

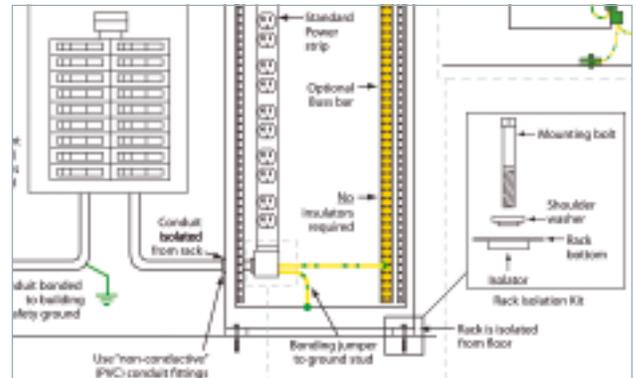


# INTRODUCTION TO POWER DISTRIBUTION AND SYSTEM GROUNDING

## The Definition of "Ground"

There are several meanings of the word "ground," which contributes to confusion and misunderstanding. Most commonly, ground refers to a return path for current. In electrical utility power, ground is an actual connection to soil for the primary purpose of lightning protection. Building safety grounds provide a return path specifically for fault current. The safety ground for audio, video, and other electronic systems must be designed to work in conjunction with the building (facility) safety ground.

For proper operation of AV equipment, all safety grounds for the electronic system must terminate at only one point.



Download "Integrating Electronic Equipment and Power into Rack Enclosures," our complete guide to power distribution and grounding, at [middleatlantic.com](http://middleatlantic.com)

## Electrical Grounding

Electrical grounding is necessary to protect the user from hazardous voltages due to lightning, some surges, and ground faults caused by equipment failure or conductor insulation failure. Proper electrical grounding assures safety by providing a low impedance path for "tripping" protective devices such as circuit breakers and fuses when a ground fault (short circuit to ground) occurs. This saves lives. Defeating a safety ground to reduce noise is illegal, dangerous and should never be done!

## Proper Grounding

Proper grounding reduces only ONE potential source of noise. Best practices of good signal path design include good cable management (keeping signal cables more than 2" away from AC wires when run parallel) and twisting signal conductors. It is permissible to strap signal cables to power cables if the conductors of both cables are twisted tightly and evenly. Both the primary electrical system grounds and the signal interconnection system grounds need to be properly designed and installed to achieve a "noise free" system. Safety ground connections that are loose or corroded may cause hazardous conditions and system noise.

## Isolated Ground

An isolated ground is also referred to as a "technical ground" or "isolated single-point ground." Equipment that is connected to an "isolated ground" system is still grounded, but the source of the ground connection is ONLY at the main circuit breaker panel or at the first panel after a transformer. This isolated grounding conductor must be insulated. It may be spliced when passing through sub-panels or junction boxes, but must not be terminated in them.

## Ground Rods

Do not create multiple ground paths by using additional ground rods. Ground only where required for safety. Any additional grounds may provide or create additional paths for ground loops and will most likely increase system noise. Using more ground rods will NOT result in quieter systems.

## Balanced Power

The less balanced the internal parasitic capacitances in equipment are, the less effective a balanced power system will be at reducing leakage currents, which are a significant cause of noise in unbalanced signal interfaces. Balanced power is not a cost effective way to reduce system noise.

## Three Phase Electrical Service

Three phase service is most commonly found in larger commercial and industrial buildings where there are motors, air conditioners and lighting controllers. Due to leakage current produced by most equipment, loads on each phase usually couple a small amount of noise onto the ground circuit. Because these phases are separated by 120 degrees, the resulting ground current frequency is tripled. These ground currents are referred to as "triplen" harmonics. Split single phase electrical service, commonly found in residences and smaller commercial buildings, not only is free of "triplen" harmonics, but also can result in at least a 6 dB reduction in noise floor as compared to three phase. Single phase transformers should be used to power electronic systems. Cross-coupling between phases is eliminated when using single phase.

## "Hum & Buzz-Free"

"Hum & Buzz-Free" audio and "clean" video can ONLY be obtained by having a "noise-free" signal path. Signal path noise vulnerability depends on whether the signal interface is balanced or unbalanced. Design and installation of the signal path wiring must include noise interference rejection schemes and effective grounding. Useful information about signal path design can be found by doing an internet search of "electromagnetic induced noise," "AES48," "pin 1 problem" and "shield SCIN."

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