

Common Mode Currents on a Feedline - a Practical Lesson

by

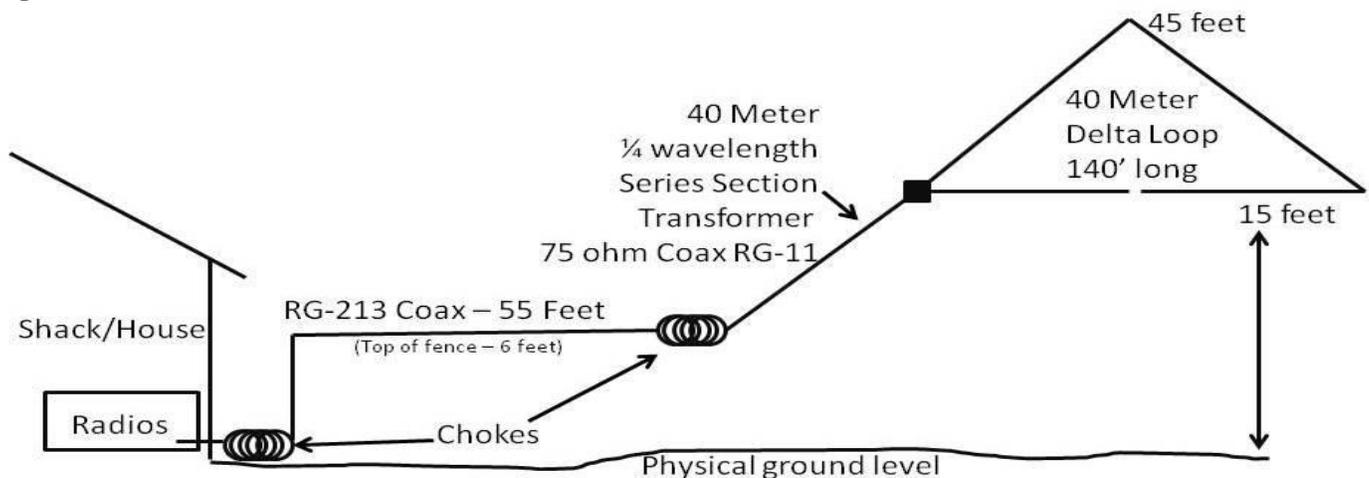
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Common mode current on a coaxial cable is that current which runs on the shield. To be specific, it runs on the "outside" of the shield. This common mode current is an extra current occurring on a coax in addition to the normal (desired) internal TEM mode currents. Remember that RF travels near the surface of a conductor -- called the "skin effect". The conductor "depth" that the RF uses for propagation along the conductor decreases as the frequency goes up. So coaxial cable, from an HF RF standpoint, has 3 conductors - 1) the center wire, 2) the inside of the shield and 3) the outside of the shield. Although the 3 conductors can be utilized in a constructive sense (Reference: Google the W5GI Mystery Antenna), most times, the outside of the shield carries a common mode current caused by a feed point "unbalanced to balance" transition or running the coax thru the antenna radiation 'near field' or from a noise source in your house or neighborhood. This destructive common mode current can generate noise in your receiver, make your mic "hot" (voltage wise) and give you bogus SWR meter measurements to name a few things. These common mode currents caught up with me recently. Fortunately, it has a happy ending.

The Antenna

My antenna "system" (reference Figure 1) consists of a 40 meter delta loop (hung, apex up) on my 45 foot tall tower/mast combination. The loop is open at the center of the base line in order to make the standing waves symmetrical and in phase for 40 meter DX, as it is fed at the corner. (The topic for a completely new article) Opening the loop also makes it a reasonable antenna for 80 Meters too, by placing the current maximum at the apex of the triangle at 45 feet. However, this requires the use of an ATU / antenna tuner. I feed the loop at the bottom corner with a $\frac{1}{4}$ wl piece of 75 ohm coax (RG-11) to transform the 110 ohm loop feed Z into 50 ohms (called an SST 'series section transformer'). The 75 ohm coax comes down to the fence where it is connected to about 55 feet of RG-213 for the run to the shack. This RG-213 coax was about 20 years old, but still measured OK some time back.

Figure 1



The loop is resonant and matched via the SST to 50 ohms on 40 meters. On 80 meters, for the Rag Chew Net, however, it is tuned and matched thru a Heathkit ATU (antenna tuning unit) in the shack. I can also “match” this system on other bands, i.e. 30, 20, 17,12 and 10 meters with the use of the ATU. One antenna, fed with coaxial “tuned feeders” loads on all bands. This system has been in the air about 5 years. Over this time I have changed the shack configuration and feedline jumpers/extenders in the shack, but nothing outside.

Recently, I have been having trouble tuning up/loading up the antenna system thru the amp and ATU on 80 meters....(Note: 40, my main band of operation, has always been OK with 600 watts out, but the system, on 40 M, is in a “matched” condition, so no extended SWR / impedance situations on 40.) On 80 I had to drop my power out on the Rag Chew Net to 100 watts, as the amplifier (AL-80B) did not like to be operated any more on 80 M. The situation continued to get worse over time. Even on 10 Meters, during the winter Ten Ten SSB contest, it was distorting the audio. Sometimes the amp sputtered and the matching network sparked over, etc. On 20 meters, the rig power supply would go into a 7.5 volt “funky” state when I put out more than 30 watts on 14 MHz. It took a power down of the power supply and the radio to get it all to unlock. Grounds, power connections and signal connections within the shack were checked and all was tight. So maybe the amplifier was a fault, maybe the tuner, but I didn’t know for sure. After multiple discussions with my friend Maurie, VK3CWB, where he also noted some RFI on my audio, we decided that there were probably common mode antenna currents on the coax and /or the coax was breaking down as it was being used as a tuned feeder. Possibly high voltage loops were occurring on the standing wave when I was running power and the SWR was much greater than 1:1.

To start the troubleshooting, I disconnected the antenna system and ran the full system (radio, amp and tuner) into my 1KW dummy load and found no problems what so ever at even 700 watts. This test and result was a good indication of the antenna system/coax, etc. being the problem. I decided to shotgun the replacement of the 50 ohm RG-213 coax. I had a nice newer piece in the junk box. I also decided to build 2 low frequency chokes to place at either end of the coax, in order to eliminate any common mode propagated from the antenna feed point or generated on the coax by the antenna radiation, as the coax was in the near field, unfortunately (I have a small lot). The chokes (see Pictures 1 and 2) were placed at the connection to the 75 ohm coax and the other at the coax’s entry into the house.



P1--Choke at the end of the matching section P2-- Choke at the entrance to the house/shack

Once all was in place, I fired up the gear. I found my new ATU settings for 80 M, 20 M and the other bands, with all bands giving me a nice low SWR for the amplifier to load into. The result was full power, 800 + watts, into the system “keydown” on all of the bands, except 30 (limit 200W by the FCC) . No hot mics, no distortion, no sparking over, etc. All seemed to be A-OK. I was pleased that such a simple fix (coax and coaxial chokes) could provide an elegantly simple , trouble free installation.

I inspected the old 50 ohm RG-213 for any kind of breakdown point, but I saw nothing over the full length of the cable. I did, however, see that the dielectric was melted through the shield webbing at the PL-259 at one end. Now, maybe that was due to too much heat while putting the cable together, I don't know....but it was the only physical problem that I saw. Anyway, that cable had the ends cut off and was relegated to the junk box for use in some non-transmission line wiring project.

What I Learned / Recommendations

Whenever running any type of “tuned feeder” coax or otherwise, be prepared to encounter common mode currents. If your feedline runs thru the near field of your antenna, be prepared for common mode currents. As a common practice from now on, I will place a choke right at the entry into the house for each feedline. This will help keep hot feedlines out of the shack.

To learn more about Common Mode Suppression, “google” the following:

Common Mode Chokes W1HIS

About Baluns W8JI

Amidon Associates

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