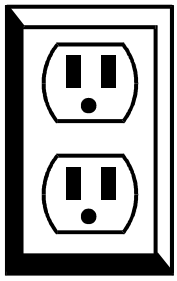
PLUGGING YOUR POWER QUALITY LEAKS

The power quality world is filled with high tech solutions. Sophisticated power conditioners, microprocessor based power analyzers, scope-meters, and smart UPS systems that can shut down a network safely are just a sample of the high tech power quality tools available. But sometimes, the simple solutions get lost amidst the state-of-the-art solutions. A simple idea can provide great benefits! And one of the simplest concepts is the way that most equipment is connected to the electrical supply: a ***plug*** and ***receptacle***.

The North American Standard



The standard North American receptacle is the NEMA 5-15R, rated for 125 VAC and 15 Amps. A ***Duplex*** receptacle accepts two plugs. Just about any consumer, commercial, or light industrial device can be connected to this type of receptacle.

It is tempting to think that this type of receptacle is the only type available, since over 90% of the receptacles that we encounter look just like this. Yet there are dozens of different types of receptacles available. Paging through any electrical wiring device catalog (such as Hubbell, Leviton, or Square D) will uncover a multitude of receptacle types and sizes. Why do we need so many receptacles?

The NEMA Receptacle Types

The National Electrical Manufacturers Association (NEMA) has developed a standard receptacle numbering system to make some sense from the many receptacles available, and to standardize devices from manufacturer to manufacturer. A typical NEMA number is L6-30P. In this case:

- The "L" means this is a locking (or twist-lock) device, as opposed to as a non-locking, flat-blade type
- The "6" is the NEMA type - in this case a 250 VAC rated, two conductor plus ground device. Receptacles are available for single phase, three phase, and many voltage levels.
- The "30" is the ampere rating
- The "P" means that this device is a Plug. (An "R" indicates a Receptacle)

Most electrical device catalogs have tables which list and illustrate the NEMA standard devices.

There are standard NEMA receptacles available for voltages up to 600 VAC and currents up to 50 Amps. You may not need these too often, but if you do, they are available.

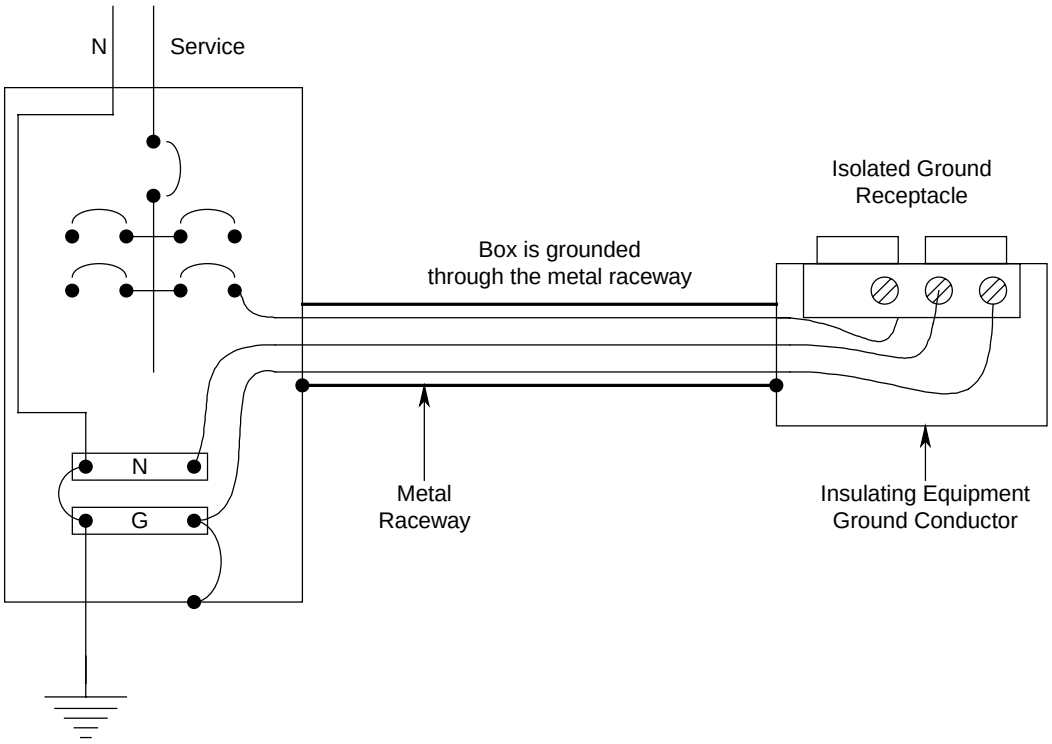
What about Power Quality ?

Simply having these receptacles available does not enhance power quality. However, the savvy design engineer can make good use of both standard and special receptacles to improve power quality. Understanding these techniques and the application of special devices can improve power quality with a minimum of expense and trouble.

Receptacle Tip #1: Isolated Ground Receptacles

One of the most difficult power quality problems to overcome is the "ground loop". Such a loop can cause electrical noise and transients, and is often difficult to eliminate in an existing installation. Design engineers can specify "Isolated Ground" receptacles to help break up ground loops. In most receptacles, the ground pin is connected directly to the receptacle mounting screws. Therefore, the ground pin is connected to ground

via both the ground conductor and the receptacle box / building steel. An isolated ground receptacle permits these two paths to be separated.



Receptacle Tip #2: High reliability mechanical connections

Ever wonder why health care facilities use ***Hospital Grade*** receptacles and plugs? These devices have a number of safety and performance enhancements that improve the safety of the connection. One of the most important factors is the mechanical connection of the plug to the receptacle. Hospital Grade devices are designed to make a better connection, and to maintain that connection over the life of the devices. Health Care codes require receptacles and plugs to be periodically tested to ensure a low resistance connection and mechanical holding strength.

Worn out receptacles can result in a number of power quality problems:

- Sporadic outages and accidental removal of the plug
- Arcing of the power and ground connections
- Voltage drop through high resistance connection

In the commercial and industrial environments, using hospital grade devices will result in a more reliable connection. Even if these more expensive devices are not used, you can make sure that plugs and receptacles are in good condition. Replacing a worn or questionable plug and receptacle is an inexpensive way to improve power quality!

Receptacle Tip #3: Use an Uncommon Plug / Receptacle Combination

A power quality engineer designed the electrical system for your high power workstation. You are connected to the facility UPS system. In addition, you have installed an isolation transformer, isolated ground receptacle, and a high energy filter to give you the best power quality in the building. You leave your workstation running a long simulation at the end of the day, confident that you will have some results the next morning.

At 7:00 p.m., the cleaning crew comes in, and plugs their floor buffer into the second receptacle of your workstations duplex outlet. The voltage sag and noise that result from this device lock up your workstation, and your simulation grinds to a halt. In the morning, the cleaning crew is gone, and there is no clue as to why your workstation crashed.

Cleaning crews are a well-known source of this type of problem, but the photocopy machines, space heaters, pencil sharpeners, and fluorescent desk lamps found in a typical office can also cause similar problems.

Proper use of receptacles and plugs could have prevented this! Instead of using a Duplex receptacle, use a device with a single receptacle. That way, there is little chance of another load being plugged in. Better still, select a non-conventional receptacle such as a twist-lock device. It's unlikely that the twist-lock receptacle will be accidentally disconnected, and the cleaning crew (or your coworkers) will look elsewhere for a place to plug in their noise producing devices.

Receptacle Tip #4: Oversize the Branch Circuit

For the knowledgeable power quality engineer, mains impedance is a big issue. Excessive mains impedance can lead to voltage drops, sags, waveform distortion, and impulses. Lowering mains impedance (through larger conductors, shorter runs, and lower impedance power conditioning devices) can improve power quality. However, electricians are often hesitant to increase conductor sizes for cost reasons.

Specifying a larger capacity receptacle (such as a NEMA 5-20R in place of a NEMA 5-15R) is one way to improve impedance without getting into a fight over wire sizes. Using a higher ampacity receptacle forces the engineers and electricians to increase the wire size, in this case from a #14 AWG to a #12 AWG. The result: Lower impedance and improved power quality!

Mind your P's (Plugs) and R's (Receptacles)

When you are designing an electrical system, or diagnosing a power problem, look first to the simple things. Make sure that the proper receptacles are used, and that they are used wisely.

- ✓ Proper voltage rating
- ✓ Proper current rating
- ✓ Grounded receptacles
- ✓ Good mechanical connections
- ✓ Noise producing loads connected to the same receptacles
- ✓ Plugs and cords susceptible to accidental removal
- ✓ Isolated grounds as required

Proper attention to your Plugs and Receptacles can yield big benefits in improved Power Quality. So mind your P's and R's!