ABB DRIVES AND MOTORS

30 top tips to tackle HVAC challenges

No.04 - Synchronous reluctance motors

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Not all motor technology is suitable for HVAC – Why SynRM could be the best choice

Synchronous reluctance motors (SynRMs) are the best fit to meet the challenges posed by the latest specific fan power (SFP) requirements. SynRMs operate very efficiently when partially loaded, or when operating super-synchronous (above 50Hz). As such, the fan design can be tailored to meet SFP at speeds not normally considered. “Efficiency islands” can be identified to ensure all of the components are selected optimally, making the packages perform best in class.

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Technical

Specific fan power (SFP)
SFP is a measure of how much electric power is required by a fan to move a given air volume. The SFP is influenced by flow rate, resistance of the ventilation system and efficiency of the fan system. By stipulating a maximum SFP, it is possible to limit the power requirements for transporting air throughout an entire building, air handling units (AHUs) and individual fans.

To meet the requirements of the SFP as stipulated in Part L of the building regulations a system design is needed. The HVAC market generally recognises four electric motor types:

- Brushless DC motor, or electronically commutated motor (ECM).
- Synchronous reluctance motor (SynRM) together with variable speed drive (VSD).
- Conventional fan controlled by conventional induction motor (IM) and VSD.
- Permanent magnet (PM) motor.

Technical

Synchronous reluctance motor (SynRM)
While the high efficiency offered by ECMs may be suitable for some applications, it is essential that the right motor technology is selected if unforeseen problems with harmonics, catching spinning loads and power dip ride-through, etc., are to be avoided.

For instance the cost-effective SynRM offers the same efficiencies as ECMs but without the aforementioned issues. A SynRM controlled by a VSD containing superior motor control algorithms brings all of the advantages such as:

- Improved harmonic mitigation
- Seamless power dip ride-through
- Fieldbus connectability
- Built-in control features to enhance the application

Technical

Synchronous reluctance motor (SynRM) Advantages

- Same price as equivalent IMs.
- ABB guarantees SynRM package efficiency
  – Has superior efficiency over IMs.
  – Achieves same efficiency as PM motors.
- Easy to optimise motor selection to the duty point.
- Easy to maintain and operate. Standard motor re-winders can repair a SynRM motor with no more than a “copy wind” approach.
- Magnet-free, therefore easier to handle than PM motors and no risk of de-magnetising. No magnets means no generated electricity from freewheeling loads. As such there is no need to lock the shaft to prevent dangerous voltages forming when carrying out maintenance on the system as is the case with PM motors. With SynRM local isolation still protects the operator.
- Available in sizes that match IM frames, or smaller, if less space is required for instance when the motor is mounted inside the duct.

Technical

- Up to 50 percent lighter and 50 percent quieter than induction motors.
- Only able to operate with a VSD, the VSD ensures a control point that saves energy.
- The VSD can be connected to fieldbuses and building management systems.
- Utilising optimised packages of SynRM motors with ABB drives allows the designed operating point to be reached in terms of pressure and flow, by dimensioning the whole system to perform to its optimal point.
- Cooler running and quieter than other motors, giving longer maintenance intervals and better working environments.
- SynRMs do not create excessive harmonics which can pollute the electricity supply, and can catch spinning loads as they are controlled by a conventional VSD and as such gain all of the benefits of a dedicated motor controller.

Technical

Synchronous reluctance motor (SynRM)
Disadvantages

- The VSD operating the motor is slightly larger than a conventional IM selection, due to higher excitation current.
- Potential cost increase is countered by additional savings from the guaranteed package efficiencies.
- Motor runs synchronously (as does PM), so some re-scaling may be needed on BMS/ SCADA.

Frequently Asked Questions

When would you not use a SynRM in a HVAC application?
There is no reason why a SynRM cannot be used in a HVAC application. ABB recommends this motor as the motor of choice when operated with a VSD.

Why is a SynRM so suited to HVAC?
The IE4 package gives super premium efficiency that allows specific fan powers to be achieved. The motors match IM hardware packages, so offer an easy replacement. A high output variant which is two frame sizes smaller, allows for easy mounting within a duct. The motors are lighter, run cooler and quieter and are more efficient than induction motors. SynRMs do not create excessive harmonics which can pollute the electricity supply, and can catch spinning loads. They do not generate dangerous back EMF voltages so that local isolation still protects the operator.

To discover more about SynRM visit:

Synchronous reluctance motor-drive packages. **Click here**

SynRM and flying start, can your drive control it? **Click here**

Four things to consider when choosing drives for SynRMs. **Click here**

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Summary

	HO SynRM	IE4 SynRM	IE4 IM	Typical PM
Motor size	Smaller	Same	Bigger	Smaller
Replaceability	Not always	Yes	Not always	Not always
Repairability	Same – copy wind	Same – copy wind	Same – copy wind	More difficult
Efficiency	Same or higher	Higher	Higher	Higher
Ease of service	Same	Same	Same	More difficult
Price	Same	Same as IE3	Higher than IE3	Higher (2-300%)
Reliability	Same or higher	Same or higher	Same or higher	Magnets can demagnetise
Availability	1.1 – 350 kW	11 – 315 kW	Above 75 kW now	Depends on manufacturer
Weight	Lower	Lower	Same or higher	Higher
Operating noise	Lower	Lower	Same	Similar
Package efficiency testing	Yes	Yes	No	No

Compared to IE 2 motors

This is one of 30 top tips for users of variable speed drives in heating, ventilation and air conditioning applications. To ensure that you receive ALL the tips as they are published, please register your interest by **clicking here**

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