

## AC Electrical System & Sensitive Electronic Equipment

Sensitive electronic systems and equipment should have an electronics grade electrical distribution system unlike “standard” electrical distribution system for proper equipment and systems operation.

The major differences between a standard electrical distribution system and an “electronics” grade electrical distribution system is the panels, wiring of the panels and branch circuits. It is common practice and meets the NEC (National Electric Code) to have shared neutrals in a standard electrical distribution system. Such a system will be a three wire topology; phase neutral & ground for a 120 volt branch circuit. The ground in a standard electrical distribution system is a combination of case ground and electrical ground (the ground of the panel, conduit and electrical outlet are common).

In a standard electrical distribution system the below conditions are common.

- ◆ The primary neutral conductor and the neutral lug are sized per the NEC (not oversized).
- ◆ The neutral conductors in branch circuits are often “shared” (common or used by more than one 120 volt branch circuit).
- ◆ The ground of the circuits and case ground (conduit & panel) are common (bonded) and not isolated. (older systems relied on conduit for ground or had no ground)
- ◆ Circuit breakers are most often builder’s grade “snap in” and seldom “bolt in” breakers.
- ◆ Electrical outlets will be builder’s grade “three wire” outlets (phase neutral & ground).

Electronics grade power distribution panels have a number of primary differences from a standard electrical distribution panel. An electronics grade power distribution panel and wiring system will always have the below configuration.

- ◆ The primary neutral conductor and the neutral lug are oversized, (sized two times NEC requirements), to deal with harmonic currents generated by switch mode power supplies.
- ◆ The neutral conductors in branch circuits are home runs (never shared or used by more than one circuit).
- ◆ Panel grounding and conduit ground is case ground and a separate isolated ground buss bar will be installed. This isolated ground buss bar will be connected directly (and only) to the service entrance ground buss bar with a stranded and insulated copper conductor sized appropriately for the distance involved.
- ◆ Circuit breakers are electronics grade “bolt in” breakers.
- ◆ Only Isolated Ground outlets will be used (phase, neutral, ground & case ground).

The reasons for installation of an electronics grade power distribution system are numerous. A few key points are:

- ◆ The ability to handle high harmonic voltage and currents.
- ◆ Separation of case and equipment ground to eliminate noise and provide an effective low resistance path for equipment shielding.
- ◆ Elimination of circuit failure from loose snap in breakers.
- ◆ Elimination of shared circuit equipment problems (unbalance loads with shared neutrals).
- ◆ Reduction of Common Mode voltage. (between neutral & ground)
- ◆ Isolation of sensitive equipment from inductive loads (AC systems, copy machines, lights, etc.)
- ◆ Reduction or elimination of common mode noise (neutral to ground voltages at high frequency)

A detailed description of an electronics grade electrical distribution panel will not add to this information. If you are not familiar with these panels, contact a power quality professional or your consulting electrical engineer for assistance. They are readily available and the additional cost (small) is well worth the investment.

At the branch circuit level, electronic grade distribution systems do not have shared neutrals and employ a four wire topology. (Phase, neutral, case ground & isolated ground) The phase (hot) wire will most commonly be black, red or blue. The neutral will be white or yellow. The case ground wire will be bare copper. (See note below) The isolated ground wire normally be will be insulated green or insulated green wire with a trace stripe (yellow and pink are the most common).

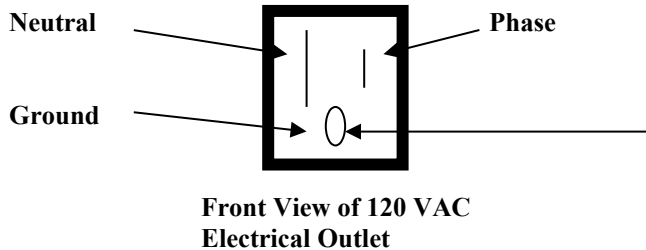
*Note:*

*It is important to note “dissimilar metals will electrolyze” is a problem common to electrical distribution systems. The result will be corrosion (high resistance) and can lead to both equipment problems and life safety problems such as fires. Galvanized conduit connected to copper is but one example. In the case of dissimilar metals the wire should be tinned or nickel chrome coated wire.*

To understand the importance of an “electronics grade” electrical distribution system for sensitive electronics you should consider how microprocessor equipment operates and what it is looking for.

One of the most frequent problems are common mode events (neutral to ground) and can cause significant disruption to the operation of microprocessor based equipment. Modern logic circuits do not enjoy the electrical isolation that was part of the older “linear power supply” technology. The microprocessor circuits are constantly measuring logic voltages against the “zero voltage reference” or safety ground. The microprocessor’s decisions are the result of discrimination of one rapid voltage transition from another, ultra-clean and quiet electrical safety grounds are essential. The microprocessor expects to see less than .5 volts of

neutral to ground voltage. If the microprocessor sees more than .5 volts it will cause system lockups, communication errors, reduce operating throughput, unreliable data, fragment hard drives and operational problems that can not be duplicated or explained. If high enough, neutral to ground voltages will damage equipment.



In an “isolated ground outlet” the case ground wire (usually bare copper) is not connected to the ground pin. Case ground is connected to the outlet frame Conduit and outlet box only. Continuity can not be measured between the ground pin and conduit, outlet box or the outlet frame.

In new construction or during remodeling project it is often easy and cost effective to install electronics grade electrical distribution panels and isolated ground circuits. The cost in existing construction can be prohibitive and point of use products are available for those instances. (Reference: Isolation Power Conditioners)