



BUSINESS

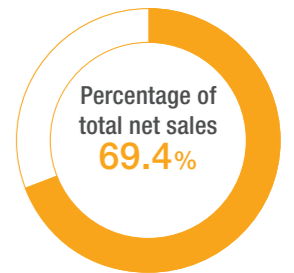
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Transportation Systems Segment

Support railway transportation that connects people and cities with safety and trust, through manufacturing that merges electronics technologies and mechanical technologies in a highly advanced manner

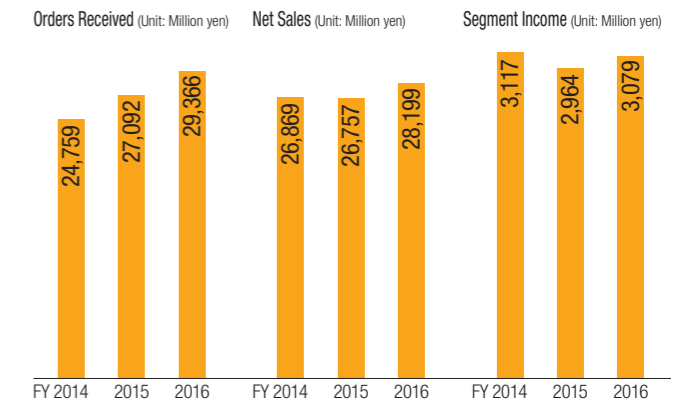
Business Overview

Electrical equipment for rail vehicles manufactured by the Company using its technological capability developed over about a century covers a wide range of fields, including propulsion systems (drive systems), auxiliary power supply and door-closing units of trains, and we contribute to the maintenance and development of railway infrastructure overseas, not to mention in Japan, by pursuing safety and comfort of trains.



Results for fiscal 2016

- Orders Received**
29,366 million yen
 (Up 8.4% year on year)
 Orders received increased 8.4% compared with the previous fiscal year to 29,366 million yen, led by upturns in Japan mainly due to demand ahead of the Tokyo 2020 Olympic and Paralympic Games.
- Net Sales**
28,199 million yen
 (Up 5.4% year on year)
 Net sales totaled 28,199 million yen, a 5.4% increase from the previous fiscal year, due to an increase in Japan.
- Segment Income**
3,079 million yen
 (Up 3.9% year on year)
 Segment income increased 3.9% compared with the previous fiscal year to 3,079 million yen.



TOPICS

Development and Delivery of VVVF Inverter Using SiC Element^{*1}

With regard to the retrofit of main circuit device of Type 3900 trains for Hiroshima Electric Railway Co., Ltd., we delivered VVVF inverters using silicon carbide (SiC) elements instead of the conventional VVVF inverters using reverse conducting GTO elements^{*2}.



Hiroshima Electric Railway Co., Ltd. Type 3900 trains

Features of the retrofitted VVVF inverters are as follows:

- Reduction of 35% in both volume and mass compared with previous VVVF inverters
- Reduction of workload of train drivers through setting a new function that enables constant-velocity drive

Type 3900 trains for Hiroshima Railway are articulated vehicles of three bodies and four trucks, which made the debut in 1990, and directly run between inner-city lines (tracks) and the Miyajima Line (ordinary railway). Type 3900 trains equipped with the new VVVF inverters started commercial operation from the end of February 2017.

The Company will continue to contribute to realizing an energy-saving society by expanding the use of electrical equipment using SiC element.

*1: An element using silicon carbide (compound of carbon and silicon) as reflux diodes.

*2: An element that incorporates Gate Turn-Off thyristor and reflux diodes into one package.

Establishment of a new company in Chengdu, China

The Company has expanded its business in China, chiefly the delivery of electrical equipment for railway vehicles of urban transit and high-speed railway, since the late 1990s. The Company established a new production base in Chengdu, a major city in China, to further reinforce its business. The new company will mainly assemble and test pantographs for urban transit railway vehicles.



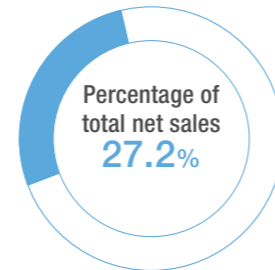
A pantograph

Company name:	Chengdu Yonggui Toyo Rolling Stock Equipment Co., Ltd.
Location:	Chengdu, Sichuan Province
Establishment:	August 23, 2017
Business activities:	Manufacture, sales, etc. of electrical equipment (mainly pantographs) for urban transit railway vehicles
Investment ratio:	Zhejiang Yonggui Electric Equipment Co., Ltd.: 51% Toyo Denki Seizo K.K.: 49%

Deliver technologies and gratitude to customers with highly precise, highly responding and highly efficient power electronics, for realization of an environment-friendly society

Business Overview

The Company is extensively contributing to customers at home and abroad through general industrial machinery and equipment, testing equipment for automobile development and social infrastructure equipment that is indispensable to the daily lives of people. In addition, we address manufacturing that contributes to the prevention of global warming, while providing products manufactured through high system-building technologies that make full use of energy-saving motors, inverters, FA controllers and networks.



Results for fiscal 2016

Orders Received
12,194 million yen
 (Up 6.8% year on year)

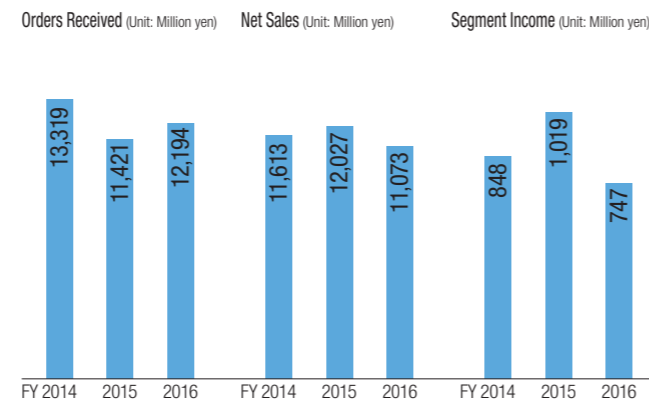
Orders received increased 6.8% compared with the previous fiscal year to 12,194 million yen, due to increased orders for processing equipment and outside Japan.

Net Sales
11,073 million yen
 (Down 7.9% year on year)

Net sales decreased 7.9% year on year to 11,073 million yen, due to decreases in sales of testing equipment and processing equipment.

Segment Income
747 million yen
 (Down 26.7% year on year)

Segment income totaled 747 million yen, a 26.7% decrease compared with the previous fiscal year, due to a decrease in sales and development costs of multi-functional testing equipment.



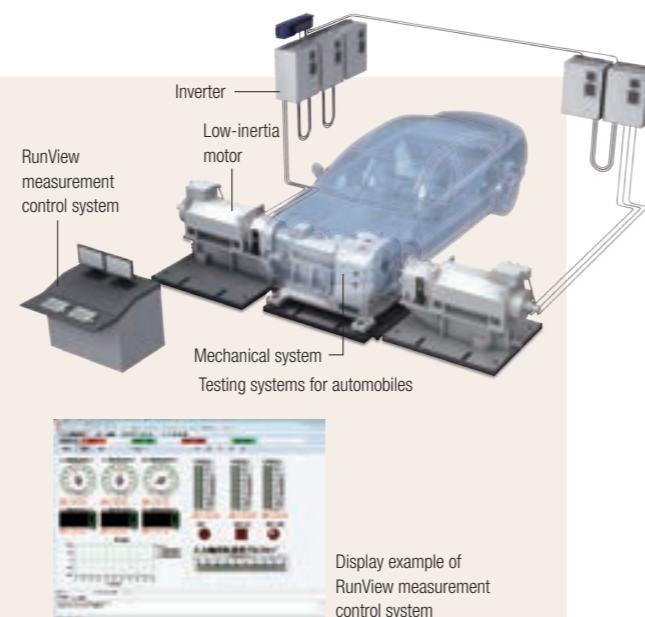
TOPICS

Further improvement of convenience and operability of testing equipment for automobile development ~ Development of measurement control system RunView

The newly developed measurement control system, RunView, enables customers who perform tests to conduct tests under wide-ranging conditions by freely customizing user interfaces, including intuitive operation, flexible composition and changes/revisions of monitor displays.

The Company has developed solution systems in which inverters and machines are combined, with a focus on the development of low-inertia, high-torque motors as well as dynamometers. The addition of this measurement control system to such solutions will enable us to respond to a wider range of requests of customers in automobile development processes.

We will strengthen our proposal capabilities to parts manufacturers, in addition to automobile manufacturers, by further enhancing these comprehensive solutions.



Provision of products that make the execution of operations on station premises and trains smooth and convenient and M2M solutions based on mobile phone networks and cloud servers using remote monitoring system

Business Overview

In the Information Equipment Systems segment, we operate in the two fields of railway station operating equipment and remote monitoring systems, by merging advanced telecommunication technologies and mechatronics.

With regard to railway station operating equipment systems, we develop and manufacture commuter pass issuing machines that quickly became IC card compliant and portable terminal devices for conductors, and provide systems for smooth toll collection and income management system to railway operators.

Our remote monitoring systems greatly contribute to labor saving and maintenance saving of customers through realization of various equipment monitoring and position monitoring, by leveraging cloud computing.



Results for fiscal 2016

Orders Received
1,788 million yen
 (Up 30.6% year on year)

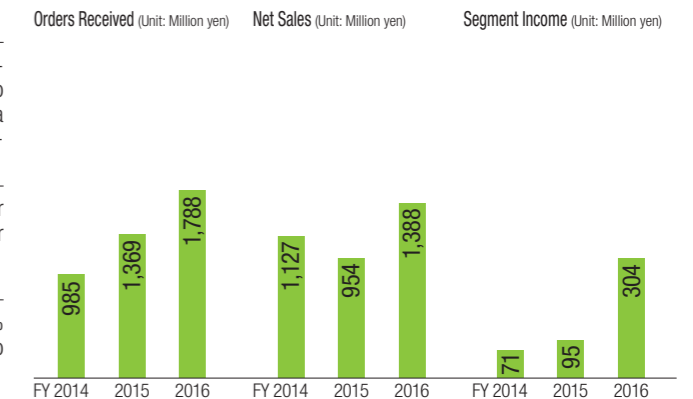
Orders received increased 30.6% compared with the previous fiscal year to 1,788 million yen, due to the receipt of a large-scale order for railway station operating equipment.

Net Sales
1,388 million yen
 (Up 45.4% year on year)

Net sales increased 45.4% year on year to 1,388 million yen for a reason similar to that for increased orders received.

Segment Income
304 million yen
 (Up 218.8% year on year)

Segment income increased 218.8% compared with the previous fiscal year to 304 million yen.



TOPICS

Order received for IC station terminal devices for the Bureau of Transportation of the Tokyo Metropolitan Government

We have received order for IC station terminal devices from the Bureau of Transportation of the Tokyo Metropolitan Government, following the order received for commuter pass issuing machines for the Transportation Bureau of the City of Yokohama last year. The hardware of this product is a composite ticket vending machine that can handle IC card-related business processing and singlehandedly issue a variety of tickets such as commuter passes, standard tickets, books of tickets and special tickets. However, the specification of the IC station terminal devices is limited to IC card-related business processing and issuance of special tickets.

The terminal devices conform to the security authorization standards of the Congress of Japan Railway Cybernetics.

We will continue to develop and provide easier-to-use railway station operating equipment.



Composite ticket vending machine (separate type)

Initiatives in distributed power source (small-scale hydropower, solar, wind power, biomass, wave power, tidal power, etc.)

We have been working to safely make the most of natural energy sources such as small-scale hydropower, solar, wind power, biomass, wave power and tidal power, by leveraging the know-how of permanent magnet synchronous generators and interconnected systems we have developed over many years.

Take the small-scale hydropower generation system for instance. The system uses water as renewable energy, and effectively utilizes water resources which have not been utilized before, such as agricultural waterways and agricultural dams. We will continue working on effective utilization of various natural energy sources.

System upgrades of distributed power source systems of Toyo Denki Seizo K.K.

- Bountiful experience with power companies in Japan
- Interconnected system protective function
- Higher efficiency by combining with permanent magnet synchronous generators
- Islanding detection function is incorporated in inverters that support interconnected systems
- Switchable from interconnected system operation to self-supporting operation
- Black start in the absence of power source systems is possible
- System upgrades of overload protection, external signal input, etc.
- Output control function
- A wide range of lineup with output from 10 to 750 kW, in particular, bountiful experience with output from 10 to 200 kW



Power Conditioner



EDG Permanent magnet synchronous generator (supports 10 - 750kW)



Initiatives in remote monitoring (IoT/M2M solutions)

We contribute to improvements of efficiency in operations through IoT/M2M solutions using mobile phone networks and cloud servers for monitoring and control.

Joint development of data acquisition and analysis systems for fuel cell lift trucks

In cooperation with TOYOTA INDUSTRIES CORPORATION, we have developed data acquisition and analysis systems for fuel cell lift trucks. With this system, operation data is collected, stored in cloud servers using mobile phone communication systems, and analyzed. For the remote data management system owned by Toyo Denki Seizo K.K., we developed a data logger capable of on-board use, which enables real-time analysis of cloud servers and is equipped with information transmission function. This system analyses and visualizes data on location information and operation states, thereby contributing to optimization of maintenance services and improvement of merchantability.



Fuel cell lift trucks

Data logger unit

Joint development of communication power generator mounted with remote monitoring system

In cooperation with Denyo Co., Ltd., we developed a communication power generator mounted with a remote monitoring system, and commenced its services. The communication power generator was developed by mounting "IORemoter," Toyo Denki Seizo K.K.'s remote monitoring terminal, to Denyo Co., Ltd.'s engine power generator. It enables sending email alerts in case of failure and remote monitoring through cloud services utilizing mobile phone lines. Customers can use various functions through ASP services. We will continue to contribute to operational efficiency through provision of easy-to-install and affordable IoT/M2M solutions.



Communication power generator



IORemoter

Research and Development/Intellectual Property

R&D to support the development of social infrastructure and supporting frameworks

Research and Development

The Group's R&D activities are based on seeking to create products that fully satisfy our customers and challenging the creation and expansion of these products, and we actively promote

development of technologies of our existing businesses and basic technology developments that support this development as well as development of new products that expand our businesses.

Results and topics from fiscal 2016

Segment	Project	Description
Transportation Systems	Development of VVVF inverter unit to which SiC semiconductor is applied	Developed our first VVVF inverter for commercial vehicles, to which silicon carbide (SiC) semiconductor is applied, for replacement of streetcars.
	Development of parallel cardan electrical equipment for super low floor type trains	Developed super small-diameter induction motor and drive unit, which enable the application of the parallel cardan drive method to super low floor type trains.
Industrial Systems	Development of high-torque, super low-inertia motor	With regard to high-torque motors used as alternative loads on the wheel side at automobile testing facilities, developed a high-torque, super low-inertia motor, whose inertia is lowered to as low as 45% of that of conventional motors.
	Development of dual bench	Developed a dual bench that can conduct evaluation tests both on torque converters and clutch packs, both of which are automotive parts, by using our proprietary transfer mechanism. This bench can singlehandedly conduct the two kinds of evaluation tests that previously required individual test devices for each test.
Information Equipment Systems	Development of software module for railway station operating equipment	Developed a common software module for various types of railway station operating equipment for the purpose of quality improvement. This module is also effective in reducing development costs at the time of repair.
	Improvement of various ticket issuing machines	With regard to composite ticket issuing machines and small ticket vending machines, realized addition of functions to hardware and standardization of control boards.
Research Laboratory	Basic development of control system for industrial use, compliant with IoT	To expand overseas development of industrial equipment, developed a system with basic IoT functions in consideration of IoT standards for plants, including "Industrie 4.0" of Germany and "Industrial Internet Consortium (IIC)" of the U.S., and built a prototype system modeled on a system in a small plant.
	Research on wireless power transmission	Succeeded for the first time in the world in power supplying from coils laid in roads to in-wheel motors during the actual vehicle run. With regard to this system, our research laboratory was responsible for the development of a converter and its controller that wirelessly transmits power via coils between the vehicle body and wheels and between the ground and wheels as well as an in-wheel motor mounted on wheels, and an inverter that controls the in-wheel motor. A joint paper on this research, which was mainly written by an employee of our research laboratory, won the 2017 IEEE Power Electronics Transactions First Paper Award of the Institute of Electrical and Electronics Engineers (IEEE).

Intellectual Property

Our intellectual property is placed as a key corporate resource. Our intellectual property department is responsible for the management of intellectual property and our research laboratory and the development divisions in each business unit actively apply for patents and utility models.

In the overseas markets which we expect to further expand our businesses, we have started to actively engage in activities concerning our intellectual property in order to protect our technologies and brand.

Patent applications granted

