

Sensitivity improvement VHF/UHF



[Contact author:](#)
[Woody AK2F](#)

[Print](#)

The Kenwood TS-2000 series of transceivers is a popular radio amongst VHF/UHF enthusiasts. Initial review of an online schematic showed a low noise 2 meter front end. Unfortunately, the receive sensitivity was not close to my trusty transverter. Why?

Instead of adding a pre-amplifier in front of the radio, like the work-around most hams have done, I decided to see if the TS-2000 itself could be improved. This decreases the possibility of overloading the front end and other dynamic range issues resulting from cascaded low noise amplifiers and possibly let the AGC in the IF handle some gain adjustments.

My first step was to increase the IF gain on 144 SSB through the "adjustment software" that must be flashed into memory. Receive gain was increased by approximately 20 dB (same as external pre-amp gain but inside AGC loop). Unfortunately, the on-air performance was not as good as it should have been so this was returned to the initial value of 127.

Next, I was getting ready to wire an ARR GaAs FET pre-amp inside the radio. I wanted to grab the 144 RX voltage for the pre-amp, so I started probing around for an acceptable point. While in there, I noticed the voltage on the second gate of 3SK241 GaAs MESFET was low. Measured around 0.8 volts, about the same as the source voltage. (Gate1, the input is at DC ground). Panasonic data sheet tests this part for noise figure at 1.5 volts. Most dual-gate GaAs FETs I've worked with usually run at half the drain voltage, around 2-3 volts. A quick test of pulling the voltage up with a resistor resulted in an audible gain improvement!

On the schematic, I've shunted R20 (270 Kohm) with a 10Kohm resistor. On my rig, this increases the G2 voltage to 2.2 volts. The resistor goes from G2 to the FET voltage source (where capacitor goes to thru board hole). Thanks to Dale K9VUJ for the close up digital picture on the right.

Improvement in receive sensitivity was checked with a HP signal generator running the TS2K in SSB 2.4 khz. Kenwood spec is 0.16 uV, -123 dBm for USA model. I now measure -132 dBm, 0.056 uV. This is a 9 dB improvement in receiver sensitivity and +10 dB absolute gain as measured by S1 and S9 readings. To improve further sensitivity would probably require reducing circuit losses in front of the FET. As a test, adding the ARR GaAs FET in the shack raised the S meter but did not help the signal quality anymore so took it out of line.

The TS2K is now as sensitive as my TR-751A and close to my trusty Microwave Modules MMT 144/28R transverter. I can hear antenna noise in my suburban QTH. This may actually be too sensitive for some users since there is a trade-off between sensitivity and dynamic range.

To get to the front end board, remove the bottom cover and 10 screws holding the IF board tray. The VHF/UHF board is located under the IF board subassembly. Follow pictures, schematic and layout on the right hand side of this page.

UHF Sensitivity

Biasing on the 70 cm side was not as bad as 2M. I was able to increase the

sensitivity a bit by placing a 56 Kohm resistor from Gate2 of FET to junction of C46/L6 and by increasing IF gain. Gate voltage is now at 2.8 volts. A 68 Kohm would probably be a better value but didn't have one in my junk box. While observing SINAD, I found it necessary to adjust the IF gain by flashing in the adjustment firmware. This can be obtained from Tony KD4K site at: <http://home.adelphia.net/~tonycash/kd4k/radio.html> Ended up with a value of 127 (was at 192).

Kenwood spec for 432 SSB sensitivity is 0.11 uV (-126 dBm). I measure 0.07 uV (-130 dBm) which is a 4 dB receive improvement. Actual receiver gain is +10 dB. This is due to concepts of thermal noise floor and system noise figure. The extra gain helps make the weak ones a little louder, at the expense of dynamic range. For this band, a mast mount preamp might be in order due to antenna cable losses.

Feedback from Kenwood-2000@yahoogroups.com yielded a posting from Oleg LY3UE indicating similar work done by UU2JJ. Check it out at: <http://www.uu2jj.nm.ru/ts-2000> pr3.jpg

In retrospect, it seems like the manufacturers of the DC to light rigs design VHF/UHF with similar receiver gain as HF. Since VHF has much less noise than HF, signals are often worked at much lower signal levels. As a result, some extra gain is called for. Your feedback and observations are appreciated.



