

Semiconductor & Device Business

May 2023

Mitsubishi Electric Corporation

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Executive Summary

Executive Summary

- Revenue and operating profit margin of Power Device Business as a Key Growth Business are on track to hit the FY2026 target^{※1}: over 240 billion yen in revenue and over 10% in OPM.

Growth Target

		FY2022 Actual	FY2023 Actual	FY2026 Target
Semiconductor & Device	Revenue	¥241.4 billion	¥281.5 billion	¥0.3 trillion
	OPM	7.0%	10.4%	12%
Power Device	Revenue	¥179.0 billion	¥210.0 billion	¥240.0 billion or more
	OPM	6.5%	8.4%	10% or more

- Accelerate business growth, making the most of market expansion, by strengthening SiC capability. Aim for SiC ratio in revenue of 30% or more, in Power Device Business by FY2031.
- Extensive SiC module installation in electric vehicles will significantly boost its demand, which will help SiC module to be applied to various fields. Mitsubishi Electric will contribute to the realization of GX^{※2} by providing highly competitive SiC modules leveraging our strengths to these wide range of fields.
- In order to ensure this growth strategy, we have doubled the investment plan from FY2022 to FY2026. Continuous aggressive investment for further business expansion will follow.

※1 Plan as of Nov. 2021 ※2 GX : Green Transformation

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Business Overview

Business Portfolio

Provide key devices to support carbon-neutral, safe, secure and comfortable society for a sustainable future.

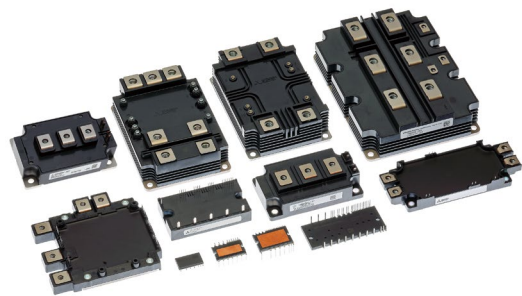
Power Device Business

Key Growth Business

Pursue technological evolution and contribute to the realization of GX

Revenue ratio 75%

Contribute to the realization of a decarbonized society and comfortable life by implementing energy-saving power electronics equipment such as electric vehicles, consumer products (air conditioners, etc.), industrial equipment, renewable energy and railways



Si Power Device

- IPM
- IGBT module
- Power MOSFET module
- HVIC, etc.

SiC Power Device

- SiC-SBD, SiC-MOSFET
- Full SiC power module
- Full SiC-IPM
- Hybrid SiC power module , etc.

High-frequency and Optical Device Business

Resilient Business

Create DX and new value through changes in functions and applications

Revenue ratio 13%

Contribute to the realization of a safe and secure world and a comfortable digital society with compound semiconductor devices, applied to various applications such as wireless communication, optical fiber communication and sensing fields



High-Frequency Device

Satellite Communications, 5G Base Stations, Millimeter Wave Radar, etc.



Optical Device

Optical Fiber Communication, Data Center, etc.



Infrared Sensor Device






Security, Monitoring, People Counting, Air Conditioning, Vehicle Interior Sensor, etc.

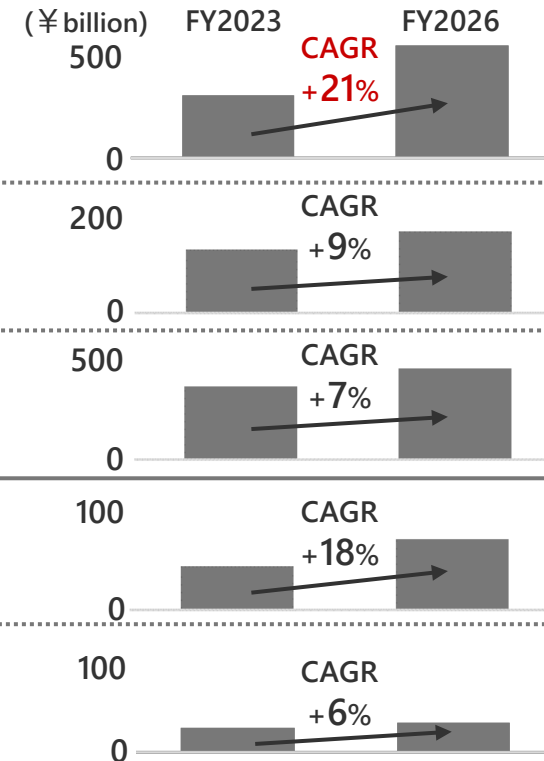
※Revenue ratio : FY2023 actual

Market Environment and Direction of Growth

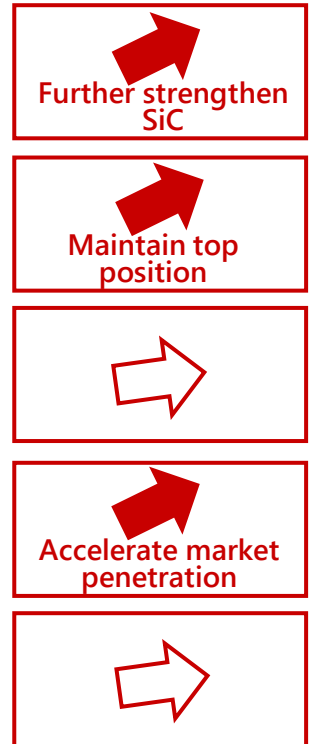
- Power Device: Strong momentum for decarbonization initiates mid-term market expansion and high growth will be achieved mainly in the automotive and consumer fields.
- High-Frequency and Optical Device: Expand GaN device sales for base station applications, where demand is expected to grow, while maintaining solid optical device business.

《 Market environment 》

Power Device		Automotive	<ul style="list-style-type: none"> ● Progress in electrification ● Accelerating a shift toward SiC, enabling significant reduction of power loss compared to Si (FY2023→FY2026 CAGR: +165%)
		Consumer	<ul style="list-style-type: none"> ● Increasing use of inverters ● Growing demand for ATW heat pumps
		Industry Renewable Energy Railways	<ul style="list-style-type: none"> ● Progress in energy saving and automation
High-Frequency and Optical Device		GaN Devices for 5G Base Stations	<ul style="list-style-type: none"> ● Demand increasing due to service area expansion and investment in emerging countries
		Optical Device for Data Center	<ul style="list-style-type: none"> ● Advances in high-speed optical networks due to larger data communication and artificial intelligence (AI)



《 Direction of growth 》



※Market size is our estimate based on the forecast by a research company.

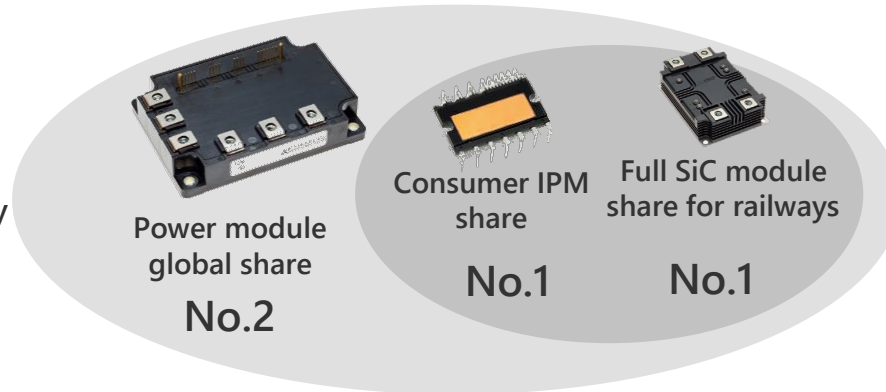
Our Strength

- Two strong businesses with global top-class product lines.
- Provide cutting-edge key devices to the market, making the most of synergies inside Mitsubishi Electric Group.

Global Top Class Key Devices

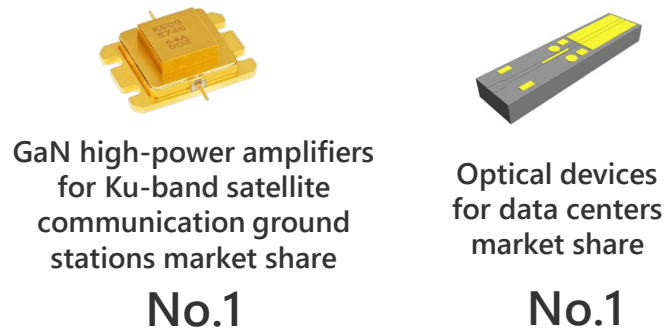
Power Device Business

- Combine design technology and manufacturing technology to achieve high performance and quality



High-Frequency and Optical Device Business

- Advanced compound semiconductor technology
- Product development capabilities to meet various market needs



Mitsubishi Electric Group Resource

- R&D Department
Product development and technical collaboration with the R&D department that brings together advanced fundamental technology and production technology within the group
- Application Business Department
Co-creation and collaboration with other departments, covering a wide range of application fields



Provide cutting-edge key devices to the market

※ All shares are actual results for FY2022, according to our estimate

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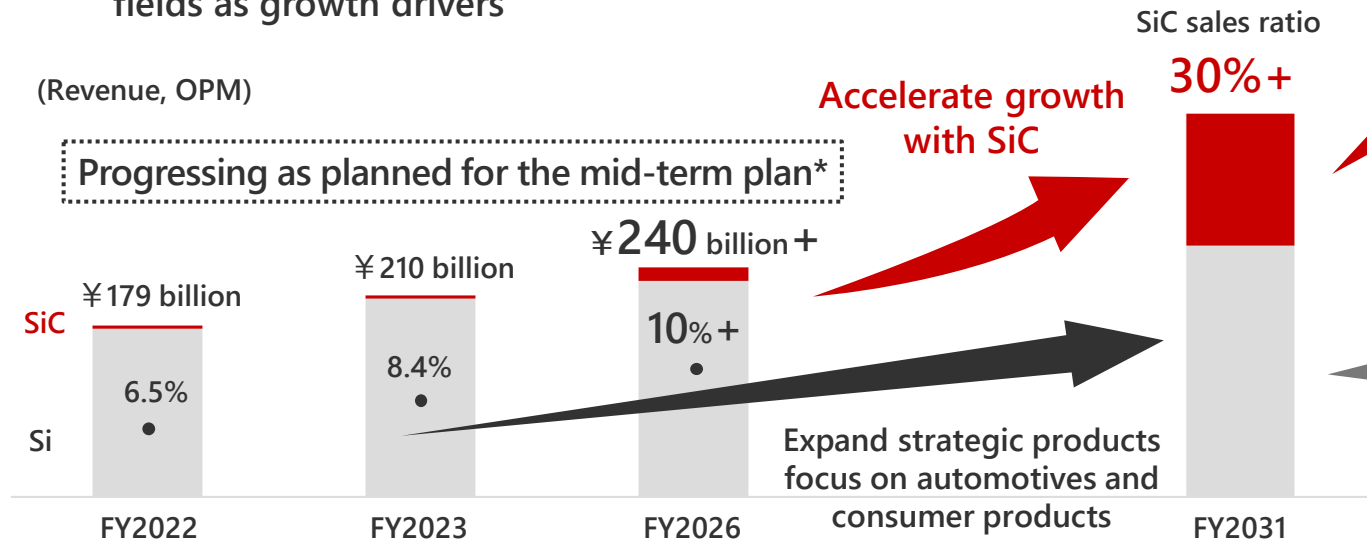
Growth Strategy of Key Growth Business - Power Device -

Growth Strategy - Power Device -

- Focus on enhancing business in the rapidly growing automotive field and the consumer field where we are strong, while maintaining industrial, renewable energy, and railway fields as solid business base.
- Strengthen the growth capability based on our long-term experience and expertise of SiC, then accelerate growth by making the most of market expansion.

《 Basic strategy 》

- Concentrate resources on fields where our strengths meet market needs
- Expand sales by further strengthening the automotive and consumer fields as growth drivers



Strengthen growth capability focusing on strong SiC

- Accelerate development and next-generation SiC products for automotives
- Strengthen global sales activities
- Secure stable procurement and strengthen technical cooperation with SiC substrate suppliers, by building strategic partnerships
- Increase production capacity (enhance productivity of 150mm wafers, construction of new 200mm factory building)

Strengthen profitability and build a business foundation for the next growth

- Transform product portfolio (promotion of standardization and sharing, expansion of strategic products mainly for automotives and consumer products)
- Further productivity improvement (expand production of Si 200mm wafers at the highly efficient Fukuyama factory, increase Si wafer diameter to 300mm)

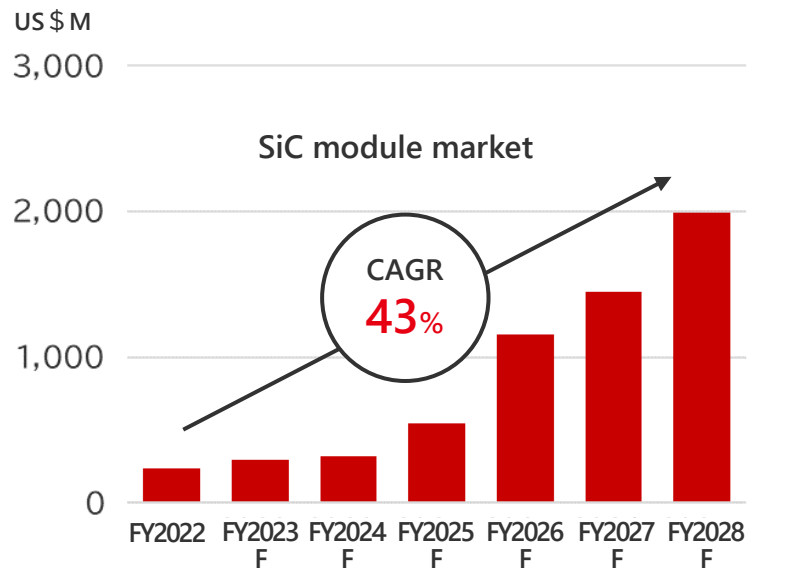
※ Plan as of November 2021

Focus Business Areas to Accelerate Growth - Power Device -

- Extensive SiC module installation in electric vehicles will significantly boost its demand, which will help SiC module to be applied to various fields.
- Mitsubishi Electric will contribute to the realization of GX by providing highly competitive SiC modules leveraging our strengths, e.g. comprehensive technology platform and rich market achievement, to those wide range of fields.

SiC Power semiconductor market trends

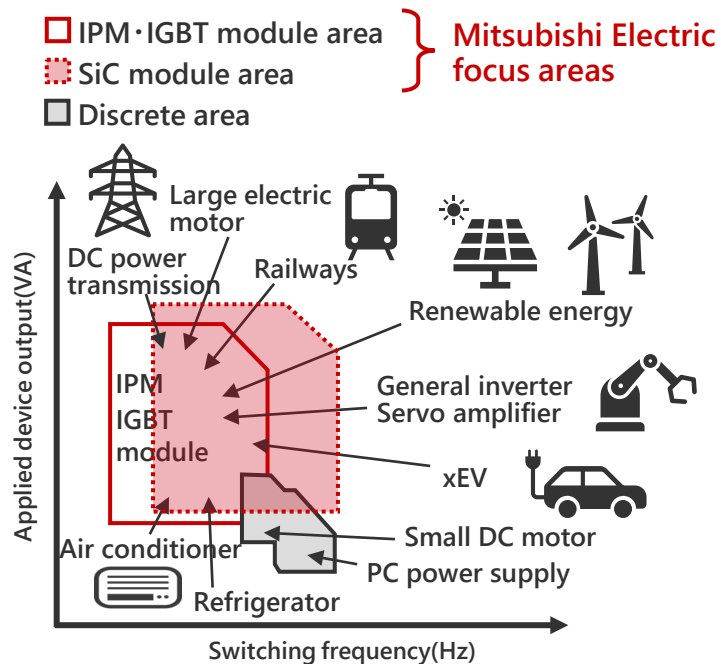
- The module market is expected to expand rapidly
- Adoption of SiC spreads to various fields of application



Source: OMDIA

Mitsubishi Electric Power Device Business Strategy

- World-leading module product line
- Provide SiC modules for various applications



1990th Began development ahead of other companies

- World's first** (Released in October 2010)
SiC DIIPM™ installed in room air conditioner "Kirigamine"
- World's first** (Released in December 2012)
Hybrid SiC-IPM installed in numerical controller (CNC) drive unit
- World's first** (Press released in June 2015)
High-capacity full SiC power module installed in main converter for high-speed railway
- World's highest output** (Development announced in February 2019)
For xEV full SiC power module installed in ultra-compact power unit

Contribute to GX in a wide range of fields

※World's first and world's highest: According to our research at the time press release

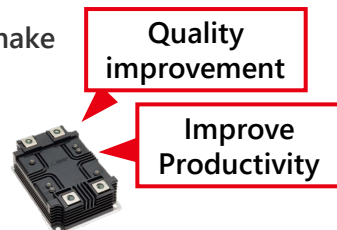
Strengths of SiC Module - Power Device -

Provide optimal devices fit for the needs of the rapidly expanding SiC module market, by combining Mitsubishi Electric's diverse elemental technologies (compound semiconductor technology, chip technology, and module technology) and our extensive achievements in the market.

● Compound semiconductor technology: Advanced epitaxial growth and wafer processing technology

- ◆ Established cutting-edge manufacturing technology to make SiC substrate defects harmless

Ensured high reliability and productivity with highly precise screening technology



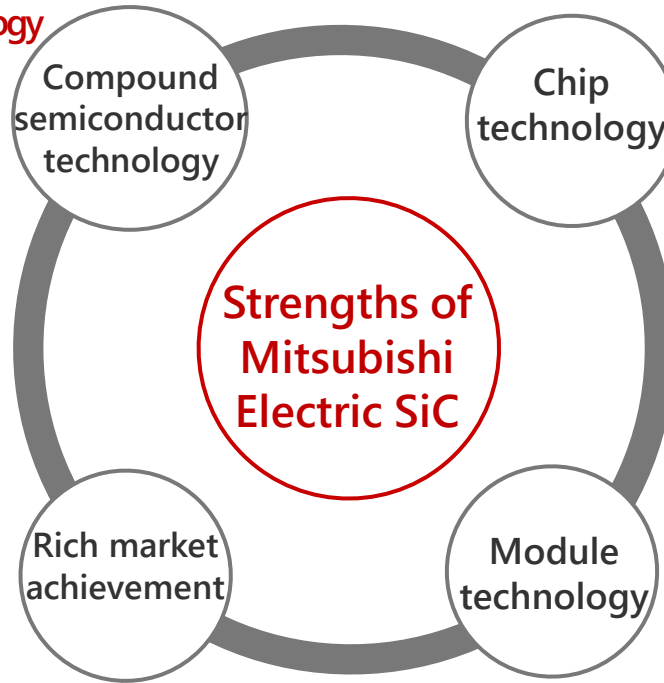
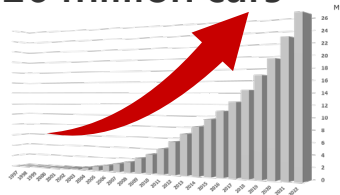
● Market achievement: SiC module

- ◆ Awarded Siemens Mobility "Moving Beyond" prize at InnoTrans 2022 for high performance and high reliability



● Market achievement: automotive market

- ◆ Cumulative adoption including Si, equivalent to 26 million cars

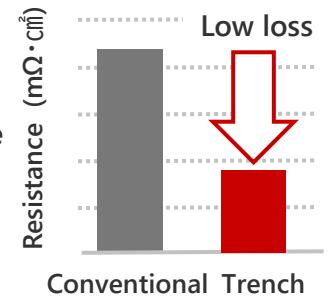


Provide module solutions, optimized for various applications

● Chip technology: World's highest level of low loss*1

- ◆ Unique trench MOSFET structure, reduces electric field, achieves approx. 50% lower on resistance compared to conventional SiC*2.

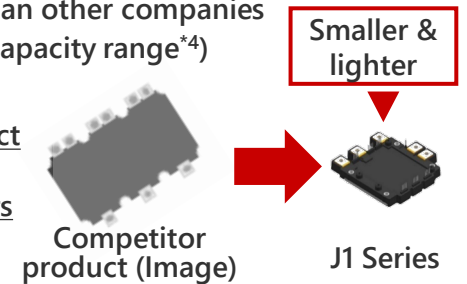
Contribute to xEV's longer cruising range and system cost reduction



● Module technology: Industry-leading compact design and weight reduction

- ◆ J1*3 Series is approx. 29% smaller and approx. 53% lighter than other companies (products in the same capacity range*4)

Contribute to compact design and cost reduction of inverters



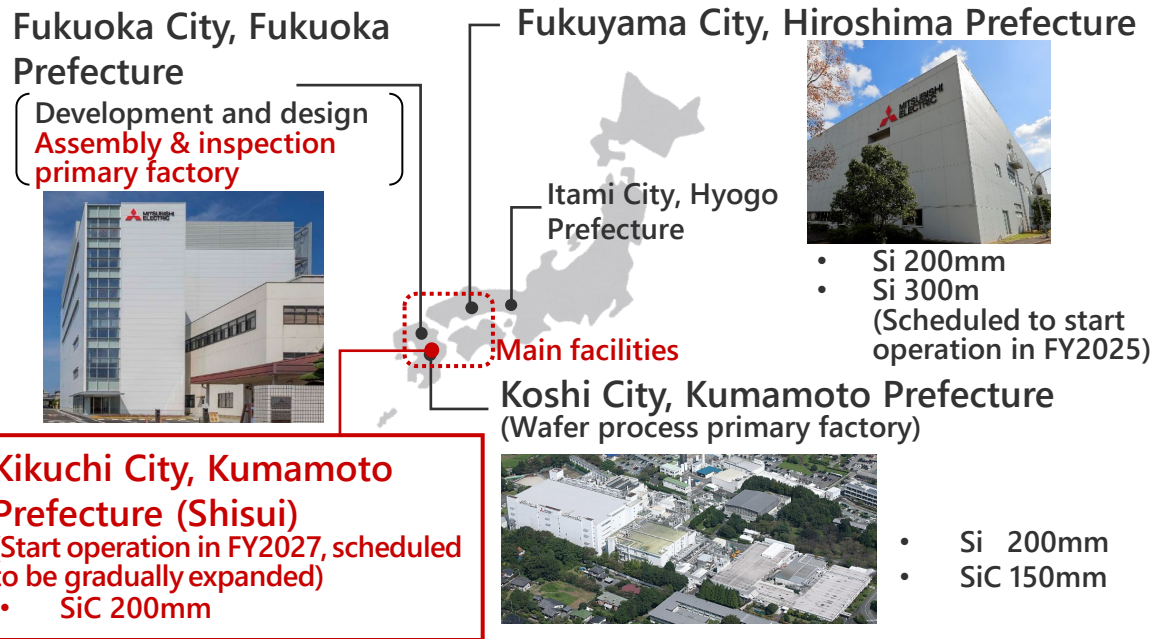
※1 For devices withstand voltage of 1500V or more. According to Mitsubishi Electric's research as of Sep 30, 2019, press release

※2 Our planar MOSFET ※3 Power module for automotive ※4 As of May 2023, according to our research

Manufacturing Strategy - Power Device -

- Promote wafer diameter enlargement and increase production capacity, in addition to establishing and expanding automated production line with high productivity.
- Establish integrated product development and manufacturing structure in assembly and inspection process for development, design and production technology verification in order to enhance product competitiveness.

Power device manufacturing map



Assembly & inspection process facilities (power module)

- Melco Power Device Corporation (Fukuoka [Fukuoka City/Itoshima City], Hyogo [Tamba City/Toyooka City])
- Mitsubishi Electric GEM Power Device (Hefei) Co., Ltd. (Hefei, Anhui, China)

Key initiatives

Wafer Process	SiC	<p>Strategic investment to expand capacity for mid-term growth</p> <ul style="list-style-type: none"> • 200mm: construct a new wafer plant in Kumamoto (Shisui) area, achieve cutting-edge energy efficiency and automation. The capacity will be increased according to future demand • 150mm: enhance existing production facilities <p>Production capacity: approx. 5 times (FY2023→FY2027)</p>
	Si	<p>Further improve productivity by expanding production at the Fukuyama Factory</p> <ul style="list-style-type: none"> • 300mm: start large-diameter line operation from FY25 at Fukuyama Factory • 200mm: constructed a line with improved production efficiency and increase production at Fukuyama Factory <p>Production capacity: approx. 2 times (FY2021→FY2026)</p>
Assembly & Inspection		<ul style="list-style-type: none"> • Enhance manufacturing capabilities: construct a new factory in Fukuoka area to integrate product development and manufacturing structure for development, design and production technology • Increase capacity: expand timely and appropriately in response to increasing demand

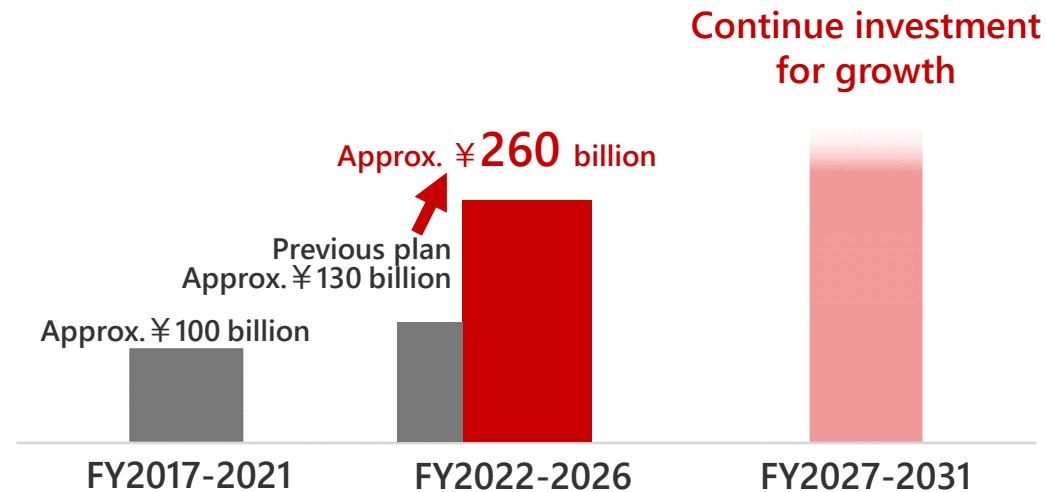
Strategic Investment Plan - Power Device -

Double the previous investment plan*¹ to approximately 260 billion yen, including the construction of a new factory building for SiC, in order to drive the growth strategy for Power Device Business.

Capital investment (actual, planned)

Double cumulative capital investment from FY2022 to FY2026

- Continue strategic growth investment for further business expansion in SiC, in addition to the conventional plan



SiC 200mm wafer new factory building

Achieve high production efficiency through cutting-edge energy conservation and high-level automation

- Achieve energy savings of approximately 30%*³ compared to the conventional system by thoroughly recovering waste heat, in addition to adopting a swirl-induced stratified air conditioning system (TCR-SWIT®*²) in clean rooms
- Employ automatic transport system to enable labor saving and equipment operation rate improvement



Startup scheduled in April 2026

※1 Plan as of November 2021 ※2 TCR-SWIT is a registered trademark of Takasago Thermal Engineering Co., Ltd. ※3 Simulation value in this project

4 Continuous Growth by Leveraging Business Synergies

Continuous Growth of Semiconductor & Device Business by Leveraging Business Synergies

- Strengthen Mitsubishi Electric Group's integrated solutions by providing key devices.
- Develop devices with high added value from the customer's perspective, by incorporating the knowledge from internal application business departments

◆ Infrastructure BA



- DC power transmission
- Railways
- Defense/Space
- Renewable energy
- Uninterruptible power system (UPS)
- Optical network

◆ Industry & Mobility BA



- Industrial robot
- Inverter, servo
- xEV

◆ Life BA



- Elevator
- Air conditioner
- Home appliances

Semiconductor & Device Business

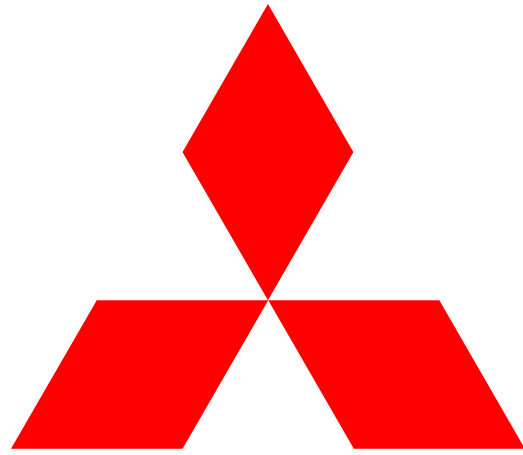
Device development with high market competitiveness



“Leading social change through the “evolution” and “innovation” of semiconductors”

- Provide high value-added devices from the customer's perspective to a wide range of markets
- Continuous growth of the Semiconductor & Device business





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ELECTRIC**

Changes for the Better