

How to Find Ground Loops and Prevent AC Hum

What is a Ground Loop?

When you hear hum in an audio system, it's almost always caused by a loop antenna effect between two or more pieces of gear, across signal lines. A loop antenna is formed by having a loop of wire where the beginning and end of the loop are connected - the loop can be any shape. The loop antenna(e) is basically a form of radio antenna and they tend to pick up the 60Hz AC signal being broadcast by a building's electrical wiring. They also pick up 120Hz, 180Hz, and all the other harmonics of 60Hz and, usually to a lesser degree, electrical noise being broadcast from all over such as radio/TV, hair dryers, etc. These loop antennae are closed circuits usually through the ground wires and hence are commonly called **ground loops**.

Examples of Ground Loops:

1. Going up the AC power cord ground from the electrical system wiring to a keyboard, going across a signal line ground from the keyboard to a mixer across the signal ground, down the mixer's power cord ground reconnecting to the electrical system wiring.
2. Going across the signal ground from a mixer to a reverb unit, going from the reverb unit across the signal ground back to the mixer and reconnecting inside the mixer.
3. Going up the AC power cord to the mixer, across the signal ground to the amplifier, down the amplifier's power cord ground and reconnecting to the electrical system wiring
4. Going up the AC power cord to a guitar amplifier, going across the input signal ground to an effects device left channel output, from the effects device right channel output to another guitar amplifier, down the second guitar amplifier's power cord ground and reconnecting to the electrical system wiring.

Which connection has the Ground Loop? (AKA Playing Audio Detective)

Identify the ground loop causing the trouble; not all ground loops cause noise or hum. For complex systems you may need to repeat these steps starting with a different piece of equipment in various combinations to locate the problem:

1. Strip the system down to one piece, such as the mixer, by disconnecting all interconnects and AC cords except for the mixer.
2. Add one piece of equipment at a time; hook up AC and interconnects (making sure all grounds are connected and in good condition) then listen for hum or noise.
3. Turn on and off the power each time you switch equipment to avoid pops and shorted outputs.
4. Proceed until you find the offending piece(s) causing the problem.
5. Plug the Hum Eliminator™ in all lines between the offending equipment and the rest of the system. For example ... insert the line outs of the keyboard into the inputs of the Hum Eliminator™, then insert the line outs of the Hum Eliminator™ into the inputs of the mixer.

It is often helpful to listen through a pair of headphones. Quite often you will only hear hum coming from a particular input channel on a mixer and that is where the ground loop will be. Alternatively, if you hear hum coming out the speakers with all the mixer's channels turned down, it's likely that the problem is between the mixer and amplifier or other equipment that comes after the mixer.

Another common path for ground loops is through a chassis into the rack and then into another chassis. Test this by removing the chassis from the rack. The Hum Eliminator™ will help but you should also try isolating the chassis from the rack with electrical tape and insulating the rack screws with nylon washers.

Note: Never use the Hum Eliminator™ between an amplifier and speaker or the equipment may become damaged. Only use the Hum Eliminator™ on line level signals.

What about clipping or lifting the AC ground or signal ground?

While these methods may or may not remove your hum, they have some real drawbacks!

Removing or disabling the AC ground:

- Can cause electrocution
- Can cause distortion due to floating signal references
- Can cause some pieces of equipment to oscillate or become damaged
- Can cause current and noise meant for the AC ground to be dumped down the interconnect (line level) to another piece of equipment instead

Cutting the shield at one end of the interconnect cable:

- Can hinder the ability of the cable to serve as a signal return
- Can cause distortion and/or clipping of the signal since there is no voltage translation matching (shifting a signal to match ground and power supply).
- Can alter the cable's frequency response.
- Can defeat the shielding effect.

Why using the Hum Eliminator is the safer and better solution:

The Hum Eliminator™ is completely transparent; its audiophile quality components don't change your sound. With a flat frequency response from 20Hz to 70kHz (*way beyond the range of human hearing*) the Hum Eliminator™ is the answer.

The Hum Eliminator™ breaks the ground loop, keeping all AC grounds intact. It provides isolated signal returns and performs automatic voltage translation matching.

The Hum Eliminator™ automatically converts from unbalanced to balanced without signal loss. With the Hum Eliminator™ you can run a signal across a room from a pre-amp, effects unit or keyboard without picking up AC hum from power cords and without the signal loss you get from a DI box. Balanced outputs from the Hum Eliminator™ benefit from true common mode rejection (CMR), canceling out noise from AC power cords and other sources.

The Hum Eliminator™ will match any ground potential difference between two pieces of equipment. If the ground of your keyboard is 6 volts higher than the ground of your mixer, the Hum Eliminator™ will shift the entire signal of the keyboard down by 6 volts to compensate without affecting the keyboard at all.

The Hum Eliminator™ is equipped with "smart jacks" (TRS); so you can run all types of line level signals; balanced or unbalanced.

No buzz, no hum. No signal degradation. No filtering. No noise gates. No dangerous ground lifts.

NO PROBLEM!