



NEXTGEN NRG

HIGH FREQUENCY
ROTARY TRANSFORMERS



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NEXTGEN NRG PTY LTD

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INTRODUCTION

High-Frequency Rotary Transformers (HF-RT) and Their Applications

High-Frequency Rotary Transformers (HF-RT) represent a revolutionary step in the field of energy transfer technologies. These devices are specifically designed to address the challenges of energy transfer in dynamic, rotational systems. Unlike traditional systems that rely on brushes and slip rings for electrical connectivity, HF-RTs employ advanced electromagnetic coupling across an air gap, ensuring seamless and efficient energy transfer without physical contact. This innovative approach makes HF-RTs especially suited for modern applications requiring high reliability, low maintenance, and compact design. The elimination of mechanical components not only reduces wear and tear but also enhances overall operational efficiency and durability.

Understanding HF-RT Technology

At the core of HF-RT technology is its unique design, which consists of a static primary winding and a rotary secondary winding. These components are magnetically coupled through a specially designed core structure separated by an air gap. The absence of direct contact between the primary and secondary windings ensures that the device operates without the mechanical wear associated with traditional systems. The air gap and magnetic coupling are meticulously engineered to prevent any flux-cutting effects, ensuring consistent energy transfer even in high-speed or variable-speed applications. This makes HF-RTs highly efficient and reliable, with performance characteristics tailored for next-generation systems such as electric vehicles (EVs) and advanced industrial machinery.

APPLICATIONS

Electric Vehicles (EVs)

One of the most prominent applications of HF-RT technology is in electric vehicle motors. Electric vehicles often rely on Wound-Rotor Synchronous Machines (WRSMs) for propulsion. Traditional WRSMs use brushes and slip rings for excitation, which introduces significant maintenance challenges and limits efficiency. HF-RTs eliminate these limitations by providing a brushless solution. By integrating HF-RTs into WRSMs, electric vehicle manufacturers can achieve higher torque and power output. Unlike Permanent Magnet Synchronous Motors (PMSMs), which suffer from significant inefficiencies at low speeds due to high reluctance torque, HF-RT-enabled WRSMs maintain consistent performance across the entire speed range. Additionally, this integration allows for precise control of the rotor's magnetic field, optimizing both efficiency and power delivery.

Fast EV Charging Systems

Beyond vehicle propulsion, HF-RT technology is critical in the realm of EV charging infrastructure. Silicon Carbide (SiC) MOSFETs, when integrated with HF transformers, create highly efficient DC/DC converters for fast EV charging systems. These systems are capable of delivering high power levels, supporting ultra-fast charging capabilities required for modern EVs. For instance, existing commercial chargers such as the Tritium Veefil-RT and ABB Terra systems have demonstrated power outputs ranging from 50 kW to 360 kW. HF-RT technology, combined with SiC devices, enhances these systems by improving power density, reducing costs, and enabling compact modular designs. These features make HF-RT-based chargers ideal for both public charging networks and home charging solutions.

Industrial and Power Generation Systems

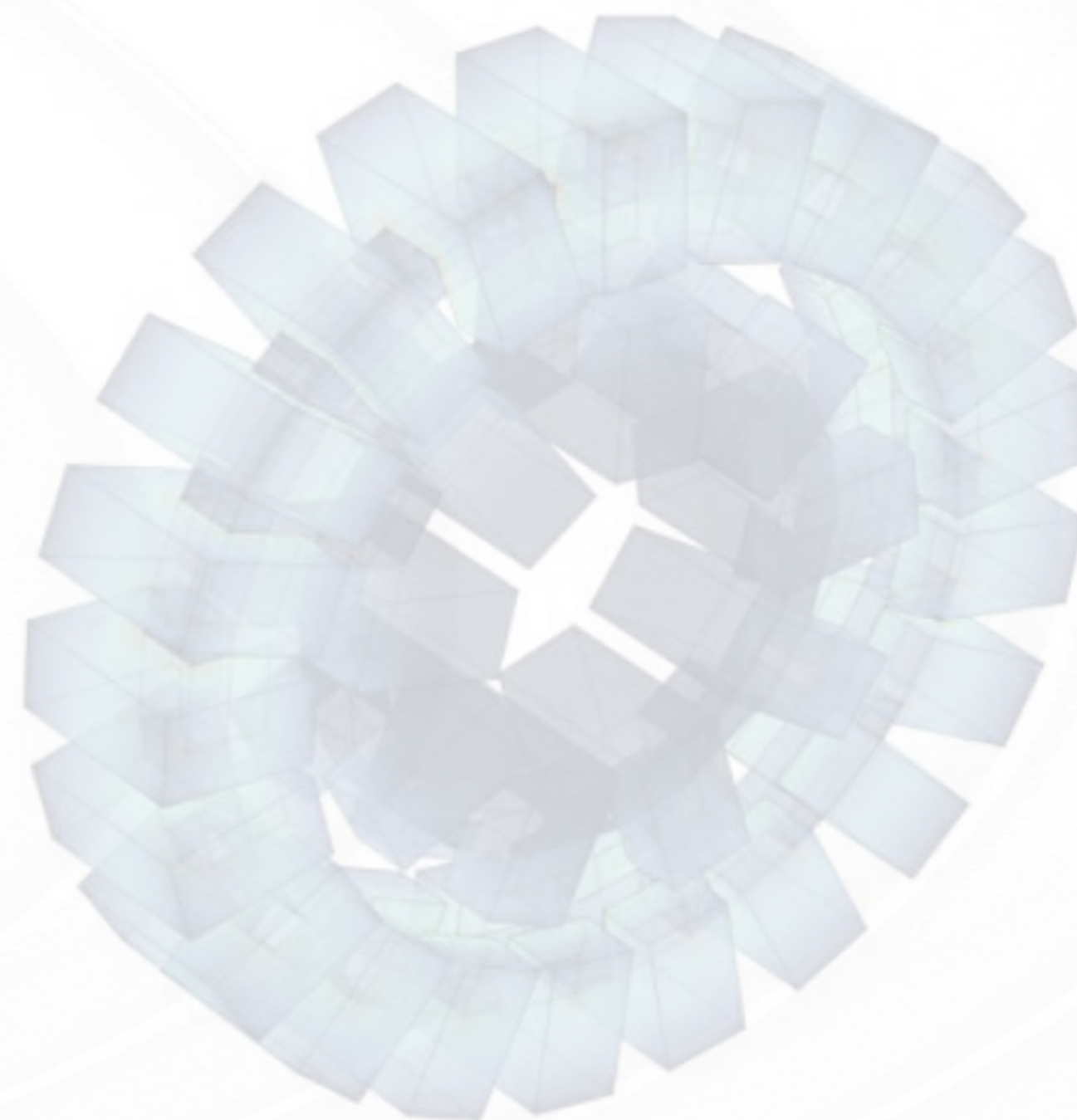
The advantages of HF-RTs extend beyond the automotive industry. They are increasingly being adopted in industrial settings, particularly for brushless synchronous generators. These generators are essential in applications requiring high reliability and low maintenance, such as aerospace systems, robotics, and advanced manufacturing. In power generation, HF-RTs are utilized in rotary systems to improve efficiency and reduce operational costs. By eliminating the need for brushes and slip rings, HF-RTs significantly lower maintenance requirements, making them suitable for remote or inaccessible installations.

REDEFINED EFFICIENCY

Technical Advantages

The technical superiority of HF-RTs lies in their ability to overcome the limitations of conventional systems. Compared to PMSMs, HF-RT-enabled WRSMs offer greater efficiency, particularly at low speeds. They achieve this by controlling reluctance torque through advanced power electronics. This capability not only enhances performance but also reduces the energy required for operation.

Furthermore, HF-RT technology simplifies the design of EV motors and reduces manufacturing costs. The rotors used in HF-RT systems are approximately 45% cheaper to produce than those in PMSMs, offering significant cost advantages to manufacturers. Maintenance costs are also drastically reduced due to the brushless nature of the system, which eliminates the wear and tear associated with mechanical components.



Charging Infrastructure

In fast charging systems, HF-RTs play a pivotal role in enabling high-efficiency power conversion. By integrating SiC MOSFETs, HF-RT-based converters achieve exceptional power density and efficiency. These converters are modular in design, allowing for scalability to meet diverse power requirements. For example, a modular bidirectional DC/DC converter based on HF-RT technology can handle power levels ranging from 60 kW to 120 kW per module, making it suitable for both residential and commercial charging stations. The integration of HF-RTs with microgrid systems further expands their applications. These systems support vehicle-to-grid (V2G) technology, enabling bidirectional energy flow between EVs and the grid. This capability is crucial for renewable energy integration and grid stabilization, highlighting the transformative potential of HF-RTs in the energy sector.

APPLICATIONS

Comparison with Conventional Systems

When compared to conventional technologies, HF-RTs consistently demonstrate superior performance. Their brushless design ensures minimal maintenance, while their compact and efficient structure reduces both initial and operational costs. In EV applications, HF-RT-enabled WRSMs outperform PMSMs in terms of efficiency, torque, and power control. Additionally, HF-RT technology allows for wide-range power factor control, a critical feature for applications requiring precise energy management. This capability is absent in PMSMs and other conventional systems, further underscoring the unique advantages of HF-RTs.

Feature	WRSM (with HF-RT)	PMSM	Traditional Systems
Efficiency	High	Medium	Low
Maintenance Cost	Low	Low	High
Manufacturing Cost	Medium	High	Medium
Power Factor Control	Wide Range	Limited	Limited
Suitability for EVs	Excellent	Moderate	Poor

Future Developments

Looking ahead, HF-RT technology is poised for further advancements. Ongoing research focuses on enhancing power density and integrating HF-RTs into emerging applications such as high-speed rail, aerospace, and renewable energy systems. The development of next-generation SiC MOSFETs and HF cores promises even greater efficiency and scalability. Efforts are also underway to expand the use of HF-RTs in microgrid and V2G systems. By enabling seamless integration with renewable energy sources, HF-RTs will play a vital role in the transition to sustainable energy solutions.



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HF-RT KEY ELEMENTS

EFFICIENCY

The transformer delivers an exceptional **95-98% efficiency**, a significant improvement over current market alternatives, which typically operate between **80-85% or lower**. In conventional setups, efficiency is lost through components such as motors, drives, or other application processes. By addressing these losses, this system ensures that the power input is almost equal to the power output, offering unmatched performance in energy efficiency.

SIZE REDUCTION

The transformer also offers an impressive **size reduction**, being **60% smaller** than traditional alternatives. A conventional **5 kW inverter**, which typically measures **500x400 mm** and weighs **25-26 kg**, can now be reduced to a **shoebox-sized unit weighing just 2 kg**. This dramatic size reduction not only improves portability but also saves significant space, offering a clear advantage for modern, compact installations.

HEAT DISSIPATION

One of the transformers standout features is its extremely low **heat dissipation**. Heat generation is minimal, only **2-3% above ambient temperature**. For example, if the surrounding temperature is **35°C**, the system operates at just **37-38°C**, ensuring thermal stability and reliability. This efficient heat management makes the system ideal for high-performance applications where overheating is a common concern.

COST

The transformers provides substantial **cost savings** compared to traditional options. For **copper-wound systems**, it is at least **40% cheaper** due to reduced component costs, particularly with the elimination of large copper conductors. **In high-frequency systems, costs are reduced by 20-25%**. Furthermore, the system's design includes **no moving parts**—such as rotors, bushes, or arms—eliminating wear and tear. This results in lower maintenance costs, improved reliability, and the ability to offer extended warranties, providing long-term value and peace of mind to users.

INVESTMENT AND LICENSING OPPORTUNITIES

Joint Venture with Established Energy Firm

A joint venture opportunity allows partnering with a major energy company to co-develop and distribute the technology. This collaboration provides access to established infrastructure, industry expertise, and a broader market reach, ensuring successful adoption and scaling of the technology.

Licensing Agreement

Licensing the technology to manufacturers in various regions presents an excellent opportunity for localized production and sales. By granting regional licenses, businesses can tap into specific markets, reduce production costs, and accelerate the technology's adoption worldwide while generating consistent royalty income.

Manufacturing Partnerships

Forming partnerships with established manufacturers enables the large-scale production of transformers. This opportunity leverages the existing manufacturing capabilities of industry leaders to meet market demand efficiently while maintaining cost-effectiveness and quality standards.

Distribution Agreement

Engaging with a global distributor specializing in electrical components and renewable energy solutions provides immediate access to international markets. Such an agreement ensures that the technology reaches key sectors and industries worldwide, enhancing visibility and driving rapid adoption.

Global Development and Marketing

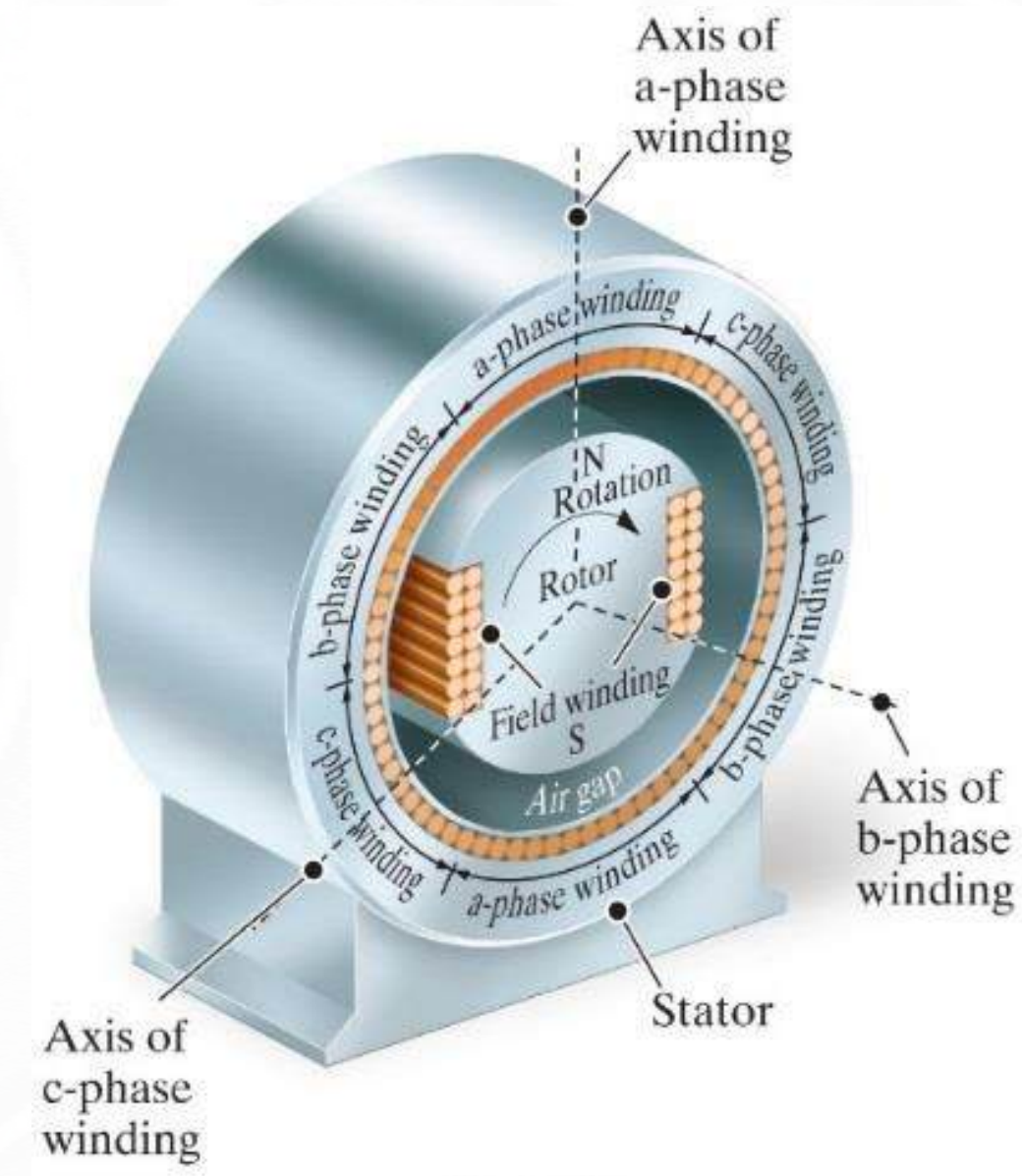
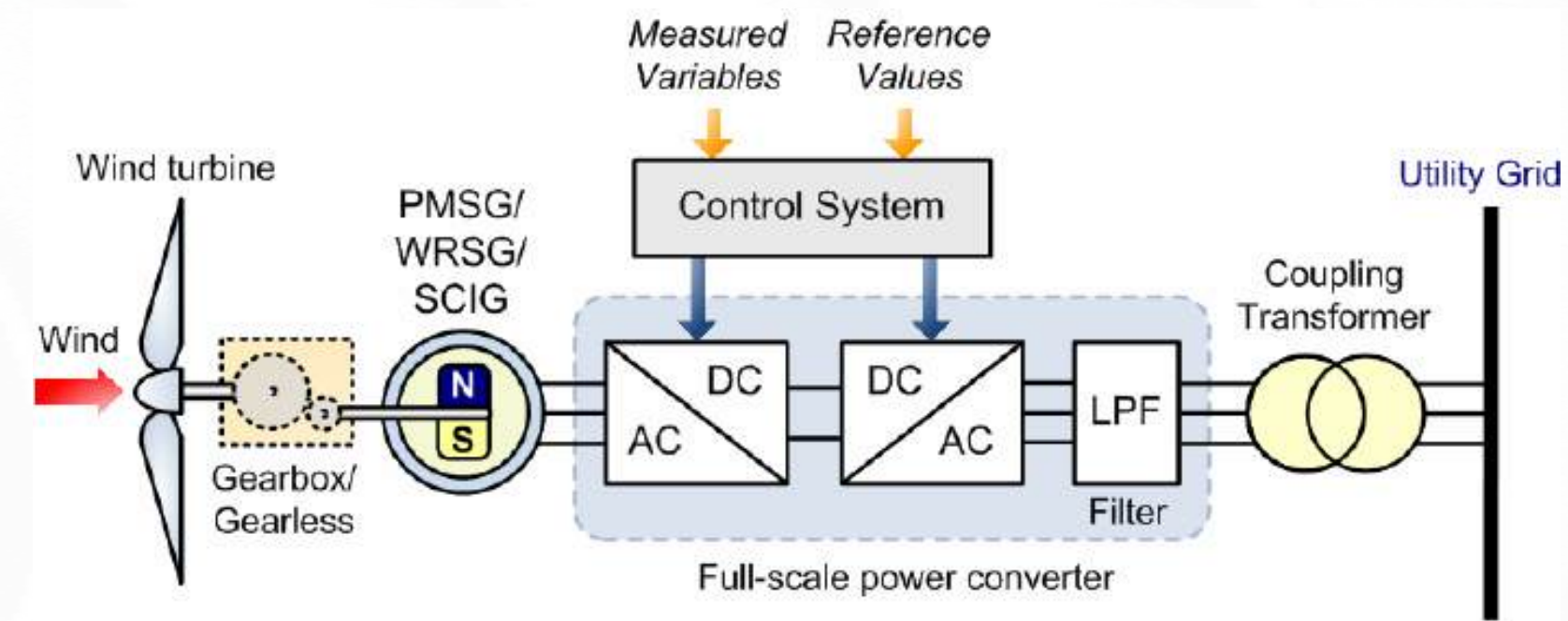
An investment opportunity aimed specifically at developing and marketing the technology globally can establish a robust launch strategy. Funds secured for global development will ensure product refinement, widespread awareness, and strategic entry into high-demand markets across the world.

Outright Sale of Global Rights

For investors or corporations seeking full ownership, an outright sale of the global rights to the technology is available. This one-time transaction offers complete control over production, marketing, and distribution while providing the seller with immediate capital return.

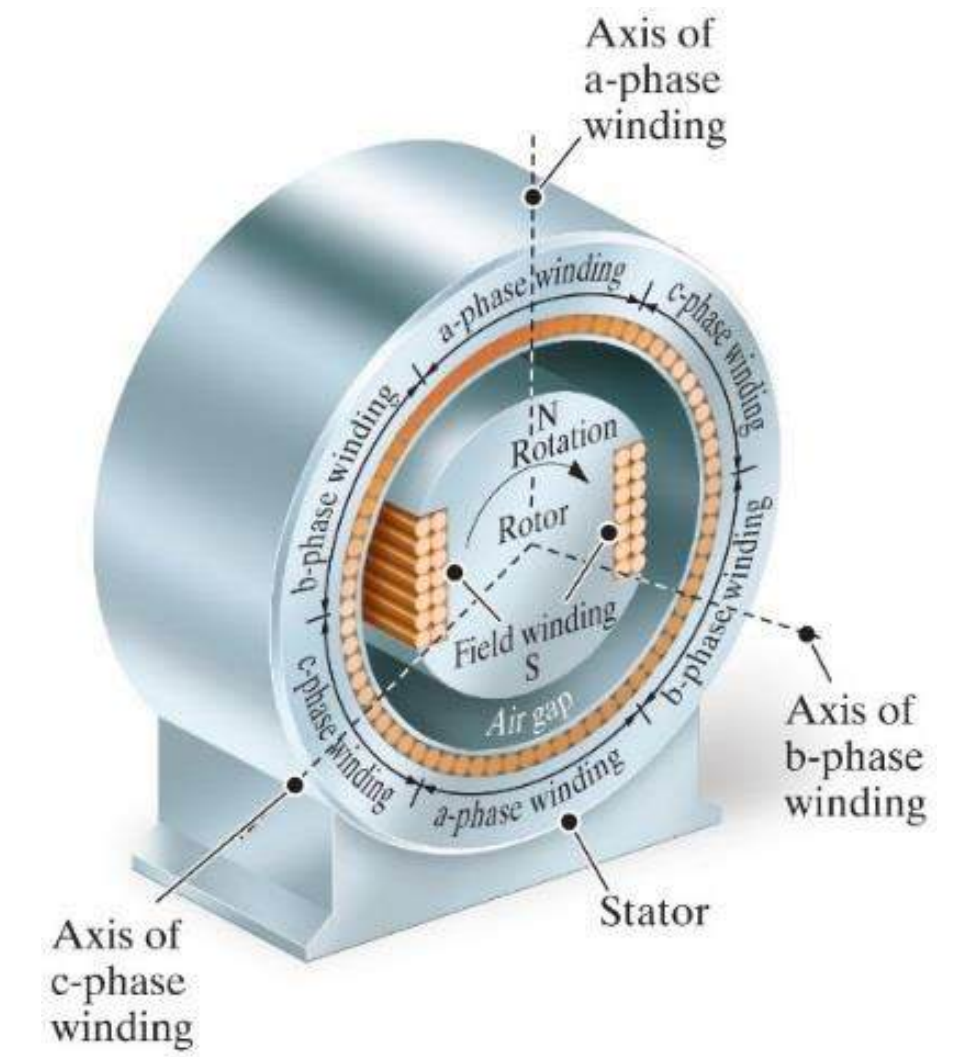
REFERENCE PICTURES

WIND TURBINES



REFERENCE PICTURES

AUTOMOTIVE MOTORS



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