Press News

Fans with integrated control and monitoring:

Intelligent equipment cooling – the right dose of air

The perfect conversion of energy is the dream of all inventors and developers yet in reality it will always remain impossible. Energy loss will always occur, in most cases as waste heat. This must be discharged, e.g. to prevent sensitive electronics against destruction due to overheating. If normal convection does not suffice for cooling purposes, fans are required. The increasing miniaturization of electronic components and higher concentration of power together with EMC-compatible shielded housings or switch cabinets often creates difficult boundary conditions. Standard fans are millionfold tried and tested yet in many cases they only present a stopgap because with a constant speed and correspondingly high noise level, they continuously generate the airflow that is actually only required in extremely rare cases.

The definition of what an equipment fan is expected to accomplish is frequently based on the conditions that are to be expected in the worst case, in other words from the maximum possible dissipated heat, an extremely high ambient temperature and thermal conduction properties that develop after a longer period of operation in the device. This high fan performance, however, is actually only necessary under these extreme conditions. For many operating phases a considerably lower airflow rate would suffice, e.g. for lower ambient temperatures or when devices are only operated with partial load. „Intelligent“ fans are therefore, a field proven solution that adapt automatically to the corresponding cooling requirements. With this type of temperature-dependent fan control, the speed drops when the thermal load is low and in turn the noise emission. It is also easy to integrate speed-controlled fans in the overall configuration. Programmable cooling, cooling on request and dialog ability are further important catchwords.

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Temperature-dependent speed control with DC fans

Compared with AC drives, it is relatively easy to realize an appropriate control for electronically commutated DC motors. In the simplest of cases, one requires only a few additional components or uses integrated switching circuits for commutation that simultaneously set the speed depending on the temperature.

Thanks to modern SMD technology, the control electronics required for this purpose are space savingly installed together with the power circuit and logic circuit of the drive on a PCB in the fan hub. A temperature sensor provides it with the required thermal information. This NTC sensor can be attached either directly to the fan hub in the airflow or externally at a random position (Fig.1). In the first case, a mean temperature of the air flowing through the fan is measured, in the second case, a special temperature in the device, e.g. inside a critical zone. This principle enables a wide range of possibilities:
The control range thus changes according to the characteristics of the sensor that is being used. Due to the different combinations of series or parallel resistors, the steepness and the origin of the temperature/speed curve can also be varied. Manual speed control can also be realized via a fixed resistor or a potentiometer. Fig. 2 illustrates the typical final device controlling characteristics and the range limit of a speed-controlled fan manufactured by the ebm-papst fan specialist. At low temperatures, the speed can be reduced by 50 % and the noise level by up to 1.5 Bel or 15 dB (A).

Integration in the device logic: Control input and tacho output

These "intelligent" fans that are available today in many standard dimensions are capable of much more: They can be connected directly, for example, to devices that already have standard interfaces for speed variation via a separate control input. Thus cooling systems can be realized that are integrated in the device logic: The fan speed can then be set e.g. via a low voltage interface or via a pulse-width modulated signal. The speed characteristic over the entire modulation range is virtually linear.

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This means, of course, that the speed of the fans must be monitored in many cases. For this purpose, a sensor integrated in the electronics generates speed-proportional rectangular pulses (Fig. 3 a,b). In order to monitor the fan speed, the commutation signals of the motor that are required anyway for creating the rotating field can also be used. In both cases, the tacho signal is available either at an open collector output, galvanically isolated or TTL-compatible. This means e.g. that the speed of the fan can be monitored in the computer or controlled externally.

Alarm signal in the event of a critical operating state

Apart from speed monitoring, different alarm options can also be realized with DC fans. Corresponding versions emit a directly usable static or dynamic alarm signal: Numerous options enable optimum adaptation to the application: E.g. either high or low signals can indicate fault-free operation, or that a defined limit speed has not been reached. For collective messages of several fans, the alarm circuit with open collector output presents an interesting option. Integrated signal storage enables the subsequent identification of short-term faults. Maximum demands on the device reliability are fulfilled by the alarm circuit that is galvanically isolated from the power circuit and last but not least the fans can also generate the alarm message as a TTL-compatible signal.

Programmable fans: Perfect adaptation to the application

The ebm-papst Vario-Pro® series (Fig. 4) represents a fan concept that is a symbiosis of all these possibilities and can be adapted to the special performance requirements of the application. Tailor-made software configuration instead of installed (fixed) hardware ensure the special configuration of the fan motor. With these fans, the user describes the desired characteristics and the internal electronics are then programmed accordingly by the manufacturer. A microprocessor in the fan monitors all the set values so that temperature-dependent speed profiles with many freely selectable interpolation points, external speed settings and a wide range of combinable alarm and tacho functions can be realized. Due to digital motor management, control accuracy is high whereas the power input and the operating temperature are reduced and the service life prolonged. Thanks to this multitude of functions, modern fans today enable "intelligent" cooling systems with performance ratings that meet exactly the requirements in question (Fig. 5). This guarantees for every single application maximum reliability, low energy consumption and low noise development.

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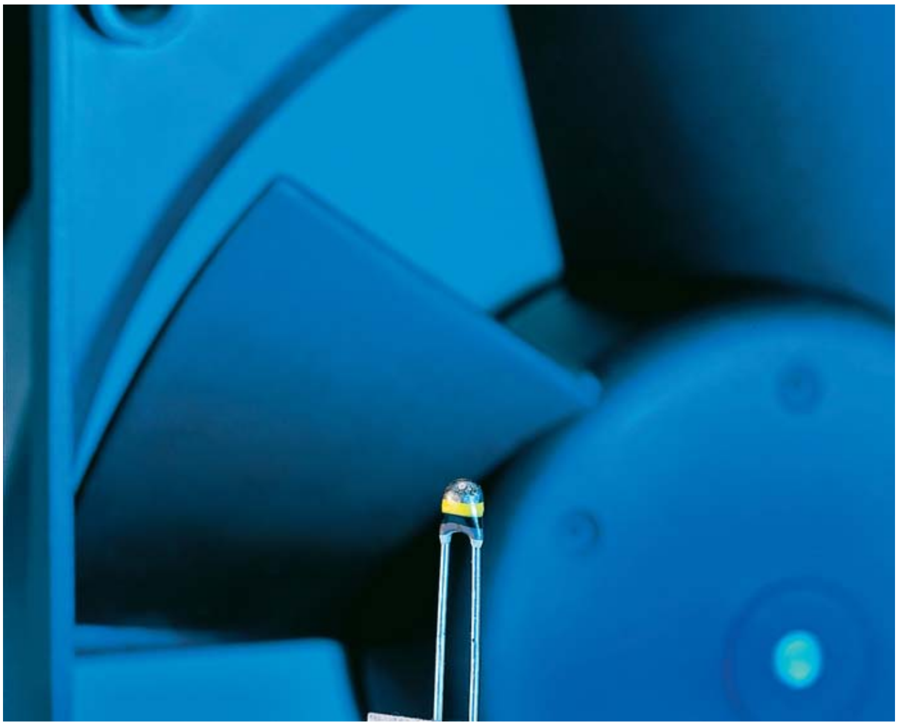

Fig. 1: Fan type VARIOFAN with external NTC sensor

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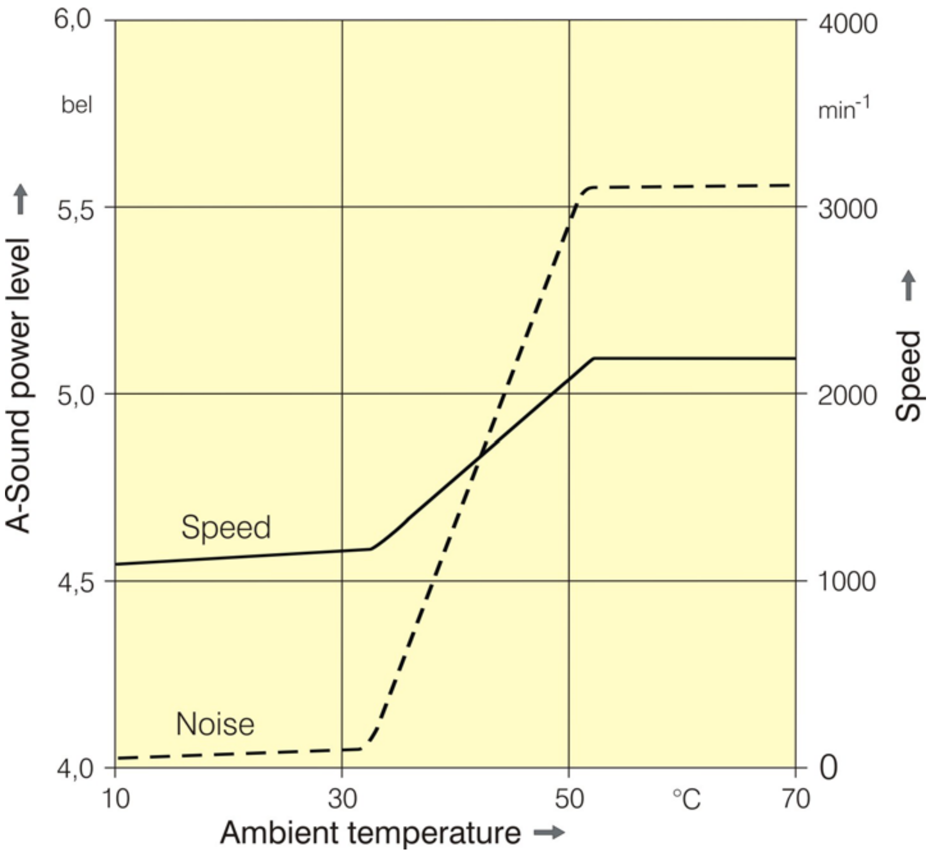

Fig. 2: Control response of a VARIOFAN

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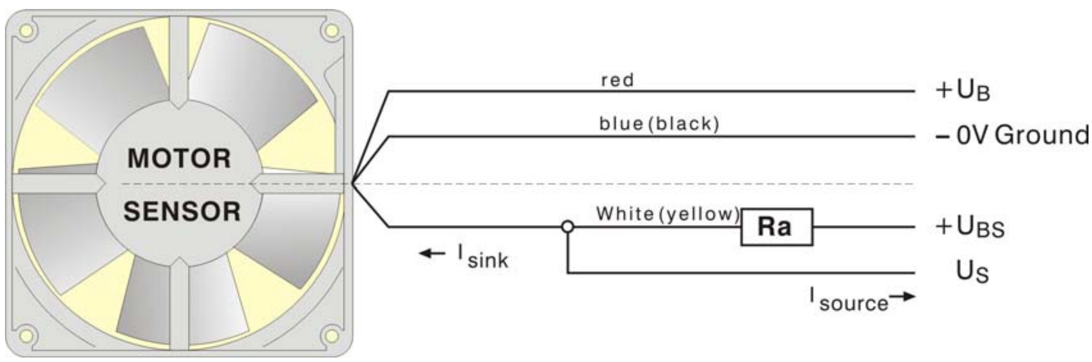

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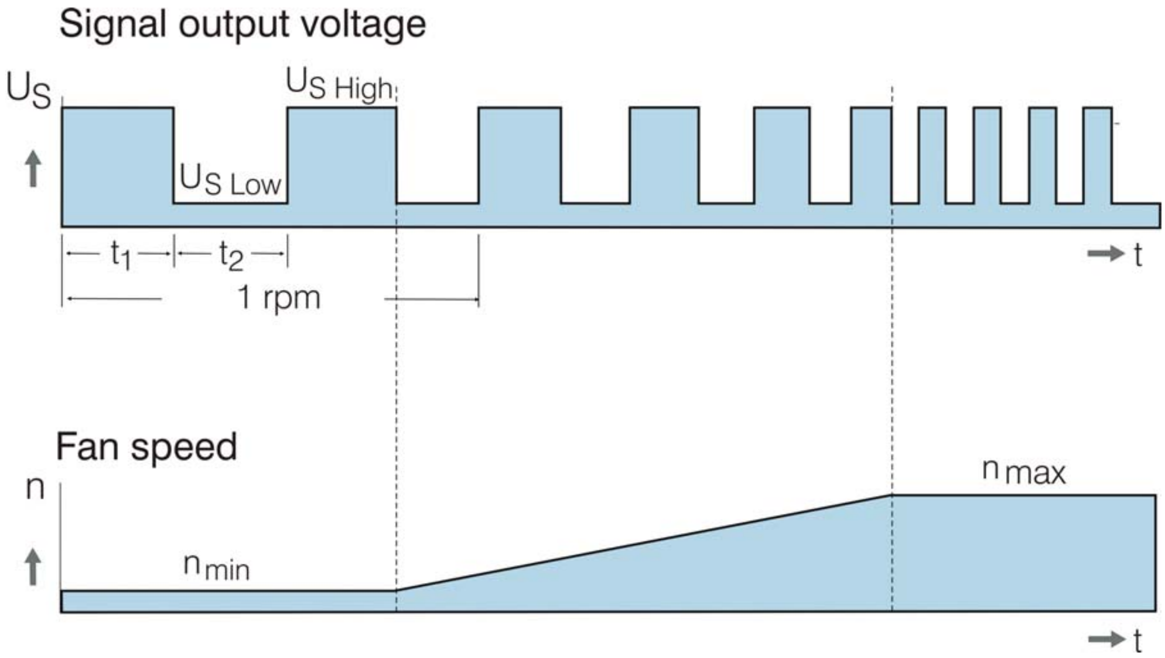

Fig. 3a u. b: Diagram of a fan (a) with sensor signal for speed monitoring (b)

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Fig. 4: Programmable fan with integrated microprocessor

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Fig. 5: Intelligent cooling system in an outdoor UMTS basis station

Text and photos/graphics can be found on the CD supplied.

Print-offs are available from ebm-papst St. Georgen on request.

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