

A Grid-type grounding scheme
by Gordon Maughan
Maughan Audio 6805 South Cook Way
Littleton, CO 80122 June 9, 1996

The Audio industry supports a number of specific line conditioning devices to improve AC line "quality". Many of these devices do improve sound reproduction sometimes at the expense of other sonic qualities. An example is AC isolation transformers. A good isolation transformer floats the neutral so that it is no longer in a circuit path with the earth ground. This will give a balanced power source. In AC lines contaminated with RF or HF noise this type of transformer does help a great deal to open up the sound by reducing stress on active devices. It does so at the expense of power factor loss. Power factor is the term for wattage delivery by the in phase alignment of current with voltage. Any loss of power factor is stated as a percentage below 100%, and is caused by misalignment of current and voltage phase since wattage equals voltage times current. Inductance (an isolation transformer) shifts the phase causing current to lag behind voltage reducing the total power in watts available. The sound reproduction suffers by reducing the equipment's ability to track power hungry dynamics. Lower range percussive impacts are affected the most, examples; timpani, lower piano scales.

What is needed is to reduce earth ground noise through a more effective sink for the power line neutral and ground without any power factor loss. Certain research facilities needing a low noise environment accomplish this with ground grid screens laid underground covering an area to give as much conductor surface area as economically possible. This screen is then connected to the AC power grid ground potential to create a low impedance ground for sinking noise. This would be impractical for homes but an alternative is to run multiple copper clad ground rods. I presented this idea to a client who has a perfectionist system in that he uses Wadia with Goldmund components and has had dedicated 20 amp services for each component. Initially we installed 10 new ground rods all sharing the feed for the existing ground rod. The difference this made was easily apparent, more so than any AC line conditioning he had previously tried except for the dedicated service runs he had previously done. The cost per ground rod with wire clamp is around \$10.00. After this experience I knew that I would do my own home and to try some measurements to see what is happening.

My existing home wiring is copper circa 1963 construction with the ground connection only having been made to the copper water line. For a listening room finished in the basement I installed a 100 amp subpanel. This afforded me the space for running dedicated circuits and six #6 wire ground feeds to six 8 foot 5/8 inch copper clad rods. Before this new room was completed my stereo used single 15 amp household service shared with some light feeds. A modified TRIPPLITE LC2400 line stabilizer/conditioner fed the preamp and CD source only. Note, the stock TRIPPLITE gave a hard edge to the sound. Once the subpanel with its low impedance earth ground was connected to the existing main panel the sound improvement was more apparent than any isolation conditioning device I had tried. I must point out that this improvement is all the more impressive considering the mediocre condition of the AC service that the system was using. Now the system is in the new room with the individual AC runs and the sound leaped in improvement as if I purchased upgraded electronics.

I measured the effects using a 50 MHz digital storage scope by placing the probe lead on a AC receptacle ground connection and the scope ground on the water main. With the subpanel (new earth grounds) disconnected I measured an AC waveform with a lot of harmonic noise on it that was 6 mV peak to peak.

This waveform had 2 mV of DC offset and RF noise that was 3 mV peak to peak. After connecting the subpanel the distorted AC waveform now had over 10 mV peak to peak but no DC offset and the RF noise was now less than 1 mV peak to peak. Why the increase in the AC waveform? I summarize that the lower impedance ground connection was now allowing more voltage noise to flow to ground, increased current flow of noise thus an increase of voltage ($V=IR$). And this lower impedance path to earth ground eliminated the DC offset (a capacitive charge) and improved the RF sink to ground.

You must check with local codes and, If you are not a qualified electrician, hire a contractor since the connections are made at the distribution breaker box where lethal voltages are present.

In summary, if at all possible do this upgrade. Start with at least six 8 foot ground rods. My client recently added four more for a total of fourteen rods and still heard a small improvement. Consider that a higher moisture content in the earth will further improve performance.