IMPROVING THE MICROWAVE MODULES MMT432/28S TRANSVERTER

Recently my good friend Jim, W7FF, asked me to investigate a problem he was having with his Microwave Modules MMT432/28S transverter. He felt that his unit, which has the factory installed dual oscillator option, was much less sensitive on the high range than on the low one. Some quick gain and noise figure measurements confirmed his suspicions. The overall gain was down about 10 dB and the noise figure was about 10 dB higher than rated when the high range oscillator was selected.

After re-tuning all of the rf, mixer, i-f, oscillator and multiplier tuned circuits, the problem remained. Suspicioning insufficient LO injection to the mixer, a spectrum analyzer was attached to gate two of the dual gate FET mixer. Switching between the two oscillators showed an insignificant difference in the injection levels. However, with an rf input signal applied, viewing the level on gate one of the FET showed the 10 dB level change when changing frequencies! This same 10 dB level shift was measurable back to the base of the input rf amplifier.

Because antenna change over from receive to transmit is accomplished in the transverter with three PIN diodes, I decided that the problem was probably located in this area. Because the schematic diagram furnished with the unit is spread out over several sheets, I drew up a simplified schematic (fig 1.) showing the major switching circuitry.

Referring to fig 1, transistors Q1 and Q2 supply operating voltage to the low and high frequency oscillators respectively. Transistors Q3 and Q4 are used for T/R switching as follows: Under control of an external PTT/VOX contact closure or of an internal rf sensing circuit, Q3 is turned "off" and Q4 is turned "on" when transmitting. Transistor Q4 then supplies B+ to the transmit stages and foward bias to the PIN diodes. The PIN diodes connect the PA to the antenna and ground the input of the first rf stage.

With J1 pin 2 open, Q1 will always be "on" (conducting) and the unit will both transmit and receive using the low frequency oscillator. This is Function 1. When Function 2 is selected, pins 2 and 4 of J1 are tied together and the unit should continue to transmit low but switch to the high frequency oscillator on receive. It is in this latter condition that the problem arises.

To turn on the high frequency oscillator, it is necessary to divert the base current from Q1, turning it "off" and to extract the base current from Q2, turning it "on". Unfortunately, on receive, Q4 is turned "off" so the only path for this current is through the PIN diodes! Because this current is fairly small ($< 2mA$) the diodes are only partially turned on. They do attenuate the signal approximately 10 dB, however.

Having found the problem, the next step was to figure out a method of solving it. Being basically lazy and not wanting to go to the considerable trouble of removing the circuit boards to make any changes, I looked for a fix that could be implemented from the top side of the board. As it turns out, the problem can be corrected without even removing the cover.

Fig 2A shows how P1 would normally be wired for PTT and range selection. By simply adding a diode (D1) and resistor (R1) as shown in fig 2B, the problem is solved. When Function 2 is selected, the resistor creates a path which sinks the transistor base current while the diode remains reversed biased and non-conducting. Q1 will be "off" while Q2 is "on". On transmit, Q4 turns on which now foward biases the diode turning Q2 "off" and Q1 "on". Functions 1,3 and 4 are unaffected and operate properly as always.

Incidentally, while tracing out the circuit looking for this problem a schematic error was found. The 78L05 regulator supplying the driver and final amplifier transistor bias networks is incorrectly located on the schematic for the PA box. Fig 3A shows the"as drawn" and fig 3B shows the "as is" condition.

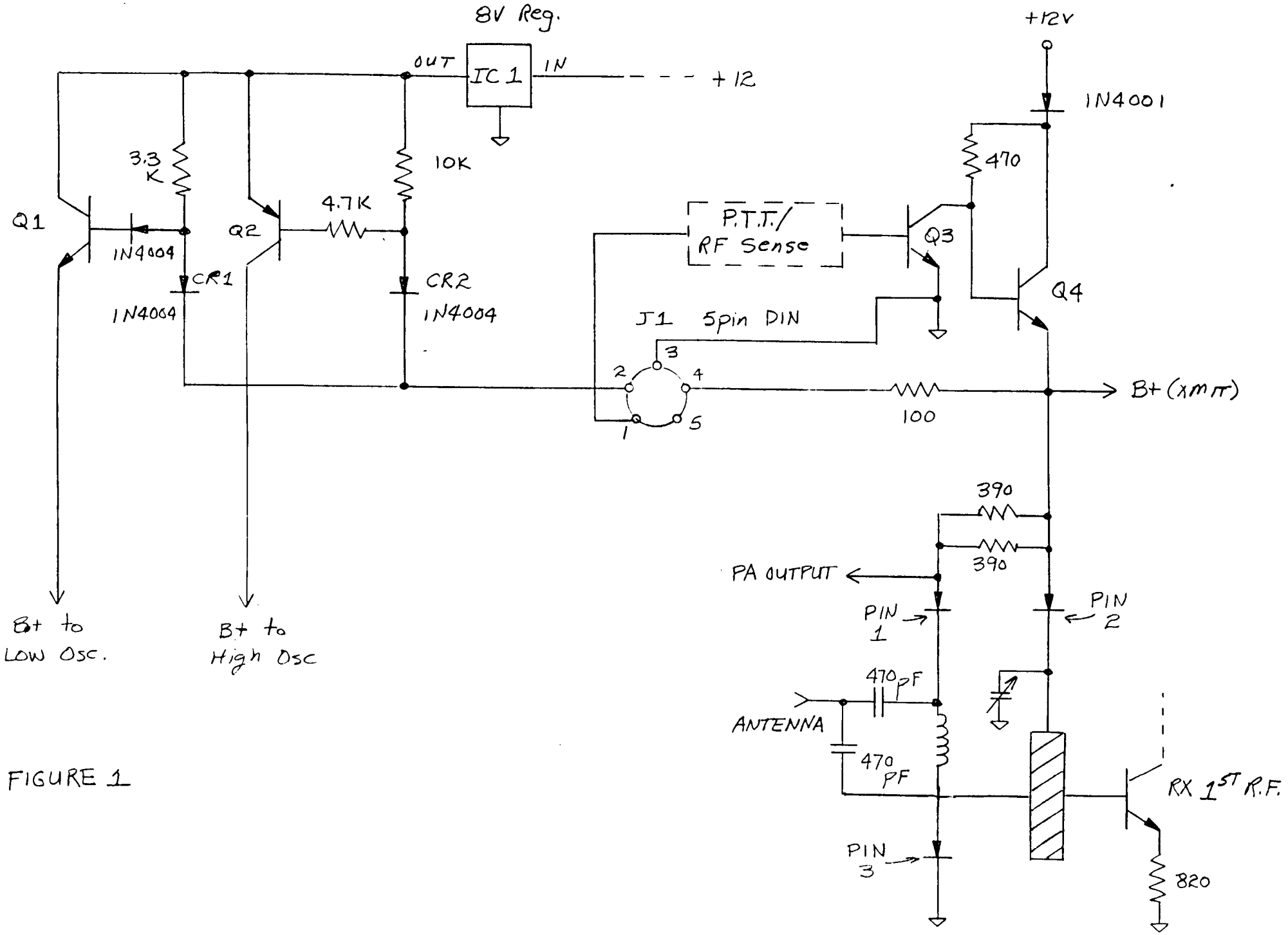
8V Reg.
OUT
IC 1
IN
+12
+12V
IN4001
3.3 K
10K
470
4.7K
Q1
Q2
IN4004
CR1
IN4004
CR2
IN4004
P.T.T./ RF Sense
Q3
Q4
J1 5pin DIN
3
2
4
1
5
B+ (xmtr)
100
390
390
PA OUTPUT
PIN 1
PIN 2
470 pF
ANTENNA
470 pF
PIN 3
RX 1ST R.F.
820
B+ to LOW Osc.
B+ to High Osc

FIGURE 1

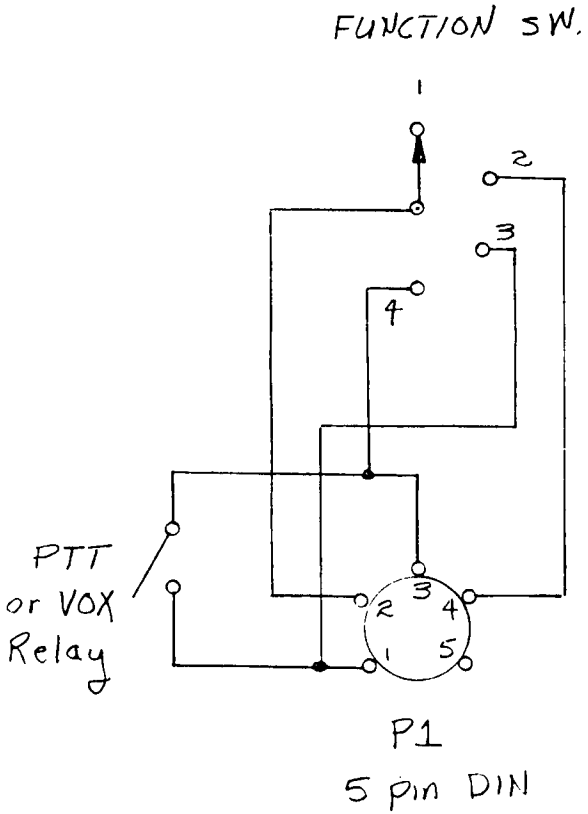

FIGURE 2A

Connector Wiring (unmodified)

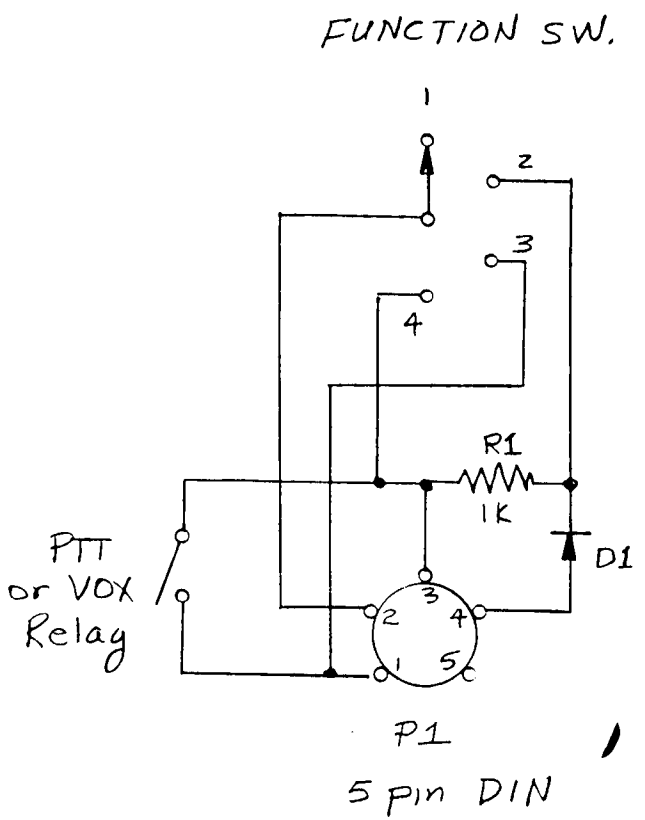

FIGURE 2B

connector wiring (modified)

R1 and D1 are the added components described in the text.

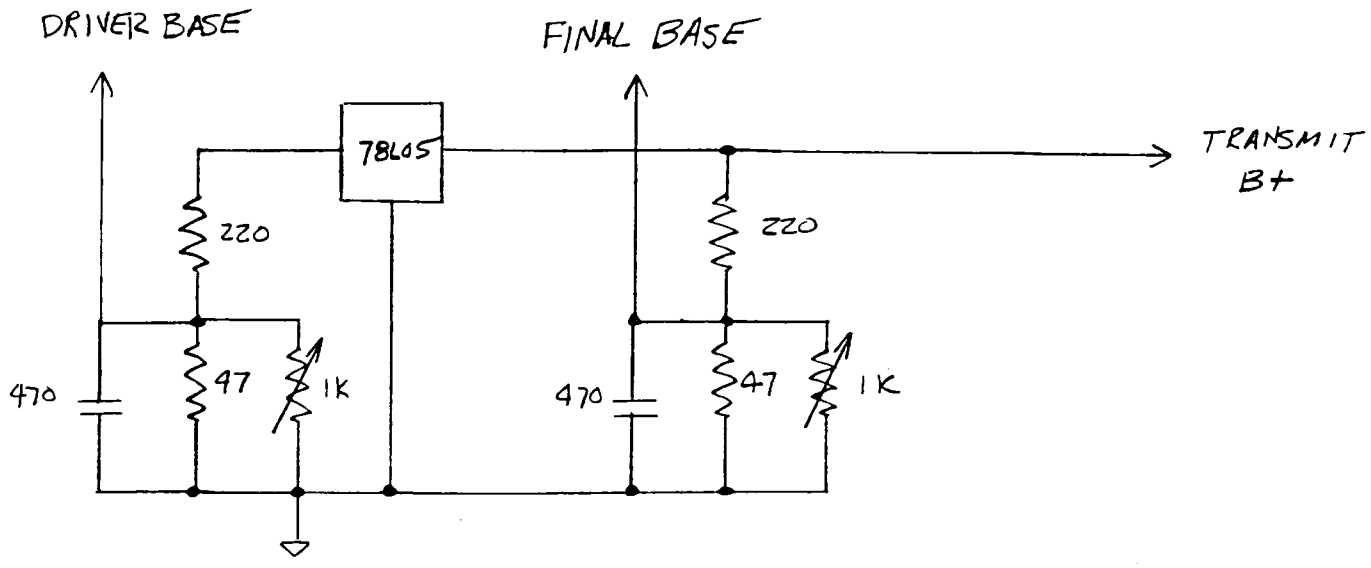

FIG. 3A. ORIGINAL SCHEMATIC

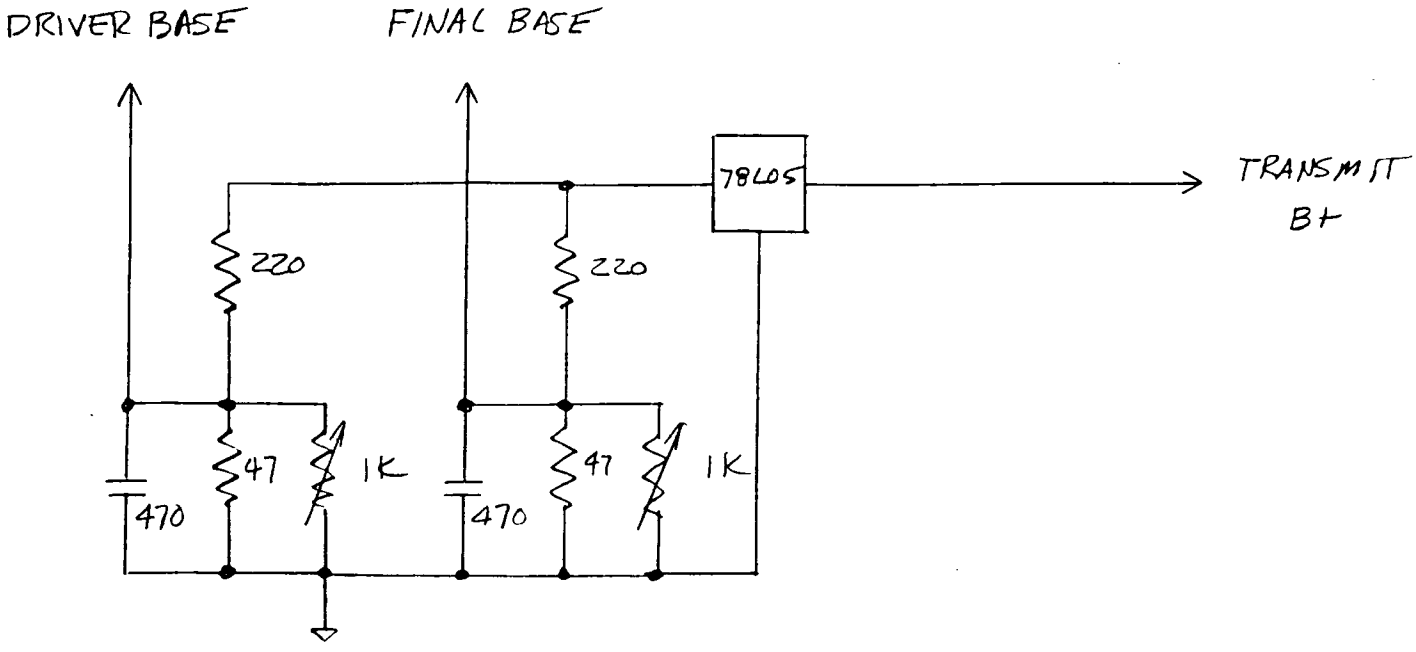

FIG 3B ACTUAL CIRCUIT