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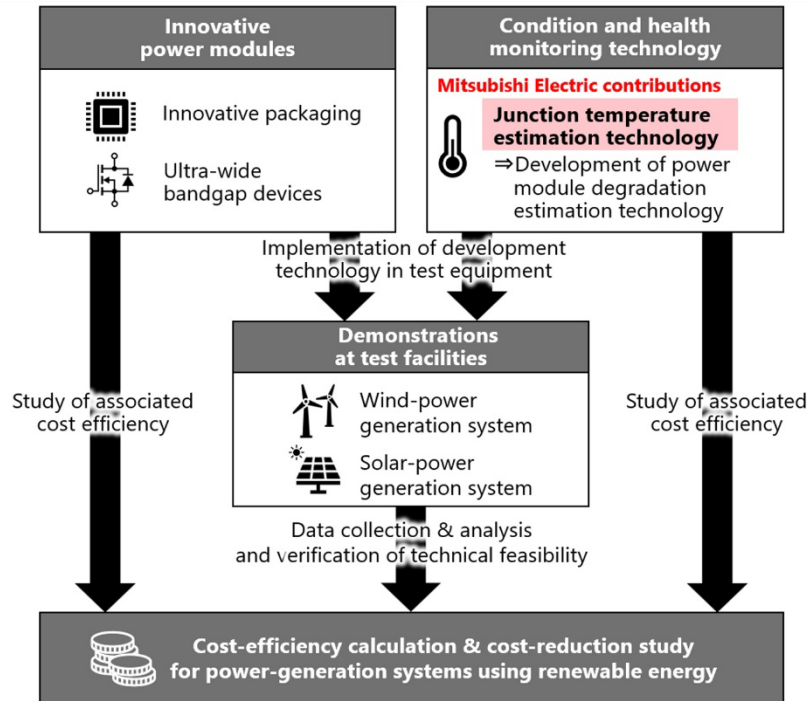
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Mitsubishi Electric Joins Horizon Europe’s “FLAGCHIP” Project to Develop Technology for Monitoring Power Module Condition

Will estimate junction temperature and related degradation of power modules



Overview of FLAGCHIP Project

TOKYO, January 30, 2025 – [Mitsubishi Electric Corporation](https://www.mitsubishielectric.com) (TOKYO: 6503) announced today that it will begin developing a prototype to demonstrate a junction-temperature estimation technology for power modules, which it is pursuing as a partner in the European Union’s Horizon Europe project aimed at developing advanced power modules and improving cost efficiency of renewable-energy power-generation. The company is participating through its European subsidiary Mitsubishi Electric R&D Centre Europe B.V., which has joined the project, called Flagship Advanced Solutions for Condition and Health Monitoring in Power Electronics (FLAGCHIP)*.

In the global effort to expand the introduction of renewable energy to support carbon neutrality, the need to

* Project website : flagchip-project.eu/

upgrade the reliability and maintenance of electronic devices for power conversion has become increasingly important. In particular, attention is being focused on technological innovations aimed at strengthening power module reliability and improving data acquisition and analysis methods to accurately determine degradation conditions in order to carry facilitate more timely maintenance.

The FLAGCHIP project currently involves 11 companies and academic institutions from nine European countries** engaged in developing advanced power modules, condition and health monitoring technologies, and devising methods for calculating cost efficiency of renewable-energy power-generation systems and reducing associated costs. Demonstrations of wind-power and solar-power generation systems using these technologies and methods will be conducted at test facilities owned by project partners in Norway and France. Mitsubishi Electric will be in charge of demonstrating a technology that estimates the junction temperature of silicon carbide metal-oxide-semiconductor field-effect transistor (SiC-MOSFET) semiconductor chips inside the power module, which will provide necessary data for accurately estimating module degradation. Starting in October 2026, the demonstration will use the newly developed prototype at a test facility in France where direct current (DC) voltage is converted to a specific DC voltage for a wind-power generation system.

Outline of FLAGCHIP Project

Purposes	<ul style="list-style-type: none"> • Develop innovative power module and condition and health monitoring technology • Calculate cost efficiency of entire renewable-energy power-generation systems and reduce costs where possible • Demonstrate technologies at test facilities for wind- and solar-power generation systems
Location	Test facilities of two partner companies: <ul style="list-style-type: none"> • SINTEF Energi AS (Norway) • SuperGrid Institute (France; Mitsubishi Electric test site)
Timing (planned)	<ul style="list-style-type: none"> • Overall project: September 2024 to February 2028 • Mitsubishi Electric test: October 2026 to February 2028



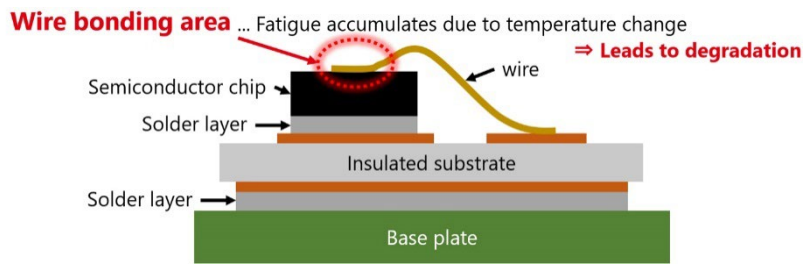
Horizon Europe and FLAGCHIP project logos

Mitsubishi Electric’s Role in FLAGCHIP Project

Demonstrating technology for estimating junction temperatures in power modules

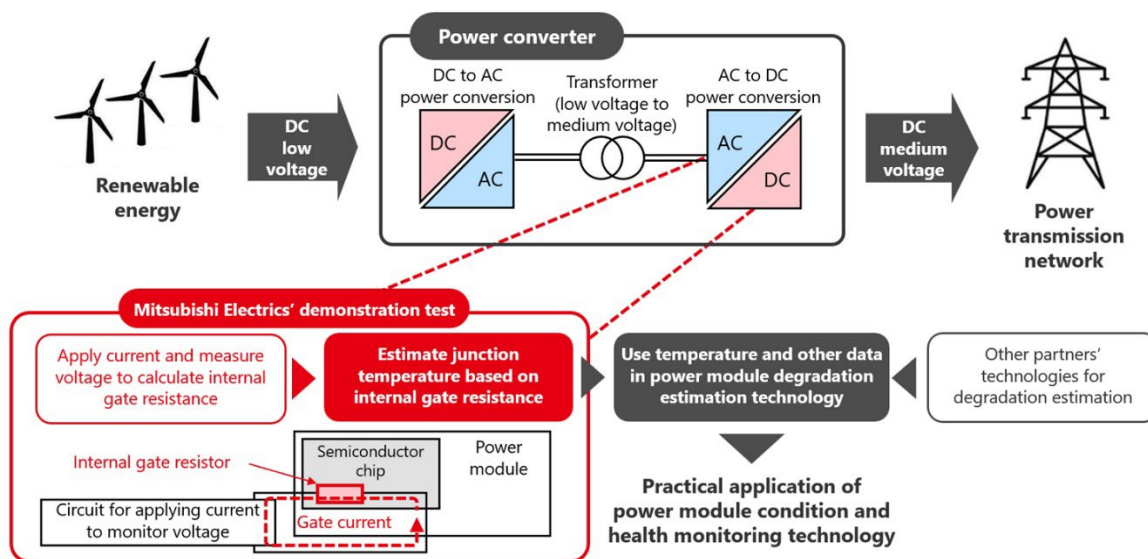
One cause of power module degradation is mechanical fatigue of the various material interfaces (e.g. wire bonding area which is the connection of the semiconductor chip and the thin metal wire connecting it to the substrate), caused by temperature fluctuations during operation. Observation of temperature changes in power semiconductor chip near the wire bonding area is expected to support degradation estimations.

** As of January 30, 2025.



Cross-sectional view of wire bonding area

The electrical resistance (internal gate resistance) on the surface of a power semiconductor chip varies with temperature. Mitsubishi Electric’s proprietary technology utilizes this phenomenon to calculate the internal gate’s resistance value. Specifically, by applying a gate current, the voltage value can be measured to accurately estimate the junction temperature of the SiC-MOSFET chip. The technology enables temperature estimation with a simple system configuration, without requiring temperature sensors to be installed in the power module. Mitsubishi Electric will demonstrate the technology at a DC/DC converter test facility for wind-power generation systems operated by the SuperGrid Institute in France. Junction temperature estimations will then be applied to degradation estimation technology for power modules developed by University of Nottingham in the UK, thereby contributing to the development of condition and health monitoring technology for practical use.



Semiconductor chip temperature estimation technology

Future Plans and Prospects

A device prototype will be completed by October 2026, after which the junction temperature estimation technology will be tested until February 2028. Mitsubishi Electric will continue to verify the effectiveness of using temperature estimations to estimate module degradation as well as conduct further research and development with the goal of commercializing the condition and health monitoring technology as soon as possible. Going forward, the company will contribute to achieving carbon neutrality by participating in the project and using the results obtained from it.

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About Mitsubishi Electric Corporation

With more than 100 years of experience in providing reliable, high-quality products, Mitsubishi Electric Corporation (TOKYO: 6503) is a recognized world leader in the manufacture, marketing and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, energy, transportation and building equipment. Mitsubishi Electric enriches society with technology in the spirit of its “Changes for the Better.” The company recorded a revenue of 5,257.9 billion yen (U.S.\$ 34.8 billion*) in the fiscal year ended March 31, 2024. For more information, please visit www.MitsubishiElectric.com

*U.S. dollar amounts are translated from yen at the rate of ¥151=U.S.\$1, the approximate rate on the Tokyo Foreign Exchange Market on March 31, 2024