Frequently Asked Questions

1. What class of motors does the NovaMAX™ motor belong?

The NovaMAX motor is an “electronically commutated permanent magnet” (ECPM) motor. It can also be correctly termed a “permanent magnet AC” (PMAC) motor.

2. What are the generic advantages of Permanent Magnet (PM) motors when compared with AC induction motors? Disadvantages?

As with all permanent magnet (PM) motors, the NovaMAX motor enjoys the following advantages and disadvantages when compared to AC induction motors.

Advantages

PM motors are inherently more energy efficient than induction motors. In an induction motor the rotor’s magnetic field is generated by an electric current. In a PM motor the rotor’s magnetic field is produced by permanent magnets. The fact that the rotor’s magnetic field need not be electrically produced reduces the electrical energy required. Other unique features of the NovaMAX design discussed below further reduce the electrical energy required, resulting in a more efficient motor even than other PM designs.

The power density of a PM motor is greater than that of an induction motor. Permanent magnet motors of the same physical size as an induction motor will typically produce more power. This means that a permanent magnet motor of the same power as an induction motor may be a frame size smaller and in many cases can support a higher service factor than the induction motor.

In many configurations, particularly with low speed motors the NovaMAX motor will have a lower FLA (full load amps) requirement. In some cases this advantage may allow the use of a smaller drive than the equivalent induction motor.

PM motors deliver high continuous torque over their entire speed range. In contrast the continuous torque available from an induction motor decreases significantly at lower speeds. The PM motor’s ability to continuously deliver high torque at low speed, along with its high power density (that is, its ability to produce more power in the same package size) may, in many applications, eliminate the need for gearing or other mechanical transmission devices. Eliminating gearboxes or other mechanical transmissions reduces the energy losses associated with those components, reduces the space required, reduces necessary maintenance, increases reliability, and eliminates the cost of the unnecessary mechanical components.

Disadvantages

Conventional PM motors are more expensive than induction motors. Conventional PM integral horsepower motors typically require the use of rare earth magnets. However, the NovaMAX motor’s unique geometry focuses the flux produced by the permanent magnets, allowing the use of readily available and lower cost ferrite magnets.

PM motors require external commutation to rotate. Unlike induction motors, a PM motor cannot be operated directly across the line. A VFD (Variable Frequency Drive) is required for commutation. However, because of the energy savings associated with running a motor at lower speeds when possible in HVAC or pump applications the use of VFDs is becoming much more common. NovaMAX motors will be most cost effective in applications requiring or benefiting from the ability to vary the speed of the motor.

3. How is the NovaMAX™ motor design different from conventional PM motors? What are the NovaMAX motor's advantages and disadvantages compared to conventional PM motors?

NovaMAX motors have an axial, rather than radial design, common with many other PM motors. This enables NovaMAX motors to have a very compact bobbin-type electrical winding. Unlike conventional radial motors there are no end turns. All of the wound conductor in a NovaMAX motor is used effectively. This results in a lower winding resistance than radial motors, and therefore lower resistive (I^2R) losses. At low speeds, resistive losses dominate. Since NovaMAX motors have less resistive loss than radial motors, low speed efficiencies are higher.

The NovaMAX motor's unique rotor geometry results in greater flux concentration than in typical PM motors. The unique rotor design and conical geometry results in more concentrated flux at the field pole, allowing for the use of readily available, low cost ferrite magnets. This, among other innovations, allows the NovaMAX motor to deliver PM performance at prices more comparable to induction motors. The flux path in a NovaMAX motor is axial versus radial. The magnetic flux path in a NovaMAX motor is transmitted axially (parallel to the shaft) across the rotor hubs through the stator (versus the radial flux paths in a more conventional PM motor), enabling the use of grain oriented steel for the stator poles. This means the flux transmission through the field poles is much more efficient than with other motor designs. The core losses in a NovaMAX motor are as much as 75% lower than in a radial motor.

The magnets are mounted within (interior to) the rotor structure resulting in improved motor performance and integrity. In an IPM motor, the magnets are embedded within the rotor structure and mechanically restrained. This is a more reliable, higher performing arrangement than surface adhesion of magnets as is done in many conventional PM motors. Interior permanent magnets also result in increased saliency. Increased saliency generates more accurate speed control and allows the motor to operate over a greater speed range before requiring external position sensors.

The motor geometry improves heat dissipation efficiency. Because the coil surface directly faces the outside of the stator, heat is more easily dissipated, resulting in cooler motor operation, extending motor life.

NovaMAX motors are priced lower than conventional PM motors. The NovaMAX motor was designed to compete effectively with induction motors – not simply to compete with other PM motors.

Disadvantages

The NovaMAX motor's rotor inertia is greater than is generally the case in conventional PM motors. While this is actually an advantage in many applications, it would be a disadvantage in high acceleration/deceleration servo positioning applications.

4. Many HVAC motors are mounted outdoors/rooftop. How "weatherproof" is the NovaMAX motor? Temperature constraints?

NovaMAX™ motors are totally enclosed with ingress protection up to IP54 available. They are dust-protected and resistant to water splashes, but are not intended for wash-down or exposure to direct rain. Covered outdoor use is clearly acceptable. Consult factory for use as condenser motors in open air, shaft-up orientation. Ambient temperature service conditions are -10 °C to 40 °C (14 °F to 104 °F).

5. How is the reliability of the motor assured?

All production motors are subjected to a series of tests prior to shipment.

Importantly, reliability has been a central design theme, with many failure modes, common to the motor industry designed out. Most of those failure modes are heat-related bearing or winding issues. The high operating efficiency of the NovaMAX motor reduces heating due to losses, allowing the motor to run cooler, hence inherently improving reliability. Additionally, as the coils are adjacent to the case of the motor, what heat is produced is dissipated more efficiently, further reducing the operating temperature of the motor.

The electrical wind of the NovaMAX motor is a compact bobbin-type with no end-turns. The simple nature of the winding improves reliability, as less stress is placed on the wire conductor during the winding operation when compared with a conventional 'stitch wound' motor.

The magnets used in the NovaMAX motor are mechanically restrained. This ensures that no motor failures will result due to magnet de-lamination as can occur in with surface mount magnets in conventional PM motor designs.

6. What type of magnets does NovaMAX™ motor use? Is demagnetization a potential problem?

Due to the flux concentration produced by the geometry of the NovaMAX motor, the motor produces rare-earth-like performance with the use of ceramic ferrite magnets. Ceramic ferrite magnets are readily available and unlike rare earth magnets, they are NOT subject to demagnetization at high temperature. They are susceptible to demagnetization at very low temperatures (below -20 degrees C) if full power is applied when at that temperature. That issue is easily remedied by limiting power to the motor until it reaches safe operating temperature.

7. Does the NovaMAX motor meet NEMA Premium and IE3 standards?

Yes, and then some! The IEC (International Electrotechnical Commission) has established standard categories/designations for various levels of electric motor efficiency. They range from IE1 to IE4. IE1 designates "Standard Efficiency". IE2 designates "High Efficiency". IE3 designates "Premium Efficiency" and IE4 designates "Super Premium".

IE3 and "NEMA Premium" are essentially the same, with small differences at a few sizes (HP). NEMA Premium is mandated in the US as of Dec 19, 2010. IE3 or IE2 with a VFD is required in Europe as of January 1, 2015.

IE4 has been defined by the IEC as a 15% reduction in motor losses from the IE3 standard. IE4 motors are higher priced than IE3 motors, and are typically made with permanent magnets.

IE5's Ultra-Premium efficiency standard has been proposed as a 20% reduction in losses from IE4.

NovaMAX motors already exceed the proposed IE5 efficiency rating!

8. Are VFD induced shaft voltages an issue with the NT motor? If so, what protective measures should be employed?

It is recommended that all motors operating on a VFD employ protection against the discharge of shaft voltages through the bearings. NovaMAX motors are shipped with a shaft grounding mechanism as a standard option.

9. How is the motor commutated? Is a sensor required?

The NovaMAX motor is electronically commutated using the back EMF of the motor for determining rotor position. No sensor is required. Variable Frequency Drives (VFDs) that support permanent magnet motors have this feature built into their algorithms. Most major suppliers offer drives that support both induction

motors and permanent magnet motors. Contact NovaMAX motor Application Engineering for a list of drives that have been tested and approved with the NovaMAX motor.

10. Can the motor be run across the line?

No. A drive is required for the motor to operate, and it cannot be bypassed.

11. Is the NovaMAX™ UL listed?

All NovaMAX motors are UL Recognized components, with authorization to apply the UL Mark.

This certification mark indicates that the product has been tested to and has met the minimum requirements of a widely recognized (consensus) U.S. product safety standard, that the manufacturing site has been audited, and that the applicant has agreed to a program of periodic factory follow-up inspections to verify continued conformance.

17. What is the history of the NovaTorque® technology?

The NovaTorque company was founded in 2005 in California. The NovaTorque technology was purchased by Regal Beloit America, Inc. in late 2016. The NovaTorque technology has been utilized in the NovaMAX motor and branded under Marathon Motors.

18. What applications benefit most from the NovaMAX motor's advantages and why?

The NovaMAX motor efficiency curve is both higher and flatter than induction motors. Hence, variable torque applications with wide speed and load requirements, such as fans and pumps, benefit significantly from the improved efficiency. A study commissioned by an electric utility, concluded that the NovaMAX motor would use 7 to 22% less power than a NEMA Premium motor when used in a fan application with a typical load profile.

The NovaMAX motor is also capable of producing high continuous torque at low speeds without overheating. Thus it is well suited for applications characterized by the need of constant torque over a wide speed range. Mixers would be an example. Treadmills would be another.

The high continuous torque and the high power density together will often eliminate the need for gearing, allowing the load to be driven directly. Many applications (example: conveyors) would benefit from the reduction in mechanical complexity, cost, inefficiency, and maintenance.

19. Where can I purchase a NovaMAX motor?

NovaMAX motors are available through Marathon Motor's® distributor network as well as contacting the team directly through the contact form on the web site or through novamax@regalbeloit.com.

20. What kind of technical and/or sales support is available for the NovaMAX motor?

The NovaMAX motor's application engineering team is available to our OEM customers for pre and post-sale technical assistance. As customer technical support requirements typically relate primarily to the drive component of the system, support is usually best first solicited directly from the drive manufacturer.