



**Eliminating Hum and
Ground Loops**





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Eliminating Hum and Ground Loops

What are Ground Loops ?

Ground loops generally occur when there is a difference in potential between the various grounding points in a home theater system. When potentials like this occur, 60hz ground currents and high frequency noise can flow around the system and cause hum in both audio and video signals. Audio hum is the most obvious evidence of 60 hz ground loop currents as one can hear it directly from the speakers. Video hum can be more mysterious. It usually manifests itself as a series of faint lines that rise up through the video image. Sometimes they are very faint but, occasionally, can be quite severe. The figure below illustrates what these 60Hz ground currents can look like (video hum bars) as seen on a projection video system.

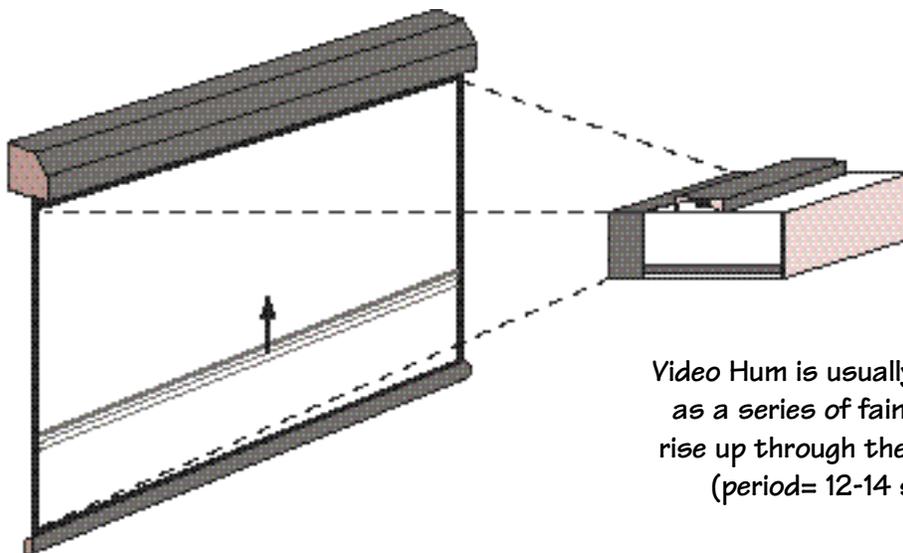
The difference in ground potentials in an A/V system can be caused by a number of factors. One of the most notorious involves the grounding of the cable TV coax where it enters the building. As shown on the diagram on

the next page, the Cable Grounding Block should be securely grounded to the electrical service ground as per the National Electrical Code (NEC). If this grounding is poor or nonexistent, external 60 Hz currents can circulate throughout the shield of the A/V system interconnect cables.

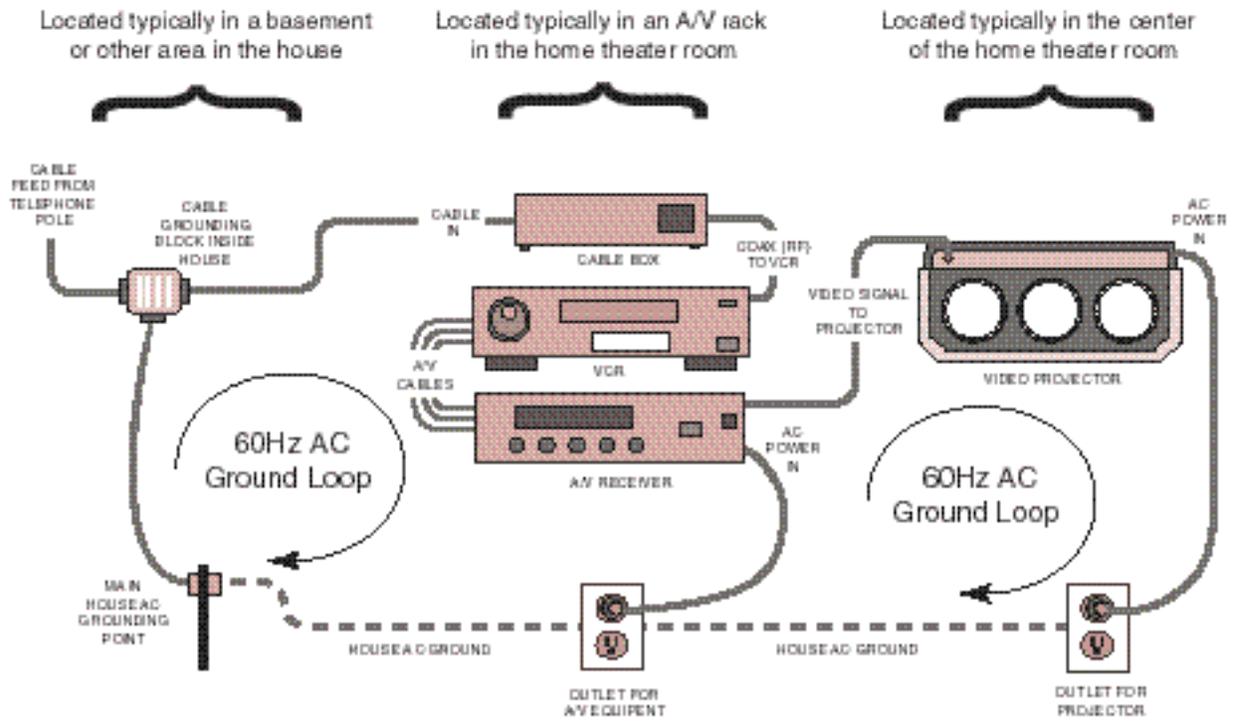
If the system is properly grounded and video hum still exists (which is very common, incidently), it is probably caused by grounding problems in from the local house AC wiring.

How do you get rid of ground loops ?

We suggest several ways to eliminate audio and video hum in a home theater system. First, however, verify that the Cable Grounding Block is well grounded to the service ground (and not just to a nearby water pipe, for example). If this appears grounded properly then see if you can plug



Video Hum is usually manifested as a series of faint lines that rise up through the video image (period= 12-14 seconds)



60Hz Ground Currents in a Home Theater System

the entire A/V system into the same outlet(s). This is often all that is needed because all the ground connections are referenced to the same point.

If that isn't possible (and in many larger home theater installations it simply isn't), you can employ special ground breaking devices. These devices are specially built transformers that are designed to pass the AC signals but block 60hz ground currents.

There are two types of DC blocking transformers. The first is an RF ground breaker that is used to isolate the cable company's grounds from your home theater system. These DC blocking transformers are inexpensive and in our experience the cause of ground loop problems in 60-

70% of the home theater systems in this country.

The second type of DC blocking transformer works at audio and video frequencies. These transformers are placed directly in-line on the audio and video signal cables. The diagram shows the Jensen Iso-Max VB-1BB isolation transformer which is used on video signal connections.

In some rare circumstances we have seen Actual AC isolation transformers used to separate a devices's power completely from attached grounds. These isolation transformer are available from a variety of manufacturers.

Ground Loop Elimination Techniques

1) PLUG ALL THE EQUIPMENT INTO THE SAME POWER FEED

Because audio and video hum is caused by 60 Hz ground currents, often the only thing you need to do is plug your entire A/V system into the same power feed from your breaker box. This removes the potential difference between grounds. This is easily done with small systems but may be difficult to do with larger home theater systems because they are often distributed throughout the house.



2) RF GROUND BREAKERS

These devices are often all that is needed to break the path for 60 Hz ground currents flowing through the RF cables. They are just a small RF transformer with the primary and secondary physically separated so that the ground path is broken. They are typically placed inline with the coax cable that feeds into the cable box. The illustration is for Jensen VR-1FF Ground Breaker. It retails for \$49.95



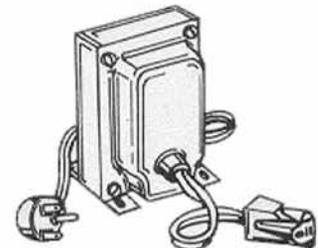
3) USE A VIDEO GROUND BREAKER

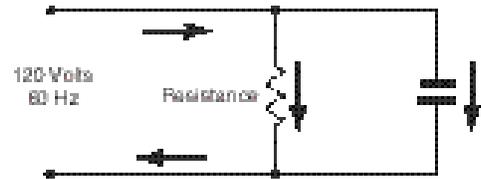
These devices are designed to break the path for 60 Hz ground currents circulating through the video cables. They are wide band transformers with the primary and secondary physically separated so that the ground path is broken. They are typically placed in series with the video cable to the projector. The illustration is for Jensen VR-1BB Ground Breaker. It retails for \$99.95

4) USE AN AC POWER ISOLATION TRANSFORMER

AC isolation transformers are common devices in electronic repair shops. Technicians use them to isolate the power on their repair benches from physical grounds in the repair shop (pipes, radiators, etc.) This is primarily for safety reasons.

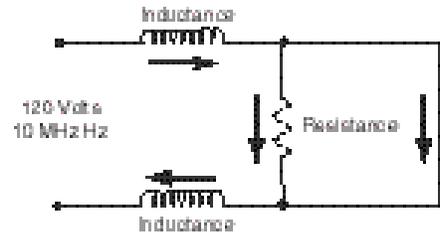
You can use the same isolation transformers to electrically isolate your A/V equipment from connected AC power and thus break any ground loops. They are typically placed in series with the power cord to the projector. We recommend the Tripp-Lite IS 250, IS500 or IS500 models





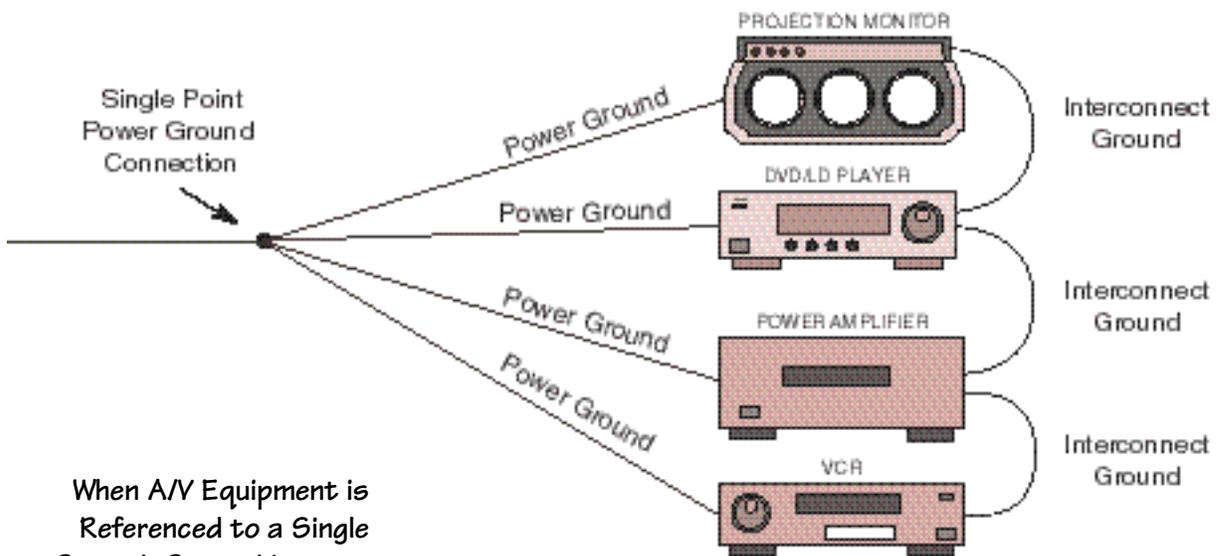
Circuit at 60 Hz

It is tempting to think that the solution to all grounding problems is connect the power cords from all your A/V equipment to any outlet that has a ground connection. The problem is that the physical ground wires that run around a building may not be referenced to the same point. The diagram below shows an ideal grounding scenerio with all the equipment connected to a single grounding point. The result is that since everything is referenced together, the equipment can "float" at the same relative potential and no ground currents will flow through the interconnects.



Circuit at 10 MHz

Another grounding issue involves high frequency noise signals. Electrical engineers know that straight pieces of wire act very differently depending on the frequency of the signal applied. The grounding wire contained in your houses Romex wiring will behave very differently at power frequencies (60Hz) versus noise frequencies (10 mHz). On the top right we illustrate an electrical circuit. When one analyzes the circuit at power line frequencies it behaves in one fashion. When analyzed at higher noise frequencies, it behaves differently. Fortunately the laws of physics still apply here. If you have single point grounding the system can still float and reduce the effects of noise-based ground loops.



When A/V Equipment is Referenced to a Single Ground, G round Loops are Eliminated