



EGS Electrical Group
Sola/HD
9377 W. Higgins Road
Rosemont, IL 60018

Power Quality Solutions For the Machine Shop

Steven P. Zwierlein, Sr. Applications Engineer
Emerson Network Power Surge Protection, Inc.

Can your machine shop afford expensive down time?

With machine shops becoming completely automated factories and turn-around time requirements getting shorter and shorter, the cost of downtime due to machine failure has increased significantly. And while some machine failures are due to faulty equipment, the vast majority of failures can be attributed to the quality of power supplied to the machine. It has been estimated that this year approximately one hundred billion dollars will be lost in US industries from damage and downtime due to power problems. **It is not economically feasible to have expensive machines sitting idle waiting for a technician to replace a damaged printed circuit board.** Unfortunately, this scenario is not uncommon (since sensitive integrated circuits have made their way into CNC machines). Some machine manufactures do not want to be held accountable for failed equipment due to power problems and have gone as far as to void warranties if preventative measures are not taken. **Certain insurance companies have also refused payment on policies that cover lost time in claims that have power related problems.**

So what can be done to protect machines and minimize downtime?

Emerson has the solution.

Types of Power Problems:

Voltage transients and noise can be of many shapes and sizes and can take any conductor as a path to your equipment. They can be a lightning induced transient that is destructive in nature, or high frequency noise that can cause long-term degradation to equipment or cause system lock up. Power surges and electrical noise can be externally generated by lightning strikes and utility power grid switching, or internally generated by ground loops, arc welders or inductive motors.

Power Surges can be caused by a lightning induced transient, or by the utility company load switching. Power surges are high-energy, low frequency disturbances that can measure in the thousands of volts and can be less than a millisecond in duration. Once inside your facility the transient will decrease in amplitude as it makes its way from the service entrance to the machinery but remains large enough to be destructive in nature. Most people do not realize that lightning does not actually have to hit the power lines to create a transient. Lightning hitting the ground as far as five miles away can change the ground potential thus "coupling" the transient onto the power line and producing an impulse with destructive power.

Electrical Noise, often known as EMI, is caused by sources such as welders, transformers, solenoids, florescent lights, and motors. When a wire or any conductor comes in close proximity to these sources, EMI can be "induced" onto the conductor and travel to equipment. EMI can be in the form of normal mode noise (noise flowing between phase lines) or common mode noise (flowing between line and ground). This noise can measure up to fifty volts in amplitude at frequencies up to 50MHz. The effects of EMI noise on equipment can include data disruption in the form of parity bit errors, and component degradation that will lead to eventual machine failure.

***Ground Loops** are a common cause of transient voltages and have become a major concern in machine shops. This is due to the popularity of DNC and CAD/CAM systems that connect industrial equipment in different locations throughout the factory. A ground loop is usually generated if each pieces of equipment has its own dedicated ground reference point, such as a ground rod on the CNC machine and a wall outlet ground at the PC. The different voltage potential causes current to flow on the ground wire that connects these two or more points. Even a small amount of voltage difference can create enough current to burn out or degrade sensitive components in the machine and computer.*

So how do you improve the quality of power within your factory?

Now that the sources of power problems have been identified, it is time to describe the critical steps to resolving these problems. Figure 1 shows both the perceived and effective solution to power quality problems. In the past, **the perceived way of solving power quality problems** was to apply a UPS at the service entrance, as well as voltage regulator and noise filters to eliminate brownouts, swells and transients from entering the facility. If this was found to be ineffective, additional surge protective devices were applied prior to checking the facilities wiring, bonding and grounding systems.

Effective power quality starts at developing a solid base or foundation within the facility. This approach can be accomplished by first auditing the facilities grounding, bonding and wiring systems. Because the vast majority of all power quality problems are internally generated, and a bulk of which are attributed to high frequency noise, filters should become a critical part of the machine's system requirements. After the required steps have been accomplished, a more pro-active approach can be taken. This approach incorporates surge protection devices, voltage regulators and UPSs at the facilities service entrance and branch panels.

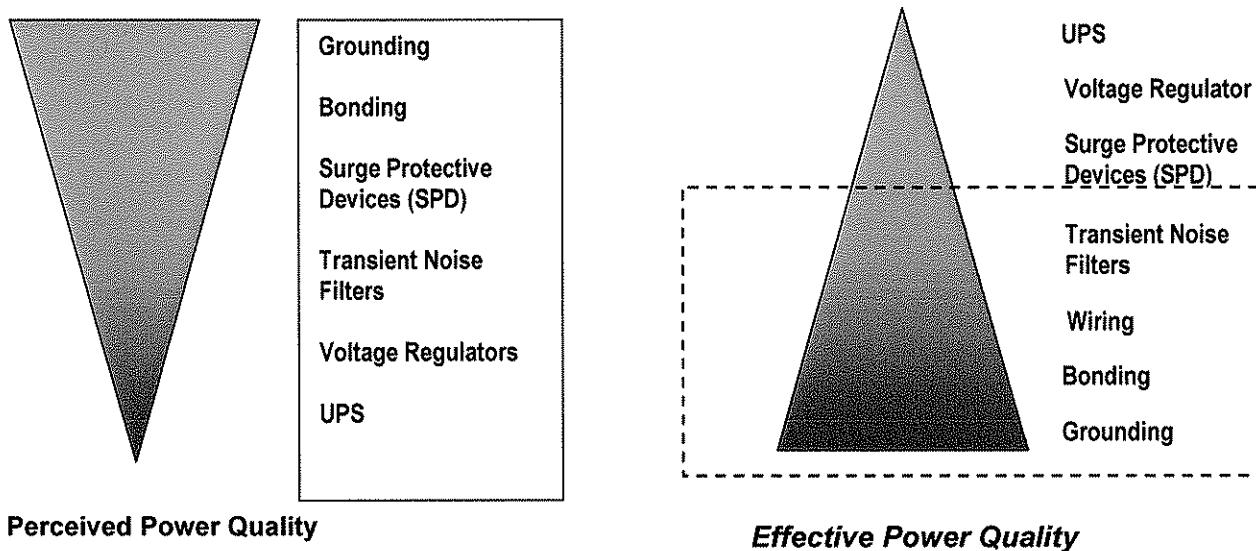


Figure 1.
Power Quality Pyramid

A Staged Approach to Protection:

The **“Total Copper Wire Protection”** philosophy is built on the idea that every wire or conductor in a factory is susceptible to noise and voltage transients. Knowing that voltage transients have different characteristics and take many different paths to equipment, we have divided the factory or machine shop into three areas or stages of protection. Stage 1 consists of facility wide panel protection, Stage 2 critical load protection, and Stage 3 data and signal protection. (See figure 2)

Stage 1. Parallel connected devices designed to clamp high-energy lightning or switching transients coming from outside the facility. Products are connected to panel boards, control panels or on the primary side of a transformer going to a machine. Generally sized based on the panel they are protecting, these products are rated by the amount of surge current they can withstand.

Stage 2. Series connected devices that use Active Tracking® technology to eliminate high frequency noise and clamp low level transients. These products are connected directly inline with sensitive equipment to provide clean AC power. They are sized based on the load that they are protecting and supplied in hard-wired and cord-connected versions.

Stage 3. Designed to protect low voltage data and signal lines from high-energy transients and electrical noise. Usually overlooked but because it contains some of the most sensitive equipment in the facility it is probably the most critical when it come to preventing downtime. When left unprotected, transients can use the low voltage lines as a backdoor to damage equipment.

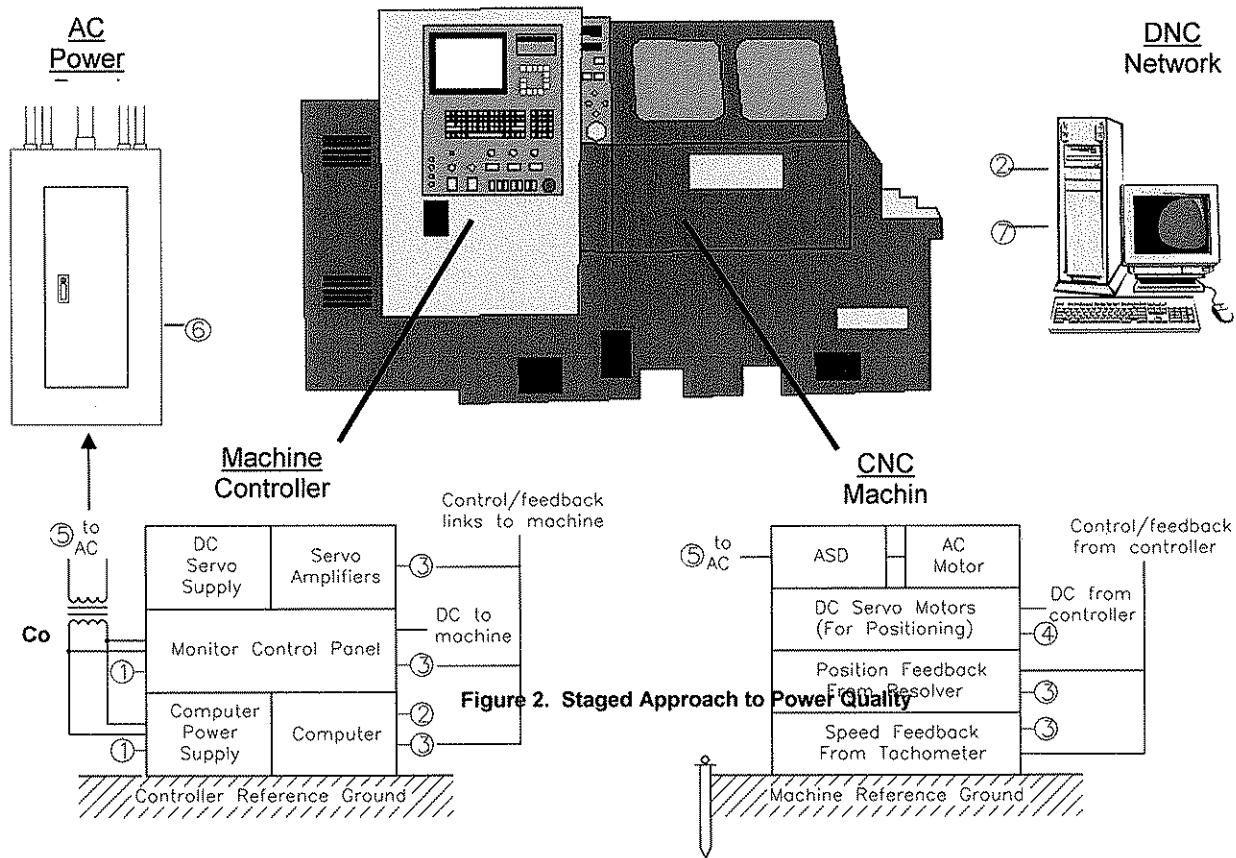


Figure 2. Staged Approach to Power Quality

Reference Number	SPD	Product Description
1	STFE or STFV Series	Series connected high frequency noise filter and surge suppressor, ideal for protecting the monitor control panel and power supply located within the machine controller. Stage 2
2	STC-642 Series	Data line protection for RS-232 lines connected to peripheral devices going to going to the personal computer within the DNC network. Stage 3
3	STC-DRS Series	Din rail mounted data line surge protection system designed to protect the control links connecting the machine controller and the CNC machine. Stage 3
4	STFV DC Series	High frequency noise filter designed to protect DC power generated in the controller and going to the machine. Stage 2
5	STV-100K Series	Stage 1 protection Parallel connected electronic grade surge protective device capable of protecting the incoming AC power at the controller and at the machine. Stage 1
6	STV-200/400K Series	Parallel connected surge protective device effective in diverting high-energy transients from service entrance or large distribution panels. Stage 1

Figure 2
Staged Approach to Power Quality

As productivity and turn-around times increase, the cost of equipment down time or “**the cost of not doing business**” also increases. For this reason, machine shops should protect critical factory equipment from all power related problems. Control Concepts manufactures the application specific devices needed for stopping anomalies from getting to your equipment. **Do not allow your CNC machines to be subjected to high-energy transients or low-level noise.**

References:

Fritz, Dan (March, 1995)
 Keeping Your Machine Shop On-Line.
Modern Machine Shop, 104-109.

Control Concepts. (1999)
Industrial Strength Protection catalog
 Binghamton, NY: Author.

Defalco, J.
 CNC Tutorial. Bergen County Technical Schools.
 12/96 Accessed 11/09/99
 <<http://users.bergen.org/~jdefalco/CNC/lathes.html>>