

RFI – From Both Sides

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RFI is a big topic. Every case is unique. I can only describe my experiences and those of my friends. If you are a new ham, ask for help.

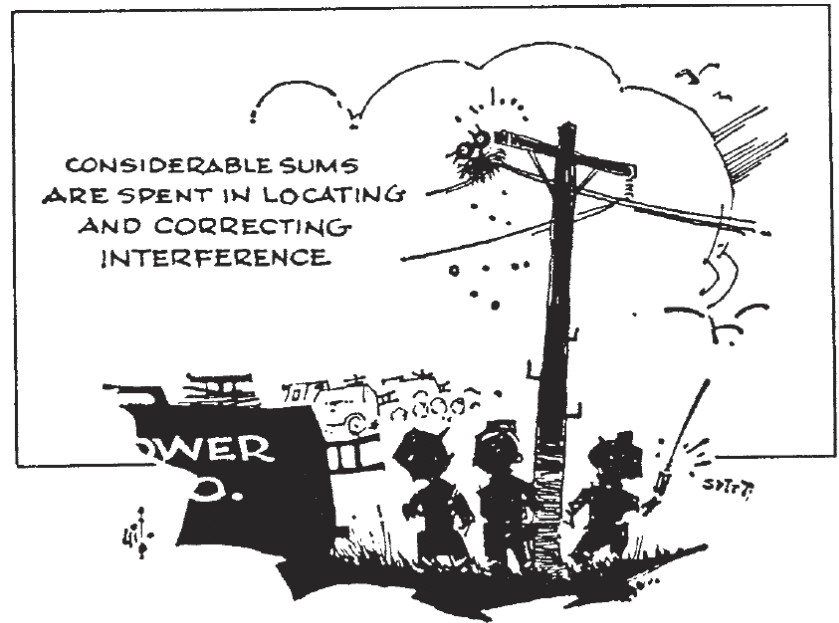
ARRL members can get help finding, analyzing and reporting RFI problems.

Patience is important. The ARRL is running a month behind. The power companies have manpower problems and often take more than a month to respond.

Find another band or activity to stay active while you work on the RFI problem

Overview

- RFI is a big issue for amateur radio. Our signals can interfere with the operation of other electronics and other electronics can interfere with our ability to hear weak signals.
- The *ARRL RFI Book* is a great resource plus the engineers at the ARRL Lab are willing to help members identify interference sources
- September 2021 *QST* has an article on finding and fixing power line interference
- Let's start with a story



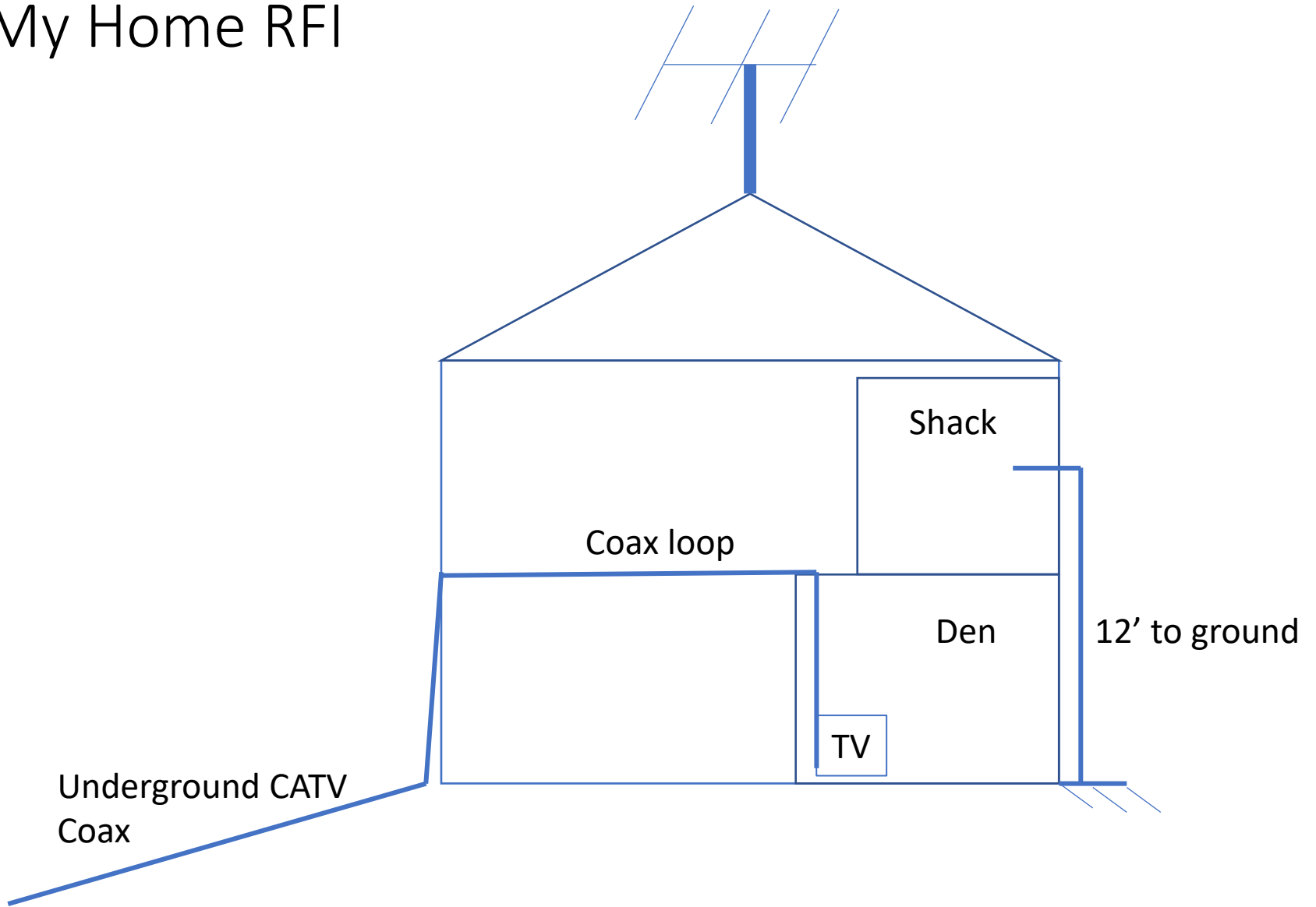
RFI at W6QR

- When I first got on the air from my present QTH in 1988 things were simpler.
 - There were fewer wall warts and computers were simpler (Commodore 64)
 - Many folks had CATV so direct RF overload through a TV antenna was less
 - In my neighborhood we have underground utilities
- For a year or so I was running 100W with wire antennas and had no problems
- Then the DX bug hit me. I put up a Yagi and bought a 1500W amplifier
- I spent the next month and a bunch of cash solving RFI problems in my home plus my neighbor's homes

What happened?

- 1500W is a lot of power. We have two TVs, one on cable and one uses a rooftop antenna, both were wiped out when I was operating.
- Rooftop TV interference was fixed with a shielded TVI filter plus 10T RG6 on a FT240-43 ferrite toroid to choke off the shield currents. I installed RF filtered AC outlets on my TVs and Stereo.
 - Always use multiple turns on a ferrite toroid. The impedance of the choke is proportional to the number of turns squared. A single coax through a clamp on ferrite is only one turn.
- I was surprised at the CATV interference, but the cable came up out of the ground on the opposite side of the house from the den where the TV is. The loop the shield made was nearly 50' long and made a good antenna. The same fix worked on the CATV
- I also wrapped excess power cord on ferrite toroids

My Home RFI



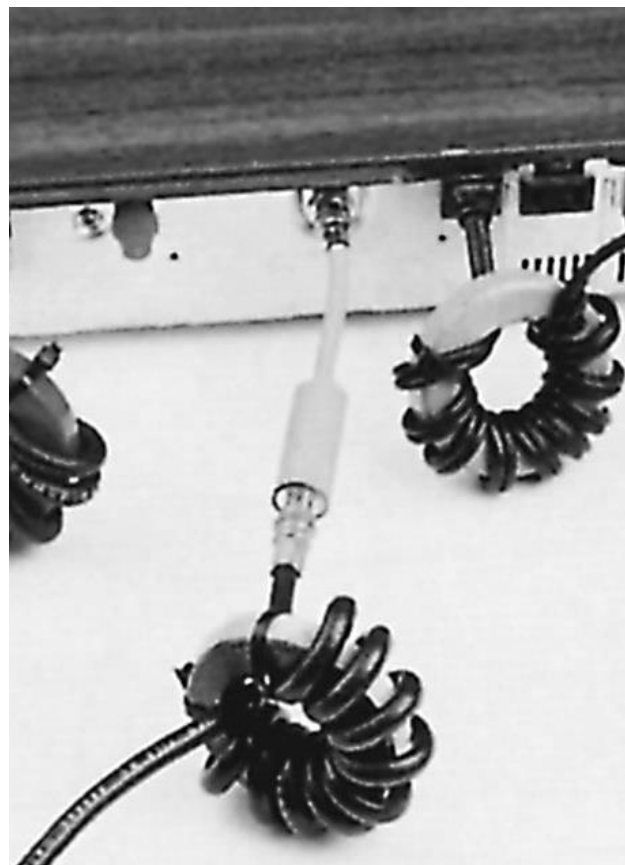
What Happened? (Cont'd)

- The stereo required an AC line filter plus 10-15 turns on a FT240-43 toroid for each speaker wire. The subwoofer on my computer speaker still thumps on some bands at high power.
- The land line phone required a commercial phone filter on the main phone plus ferrites on the wall warts for extension phones
- One neighbor had a VCR with a 1.8MHz IF. That took extra measures to fix

I assumed the attitude that it was my hobby
and I fixed the problems it caused

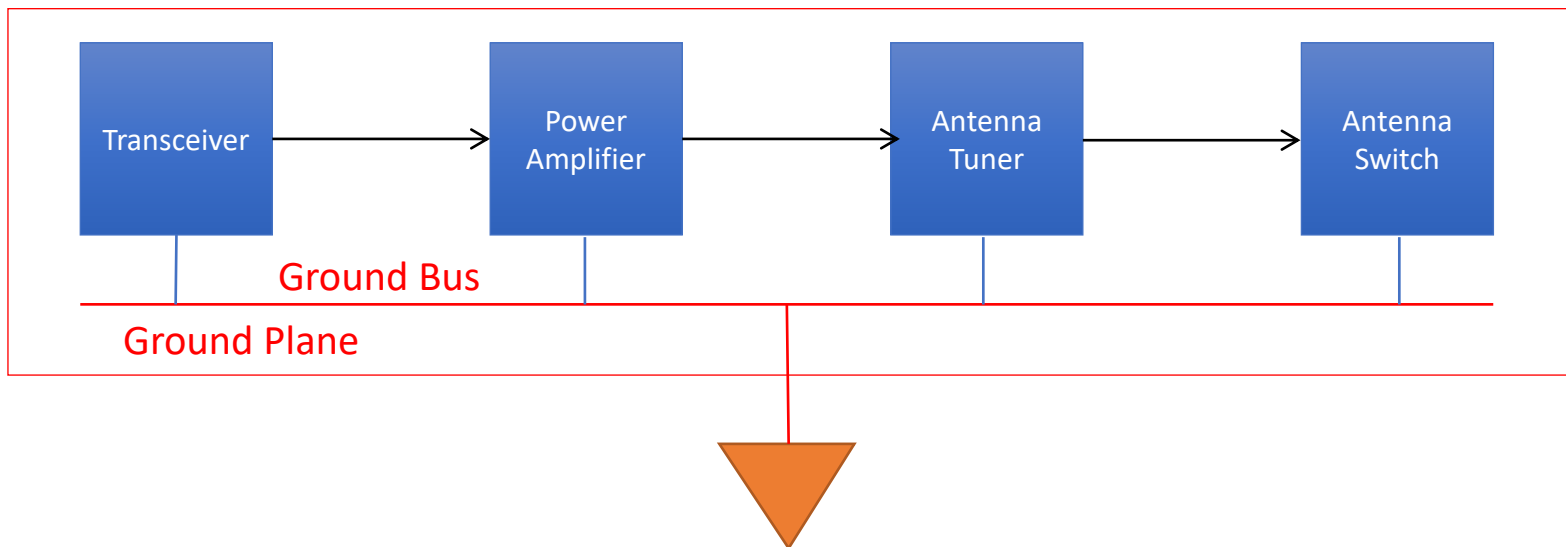
RFI in My Shack

- 1500W made everything RF hot. The 12' copper pipe coming from a ground rod to my shack was inadequate
- I installed quarter wave counterpoise wires for every band, bought industrial quality AC line filters and wrapped all DC, audio and control cables around ferrite toroids.
- A good ground system is your first line of defense against shack RFI
- I recently installed aluminum flashing on my operating desk to improve the grounds (ARRL Grounds book Chap 5)
- It is good practice to make sure all coax connectors are tight



Ground Planes

- In the ARRL book *Grounding and Bonding for the Radio Amateur* the author, Ward Silver, N0AX, introduces the idea of a ground plane.
- He puts a piece of 14" wide aluminum flashing on his operating bench with a copper pipe ground bus along the rear of the bench on top of the flashing. This produces a very low impedance ground



A Better Ground

- A ground plane presents a very low impedance ground with no loops, it is a better solution for complex stations and 2nd floor shacks
- I didn't add a computer, but if you use one to control your radio or use digital modes the loop problem can be much worse
- Most computers can't be properly grounded because they have no real shielding. Connectors are connected to PC Boards but not grounded to any shielding that might be present.
- If DC power or computer interconnect cords are an issue use a large bead with 3-5 turns wound on it. One bead may provide 50 ohms reactance, 3 turns provides 450 ohms, 5 turns provides 1200 ohms reactance.
 - Type 31 ferrite for 1-10 MHz
 - Type 43 ferrite for 10-30 MHz

Other Considerations

- Keeping unwanted RF out of your shack is more important than ever due to the large amount of consumer electronics
- Always use a balun at the antenna feedpoint to keep RF from direct coupling to the coax shield. Conventional wisdom says you need 500 ohms of choking impedance. This is OK for the antenna alone without outside influences since you are not receiving when you transmit
- Good coax, like LMR400, prevents any residual pickup from direct coupling to the signal path inside the coax
- A second isolator in the shack eliminates any outside shield pickup, especially if you have long coax runs. Ground is very noisy, so running coax on the ground does not help, it usually hurts. You will get RF pickup since you are in the near field of your antennas
- Recent estimates suggest >5000 ohms choke impedance to prevent unwanted RF pickup. Receive signals go down below -125dBm, that's pretty low.



RFI In Your Home

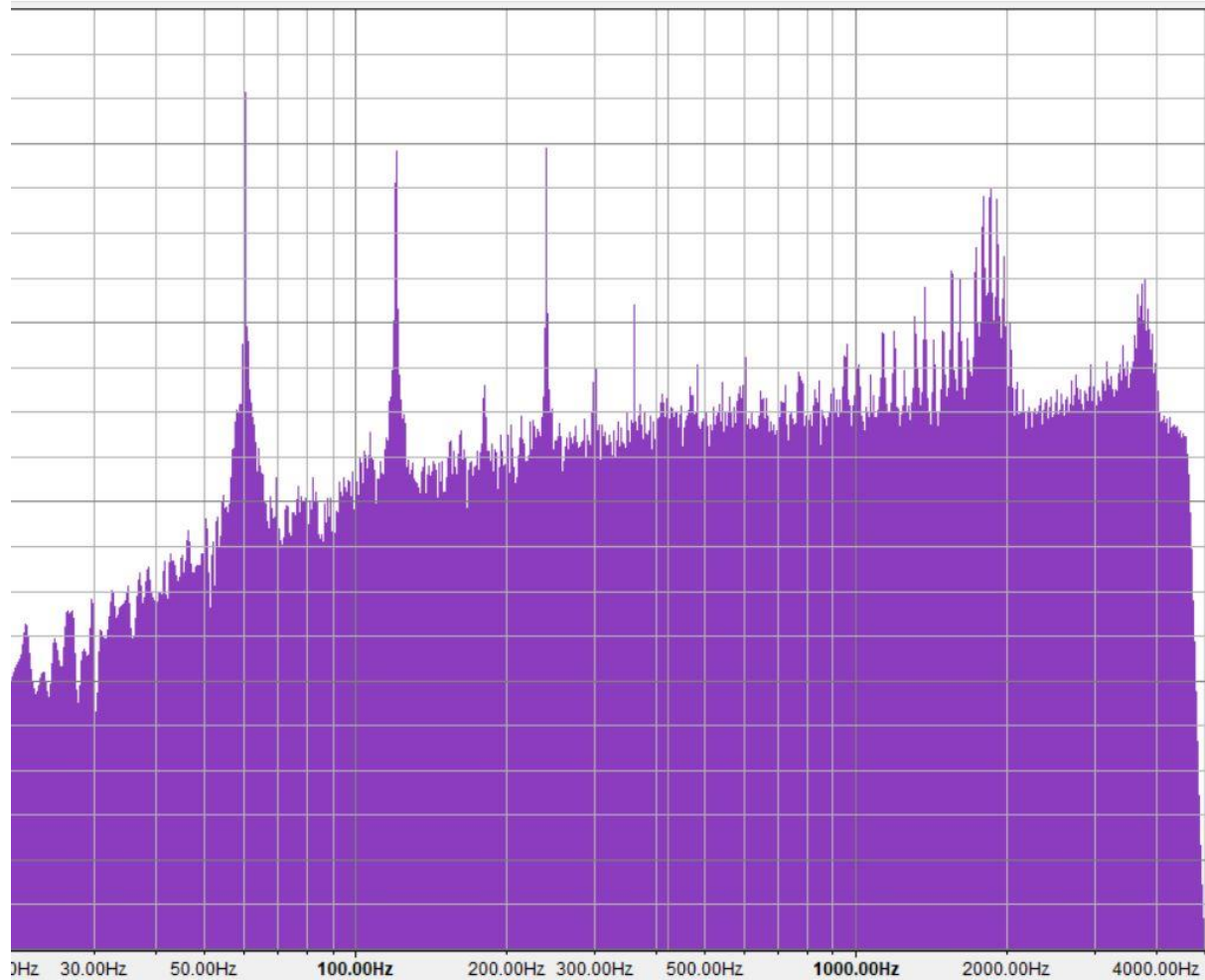
- A good station ground is the first place to start
- If you are running low power, 100W or less, you will most likely have no transmit RFI issues. If you do, simple ferrite fixes will probably work well
- Running higher powers, you run into what I call thresholds. These are voltages that trigger a response in another device. Like the time I blew out the fluorescent recessed lights in my wife's den running 500W on 15M
- In the South Bay power line transients are common so AC power strips with transient suppression and RFI filtering are suggested for all electronics

RFI In Your Home (cont'd)

- If you are experiencing RFI in your receiver the 1st thing to do is a home RFI survey. My shack runs on batteries, so I turned the house power off to verify it was not coming from my home.
 - Unplug wall warts one at a time if you don't have too many
- The next thing to do is use a directional antenna like a small Yagi or a loop to find the source direction. Most noise sources extend up to the VHF region so you can use a 2M handheld Yagi. A small portable HF loop can be used as well.
- I walked around my neighborhood and found my 6M noise was coming from a power substation about 0.4 miles away
- My friend Steve, N6TT, found his was coming from a nearby power pole



ARRL Noise Analysis



RFI Sources

- Wall warts
- Cheap Grow lights
- LED lights
- UPS
- Power poles, transformers, sub stations
- Machinery
- Plasma TVs
- Solar systems
- Ground Fault Interrupters
- Bad antenna coax shield connections
- Plus, a growing list of others

What to do when you find the source

- It is illegal for someone to interfere with a licensed radio service. The FCC will investigate if requested
- Send details plus a recording of the noise to the ARRL Labs for spectral analysis.
- The Los Angeles Section has technical assistants to help locate RFI. They can also help you contact the power company and notify the FCC
- Always be diplomatic, not threatening, when approaching the owner of a potential RFI source

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SPECTRUM SCOPE

FIX



3.6

3.7

3.8

EDGE

HOLD

CENT/FIX