PMSM Propulsion System for 1000 Series EMUs of Tokyo Metro Co., Ltd.

PMSM

VVVF inverter

Toshiba has released a permanent-magnet synchronous motor (PMSM) propulsion system for the new 1000 series electric multiple units (EMUs) of Tokyo Metro Co., Ltd.

This propulsion system, in which a permanent magnet is used for the rotor of the motor, thus eliminating the need for an excitation current, reduces heat generation due to the higher efficiency achieved compared with conventional motors. The PMSM can therefore be designed in a totally enclosed configuration, reducing both noise emission and maintenance. In order to realize a 2.5M3.5T (2.5 motor cars and 3.5 trailers) fleet, the variable-voltage variable-frequency (VVVF) inverter of the system has been designed in two types, one for two motors and the other for four motors, making it possible to reduce the size of the inverter.

Commercial operation of the new EMUs started in April 2012. From now on, we will investigate the energy-saving effects of the system.

1000 series EMU for Tokyo Metro Co., Ltd.

Development of 60% Smaller Volume Railway Propulsion Inverter Applying SiC Diode

Inverter for EMUs incorporating SiC power devices

Toshiba has developed a PMSM propulsion inverter applying a proprietary silicon carbide (SiC) diode with a rated voltage of 1 700 V and a rated current of 1 200 A.

The high voltage capacity and high efficiency of the SiC diode reduces loss during conversion between DC and AC power and makes it possible to realize a compact cooling device. As a result, the newly developed inverter achieves a 60% reduction in volume.

The PMSM is a lightweight and energy-efficient motor equipped with a permanent-magnet rotor, allowing an energy saving of 20% in combination with the inverter compared with a conventional system(*).

This work was carried out as part of the Research and Development Program for Innovative Energy Efficiency Technology commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

(*) In comparison with our propulsion inverter using a Si diode and an induction motor.

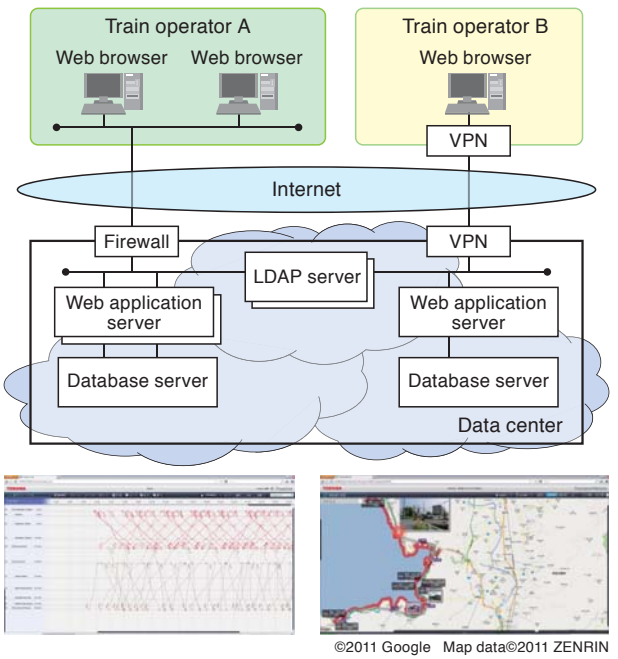
Cloud-Type Transportation Planning System and GIS Operation Monitoring System

Toshiba has developed a transportation planning system and a geographic information system (GIS) operation monitoring system that operate on a cloud base. The transportation planning system is used for creating train timetables and daily rolling stock assignments. The GIS operation monitoring system provides train dispatchers with train traffic information and local weather conditions displayed on Google™ Maps/Earth.

By taking advantage of cloud computing, these systems provide the following benefits to users:

- reduction of initial deployment costs
- reduction of system operating costs
- improvement of robustness against disasters
- worldwide accessibility with support for 31 languages.

Google, Google Maps, and Google Earth are trademarks of Google Inc.



VPN: virtual private network
LDAP: Lightweight Directory Access Protocol

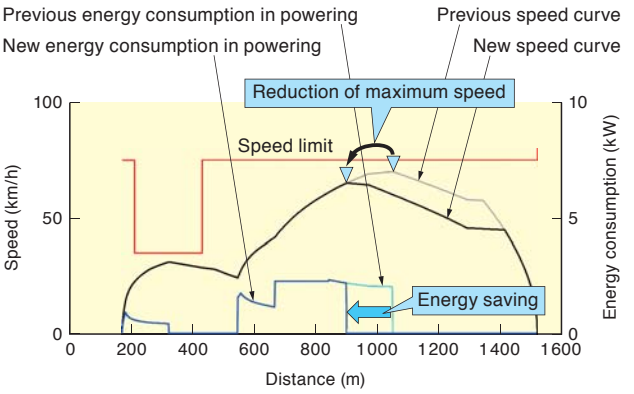
Configuration and examples of screenshots of cloud-type transportation planning system

Examination of Summertime Energy Saving for Rolling Stock

In the summer of 2011, railway companies in Japan were ordered to reduce energy consumption by 15% compared with that in the summer of 2010 as a consequence of the Great East Japan Earthquake of March 11, 2011. In order to secure the safety of transportation while cutting electric power consumption, Toshiba, in cooperation with Tobu Railway Co., Ltd., performed energy saving simulations for rolling stock.

From the results of the simulations, we have confirmed that an energy saving of 21% can be achieved in powering by applying a PMSM system and that an energy saving of 15% can be achieved by either reducing the maximum speed by 5.6 km/h or reducing the frequency of service from six trains per hour under the current system to five.

A technical paper presenting these results was published for the 48th Japan Railway Cybernetics Symposium in November 2011, where it was awarded a prize.



Results of simulation of electric energy reduction by controlling train running speeds

SCiB™ Battery Module for Electric Vehicles

The market for environmentally friendly vehicles such as electric vehicles (EVs) and hybrid electric vehicles (HEVs) has been steadily expanding in line with efforts to prevent global warming.

Toshiba has developed the SCiB™ battery module, which is installed in the i-MiEV M and MINICAB-MiEV (CD 10.5 kWh) model EVs released by Mitsubishi Motors Corporation in 2011.

These two EVs make optimal use of the features of our SCiB™ battery cells; namely, long life, good performance even in low-temperature environments, and fast charging.

In the case of charging using the highest current available with CHAdeMO(*), the SCiB™ battery reaches 80% of its full capacity in about 15 minutes. This is half the charging time required by typical lithium-ion batteries under the same conditions.

Moreover, the number of full charge-discharge cycles for the SCiB™ battery is 6 000 times, which is three times or more the number of cycles of other lithium-ion batteries. The long life characteristics of the SCiB™ battery module also allow its reuse in other applications after use in EVs.

SCiB™ battery module and cells

(*) The CHAdeMO Association is promoting a global standard for fast charging of EVs.

i-MiEV M model EV equipped with SCiB™ battery modules

MINICAB-MiEV CD 10.5 kWh model EV equipped with SCiB™ battery modules

Photos provided by Mitsubishi Motors Corporation

TOSVERT™ VF-S15 Compact Multifunctional Inverter

Industrial inverters for variable-speed motor drives are widely used for the purpose of reducing carbon dioxide emissions, saving energy, and conserving electricity as a countermeasure against global warming. Further enhancement of the efficiency of such drives has become increasingly important due to the enactment of legislation mandating high-efficiency motors in various countries around the world in recent years.

To fulfill a broad range of market needs, Toshiba has developed the TOSVERT™ VF-S15 series compact multifunctional inverters for industrial use. The applicable motor capacities for 3-phase 240/500 V-class models range from 0.2 kW to 15 kW.

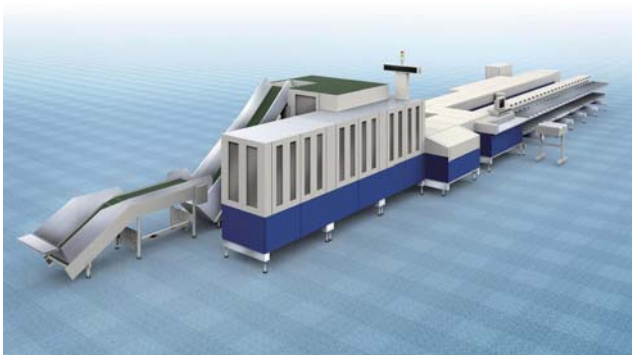
The main features of the TOSVERT™ VF-S15 series inverters are as follows:

TOSVERT™ VF-S15 series compact multifunctional inverter for industrial use

- large setting dial for easy setup and operation
- all models equipped with built-in noise filters
- energy-saving mode and capability to drive permanent-magnet motors
- extensive network options including EtherCAT®.

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH.

TSC-1000SA Culler-Facer-Canceller for South African Post Office Limited



TSC-1000SA culler-facer-canceller for South African Post Office Limited

Toshiba has developed the TSC-1000SA culler-facer-canceller to fulfill the mail processing needs of the Republic of South Africa. Four systems were delivered to South African Post Office Limited in 2012.

First, the system receives postal items deposited in street post boxes and extracts standard-sized letters that can be processed automatically. Next, the system recognizes the indicia, including postage, on the letters, and then arranges them so that they are all upright and facing in the same direction. Finally, the system prints a postmark on each of the indicia using an inkjet printer and sorts the letters into stackers by indicia type and postage.

The TSC-1000SA achieves a high throughput of more than 30 000 letters per hour, and can recognize all major types of indicia and postage circulating within South Africa with a high recognition rate. It is also an environmentally friendly system with low acoustic noise emission and low electricity consumption.

Fully Automatic E-Passport Printer for Overseas Markets

Fully automatic e-passport printer for overseas markets

An e-passport printer prints a passport holder's data onto a personal data page and encodes the data into an integrated circuit (IC) chip. Toshiba has now developed a fully automatic e-passport printer for overseas markets.

In consideration of user-friendliness at the passport issuing office, the e-passport printer has a passport feeder, a page opening function, a printed image capture function for image inspection, a page closing function, a personalized passport stacker, and reject stackers for passports with defective printing or a defective IC, in addition to the machine's printing and IC encoding functions.

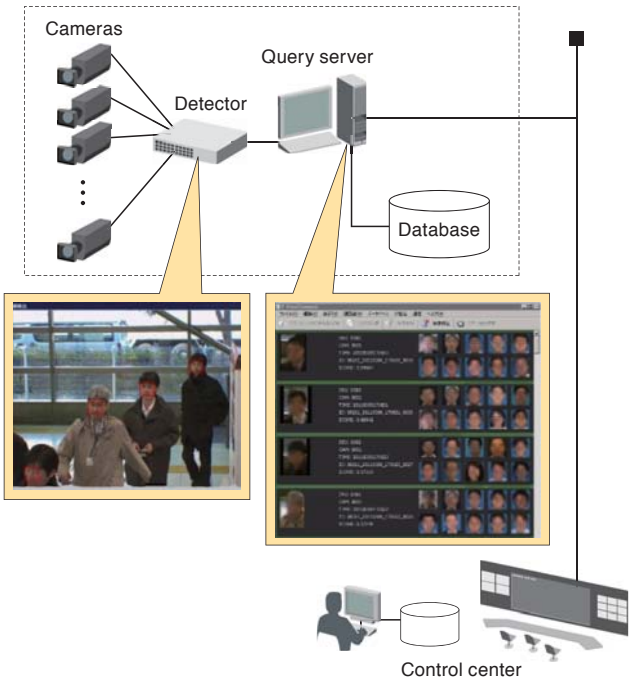
The printer realizes easy operation, allowing the operator to simply insert closed passports into the feeder and remove the closed personalized passports from the stacker. The fully automatic operation greatly reduces the operator's workload and operation time.

Large-Scale Identity Search System Using Face Recognition

In recent years, there has been a growing need for the improvement of social infrastructures to offer greater convenience and ease of use as well as safety and security. Taking immigration procedures as an example, most people would like to pass through immigration quickly as well as in a secure manner. To fulfill these requirements, Toshiba has developed a large-scale identity search system with high speed and high accuracy to detect a specific person from images of surveillance cameras.

This system makes it possible to search for a specific person among images captured by 100 surveillance cameras using a database containing 1 million facial images in one second. A test using the FERET (Facial Recognition Technology) database provided by the National Institute of Standards and Technology (NIST), with a false positive error rate setting of 0.1%, confirmed that the system achieves a correct matching rate of 98.9%.

This work was conducted as part of the innovation promotion programs commissioned by NEDO.



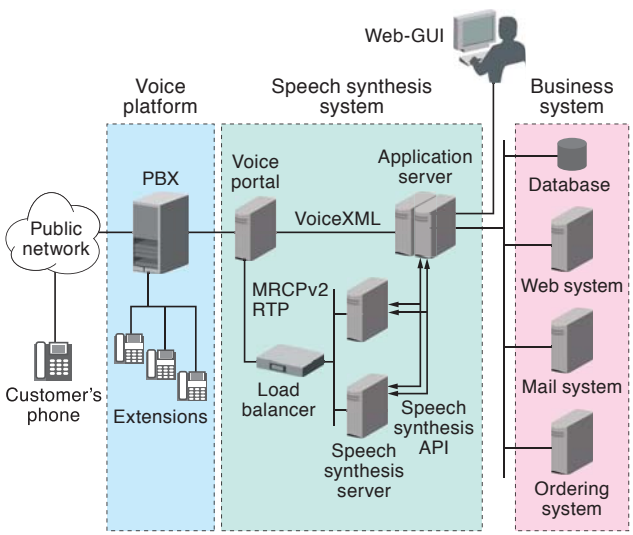
Outline of large-scale identity search system

Speech Synthesis System for Call Centers

Phone calls received by call centers for orders, claims, and questions related to various products and services are mainly processed by human operators. However, in order to reduce both operating costs and the burden on operators, demand has arisen in recent years for automated interactive voice response (IVR) systems as an alternative to the use of operators.

Such a system provides announcements in response to incoming calls, which are prepared by editing a recorded professional announcer's voice or a specific operator's voice. However, the diversification of handled commodities and the necessity for responses tailored to each customer has greatly expanded the types of response guidance that need to be provided by IVR systems. As a result, the costs of voice recording using announcers and the mental burden on human operators are increasing.

With these trends as a background, Toshiba has developed a speech synthesis system for call centers that incorporates a high-quality speech synthesis engine and can function cooperatively with peripheral business systems. This system automatically generates stable response guidance texts based on information provided by customers, and responds using a synthesized voice with realism close to that of a real operator's voice.



GUI: graphical user interface
PBX: private branch exchange
VoiceXML: voice extensible markup language
MRCPv2: Media Resource Control Protocol version 2
RTP: Real-time Transport Protocol
API: application programming interface

Speech synthesis system for call centers

Multiband Distributed Antenna System for LTE Indoor Coverage

Multiband distributed antenna system for indoor coverage of LTE cellular phone BTS

Toshiba has developed a distributed antenna system for indoor coverage that is applicable to both Long Term Evolution (LTE) 3.9th-generation (3.9G) and 3rd-generation (3G) cellular phone base transceiver stations (BTS).

This distributed antenna system for indoor coverage enables expansion of cellular phone communication areas by distributing the radio frequency (RF) signals from LTE and 3G BTS to multiple antennas via optical fibers. The fiber optic technology makes it possible to transmit the signals over long distances, realizing wide indoor communication areas including high-rise building areas and underground shopping malls.

The newly developed system is based on our original multiplex technologies for LTE and 3G BTS signals with multiple frequency bands, which can transmit 3G signals and LTE multiple-input multiple-output (MIMO) signals bidirectionally over one optical fiber. Multiband transmission greatly increases communication capacity in indoor areas.

Thanks to the above technologies, the system allows cellular phone operators to flexibly realize a wide variety of large-capacity communications in indoor areas, including LTE MIMO high-speed data services.

FA3100S Model 9700 Industrial Computer Equipped with Quad-Core Processor

FA3100S model 9700 industrial computer

Desktop-type industrial computers are used in general industrial applications, particularly in fields that require high reliability, robustness, and long-term supply. These computers are often embedded in industrial equipment. Recently, demand has arisen in the fields of semiconductor manufacturing systems and visual inspection systems for high-performance industrial computers with performance equivalent to that of server-class computers.

To meet these requirements, Toshiba has developed the FA3100S model 9700 industrial computer applying our proprietary technologies for server products, equipped with the L5518 quad-core Intel® Xeon® processor (operating frequency: 2.13 GHz) containing four independent cores in one package for industrial computers. The FA3100S model 9700 has high-performance multitasking capabilities enhanced by the parallel processing of each core, in addition to the features of existing models in the FA3100S series such as high reliability, expandability, and maintainability.

Intel® and Xeon® are registered trademarks of Intel Corporation in the United States and other countries.

LDA Equipment for Tokyo International Airport (Haneda Airport)

Toshiba has developed and installed localizer-type directional aid (LDA) equipment for Tokyo International Airport (Haneda Airport), marking the first time that such equipment has been installed at a Japanese airport. This LDA equipment has been applied to the newly assigned landing approach to the airport.

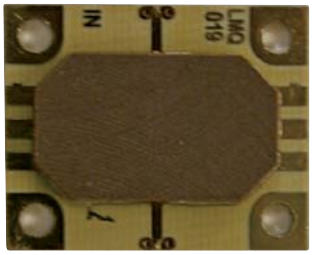
Haneda Airport has recently been expanded with the addition of a new runway in order to meet increased capacity demand. Before the expansion, landing aircraft were guided by instrument landing system (ILS) equipment along an extended runway centerline. However, as the new runway has an offset approach course due to regional restrictions on the airspace around the airport, the first LDA equipment to be introduced in Japan has been installed there.

This equipment employs a dual-frequency type LDA, whose capture effect can suppress interference from the nearby terrain and buildings. It is contributing to the safe landing of aircraft even in the heavy air traffic conditions accompanying the expansion of Haneda Airport.

LDA antenna

LDA transmitter equipment

Ka-Band GaN HEMT with 20 W-Class Output Power

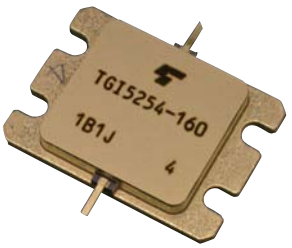


20 W-class Ka-band GaN HEMT

Toshiba has developed a gallium nitride high electron mobility transistor (GaN HEMT) with 20 W-class output power in the Ka band (26-40 GHz). It achieves 20 W (43.0 dBm) output power at 30 GHz, which is the highest performance ever reported in this frequency band. Furthermore, the power density is more than double compared with conventional gallium arsenide field-effect transistors (GaAs FETs). These breakthrough performances are realized due to optimization of the epitaxial layer structure and the gate fabrication design of our well-established X-band (8-12 GHz) and Ku-band (12-18 GHz) GaN HEMT processes for the Ka band.

This high-power GaN HEMT is expected to realize a solid-state power amplifier (SSPA) that replaces conventional traveling-wave tube amplifiers used for Ka-band satellite communication applications, and to improve reliability.

1 kW-Class GaN Solid-State Power Amplifier for 5 GHz-Band Weather Radar Systems



160 W-class GaN power HEMT

1 kW-class GaN SSPA

The transmitters of 5 GHz-band weather radar systems used for observing weather conditions over a wide area have conventionally been equipped with large-size electronic tubes such as magnetrons and klystrons. It is desirable to replace these electronic tubes with SSPAs, both to reduce the size of the system and realize high reliability.

In 2007, Toshiba developed an SSPA using 90 W-class GaAs FETs for this purpose. We have now developed a compact and lightweight 1 kW-class SSPA using new 160 W-class GaN power HEMTs.

In this SSPA, eight 160 W-class GaN power HEMTs in the final stage, a low-loss miniature 8-way combiner, and AC/DC converter modules are highly integrated to realize double the output power and half the overall size and weight compared with conventional SSPAs. Its excellent performance in spurious signal suppression narrows the occupied frequency bandwidth, resulting in efficient use of frequency resources.

We intend to lead the world market for 5 GHz-band weather radar systems by applying these GaN SSPAs.

Cyclone Solid-Liquid Separators

1.8 m^3/h 18 m^3/h

Cyclone solid-liquid separators

The coagulating sedimentation process, in which suspended solids are formed into clumps through the addition of flocculants that are eventually removed by gravity sedimentation, is commonly used for the treatment of inorganic wastewater. For this process, a huge coagulating sedimentation basin with a diameter of 5 m capable of treating 1 000 tons of wastewater per day is required.

Toshiba has developed cyclone solid-liquid separators that allow more effective removal of suspended solids with minimal space requirements. These separators are designed to remove ultrafine particles in order to achieve optimal suspended solid removal from wastewater based on hydraulic analysis, and can effectively remove suspended solids using centrifugal force, thus significantly reducing the required space.

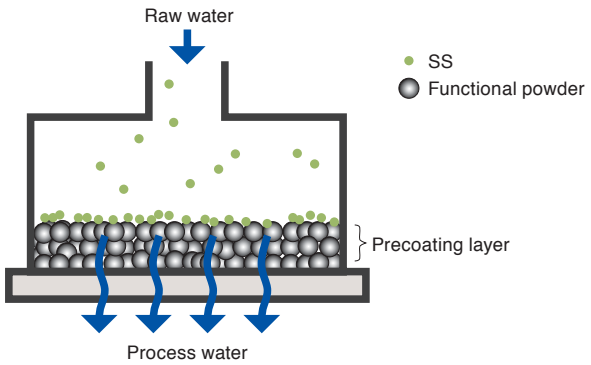
A currently installed coagulating sedimentation basin of 5 m in diameter can be easily replaced with two cyclone solid-liquid separators of 0.2 m in diameter without the need for civil engineering work.

Non-chemical Feed Filtration System

Toshiba has developed the Non-chemical Feed Filtration System, a new filtration system that does not require the use of flocculants for suspended solids (SS) contained in industrial wastewater. We launched this system on the market in April 2011 and received the first order in June the same year.

In the conventional approach, coagulating sedimentation or dissolved air flotation is generally applied. The use of flocculants is indispensible in this approach, in order to make the SS clump together. This increases the amount of sludge generated. Our newly developed water treatment system has a horizontal filter and uses a special magnetic powder called a “functional powder” as a filter aid, which acts to prevent clogging of the filter and also removes minute SS.

The Non-chemical Feed Filtration System operates stably with periodic automatic washing. The functional powder can be used repeatedly, eliminating the need for flocculants and lowering the running cost.



Principle of filtration treatment using functional powder

SHF-500 horizontal filter

Battery-Powered Electromagnetic Flowmeter Offering New Solutions for Wide-Area Water Supply Infrastructure

Battery-powered electromagnetic flowmeters

In recent years, there has been growing demand for accurate monitoring as a countermeasure against water leakage in water utilities, particularly in developing countries. Electromagnetic flowmeters have superior features including higher accuracy and higher reliability compared with other types of flowmeters. However, the necessity for power sources and the costs of wiring between power sources and flowmeters limit the use of electromagnetic flowmeters in the field of wide-area infrastructure systems such as water supply networks. Rotary-type flowmeters are commonly used in such locations.

In response to this situation, Toshiba has developed a high-performance battery-powered electromagnetic flowmeter. This flowmeter can operate for up to nine years powered by its internal battery, and achieves almost the same accuracy as mains-powered electromagnetic flowmeters. By installing this flowmeter in combination with a wireless network in the wide-area infrastructure of a water supply system, flow data and alarm states in each location can be collected efficiently and accurately even without mains power. The collected data are useful for the early detection of water leakage and reduction of the rate of non-revenue water usage. We are promoting the expansion of this solution throughout the world.

Ultrahigh-Speed Large-Capacity Elevators for TOKYO SKYTREE®

©TOKYO-SKYTREE

High-speed and high-power traction machine for elevators in TOKYO SKYTREE® equipped with PMSM

Toshiba Elevator and Building Systems Corporation has developed four ultrahigh-speed, large-capacity elevators (speed: 600 m/min, capacity: 40 passengers) that travel to a panoramic deck (350 m elevation) from the ground in approximately 50 seconds, as well as two elevators accommodating up to 27 passengers that traverse a path of 464.4 m, the longest elevator traveling distance in Japan. These elevators were installed in the newly constructed freestanding broadcasting tower, TOKYO SKYTREE®.

Technologies at the world's highest level that we have developed for our elevators, such as the Japan's largest(*1) capacity elevator (speed: 240 m/min, capacity: 75 passengers) for the Izumi Garden complex in Tokyo and the world's fastest(*2) high-speed elevator (speed: 1 010 m/min, capacity: 24 passengers) for the TAIPEI101 building in Taiwan, have been incorporated into the elevators for TOKYO SKYTREE®.

In order to realize a safe and comfortable ride for these ultrahigh-speed large-capacity elevators, they are equipped with a double safety system mounted on both the lower and upper parts of each car, in contrast to the conventional system mounted only on one side, as well as an aerodynamic capsule covering each car to prevent the generation of turbulent air flow in the hoistway. Moreover, the system incorporates functions that provide countermeasures against shaking of the structure during operation in the event of strong winds or a long-period seismic emergency.

(*1) As of June 2002 (as researched by Toshiba Elevator and Building Systems Corporation)

(*2) As of December 2004 (as researched by Toshiba Elevator and Building Systems Corporation)

TOKYO SKYTREE is a registered trademark of Tobu Railway Co., Ltd. and Tobu Tower Skytree Co., Ltd. in Japan.

Standard Elevator Realizing Energy Saving and Environmental Friendliness

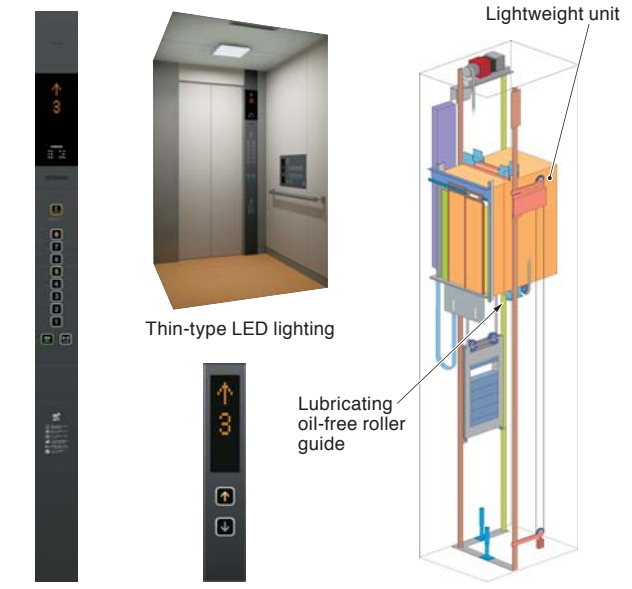
In response to the global trend of demand for elevators offering energy saving and environmental friendliness, Toshiba Elevator and Building Systems Corporation has developed the SPACEL-GR™ standard elevator for the Japanese market and the SPACEL-III and ELCOSMO-III elevators for the Chinese and Indian markets.

To improve riding comfort, roller guides normally used in high-grade models have been applied to the standard elevator. Moreover, the lubrication oil required for the conventional guide shoes has been eliminated and light-emitting diode (LED) lighting has also been adopted for the ceiling to obtain high performance and contribute to reduction of the environmental burden.

For energy saving, the standby power is reduced by the use of a new controller, and with the use of a regenerative-power function (optional), in which power from the motor is returned to the point of origin during operation, power consumption is reduced by up to 50% compared with the conventional model.

A wide variety of ceilings and operation panels are available, with a full lineup of new designs adopting thin-type LED lighting with a light guiding panel for the standard type ceiling.

Furthermore, a notification door beam function (optional) to prevent passengers from being caught if they rush into the elevator, that operates by detecting objects including passengers near the elevator entrance, contributes to the safety of the door area.



SPACEL-GR™ standard machine-room-less elevator