Fan Technology Advances To Meet Today's System Demands

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Cooling devices are constantly evolving, and while fans appear to be a simple technology, they are not what they were six months ago. AC and DC fans are continuously being enhanced to include additional capabilities and more precise specifications — such as increased control and higher airflow — to meet a number of application-specific needs in the telecom, datacom, industrial equipment, and even medical arenas. Higher performance specifications, specialized functions and reduced sizes are just a few of the areas in which manufacturers are placing greater demands on fan technologies.

Higher Performance Specifications

Because of their increased use as a thermal management solution in a myriad of applications, fans need to move a greater amount of air to reduce the overall temperature of the end unit. Computer processors, for example, are running at higher speeds than ever before, and their packages are denser to meet the growing demand for small devices. Thus, thermal management of electronics has become an extremely critical design challenge. By increasing the airflow of the fan measured in CFM (cubic feet per minute), more air is circulated through the enclosure, keeping the electronics within the device below the threshold temperature. To meet today's requirements, many applications need dramatically increased airflow, which is challenging fan suppliers. Some fan manufacturers, such as Orion Fans, have responded with various fan models that provide airflow in excess of 1100 CFM to meet these demands.

Image: Orion Fans' OA254 AC and OD254 DC fans feature CFMs to 850 and 900, respectively

In order to operate at their maximum potential, electronics must be kept at an optimum operating temperature so they do not overheat. In addition to increased

airflow, there is also a growing requirement for fans capable of operation in extremely high static pressure environments (that is, a measure of the differential air pressure inside the enclosure versus outside the enclosure), such as within telecom networking enclosures and industrial cabinets. Maintaining airflow within an increased static pressure stabilizes the temperature, allowing the electronics to operate at maximum capacity.

Despite the increased airflow provided by high CFM fans, some applications, such as densely packed industrial enclosures, often require additional cooling to maintain optimum temperature in specified areas within the cabinet. The use of enhanced "spot cooling" fans increases airflow to specific "hot spots" within the enclosure, and are often supplied with a standard AC power cord and plug, providing enclosure manufacturers the ability to add them anywhere within their cabinets. Such "spot cooling" fans allow manufacturers to quickly and efficiently solve an elevated temperature problem – especially one that is discovered after the enclosure is already built and being tested –2 without a costly redesign, or even the need for rewiring to add a fan, as most AC spot coolers simply require an outlet to plug in.

Increased Functionality

While higher performance specifications are a frequent requirement for many fans, so too is the functionality of the fan itself. Not only do manufacturers want to have more control over the fan's capabilities, but energy efficiency and "green" considerations are also recurring trends. To meet these demands, fan manufacturers are implementing specialized functional controls in their fans such as tachometer output, locked rotor alarm, pulse width modulation (PWM) input, and thermal and constant speed controls.

Tachometer output provides design engineers with an accurate means of monitoring and reporting a fan's rotational speed, as well as triggering of an alarm or indicator if the fan's speed falls below a certain RPM, both of which help to monitor fan performance and maintain optimal thermal conditions in the system. Often, the tachometer output option is available as either a standard 5V TTL signal, or as an "open collector" signal.

Locked rotor alarms detect whether a fan is running or has stopped by generating and transmitting a high or low output signal, minimizing fan downtime and thus avoiding an overheating situation. This minimizes the possibility of system/application failure due to the electronic components within the system exceeding the specified temperature threshold.

PWM input varies the width of the electrical pulse in order to control the average voltage delivered to the fan, allowing for a higher efficiency than linear control provides. The PWM option also allows users to digitally control the speed of the fan by varying the electric pulse running to it. Also, the constant speed function senses variable input voltage, which causes variations in power output and maintains the fan's constant speed regardless of input voltage fluctuations.

Finally, thermal speed control employs a thermistor-controlled circuit that increases fan speed only when the temperature rises above a determined set-point, thus reducing overall energy consumption by lowering fan speed when temperatures within the enclosure are below the set-point. By controlling the fan so it only turns on when the temperature exceeds a specified point, energy is conserved, thus providing a "green" option by cooling only when necessary. Thermistor control circuits can be mounted directly in the fan hub or remotely mounted via a lead wire, and can be positioned anywhere within the enclosure, giving design engineers the flexibility to regulate fan speed based on ambient temperature in a specific area.

Image: This high performance vane-axial DC fan (OD1238) from Orion Fans can be equipped with all the special functions described above for increased functionality in telecom, industrial and medical imaging equipment

Smaller Sizes

Because fans are being specified as the primary means of thermal management in a variety of space-constrained applications such as cooling fuel cells in hybrid electric vehicles, 3battery powered products and datacom equipment, fan designs are trending towards much smaller frame structures. 25mm fans are becoming increasingly popular, as they meet the needs of extremely low-profile and thin 1U rack systems. Directional blowers are also being employed as these low-profile devices provide directional cooling similar to spot coolers but in flat, compact designs. Even in larger applications such as server rooms, direction blowers are utilized in applications where rather than blasting air out of the back of the device, the requirement is to direct the air in smaller, more controlled directions, such as up, down or diagonally. Along with meeting the space and directional requirements of various applications, blowers can also provide the speed and airflow necessary to optimize thermal management.

Fan technologies today are capable of optimizing cooling needs in a number of applications, allowing electronics to perform at peak specifications. From reduced sizes to enhanced capabilities and increased specifications, fans will continue to

evolve and be specified in more and more applications as the primary means of thermal management.