

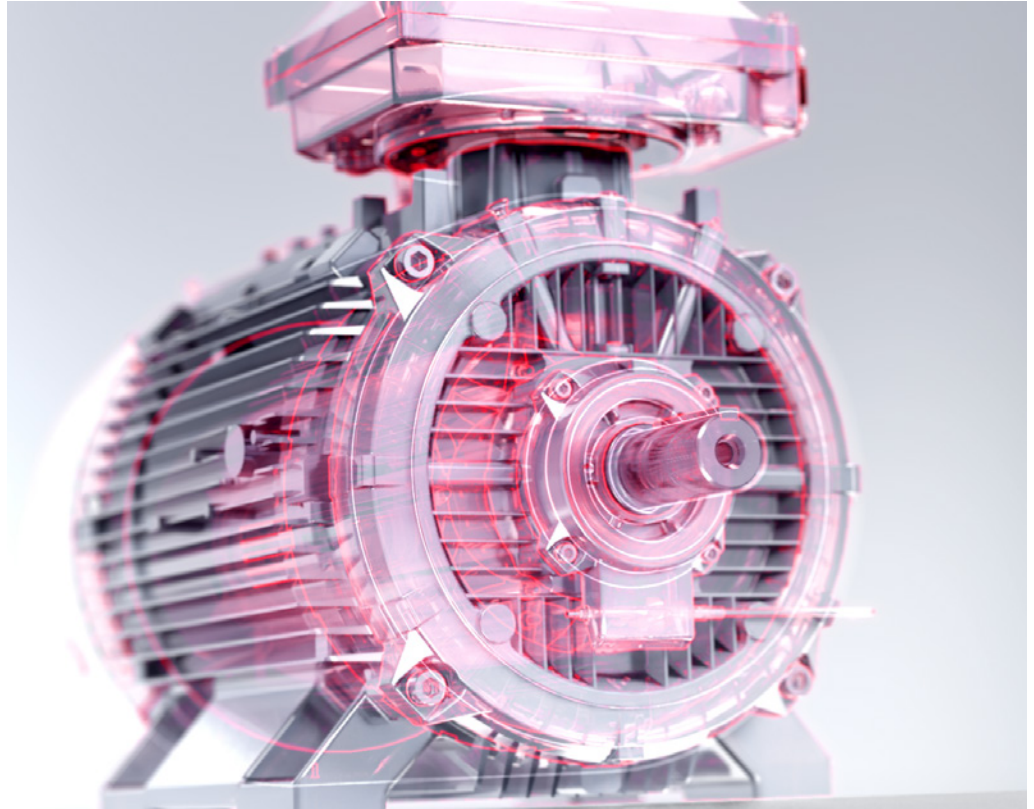
Why you should upgrade to IE5 ultra-premium motor efficiency

Upgrading to a package that combines a synchronous reluctance motor (SynRM) with an IE5 ultra-premium efficiency rating and a variable speed drive (VSD) not only saves on energy and maintenance costs, but improves productivity and answers sustainability concerns – Tero Helpio of ABB Motion explains.

While electric motors keep the world turning safely and reliably, there is a price to pay in terms of energy consumption and associated CO2 emissions. Around 70 percent of all electricity used by industry is consumed by electric motor systems.

The EU Ecodesign Regulation addresses this for low-voltage motors by establishing and enforcing International Efficiency (IE) classes defined by the International Electrotechnical Commission (IEC). From July 2021, it sets IE3 as the minimum standard, including motors used with VSDs. There is also the IE5 ultra-premium rating that goes well beyond the EU Ecodesign regulation, but some manufacturers are already supplying motors compliant with it. Industrial operators can upgrade now and enjoy practical and economic advantages – as well as demonstrating their environmental responsibility.

IE5 SynRM motors can reduce energy losses by 40 percent and significantly lower energy consumption, compared to the commonly used IE3 induction motors. Exact energy savings vary with applications and conditions, but indus-



Synchronous reluctance technology combines the performance of a permanent magnet motor with the simplicity and service-friendliness of an induction motor

trial case studies with SynRM motor and VSD packages have shown typical reductions in energy bills from 14 to 25 percent, compared to the replaced motors.

If 80 percent of today's installed industrial motors were replaced by IE5 units, the estimated annual energy saving would equate to the annual power consumption of Poland. There are also other substantial benefits to be gained from IE5 SynRM motors, including lower maintenance needs, higher reliability, longer equipment life, and better performance.

What is different about a SynRM motor?

From the outside, a SynRM motor looks very much like an induction motor. Inside, the innovative rotor structure is very different, as it has no windings at all. It contains stacked steel plates with intervening spaces that form a light but

robust structure. Furthermore, the rotor does not contain magnets or rare earth metals, unlike other synchronous motors, such as permanent magnet (PM) motors. This contributes to sustainability, as the production of rare earth metals has a serious environmental impact and limited potential for recycling.

The SynRM motor's stator establishes a magnetic flux which the VSD controls and rotates. The rotor, remaining aligned with the rotating flux, is pulled around – and thus, torque is created. Meanwhile, the VSD monitors the rotor's position and keeps it synchronised.

In conventional induction motors, heavy currents flow due to the squirrel cage rotor design and the short circuit formed by its end rings. These currents account for around 40 percent of the motor's energy losses, resulting in the generation of additional heat.

Feature: Motor efficiency



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By contrast, SynRM rotors have no squirrel cages or windings to generate currents and heat, so energy losses are virtually nil. IE5 SynRM technology provides performance comparable to that of permanent magnet motors, but without the environmental costs of rare earth magnets. At the same time, it offers the simple maintenance of an induction motor.

Higher efficiency and more

In addition to their verified IE5 efficiency, cutting energy losses by 20 percent compared to IE4 super-premium motors and by 40 percent compared to IE3, SynRM motors are superior in other ways. They run at cooler temperatures than induction motors, which extends the life of stator windings, bearing lubricants, and the bearings themselves – and reduces the need for cooling of workspaces.

Lower running temperatures and their relatively simple construction make IE5 SynRM motors easier to service and extend their servicing intervals. Risks of failure are smaller and, for extra confidence, the motor and drive's monitoring connections can be used to detect problems.

IE5 SynRM motors are also significantly quieter than traditional induction motors, so working environments are more comfortable.

IE5 SynRM motor and VSD – the perfect package for any application

A SynRM motor is always installed with a VSD to form an optimised package. In the most common motor applications, such as pumps, fans and compressors, a VSD typically saves about 25 percent on energy consumption. This is because the VSD adjusts the motor's speed and torque to match the load, rather than running at full speed all the time.

Currently, a wide range of VSDs is programmed to work with IE5 SynRM motors. Extensive testing has been carried out with ABB's VSDs, which feature the latest purpose-designed software for extremely precise and dynamic control. The versatility and accuracy of both the motor and VSD ensure excellent speed stability, which is often essential to maintain product quality and minimise rejections. Accurate control at low speeds, right down to zero, allows constant maintenance of optimal torque, without tripping. ABB's direct torque control (DTC) precisely governs speed and torque, without speed sensors, encoders, or other feedback devices.

This flexibility and precision enable IE5 SynRM motors to replace standard induction motors in any application. They are highly accurate and efficient across the whole speed range, even with partial loads, and can deliver full torque from zero speed. In addition to providing quadratic torque with high efficiency in machines like pumps, fans and compressors, they can supply constant torque with precise control in demanding applications, such as extruders, mixers, winches, and conveyors.

SynRM technology proven in the field

The performance and efficiency advantages of ABB SynRM and VSD packages have been proven in a variety of case studies. Most recently, Campbell's – famous for products such as soups – implemented a package in a refrigeration compressor at its Shepparton plant in Australia. Along with a 14 percent reduction in energy costs, the company noted reductions in running temperature, vibration, and noise.

Evides Waterbedrijf, a large water business in the Netherlands, has used similar pump and drive packages for vital pumping machinery. The energy saving was estimated at 20 percent, while cooler running was expected to extend motor and bearing life. This was a key factor in the company's decision, as it required a 20-30-year life expectancy from the equipment.

In the plastics sector, Radius Systems replaced a troublesome DC motor on an extrusion line at its Derbyshire plant with a SynRM motor and VSD package. It met all challenges, including the need for a high starting torque, followed by constant torque, and delivered an estimated energy saving of eight to 15 percent. It saves around £2,000 annually on maintenance, and its quiet operation has also been welcomed.

Plastic container manufacturer, PrimePac, had problems with a worn-out hydraulic motor on a blow moulding machine at its plant near Belfast. As well as consuming energy excessively, it was producing poor bottle quality, due to inaccurate speed holding. A SynRM package not only solved those problems, but with an energy saving peaking at 60 percent, it enabled PrimePac to install a new extruder – without having to spend £250,000 on upgrading the site's power supply.

An easy swap and early payback

Replacing an existing induction motor with an IE5 SynRM motor is simple. They have the same dimensions and output power, so there is no need for mechanical modifications to existing setups. The additional cost of specifying an IE5 SynRM and drive package, rather than an IE3 motor and VSD, can have a payback time as short as one year. It's time for industry to consider upgrading motors to the ultra-premium efficiency made possible by IE5 motors with VSD control.

For further information, visit <https://new.abb.com/motors-generators/iec-low-voltage-motors/process-performance-motors/synchronous-reluctance-motors>.



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