

How Temperature Monitoring Impacts the Generator Market

New Stator Sensors from TE Connectivity Provide Greater Reliability and Efficiency for the Growing Global Generator Market

Trend Paper

The global market for electric motors and generators have grown steadily over the past few years. According to Orbis Research, this is due to the growing need for quality inspections, the surge in demand for power utilities and automobile production, and the increase in commercial and residential infrastructure growth, especially in developing economies. As an example, Orbis estimates that the global electric motor sales market will reach \$144.37 billion in value by 2023, up from \$99.95 billion in 2017 — an estimated CAGR of 6.32%.¹

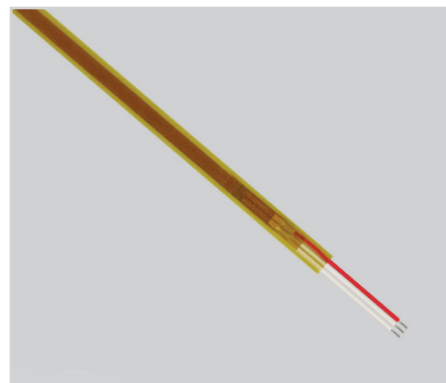
Further expanding the market for generators, China's "One Belt, One Road" initiative is promoting electricity demand in emerging markets in Asia, Africa, the Middle East and South America. With a strong push from the Chinese government, this ambitious project focuses on improving connectivity and cooperation among multiple countries spread across the continents of Asia, Africa and Europe.

Clearly, the expectations for stable power have increased around the globe. Sensors enable the measurement of properties such as temperature to validate motor or generator performance and system efficiency. So what is the impact of these trends? At TE Connectivity (TE), we recognize that large generator equipment is costly and difficult to repair.

As a global technology leader, TE Connectivity provides sensors and connectivity essential to today's increasingly connected world. In fact, we are considered one of the largest sensor companies in the world. TE sensors are vital to the next-generation of data-driven technology. With expertise across a broad range of applications — automotive, industrial, medical, appliance, aerospace and defense, and industrial and commercial transportation — we have deep expertise working with generator and electric motor manufacturers, and their design engineers. And TE offers a solution that can meet the growing demand, trends, and needs of this marketplace.

Stator Core Deterioration

Generators have an expected lifespan of 10 to 30 years depending upon the start/stop usage of the generator. Yet the most common failure of a generator takes place at the stator core via degradation of the insulation. This is typically caused by excessive heat or mechanical wear. Breakdown of the insulation will cause shorted turns or a ground between conductors and the field forgings. Very large generators can cost millions of dollars to replace or repair, and the downtime of the generator can be devastating to customers. And once the Vacuum Pressure Impregnating (VPI) is complete, parts cannot be removed. This makes condition monitoring for measurements like temperature during generator operation critical.



Further complicating things, in many cases, serious reliability problems with large synchronous motors may simply go unnoticed especially if the industrial facility's operation is a priority. In industrial applications, we've found that these problems are not well understood or known, making them difficult to detect in the early stages of development — that is, until a motor failure occurs. According to an article published in IEEE Transactions on Industry Applications, "Localized rotor overheating, commonly known as hot spots or black marks for large motors and specifically synchronous motors, is one example of such a scenario."²

Quality Stator Sensors Are Essential to Generator Lifespans

Very often dual-element stator RTDs are used in the slots of the stator coil, where one of the elements is only used as a backup in the rare instance that the other element fails. In many cases, there may be extra stator sensors installed into the motor/generator for that very same reason. While six stator sensors are required for a three-phase motor, there are often seven to nine sensors installed in the event one or more may fail.

TE's Solution for Temperature Monitoring Inside Large Motors

TE Connectivity's new Stator Temperature Sensor (Stator RTD and Stator Thermocouple) can offer the performance and reliability that global generator manufacturers require. Our stator sensors are used to monitor and respond to any temperature changes for potential damage of a motor/generator. Here's how they work.

The sensors are installed between the coils of the stator and are distributed around the circumference of the stator coil, and typically positioned in the center of the length of the slot. The sensors have direct contact with the insulation of both the upper and lower coils within the stator.



What are the standard signals, where are they sent, and how are they converted? RTD sensors will output a resistance. As the motor/generator is operating, the resistance will rise with the temperature of the motor. If a hot spot occurs or other failure takes place within the stator that causes the temperature to spike, the resistance of the sensor will also spike. This will be transmitted to the instrumentation used to monitor the motor or generator and will then trigger an alarm.

TE manufactures stator RTD sensors to meet the specification of ANSI C50-10-1990.

These temperature sensors are typically used in synchronous motors — small, medium and large — and generators that can produce high voltage. Our multiple sensing technologies and structural configurations can serve a wide variety of applications. These include hospitals, government buildings, wind turbines, ship generators, hydro-dam generations, nuclear power plants and large factories.

To achieve best results in sensing the stator slot for hot spots, a longer sensitive area is preferred. This allows the sensor to recognize hot spots of the stator coil over a much larger area than a small single point sensor, such as a single point RTD or a single junction thermocouple. TE stator sensors use longer sensitive areas on our stator RTDs.

TE Offers Excellence in Performance and Much More

With temperature monitoring during generator operation of such critical importance, TE's stator temperature line provides a good choice for customers who require flat, rigid, averaging sensors to measure stator-winding temperature inside large motors.

With flexibility to serve diverse applications, particularly large generators, and long-standing experience producing stator sensors, we can offer a high value when compared with other solutions. Here are the key benefits:

The Flexibility for Diverse Applications

From single and dual elements to sensing elements in platinum, copper, or nickel as well as in thermocouple packages, TE can match your application requirements. Body thickness can be as thin as 0.03 inches and body widths can be between 0.25 inches to 2.5 inches.

The Expertise and Experience with Sensors for Large Motors

Our stator sensors have high dielectric strength up to 5KV, and high operation temperature up to 180°C. These characteristics give our sensors excellent performance in large motors.

The Reliability and Proven Performance You Require

We have extensive experience in the sensor market and have a proven track record in quality and reliability.

The Global Reach with Local Support You Value

At TE, we have production set up for both the U.S. and China to provide service to a growing marketplace and have extensive local support resources that can offer you a quick response to your design engineering needs.

SOURCE

¹ Source: <https://www.reuters.com/brandfeatures/venture-capital/article?id=37757>

² Source: <https://ieeexplore.ieee.org/document/7600446>

TE Connectivity (TE) is a global technology leader, providing sensors and connectivity essential in today's increasingly connected world. We are one of the largest sensor companies in the world with solutions that are vital to the next generation of data-driven technology. TE's portfolio of intelligent, efficient and high-performing sensor solutions are used for customers across several industries, from automotive, industrial and commercial transportation and aerospace and defense, to medical solutions and consumer applications.

Learn more today at www.te.com.