Friday, February 20, 2009

Power Supply Considerations for Industrial Applications

Although power supplies are among the most important components of any industrial application, they seldom receive any significant attention. Engineers often do not fully understand all of the variables that go into choosing the correct power supply, and may select a product that is insufficient or more costly than what is needed.

When considering a power supply for an industrial application, it's helpful if a designer has an understanding of the steady state output parameters of the product, as well as the electrical and physical environment that the equipment will operate in. Here are some critical considerations.

Unique Load Requirements
Motors, solenoids and relay controls require higher levels of current when they are turned on than they do for continuous operation. It is necessary for the designer to examine the magnitude of the pulses and either specify a power supply that is capable of providing the surge currents continuously, or use a product that can provide peak power for a limited time. Certain models, for example, can deliver up to 200% of the nominal rated current for up to 30 seconds. This enables the user to purchase a 240W unit to meet a 480W surge load, saving both money and space.

The designer should also anticipate potential mechanical failure of factory equipment. If a motor stalls or a relay "sticks", the current draw can rise dramatically. Using a power supply that is capable of protecting itself in overload conditions will both protect the unit and the system.

Input Line Disturbances
In most industrial environments the AC line is far from clean. This is because the same line that feeds a power supply is also being used to drive larger equipment. Large disturbances such as power sags and surges are commonplace.

High spikes on the AC line can damage a power supply in a similar way that ESD can damage semiconductors. On the surface, the unit can pass bench testing but long-term damage may occur to capacitors and power semiconductors, which leads to failure after just a few months of operation in the field. Industrial power supplies should meet EN61000-4 standards for immunity to line transients, and for extremely dirty AC line conditions the designer should consider using an external AC line EMI filter with high voltage pulse attenuation specs.

To prevent loss of DC power during sags, which is typical when a large piece of equipment is switched on that is in close proximity to our designer's system, it will help to specify a power supply that has a wide AC input range. If the AC line is 208VAC nominal, and sags down to 140VAC occur, utilizing a product that has an input range of 85 – 264VAC will allow DC power to be supplied without interruption. Even a short dip in the DC output can cause microcontrollers to reset and the host equipment to run through a reboot sequence.

Mounting Considerations
Most power supplies typically use electrolytic capacitors for filtering and energy storage. The higher the operating temperature of these capacitors, the shorter the life. As these parts age, the output ripple of the power supply increases, causing functional problems with the load equipment.

When mounting the power supply, ensure that adequate space is provided around the product to allow air to circulate. Do not block off heatsink fins with mounting brackets, restrict air inlet or exit from fan cooled units (1.5 to 2" clear space is a good rule of thumb), or mount the supply in a plane other than its standard-mounting orientations without consulting the installation manual.

In the event that other fans are in the enclosure, take note of the general system airflow direction, and be aware of any potential backpressure issues that may occur.

Operating Temperature and Life Effects
In addition to mounting considerations, the operating ambient temperature also plays a key part in the life of the power supply. The life of an electrolytic capacitor doubles for every 10°C reduction in temperature. The designer should be aware of the derating characteristics of the proposed power supply. Most AC/DC

power supplies start to derate from 40°C or 50°C, and can only operate at 50% of its rated load at 70°C.

The derating calculations may indicate that a higher power unit is needed. Using a manufacturer with a broad base of products and a large number of models within a series will simplify this choice.

As a note, the ambient temperature is specified at the inlet of the fan or close proximity to the power supply. Designers should take into account any internal temperature rises in their system when considering potential derating.

To make an "apples-to-apples" comparison on competing products, also consider the warranty of the power supply. A product with a five-year warranty will have greater component deratings and higher quality components (use of 105°C rather than 85°C rated capacitors) for a longer field life than a product with a one-year warranty.

Operating Environment
Vibration and shock will also heavily influence the life of a power supply. A more rugged power supply will meet more stringent MIL-STD specifications. When considering the specifications, remember that how the power supply is mounted can cause mechanical resonance in the system. When the entire system is subjected to shock and vibration, a power shelf containing one or two supplies may start to vibrate at amplitudes greater than the system itself.

Think Ahead
While it is true that the power supply is only a small fraction of the size, complexity, and cost of industrial equipment, it is a key component that can have a disproportionate impact when the role in the system is not carefully considered. Because of the power supply's high unit cost compared to other electrical and electronic components, it is often targeted as an item for cost reduction. In the world of power supplies, you truly get what you pay for. Bargain-priced power supplies are not a bargain when the costs of field-failures, customer complaints, warranty repairs and potential damage to your company’s brand name are included in the equation.

Designers who consider their power applications carefully and early in the project are more likely to see their project go more smoothly, faster and most importantly protect their company's name and reputation with greater field reliability.

Posted by Power Guy