

Help!

At the October 2023 in-person meeting of the Tulsa Amateur Radio Club, Mark, WA5MA, our president, announced that he had been contacted by a desperate homeowner whose kitchen stove electronic controller would periodically become scrambled during the night by transmissions from the nextdoor amateur radio operator. WA5MA asked whether anyone present had experience suppressing Radio Frequency Interference (RFI); apart from the obvious addition to power cords of snap-on toroids, there was nothing heard. WA5MA asked anyone present with ideas to contact him.

Poltergeist or RFI

At that point, we had too little information to know how to respond properly. After all, it could be poltergeist, in which case the homeowner would need a priest with bell, book, and candle to perform an exorcism instead of helpful Ham with a bag of toroids.

Ideas

After the meeting, Andrew, W5AWS sent Mark some ideas about how to approach the problem, most of which applies to any RFI:

1. Has the owner accidentally activated the automatic turn-on turn-off feature of the oven.
 - (a) There should be zero volts AC and continuity between the chassis and the grounding system of the house.
2. When did the problem start happening?
 - (b) Voltage or high resistance is cause for suspicion.
3. How long has it been happening?
 - (c) Check for voltage first before continuity.
4. Are others in the neighborhood experiencing strange behaviour of their electrical equipment?
5. What changed around the beginning of problem?
6. What makes the homeowner think that the problem is the amateur radio operator?
7. Get the make and model number of the oven.
8. Does the neighborhood suffer from power surges or glitches that could influence the oven?
 - (a) One of the largest loads in a house is the air-conditioning that could be causing a drop in voltage during start that might affect the oven, it could be enough to reset a microprocessor.
9. Check proper connection of the oven to the safety ground.
 - (a) These days, power input to houses are two-phase 208/120 at 200A.
10. One of those outlet checkers would be worth using to confirm correct connection of the utility outlets.
11. Is the house recent construction or old?
12. Domestic electrical systems have the grounding developed at the main distribution panel where the ground and neutral busses connect to the ground-rod outside.
 - (a) If it's an old house, the ground rod may have eroded, or the clamp connection has become loose.
13. According to the National Electrical Code (NEC), the ground-rod should have a resistance no greater than 25 Ω .
 - (a) If it's an old house, the ground rod may have eroded, or the clamp connection has become loose.
 - (b) An inductive ground-tester would help here.

1. However, inductive ground testing can be problematic and needs careful consideration.
- (c) The NEC resistance limit is somewhat arbitrary and only requires a second ground electrode six feet away from the original, bonded together to mitigate readings above 25 Ω .
14. Add snap-on Ferrite cores to the power lines close to the power input to the range.
 - (a) Doing so shouldn't hurt anything.
15. To blame the nearby amateur radio operator we would need incontrovertible evidence.
16. Create a log and document actions taken, preferably with a club letterhead. Electro Magnetic Compatibility (EMC) and Radio Frequency Interference (RFI) are within our scope as a club and would put us under club insurance should any liability problems arise.
17. The Federal Communications Commission (FCC) now requires amateur radio operators to perform Radio Frequency (RF) Exposure analysis. Follow this link for more information:

<https://www.arrl.org/fcc-rf-exposure-regulations-the-station-evaluation>

Since the original request for help, more information became apparent in various emails:

- In addition to the range, a curio cabinet LED lighting flashed in time to Morse code, which is incontrovertible evidence of amateur radio induced RFI.
- The amateur operator occupies the house adjacent to the homeowner experiencing RFI.

On-site

In November 2023, Mark, WA5MA, and Andrew, W5AWS, visited the homeowner to find out the full story and see the lay of the land.

- There had been RFI affecting the television.
- The cable-TV company installed additional filters on the exterior cable box.
- The Op nextdoor had installed a ring toroid and wound multiple turns of the HDMI cable onto it, which prevented RFI with the TV.
- The homeowner said that when approached about RFI, the Federal Communications Commission (FCC) was uninterested in becoming involved, which is contrary to their published regulations of Amateur Radio activity.
- The RFI is sporadic, but occasionally, the landline wireless telephone had shown problems though nothing happened recently.
- There have been no reports of other householders in the neighborhood experiencing RFI.
- The Samsung gas stove has electronic controls with manual operation of the gas valves. Thus far, though the RFI scrambles the electronic settings, no ignition of gas has happened yet.

Sometime in the past, there was a squabble about property lines that caused the OP to take the homeowner to arbitration resulting in the homeowner having thirty

days to move a chain-link fence; since then neighborly relations deteriorated to the point that the Op refuses to have any further interaction with his neighbors.

What We Found

The Op's property occupies about an acre of wooded land. He has erected what looks like a horizontal loop antenna at about twenty-five to thirty feet above ground with the feed-point at a thin mast erected in his front yard.

One leg of the loop passes parallel to and within about ten to fifteen feet of the side of the homeowner's house, the side where the kitchen is, with the gas stove located against the interior outside-wall of the house. In this location, RF radiation from the antenna can easily influence the stove.

The curio cabinet is about eight feet farther away in a corridor on the other side of another wall, in the same orientation to the antenna as the stove.

Our Tests

We used a domestic convenience power outlet tester to verify that the household wiring is correct.

Outside, we found the main power inlet to the house on the opposite side from the kitchen. We tested the building ground using an inductive ground tester and found the resistance to be more than 160 Ω , which is much higher than the 25 Ω or less specified by the National Electrical Code (NEC) for building ground electrodes; also, there was about 1.5 mA of current flowing in the ground line which is well within limits. Lowering the ground-electrode impedance to NEC specifications would require work by a licensed electrician.

The stove is freestanding with a flexible gas coupling that allowed us to pull it out to give us access to the rear. The range receives electrical power via a standard three-wire 15 Amp power-cord with a molded three-pin plug.

The stove chassis is steel and there is electrical continuity between the chassis and the metal gas line, which means the stove is likely sufficiently well-ground to resist any RFI, leading us to suspect that the power-cord is acting as an antenna.

The curio cabinet has LED lighting in the top fed by an electrical extension cord to the touch controller on top of the cabinet, a fine antenna in proximity to the radio Op's horizontal loop.

Our Corrective Actions

Mark, WA5MA, added two Mix-31 snap-on toroids to the stove power-cord looped twice as close to the cable entrance to the stove as he could get it. Sadly, we forgot take a picture. Two toroids are likely massive overkill, but we wanted to be absolutely sure that we've eliminated the problem with RFI, which we cannot be certain about until the homeowner has had ongoing trouble-free operation of the stove for several weeks.

Mark, WA5MA, added Mix-31 snap-on toroids to both input and output of the curio cabinet LED controller, as close as he could get them to the controller itself. We didn't want RF getting into the controller from either side; however, the controller

may remain susceptible to interference from RFI through the case; if this happens then shielding the case with baking foil has a good chance of solving any remaining problem.

Conclusion

The homeowner was grateful for our help and wanted to know what monetary cost he incurred by our visit. We stated that we haven't definitively eliminated the problem until the homeowner has enjoyed continuing trouble-free circumstances after our departure. We suggested that the homeowner make a donation to Tulsa Amateur Radio Club sometime in the future at his convenience.

Hopefully, our intervention has helped mitigate the bad publicity for Amateur Radio generated by the neighboring operator who is actually violating the terms of his license. Since 3 May 2021, FCC rules took effect that now require amateur radio operators to evaluate the amount of RF energy people nearby are exposed to, and is in compliance with FCC RF exposure limits: <https://www.arrl.org/rf-exposure>.

In this case, given proximity of the homeowner's house to the amateur radio operator's antenna element, RF exposure is a genuine concern, especially if the grandparents have in-body medical electronics like heart pacemakers.

Follow-up

A few weeks later, the homeowner told us that there was some RFI induced flashing of the curio cabinet lighting, but thankfully no further problem with the stove. We suggested that the homeowner try wrapping the curio cabinet lighting controller with baking foil that covers both the toroids and the controller, with the end edges of the foil pinched around the cables. However, the capacitive touch-switch could still be influenced by RFI, in which case there isn't much more that we can do.

Final

Apparently, wrapping the LED light controller with aluminum foil didn't eliminate the flashing LED problem. We speculate that the capacitive touch-switch is sensitive to the RF field.

We asked whether the homeowner wanted to pursue the issue further, who said that they were just glad that our intervention ended the three-year ordeal with the oven and that they would leave the curio cabinet light disconnected.
