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Photo Copier Capers

Copier Capers by Harold P. Kopp
http://www.kennedyelectric.com/SureTest/Suretest-PhotoCopierCapers.htm - Link Now Dead

Congratulations! Your number one sales person has just closed a deal he has been working on for months, your best state of the art, top of the line office copier. The customer is salivating to get his hands on this high quality state of the art cost savings high speed copier.

All you have to do as the installer is to deliver the copier, plug it in and give some simple instruction as to basic operation, and of course show them where the operation manual is stored. Before delivery your sales person instructed the customer that for best results this sophisticated computerized copier would need a "dedicated outlet". They called the electrician and he ran a special line right from the panel. Great, that should take care of the power.

The installation went fine, but within two hours of returning to the shop the customer calls asking what "E-33" or some other code means. "Oh #&@t!" I've heard this before... Deja-vu.

You give a reasonable explanation that this happens sometimes and cringe while hanging up the phone. Your gut tells you that out of the last 100 copiers you installed, this is going to be a problem. You already know it's going to be bad power. But what to do? They have a dedicated outlet. The electrician swears the outlet is on its own circuit and nothing else is connected to that breaker. A dedicated circuit?

What's going on and why?

Unless the electrician connected the dedicated outlet to an electrical panel that has a ground-to-neutral bonding point, you do not have a dedicated outlet. You can check whether there is a ground-neutral voltage. It may be intermittent and need to be checked over a period of time using a peak-hold instrument (SureTest® or other). There are only two ways to connect to a panel with a ground-to-neutral bonding point. First where the power enters the building, second after a distribution transformer where the ground and neutral are allowed to be bonded together at the secondary of the distribution transformer.

What is the big deal ? "Shared Neutrals" !

Normally on three-phase distribution systems the voltage in the common neutral is canceled out if the loads in each phase are balanced. But that was in the good

old days before electronic equipment started causing harmonics. With harmonics present the currents in the neutral do not cancel out and can even cause overheating of the neutral conductor. The harmonics are caused by computers, copiers, and fax machines. All these devices have electronic switching power supplies which draw non-linear currents and cause harmonics which appear on the shared neutral.

A common cure for this overheating of the neutral is to use larger neutral wire. This will reduce the heating and, because of the lower resistance will reduce the voltage between ground and neutral - but not eliminate it! This voltage and the harmonics appear at all the outlets connected to the branches on this sub-panel. Surges from motors starting and from inductive loads being switched on and off will appear at all the outlets connected to the branches on that sub-panel. This can cause sensitive electronic equipment to malfunction or even become damaged.

For example if the neutral resistance from the sub-panel back to the main panel were 0.025 ohms and the current flowing through the neutral were 100 amperes, the voltage between ground and neutral would be 2.5 volts. This voltage would appear between ground and neutral at all the outlets on all the branches connected to this sub-panel.

What does the copier care, and why the error code?

The most common problem is the circuit for the lamp in the copier. Since this lamp draws a lot of current it is desirable to turn on the light at the zero crossing of the ac wave-form. This is done by a zero crossing detector in the lamp circuit. The idea is to eliminate the surge of power to the bulb by starting it at zero volts and letting it ramp-up to full voltage with the sine wave of the line. This also causes less surges on the ac power line which could affect other equipment which shares the common neutral.

The zero crossing detector watches for the voltage between hot and neutral to become zero volts. This is the zero crossing of the Ac line voltage supplying the copier. With the harmonic voltage is impressed on the Ac wave-form. Some of the harmonics will actually fall on the zero crossing of the 60 Hz line, the harmonics raise the zero crossing voltage off zero volts and the zero crossing detector misses the timing signal that starts the lamp. This will cause an error code and the copier will not work.

How to cure the problem? Minimize the ground-neutral voltage and interference from other equipment sharing the common neutral.

Check the present power system for bad connections. Excessive long runs from the main panel can cause problems. Check the line impedance under load (SureTest® or other instrument) to identify poor connections or other sources of high line resistance.

1. Check the quality of the Grounding system by testing the ground circuit under load (SureTest® or other instrument). The IEEE recommends that the resistance of a grounding conductor for sensitive electronic equipment be no more than 0.25 ohms. If the ground circuit is measured with common neon testers, a ground with a 2,000 ohm resistance would test as "grounded" ! A false sense of security results because noise from equipment on the same grounding circuit can interfere with the operation of the copier. Further, the ground circuit cannot dissipate current surges resulting from over-voltages, and surge protection devices cannot function properly to provide the intended protection. Current will flow where it is not intended - in the neutral, network cable shielding, ground pins on the serial ports, etc. - causing copiers to malfunction, and/or components to fail. Serial ports, interface cards and cable shielding can be destroyed (entire UPS networks can be shut down).
2. Put in a real dedicated line. The ideal would be to run the power for the copier all the way back to the main panel where the ground-neutral bond is. Running a separate neutral back to the main panel is often sufficient. This would eliminate the noise caused by the other branches on the sub-panel.
3. A sure cure is to run the copier off an active U.P.S. This is a power device that generates a new ac power supply by rectifying the original ac and converting it to dc. It then generates a new ac wave-form that is completely isolated from the power lines. This device must handle the full current requirement of the copier 100 percent of the time. It could be expensive but should be a sure cure.
4. Install a line isolation transformer for the copier. Of course it must have the voltage/ampere rating to carry all the current required by the copier (usually a large and expensive transformer). Once installed, the ground and neutral may be connected on the secondary. This is called bonding the ground and neutral. This can only be done after the isolation transformer. Bonding the ground and neutral at the secondary will make the voltage between ground and neutral become zero volts. No voltage or harmonic noise will appear between ground and neutral and the zero crossing detector will operate properly. The inductance of the transformer inductance and capacitance will help to attenuate surges and noise. The low frequency response of the transformer will also help to attenuate the harmonics . You should probably use a surge suppresser before the isolation transformer to optimize the installation. But again, be sure the

ground quality is good or the surge suppresser may not work when it is needed.

5. Another approach would be to install a harmonic filter which would attenuate the third and fifth harmonic components. This would keep the harmonics from interfering with the copier zero crossing detector. This would be less costly than the isolation transformer.

Danger, Caution, Don't do this

Never connect the ground and neutral together at the copier or sub panel. While it may seem logical that it will eliminate the voltage between ground and neutral it will cause more problems than you have now. First it could cause a fire because the total neutral current from all the branches will seek a parallel path through the neutral of the copier circuit and then through the ground wire back to the main panel. Since the copier branch is probably a 20 amp circuit you could have several times that current going through the copier branch neutral and back to the main panel through ground. The neutral and the ground would be severely overloaded and could cause a fire. Also it would cause current to flow through the ground wire which is not allowed and could cause electric shocks and be a safety hazard.

Most commercial buildings of new construction use neutrals of ample size and properly placed distribution transformers to eliminate most of the neutral problems. The majority of problems will be encountered in older buildings which have been expanded and have had additions added. Needless to say any investigation of problems and modifications or additions of wiring should be done by a qualified electrician.

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