Keep cool – new heat dissipation concept for power supplies

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Mechanical engineering requirements for power supplies are demanding and diverse. The objective is to attain sustained high levels of reliability and longevity, and to do so under environmental conditions that are often very demanding in terms of vibrations and temperature. Phoenix Contact Power Supplies GmbH has met both challenges with Trio Power, its new generation of power supply units, and achieved a completely new heat dissipation concept for the devices for the first time ever. (Lead image)

At first glance, temperature and vibration appear to have nothing in common. But this is just where the central question about power supply units, which are becoming increasingly compact and powerful, presents itself: How do I efficiently remove the heat generated by the device? It exposes the components to a thermal stress factor and reduces the device’s service life.

What do we do with the heat?
Fundamentally, the best solution would be to avoid any heat from escaping from the device’s components. But this is physically impossible, which means that development engineers must consider suitable heat dissipation concepts as early as the engineering phase. In the process, technological and economic aspects must
also be considered. This ensures that the new development of power supply units, which is cost-intensive, is profitable and can be marketed at a competitive price.

**Heat dissipation without an interior cooling element**

The required output power must be provided effectively and quickly, even when the power supply unit’s output load is constantly changing. This dynamic process can sometimes put a recurring load of up to 150% of the rated current lasting at least five seconds on the power supply unit.

The consequences are that all internal components, such as semiconductors (MOSFETs) and wound elements develop additional heat, with the amount depending on their interior resistance. This component self-warming is added to the warming caused by the ambient temperature, negatively affecting temperature-sensitive components such as electrolytic capacitors.

**10 Kelvin is enough to determine service life** To illustrate: The electrolytic capacitor is the component that determines the service life of the power supply unit. Take one with a specified permissible ambient temperature of 105°C. If the capacitor is operated at 95°C instead of its specified limit of 105°C, service life doubles.

The very advanced approach to heat dissipation used in the automotive industry is to use high-power diodes on the PCB in lighting technology. Based on that approach, a new, EMC-tolerant controller and switching topology has been developed for the new Trio generation, taking into account performance-associated hot-spot zones. The one-sided PCB also facilitates a high degree of automation in series production. Power semiconductors are systematically designed as SMD components, and thermally critical components, such as electrolytic capacitors, positioned in non-critical temperature zones.

At the hot-spot zones that arise at specific points, the heat is systematically conducted through the PCB and very quickly, homogeneously, and efficiently spread over the housing with the integrated cooling element.
Reliable even in shock and vibration
It is necessary not only to manage temperature, but to reduce inert masses as much as possible for the development of a vibration-resistant power supply like those preferred for use in machinery construction. Trio Power, the new generation of power supply units, involves a minimum of screw fastening technology, unlike the first generation. An innovative bonding technology is used to attach the PCB to the housing interior. One of the most important innovations is the complete absence of cooling elements in the interior of the power supply unit because convection there is negligible. This allows easy orientation-independent installation in small switching distributors.

Style, not inert masses
A consistent reduction of inert masses has made the mechanical resistance many times as great as it was. The result is shock values of 30 g per spatial direction (in accordance with IEC 60068-2-27) and a significantly improved vibration value from 2.3 g to 4 g for the entire frequency range from 15 to 150 Hz for 90 minutes.

The seven new Trio Power supply units are divided into four single-phase and three three-phase power supply units with output currents of 3–20 A. Tool-free wiring with push-in connection technology saves time during installation, and the slim design saves room in the control cabinet. For example, the three-phase 20 A device is 68 mm wide. The wide temperature range from -25°C to +70°C and reliable starting of devices at -40°C guarantee a high level of versatility. The broad input voltage range for all conventional AC and DC networks and the comprehensive certification package mean that the devices can be used worldwide. The adjustable output voltage (24–28 V DC) allows compensation for voltage drops. The innovative concept makes Trio Power mechanically and electrically robust.

Bundled power supply competence
In all industries, reliable powered modules are a requirement for flawless and uninterrupted production machines, plants, and systems. The increasing complexity of industrial systems and the rising pressure of costs in international competition
have been pushing up power supply requirements for years. But many users feel that they have been left on their own in selecting power supply units that are compatible with their applications. That is why both offering high-quality standard products for as many applications as possible and developing customer-specific solutions will be indispensable for power supply manufacturers in the future. A clearly organized, quickly understandable positioning of the power supply unit product ranges saves the user time during the selection process.
Phoenix Contact has expanded its power supply business unit at its new location in Paderborn, Germany, where development, marketing, and production competencies cooperate closely to provide innovative power supply products.
Thus new technologies arise from customer requests. Phoenix Contact has long proven its technological competence, developing SFB technology in 2007 and ACB and IQ technology in 2012.