Heat Dissipation Through Air Cooling

Reliable heat dissipation is an absolute must for modern high-performance electronics. Discrete power electronics or computer components, such as those in servers, are composed of many individual heat sources. Each component part has a different waste heat flow, for which dissipation is necessary. Particularly when the waste heat flow fluctuates greatly (standby/full load), uniform cooling of all components is difficult. Previously, this required large fans that required a substantial amount of space.

Heat dissipation through air cooling is a complicated subject. Many individual "secondary conditions", such as the type of flow (turbulent or laminar), pressure drop due to cooling ducts or fixtures in the cooling air flow (filter, upstream components), etc., make cooling using a central air supply difficult. Using a fan installed directly on site,
many of the usual resistances in cooling operation can be bypassed. An individual fan with highly variable output for each subassembly or device specifically adapts the air volume to the local heat and air flow.

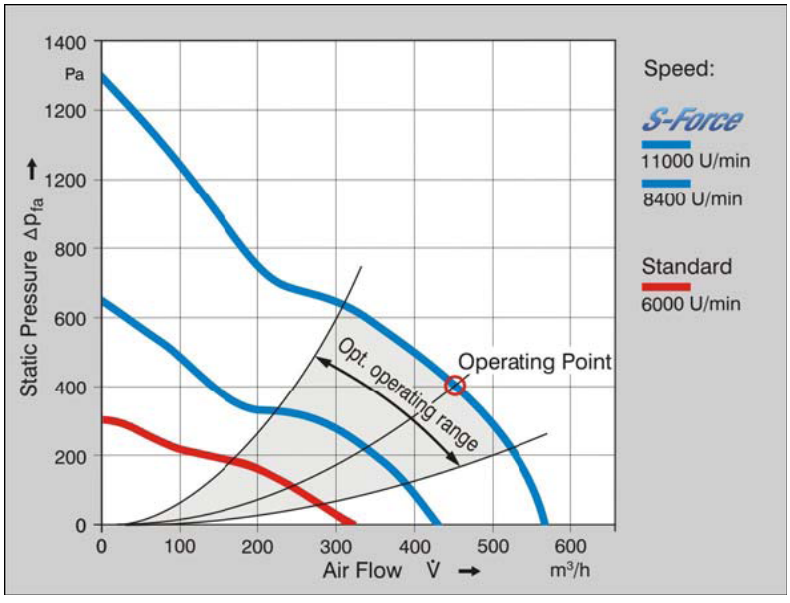
Solution:
With this fact in mind, ebm-papst developed a completely new generation of fans. The S-Force fans stand for targeted high-performance cooling where necessary and a wide air flow bandwidth for standby or normal operation.

The new cooling concept replaces the previous philosophy of "large air flow = large fan" with small fans with variable speed. Previously, fixtures in servers or industrial equipment, such as welding inverters, frequency inverters, brake resistors or outdoor equipment in the telecommunications area, were supplied by central fans regardless of their actual amount of heat. Today, the components are cooled by individual fans or upstream fan trays. With their wide air flow bandwidth, the new S-Force high-performance fans meet the requirements for a discontinuous heat flow. If short or long-term peak heat levels, the fans increase the cooling air flow accordingly. This provides targeted dissipation of enormous amounts of energy in a small space. The greatest advantage of this is that despite their much higher blower output, the new fans are very compact. The advantage of today's electronic components - their high power density per unit of volume - is not defeated by a voluminous air flow.

Compact high performance -- Achieving the objective of high performance in a standard size requires substantial improvements in the fan design. In the foreground are motor technology, aerodynamics and electronics—three components without which it would be impossible to obtain the desired air flow bandwidth. Thus all mechanical parts of the fan generation have been newly developed from the ground up and adapted to the more stringent requirements. Five sizes are available, with diameters from 80 x 80 mm to 172 mm and air performance from 190 to 950 m^3/h (free-flowing), with pressure build-up of up to 1200 Pa. Even before each prototype was designed, computer simulations ensured precise calculation of the critical parameters. Then, all components of the fan were tested on the test rig at nominal speeds of up to 14,000 rpm. Particular attention was paid to the design of the impellers and blade profiles and the venturi housing. A connection and shape of the fixed links between the motor and housing improved the strength of the entire fan.

The ball bearings, which are specially designed for high speeds, make a critical contribution to the excellent service life of the new fans. Additional reinforcements on the housing minimize the physical structure-borne noise excitation at maximum speeds. To provide the necessary drive energy at the new impellers, the fans are also equipped with 3-phase multipole motors, which likewise have been newly developed. Their 6, 8, 10 or 12-pole magnetized rotor units, together with the 9-slot stator pack, provide significant optimization of the magnetic circuit. Therefore, depending on the design, the new motor attains peak power of over 300 W. This means a performance increase of about 500% compared to the predecessor models. Here, too, reliability is of the utmost importance.

Because extremely high speeds and temperatures can also cause increased wear, ebm-papst has equipped the motors with speed-dependent, targeted self-ventilation. Every detail of the inside air flow of the motor is adapted to the stringent requirements Thus despite the higher speed, these fans easily attain the same long service life of previous standard types. Electronically commutated drives always have an edge when it comes to service life, energy savings or power output of fans. Likewise, in the control center of the S-Force fans, all settings are adapted to the new requirements. Instead of steep switching flanks, a "soft" commutation decreases structure-borne noise excitation; speed monitoring and closed loop speed control allow constant air flow with minimal energy consumption. The integrated operation monitoring and microprocessor-controlled motor management for software-controlled fan operation allow optimum individual integration of the fans into a comprehensive cooling concept, even for the largest computer systems. Modern electronics and sophisticated aerodynamics, in conjunction with housing and bearing rigidity improved by computer simulation and new materials, enable completely new high-performance fans to be manufactured with remarkable air performance and pressure values. They enable efficient cooling of tightly packed electronics components, thus drastically reducing the space required for cooling. The more compact dimensions and higher reliability mean less space required, for example in server rooms, and better handling for inverter welding units and thus more economical work.



Summary:

The cooling of high-performance electronic components, such as those in servers, TCA systems, telecommunication devices, welding inverters and many other industrial applications, was previously associated with considerable space requirements. Now, a new cooling concept using high-performance fans provides significant improvement in this area. The compact fan dimensions accommodate the

increased power density of the electronic components. Devices with high waste heat flow are significantly more compact than before. The new S-Force fans from ebm-papst St. Georgen can manage even the highest heat flows with their extreme blower output up to 950 m^3/h and a pressure build-up of up to 1200 Pascals. At full load (approx. 14,000 rpm) and as required, the new fans provide up to 100% more output than the predecessor model, but work with a significantly wider air flow bandwidth than previous ones. Their intelligent motor features allow them to be individually adapted to every application, and they can always provide optimum cooling to an extremely wide variety of devices and systems. Because the standard dimensions of previous fans have been kept, converting, upgrading or retrofitting is easy. S-Force fans are available in the standard square dimensions of 80, 92, 120 and 140 mm and with a round housing in 172 mm. The drives are designed for operation on 24 and 48-volt direct current (in some cases, also 12-volts) and feature reverse polarity and overload protection. Optionally, the motors can be equipped with a wide variety of control and monitoring functions, including speed monitoring, alarm signal, open loop speed control via PWM, control voltage or integrated or external temperature sensor.