Semiconductors Business Group Research and Development looking toward FY2026

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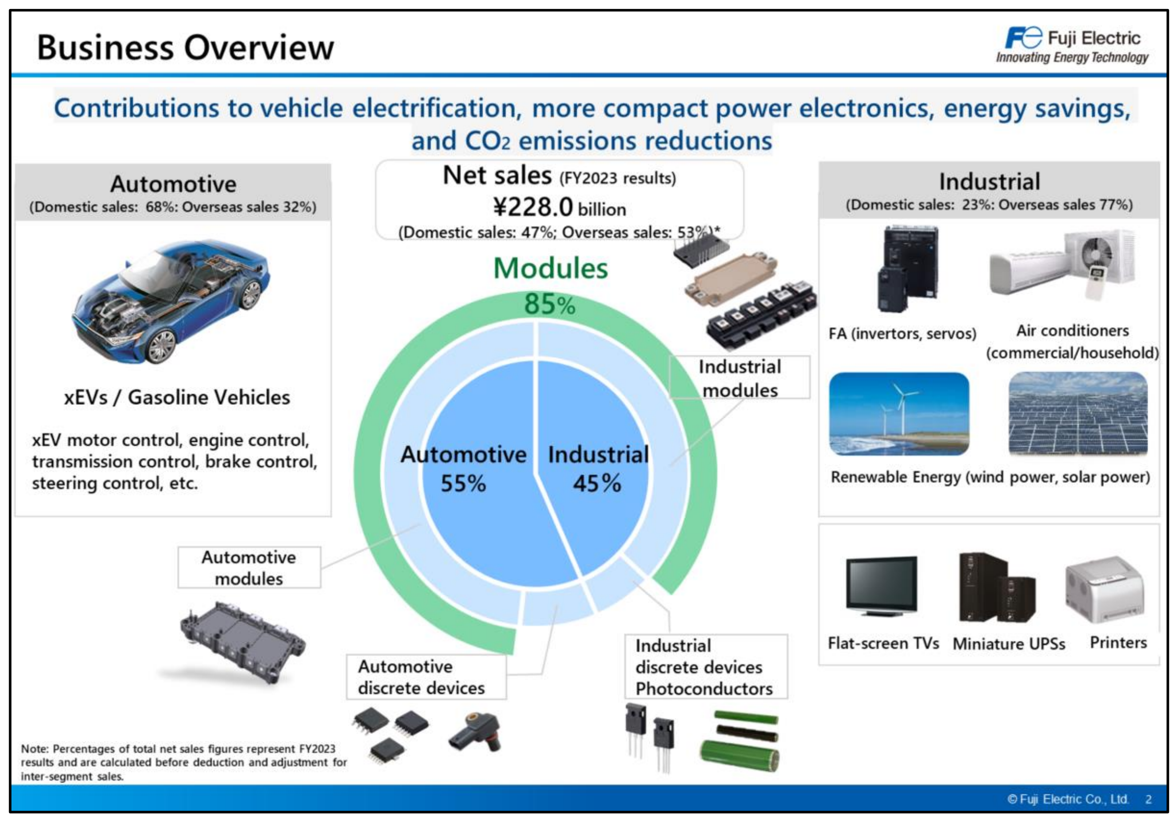
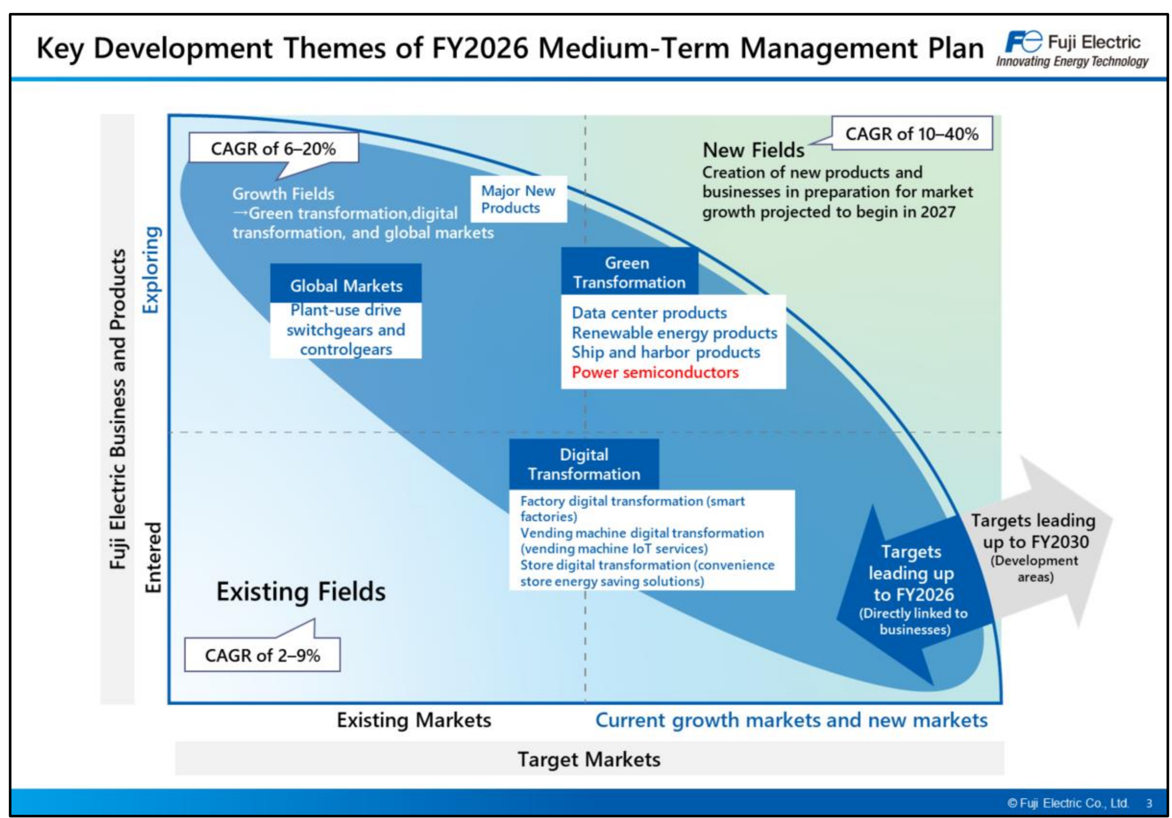
I'm Oonishi in charge of Development Division in Semiconductors Business Group. I will explain R&D looking towards FY2026.



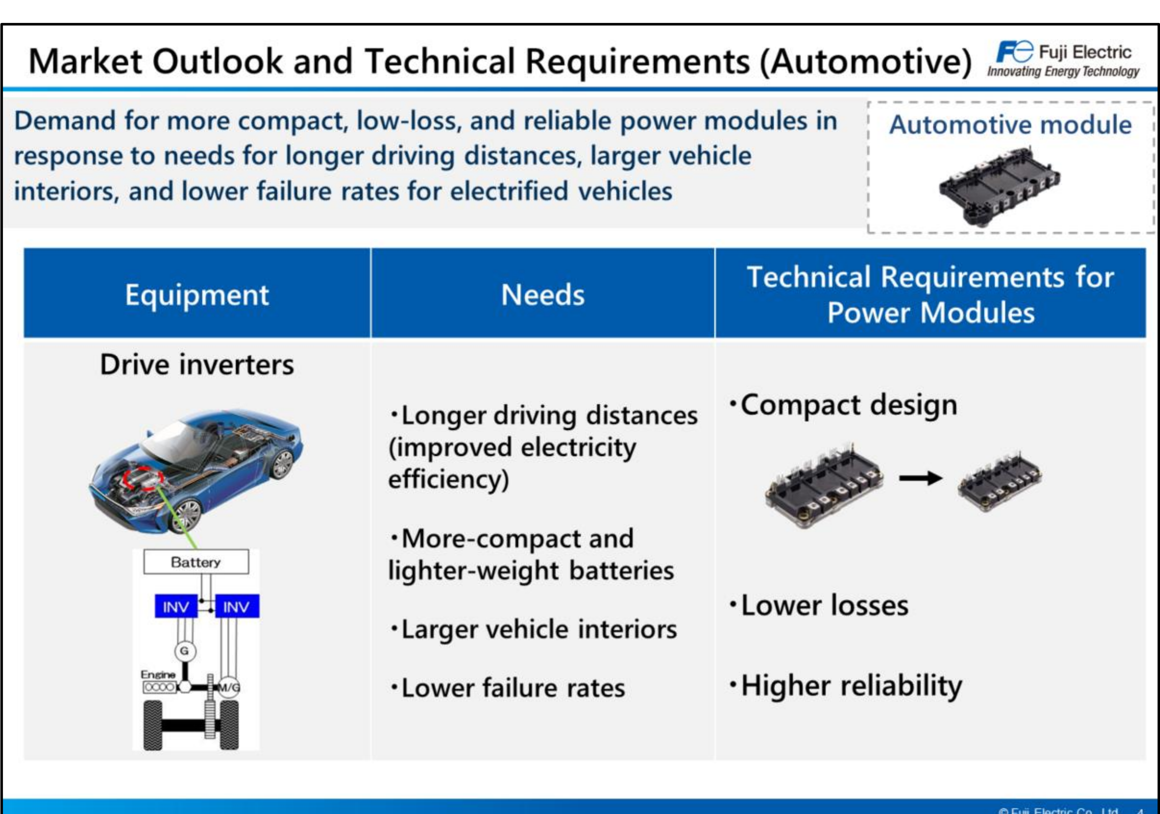
This page shows the business overview. Our semiconductor business is divided into industrial and automotive fields.

Net sales for FY2023 were 228 billion yen, of which the industrial field accounted for 45%, and the automotive field accounted for 55%.

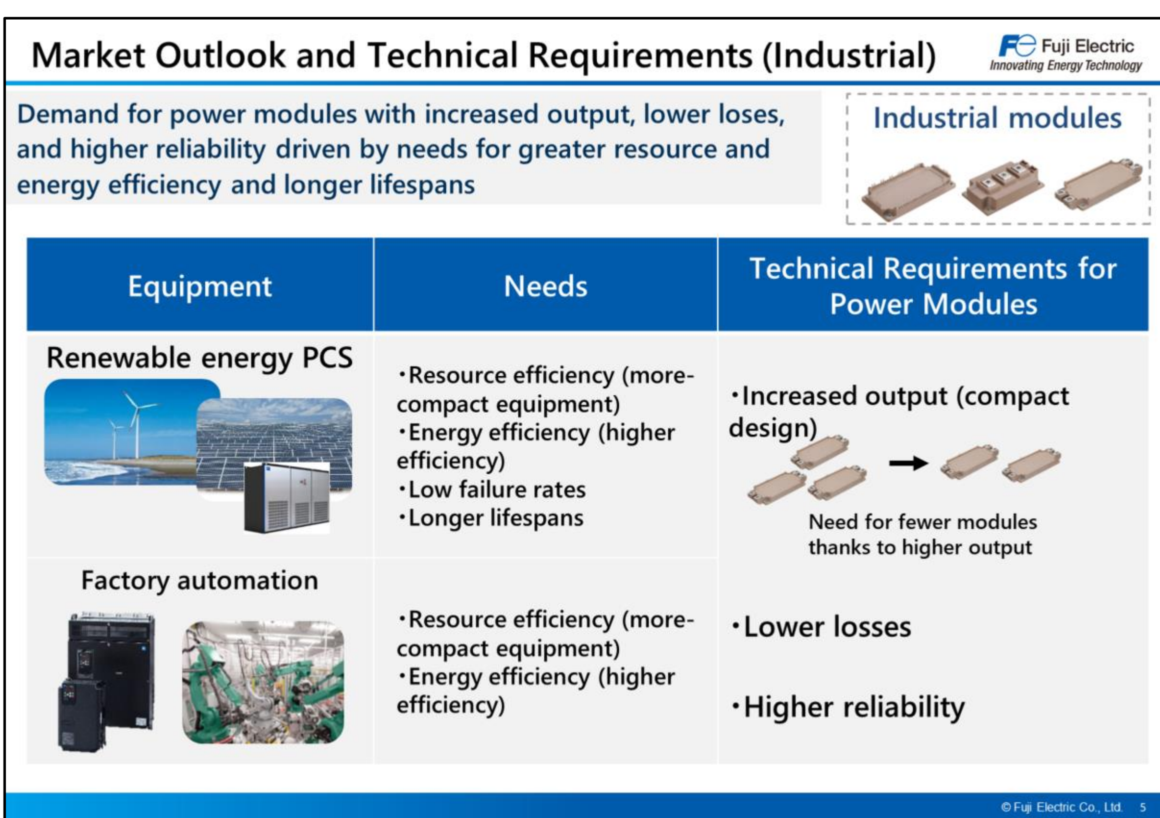
Industrial products are mainly for overseas markets, and automotive products are mainly for domestic markets.
Modules account for 85% of our net sales, and they are our mainstay products.



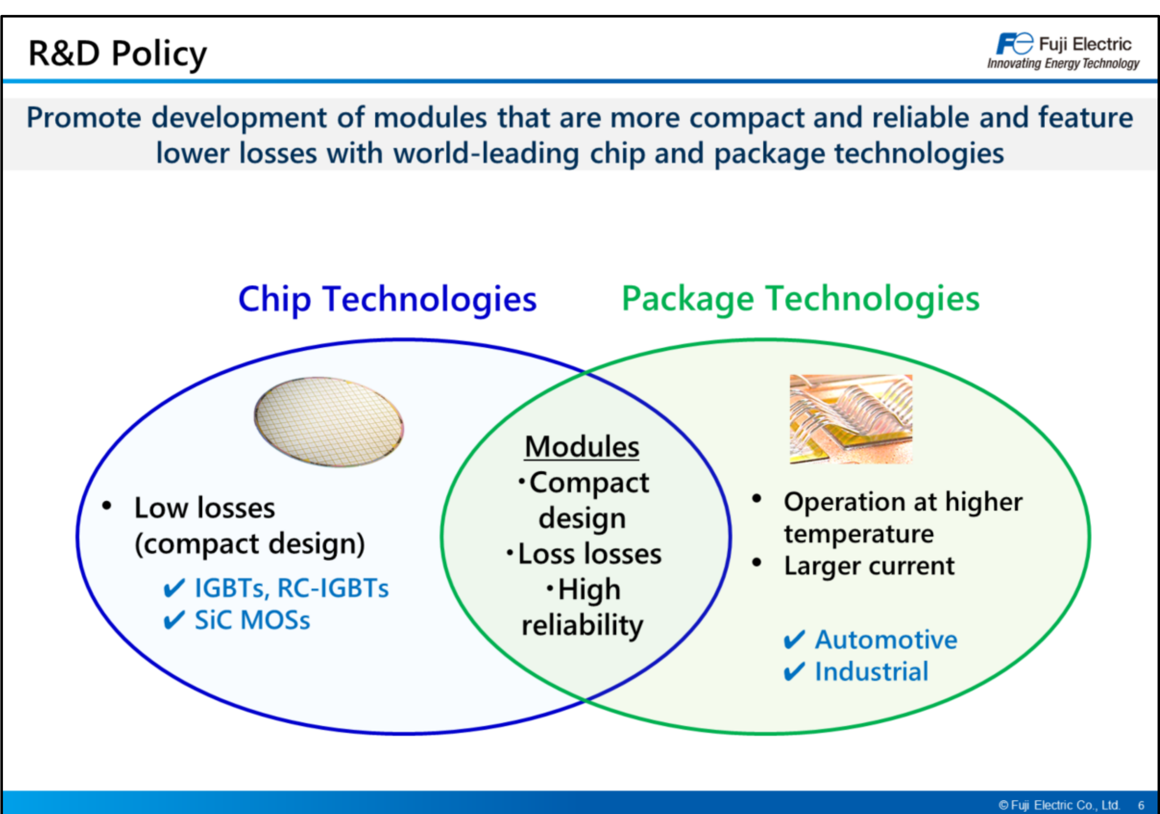
Power semiconductors are one of the growth areas and key development themes of the FY 2026 Medium-Term Management Plan. Today, I will focus on those modules in my presentation.



This page is about market outlook and technical requirements.
For automotive drive inverters, there are needs for longer driving distance, smaller and lighter-weight batteries, larger vehicle interior space, and lower failure rates, and power modules are required to be smaller with lower losses and higher reliability.



In the industrial field, for PCS (Power Conditioners) for renewable energy and FA (Factory Automation), there are needs for resource efficiency, energy efficiency, low failure rates, and longer lifespans, and their power modules are required to have higher output (compact design) with lower losses and higher reliability.



In response to these market trends, needs for equipment and technical requirements, we set our R&D policy to promote compact design, loss reduction, and high reliability of modules by applying the world-leading technology for loss reduction (compact design) for IGBTs, RC-IGBTs, and SiC-MOSFETs and the package technologies such as operation at high temperature and compatibility with large currents.

Reduction of Losses for IGBTs and SiC MOSs

Fuji Electric
Innovating Energy Technology

Development of new products (8th-generation IGBTs, 3rd-generation SiC MOSs) and next-generation products with lower losses

- ✔ 8th-generation IGBTs: Reduction of losses through unique surface structure and thinner wafers
- ✔ 3rd-generation SiC MOSs: Reduction of losses through new structure (proprietary precision-engineered structure)

Loss*
100
80
60
40
20
2015
2020
2025
2030
IGBT
6th-gen
7th-gen
8th-gen
More than 15% reduction
Next-generation
more than 10% reduction
SiC-MOS
1st-gen
2nd-gen
3rd-gen
More than 15% reduction
Next-generation
more than 10% reduction

* 6th-generation Si-IGBTs indexed to 100

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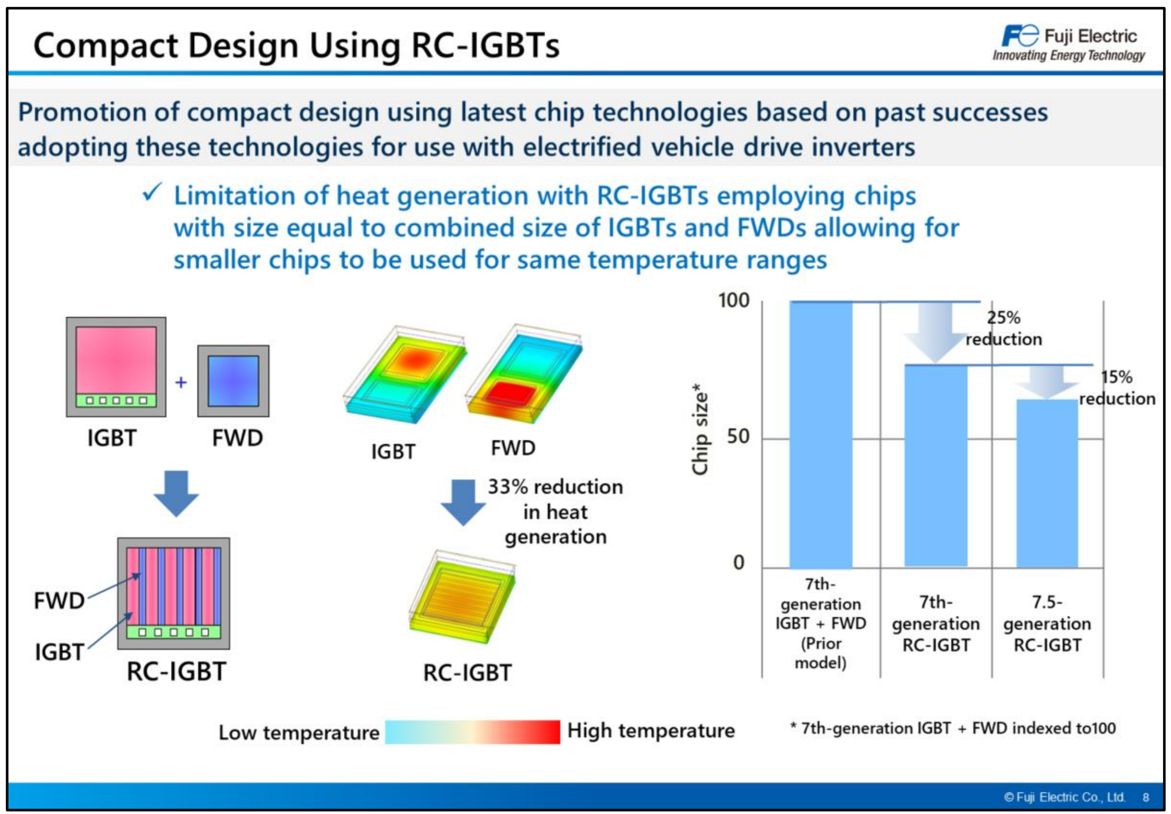
Next page is about our efforts to reduce losses of IGBTs and SiC-MOSFETs. For IGBTs, we are developing a new product of the 8th generation IGBT to achieve a loss reduction of more than 15% compared to the current 7th generation IGBTs with our unique surface structure and thinner wafers.

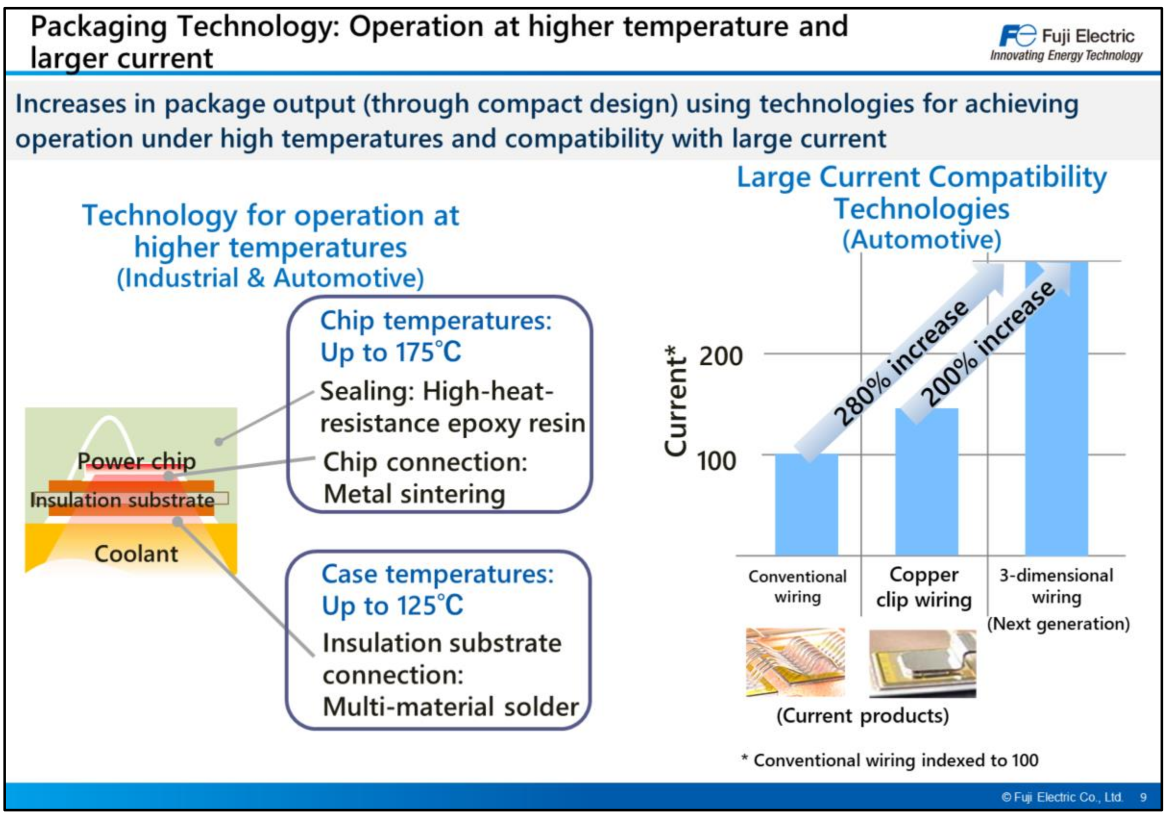
For SiC-MOSFETs, we are developing a new product of the 3rd generation SiC-MOSFET to achieve a loss reduction of more than 15% compared to the current 2nd generation SiC-MOSFETs by adopting a new structure (proprietary precision-engineered structure)

We plan to promote the development of next generation products.



This page explains the compact design of chips by RC-IGBTs.
The RC-IGBT is a combination of an IGBT chip and a FWD (free-wheeling diode) on a single chip. Compared to the case where an IGBT chip and a FWD chip are used separately, RC-IGBTs can reduce heat generation and the chip size.

Compared to the combination of a 7th generation IGBT chip and a FWD chip, the 7th generation RC-IGBT can be 25% smaller. Furthermore, the 7.5th generation RC-IGBTs that apply the latest technologies of IGBT and FWD chips, can reduce the size by 15% compared to the 7th generation RC-IGBT. We will continue to promote further size reduction with the latest chip technologies and RC-IGBTs.



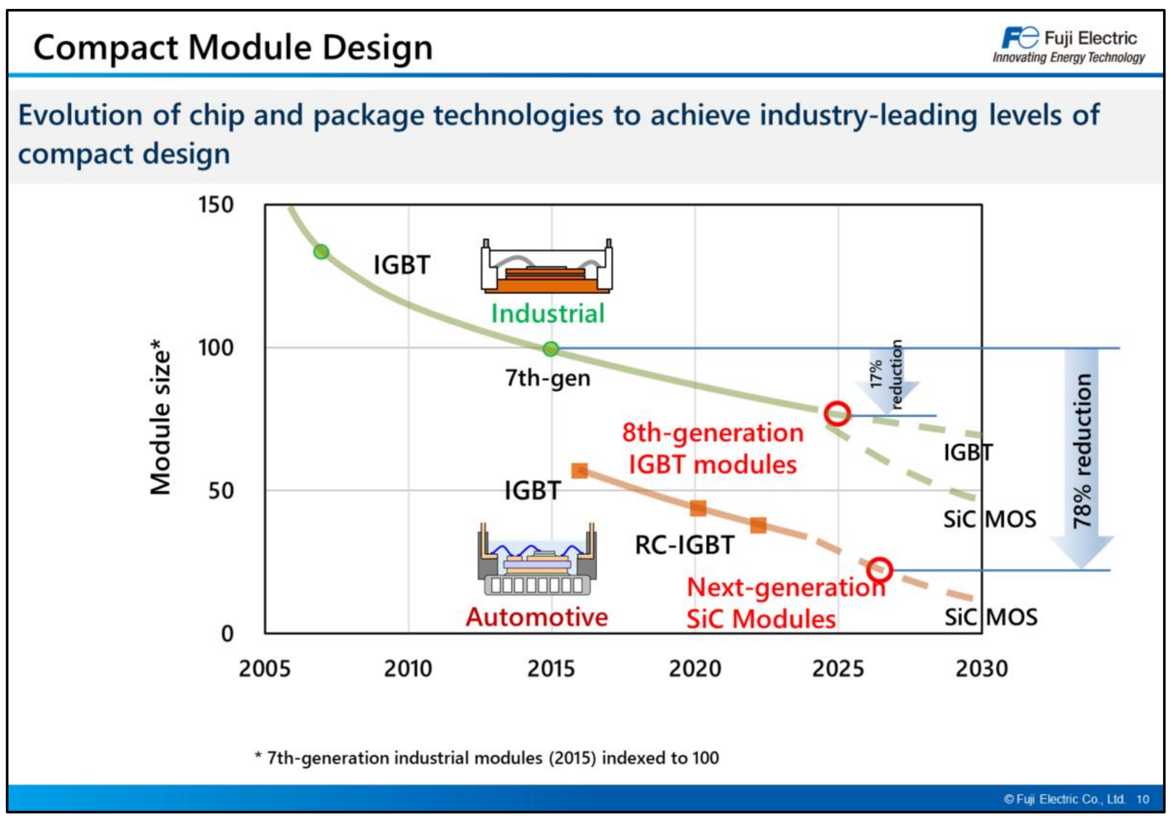
This page explains about operation at higher temperatures and larger current compatibility as package technologies.

If a module can be operated at a higher temperature, a larger current can be applied to increase the output power. To achieve such high-temperature operation, we are developing package technologies that enables operation at chip temperatures of 175°C or higher and case temperatures of 125°C or higher.

As a measure to address high chip temperatures, we are developing high heat-resistant epoxy resin for sealing material and metal sintering material for chip bonding. Also, to address high case temperatures, we are developing a technology of multi-material solder, which is a bonding material for insulation substrates.

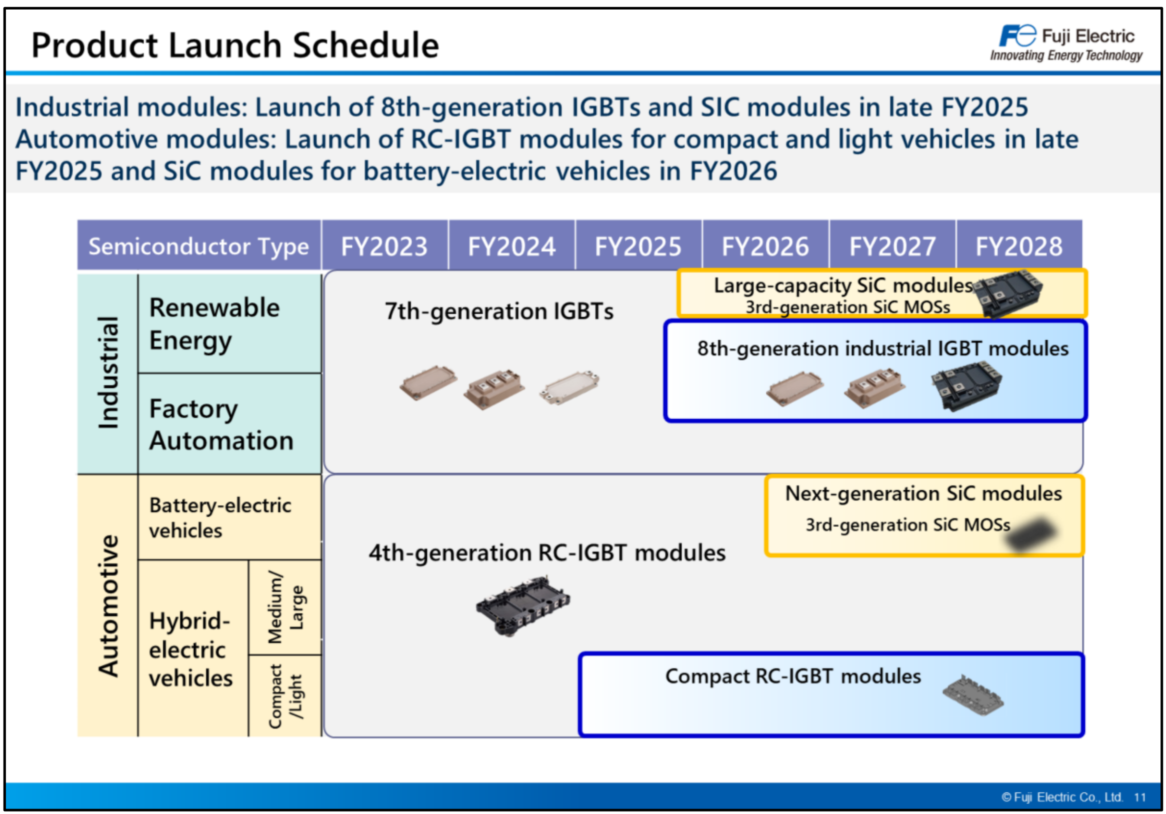
We are also developing three-dimensional wiring technology for compatibility with large current. Compared to conventional wire wiring and copper clip wiring, three-dimensional wiring enables compatibility with 2 to 2.8 times larger current.

We will continue to promote increasing package output by these technologies of high-temperature operation and large current compatibility.



This page is about our efforts for compact module design.
Utilizing the chip and package technologies explained earlier, we are developing technologies to realize the industry-leading level compact design.

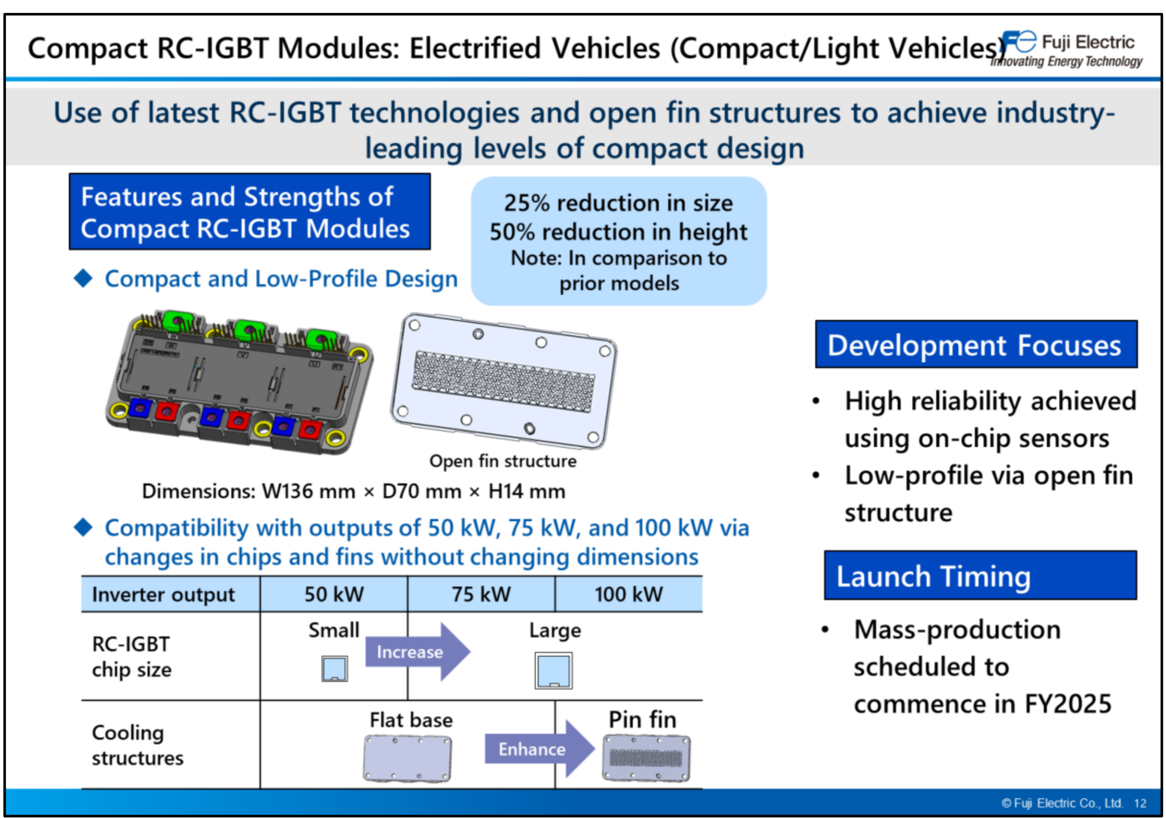
We are aiming to reduce the size of the 8th generation IGBT modules for industrial applications by 17% compared to the 7th generation products.
And for the next generation SiC modules for automotive applications, we are aiming for a 78% reduction in size compared to the 7th generation IGBT modules for the industrial applications.



This page is about product launch schedule for modules.

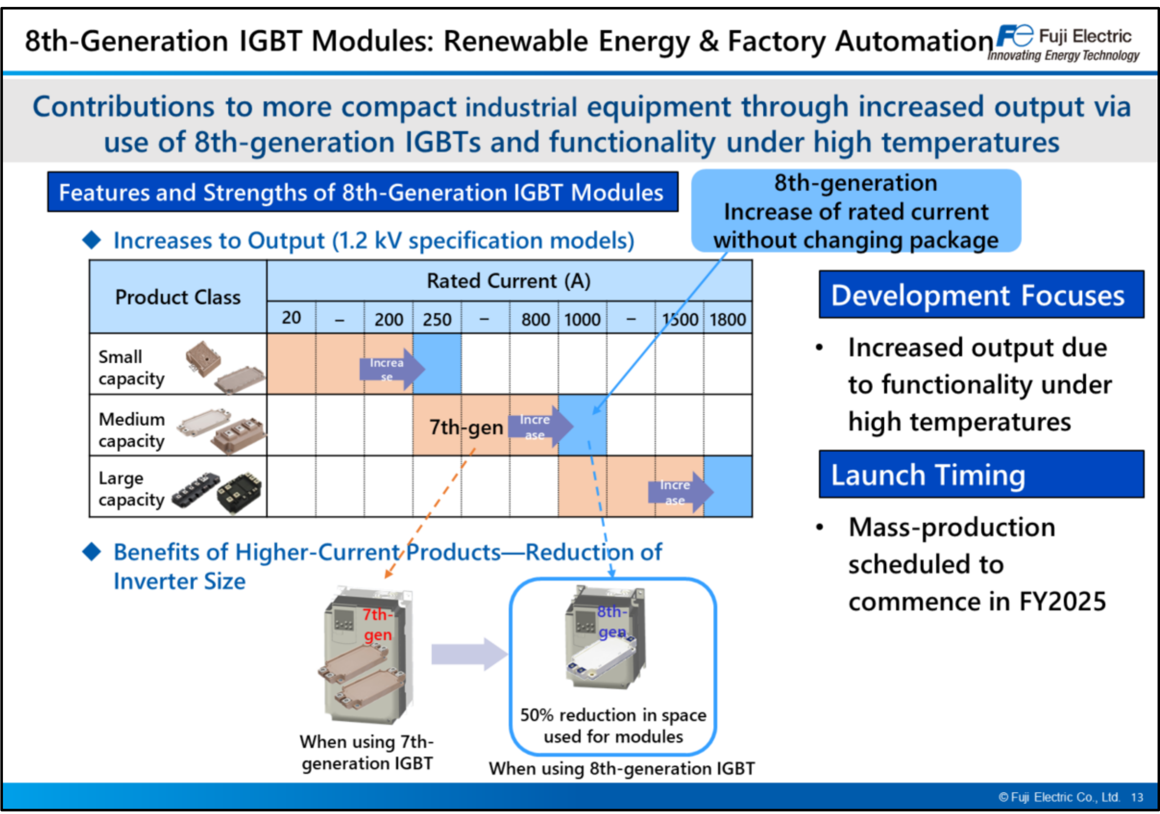
For industrial modules, we plan to launch the 8th generation IGBT modules and large-capacity SiC modules in the second half of FY2025.

For automotive modules, we plan to launch SiC modules for BEVs (battery-electric vehicles) in FY2026, and RC-IGBT modules for compact and light vehicles in FY2025.



For RC-IGBT modules for compact and light vehicles, we aim to achieve the industry-leading level compact design by employing the latest RC-IGBT technology and the open fin structure to realize a 25% reduction in size and a 50% reduction in height (height reduction) compared to conventional products.

Furthermore, by changing the combination of chips and fins, we plan to expand the product lineup to accommodate outputs of 50kW, 75kW, and 100kW without changing dimensions of the module.



This page is about the 8th generation IGBT modules applied for the fields of renewable energy and factory automation.

By increasing the output power through adopting the 8th generation IGBT chips and the package technology that supports high temperature operation, we aim to contribute to reduce the size of industrial equipment.

Taking a product with medium capacity as an example, the conventional rated current ranging from 250-800A, can be increased to 1000A without changing its package size.

As a result of this output power increase, the number of modules used for an inverter will be only one with the 8th generation modules, whereas two modules were required for the 7th generation modules, thus contributing to downsizing of inverters.

Large-Capacity SiC Modules: Renewable Energy & Electric Trains

Higher output and efficiency achieved through use of 3rd-generation SiC MOSs and new packages

Features and Strengths of Large-Capacity SiC Modules

◆ Increased output (50% increase in comparison to 7th-generation IGBTs)

60% reduction in loss in comparison to 7th-generation IGBTs

Dimensions: W140 mm × D100 mm × H40 mm

◆ Planned Product Lineup

	Rated Voltage	Rated Current
Large-capacity SiC modules	2.3 kV	1200 A
	3.3 kV	850 A

Development Focuses

- Reduction of loss through low inductance
- Optimization of port layout to enhance ease of parallel connection

Launch Timing

- Mass-production scheduled to commence in FY2025

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This page is about large-capacity SiC modules used for renewable energy and electric train applications.

With higher output power by adopting the 3rd generation SiC-MOSFETs and new package technology, we aim to contribute to higher efficiency of the equipment on which these modules are installed.

Compared to the 7th generation IGBT module, we can increase the output power by 1.5 times and reduce the loss by 60%.
As for the product lineup, we plan to develop a 2.3kV/1200 A product for renewable energy applications and a 3.3kV/850 A product for electric train applications.

The development focuses on loss reduction through lower inductance and optimization of the port layout for easier parallel connection of large-capacity modules.

This concludes my presentation.

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