Thermosimulation for power supplies enables shorter time-to-market

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Heat flow simulation is a vital technique allowing power supply developers to measure and evaluate parameters in terms of thermodynamics and computational fluid dynamics at every point in the appliance.

Next-generation power supplies are high-tech products designed today to meet a wide range of highly-diverse technical and commercial market demands. Switch-mode power supplies are subject to high integration density and typical places of operation, resulting in increasingly high power density in relation to the total volume of each power supply, in every conceivable place and under every kind of environmental condition. In order to meet the high standards required of product development based on lead times and development budgets that are in line with market conditions, experience in the field of heat removal and traditional processes (for instance, from an idea for a new power supply to a series of laboratory samples and then a prototype) is no longer adequate. Only by using the latest development tools and otimised processes can new developments still be effectively realised in terms of time and costs. For more than twenty-eight years, MGV has been renowned for developing customised switch-mode power supplies of a high technical standard. The company uses the most innovative and most powerful flow simulation software available to master new challenges. With the aid of flow simulation, all thermodynamic parameters relating to the system under review can be recorded on a three-dimensional level anytime and anywhere for subsequent evaluation. Unlike conventional measuring methods, such as temperature probes or thermographic mapping, this puts developers in a position to monitor key indicators in terms of both thermodynamics and computational fluid dynamics, which would be very difficult or even impossible to assess based on the the conventional methods. Apart from the heat flow in components, this simulation notably includes the flow around components and their reaction to the flow in the power supply itself.

Figure 1. Power supply series SPH1013 and SPH500

The flow simulation software used by MGV for development work is based on a completely new CFD software concept. Among other things, its 3D CAD models allow for direct simulation of flows and heat transfer without having to previously copy or convert data. As a result, standard problems relating to thermodynamics and computational fluid dynamics

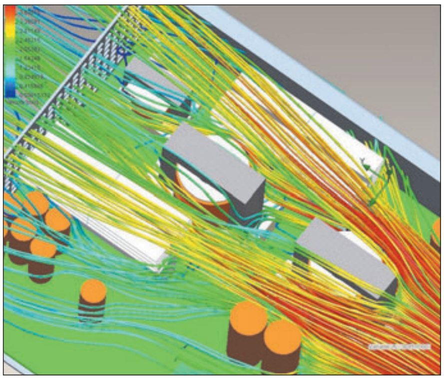

Figure 2. Flow pattern in appliance without baffle plate

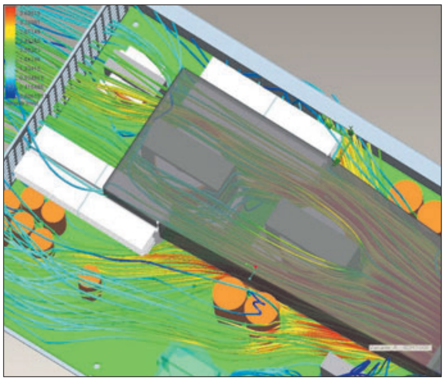

Figure 3: Flow pattern in appliance with baffle plate

actually occurring in practice can be simulated, and allowance made for changes at any time during the development phase. Standard simulations include: flow through and around components, various flow areas with different physical parameters in one model, incompressible and compressible flow of viscous gases, including subsonic, transonic and supersonic flows, relative humidity model, wall roughness, and wall-glide model. Furthermore, the standard simulation features: rotating parts (rotors, stators), centrifugal and Coriolis forces, heat exchange with solids, thermal conduction and convection, forced, free or mixed convection, surface radiation, solar radiation, radiation exchange with the surroundings, time-dependent flow and temperature field calculations, and compact models for heat sinks with fan.

The advantages and effective use of simulation software can be demonstrated by examining a 1000-watt power supply from the SPH1013 series. The inner workings of the power supply considered by the simulation include heat sinks, power semiconductors, capacitors and inductance. Forced cooling of the assembly occurs via a fan mounted directly on the air intake plate. The power supply is mounted on the DIN rail with the long side of the housing in a vertical position. The fan sucks in air from underneath the appliance, passing it through and then out of the housing. An outlet is provided in the form of a ventilation grille on the upper side of the power supply. Figure 2 shows the flow pattern inside the appliance which occurs in the absence of any air-conducting measures. It can be clearly seen that a large part of the air flows away over the two heat sinks. By inserting an air baffle plate (figure 3), cooling of the heat sinks is significantly improved. This is achieved as a result of directing the airflow specifically at the heat sinks towards the integrated circuit card. The increased volume flow allows more power loss to be dissipated in the relevant components. ■