

GE Energy

# Mining & Minerals

Motors and Generators



imagination at work

# Experience Matters



We've manufactured motors and generators for over 125 years. In 1879, GE founder, Thomas Edison constructed the first electric motor for a 110 to 120 Volt line at Menlo Park, NJ. This device still exists and is operative! It is located in the Edison Historical Collection in New Jersey.

GE's experience in the Mining Industry spans over 80 years. GE offers comprehensive motor solutions for mining process applications. With an increasing global demand for metals and minerals, mining environments are becoming more extreme. It may be in a remote underground mine in Mongolia or in the mountains of Chile. It may be in the extreme cold of Alaska and the Canadian North or the blazing Australian Outback. Motors provide a lifeline to driven equipment and are the backbone of production and operation. Based on our extensive motor application experience and expertise, we are very well positioned to help customers chose the right solution for your process.

## GE Advantages

We are known for designing products with a high mechanical integrity and superior electrical design.

- GE's legendary Global Research Center is committed to the Mining Industry.
- GE utilizes state-of-the-art design tools such as finite element analysis.
- GE motors are known for high reliability and efficiency.

We regularly deliver high efficiency solutions that help improve revenue generation for customers. Our products are produced with flexible customization to meet the most stringent requirements.

We operate world class test facilities to ensure every machine complies with global standards such as IEEE, IEC, NEMA, etc.



GE Quadramatic™ Drive System in a ball mill application



GE offers advice and application expertise to assist at the early stage of exploration and feasibility study. Our vast experience in mining motor applications allows us to select the most appropriate techno-economical solution to maximize productivity and help ensure the long-term success of mining projects.

GE works with mine owners, mill builders and original equipment manufacturers (OEMs) to help match the best application based on customer process requirements. What really sets GE apart in the mining industry is our vast knowledge, acumen, expertise and the longest running installed base of rotating machines in the world.

GE has AC and DC products for drilling applications. Motors are used in pumps and fans for ventilation, hydraulics and fluid cooling requirements depending on the process being used.



#### Motor Applications

- Feasibility Machine Cost
- Application Expertise
- Cost Evaluation
- Pumps
- Fans
- Mine Hoists



Core samples taken from special rock drills driven by GE motors.



Mine hoist application used in transporting personnel and equipment to deep underground mines.

Vertical Shaft High Thrust motors are used primarily in pump applications.

## Motor Applications

Excavators  
 - Draglines  
 - Shovels  
 Shuttle Cars  
 Continuous Miners  
 Conveyors  
 Pumps  
 Fans



In surface mining, after blasting with explosives, huge earthmoving equipment, such as draglines and large shovels scoop off the layers of soil and rock covering the mineral bed. Once the mineral is exposed, smaller shovels are used to lift it from the ground and load it into trucks.

**GE is the world leader in the design and manufacture of electrical drive systems for draglines and shovels.** Most operating draglines in the world today are driven by GE's proven, rugged motor and control technology.

Uptime and cycle time are two measurements that provide the most meaningful indication of **lower cost per material ton moved (\$/MTM)**. Modern high performance IGBT control systems and rugged, proven motor-generator technology provide high reliability and productivity for GE customers. Horizontal and vertical motor applications are selected and designed based on various—and many times unique—motion requirements of these large earthmovers.

When resources are found deep underground, rubber-tired shuttle cars, powered by reliable GE motors, haul earth from a mine face to intermediate haulage systems. They are also used to haul personnel, tools and supplies throughout underground roadways. Smaller tracted continuous miners, powered by rugged GE motors, simultaneously dig large amounts of material while loading.

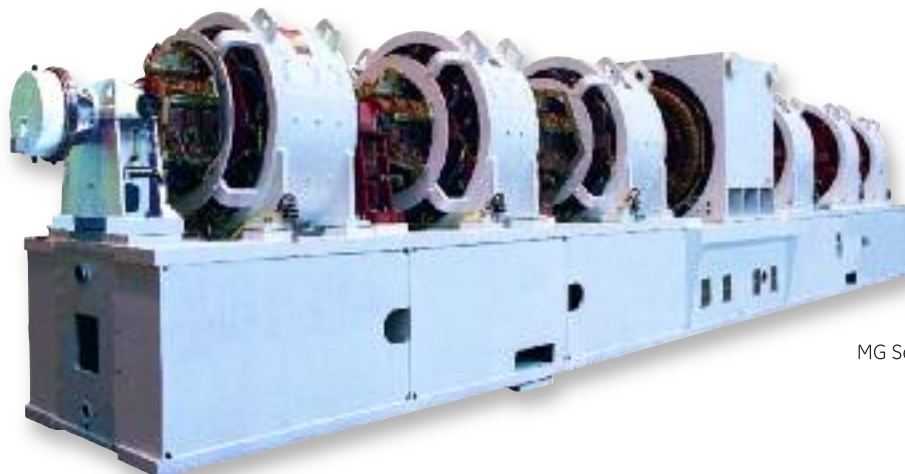
All bulk material from iron ore to coal is transported on a looped procession of hooks, buckets, wide rubber belt, etc. To keep these conveyors moving, GE has a full line of high efficiency motors which also helps improve the customers \$/MTM ratio.



Dragline interior showing vertical and horizontal motors along with MG set.



MG Set for a large shovel application.



MG Set for a dragline application.

Motor Applications

SAG Mills  
Ball Mills  
Crushers



Before the mineral rocks enter a grinding mill, the rocks pass through a crushing system. GE has a full range of vertical and horizontal motors designed for primary, secondary and tertiary applications such as gyratory crushers, Handseil mills, hammer mills, and jaw crushers.

Several different technologies are used in grinding applications. Both asynchronous and synchronous motor technologies can be used in fixed and variable speed processes.

**Apart from the above, GE has a unique motor application for grinding mills called Quadramatic™.** The Quadramatic™ System has the highest efficiency for fixed speed mill applications in the industry. It is the only technology that provides leading VAR's without the need for additional equipment. This can contribute to a smaller generating plant and a decreased energy purchase. Low speed Quadratorque™ motors require no intermediate gear, couplings or lube systems. Clutches provide drive train protection in the event of an electrical system or other fault. The Quadramatic™ System has an excellent operational performance record spanning over 30 years.



The Pegasus™ LMV TEAAC is ideally suited for crushing applications.



Quadratorque™ synchronous motor.



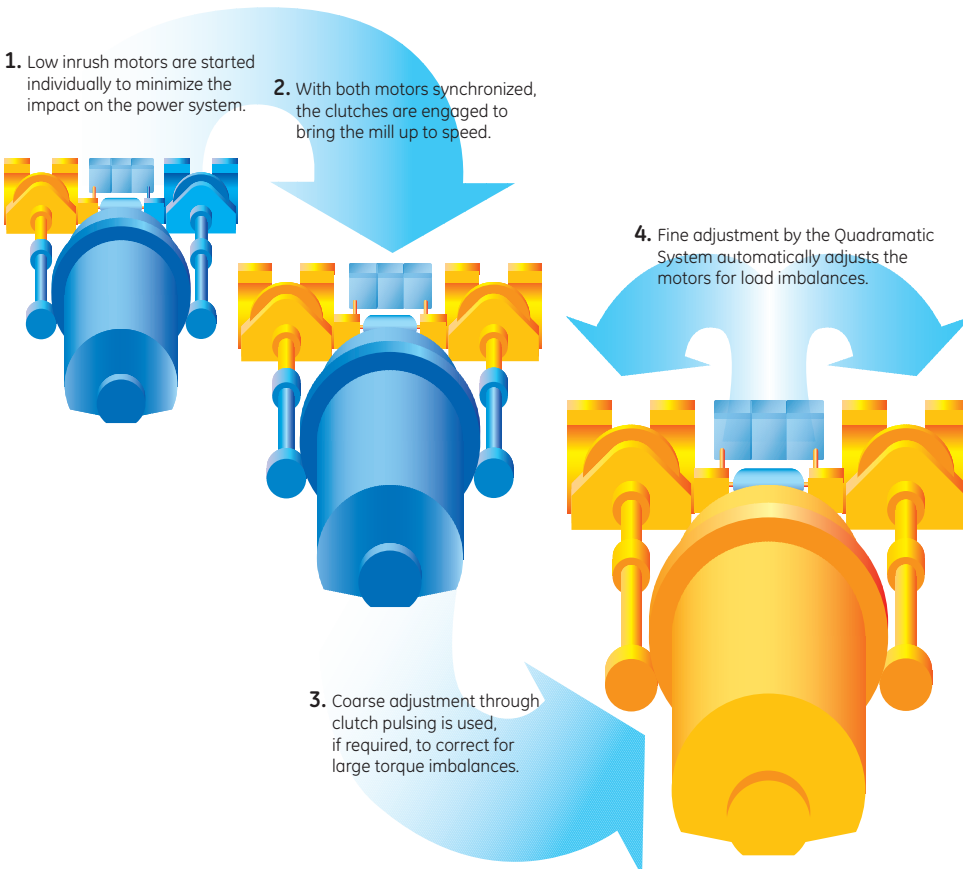
Quadramatic™ Drive System control cabinets.

1. Low inrush motors are started individually to minimize the impact on the power system.

2. With both motors synchronized, the clutches are engaged to bring the mill up to speed.

3. Coarse adjustment through clutch pulsing is used, if required, to correct for large torque imbalances.

4. Fine adjustment by the Quadramatic System automatically adjusts the motors for load imbalances.



## Motor Applications

Gravity  
Flotation  
Magnetic  
Dissolution  
Solvent Extraction  
Electro Wining  
Smelting  
Precipitation  
Physical Sorting



When all the material has been pulverized into a fine powder from a grinding mill, metal is separated from the ore in a wide array of electrolytic and chemical processes. In all of these, motors are used to transport materials, pump reducing and purifying chemicals, rotate mixing machinery, and in sorting systems. GE offers a complete range of high efficiency and reliable motors to meet these tasks.

Many of these applications are in harsh and corrosive environments. Customers require machinery that not only withstand these conditions, but run consistently with little or no maintenance. The X\$D Ultra® motor is made out of rugged corrosion-resistant SAE Grade 5 hardware. Grease fittings and plugs provide relubrication access to extend bearing life. An embossed 316 stainless steel nameplate is stamped with over 30 motor specification details and all required standards.

X\$D Ultra® motors are among the most efficient in the world. For instance, a new 100HP 1800RPM X\$D Ultra® can pay for itself in energy savings in 1.5 years and up to US\$31,700 in total life cycle costs if used to replace an equivalent motor installed anytime before 1992.

*Statements made assume 100% constant running at \$0.08/kWH.  
Actual efficiency improvements and benefits will vary.*



The X\$D Ultra® motor is a product of GE ecomagination. GE imagines and builds innovative solutions that help customers meet environmental challenges and improve their operating performance.



Conveyor application for coal transport.

## Motor Applications

Loading Cranes  
Locomotive Traction



GE is one of the largest manufacturers of traction motors in the world. With decades of experience designing and manufacturing traction motors, GE is known industry-wide for producing sturdy and reliable motors. We transfer our OEM expertise to a full line of traction products, including motors, armatures, parts and components. Our traction motor products meet or exceed the original specifications, while delivering GE quality.

Crane motors are often exposed to extreme weather conditions and are subject to high operational requirements. They have to withstand high humidity, salty air and high wind speeds while ensuring a high overload capacity and a wide speed control range.

With ambient temperatures reaching above 50°C in some parts of the world and humidity up to 100% in salty atmospheric conditions, GE energy-efficient and reliable motors with excellent service records are the perfect solution for crane duty applications.

The tangible benefits of a reliable GE motor are felt in safety and increased productivity. Our motors respond accurately to soft control and feature a good torque response. This is vital to control the positioning of the load.

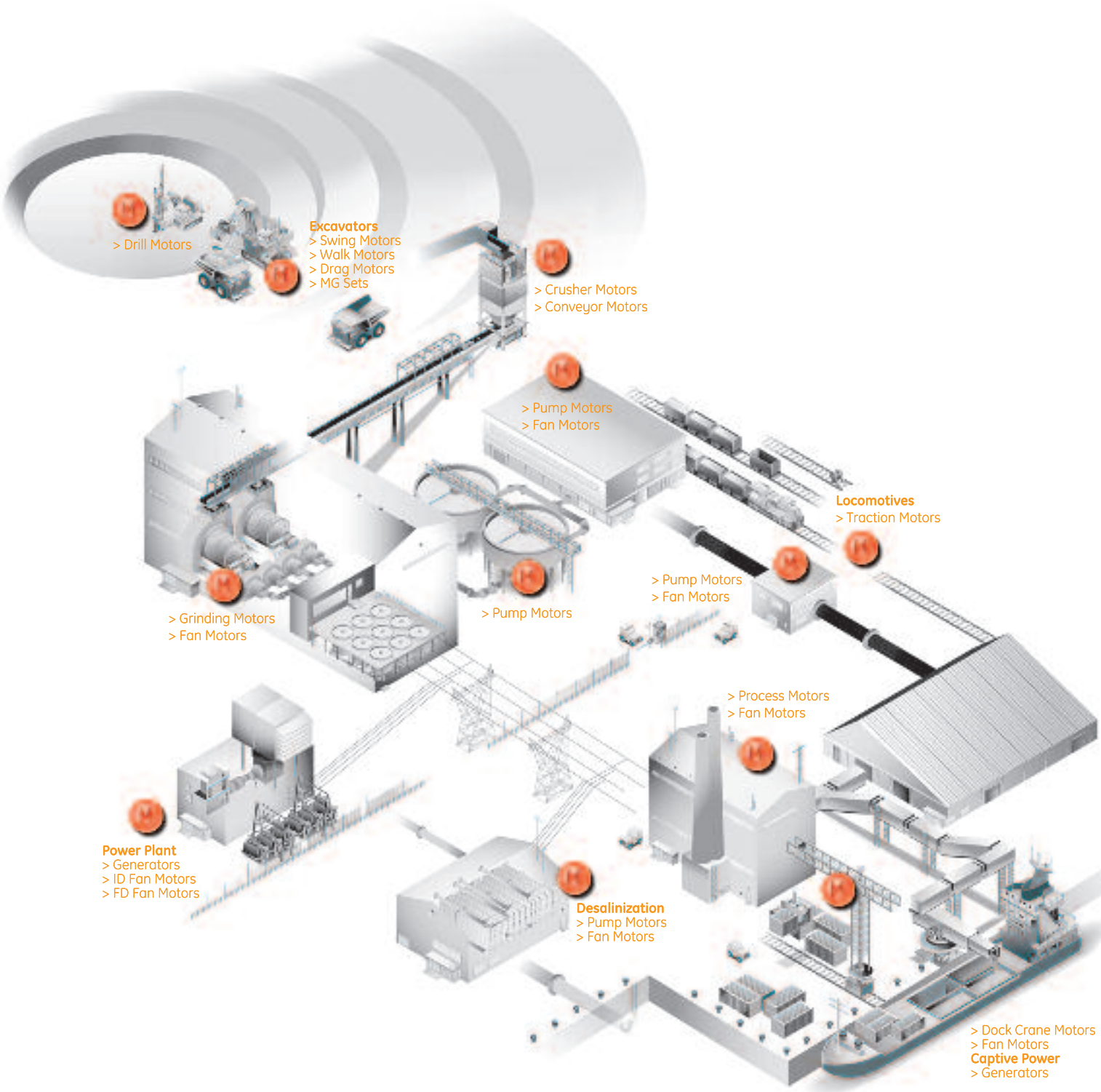


The MD800 is a reliable motor commonly used in crane duty applications.



The Evolution™ Series locomotive powered by rugged GE motors are extensively in use to transport bulk minerals (coal, iron ore etc.) from mines to port of export or final destination.

# Motor Application Map





# Product Reference

Motor Applications	Requirements	GE Products	Standards
Ball Mill SAG Mill	Variable Torque Starting Conditions and Frequency Vibration Restrictions	Quadramatic™ Drive System Custom 8000™ Series 9000™	CSA, IEC, IEEE, NEMA, ANSI
Captive Power	Turbine Stress Curve Ambient Temperature Altitude Conditions Service Factor	Series 9000™ Series E-40	IEC, IEEE, NEMA, ANSI
Continuous Miners Shuttle Cars	Size Restrictions Vibration Restrictions	EMV Motors	IEC, IEEE, NEMA, ANSI
Conveyor	High Inertia Starting Conditions and Frequency Harsh Environment	X\$D Ultra® Quantum™ LMV	IEC, IEEE, NEMA, ANSI IEEE, NEMA, ANSI
Cooling Fans	Vertical Orientation Belt Driven Harsh Environment	X\$D Ultra® 661	IEEE, NEMA, ANSI
Crushers	High Inertia Starting Conditions and Frequency Vibration Restrictions VFD Compatible	Pegasus™ MHV Quantum™ LMV X\$D Ultra®	IEC, IEEE, NEMA, ANSI
Dock Cranes	High Torque, Low Speed Starting Conditions and Frequency Inverse Duty	MD800	AISE
Excavating — Dragline — Shovel	Vertical and Horizontal Construction Starting Conditions and Frequency VFD Compatible Inverse Duty	MG Sets IGBT Controls MD Series Motors	AISE, IEEE, ANSI, NEMA
Mine Hoist	High Torque, Low Speed Vertical Construction Various Thrust Loads Starting Conditions and Frequency Inverse Duty	Custom 8000™ Series 9000™	IEC, IEEE, NEMA, ANSI
Pump	Vertical and Horizontal Construction Harsh Environment Vibration Restrictions	X\$D Ultra® Vertical Hollow Shaft Energy \$aver™ Quantum™ LMV	IEEE, NEMA, ANSI
Rail Transportation	High Torque Starting Conditions and Frequency Harsh Environment	Traction Motors	IEC, IEEE, NEMA
Synchronous Condensers	VAR Compensator	Series 9000™	IEC, IEEE, NEMA, ANSI
Ventilation Fan	High Inertia Starting Conditions and Frequency Vibration Restrictions	Custom 8000™ Quantum™ LMV	IEC, IEEE, NEMA, ANSI

# Technology

---



GE Motors continuous product development allows us to bring new solutions for oil and gas applications. We have a proven design process utilizing the latest 3-dimensional modeling tools. These allow us to custom build the machine on a computer to meet or exceed customer expectations as well as conforming as requested to the latest standards. Among the tools used are:

- **Electromagnetic Finite Element Analysis**
  - Flux Distribution Analysis
  - Computational Fluid Dynamics
- **3D Solid Modeling**
  - Stress Analysis
  - 4 Pole Rotor
  - Wound Stator
  - Dynamic Modal Analysis



# People, Service and Systems

---



GE Motors has teams of highly motivated and technically skilled application engineers, sales and project support staff that help to ensure you have an optimal and cost-efficient solution for your needs.

## **Pre-Order & Product Application Support**

- Experienced Inside & Outside Sales Force
- Application Engineering available to optimize your solution (factory and field)
- Web-based tools customized for each user's needs
  - Pre-Order Product information
  - Order and Project Management
- Spare Parts Program
  - Minimize downtime with an adequate spare parts inventory plan for your GE motors.
  - Performance Enhancement Program (PEP) – GE can evaluate your existing machines (GE or otherwise) to find efficiency or power output opportunities within the existing frames.

## **Order & Project Management Support**

- Design, application and specification reviews
- Documentation for approval and as built
- Project coordination
- Inspection plans
- Test scheduling
- Shipping coordination
- Start up and commissioning support
- Worldwide service capabilities



# Product Development



The **Pegasus™ MHV** Horizontal AC Induction motor is a result of a significant investment in design, engineering and manufacturing equipment. Pegasus™ MHV yields more horsepower per frame size, has an improved efficiency and

power factor with a more compact design. It is offered in a range from 500 – 22,000 HP (300 – 16,000 kW) in NEMA or IEC.



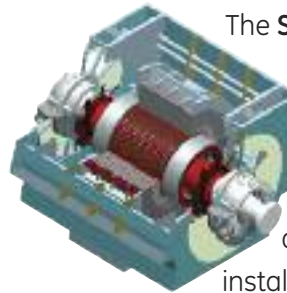
The **X\$D Ultra® 841** motor is a TEFC (totally enclosed fan cooled) Industrial AC Motor ranging from 1 to 300 horsepower. It meets or exceeds NEMA Premium®

Nominal Efficiency Standards and exceeds the minimum guarantee. Therefore, improved energy consumption and usage are dramatically realized, leading to its certification as a GE product of ecomagination. It also complies with the IEEE-841 specification.



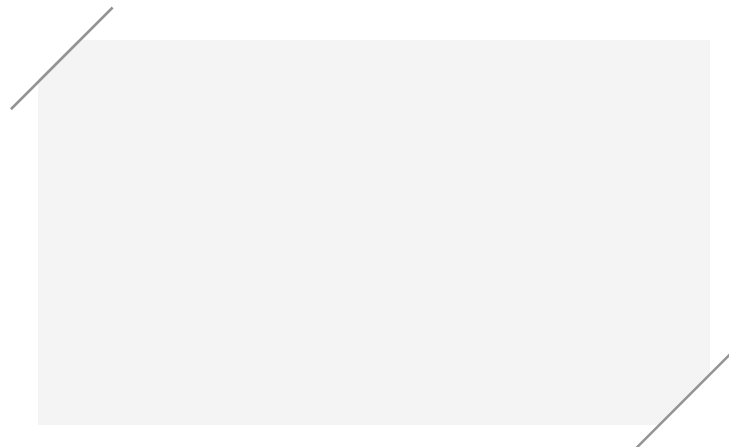
The **Quantum™ LMV** TEFC Induction motor was designed by a global engineering team yielding a motor for worldwide applications. This motor uses an innovative D-Duct heat transfer

technology (patent pending). This unique internal structure allows for maximum airflow. This more compact design yields more horsepower per frame size and has an improved efficiency and power factor. The Quantum LMV is offered from 350 – 2000 HP (200 – 1,500 kW) per NEMA or IEC up to 6600 volts.



The **Series E-40** is a synchronous generator used primarily in renewable power generation applications. This machine can be shipped fully assembled, allowing for fast and safe

installation. Self-aligned spherical seat bearings are supported by a robust frame construction. The rigid mechanical construction (shorter distance between bearings) allows for low vibration levels. The Series E-40 follows critical industry trends for simple, modular and integrated designs. It is offered from 10 to 40 MW, 6.6 to 13.8 kV, 50/60 Hz.





For more information, please contact your GE sales representative.

GE Energy  
Fort Wayne, IN 46802  
Motors 800 541 7191  
Parts 800 458 0451

[www.ge-energy.com/motors](http://www.ge-energy.com/motors)

© 2009 General Electric Company. All rights reserved.  
The GE Monogram, Custom 8000, Series 9000, Pegasus, Quantum, Quadramatic, Quadratorque, XSD Ultra, Energy Saver are trademarks and ecomagination is a service mark of General Electric Company.

GEA-17789 (07/2009)