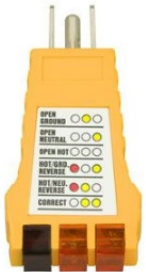
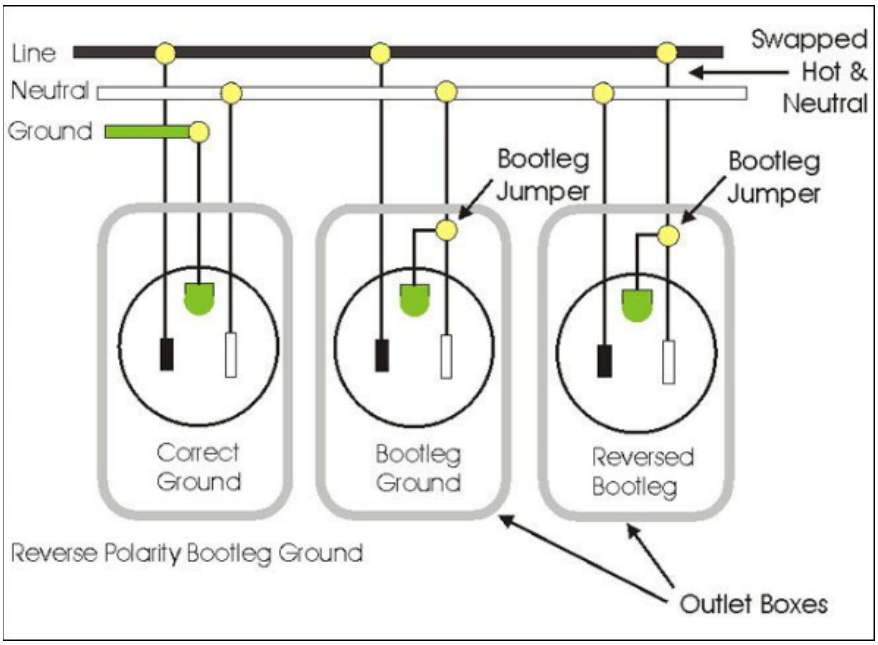
The purpose of this document is to troubleshoot the most common causes and solutions for system noise relating to ground loops, Radio Frequency Interference (RFI), and Electromagnetic Interference (EMI) which can all cause an audio system to "hum".

1. Verify a good earth ground at the control system power outlet and that the outlet is wired correctly. Use an outlet tester for this test.

   Note: This tester will not detect a "bootleg" ground. This would apply in old buildings where 2-prong outlets have been converted to 3-prong outlets, but no ground wire was installed so the ground is tied to neutral instead.



Outlet Tester



You will need to test the outlets with both a ground impedance tester (aka Wiring Circuit Tester) and a non-contact voltage tester (NCVT). The ground impedance tester will indicate if you have a ground fault, and the NCVT will indicate a Reversed Bootleg situation as illustrated above.

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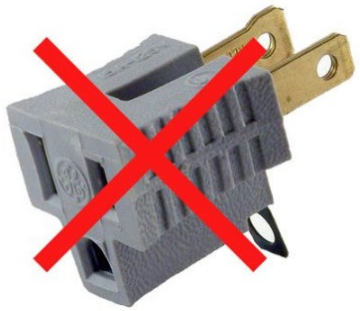
Non-Contact Voltage Tester (NCVT) **Wiring Circuit Tester**

2. The difference in ground potential can be a major cause of system hum and noise. Common causes are ground wires with different gauge wires in the circuit and bad connections where ground wires are tied together using wire caps. A certified electrician should be called in to solve this type of situation.

3. If possible, connect your equipment to the same circuit and avoid using different outlets. For example, try to use the same circuit for the fiber conversion box, control rack, and announcer's interface.

4. In any case, do not use power ground lifts to eliminate a ground loop problem.



5. If you know your power circuit ground is good, but hum is still present, then you'll need to track down which piece of gear is the likely suspect for the problem.

   Unplug control system by unplugging power and disconnecting output signal cable. If hum goes away, check control components one at a time to isolate the problem. Unplug power and disconnect signal. If there are long, unbalanced cables connected to the system, disconnect those first as they are the most likely cause.

6. Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI) are two other forms of noise that can be induced in audio system signal lines. RFI comes from cell phones, wireless mics, radio transmitters, garage door openers, etc. Typical EMI noise sources are power supplies, monitors, computers, and other similar appliances. These can be difficult to track down and eliminate. Some recommendations:

   a. Keep audio cables and power cables as far away from each other as possible. If they must cross, do so at a 90-degree angle.

   b. Keep audio cables away from power distribution boxes and power adapters as both can be sources of EMI.

   c. Eliminate equipment in the pressbox/control room that may be on the same circuit as the audio system. Disconnect them to see if noise goes away. Place on separate circuits if needed. For example, have you ever had your refrigerator's compressor turn on and heard a hum in your home theater speakers? That's EMI – the refrigerator is putting spurious noise in the power lines, which then leaks into your audio system.

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   d. If there are light dimmers in the control room, ensure the audio system is on a separate circuit. Eliminate the dimmer if necessary. Again, consult a licensed electrician.
7. If hum is still present or worse when removing control components from the system, access to the audio cabinet is required for further troubleshooting.

8. If the system has both a digital and analog backup, disconnect the analog backup at the audio cabinet (receiving) end to verify it's the analog line that is noisy.

9. Low quality audio cables are more prone to noise induction. Ensure the proper specified analog backup audio cable is used, such as Belden 9451 (Daktronics part # W-1615). If improper cable was installed, pull new cable.

10. Ensure there is a balanced cable connection on the receiving end. Use of a Minilyzer ML1 or similar device simplifies this process. Playing a test signal and measuring the VAC between pins 1-2 and pins 1-3 with a multi-meter is an alternative solution for common-mode rejection balanced devices. Signal should be equal but opposite. If device is impedance balanced, then measure the VAC between pins 2-3 and 1-2.

11. Most standard Sportsound systems have isolation transformers installed to help isolate the analog line from ground loops. Verify proper connection and that the transformer is working. Refer to DD3417357 for troubleshooting.

12. If transformer appears to be working, try disconnecting the shield wire at the receiving end of the equipment (at the ISO-Max). Due to improper component grounding techniques, this could stop the noisy hum, but only at low frequencies.

13. If humming is still present, try installing a hybrid shield termination so the receiving end is capacitively coupled. Neutriks EMC-XLR is a good example.

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