

Grounding and Reducing Noise In Your Radio Station

by Xtal Staff

The amateur radio station in our Xtal Set Society workshop is shown in the picture at right. The YAESU FT450D transceiver at center is supported by an LDG YT-450 100-



Watt Automatic antenna tuner at left and an Astron SS-30M power supply at far right. An LDG RBA-4:1 Balun, 120 foot long-wire antenna and 8-foot ground rod situated just through the wall outside serve as the current antenna system. We added the station just after attending the Dayton Hamvention in 2011. We use it to confirm AM broadcast stations tuned on crystal sets, of course, and for CW operation on the 80 through 6 meter amateur radio bands.

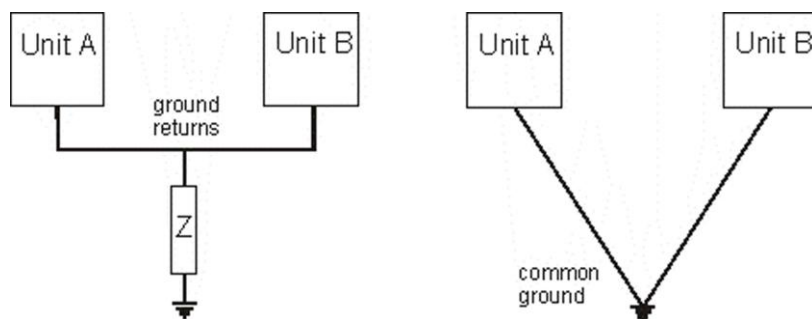
When the shiny new FT-450 D transmitter-receiver (transceiver) and accessories arrived from the vendor we unboxed them and set them up on a table next to our computer desk. We added an AC power strip for the Astron supply and plugged it into the nearest AC outlet some six feet away. Various lengths of coax were used to interconnect the transceiver, antenna tuner, 4-1 balun and antenna. Power leads (+12V and ground) were run from the Astron to the FT-450D. A short wire was run between the ground lugs on the transceiver and tuner, as recommended, but not other grounding was added. We attached a Bencher CW keyer and headphones and began to use the station.

At first blush – and this shouldn't be a surprise – we noticed some hum and other background noise in addition to the usual galactic noise produced from outer space and presenting itself at the desired frequencies of operation. We put up with the hum and such until recently since we always had something else more pressing that needed our attention. This spring, however, after struggling to earn a W25 Certificate from the Four-State QRP Society (4SQRP), partly due to these various noises making their way into the headphones, we decided it was time to properly install and ground the station, hoping to increase the clarity of the desired signals. We're happy to report that the changes made and outlined below, while basic, noticeably improved signal quality.

To reduce or eliminate unwanted signals from entering a system, their signal paths into the system – or conduits if you will – must be restricted or cut. With radio systems, two types of interference coupling exist, radiated and conductive. You can think of the first as a transformer, where the current in one circuit produces an electromagnetic field when in turn causes a current in another circuit loop. If there is a loop inside your desired circuit and the magnetic field of an outside interfering signal can reach it, you'll pick up some of that signal. An undesired conductively coupled signal simply happens when some portion of the unwanted is carried by a conductive path into your system. You'll have to cut, filter, or increase the impedance of the path for that signal to be reduced.

Generally one places an electronic system sensitive to radio fields inside a shielded enclosure. Most commercially build radios are well shielded and get the job done. However, conductive coupling can still occur with well built equipment when various boxes within a station are not properly cabled and grounded together.

This is perhaps the most common source of interference. Look at the two wiring jobs in the figure at right. With the system on the left Unit A and B have a ground wire running between them with a shared/common wire, labeled Z, running to earth ground. A better practice is to run individual wires, as note in the system at right, to one common ground point.

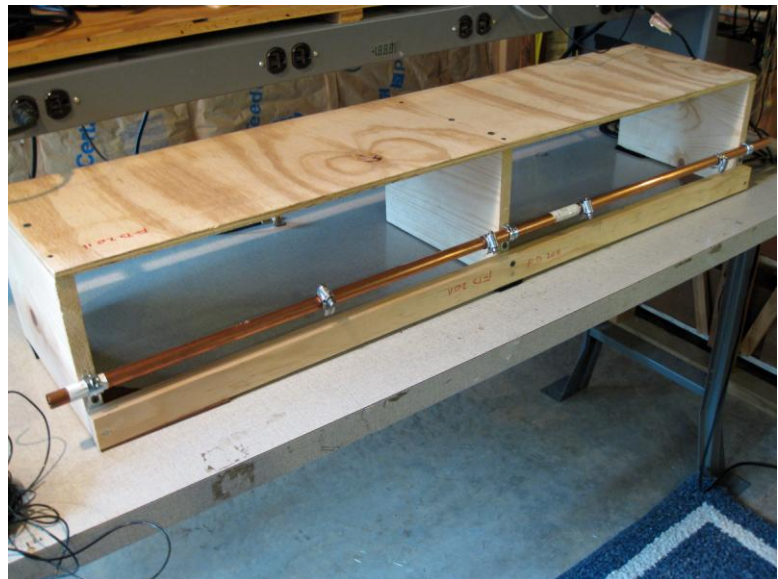


Why is this better? Let's take a severe example. Suppose that Unit A is a low signal receiver module and Unit B is a power transmitter at a given RF frequency. When you key the transmitter, the DC current flowing from the power supply to Unit B then flows through Unit B and returns to the system ground supply via conductor Z (at left). If the transmitter draws 10 amperes and Z is an impedance (wire) of 0.001 ohms, the voltage across Z will be 10 mV. Hence, if a 10 micro-volt signal is entering Unit A, it is being modulated by 10 mv on its ground pin! The signal heard in your headphones will not sound clean or nice! If both units are wired directly to a common modulation of Unit A's ground pin will be minimal. If our station were more complex, consisting of N units instead of just two, we simply continue our theme: each unit must have its own ground wire running directly to the earth ground.

When we rewired our station, the ground rod, our outside common ground, was just a couple of feet outside the house wall and a four foot piece of copper braid was attached between it and our inside common ground – a 1/2-inch by 4 foot piece of copper pipe. The pipe was affixed to the back of our station shelf as noted in the picture below. While the arrangement clearly is not a single ground point – in that it has some length – it is a big piece of copper so the resistance is very low – and as it turns out good enough.



We attached the copper pipe to the back of our station shelf with C clamps in three places and added four screw-clamps. Separate strips of copper braid were then secured to each screw-clamp on the pipe and run to the ground lug on one piece of equipment: power supply, transceiver, and antenna tuner. A very short run of coax, about 6 feet, was then run from the antenna tuner to the SO-329 coaxial connector on the Balun that was mounted outside on the ground rod. The output leads of the Balun were wired to the end-fed antenna and the ground rod. Since the Balun is a magnetically coupled device, the ground of the coax from the tuner to the Balun did not create a ground loop – from outside ground to the copper pipe to the tuner and back to the ground rod.



With the station thus grounded, nearly all of the hum and other noise effects noticed with our first installation - to our delight - were gone. We also noted that the key-click like sound reaching the headphones when keying the transmitter for CW no longer existed.

Now look back at the front view of our picture of the station and you'll see a small printed circuit board on the table in front of the FT450D wired to its headphones jack. The PCB and parts is an experimental audio regenerative CW filter described in this issue of the newsletter. The gain of the regen can be as high as 40! You can imagine what we were hearing in our headphones on CW key down when using this filter with our old station wiring. The phones would blast out a nasty "SQUAK- SQUAK- SQUAK" when keying the letter S. At first we thought the side-tone of the FT-450D was somehow at fault. With the station rewired and well grounded, we simply hear a very nice side tone now, albeit with the hollow sound of a very narrow filter. Sweet!