Having recently purchased an Icom 7200 at the 2013 Dayton Hamvention and reading all the negative comments on the "Chinese" version of the HM-36 supplied microphone, I wanted to get to the bottom of whether the microphone had issues or not and if so, could the mic be improved at low cost. Quick listening tests indicated to me that the unmodified mic was not as horrible as some people indicate but was definitely lacking in crispness. I will describe subsequent more detailed measurements I took on the HM-36 before and after my modification.

I was surprised at all the different mods that we ingenious hams had implemented; namely:

1. The SE5X mod. See ICOM_HM36_mod2.pdf in the Files section of IC7200 Yahoo group. (Remove R1, 1 kOhm and C2, 10 uF. 2. Change C1 from 0.22 uF to 0.01 uF).

2. The WB1FPA mod (see HM36 Mod.GIF in the WB1FPA folder in Files section of IC7200 Yahoo group) using a "T" network to increase lows and reduce midrange with lower total series R for better bias to the mic element.

3. Send your mic to Bob Nagy, AB5N for a new mic element (gets good reviews).

4. N9EWO mod: http://n9ewo.angelfire.com/misc.html.

5. PY3SS mod to add a mic preamp for better impedance matching (See ICOM-HM36_transistor_mod_by PY3SS.pdf in the Files section).

6. DG2IA2 mike mod (preamp with a new dynamic cartridge.) See IC7200_DG2IAQ Modifications.pdf in IC 7200 Mods folder in the Files section of IC7200 Yahoo group.

7. K7SFN mod (4:1 impedance matching transformer with bypass tantalum cap).

As an electrical engineer, it was clear to me that the mic circuit in the '7200 was excessively loading down the mic element as it has a 1K resistor to 8 volts for mic biasing. I decided to use either the PY3SS mod (mic preamp for reduced loading of the mic element) or the K7SFN mod (transformer impedance matching). The PY3SS mod uses lower cost components and is physically easier to install and probably results in comparable performance. The schematic of the unmodified Chinese HM-36 and IC-7200 input circuit are shown in Figure 1 (courtesy DG2IAQ modifications article). The voltage on the "+" is +8V.

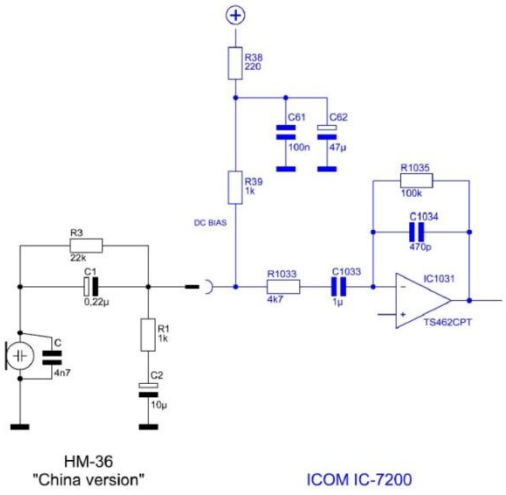


Figure 1 - Unmodified Chinese HM-36 and IC-7200 input circuit.

The schematic of the PY3SS mod plus the input circuit in the '7200 are shown in Figure 2.

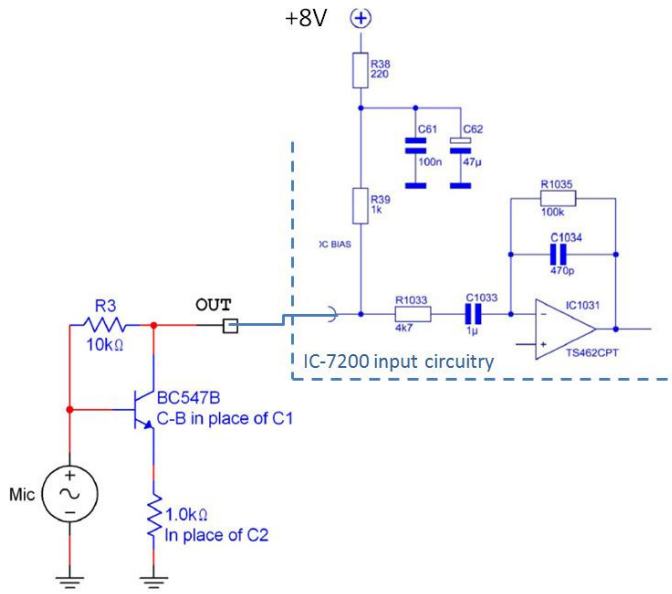


Figure 2. PY3SS preamp with input circuit of Icom IC-7200

Note that R39 in the IC-7200 is actually part of the preamp circuit. R1033 and C1033 form a high pass filter function while R1035 and C1034 form a low pass filter function. R1033 and C1033 cause additional ac loading with the R1033 appearing in parallel with R39 at midband and higher frequencies. If we forget about secondary effects, the gain of the preamp is roughly the ratio of R39 (1K) to the 1K in the emitter of the BC547B since the collector current is roughly equal to the emitter current if we neglect the small base current, and the emitter voltage is equal to the base voltage less a diode drop. So for A.C. one can consider the emitter voltage to be roughly equal to the base voltage which is the input to the preamp circuit. The actual gain will be less than one due to negative feedback introduced by R3 and finite base current.

So what good is a preamp with a gain of less than one? It's very important function is to allow the microphone element to see a high impedance instead of the 1K it sees in the unmodified circuit.

To check the DC voltages at the emitter, base, and collector of the BC547B, I did an LT Spice model of the circuit shown in Figure 3. I used a 2N2222 model which was in the LT Spice library. I actually used a 2N2222A metal case transistor from my junkbox in my mod. The BC547B used by PY3SS is fine. A plastic case 2N3904 is fine and cost 19 cents or less in small quantities such as Digikey P/N 2N3904TAFSCT-ND. The NPN bipolar transistor is not critical but should have a minimum VCE=20V, Ic max=20mA or more, and hfe of 40-50 or more to minimize operating point variations.

Instead of 1.0K, I used 1.5K for the emitter resistor in the mod to raise the collector voltage closer to the 8 volts that the mic element wants to see. I have no data on the mic element bias voltage requirement.

Resistor R4, set to 22K ohms, was used to represent the impedance of the mic element, to make the LT Spice voltage come close to actual measurements. With a 1.5K emitter resistor, my measured values for the transistor DC voltages were: Vc=6.17V, Vb=3.83V, and Ve= 3.2V. Thr LT Spice model shows Vc=5.7V, Vb=3.8V, and Ve=3.17V. With the 1K resistor, the LT Spice model indicates Vc=5.10, Vb=3.42V, and Ve=2.74V. Use of a 1.5K instead of 1K increases the mic bias voltage (Vb) from 3.42 to 3.8V, a fair bit higher at the expense of preamp gain of roughly 1/1.5. But the preamp has more than adequate gain anyway. Most electret cartridges can operate at lower voltages than 8 volts, with as little as 2-3 volts.

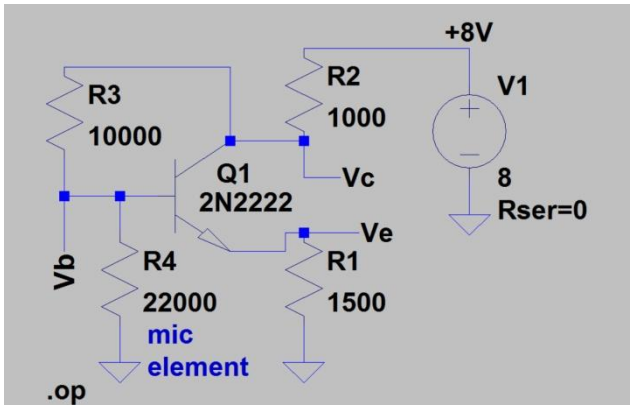


Figure 3. LT Spice model of preamp

So how well does the mod really work? I used a laptop running a white noise generator program feeding some hifi amplified speakers to drive the microphone to just below kicking in ALC to minimize any effects on frequency response. Many free white noise generators are available on the net including one from mynoise.net. I then looked at the received spectrum of the 7200 in SSB mode using a Softrock Ensemble II receiver with HDSDR software. A screenshot of the unmodified HM-36 mic is shown in Figure 4. A screenshot of the modified HM-36 mic with the PY3SS mod (changed 1K emitter resistor to 1.5K in the mod) is shown in Figure 5.

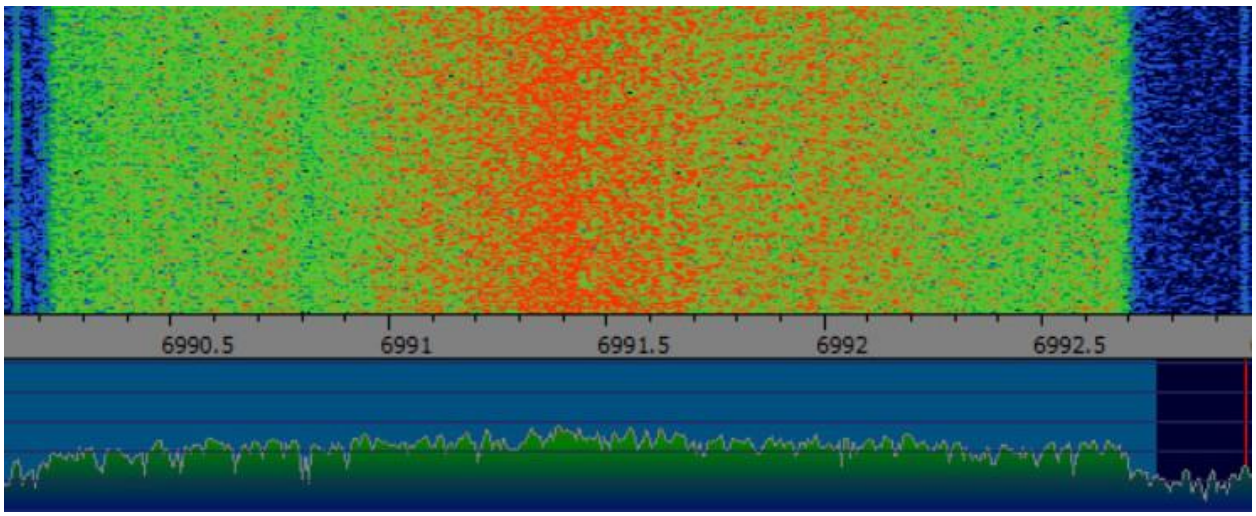


Figure 4. Unmodified HM-36 spectrum with white noise generator driving mic. Note that the spectrum shows spectral content primarily at midrange with dropoff at low and high frequencies. Note that the red line is carrier center and frequencies are increasing from right to left. Ignore the bogus frequency scale. Yes I transmitted in band. (I did not set the softrock's center frequency from HDSDR.)

Figure 5 shows the spectrum of the modified HM-36 mic

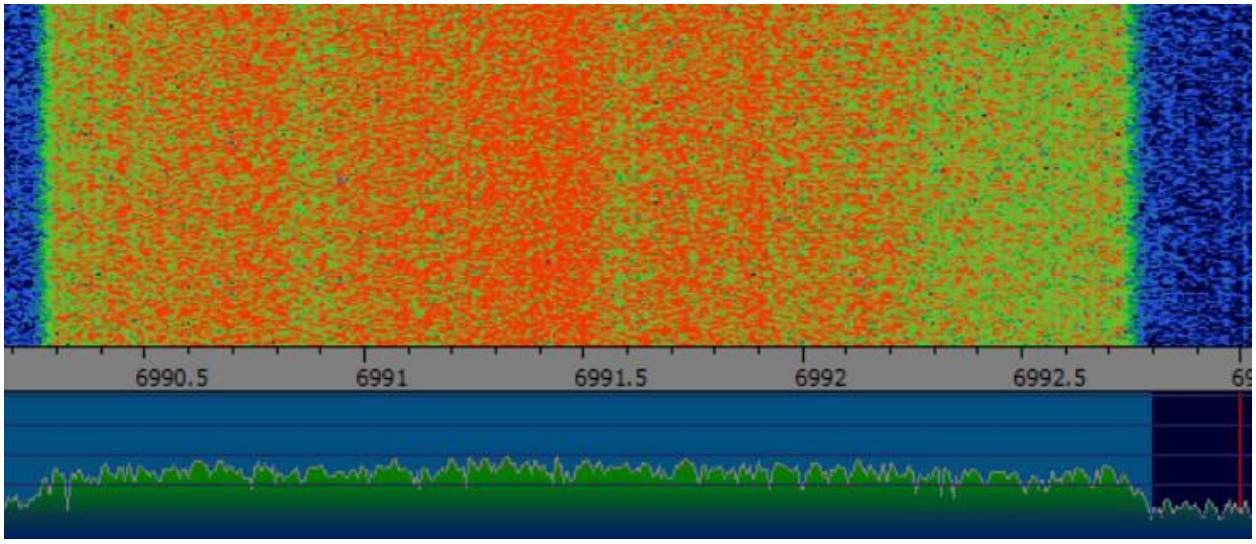


Figure 5. HM-36 mic modified with PY3SS mod (1.5K emitter resistor).

Now, the spectrum is much flatter with more spectral content appearing at low frequencies but most importantly at high frequencies. This spectral display correlates with better sounding audio. Note that I did not do any of others' suggested acoustic mods (Removal of the ½ inch WHITE cotton "Plug" or Gray Foam in later production that sits in front of the mic element. It's located in the same black rubber holder with the mic element).

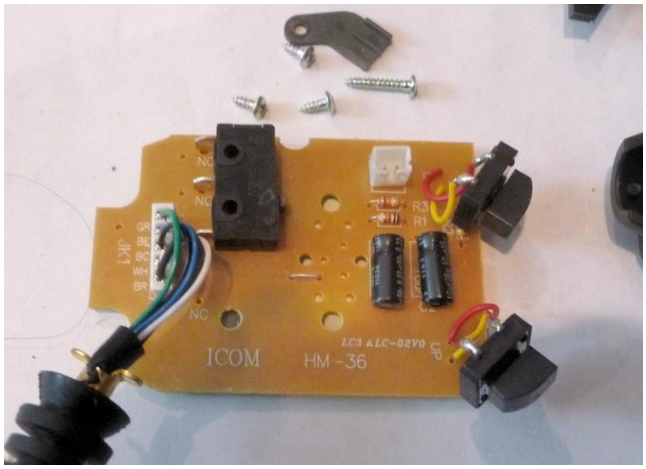
The following provides the detailed steps needed to implement the mod. I am not responsible for your modifying your mic, voiding warranty, and possible damage. Do so at your own risk. Do not attempt unless you are familiar with soldering of small circuit boards and assembly/disassembly of relatively small and fragile physical elements!!!

1. Remove the 3 case screws.

2. Separate the two halves of the microphone.

3. Separate the PTT lever and PTT spring from the side with the PC board (taking careful note of placement as you disassemble). Remove the 4 screws holding the main PC board down. One is longer than the other 3 , the longer one passes through the PTT microswitch and a small plastic bracket . Separate the board from the case and slide out the up-down buttons.

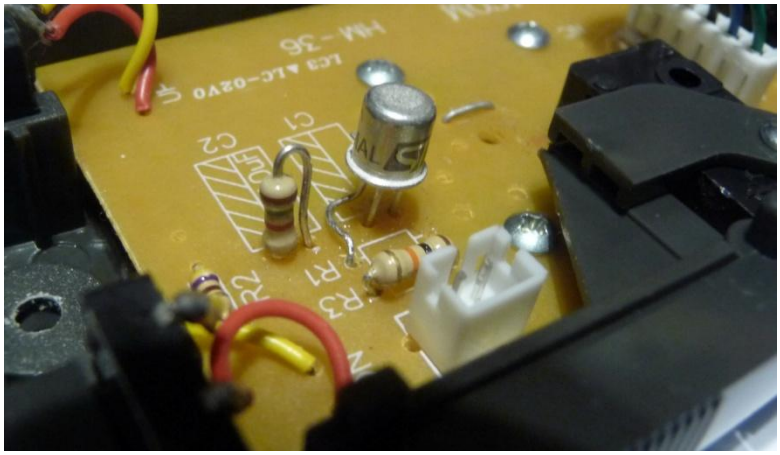
4. The removed P.C. board appears as shown:



5. Unsolder/remove C1 (0.22uF), C2(10uF), R1(1K), and R3(22K). Use solder wick and/or a needle while heating the joints to clear the holes. (Note: The solder may be lead free as it is dull and does not desolder very easily compared to solder I am normally used to working with.) Take care not to damage the low cost (phenolic?) PC board.

6. Install a 1.5K 1/8W 1% resistor in the C2 location and stand it up vertical.

7. Install a 10K 1/8W 1% resistor in the R3 location.



8. Install the transistor (I used a metal case 2N2222A, or use a BC547B per PY3SS or a 2N3904) with base and collector in the C1 location and the emitter in the R1 hole nearest the edge of the board. It will need to be bent to fit into the hole. 9. Reassemble the PC board into the mic case with the four screws.

10. Seat the mic cable and carefully put together the two mic halves, orienting the up/down switches so they fit properly in the mic case.

11. Reinstall the three case screws.

Voila! You are done! Enjoy your improved audio quality on the HM-36 mic.

-Steve Dick, K1RF