

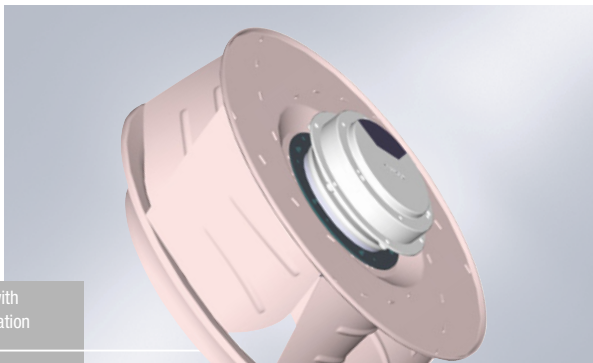
From mere dwarf to a giant of a fan

1. Introduction

By now, it has become almost second nature for most people to go soft on and save natural resources. This is why companies, too, should face up to their obligation to make their products contribute actively to environmental care. As huge numbers of fans are to be found in the most



modern DC motor with electronic commutation



varied of applications, there is an enormous potential for saving energy here. Unfortunately, this potential is still not being tapped fully, despite the fact that the simple use of electronics offers this possibility. Nevertheless, the solutions known so far are flawed by three disadvantages: significantly higher costs than conventional solutions, electronics that appear to be complicated and have to be connected separately, plus rather an unsatisfactory noise behaviour.

Against this background, ebm-papst as market leader in motors and fans has taken up the challenge and now sup-

plies the market with a complete line of innovative fans that can be connected directly to the mains and which substantially and positively differs from current solutions both in technical and economic terms.

2. Advantages of EC technology for fan applications

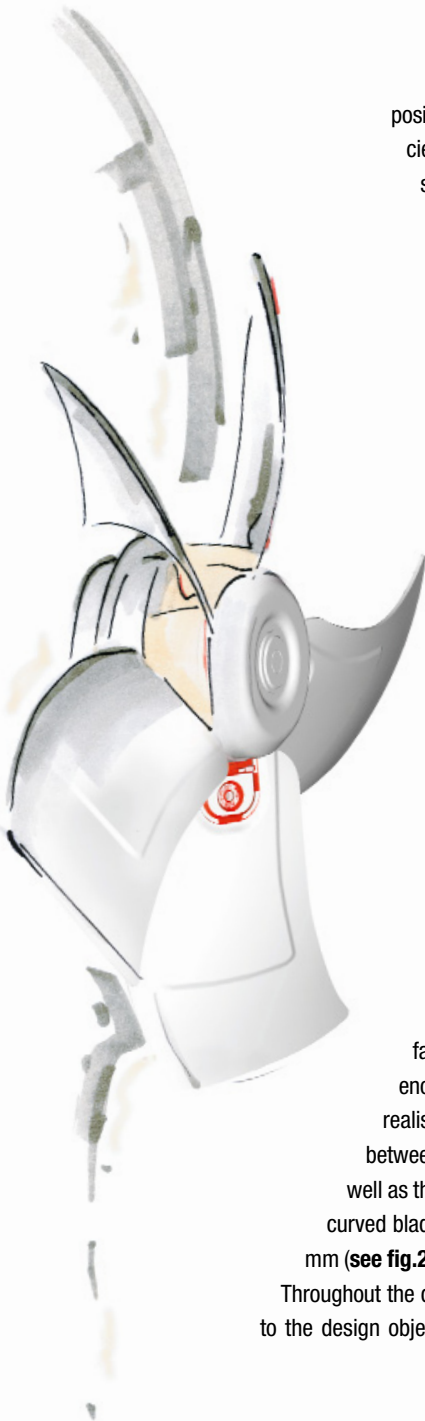
Using a classic asynchronous motor is still justified in many applications. However, when used as fan drive, there are quite a few shortcomings to consider, among them:

- Maximal efficiency of less than 75%, which can, moreover, only be achieved within a narrowly defined speed range.
- In order to realise different speeds, designs with different numbers of pairs of poles are required, and thus there is an ever bigger variance.
- Different motors or motor designs are needed for operations at 50 Hz or 60 Hz.
- In order to change speeds, additional components (star-delta transformer, triac control, frequency converter) are needed that result in higher costs, require more space, cause additional losses and lead to higher noise emission.
- A fan is suited for only one optimal operating point for which it has to be designed precisely – and so the number of variants goes up once more!

These disadvantages can be avoided with motors in EC technology in the power range of up to 3 kW, which shall be dealt with here.

EC motors are synchronous motors excited by permanent magnets and with phase currents being converted by an electronics in dependence from the rotor





position. This principle allows to reach efficiencies of up to 90% across a very wide speed range – and this with the losses caused by the electronics already being taken into account! As the electronics makes it possible to operate the motors at different speeds, there is no longer any need to supply variants with different numbers of pole pairs. This reduces the number of variants for both manufacturer and customers. Their controllability also makes sure that optimal operating points can be set exactly; moreover, the comfortable open and closed loop control possibilities do in no way have a negative impact on acoustics, efficiency or system costs!

3. New fan lines

During the past three years, ebmpapst Mulfingen has consistently developed an entire line of EC motors. This line consists of motors in four sizes, from 100 W to 3 KW. Each size is available in two or three face-to-face dimensions and is thus graded fine enough. These motor variants suffice to realise the line of axial fans with diameters between 250 mm and 1,000 mm (see fig. 1), as well as the line of centrifugal fans with backward curved blades and diameters from 250 mm to 630 mm (see fig.2).

Throughout the development, special attention was paid to the design objective of getting groups of components

properly separated. This then made it possible to manufacture the groups of components at different locations, and it also ensured safe and economical assembly. The new motor design also comes in protection type IP54 without requiring any additional efforts. These EC fans are simple to install: they are fully compatible with and can be used like 3-phase fans – there is no need for additional components. However, the EC fans can also be controlled via linear or BUS interfaces.

4. Potential for saving energy and costs

The power input of an axial fan in EC technology is compared to that of an axial 3-phase fan in figure 3, with three different control modes used. In the maximum air flow range, the EC motor requires 15% less power input than the 3-phase motor, which is due to its better efficiency. When it comes to lower air flow values, especially in the partial load range, then the advantage of the EC technology get even more pronounced. This is simply due to the fact that the EC motor has a high efficiency across a wide speed range, whereas the efficiency of the 3-phase motor quickly drops with decreasing speed. Power input in the partial load range is more than 50% lower than what the 3-phase motor requires. Based on an average annual operation time of 4,000 h/a and the power saving according to fig. 3, the annual saving in

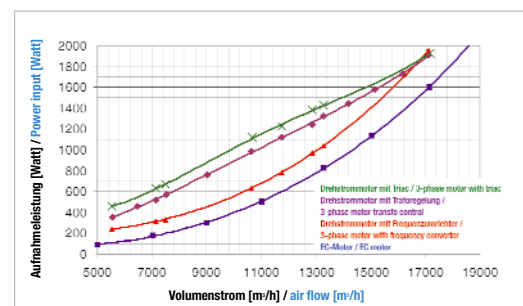


Fig. 3: Comparison in power input between axial fan in EC technology and axial fan in 3-phase technology in the partial load range.

„Installing the EC fans is absolutely simple ...“





				
Motor type	M3G074	M3G084	M3G112	M3G150
Impeller Ø [mm]	300 250	450 400 350	630 560 500 450	1000 910 800 710

Fig. 1: New line of energy-saving EC axial fans


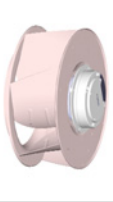
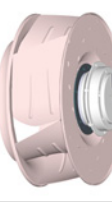

				
Motor type	M3G074	M3G084	M3G112	M3G150
Impeller Ø [mm]	310 280 250	400 355 310	500 450	630 560

Fig. 2: New line of energy-saving EC centrifugal fans

costs by simply using an EC fan can be calculated easily by relying on **fig. 4**.

These enormous savings in operating costs as offered by EC technology have, so far, not been adequately taken into account. Regarding the entire service life, the savings thus gained are substantially higher than the purchasing cost of the EC fan! For operators of plants, the consequence is simple and straightforward: only energy- and cost-saving EC fans should be exclusively used in future. Yet those responsible for setting up a plant were forced, for competitive reasons, to go for speed-variable fans in 3-phase design as EC solutions available up to now have been more expensive than the conventional types. The new ebm-papst line marks the beginning of a

new era: suddenly, purchasing costs of EC solutions are at the same level as the purchasing costs of technically

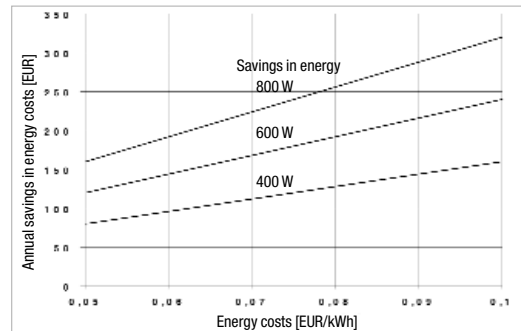


Fig. 4: Saving in operating costs by using EC fans, at an operating time of 4,000 h/a.

comparable 3-phase solutions.

Cost savings that normally do not get considered are to be found on the logistic side of things: EC fans can be operated without any need for modifications on power supplies with different frequency, and the operating point can be set via variable speed. For this reason, it is possible to replace a large variety of 3-phase fans with just one EC fan.

5. Noise behaviour of the new fan lines

Whenever a 3-phase fan is operated with triac control or frequency converter, the noise behaviour in the partial load range gets negatively influenced. This is illustrated in **fig. 5**, and comes as a result of the oscillations in the electro-magnetic fields and deviations in electric conductance which form electro-magnetic harmonics with their resulting power and torque excitations. The fan emits them in the form of air-borne or structure-borne noise.

So far, and from an acoustic point of view, the most harmless case has been operating a 3-phase fan with a transformer. The same positive noise behaviour can now be

From mere dwarf to a giant of a fan –
Saving energy with a new line of speed-variable fans

achieved with EC fans, with phases and their time sequence being impressed in a suitable way.

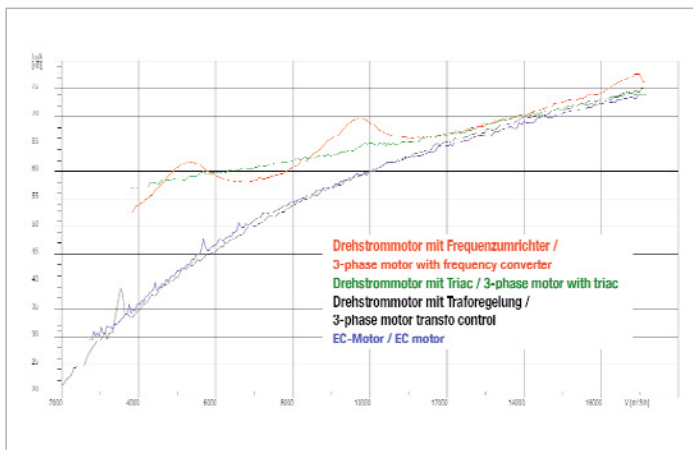


Fig. 5: Comparison of noise behaviour between axial fans in 3-phase technology and an axial fan in EC technology.

6. Summary

With this newly developed and complete line of ebmpapst external-rotor motors in EC technology with integrated electronics, there is an intelligent and compact alternative for speed-variable fans a wide market can make use of. The new lines offer a substantial potential for saving energy, with the purchasing costs paying off quickly, as operating costs can be reduced significantly. Compared to axial fans with speed-variable 3-phase motors, the new EC fans do not generate higher motor noise in controlled operation.



Dr.-Ing. Thomas Bertolini
Executive Technical Director
ebm-papst Mulfingen GmbH & Co. KG