Preface
This article was found on the g4apl's system hard disk.
A number of MC80's are used at the GB7CIP/GB7CR and GB7CP Amateur Packet Radio stations.
Hope you find this helpful de Paul g4apl

UHF MC80 as used at GB7CIP 9600bd 70cm Radio Link

Modifying the Motorola UHF MC80
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by Steve Wilson, G3VMW
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Part 1) Description and Pin-Outs
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Recently a large amount of Motorola MC80 Transceivers have been released on to the surplus market. These small and compact (180mm x 170mm x 70mm) two-channel transceivers are very well built and have PIN diode antenna changeover. There appears to be two popular bands: 403 - 430 MHz and 440- 470 MHz and both are suitable for conversion to 70cms for packet radio use. All the radios I have converted have been 25 kHz bandwidth. TX output power appears to be about 15-18W maximum.

The UHF MC80 has a single conversion receiver with a 10.7 MHz I.F. There are two 10.7 MHz filters in cascade providing a high degree of adjacent channel selectivity. The Discriminator uses the popular CA3089 IC. The mixer and RF amplifier is embedded inside a substantial diecast chamber complete with a three-pole filter before the RF amplifier and a five-pole filter between the RF amplifier and the FET mixer. The diecast RF deck also houses a four-pole filter for the RX oscillator/multiplier. In addition, there is a great deal of screening under the main PCB and also around the various coils on top of the board. This is not a receiver that easily de-senses!

The transmitter has a TX oscillator/Tripler, a buffer, a Tripler, an RF amplifier, a power Tripler followed by a three-pole tripler filter (which is encased in the diecast RF deck), then a thick-film UHF power amplifier module, PIN diode antenna c/o switch and harmonic filter.
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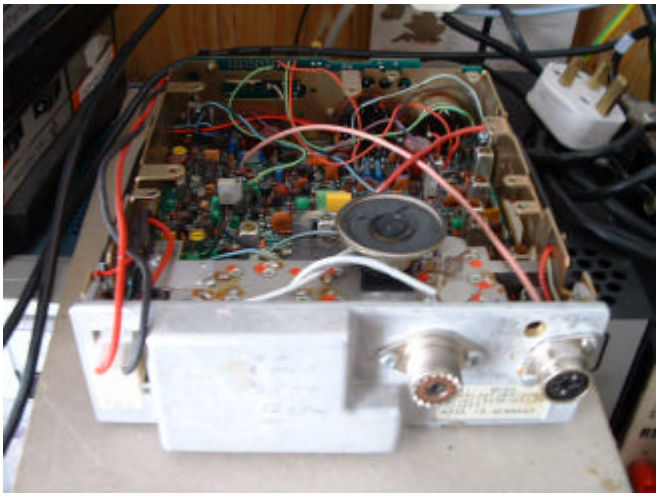
A 5-Pin, 270 degree DIN socket - J601, located on the rear apron of the MC80, provides microphone access and is an ideal interface point for the TNC. However, a little bit of work needs to be done to achieve this. Pin connections as follows:

Pin 1 - Audio output (White) - linked to Pin 32 on Mother Board
Pin 2 - Mic Low (Braid) - linked to Pin 3
Pin 3 - Ground (Black)
Pin 4 - Mic High (Red)
Pin 5 - PTT (Green)



GB7CIP UHF 9600bd MC80

Power and loudspeaker connections are made by a 15-way connector J191 on the rear apron of the MC80. I was not able to find a matching plug for this connector and the easiest cure is to remove it completely and provide alternative connections for the power in and loudspeaker. There is also a PTT connection on J191 which I will describe later. Pin connections on J191 are as follows:

Pin 1 - No connection
Pin 2 - Ground (Black)
Pin 3 - No connection
Pin 4 - +ve 13.8 Volts input (Red)
Pin 5 - No connection
Pin 6 - Ground (Black)
Pin 7 - No connection
Pin 8 - PTT (Green)
Pin 9 - No connection
Pin 10 - No connection
Pin 11 - No connection
Pin 12 - Loudspeaker (Brown)
Pin 13 - No connection
Pin 14 - No Connection
Pin 15 - No connection

At this stage, remove the MC80 from its plastic case by removing the two screws at the side of the case and unplugging the knobs. Ease up the plastic case at the rear of the MC80 and ease the chassis out of the case.

The last two MC80s which I acquired had CTCSS boards which had connections to J191.

The three CTCSS boards (Part numbers 8408510 B01 T2, 8402 203B01 T4 and a small PCB named MC80 MOD) are removed completely simply by hacking through the wires which connect them to the main PCB after unscrewing the fixing screws.

The CTCSS boards bolt component-side down on the top of the MC80 chassis. Removal is very straightforward and gave very little difficulty.

All the surplus bits of wire can be unsoldered from the main PCB and many of the connecting wires are on plug/socket type connectors.

Save a couple of these push-on connectors for later, when you will be re-aligning the set, they make connection to the test-points very simple.

Modifications for use on Packet Radio:

The standard MC80 may need some slight modifications to make it suitable for packet radio use. This part of the MC80 modification sheet describes the pin connections I had to make before the MC80 would work on packet.

Power Supply and Loudspeaker Connection:

As it stands, the MC80 has a most unusual multi-way power supply connector; the pin-outs are described in Part 1) of this series. I could not find any source of supplier of the power plugs, so a modification was necessary.

The plastic plug was removed completely and a small aluminium plate (40mm x 23mm) was fabricated to cover the hole which was left.

A new DC power input socket was fixed to the aluminium plate, as well as a miniature jack socket for the loudspeaker connection. The following are the Maplin part numbers of the plugs/sockets that I used:

2.5mm single-hole-fixing power socket - Maplin part number JK10L
Matching in-line plug - Maplin part number HH62S

2.5mm single-hole-fixing speaker socket - Maplin part number JK03D
Matching plug - Maplin part number HF77J

Links on PCB:

It is likely that you will have had to remove a SELCALL board or some additional hardware whilst cleaning up the MC80. After doing so, you must check that several important links are still made on the motherboard. If not, it is likely taht the radio won't work!

TX Audio - JU101 Link Pins 40 & 41 - immediately in front of the channel switch.

A screened cable with a red outer sheath connects from J601 the DIN socket on the rear of the MC80 case, inner to Pin 40, outer to ground.
Pin 41 is immediately adjacent to Pin 40 and these two pins should be linked to route the TX audio through to the microphone amplifier circuit.

TX Key - JU102 Link Pins 36 & 37 - immediately in front of the channel switch.

Pin 36 has a green wire which routes to the DIN socket (J601) on the rear apron. Pin 37 has another green wire which originally routed to Pin 8 on J191, the power socket which you should have removed.

I re-routed the spare TX key line from Pin 8, J191 to one of the spare wafer switches on the MC80 front panel (The one marked with a music symbol) to form a front-panel TX test key.

RX audio - JU61 Link Pins 14 & 35 - immediately in front of the wafer switches.

This link was already made on the MC80s I worked on, and if you already can hear audio on a loudspeaker, don't bother adding another link!

Packet TNC Connections:
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The DIN socket on the rear apron is an ideal connection point for a TNC, and the only additional connection that needs to be made is the RX audio to TNC connection. A white wire from Pin 1 of J601 routes to Pin 32 on the MC80 motherboard. You need to link RX audio to Pin 32 to provide TNC audio. I took the audio from the top of the RX volume control, before the audio amplifier, U81. Simply link Pin 32, which is in the front left-hand side of the board (as viewed from the component side), to the top of the volume control (R86). R86 is fixed to the PCB, and on the underside of the PCB, a track runs past the channel change switch, to the other side of the PCB. It is the only track which connects to the volume control on the underside of the board - that is the connection point to link to Pin 32 to provide RX audio on J601.

The volume control does not affect TNC audio with this method, and there is ample audio output to drive a BSX TNC. With a small monitor loudspeaker connected to the MC80, you can listen to the packet tones, or turn the audio off completely without affecting the operation of the TNC.

All connections to the TNC are made via the rear panel DIN socket (J601) and this makes for a tidy interconnection.

Do NOT exceed 3.25 kHz peak deviation on TX. R121 or R131 set the deviation levels for the respective channels. In my MC80s, only one channel was fitted and R121 is the deviation control for TX.

Alignment:
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To bring the MC80 up on 70cms, a complete re-alignment of both TX and RX will be necessary. The last radios I acquired were on 407.25 and 408.25 MHz and needed major re-alignment. The TX side is very easy to re-align, but the RX can be quite difficult, however, I hope this information will make alignment that bit easier.

Crystal Frequencies:
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RX Xtal = (fo - 10.7 MHz)/9

For example: RX frequency = 432.625 MHz, xtal frequency = 46.8805 MHz.
HC25/U - Series Resonant +2 +3 kHz Offset

TX Xtal = fo/27

For example: TX frequency = 432.625 MHz, xtal frequency = 16.02315 MHz.
HC25/U - 28pF +/- 10ppm

McKnight Crystals will supply crystals for the MC80 to the correct specification at 5.50 each inclusive. Be sure to quote MC80 when you order.
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RF Deck Alignment Points:
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Underside
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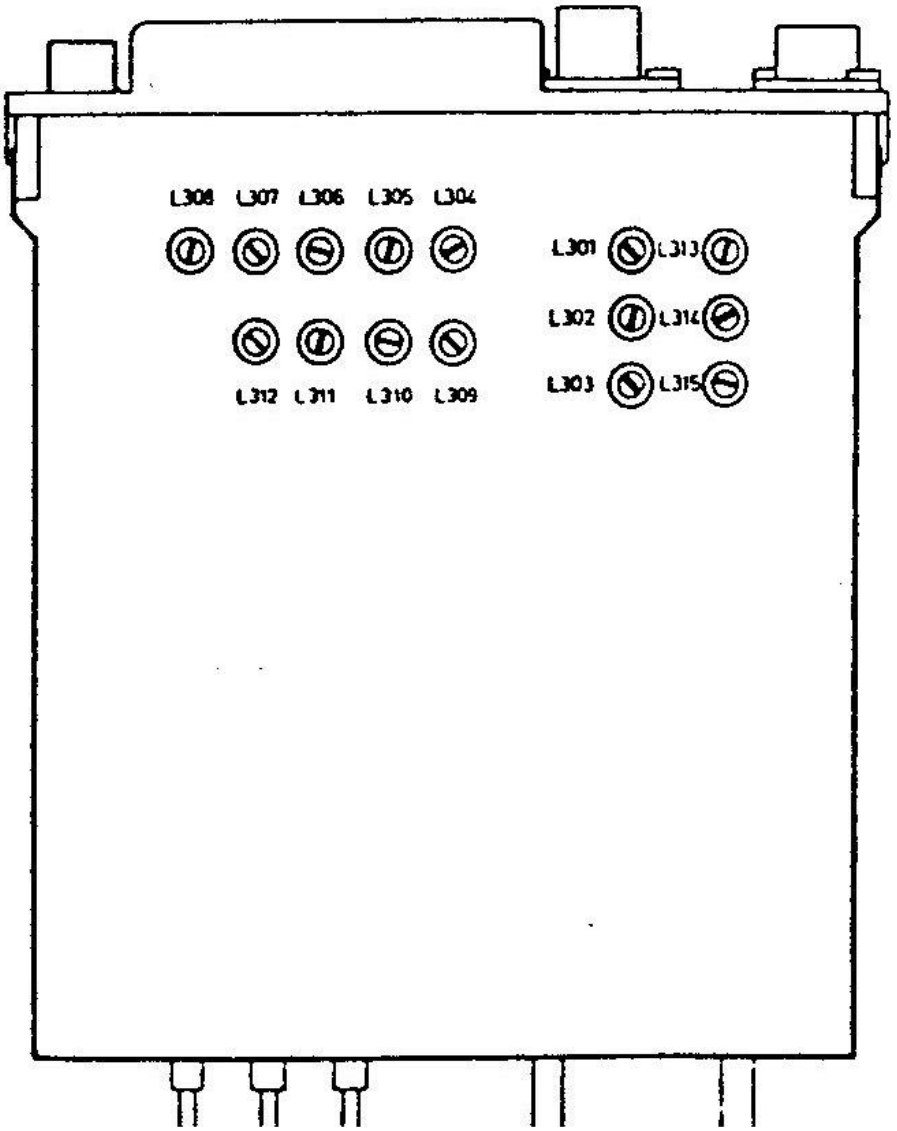

Topside
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J601 ANT
J221
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GEPD1256.2

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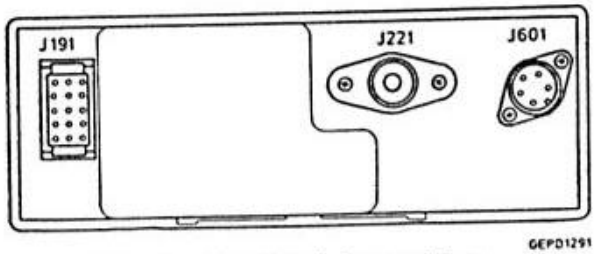

GEPD1291

Fig. 4 Electrical Connections
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Receiver Alignment:
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In some cases, peak meter readings may occur at two points in the tuning range of the coil. Always chose that point where the slug is nearest to the top of the coil form (away from the circuit board).

Metering Points:
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Receiver Metering

Metering Point	Voltmeter Lead Connections Positive	Negative	Voltmeter Scale	Typical Reading
M1	J61-1	Ground	2.5V DC	2V for 40uV
M2	J61-2	Ground	10V DC	5V +/- 0.2V
M3	Pin 10	Ground	50uA DC	15-45uA

Transmitter Metering

Metering Point	Voltmeter Lead Connections Positive	Negative	Voltmeter Scale	Typical Reading
M3	J141-8	Ground	50uA DC	> 10uA
M5	J141-7	J141-5	100uA DC	> 40uA

Receiver Alignment:
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Adjust power supply output voltage to 13.2V at the radio power connector input. Preset squelch control R342 to the counter-clockwise position and adjust the volume control for normal audio output.

Quadrature detector coil adjustment:
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Inject a 10.7 MHz signal, loose coupled from the RF generator, to the base of Q32.

Adjust L36 for 5V +/- 0.2V on M2 with a 20 Kohm/volt DC voltmeter. Be sure that L36 is adjusted for the desired minimum or maximum values of the discriminator 'S' curve.

Injection pre-tuning:
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a) Switch the channel selector switch to the lowest frequency channel and peak L3 whilst reading M3.

b) Switch the channel selector switch to Channel 1 and peak L2 whilst reading M3.

c) Switch to Channel 2 and peak L22 whilst reading M3.

d) Switch to the lowest frequency channel and adjust L309 to L312 in that order, as follows:
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Tune	Meter	Desired Reading
L309	M3	Peak
L310	M3	Dip
L311	M3	Peak
L312	M3	Dip

e) If there are two peaks (dips), tune for maximum peak or maximum dip.

f) If no dip can be found in the range of L312, preset slug same as L311.

Frequency adjustment and IF alignment:

a) Connect an unmodulated signal generator to the antenna connector and set the carrier frequency to the exact channel frequency. Set the output level to 25mV pd, reducing the level as tuning proceeds to keep meter 1 (M1) reading between 25 and 35 microamps.

b) Switch the channel selector switch to channel 1 and tune L2 for peak M1 reading.

c) Inject a 10.7 MHz signal, loose coupled to Q32, to produce a beat note in the radio's speaker.

d) Adjust L2 for zero beat note.

e) Repeat the above steps for channel 2, tuning L22.

f) Turn 10.7 MHz signal generator off.

g) Tune L32, L33 and L34 in that order for maximum M1 reading, reducing the signal generator output level as tuning proceeds to keep the M1 meter indication between 25 and 35 microamps.

Front-end tuning:

a) Set the signal generator to the exact highest channel frequency and switch the radio to this channel. Adjust the generator output level for a 30 microamp reading on M1 and proceed according to the following table, reducing the signal generator output level as tuning proceeds to keep M1 reading between 25 and 35 microamps. Perform tuning in the order given:

Step	Tune	Meter	Desired Reading
1.	L308, L307, L306,	M1	Peak L305, L304
2.	L302, L301, L303	M1	Peak

b) If there are two peaks, tune for maximum peak meter reading.

Injection tuning:

a) Set signal generator to exact lowest channel frequency and switch the radio to this channel. Adjust the signal generator output level for a 30 microamp meter reading on M1 and proceed according to the following table, reducing the signal generator output level as tuning proceeds to keep M1 reading between 25 and 35 microamps.

Step	Tune	Meter	Desired Reading
3.	L309, L310, L311,	M1	Peak L312 in that order

b) If there are two peaks, tune for maximum peak meter reading.

c) Adjust L32 and then L33 for a peak M1 reading.

d) Repeat steps 2, 1, and 3.

e) Set signal generator to the exact highest frequency channel. Switch the radio to this channel and align L311 and L312 for a peak M1 reading.

Test procedure for 12dB SINAD:
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a) Set generator output level to 10 microvolts pd and tune exact channel frequency.

b) Adjust modulation for 70% of maximum permissible deviation at 1 kHz.

c) Set volume control for 50% of rated output power (AC voltmeter across the speaker terminals to indicate 2.45V). Use distortion meter across the speaker terminals.

d) Reduce generator output until a 12dB decrease on the distortion meter is obtained.

e) Read the output level on the signal generator attenuator. Spec. limit is 0.3 microvolts pd.

Transmitter Alignment:
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Connect an RF wattmeter, terminated in a 50 ohm resistive load, to the radio set antenna connector J201. Connect a 13.2 DC power supply to the radio.

Alignment and power setting
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a) Set R183 power set control to maximum (counter-clockwise when viewed from component side).

b) Key transmitter with front-panel KEY switch and make sure that the supply voltage at the power connector is 13.2 volts.

c) Switch channel selector switch to the lowest frequency channel and align L142 and then L143 for a peak M3 reading. Limit 15uA.

d) Tune L143 for a dip on M3 meter reading.

e) Tune L144, then L147 for a peak M5 meter reading. Limit: 15uA min; 40uA max.

f) Tune L143 for a peak on M5.

g) Tune L314, L313, and L315 in that order for maximum power on the wattmeter.

h) Retune L143 for a peak M5 reading.

i) Tune L149 for a peak M5 reading.

j) Repeat alignment of L147 (peak meter 5); L144 (peak meter 5) and L143 (peak meter 5) in this order.
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k) Adjust R183 power set control for a nominal output of 6W for 6W models and 10W for 10W models. The power output obtainable by varying R183 should be at least 1W more than the nominal output.

For packet radio, set the peak deviation with R121 at 3.25 kHz for 25 kHz channel spacing and 1.5 kHz peak for 12.5 kHz channel spacing.

Current Drain:
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Maximum current drain whilst transmitting - 6W models: 3A - 10W models: 3.5-4A

9600 Baud Packet Radio
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The UHF MC80 lends itself readily for operation at 9600 baud in packet trunk link service. The MC80 features a very fast PIN diode changeover system which will work at TXD values of 70 ms (TXD=7).

A 25 kHz receive filter is essential for 9600 baud operation, and the TX should have a flat audio response, without significant phase distortion up to 7.5 kHz. Clearly, most of the Japanese 'Black Box' radios are not suitable unless they are modified. By comparison, the MC80 is relatively easy to get running at 9600 baud.

Filters:
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The part numbers of suitable 10.7 MHz 25 kHz filters for 9600 Baud working are as follows:

a) Toyocom 10M3E5 or;
b) ITT type 033-CA-8024.

TX connections:
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The screened microphone input lead from the DIN socket on the rear apron (J601), which is used as a connection to the TNC, is disconnected from the main circuit board (Pin 40). The TNC connection is made directly to the deviation potentiometer R121. The PCB track between R121 and the associated input amplifier circuit for the microphone should then be cut. Don't forget that if the MC80 is a two-channel version, the tracks to R121 and R131 from the microphone amplifier both need to be cut to provide isolation.

RX connections:
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Audio output to the TNC is taken directly from the discriminator IC - U61.

Take the output via a screened cable from Pin 1 of the DIN socket on the rear apron of the MC80 (J601) to Pin 35 on the main PCB (which should be linked to Pin 14). C80, a 6n8 capacitor forms part of the receiver de- emphasis network and must be removed, since it is connected across the discriminator output to ground.

The peak-to-peak audio across R121 is approximately 1.6V for 6 kHz peak deviation, and about 220 mV of audio is available at the input of the 9600 baud modem.

(Adapted from notes by G4OAA)

G3VMW @ GB7WRG July 1993

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