



How To Eliminate Engine Noise

(For Amplifier And Additional Audio Equipment Installations)

Document# 999502

For additional information on similar topics, please consult the following technical documents:

- 999502** How To Eliminate Engine Noise (For Basic Radio Installations)
- 999503** Road And Wind Noise (Alternate Methods To Fight Road And Wind Noises)
- 999001** Basic DC Electronics For Automotive Applications (Voltage/Current/Resistance)
- 999002** Car Audio Basics (How Mobile Electronics Integrate With Each Other)
- 999003** Radio Install Basics (How Aftermarket Radios Integrate Into Electronics Of Vehicles)

Do You Have A “Whine” Or A Low Hum In Your Speakers Connected To An Amp?

All strange noises you hear in your speakers are caused by 1 of 2 problems: **Ground Loops** and **EMI** (ElectroMagnetic Interference). Commonly referred to as “engine noises”, these 2 problems are responsible for ALL “engine noise” problems. These problems are very common after an amplifier has been added to a stereo system. “Engine Noises” are many times hard to diagnose, especially as more equipment is added to a stereo system. But, there are some very basic rules of thumb to keep in mind when installing an amp that may prevent “engine noises” in your stereo system. If you already have engine noise, these tips may help you reduce or eliminate noises already in your system. Just remember, “engine noises” are usually the result of installations where the installer did not prepare the system to avoid “engine noises”. The best way to prevent “engine noises” is to think ahead by following these tips.

Ground Loops: Electronic circuits are simply a power source connected to device or load (electronic equipment). In order for the circuit to operate, voltage from the power source (in mobile electronics that source is the vehicles battery) is sent through wires to the electronic device or equipment. The device will still not work unless a return wire is connected from the devices “ground” connection to the power sources “ground” connection or terminal which will complete the circuit path allowing the equipment or device to work. In automotive applications, the vehicles battery has a thick or heavy gauge battery cable connected to the (+) positive terminal or battery post that supplies the vehicles electrical system with power. What most people do not see is a similar heavy gauge power wire connected to the batteries (-) negative terminal or battery post. This cable usually connects to the vehicles alternator (-) negative terminal or contact then it is bolted to the metal frame of the vehicle itself. In doing this, the metal frame of the vehicle is now the electric “ground” of the vehicle. A “ground” is simply another word for the (-) negative return path back to the power supplies (vehicles battery) (-) negative terminal or battery post. Auto makers do this because it effectively reduces the wire run through the electrical system in half. The auto maker generally only has to run (+) positive voltage wires to components while the (-) negative ground wires can simply be screwed directly to a nearby metal part of the vehicles body frame. This way the (-) negative ground return to the battery is carried by the vehicles metal frame, to the heavy gauge battery cable bolted to the frame which will return the (-) negative ground back to the battery - completing the circuit necessary to make the equipment run.

Ground loops are usually caused when the (-) negative ground returning from the amplifier to the battery has a high resistance; or the wire or metal frame used to send the (-) negative ground is not the best path back to the battery forcing the (-) negative ground to fight to return back to the battery.

Amplifier (and other added equipment) Ground Loops:

The amplifiers ground has too high of a resistance. This is a common problem when installing an amplifier and other additional equipment to a stereo system. A ground wire, especially for equipment that DEMANDS high current loads such as stereo amplifiers, must be a solid connection to the vehicles metal frame.

Scrape away paint: all paint and sound deadening rubber must be scraped away to show a silver shine of clean metal. A layer of paint between the crimp terminal attached to the ground wire and the vehicles metal will create a poor electrical connection to the vehicles metal frame and will force the amplifier to have a high resistance ground.

Metal too thin: Another related problem is a common mistake made by inexperienced installers who select thin metal in the vehicle that is not a solid part of the vehicles metal frame. Even metal that seems like a solid piece of metal may be secured to the main part of the vehicles metal frame by a weld. These metal surfaces, although solid mechanically, may have a “bad” ground back to the battery of the vehicle. A (-) ground return back to the battery will have to fight through the weld joint bonding the metal surfaces together.

Ground wire may actually create high resistance: The thickness, (known as the AWG or the American Wire Gauge) and the length of the power wire determine the resistance of the wire. Consult the amplifiers owners manual to make sure you use AT LEAST the recommended AWG gauge wire if no wire is included with the amplifier. Ground wires need to be under 2 feet long, and should be less than 1 foot. This is an important consideration when planning where to install an amplifier. A rule of thumb: thicker and shorter are better for power and ground wires.

There are several solutions to prevent or solve high resistance on a ground wire:

Solution 1: The amplifiers ground wire should have a ring terminal connected at the end where it can be secured to the vehicles frame. Make sure this ring terminal connector is securely crimped or soldered.

Solution 2: Select a solid part of the vehicles metal frame for the amps ground wire to be secured to.

Solution 3: COMPLETELY scrape away ALL paint and rubber sound deadening material until the silver of the metal is visible before securing the amplifiers ground wire.

Solution 4: Bolt the amplifiers ground wire to the bare metal frame of the vehicle. Many installers use self tapping screws to secure the ground wire. Unfortunately, screws can and do vibrate loose when the vehicle itself vibrates. This can allow the ground wire to become loose, increasing the resistance of the (-) negative ground return back to the battery.

EMI Noises: EMI (ElectroMagnetic Interference) has become a buzzword in the electronics industry. What is EMI? As voltage runs through wires, an electric field is generated around the wire. This magnetic field surround ALL wires that have voltage running through them, it is a law of physics. Usually the thicker the wire, the more current that wire can handle. Many auto makers, without a care to the radio system, run power wires above, below, and around the stereo. These power wires are necessary for accessories such as the air conditioner, hazard switch, cigarette lighter, and other accessories to operate. These wires, following the laws of physics, spray out magnetic waves in all directions. These magnetic wave will be picked up by other power wires as well as audio cables such as RCA cables. Now other wires are being affected by a single wires electromagnetic field. Some of the wires affected may be the stereos or amplifiers (+) 12 Volt power wires and even wires INSIDE the radio or amplifier.

EMI is actually a big problem with high end stereo systems that use amplifiers to power the speakers. EMI problems are sometimes hard to isolate or even fix, but there are some basic solutions to help solve EMI problems in amplifier installations:

Route power wires and audio cables separately: one of the best, and simplest, tips to avoid EMI problems when installing amplifiers is to route the amplifiers power wire on the opposite side of the vehicle as the amplifiers RCA audio cables. The amplifiers power cable should be connected to the battery, run through the metal fire wall at the dash and then run down the side of the vehicle to the location of the amplifier. Now run the audio RCA cable outputs from the radio down the opposite side of the vehicle to the amplifiers location. This will assure that the EMI magnetic field generated by the amplifiers power cable does not induce into the RCA audio cable.

RCA cables: when running RCA cables from the radios output to the amplifier, make sure to avoid possible EMI “hot spots”. These “hot spots” are usually located around the radio itself (air conditioner, hazard switch, cigarette lighter, etc.) so it is best to route the RCA cable below the carpet as quickly as possible. Many installers choose to route the first few feet of the RCA cable under the dash, weaving it through the maze of wires under the dash. This is a sure ticket to EMI problems. When possible avoid any location where there is a concentration of wires.

Ground Loop Isolators: you might think this belongs in the ground loop section, but ground loop isolators are small devices that plug in-line between 2 sets of RCA cables. Ground loop isolators, although not always an answer, can many times filter out EMI noises if the ground loop isolator is installed close to the amplifier. Try the above methods to prevent EMI as well as the solutions to prevent ground loops before trying a ground loop isolators. All of the other solutions and methods described in this document are FREE methods and require no additional parts to be purchased. Why purchase a ground loop isolator when the solution may be FREE.