

### Combatting AM (And SW) Interference

I am frequently asked by readers how they can improve their AM (and SW) reception. They usually ask me what kind of radio is best for AM, or which radio will bring in a particular station they are unable to receive adequately. The answers are often complex because one of the most misunderstood aspects of getting good AM reception is dealing with and reducing local noise, referred to as Radio Frequency Interference, or RFI. The most important single piece of information I can give you is that most AM reception is limited by local noise, even if you have a good radio. In fact you may not be able to notice much difference between an excellent and an average radio if noise is the limiting factor. You can find many technical and semi-technical articles about RFI but the aim of this article is to distill all that information down to some very specific things you can actually do to improve your AM radio reception.

In a typical home today there is so much RFI that only strong local AM signals can break through. The noise usually sounds like a buzz, hum, whine or whistles. In such conditions, getting a better radio will provide little improvement because the reception is limited by the noise floor...when signals are near or below that noise floor no radio can do much to improve things. An important term to learn is "signal to noise ratio" – simply it describes how much stronger the desired signal is than the RFI. If you want to improve your reception of weak signals you must work to reduce the noise level to be lower than the desired signal. Because of the noise problem, many comparisons of radios, or listening tests, are inaccurate, because in the presence of high noise levels, you cannot distinguish the true differences among radios. I am lucky enough to live in a private residence with relatively low noise, but even so, noise is an on-going battle I have had to deal with, and I have found that some parts of the house are much quieter than others. Even so I still occasionally take radios outside, well away from the house where the last vestiges of noise disappear, in order to reveal extremely subtle differences among the most sensitive radios.

In this article I will describe how to identify and reduce local noise as much as possible, then I'll give you some tips on what you can do to improve your AM/SW reception as much as possible in your local conditions. Even though you may not achieve perfection there are some very real steps you can take, many of which cost little or nothing, to maximize your AM reception.

**Shielded Buildings:** Another big problem is that many buildings, such as steel-framed structures, stucco with embedded mesh-like wire, concrete walls with rebar, foil-backed insulation and aluminum siding can block AM signals. If your signals are much stronger outside than inside this could be an additional problem...we'll talk about things you can do to maximize your reception in shielded buildings.

**Inside versus Outside Noise Sources:** It's an unfortunate fact that many modern electrical devices generate AM interference...after all that's one reason why FM was invented. But if you love AM the first thing to do is to become aware of what your noise sources are, which ones you can control or reduce and those which you must deal with. To do that we must first divide the noises up into two main categories; that which comes from outside your home (most of which you can do little about), and that which comes from within your home. If you live in a densely populated area, such as an apartment building, there is likely very little you can do about external noise sources, although you can often minimize its impact to some degree. If you live in a stand-alone dwelling you may still have noise coming in from the power lines so again, you'll have to learn how deal with it. But for noises within your home there is a lot you can do to reduce or eliminate noise sources, although some are tricky to find. As always, please always use extreme caution when working around AC power...safety should always be the first thing on your mind.

*A good starting point* is to turn off the main power to the house to see if the noise changes. The easiest way to do this is to use a small portable radio, tuned to a fairly weak AM station that is plagued by noise. Then shut off the main power switch or begin turning off the breakers one at a time. If most of the noise abruptly stops that tells you that it was coming from something within your house. Usually this will be the case...see below. You can also turn individual circuits on and off to see if a particular circuit causes the noise. However, if the noise continues, even at a reduced level, that tells you it is coming in on the power lines or it is simply in the air from noise sources outside. In that case you can take your radio for a walk outside to see if you can pinpoint any noise sources, such as a neighbor's Plasma TV or a noisy power pole. Almost all portable radios use an internal ferrite rod antenna for AM and this is very directional. Signals and noise are maximized when they arrive broadside to the radio, so if you hear a noise source you can tell where it is coming from by aiming your radio at it. The noise will be loudest when it is coming from a direction broadside to the radio...if you aim the radio to minimize or null the noise it will be aimed directly at the noise source...this is RDF...Radio Direction Finding in its simplest form. I have read accounts of noise hunters locating noisy insulators on power poles by hitting the pole with a wooden bat to see if they could hear spikes in the noise. I've personally never done that but it sounds interesting. Of course, contact your utility company to fix the problem if you find one. But probably you will find the noise is just all around, coming from the overhead power lines and neighbor's homes...you will have to deal with minimizing its impact on your listening.

However, you may find that most or all of the noise stopped when you cut the power off. If so, count yourself lucky, because you can probably eliminate some of it, and deal with the rest even though it may not be easy. I have often located noise sources by turning the circuit breakers off one at a time, listening for noise changes with each one. When you hear one, you then have to track down what it is on that circuit that's making the noise and proceed from there....even that can sometimes be tricky as I'll explain. Also be aware that sometimes turning a circuit back on may not cause a noise to return immediately as some devices cycle themselves as they see fit.

**Typical noise sources include:**

Overhead wires & transformers (those big "cans") on utility poles

Computers/monitors/scanners/modems and their “wall-wart” power supplies

Wall-wart chargers of the switching type (most modern light-weight ones such as for cell phones and the like)

TV sets (especially Plasma...extremely noisy)

Fluorescent and CFL (Compact Fluorescent) light bulbs

Dimmers

Touch lamps

Auto sensing light switches (as on outdoor security lights)

AC Wired Smoke and O2 Detectors

Motors

Electric Fences

Garage Door Openers

Faulty connections and electrical components such as power strips (more on this later)

Some of these devices don't have to be turned on and running to cause noise...many cause interference the moment they are plugged in to the AC outlet. Others are intermittent offenders...finding those can be among the toughest of challenges.

The easiest problems come from those devices which you can simply turn off or unplug when you want to listen to radio...light dimmers for example. Touch lamps (as far as I'm concerned) are expendable... not everyone will agree with this of course. Other noise sources which you can't eliminate, such as TV sets others are watching or smoke detectors, must be dealt with – it's a matter of learning how to minimize their nuisance value. Each case must be attacked on an individual basis.

### **Some Examples Of Ways I've Dealt With Various Noise Sources:**

Noise On The A/C Line & Battery Operation: RFI from many sources gets into your radio via two routes – directly through the air and by riding along the power lines. The noise on the A/C line will vary from circuit to circuit and area to area in your house so simply plugging your radio or the noise-making device into a different outlet or circuit can make a big difference. Experiment to see what improvements you can get this way. Given today's typical household noise levels, if your radio can run on battery power it will almost always suffer much less noise that way than when plugged into the A/C line. Also, many modern power supplies for radios (wall-warts) are themselves noisy through improper design. Try battery power...if you haven't tried that before you may be in for a treat...it can dramatically lower the noise level.

One of the first noisy items I encountered was a *flatbed scanner*. It took me awhile to localize it because I had never before encountered a device that was noisy without being turned on...it just had to be plugged in. Once I figured that out I simply left it unplugged except when I was using it. Eventually it became outdated and was replaced with a new model which is not noisy.

Modem: My modem was an intermittent noisemaker. Often I would unplug its wall-wart and the noise would stop, but I could plug it in again and the noise would not come back for hours or days. I never figured out why but I replaced the wall-wart and the noise stayed away.

O2 (Carbon Monoxide) Detector: This was causing lots of hash on AM until I relocated it to another outlet. If I had been aware of this issue when I first bought it I might have tried a different model but this solution worked for me.

Surge-Suppressor Power Strip: This was one of the hardest ones to locate because it was both quirky and intermittent. I discovered it when I was turning circuit breakers off individually. I turned one breaker off and the noise stopped, but when I turned the breaker back on the noise did not come back...for three days. I determined which outlets were controlled by that circuit and when the noise finally returned I systematically started pulling plugs but this time I got an unexpected result when I unplugged a power strip which had several devices plugged into it. It turned out that the power strip was the culprit but only when one certain piece of equipment (an audio processor) was plugged into it...now that's nasty. The processor was fine when plugged in to the outlet directly, and the power strip was fine when used with anything else, but plug that particular component into that particular power strip and BUZZ! It turns out that power strip had a MOV (Metal Oxide Varistor) surge protector. These MOV's tend to weaken with time so many such strips include an indicator light to let you know their status. So I admit I don't know if it was the neon indicator or the MOV itself which was causing the noise but the clear solution was to replace the strip.

<http://radiojayallen.files.wordpress.com/2011/09/picture-002-large.jpg>

Terk Loop At Right Kills The Buzz From A Nearby Dimmer

Dimmers: Some dimmers are far nosier than others. When installing or replacing a dimmer be sure to look for one with RFI Suppression built in...it should state this on the packaging. Even so, dimmers are noise generators, and are generally at their worst at mid-brightness settings. One solution I found was to use a small AM loop antenna to help improve the signal to noise ratio. Loop antennas are natural noise-fighters because they respond to the magnetic portion of the radio signal while ignoring the electrical component, which is where the noise is. I have a GE Reproduction Cathedral radio in my kitchen and it sits very near a dimmer switch which has to be on most of the time. I found that my Terk AM Advantage loop antenna placed next to the radio as shown virtually eliminates the buzz caused by that dimmer on the AM station that radio is always tuned to...it seems to be the only practical solution in this case.

TV Sets have always been the bane of AM radio listeners but Plasma sets are by far the worst offenders ever. If you are choosing a new set be aware that LCD/LED sets produce far less interference; generally if you are several feet from the TV you will be OK, whereas Plasma sets often cause interference over much greater distances. If a nearby TV is causing interference about the only thing you can do is to find a spot where your reception is less affected by it, aim your radio carefully to minimize it and again, try a loop antenna.

#### **Other Solutions:**

Noise Suppressing Power Strip or Outlet: These are available in many forms and may sometimes be of value but their effectiveness is hard to predict. I rate them as worth a try but don't expect miracles.

Try A Windowsill: OK. You've been through it all, but living in an apartment building you just have weak signals and tons of noise. There is still hope. If your AM and SW reception is much better in a windowsill than anywhere else inside your home, you can "import" that signal to a more convenient listening spot using an antenna designed to do this. For AM one excellent choice is the C. Crane Twin Coil Ferrite Antenna (<http://radiojayallen.com/c-crane-twin-coil-am-antenna/>). The pickup or head end of this antenna can be placed on your windowsill to intercept signals that don't make it through the walls, then deliver them to your listening spot. The antenna comes with a 6 foot cable for this purpose, but you can also obtain 25 and 50 foot extensions as needed. For this purpose I know of no other antenna that works this well. For Shortwave there are a number of loops available such as the Sony ANLP-1 (<http://radiojayallen.com/sw-loops-degen-de31-vs-sony-anlp-1/>) (SW only) and Degen/Kaito loops (SW Only SW/AM models (<http://www.kaitousa.com/KA33.htm>) available). Many listeners have gotten good results by merely creating a stealth antenna...one which is almost invisible, using fine wire or foil arranged around the window's perimeter...again, experimentation is the key here as there are few hard and fast rules about what may work in your particular setting. If you can open a window or balcony door you can place an antenna outdoors...a passive or active whip such as the Sony AN-1 (now available from Japan via eBay as the AN-12). Of course, if it happens to be convenient you can simply leave the radio on the windowsill, perhaps aided by a small passive loop...several are available and all are equally effective.

**Other Antennas:** I have focused on simple indoor solutions for noise but if you live in a low noise residential area (where the noise outside is much less than inside your house) and can erect an outdoor antenna – an outdoor random wire is the simplest and least expensive antenna you can have and often works very well. Often mistakenly referred to as longwire antennas, random wires get their name because they are much shorter than the wavelengths they are intended to receive and their length is not critical...they do not have to be made to a specific length to resonate on certain wavelengths or frequency bands. Any wire from about 30 feet up to as long as you can manage will be an excellent receiving antenna for AM and shortwave if the noise levels are low in your area...50 to 100 footers are common. Just be sure to use a balun with shielded coax lead-in to maintain low noise...a simple unshielded lead-in wire will introduce noise. Here's one good site for general antenna building information.

<http://www.hard-core-dx.com/nordicdx/antenna/> (<http://www.hard-core-dx.com/nordicdx/antenna/>)

There are also several manufactured antennas you can buy...these are cut to specific lengths and are usually tuned and trapped to work within specific frequency ranges but can offer better performance than the random wire. While most are aimed at the shortwave listener many also perform well for AM. Universal-Radio (<http://www.universal-radio.com/>) is one good source...an internet search will yield many others. As I mentioned earlier, loop antennas are generally the best tools for overcoming noise problems and they can also be of immense value when located externally, either outdoors or just in another room or attic. The Wellbrook loops (<http://www.wellbrook.uk.com/>) (<http://www.wellbrook.uk.com/>) are probably the finest available. A newer offering from Pixel (<http://www.pixelsatradio.com/product/shortwave-magnetic-loop-antenna/>) has been getting favorable comments as well. Loops are valuable because they can outperform wire antennas where noise is in the air outdoors. The simplest to install are hula-hoop-sized loops which perform amazingly well and can be used indoors or outdoors, (I use a Wellbrook ALA-3330S (<http://radiojayallen.com/wellbrook-als-330s-active-loop/>)). There are also larger wire loops with even greater capture area for the best performance you'll find anywhere. The T2FD loop is very effective as are the large aperture loops from Wellbrook or homebrew designs.

**Conclusion: (Sub-tiled. "Why is my car AM radio so much better than any other radio I own?")**

There's much false information floating around about why car radios seem so much better than most home AM radios; here are the facts. First, it is indeed true that the best AM car radios are superb receivers. They are well-built and have well-designed circuitry. In the past, when radios were optional equipment, they generally cost hundreds of dollars for an AM only model...wouldn't you expect it to be better than a \$50 portable? They also have the advantages of powerful amplifiers and a robust automotive power supply. However the very best portable AM radios are also excellent but as I said at the start, they are usually hampered by the typical household's difficult RF environment.

Many people point to once-ubiquitous whip antenna and car body as an excellent pair for good AM reception. This is partially true for outdoor use, but if you could bring the whole car indoors you would find its whip antenna would fare much less well because it would pick up tons of noise which a portable radio's ferrite rod (being a loop) can ignore. Also you can't aim a whip for AM directional reception. I once worked in a car stereo sales and service shop ...indoors the car radios received far less well than they did outdoors and it was the location, not the absence of the car body that made the difference.

Often, when people have emailed me asking why such and such a radio which I have rated as excellent, such as the 5 star radios in my AM Mega Shootout, doesn't receive as well as their car radio, I have asked them to take their radio outside to see how well it does there and many times they reply with a astonishment at how much better the reception is outside their house.

AM and SW radio have always fascinated me, but to maximize your reception you must be aware of the factors that can ruin reception in order to have any hopes of improving your results. I hope this article will give you some ideas of ways you can improve yours.

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