General Brochure of the Railway Systems Division
Further beyond, steadily and thoughtfully

Toshiba's railway technologies that contribute to individuals, society, and the environment

Toshiba has supported domestic and foreign railway systems in areas such as electric components for rolling stock, locomotives, electric power supply, and information technology. In addition, based on customer expectations, we are endeavoring to reduce life cycle costs, improve safety, accuracy, and comfortability and develop environmental-friendly products. We are also trying to create new values by combining competitive Toshiba products with IoT and AI-related advanced technologies and proven railway system technologies. Toshiba will continue to use its technologies to achieve the future vision of high-quality and reliable railway systems.

### Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolling Stock Systems</td>
<td>P.04</td>
</tr>
<tr>
<td>Locomotives Systems</td>
<td>P.06</td>
</tr>
<tr>
<td>Power Supply Systems</td>
<td>P.08</td>
</tr>
<tr>
<td>Information Systems</td>
<td>P.10</td>
</tr>
<tr>
<td>Full Turn Key Solution</td>
<td>P.12</td>
</tr>
<tr>
<td>Global Network</td>
<td>P.14</td>
</tr>
<tr>
<td>World-wide Experience</td>
<td>P.15</td>
</tr>
</tbody>
</table>

---

*1 PMSM: Permanent Magnet Synchronous Motor  *2 TCMS: Train Control Monitoring System  
*3 VVVF Inverter: Variable Voltage Variable Frequency Inverter  *4 APU: Auxiliary Power Unit  
*5 ATO: Automatic Train Operation Equipment  *6 Results of cell level tests under certain conditions. Not a guaranteed performance.

---

**SCiB™, Toshiba’s rechargeable battery with superior safety**

SCiB™ provides a long life of over 20,000 charge/discharge cycles, rapid charging, high input/output power performance and excellent low-temperature operation, all while maintaining a high level of safety.
Rolling Stock Systems

Solutions for rolling stock systems that evolve to achieve safe transportation and energy-saving.

Toshiba initiated the transport system business in 1899 and started to manufacture traction motors for electric railcars, control equipment, and bogies. Since then, we have been designing and manufacturing rolling stock systems to solve the challenges that our clients face while always seeking innovation. We combine advanced technology and energy-saving technology for various systems such as the propulsion system, auxiliary power supply system, air conditioning system, and train information system, and seek improvements in safety, security, and stability, which are fundamental requirements for railway transportation, and provide solutions with superior environmental performance and maintainability.

**Traction battery system**

The lithium-ion rechargeable battery developed by Toshiba (SCIB) is structured to suppress risks of explosion and fire. It boasts a long life of more than 20,000 cycles of charge and discharge and has superior characteristics for operation in low temperatures. The rapid charge capabilities make it suitable to store energy generated in the regenerative brakes and reuse the energy to accelerate the train. The battery system is also used as an emergency power source for transporting passengers to a safe place when the power supply from the catenary is stopped.

**Train information system / Train safety system**

Toshiba provides train information system employing a highly reliable CPU and rapid transmission system. The system is integrated with functions for highly efficient control, safe operation, and improved guidance services for passengers. We adopt highly reliable and fail-safe CPUs for the safety systems such as to provide automatic train control (ATC) devices, automatic train stop (ATS) devices, and automatic train operation (ATO) devices. It is structured as a redundant system to support stable operation.

**Propulsion system**

Our propulsion system adopts a permanent magnet synchronous motor and contributes to decreasing power consumption by 35% compared to conventional induction motors, and also reduces the maintenance time. The traction converter that uses the state-of-the-art SiC device achieves 38% down sizing and weight reduction compared to conventional equipment.

**Air conditioning system**

Toshiba adopts a highly efficient compressor to operate air conditioning system, and by employing inverter control it achieves optimized operation to reduce power consumption and improve comfortability.

**Auxiliary power supply system**

Toshiba provides various auxiliary power supply system for supplying power to the air conditioning system, lighting system, and etc. in the train while taking redundancy into consideration.

---

1) Results of field tests under certain conditions, not a guaranteed performance.
Toshiba provides solutions for locomotive systems that lead the world market based on years of experience and superior technological ability.

Toshiba has been providing various locomotives that are indispensable for personnel and freight transportation since we started manufacturing electric locomotives in 1923. Toshiba’s locomotive technologies are used worldwide to operate hybrid locomotives driven by both the high-performance lithium-ion battery and the engine. Advanced locomotives that adopt permanent magnet synchronous motors, and large capacity locomotives that use large capacity induction motors in combination with the water-cooled main traction converter.

Accumulated experience

Domestic

EF65
Japan Freight Railway Company / 1965

EH500
Japan Freight Railway Company / 1997

EH200
Japan Freight Railway Company / 2001

HD300
Japan Freight Railway Company / 2012

EH800
Japan Freight Railway Company / 2013

EL120
Nagoya Railroad Co., Ltd. / 2015

Oversea

E43000
Turkish State Railways (TCDD) / 1987

HXD3
China Railway / 2007

19E
South Africa for Transnet / 2007

Hybrid system

The hybrid system uses an engine generator and the high-performance lithium ion battery (SCiB™) as the power source. Various combinations of systems can be adopted for each purpose. Using the power supplied via the catenary as the power source is also possible by installing a pantograph as an option. This system reduces fuel consumption and suppresses the emission of CO₂ and NOx.

Hybrid driving
The locomotive is driven by using both the engine generator and SCiB™ Battery System as the power source.

Battery driving
Suitable for low-speed operation and freight shunting.

Reuse of regenerative energy
Regenerative energy is stored in SCiB™ Battery System when the brake is applied on the locomotive. The stored energy is reused for acceleration.

Standardized Hybrid Locomotive for European market (under development)
**Traction Energy Storage System (TESS)**

TESS can be used not only for energy saving purposes, but also as an alternative solution to building new substation and as emergency power supply system in case of power failures. Using Toshiba’s rechargeable battery SCiB™, TESS charges surplus regenerative energy from decelerating trains and discharges it to accelerating trains. This contributes to energy saving in railway systems. In addition, by adopting TESS as an independent battery substation, a simpler power supply system with significant reduction in space footprint compared to conventional substations, can be achieved. Furthermore, TESS contributes to the improvement of safety and reliability in railway operation through its ability to provide emergency power to the trains during wide area power failures.

Energy saving & peak shaving
- Enables energy saving and peak shaving of power consumption by using regenerative power.

Emergency power supply
- In case of wide area power failures, TESS enables train operation in emergency mode.

Alternative to substations
- By adopting TESS as an independent battery substation, a simpler and more compact power supply system can be realized.

Storage of regenerative energy during braking operation
- Effectively reuses regenerative energy instead of wasting it as heat through resistors in conventional systems.

**Solid Insulated Switchgear (SIS)**

Greenhouse gases are not used.

SIS utilizes high-performance epoxy resin to insulate the main circuit conductor and the main circuit components. It reduces SF6 gas, which causes global warming, by 100%. The amount of SF6 that is used for the cubic type of SF6 gas insulated switchgear (C-GIS) is reduced from approximately 300 kg / system*2 to 0 kg.

*2 Comparison with Toshiba’s GF type C-GIS. Excluding cases wherein VCT, which requires connection interface of SF6, is used.

**Vegetable oil transformer**

Transformers for which vegetable oil that is certified in the Eco Mark program is used as the insulating oil. It contributes to the decrease of environmental load with a carbon-neutral*3 design.

*3 Carbon dioxide (CO₂) generated when oil is incinerated for disposal is offset by the absorbed amount during rapeseed plant growth.

**Electric power supply, the core of railway transport**

Power Supply Systems

Stable supply of power to railway systems through the use of highly reliable equipment based on energy efficient and environment-friendly technologies.

Toshiba provides highly reliable DC and AC feeding substation equipment, as well as SCADA system, in various railway systems such as Shinkansen, suburban and subway lines.

Toshiba also provides environment-friendly products and energy saving solutions based on advanced technology to support stable power supply in railway infrastructure.
Creates new value with a combination of technologies and knowledge

Information Systems

Achieves the advanced railway system by using IoT technologies and supports safe, stable, and accurate operation.

Toshiba establishes control and information systems for areas of train operation, transportation scheduling, rolling stock & crew management, facility management and signaling by combining advanced information-communication technology and the accumulated knowledge of railway operation. In addition, we offer total solutions that improve the efficiency in railway operation based on the integrated railway information system with advanced technologies such as IoT.

Transportation Scheduling Systems

Toshiba provides solutions to improve the efficiency of overall transportation scheduling tasks, such as train timetabling, rolling stock operation & maintenance scheduling and crew duty scheduling.

SaaS, the only one that features all the basic functions for transportation scheduling.*

TrueLine™

* As of September 1, 2019.

TrueLine™ is a registered trademark of Toshiba Digital Solutions Corporation that represents a co-developed product.

We have experiences in the provision of on-premise systems specifically designed for each operator.

Automatic Train Supervision Systems

Toshiba provides solutions to improve railway’s operational efficiency such as train tracking, operation monitoring, automatic route control, and in case of traffic disruption, train rescheduling and delay recovery control.

Available for high-density train timetable and complex operation modes.

Uses AI and IoT technologies to efficiently support train operation control tasks.

IoT Solutions

Our IoT solutions thoroughly connect devices and users in operation control center, stations, substations, depots and crew offices, and utilize the collected data to contribute to achieving an integrated railway system.

Saving | Available through monthly subscription for only necessary functions from your PC connected to the Internet.
Simple | The award-winning user interface supports an intuitive look and feel.
Secure | The data center protected by robust security maintains and operates 24 hours a day, 365 days a year.
Seamless | Collectively manages the data to contribute to achieving the seamless cooperation among tasks and functions.

We have experiences in the provision of on-premise systems specifically designed for each operator.
Purple Line (Thailand)

First Japanese rolling stock running in metropolitan area in Thailand.

The Purple Line, an urban railway line with 16 stations that runs about 23 km between north western area of Bangkok and Nonthaburi Province was inaugurated in August 2016. The joint Venture that Toshiba established with partner company got a bulk order for a whole railway system (rolling stock, substations, signaling, platform screen door system, communication system, automatic fare collection system, rolling stock depot facilities, etc.). After submission of proposals and negotiation for about 3 years, we made full endeavors to meet requirements such as completion and inauguration within 34 months after we got the order and compliance with European standards and specifications. Then finally we managed to introduce the railway system produced by Japanese enterprises for the first time in the urban transport market in Thailand that was occupied only by European enterprises. In addition, the joint venture is awarded the 10-year maintenance contract to contribute to stable operation of the Purple Line.

Taiwan High Speed Rail (Taiwan)

First export case of Japanese Shinkansen

Taiwan High Speed Rail of which the section of approximately 350 km from Taipei to Zuoying was inaugurated in January 2007 as a main artery in the north-south direction is the first export case of Japanese Shinkansen System. Toshiba joined the consortium of 7 Japanese companies that tried for the project and provided electric units for rolling stock, substation and power receiving facilities, operation management/maintenance management systems, communication facilities, and dispatcher’s desk facilities. Even after the inauguration, Toshiba provided additional facilities for 4 stations including the extended section to Nangang Station, additional rolling stock, and IT system updates. Even now we are contributing to the development of the high speed railway infrastructure in Taiwan while adopting our rich experience in the area of maintenance and operation of Japanese Shinkansen and advanced technologies.
Global Network
We rapidly support our customers from worldwide locations.

Oversea bases

Headquarters

Major Manufacturing Facilities

Country name
Client name
Delivery year

India
Delhi Metro Rail Corporation Ltd
2016

DB Cargo HELMS (2 prototypes)

Aiming to achieve high efficiency and high reliability by applying the hybrid technology compliant with European standard.

● Hybridization of existing 1,000kW class diesel shunting locomotive

● Toshiba series-parallel hybrid technology with SCiB™

SMRT C151 Series

Equipped with our PMSM driving system. Since it was introduced in commercial operation in 2015, it brings superior energy savings compared to existing equipment systems and delivers safe operation with high reliability.

● Refurbishment of existing drive system

● PMSM drive system for 750Vdc

KORAIL 8500 series

Thanks to our reliability that has been cultivated for more than 20 years in the Korean market and locomotive technologies, we delivered electric equipment for 56 units of large capacity electric locomotives. It has maintained high quality since delivery in 2011 and delivers stable freight transport.

● Driving system and power source system for large capacity (6,600kW) electric locomotives

WMATA 7000 series

WMATA7000 series car includes Buy America compliant Propulsion and Vehicle Information System for 748 cars manufactured in Houston, Texas. Toshiba’s highly reliable system contributes to stable operation in the Washington metropolitan area since the start of revenue service in 2015.

● Driving system and Vehicle Information System for 750Vdc

Global supply records (after 2005)

DB Cargo

Mexico

Toshiba Transmission & Distribution Systems (India) Private Limited

Germany

SMRT

South Korea

KORAIL

United States

WMATA

Taiwan

WMATA 7000 series car includes Buy America compliant Propulsion and Vehicle Information System for 748 cars manufactured in Houston, Texas. Toshiba’s highly reliable system contributes to stable operation in the Washington metropolitan area since the start of revenue service in 2015.

● Driving system and Vehicle Information System for 750Vdc

Global supply records (after 2005)

Country name
Client name
Delivery year

India
Delhi Metro Rail Corporation Ltd
2016

DB Cargo HELMS (2 prototypes)

Aiming to achieve high efficiency and high reliability by applying the hybrid technology compliant with European standard.

● Hybridization of existing 1,000kW class diesel shunting locomotive

● Toshiba series-parallel hybrid technology with SCiB™

SMRT C151 Series

Equipped with our PMSM driving system. Since it was introduced in commercial operation in 2015, it brings superior energy savings compared to existing equipment systems and delivers safe operation with high reliability.

● Refurbishment of existing drive system

● PMSM drive system for 750Vdc

KORAIL 8500 series

Thanks to our reliability that has been cultivated for more than 20 years in the Korean market and locomotive technologies, we delivered electric equipment for 56 units of large capacity electric locomotives. It has maintained high quality since delivery in 2011 and delivers stable freight transport.

● Driving system and power source system for large capacity (6,600kW) electric locomotives

WMATA 7000 series

WMATA7000 series car includes Buy America compliant Propulsion and Vehicle Information System for 748 cars manufactured in Houston, Texas. Toshiba’s highly reliable system contributes to stable operation in the Washington metropolitan area since the start of revenue service in 2015.

● Driving system and Vehicle Information System for 750Vdc

Global supply records (after 2005)

DB Cargo

Mexico

Toshiba Transmission & Distribution Systems (India) Private Limited

Germany

SMRT

South Korea

KORAIL

United States

WMATA

Taiwan

WMATA 7000 series car includes Buy America compliant Propulsion and Vehicle Information System for 748 cars manufactured in Houston, Texas. Toshiba’s highly reliable system contributes to stable operation in the Washington metropolitan area since the start of revenue service in 2015.

● Driving system and Vehicle Information System for 750Vdc

Global supply records (after 2005)

Country name
Client name
Delivery year

India
Delhi Metro Rail Corporation Ltd
2016

DB Cargo HELMS (2 prototypes)

Aiming to achieve high efficiency and high reliability by applying the hybrid technology compliant with European standard.

● Hybridization of existing 1,000kW class diesel shunting locomotive

● Toshiba series-parallel hybrid technology with SCiB™

SMRT C151 Series

Equipped with our PMSM driving system. Since it was introduced in commercial operation in 2015, it brings superior energy savings compared to existing equipment systems and delivers safe operation with high reliability.

● Refurbishment of existing drive system

● PMSM drive system for 750Vdc

KORAIL 8500 series

Thanks to our reliability that has been cultivated for more than 20 years in the Korean market and locomotive technologies, we delivered electric equipment for 56 units of large capacity electric locomotives. It has maintained high quality since delivery in 2011 and delivers stable freight transport.

● Driving system and power source system for large capacity (6,600kW) electric locomotives

WMATA 7000 series

WMATA7000 series car includes Buy America compliant Propulsion and Vehicle Information System for 748 cars manufactured in Houston, Texas. Toshiba’s highly reliable system contributes to stable operation in the Washington metropolitan area since the start of revenue service in 2015.

● Driving system and Vehicle Information System for 750Vdc

Global supply records (after 2005)

DB Cargo

Mexico

Toshiba Transmission & Distribution Systems (India) Private Limited

Germany

SMRT

South Korea

KORAIL

United States

WMATA

Taiwan

WMATA 7000 series car includes Buy America compliant Propulsion and Vehicle Information System for 748 cars manufactured in Houston, Texas. Toshiba’s highly reliable system contributes to stable operation in the Washington metropolitan area since the start of revenue service in 2015.

● Driving system and Vehicle Information System for 750Vdc

Global supply records (after 2005)

Country name
Client name
Delivery year

India
Delhi Metro Rail Corporation Ltd
2016

DB Cargo HELMS (2 prototypes)

Aiming to achieve high efficiency and high reliability by applying the hybrid technology compliant with European standard.

● Hybridization of existing 1,000kW class diesel shunting locomotive

● Toshiba series-parallel hybrid technology with SCiB™

SMRT C151 Series

Equipped with our PMSM driving system. Since it was introduced in commercial operation in 2015, it brings superior energy savings compared to existing equipment systems and delivers safe operation with high reliability.

● Refurbishment of existing drive system

● PMSM drive system for 750Vdc

KORAIL 8500 series

Thanks to our reliability that has been cultivated for more than 20 years in the Korean market and locomotive technologies, we delivered electric equipment for 56 units of large capacity electric locomotives. It has maintained high quality since delivery in 2011 and delivers stable freight transport.

● Driving system and power source system for large capacity (6,600kW) electric locomotives

WMATA 7000 series

WMATA7000 series car includes Buy America compliant Propulsion and Vehicle Information System for 748 cars manufactured in Houston, Texas. Toshiba’s highly reliable system contributes to stable operation in the Washington metropolitan area since the start of revenue service in 2015.

● Driving system and Vehicle Information System for 750Vdc

Global supply records (after 2005)
History of our railway business

Toshiba's transport business started with manufacturing of main motors, control equipment, and bogies for electric railcars in 1899 and has recorded about 120 years of history since then. Toshiba has continuously delivered various cutting-edge products to clients such as the JR group, private railway companies, and foreign railway users. Toshiba will continue to deliver railway solutions with an increasingly complicated society.

- **1875** Tanaka Seizo-sho, the predecessor of Toshiba Corporation, was established.
- **1899** Started to manufacture control equipment and main motors for electric railcars. This year is commemorated as the start of the transport business for Toshiba.
- **1901** Delivered first main motor and bogie in Japan to Daishi Railway (predecessor of Keikyu Corporation).
- **1923** Completion of our first electric locomotive with the delivery of 6 Deki 1 vehicles (40 tons, B-B) to Ina Electric Railway (predecessor operator of a part of the Iida Line of Central Japan Railway Company.).
- **1928** Delivered electric locomotive EF52 for the Tokaido Line to Japan Railways (predecessor of the Central Japan Railway Company).
- **1940** Fuchu Plant (predecessor of Fuchu Complex) was completed and started operation as a railcars factory.
- **1945** Toshiba Sharyo (predecessor of our division) was established.
- **1956** Exported electric railcars for the Sarmiento Line of Argentina National Railways for the first time as a Japanese company.
- **1965** First export of AC electric locomotives (85t, 2,400kW), 15 vehicles to Indian National Railways.
- **2007** Taiwan High Speed Rail inauguration of the section between Taipei and Zuoying, for which we are engaged in as a member of the main contractor.
- **2010** Started to provide the PMSM for subway lines and its control devices for the Marunouchi Line of Tokyo Metro Co., Ltd.
- **2012** Delivered the HD300, the first Japanese mass production hybrid locomotive, to JR Freight Railway Company.
- **2018** The world's first delivery driving system using three advanced technologies together (All-SiC, PMSM and SCiB™) on the Marunouchi Line of Tokyo Metro Co Ltd.

---

**Toshiba Infrastructure Systems & Solutions Corporation**
72-34, Horikawa-cho, Saiwai-ku, Kawasaki-shi, Kanagawa 212-8585, Japan
Railway Systems Division   TEL. +81-(0)44-331-1600

**Toshiba Transport Engineering Inc.**
1, Toshiba-cho, Fuchu-shi, Tokyo 183-8511, Japan
Overseas Sales Division   TEL. +81-(0)44-331-1625

Please contact us for details.
http://toshiba-railway.com

---

* The information contained herein is as of December 1, 2019.
* The information contained herein is subject to change without notice.
* The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others.
* TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and sold, under any law and regulations.
* TOSHIBA products do not take any responsibility for incidental damage (including loss of business profit, business interruption, loss of business information, and other pecuniary damage) arising out of the use or disability to use TOSHIBA products.
* The products described in this document may include products subject to the foreign exchange and foreign trade laws.
* The products described in this document may contain components made in the United States and subject to export control of the U.S. authorities. Diversion contrary to the U.S. law is prohibited.