 to be 29.30 MHz:-

chan 1 RX = Fxrx + Fdrx + FI
29.30 = 15.2262 + Fdrx + 10.695
Fdrx = 3.38

Divide ratio = 3.38/0.01 = 338
and, similarly, for chan 40 = 377

chan 1 TX = 2x(Fxtx + Fdtx)
29.30 = 2x(11.68061 + Fdtx)
Fdtx = 2.97

Divide ratio = 2.97/0.005 = 594
and, similarly, for chan 40 = 633

CLEARLY, THE MC145106P CAN'T PROVIDE SUCH LARGE DIVIDE RATIOS FOR TX.

An alternative method is to change both RX and TX crystals:-

chan 1 RX = Fxrx + Fdrx + FI
29.30 = Fxrx + 1.68 + 10.695
Fxrx = <u>16.925</u> MHz crystal (VCO = 18.605 MHz)

chan 1 TX = 2x(Fxtx + Fdtx)
29.30 = 2x(Fxtx + 2.12)
Fxtx = <u>12.530</u> MHz crystal (VCO = 14.650 MHz)