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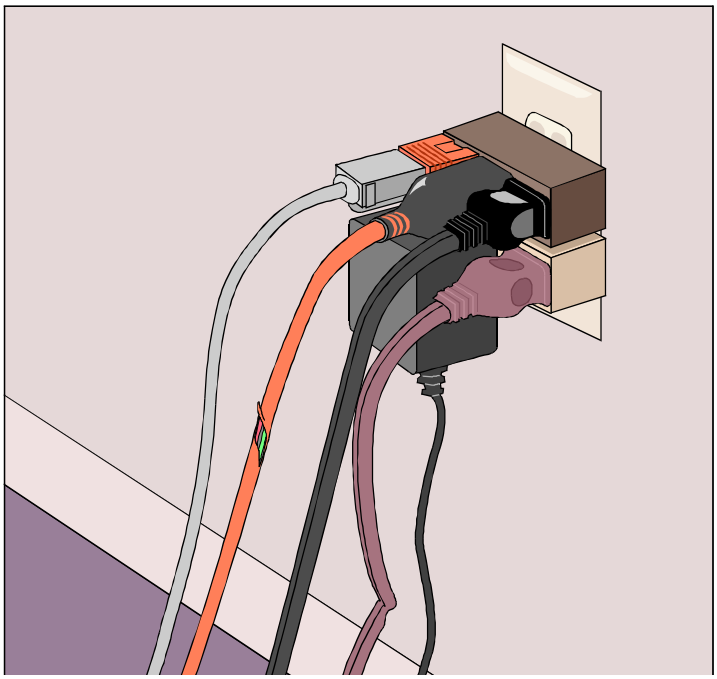


Understanding The Benefits of Dedicated/Isolated Electrical Circuits

POWERVAR
Solutions for Power Quality

Introduction

Dedicated electrical circuits with isolated safety grounds have a long history of usage in the computer and electronic industry. They are, in fact, one of the most familiar but perhaps least understood "power quality" methodologies still in use. It's important to know what dedicated/isolated electrical circuits are all about, what such a circuit is by strictest definition, and what it can reasonably be expected to accomplish for the computer user, technology reseller, and service provider.

Component Parts

There are two effective components to be discussed; the **dedicated circuit** and the **isolated safety ground**.

The strictest definition (also the original one) of a dedicated electrical circuit is one in which each of the power and grounding conductors are "dedicated" to the electrical needs of a single electricity consuming appliance (i.e. a computer, printer, POS system, etc.). In addition, these dedicated conductors must run continuously in their own dedicated electrical conduit or raceway from the appliance all the way back to the facility's main electrical distribution panelboard. Figure 1 illustrates the installation requirements of a true dedicated electrical circuit.

Isolated safety grounds are ones in which the dedicated safety grounding conductor is a full size, insulated conductor that does not touch any part of the conduit, raceway, or other "noisy" electrical ground connection at any point between the appliance and the power source. At the main distribution panelboard, this isolated grounding conductor must attach to a point that is electrically the same as the building's first neutral to ground bonding point. At the appliance or load connection, the grounding conductor is connected to a wiring receptacle whose safety ground pins are insulated from the receptacle's mounting ears. Isolated ground or "IG" receptacles are often orange colored as an identifier.

The Objective

Dedicated/isolated circuits have been around for a long time, and it's important to know what objectives were in mind when they were first specified. There are several.

Early generations of systems used linear power supply technology that was characterized by two features; **voltage sensitivity** and **high power consumption**. In other words, early systems required a very stable, well regulated supply voltage in order to function properly. In addition, a single computer and daisy wheel printer could easily consume ten amps or more, and it was surprisingly easy to exceed the ampacity of branch electrical circuits. Dedicated circuits answered both concerns quite easily.

Voltage regulation problems are often the result of overloaded branch circuits or distribution sub-transformers. By powering systems from the building main transformer, the system was assured of a relatively stable voltage supply. At the same time, a properly sized circuit dedicated only to the electrical needs of a single computer wouldn't easily be overloaded. Nuisance breaker tripping and unreliable operation would be eliminated and the user would only be affected by utility company actions or those of the unknown "electrical hitch-hiker" like a janitor with a vacuum cleaner.

Isolated grounds were employed in an attempt to provide the computer system with a separate, noise-free, low impedance ground path back to the building's neutral-ground connection to earth. Theoretically, if all parts of a computer system (terminals, mainframe, printers, etc.) were provided with isolated ground circuits, ground loops and noise current flow within the computer system would be eliminated.

Finally, dedicated power and grounding conductors interposed a significant amount of wiring impedance between the

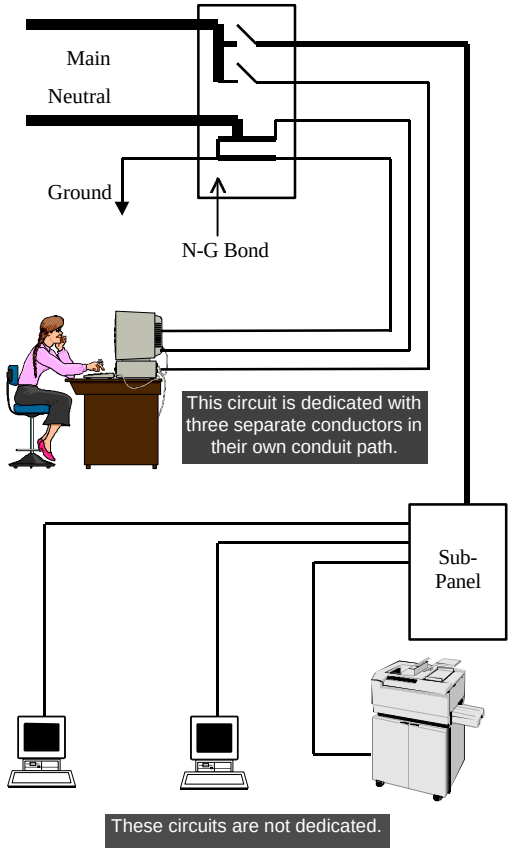
critical load and other loads within the electrical system, prohibiting disturbances from other devices from entering the computer system.

The Real World Comes Calling

Unfortunately, as time has passed, several factors have interfered with the proper utilization of dedicated circuits. It's helpful to consider changes that have occurred along the way.

Computer systems no longer occupy formal computer rooms. Modern systems are now distributed throughout office cubicles, wiring closets, and in some cases even above suspended ceilings and in crawl spaces. In addition, the number of systems in use today is many times the population of computers and peripherals twenty years ago.

Figure 1 - Main Distribution Panelboard
Simplified Single Phase Circuits



As a result, there is insufficient main panelboard space in older buildings for every microprocessor to have its own circuit. Many new facilities are also being built without consideration for the electronic load being installed. It's also not practical (or possible) in many cases to install dedicated conduit runs, and the circuits powering sensitive electronics often share conduits with circuits powering lighting, copy machines, microwaves, etc.

These factors are largely responsible for a relaxation in standards for installing dedicated/isolated circuits. It's not uncommon to find specifications that allow circuits to be dedicated only to a sub-panelboard. Other specifications allow isolated grounds to be attached at the sub-panelboard as well (often to the main safety ground connection instead of to an IG bussbar). Failure to install dedicated or isolated circuits according to strictest conventions results in a performance compromise and ultimately raises questions about their usefulness for modern technology.

Changing Power Requirements

Modern computer systems have changed substantially from their predecessors. Not only has power consumption dropped into the single digits, but state of the art design generally incorporates newer switch mode power supply technology (SMPS). The operating characteristics of SMPS's make them almost completely immune to variations in the AC supply voltage (see POWERVAR Whitepaper #205). In the process, one major argument in favor of dedicated circuits has evaporated.

At the same time, processor speeds have increased thirty times or more, and the distributed computer system now extends like the dendrites of our central nervous system throughout a facility. This new environment virtually ensures that isolated safety grounding systems (even if properly specified and installed) will be inadequate to meet the electrical noise immunity needs of the modern system.

Implications

The implications are clear. Dedicated/isolated circuits are useless unless installed according to original definitions. Even when properly installed, they have limited capabilities for meeting the power quality demands of modern electronic systems.

The system reseller and service provider have additional concerns. Dedicated/isolated circuits are another step to be completed in the system installation process. They are also another point at which misinterpretation of a wiring specification by an electrical tradesman may take place.

System manufacturers and resellers exist in a fast paced environment. Users are often anxious and impatient to install new systems and they expect systems to work correctly once they are installed. The work of installing dedicated/isolated electrical circuits adds time and coordination headaches to the installation process. Once installed, dedicated/isolated circuits also dictate the installation location for equipment and limit its portability and adaptability to changing office or workplace conditions.

Effective Alternatives

Properly designed power conditioners offer an effective alternative to the dedicated/isolated electrical circuit. Each power conditioner contains three elements that provide distinct benefits.

A surge diverter and a noise filter in each conditioner provide complete protection against both externally and internally generated noise and transient disturbances. A low impedance isolation transformer ensures that common mode (neutral to ground) voltage disturbances cannot interfere with system operation. This is accomplished by placing the neutral-ground bond adjacent to the electronic load (the electrical equivalent of bringing the *"mountain to Mohammed"*).

System manufacturers, resellers, and service providers will all appreciate the *business* benefits. These include:

- Better power protection
- Fewer system failures
- Predictable electrical installations
- No electrical contractors to schedule or misinterpret specifications
- Power quality that is "portable" and computer environments that are easily rearranged
- Faster installations due to elimination of special electrical requirements

In addition, because customers are usually prepared to pay the cost of updated electrical wiring, system providers can improve their bottom line instead of the electrician's by offering cost effective power quality solutions in place of an electrician's services. The alternative is cost competitive, too.

Conclusion

Power conditioning offers superior power quality at a competitive price. It provides system manufacturers, resellers, and service providers with a power quality solution that is portable and profitable. In addition, it simplifies system electrical requirements to the point where the only necessary specification is electrical wiring that is safe and adequately sized.

Customers enjoy significant benefits, too. Installations are quicker. They receive better protection for the dollars they are already prepared to spend. Work spaces are not defined by the location of dedicated receptacles. Portable protection solutions allow computer systems to be easily relocated to adapt to the changing needs of a business. For more information on power conditioning alternatives, call POWERVAR.