



Deploying intelligent power supplies to save energy

A White Paper presented by:

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Key concepts

- The increasing use of 24 V DC power in control cabinets places more demand on power supplies
- Today's intelligent power supplies help the user monitor the condition of the power supply's output
- With a better understanding of the power supply's condition, the end user can improve the energy efficiency and reliability of the entire control system

Introduction

Today's control systems increasingly use 24 V DC power. This places more demand than ever before on the power supply in the control cabinet. It also creates the need for larger power supplies to produce larger amounts of DC current. Since these larger power supplies now provide most, if not all, of the control power for the cabinet, knowing the condition of that power is of growing importance.

Energy efficiency

Historically, 24 V DC power supplies were big, bulky and oversized for most applications. These linear regulated power supplies wasted almost half their energy conversion process to waste heat dissipation. Most of these devices were only 40 to 60 percent efficient. This directly relates to cost of ownership, with the owner wasting money to heat through poor power conversion.

Today's high-end power supplies are based on advanced primary switch mode power supply (PSMPS) technology. This topology improves the energy conversion process to the level where many power supplies boast efficiency levels of 93 percent or better. This conversion efficiency lowers the power supply's heat emissions substantially. Lowering the heat loading on the cabinet reduces the size and cost of air-conditioning equipment. Part of the energy efficient design of these power supplies is the ability to provide the same amount of output current with less consumption of energy on the input. With PSMPS drawing less current to produce the same amount of output power, the cost-of-ownership decreases dramatically. With the cost of energy increasing constantly, this cost savings amplifies itself when there are multiple control cabinets in a single facility.

Power monitoring

Beyond the construction and efficiency of the power supply, advanced power supplies can provide feedback on the condition of the output power to the control system. Some power supplies offer two different feedback modes to alert the user to the status of the DC power system. This "power quality" monitoring can often mean the difference between a properly operating system and one that is inefficient or about to fault.

The first indication that can be used to measure DC power quality is the feedback indication circuit, such as the "Power Boost" offered by Phoenix Contact's QUINT SFB power supplies. This feedback circuit alerts the user that the power supply is providing more current than the nominal output of the power supply. For instance, if the load circuits are designed to draw eight amps of current from a 10 amp power supply, and over time the power supply starts to provide more than 10 A (for example, 11.5 A), the power supply will provide a remote indication alerting the user of this condition. This condition could indicate that there is a faulty device drawing more current than it is designed for. This is typical with small motors. As a motor ages, it begins to draw more energy from its source. Feedback indication like the Power Boost can provide an early warning to the user before major operational issues arise.

This indication can also identify when the power supply is drawing too much current from the AC line. This indicates inefficiencies in the system, and a technician should take a look at the control platform to identify potential fault conditions.

A second level of indication is the “DC OK” status output. This indication activates after the power supplies are in the overload state. In the case of an overload, a 10 A power supply can provide up to a continuous output of up to 15 A. As the output of the power supply passes the 10 A output level, the previously mentioned feedback indication activates. However, if the loading of the devices is beyond the capacity of the power supply, it will still continue to provide the output current at a reduced voltage. This could indicate either a fault condition or a severe overload. Once in this overload state, the power supply will provide a status contact change once the output voltage drops to 90 percent of the adjusted output value.

This is a key indicator that can help the sustainability of the control system. In this condition, the power supply provides an emergency feedback loop indicating that the voltage has dropped below adequate output levels. However, there is still voltage and current present where the control system may still be operating. Drawing current at this level on the power supply indicates that there is a problem in the system. Energy efficiency is not optimal, and the system may be on the verge of shutdown.

DC reliability

Most PSM power supplies on the market today have an inherent fault, and most users are unaware of this fault. In a condition of a short circuit or fault on a given output branch, the power supply will typically trip off or “self-protect” before the circuit breaker has a chance to trip. Thermal-magnetic breakers (TMC) often need six times their nominal current to clear a fault, and a time of close to 5-12 milliseconds (ms) to do so. Most power supplies will react faster than the short circuit and either go into a fold-back condition or a self-protect condition. A power supply that does this limits the reliability of the uptime for a DC control system.

Having a power supply that can provide enough current for a long enough period of time solves this often unseen problem. Power supplies equipped with Selective Fuse Breaking (SFB) technology have up to six times their nominal current for 12 ms. This provides enough energy to clear a fault without losing the entire DC bus structure. The QUINT SFB power supplies from Phoenix Contact are the only power supplies on the market with this technology. It ensures the DC reliability in critical applications where DC availability is a must.

Conclusion

The cost of controls equipment and energy usage continues to climb. Using energy-efficient and intelligent power supplies provides cost savings from the energy consumption standpoint, as well as the control sustainability aspect. Although Energy Star designations do not apply to industrial control power supplies, high-efficiency power sources reduce energy consumption and costs. With multiple control cabinets throughout a facility, the energy savings add up quickly. The intelligence of these power supplies provides support information to the condition of the output and early warning mechanisms to enable the most efficient usage of the available energy.

About Phoenix Contact

Phoenix Contact is a world leader in electrical connection, electronic interface and industrial automation technologies. Phoenix Contact GmbH & Co. KG, Blomberg, Germany, operates 46 international subsidiaries, including Phoenix Contact USA in Middletown, Pa. Global sales exceed more than 1 billion euro annually. Phoenix Contact’s formal Integrated Management System is registered to ISO quality, environmental and safety standards (ISO 9001:2008, 14001:2004 and 18001:2007).