

Rangehood Efficiency Improvements And Additional Functionality With Inverter Technology

Increasing energy costs and environmental awareness due to the serious consequences of global warming are accelerating the introduction of energy labels that inform consumers about the energy efficiency of the major energy consuming home appliances (washing & drying machines, refrigerators, dishwashers etc.) as well as of other appliances such as vacuum cleaners, rangehoods etc. We can also expect EN norms that will require significantly higher efficiency levels as compared to those that the appliances feature today.

Mr. Vojko Blažič, head of motor controls R&D group, ATech elektronika d.o.o., Slovenia

Mr. Gregor Franič, marketing director, ATech elektronika d.o.o., Slovenia

This article is focused on the presently available technologies for the improvement of the efficiency of the rangehood as well as on the many additional functions these new technologies offer.

Present Rangehood Technology

Rangehoods are available in almost every imaginable shape and colour, from basic to high-end, often also with cooktop illumination units. Usually, the user can select from among three levels, while the entry level products are a fixed power type. The high-end products typically have more sophisticated user interfaces such as capacitive keyboards and even displays indicating the weather forecast.

However, the basic function – air aspiration or filtering – uses two motor technologies, Shaded Pole AC (SPAC) motors and Permanent Split Capacitor (PSC) motors.

These are very low cost motor types with 2 major drawbacks: very low efficiency (SPAC motor typically less than 60%) and fixed or step speed levels. The actual technical solution for variable speed is to use a PSC motor with a special winding for each speed/power level (see table 1). A technical solution for stepless speed regulation would be to have a phase control drive with a PSC motor that was sometimes used in the past, but is very problematic in terms of efficiency (only around 30%), noise and especially in terms of Electromagnetic Compatibility (EMC).

Improvements on Existing Motor Technology

Improvements of the Shaded Pole AC (SPAC) motor and Permanent Split Capacitor (PSC) motor performance are possible by the use of an inverter. The inverter changes the frequency and voltage supplied to the motor thus allowing very precise and silent speed regulation without sacrificing the efficiency. Depending on the motor, the efficiency improvements may vary (see table 1).

As a specialist in electronic motor controls for home & professional appliances, ATech has expanded

all data at nominal speed	SPAC	PSC	3-ph ACIM	BLDC	PMAC
efficiency without inverter	<60%	<70%	N/A	N/A	N/A
efficiency with phase control speed regulation	30%	35%	N/A	N/A	N/A
efficiency with inverter	<60%	<70%	85%	>90%	>90%
noise level	0	0	++	+	++

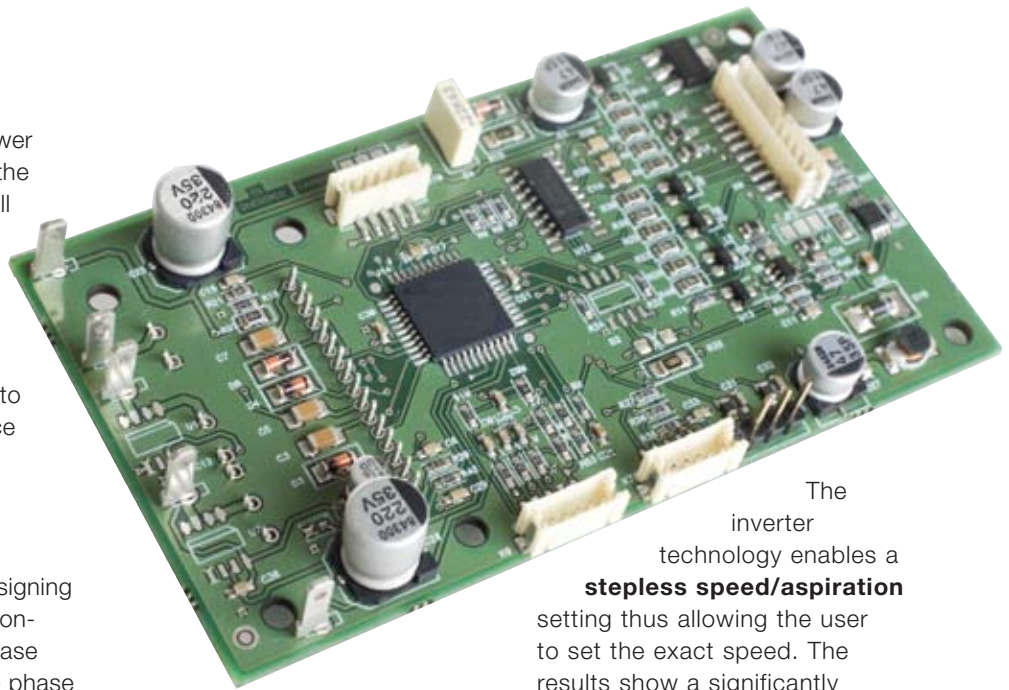
Table 1.

its INVERTERS' range to lower power levels thus covering the power range of practically all the rangehoods available on the market today. These inverters come in power ranges of 150W to 300W. There is another product for applications up to 60W also targeting residence ventilation.

This product family takes advantage of the extensive experience ATech has in designing and manufacturing application-specific electronics for 3-phase AC-induction motors, single phase induction motors and Brushless motors (both DC-trapezoidal and AC sinusoidal).

At first sight, an inverter – sophisticated technology regarded as expensive – may seem to be too much for a rangehood. However, in order to meet the challenging cost target (a key characteristic of a rangehood inverter), ATech designed the product around a very cost-effective microcontroller and applied a proprietary technology for the power part.

From the practical point of view, the inverter is an addition to the wiring of the hood. Due to its limited size of approximately 50 cubic centimetres, it is easy to find an area to install the electronic board. The existing serial communication is easily connected to more sophisticated user interfaces of high-end products. As the technology is sensorless, there is no need to change anything on the motor.



The inverter technology enables a **stepless speed/aspiration**

setting thus allowing the user to set the exact speed. The results show a significantly improved user experience as this overcomes the most typical dilemma of the few preset speed levels on the majority of today's rangehoods – to choose between a too noisy setting with excessive aspiration or a noise acceptable setting not providing enough aspiration.

ATech's inverters are being used mostly in combination with PSC motors present in mid- and high-end products. The use of the inverter allows the rangehood manufacturer to use a **single winding motor**, which, in practice, means the use of **more economical motors** in comparison with commonly used 3-winding motors.

The advanced driving algorithm also allows the accurate monitoring of the motor performance, which allows implementing advanced status **detection**. The inverter senses changes in motor load and elaborate this data to identify

Consequently, **the application of the inverter on an existing product** does not bring any major design or purchasing changes to the product.

Performances of systems using inverters are predominantly influenced by the motor design. It must be pointed out, however, that the improvements made possible by the use of the inverter are limited, especially if the manufacturing level and the motor design are poor.

Additional Benefits

In addition to efficiency, the use of the inverter on Shaded Pole AC (SPAC) motors and Permanent Split Capacitor (PSC) motors has other advantages, as well. The use of the inverter can provide **nominal aspiration increase** using the same motor as the FIELD WEAKENING principle allows the motor speed to increase over its nominal speed.

it as a transition effect or a **full filter, dust obstruction** and even an **unbalanced fan**.

The computing power of the inverter electronics is also able to **integrate the logic** for the most **sophisticated user interfaces** and other features such as remote control and **smoke/fumes sensing**. ATech has extensive know-how in various user interfaces, from **»ONE-TOUCH« technology** and **capacitive keyboards** to **RADIO FREQUENCY** and **infrared remote controls**, or devices connected via **ZigBee**. The product can also integrate a proprietary, **cost-effective smoke and fumes detection for automatic operation function**.

Improvements Possible by Other Motor Technologies

The inverter technology practically allows the use of a 3-phase motor on the single phase mains supply. This widens a range of motor technology possibilities, from low cost 3-phase AC induction motors to Brushless DC and Permanent Magnet AC motors.

All these motors feature significant improvements in efficiency, while the 3-phase AC and Permanent Magnet AC motors also feature lower noise levels (see table 1).

Summary

In order to increase the efficiency of most popular rangehood types there is no need for major design changes. The addition of a compact

size inverter in the wiring of the rangehood, with no changes to the motor whatsoever, is fast and easy and allows several additional features: stepless speed selection, speed increase, advanced status sensing, and many others. ATech's inverter products for rangehoods are universal and the performance fine-tuning is performed at ATech laboratories.

Further improvements are possible by changing the motor technology to BLDC, 3-phase AC induction motor or Permanent Magnet Alternating Current (PMAC) motor for the lowest noise.

ATech has considerable know-how in integrating user interfaces, smoke and fumes detection and various remote control functions.

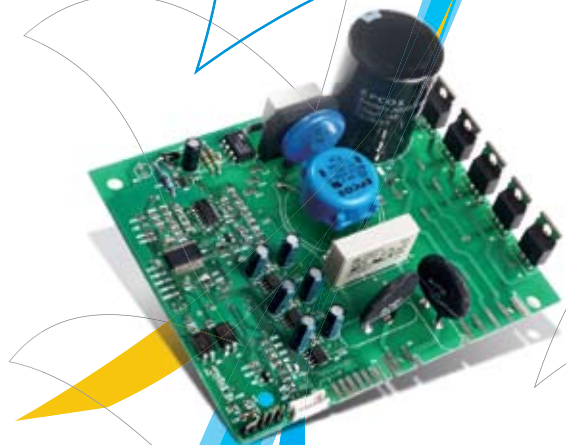
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ATech elektronika d.o.o., Bač pri Materiji 30, SI – 6242 Materija, Slovenia, T: +386 5 6800 000, F: +386 5 6874 244, info@atech.si, www.atech.si