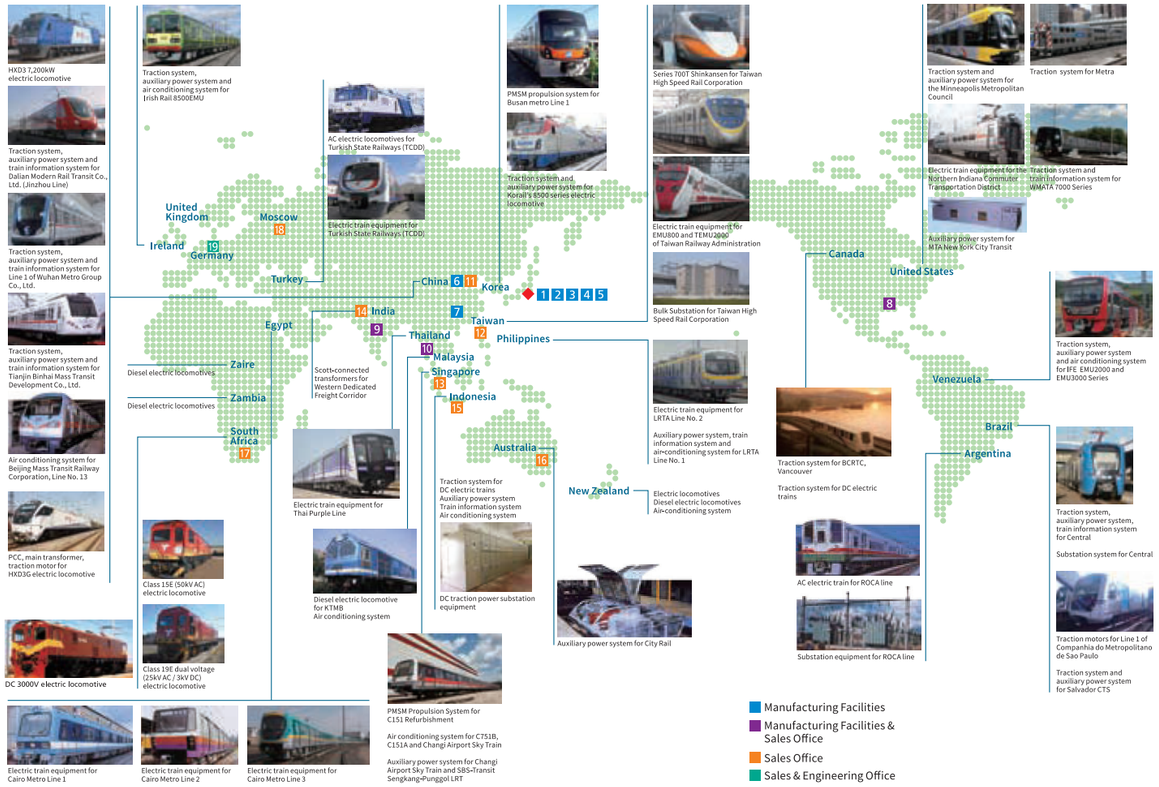
Toshiba's transportation system technology is widely-used all over the world.



Headquarters

◆ Headquarters (Kawasaki, Japan)

Manufacturing Facilities

1 Fuchu Complex (Tokyo, Japan)
Electric locomotives, traction control equipment, auxiliary power supply equipment, traction motor, train information system, ATC/ATS system, etc.

2 Mie Operations (Mie, Japan)
Transformers, motor control centers

3 Hamakawasaki Operations (Kawasaki, Japan)
Transformers, switchgears, surge arresters

4 Kashiwazaki Operations (Kashiwazaki, Japan)
Rechargeable Battery

5 Toshiba Carrier Corporation (Fuji, Japan)
Air-conditioning systems

6 Dalian Toshiba Locomotive Electric Equipment Co., Ltd. (Dalian, China)
Drive systems for locomotives, DC train drive systems, auxiliary power supply, traction motor, train information system, etc.

7 Guangzhou Toshiba Baiyun Electrical Equipment Co., Ltd. (Guangzhou, China)
MV Switchgears

Manufacturing Facilities & Sales Office

8 Toshiba International Corporation (Houston, U.S.A.)
Motors, adjustable speed drives (inverters), UPSs, switchgears, transportation systems, etc.

9 Toshiba Transmission & Distribution Systems (India) Pvt. Ltd. (Telangana, India)
Convertor/inverter system, Auxiliary convertors, Train control and monitoring system, Control electronics

10 Toshiba Transmission & Distribution Systems Asia Sdn. Bhd. (Petaling Jaya, Malaysia)
MV Switchgears, EPC of Substations

Sales Office

11 Toshiba China Co., Ltd. (Dalian, China)
12 Toshiba Electronic Components Taiwan Corporation (Taipei, Taiwan)
13 Toshiba Asia Pacific Pte Ltd (Singapore)
14 Toshiba India Private Ltd. (Gurgaon, India)
15 PT. Toshiba Asia Pacific Indonesia (Jakarta, Indonesia)
16 Toshiba International Corporation Pty Ltd (Sydney, Australia)
17 Toshiba Africa (Pty) Ltd. (Sandton, South Africa)
18 Toshiba Rus LLC (Moscow, Russia)

Sales & Engineering Office

19 Toshiba Railway Europe GmbH (Kiel/Düsseldorf, Germany)
Hybrid Locomotive

Find out more about Toshiba transportation solutions on http://toshiba-railway.com

Toshiba Infrastructure Systems & Solutions Corporation

72-34, Horikawa-cho, Saiwai-ku, Kawasaki-shi, Kanagawa 212-8585, Japan

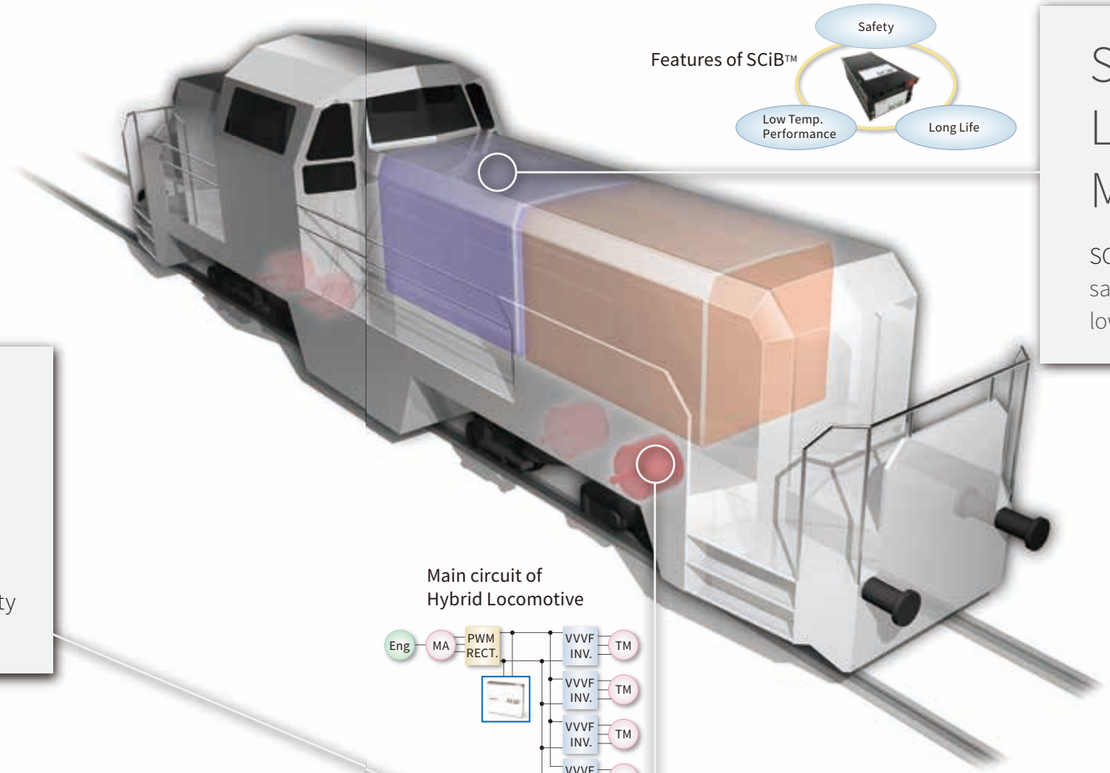
Railway Systems Division TEL.+81-(0)44-576-6737

2019-09(1)

TOSHIBA

Toshiba Locomotives

Toshiba Locomotives: Aiming to Meet Your Needs

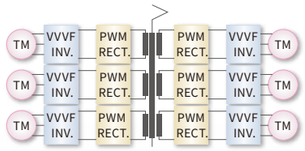


Features of SCiB™

Safe and Durable Lithium-ion Main Battery

SCiB™ Toshiba's lithium-ion battery realizes safety, long life and good performance, even in low-temperature environments.

Independent-control main circuit of Electric Locomotive



High Availability with Water-Cooled Power Converter

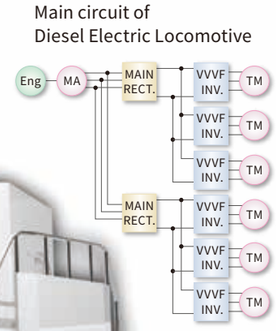
Independent control is applied for high availability and performance.

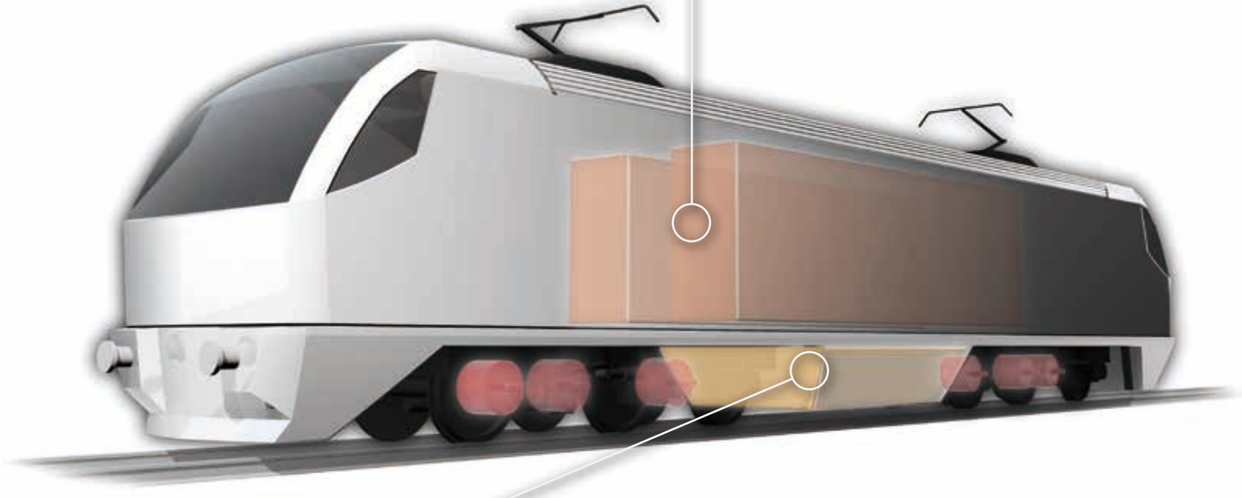
Main circuit of Hybrid Locomotive

Hybrid Locomotive

Specifications		HBR700
Maximum Power	Locomotive Total at Tread (Battery Output) (Diesel Engine Output)	700 kW 800 kW 330 kW
Length		15.0 m
Weight		80 – 100 tons
Bogie Arrangement		Bo - Bo
Maximum speed		60 km/h

Main circuit of Diesel Electric Locomotive





Low-emission Transformer

Nitrogen gas sealed transformer technology reduces need for insulation oil exchange.

Electric Locomotive

Specifications	EL72	EL96	EL45
Catenary Voltage		25kVac 50/60Hz	
Maximum Power at Tread	7,200 kW	9,600 kW	4,500 kW
Gauge	Standard	Standard	Narrow
Weight		132 – 150 ton	
Bogie Arrangement		Co - Co	
Maximum speed		120 – 160 km/h	120 km/h

Efficient Traction Motor

PMSM (Permanent Magnet Synchronous Motor) technology realizes high efficiency of up to 97%.*

* The efficiency of PMSM was calculated with loss measurement based on IEC 60349-2 at the temperature below 40˚C from 8/25/2009 to 9/25/2009.

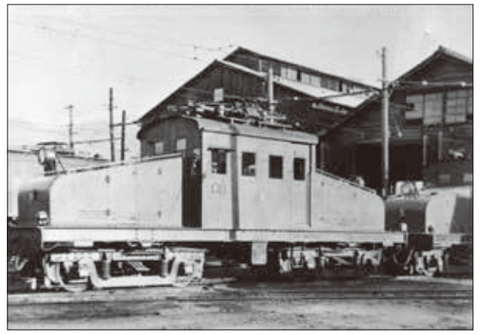
Diesel Electric Locomotive

Specifications	DEL45	DEL35
Maximum Power (Engine Output)	4,500 BHP (3,356 kW)	3,500 BHP (2,610 kW)
Gauge	Standard	Standard / Narrow
Weight	120 – 150 tons	96 – 120 tons
Bogie Arrangement	Co - Co	
Maximum speed	120 km/h	

History

Toshiba's first electric locomotive

Toshiba's glorious locomotive business began with supplying electric components for the 40-ton electric locomotive built by Ishikawajima Shipbuilding & Engineering Co in 1923. The first locomotive Toshiba manufactured was the 73-ton locomotive in 1926. This locomotive was used for coal transportation. Since then, Toshiba has supplied 600 complete locomotives or electric components for locomotives for Japanese customers.



Toshiba's first locomotive
(40 ton electric locomotive)

Overseas business in early times

Toshiba locomotive business has entered into the global market by supplying electric locomotives to Indian Railways. This was followed by supplying 5 electric locomotives to New Zealand in 1968. Since then, more than 2,000 locomotives or their components had been supplied to customers outside Japan.

Type 10E/10E2 (1985 – 92)
(Transnet, Republic of South Africa)

3,180 kW Electric Locomotive for Turkish State Railways (1987 -)

Diesel electric locomotive

Toshiba's first diesel electric locomotive was built in 1934, equipping a 750 HP diesel engine. Since 1969, Toshiba had manufactured 26 locomotives (500 HP/1050 HP) for Zambia and Brazil. Since 1981, 24 locomotives with two 500 HP engines had been shipped to New Zealand. In 1987, 24 locomotives with 2400 HP were delivered to Malaysia in collaboration with Kawasaki Heavy Industry, ltd. The locomotives for steelworks with radio remote control were manufactured in 1991 and some were delivered to various locations in Japan.

Diesel Electric Locomotive
(New Zealand Railways Corporation)

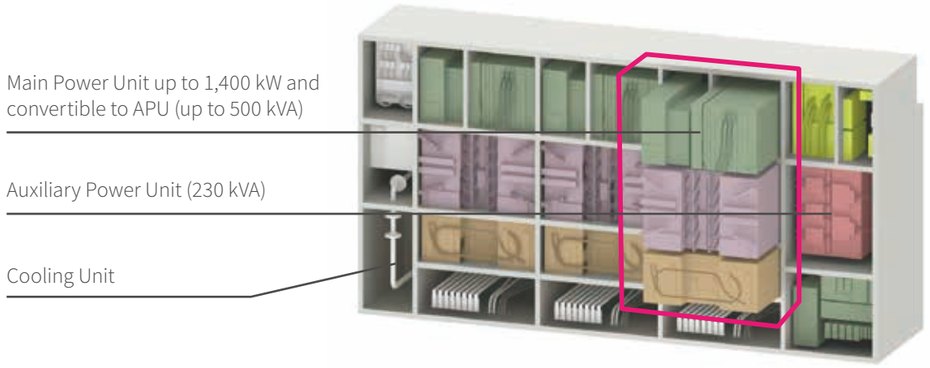
Diesel Electric Locomotive
(Malayan Railway Administration)

Diesel Electric Locomotive with Radio
Remote Control
(for Steelworks)

Key Technologies for Locomotives

Power Converters

Modular design power converter cubicle for locomotive –
The optimum configuration can be realized.



3-MPU(1,400 kW), 1-APU (230 kVA) configuration

2-MPU (1,400 kW), 1-APU(500 kVA)

2-MPU (1,400 kW), 1-APU (230 kVA)

2-MPU (1,400 kW)

Other existing IGBT power converters

Power Converters for Electric Locomotives – Wide range of tractive power can be covered.

500 kW / axle | 750 kW / axle | 1,400 kW / axle

Power Converter for DEL

Power Converter for Hybrid

Traction Motors

PMSM (Permanent Magnet Synchronous Motor)

PMSM technology with reduced energy loss realizes high efficiency up to 97%.* This high efficiency also realizes smaller size or higher power compared with our conventional products.

* The efficiency of PMSM was calculated with loss measurement based on IEC 60349-2 at the temperature below 40˚C from 8/25/2009 to 9/25/2009.

AC Induction Motor

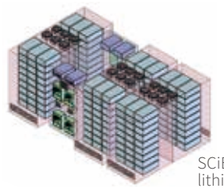
500 kW class	750 kW class	1,400 kW Class

Main Transformers

Catenary Voltage: 20 kVac	Catenary Voltage: 25 kVac	Catenary Voltage: 50 kVac

Main Battery

SCiB™ anode material LTO (Lithium Titanium Oxide) makes the battery good performance, versatility and durability.



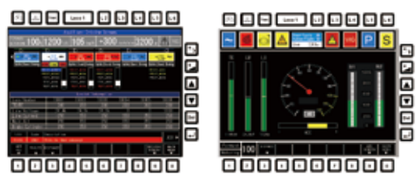
SCiB™, Toshiba's lithium-ion battery

Main Alternator

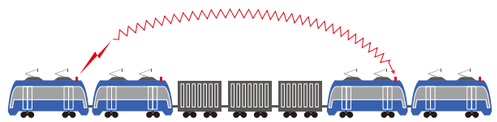
Main alternator
for diesel electric locomotive

TCMS

Distribution of Powering/Regenerative braking command to other locomotives in the same train set with wired/wireless communication.



Driving screen examples



Wireless Communication

Recent Products

Electric Locomotive

HXD 3 Electric Locomotive
(Ministry of Railways, China)

Application :	Freight
Number of locomotives :	1,090
Catenary :	25k Vac-50 Hz
Rated power :	7,200 kW (continuous) at tread
Axle arrangement :	Co-Co
Locomotive weight :	138 tons, 150 tons
Maximum speed :	120 km/h

Toshiba supplied electrical equipment

Class 15E Electric Locomotive
(Transnet, Republic of South Africa)

Application :	Freight (heavy ion)
Number of locomotives :	44+32
Catenary :	50k Vac-50Hz
Rated power :	4,500 kW (continuous) at tread
Axle arrangement :	Co-Co
Locomotive weight :	180 tons
Maximum speed :	90 km/h

Manufactured in collaboration with a local locomotive builder

Class 19E Electric Locomotive,
(Transnet, Republic of South Africa)

Application :	Freight (coal)
Number of locomotives :	110
Line Voltage :	25k Vac-50 Hz / 3,000 Vdc
Rated power :	3,000 kW (continuous) at tread
Axle arrangement :	Bo-Bo
Locomotive weight :	100 tons
Maximum speed :	120 km/h

Manufactured in collaboration with a local locomotive builder

Diesel Electric Locomotive

Class 29 Diesel Electric Locomotive
(KTMB Malaysia)

Application :	Freight
Number of locomotives :	20
Engine power :	2,580 kW
Axle arrangement :	Co-Co
Maximum speed :	120 km/h

Toshiba supplied electrical equipment

Hybrid Locomotive

HD300 Hybrid Locomotive
(Japan Freight Railway Co)

Application :	Shunting
Number of locomotives :	31
Maximum power :	500 kW at tread
Axle arrangement :	Bo-Bo
Locomotive weight :	60 tons
Maximum speed :	45 km/h