As Mitsubishi Electric nears its 100th anniversary, our mission is clear — apply our technologies to contribute to society and enhance the quality of life around the globe. We are working to create a brighter future through innovation and ensure a more sustainable world. We are extending our global reach and pioneering developments in fields ranging from home appliances to satellites, introducing breakthrough after breakthrough for the benefit of society, industry, and individuals. Our path to the future is built on an untarnished record of innovation and excellence, and our tradition of "changes for the better."

**JUST A FEW OF OUR ACHIEVEMENTS**

- **Power Semiconductor Devices**
  - Power semiconductor devices are essential for making various kinds of power electronics equipment more energy-efficient, from Traction and Electric Vehicle (EV) / Hybrid Electric Vehicle (HEV) to industrial robots and air conditioning systems.

- **Transformer Equipment Development Technologies**
  - We verify the reliability of our transformers utilizing the largest environmental testing facilities capable of simulating severe natural environments, including extreme cold/heat, lightning, and earthquakes.

- **Micro-via-laser Drilling Technologies for Printed Circuit Boards**
  - High-speed and high-accuracy precision laser processing enables printed circuit boards to be pierced at 6,000 holes per second; an FA technology supporting the evolution of smartphones.

- **Mobile Mapping System (MMS)**
  - Consisting of equipment such as GPS antenna, laser scanners and camera mounted on a vehicle, the MMS can acquire 3D position data including buildings, road contours, and other roadside data while driving. It has diverse applications such as public survey projects and infrastructure management.

- **SIC Train Circuit Systems**
  - Utilizing an age of green railway infrastructure, our silicon carbide (SIC) traction inverters, together with our regenerative braking systems and other technologies, are delivering unprecedented energy savings.

- **Continuous Industrial Revolution**
  - While we are in the midst of the 4th industrial revolution Mitsubishi Electric automation products have and will continuously contribute to the advancement of manufacturing; from next generation PLCs, “the brains behind the production line”, to advanced robotics and precise servo and motion control Mitsubishi Electric is delivering manufacturing technologies that are a step ahead of the times.

- **Ultra-high-speed elevator in Shanghai Tower**
  - Completed in 2015, three ultra-high-speed elevators serve the Observation Deck (119 floors above the ground), one of them The ultra-high-speed passenger elevators with a world-class speed of 1,230m/min.

- **Autonomous Control Technologies for Spacecraft**
  - Featuring advanced guidance, communications, data processing and power-supply technologies, our autonomous control module pilots Japan’s first unmanned automated supply vehicle to the International Space Station. Pictures of the ISS and HTV have been provided by JAXA.

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Towards next generation safety, stability, comfort and energy conservation. Advanced rail solutions that only Mitsubishi Electric can offer.

Safety
The pursuit of safety is an important task in the world of rail no matter what the era. Mitsubishi Electric’s diverse array of advanced technologies, including automated technologies such as the Train Control and Management System (TCMS) and safety systems – which are able to monitor the status of a situation and apply control automatically – are supporting the creation of transportation systems that all passengers can feel secure.

Stability
Mitsubishi Electric supports to realize to maintain the punctuality of transportation services through the provision of highly flexible solutions in response to diverse transportation needs.

Comfortable
We strive to create transportation systems that are both easy to use and offer a high level of comfort to all users. Wide-ranging technologies that can only be realized by a comprehensive electrical manufacturer enable integrated, high-quality transportation services that offer comfortable trains and convenience and timely access to the necessary information when in the station.

Ecology
For the sake of the sustainable development of society and our future ways of life, we propose environmentally-conscious transportation systems. Bringing together monitoring and control technologies and energy-saving technologies, we are able to realize comprehensive, advanced environmental performance in the four domains of train, station, depot and line.
Leveraging the technological power of a comprehensive electrical manufacturer to create rail systems in close involvement with customers.

Mitsubishi Electric’s proposal-based sales system, which allows us to grasp our customers’ real needs face-to-face, ensures sincere and speedy responses. Offering backup via a comprehensive range of support systems, from the stage of formulation of the customer’s introduction plan to post-introduction maintenance and management, we work with you to create optimal rail transport systems.

### Evaluation tests / Verification

- **Actual train environment simulator**
  - We are constantly working to improve the quality of our software in order to ensure exact reproduction of an operating train in the test environments employed in our factories.

- **Feeding network simulator**
  - We conduct power simulations incorporating large-scale and complex feed circuit networks.

### 3D simulation

- **We have introduced 3D design in pursuit of even higher-quality development, enabling us to achieve high quality from the initial stage.**

### Test verification equipment

- **Verification in combination with traction systems**
  - We conduct verifications by applying inertial loads to propulsion control systems and traction motors.

### International certification

- **We have CMMI and certification through third-party certification organization including IRIS, and are able to respond to overseas projects.**

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**CMMI certification**
- Subject to certification:
  - Transmission & Distribution Systems Center Ako Factory: Main transformer for electric train

**IRIS Certification**
- **International Rail Industry Standard (IRIS) certification**
  - [Subject to certification]
    - Brake control unit
    - Train propulsion control equipment
    - Train information equipment
    - Train depot systems
A system integrator that realizes "Powering," "Braking," "Control" and "Comfort" functions in a single company.

Powering trains safely and stably
Prevention control and power supply unit that incorporates leading edge inverter control. We support safety and comfortable operation with proven AC motors and drive equipment in addition to the latest technologies.

Full-50°C VVVF inverter
Using the well-proven inverter I3C, we have realized a cooling structure with the latest technology. Using the next-generation material SiC, we have realized a 40% reduction in power consumption, in addition to 40% reduced volume and mass.

High-speed and high-volume Ethernet communications realize a simple and secure system. We employ high-speed and high-volume Ethernet communications to achieve a consistent and secure communication between rail and vehicle equipment.

Wayside equipment
Wayside equipment also includes systems such as automatic train operation (ATO), automatic train operation (ATC), etc.

Train Systems
Train Systems equipment enables us to also realize CBM*1. *1 Condition Based Maintenance

Convenience and comfort / Providing spaces in which passengers can feel safety and secure
We contribute to improving passenger services with air conditioning comprising both passenger and driver sections, and image display, incorporating the latest information technology. We also work to enhance indoor security.

Onboard display (Full-color LED)
A display that we incorporate in every passenger car enables us to also display driving data for the driver's cabin. A display also serves as a wide area of the base ceiling.

Train Control and Management System (TCMS)
Train Control and Management System (TCMS) communication between trains and wayside equipment.

HVAC (Air conditioning)
Multiple temperature sensors allow the onboard environment to be controlled to a comfortable and sound environment.

Onboard crime prevention systems
High-resolution cameras monitor and record every part of the train, deterring crime. Functions can also be expanded to live display of the driver's cabin, etc.

Loudspeaker (Linear Fan)
Continuous improvement in air conditioning systems.

Train safety / Security equipment / Automatic Train operation
Safe and secure braking / Automatic control

Brake control unit
A learning function increases ride comfort and the precision of stops, while predictive control for busy traffic periods realizes energy-saving operation.

Onboard crime prevention systems
High-resolution cameras monitor and record every part of the train, deterring crime. Functions can also be expanded to live display of the driver's cabin, etc.

Integrated security device
Simplifies maintenance and assembly, reduces noise; eliminates the need for cleaning and reduces cost, loss and reduced noise; eliminates the need for cleaning and reduces cost.
The combination of advanced digital control technology and a self-diagnostic function results in a high-reliability system that also reduces maintenance manpower.

Control and protection equipment

We supply shell-type rectifiers employing a dense layout of silicon rectifiers incorporating shell-type transformers and high-voltage elements. The units save space and reduce loss.

Transformer rectifier

Large-capacity (100kA) DC breaker with high-speed breaking capability.

DC Breaker

These units conserve energy by converting train regenerative energy into AC and enabling it to be used for ancillary equipment. They enable stable operation even in response to rapid changes in regenerative energy.

Regenerative inverter

Latest IEC Standard complied, compact size cubicle type gas insulated switchgear (C-GIS).

Power-receiving switchgear

Today, “Shinkansen” is a word that the entire world knows. Mitsubishi Electric traction transformers and Converter-Inverter support the operation of the Shinkansen network. The advanced technologies that we cultivated during development for the Shinkansen, a domain in which limit performance is demanded, are highly regarded. Now it has been applied to urban lines and LRV™ in AC catenary systems. Together with our air conditioning systems that create a comfortable onboard space, the application of these technologies continues to expand.

Converter-Inverter

The use of SiC module reduces size and increases efficiency.

Traction transformers for high speed railways

A proprietary configuration reduces oil use in addition to realizing reductions in size and weight; we have also worked to reduce the necessary maintenance.

HVAC (Air conditioning) (Shinkansen)

Compressor controlled by inverter enables fine control of onboard temperature.

*6 Light Rail Vehicle

Shinkansen

* * *

S-EIV®

(Station Energy Saving Inverter)

Power switching equipment that employs dry air composite insulation and uses no greenhouse gases. A CBM* function enables abnormalities to be detected at an early stage.

7.2kV composite insulated switchgear

New Energy Grand Prize

Director-General’s Prize, Agency for Natural Resources and Energy

CBM

function

Substation

Supplies the surplus regenerative energy created by train’s breaking to station electrical equipment.

S-EIV®

(Station Energy Saving Inverter)

Power supply system

Contributing to the creation of more environmentally-friendly railway systems with diverse energy technologies.

From leading-edge power management systems to environmentally-conscious equipment. Cooperation between onboard equipment and wayside equipment makes it possible to use regenerative energy more effectively, enabling energy to be saved throughout the entire railway system.

200kW – 30sec

Brake

Flow of regenerative energy

Station

S-EIV

Station electric room

HVAC (Air conditioning) (Shinkansen)

Shinkansen

Hokkaido Shinkansen

Tohoku Shinkansen

Akita Shinkansen

Yamagata Shinkansen

Joetsu Shinkansen

Hokuriku Shinkansen

Sanyo Shinkansen

Kyushu Shinkansen (Kagoshima route)

Hiroshima

Kagoshima-chuo

Hokkaido Shinkansen

Tohoku Shinkansen

Akita Shinkansen

Yamagata Shinkansen

Joetsu Shinkansen

Hokuriku Shinkansen

Sanyo Shinkansen

Kyushu Shinkansen (Kagoshima route)

Shin-Yokohama

Hiroshima

Kagoshima-chuo

Hokkaido Shinkansen

Tohoku Shinkansen

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Flow of regenerative energy

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AC substations

Power-receiving switchgear
We employ torsion bar spring-operated equipment with excellent energy transmission efficiency from 145kV to 550kV.

Feeding transformer
We have realized practical use of roof delta (RD) connected transformer for simple connection and a simple configuration. The equipment is also lightweight and saves space.

Control and protection equipment
The employment of an MX-type distributing board boosts reliability and operability, in addition to reducing the expenditure of labor power in maintenance.

DC substations

Control and protection equipment
The combination of advanced digital control technology and a self-diagnostic function results in a high-reliability system that also reduces maintenance manpower.

Power-receiving switchgear
Latest IEC Standard complied, compact size cubic type gas insulated switchgear (C-GIS).

Regenerative inverter
These units conserve energy by converting train regenerative energy into AC and enabling it to be used for ancillary equipment. They enable stable operation even in response to rapid changes in regenerative energy.

Transformer rectifier
We supply shell-type rectifiers employing a dense layout of silicon rectifiers incorporating shell-type transformers and high-voltage elements. The units save space and reduce loss.

DC Breaker
Large-capacity (100kA) DC breaker with high-speed breaking capability.

From leading-edge power management systems to environmentally-conscious equipment. Cooperation between onboard equipment and wayside equipment makes it possible to use regenerative energy more effectively, enabling energy to be saved throughout the entire railway system.

Power-supply system

Remote power monitoring and control system

Substation

Power control center

Station

Power company

Train

Power station

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Remote power monitoring and control system

Substation

Power control center

Station

Power company

Train

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Rising to the challenge of new forms of transportation in the ICT era.

Ensuring safe and stable transportation through the optimization of trainset operation and operation control. In addition, precise train control realized via cooperation between onboard and wayside equipment optimizes energy consumption throughout the entire transportation system.

Automatic Train Supervision (ATS)

These systems enable centralized monitoring and control of train operation. User interfaces that offer superior visibility and operability enable accurate understanding of the status of train operation and rapid and precise command decisions. Diverse functions also assist in the formulation of operation plans.

Passenger Information Control (PIC)

LCD panels display train departure and arrival information, line information, advertisements, etc. Videos, still images and information in letters and characters can be freely combined.

Radio train control systems (ATACS*/CBTC*)

These systems enable trains to detect their own position, and enable control via two-way radio transmission between onboard and wayside equipment. In addition to making it possible to streamline wayside equipment (doing away with signals, etc.), cooperation between onboard and wayside equipment using advanced radio technology enables high-density operation, automatic operation and power-saving operation.

Radio equipment

A full lineup of radio equipment tailored to train control using the radio LAN band, the train radio band, etc. Ensures stable communication quality.

Wayside equipment

Wireless technology enables position data and control data for each train to be exchanged, and control to be applied to the distance between trains, speed, route, etc. The use of a failsafe processor ensures a high level of safety.

Onboard equipment

Obtains control data related to the interval between trains while transmitting position data for the subject train to wayside zone controller via radio communications, enabling ATO to be applied within a restricted speed.
Creating next-generation information infrastructure by offering various products.

Voice communication between wayside systems and onboard systems and the deployment of communications systems in areas including signals and power are essential to train operations. Leveraging the technologies that we have cultivated over many years, we are able to supply systems of the highest reliability.

Increasing the efficiency of maintenance via a sufficient support system and unique technologies.

Contribution to reducing lifecycle costs by providing support for CBM. A full range of maintenance services also offer rapid response to malfunctions and increase the efficiency of inspection procedures.

Train lifecycle management solutions.

Creating platforms for systems that collect and utilize train monitoring data by integrating the Train Control and Management System (TCMS) with wayside equipment. The sharing and use of monitoring data and related data enables rapid response to malfunctions (breakdown maintenance) and increased efficiency in inspection procedures (time-based maintenance). It also allows monitoring data analysis techniques to be honed and knowhow obtained towards the realization of condition-based maintenance (CBM).

Maintenance services

Mitsubishi Electric provides comprehensive maintenance services that respond to our customers' needs, from onsite responses to handover-related services. We always respond with honest maintenance services that consider the customer.

Making stations even more comfortable with facilities offering absolute safety and security and abundant information services.

Today, in the ongoing diversification of the services provided by rail operators, stations are no longer place simply to take a train; they form part of our living space in which people come together. Mitsubishi Electric supplies a range of products and systems that assist in making stations safe and comfortable spaces that respond to the needs of their diverse users.

Safety and security

Elevators and escalators

Seeking to realize shared spaces that everyone can use together, we provide elevators and escalators for platforms and concourses that are both easy to use and welcoming to all users.
Train depot systems

Maintenance information management system (MIMS)
Centralized management of train equipment logs and train data, including maintenance data and malfunction data, in a database. Supports expansion to use in malfunction prediction and improvement of maintenance procedures.

Depot information management system (DIMIS)
Formulates train operation (allocation) plans based on main line timetables and train maintenance plans. Can also be used in the formulation of depot work plans and route control.

Measurement and analysis of wayside equipment.

Mitsubishi’s MMSD™️ infrastructure monitoring system enables measurement and analysis of wayside equipment using measurement cars
Using high-precision 3D measurement and a range of sensing technologies, we are able to automate social infrastructure inspections and equipment measurements, reducing the expenditure of manpower and increasing precision. Conducting measurements in motion using road-rail vehicles and similar equipment makes it possible to conduct precise 3D measurements in a short period. Analysis and processing of 3D shape data enables its use in a variety of fields and applications.

Examples of analysis

① Measurement of structure gauge
   Enables measurement of structure gauge for tunnels, etc.

② Tunnel wall status analysis
   Internal changes in tunnels are displayed as differently-colored areas.

③ Beacon and signal location measurement
   Enables measurement of absolute position of beacon, equipment management based on absolute position.

④ Measurement of deviation of contact wires
   Enables measurement of distance from central position of catenaries.

⑤ Formulation of 3D CAD data
   Enables 3D CAD data to be formulated from 3D shape data.

Reinforcing relationships with local railway operators and car builders by expanding global manufacturing and services.

New rail projects are getting underway one after another throughout the world. Attention is being focused on rail as an environmentally-friendly form of mobility. Mitsubishi Electric works with joint ventures and adds to its range of local manufacturing and servicing bases. Integrating with local communities and contributing to local regions, we advance our activities every day with the goal of forming close local partnerships.
Meeting the needs of the present age with uncompromising high-quality manufacturing and cutting-edge technologies.

With an absolute commitment to quality, we adopt a total approach to manufacturing in order to enable us to offer products of ever-higher quality. We are working to strengthen cooperation between our manufacturing bases and research centers, always striving to resolve a range of difficult issues with a view towards the future of the rail industry.

**Main Domestic Manufacturing and Research Bases**

- **Itami Works**
  - Building stock systems
  - Signal control systems
- **Transmission & Distribution Systems Center**
  - Switchgear
  - Lightning arresters
- **Kobe Works**
  - Automatic Train Supervision
  - Transportation power supply system
  - Optical network systems
  - Disaster prevention systems, etc.
- **Nagasaki Works**
  - Train air conditioning
  - Platform screen doors
  - Passenger information display
    - (Full-color LED)
  - On-board display
    - (Full-color LED)
- **Nakatsugawa Works**
  - Linear fan (Lindelier)
  - Solar systems
- **Power Distribution Systems Center**
  - Power distribution system
- **Power Device Works**
  - (Fukuoka, Kumamoto Prefecture)
  - Power devices (IGBT modules, IPM, SiC power modules, etc.)
- **Advanced Technology R&D Center**
  - SiC power modules
  - Computer platforms for traffic data control (traffic management, transportation planning, support for command systems)
- **Information Technology R&D Center**
  - Train radio system
  - LCD, millimeter-wave
  - Train dynamics monitoring systems
- **Integrated Design Center**
  - Passenger information system
  - (Concept/Screens)
  - Screens for train information systems
  - Screens for automatic train supervision (including Operation Control Center design)

**Milestones in Mitsubishi Electric’s Transport Systems Business**

- **1950**
  - First advance into overseas markets:
    - Delivery of electrical components to Indian Railways
- **1960**
  - Advance into European market: Delivery of electrical components for the Spanish National Railway Network
  - Completion of traction motors for Shinkansen production cars
  - Marketing of Japan’s first* Automatic Train Control (ATC) and Automatic Train Operation (ATO) equipment
- **1970**
  - World’s first* mass production and delivery of chopper control system
  - Chopper control system
- **1980**
  - Japan’s first delivery of Unattended Train Operation (UTO) system
    - Delivery of Japan’s first VVVF inverter for 1500V catenary
- **1990**
  - Delivery of converter-inverter applying IPM semiconductors (First for Shinkansen*)
    - Converter-inverter applying IPM semiconductors
- **2000**
  - Delivery of Japan’s first* Train Integrated Management System (TIMS)
  - Delivery of Japan’s* first passenger information system (Train Vision)
  - Delivery of totally enclosed induction motor
    - Totally enclosed induction motor
  - Marketing of air conditioning using substitute refrigerant
    - AJP/6A-G4 air conditioning
- **2010**
  - Marketing of world’s first* VVVF inverter using SiC
    - WVF inverter using SiC
  - Marketing of Station Energy Saving Inverter (S-EIV)
    - Station Energy Saving Inverter (S-EIV)

*According to in-house survey conducted in March 2017

*According to in-house survey conducted in March 2017