EMI HALL OF SHAME BEGINS—HALOGEN LAMP

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This item was extracted from an e-mail thread between W1HIS and ARRL Lab Supervisor Ed Hare, W1RFI.

◊ After reading a recent story about QRN from an electric blanket, I thought that others might find aspects of my own story interesting.

A QRN (EMI) Hunt

I was hearing QRN throughout the MF and HF bands. It was a buzz that was clearly 60-Hz power-line related. Its RF spectrum had strong peaks that were a few kilohertz wide and centered at intervals of about 30 kHz.

I guessed that the source was a switching power-supply connected to the ac line, and that it had to be in my own house because the interference was extremely strong: tens of decibels over S9 in a 2 kHz receiver bandwidth on the 80 meter band.

The QRN was intermittent, however, so brief and infrequent that locating the source was difficult. Before I could get from my second-floor shack to the panel in my basement and flip off a circuit-breaker, the QRN would stop by itself.

To find the source, I tuned my battery-powered portable AM receiver to a quiet spot in the broadcast band where one of the 30 kHz harmonics fell. I kept the boombox on with volume sufficiently high that I could hear, and carried it around with me, inside the house and out, almost continuously, until I heard the buzz return. I then raced to the basement and was able to flip off the main (200 A) breakers for my house before the buzz stopped of its own accord.

The buzz from the boombox continued unabated. I was amazed, but I rushed upstairs and outdoors with the boombox, hoping to track the noise to something out there.

It became obvious very quickly that the source was in the house of a neighbor across the street and that the source was extraordinarily strong, as though the power line itself were arcing. At my neighbor's front porch, the QRN obliterated a nearby 50 kW broadcast station.

I rang the doorbell, let my neighbor hear my boombox, and suggested that her house might be in danger of burning down. She showed me the way to the circuit-breaker panel in her basement. There were 25 breakers in it. When I flipped the very last one off, the buzz stopped.

Even knowing what circuit contained the source, it took me a while to find the QRN source. It was indeed an arc, and it was burning brightly, too.

In my neighbor's kitchen were many 12 V, 20 W quartz-halogen lamps in small recessed fixtures, fed by a cheap Chinese-made so-called solid-state transformer. In other words, switching, power-supplies. By flipping wall switches, I quickly identified a particular set of parallel-connected lamps, or their so-called transformer, as the culprit. Neither the 120 Vac input nor the so-called 12 Vdc output of this transformer seemed to have much filtering, so I installed my usual RFI fixes: First came common-mode chokes, then brute-force LC filters on both the input and output leads.

Strangely, the QRN was only slightly reduced. Further investigation revealed that this piece of equipment was not the direct source of the spectacular RFI. Neither was any of the wiring associated with it. Finally, I discovered that one of the 12 V, 20 W quartz-halogen bulbs—yes, *bulbs*—was the culprit. Its filament was broken, but the gap was so tiny that I had to know it was there to detect it with my naked eye. I saw it first through a 25-power microscope (see Figure 1). With power applied, a bright white arc burned (*stably*!!!) within this gap. This arc was modulated by the substantial 30 kHz ripple on the poorly filtered "12 V" output of the transformer. Simply replacing this bulb solved the problem. Now, this little accidental arc-light bulb is proudly displayed in my RFI trophy room.—*Chuck, W1HIS*

How Small is that Filament Break?

As I wrote originally, I could not see the break in the filament of this bulb with my naked eye until after I had found it with a 25-power microscope. This evening, using the same 25-power microscope, I tried but could not find the break again! For a few horrible moments I thought that I'd gotten senile and had mounted the wrong bulb above the title, "Sue Fallon's RFI Generator." (It was in my neighbor, Sue Fallon's, kitchen that I found this bulb.)

Then I got out my ohmmeter and confirmed that there is no continuity between the two base pins of the bulb (see Figure 2). (Yes, the meter *does show* continuity between different points on the same pin.)

Apparently, the slight vibration of my gentle handling was enough to shake the broken filament ends back into alignment—so precisely that now I cannot see the break with my 25-power microscope. Yet, the break is there, and it is wide enough that the 2 V applied by my digital multimeter is insufficient to break down the gap.

Since a little vibration was able to realign the broken filament, I expect that more vibration or shock could knock it out of alignment and make the break easy to see. I am reluctant to disturb such a delicate thing. It amazes me that a visually flawless filament could be discontinuous electrically.—*Chuck Counselman, W1HIS;* **w1his@arrl.org**

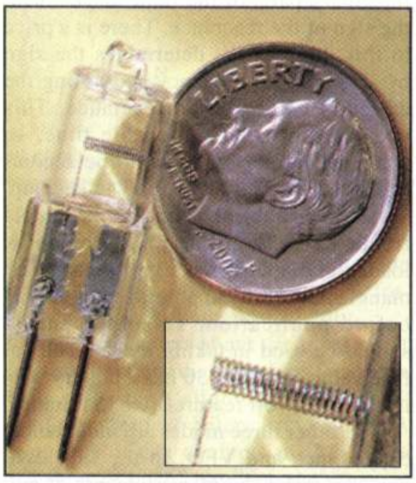

Figure 1—The first of Technical Correspondence's EMI "rogues." Can you spot the broken filament here? The author needed a DVM to detect it and a 25-power microscope to see it. When fed (modulated) by the lamp's 12-V, 30-kHz switching supply, the break becomes a spark transmitter to "light up" receivers in the neighborhood. The cure? Replace the lamp bulb.

Figure 2—The proof that the filament is broken. The "1" on the DMM display indicates an overflow (infinite resistance).

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