

Infrastructure Systems

Comprehensive ITS Project for North-South Expressway in Vietnam under EPC Contract



Toll gate equipped with ETC system



Traffic control center

Toll collection system and traffic control center of ITS for North-South Expressway in Vietnam

In Vietnam, construction of the North-South Expressway, which will run from Hanoi, the capital, to Ho Chi Minh City and areas further south, is currently in progress.

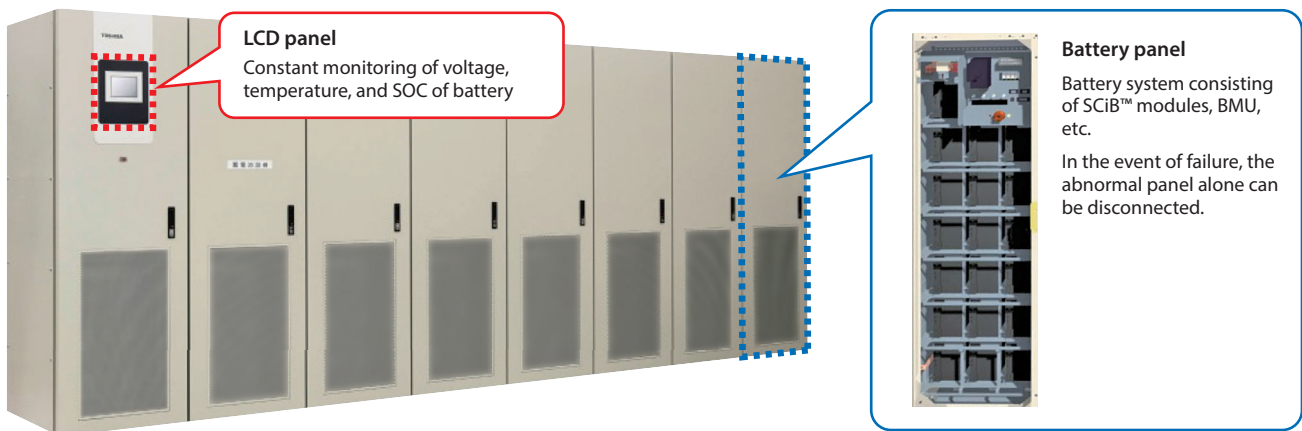
In March 2014, Toshiba Infrastructure Systems & Solutions Corporation concluded an engineering, procurement, and construction (EPC) contract for a comprehensive intelligent transport system (ITS) project covering the 55 km section of the North-South Expressway on the eastern side of Ho Chi Minh City. A group of Japanese companies led by Toshiba formed a consortium for this project. This was the first time that Japanese companies had participated in the construction of a comprehensive ITS in Vietnam.

This project encompassed 11 subsystems such as toll collection systems including an electronic toll collection (ETC) system, traffic control and monitoring systems to provide drivers with traffic information and promptly deal with traffic accidents, and a weigh-in-motion system to automatically detect overloaded vehicles. We undertook system design,

production, procurement, and on-site adjustment for all of the subsystems. We also customized our standard software package for the central server system, as a core technology of the system, to match the Vietnamese situation. The packaged software was developed with a focus on simplicity, flexibility, and operability for overseas use based on our long experience and achievements in Japan. For the implementation of the project, we proactively employed Vietnamese subcontractors, considering the need for local adaptation of the system specifications and post-installation maintenance, while we concentrated on system integration.

As a result of these efforts, the project was successfully completed in May 2017 as scheduled and is contributing to the effective operation of the expressway. With the rapid economic growth of Vietnam, demand for ITS is expected to increase there. We hope to leverage the success of this project to further contribute to the realization of smooth, safe, and comfortable roads in Vietnam.

Small, Lightweight, and Long-Life Uninterruptible Power Supply System Powered by SCiB™



SCiB™ battery system for UPS

Comparison of characteristics of typical lead-acid battery and SCiB™ battery system for UPS

Item	Battery system for UPS	
	General lead-acid battery	SCiB™
Size (mm)	10 500 (width) × 916 (depth) × 1 900 (height)	4 800 (width) × 700 (depth) × 1 900 (height)
Installation area (m ²)	9.62	3.36
Total weight (kg)	16 000	4 250
Expected life (years)	Normal model: 7 to 9; long-life model: 9 to 12	15

With the advancement of the information society, uninterruptible power supply (UPS) systems have become widely disseminated, resulting in increased market demand to reduce the size and improve the maintainability of such systems.

In response, Toshiba Infrastructure Systems & Solutions Corporation has developed a UPS system using the SCiB™ lithium-ion rechargeable battery, which is smaller and lighter and provides longer life than lead-acid batteries.

The newly developed UPS system incorporates battery panels whose control method and structural configuration are designed according to the requirements of a UPS system. The battery panels house SCiB™ modules and a battery management unit (BMU), and each battery panel can be separately disconnected from the DC circuit bus. In the event of failure of a battery module, the battery panel containing the failed module can be disconnected so that operation of the UPS can be continued with healthy battery panels. In addition, the voltage, temperature, and state of charge (SOC) of each battery can be constantly monitored via a liquid crystal display (LCD) panel.

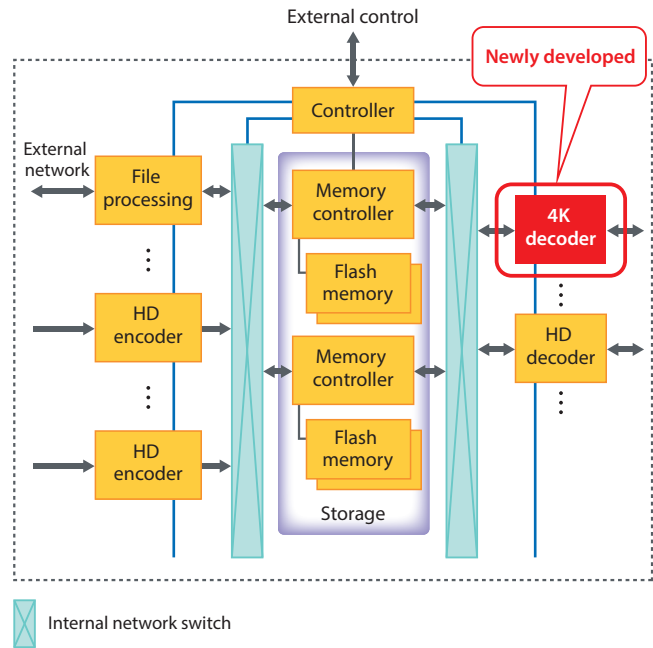
The main features of the new UPS system are as follows:

- **Small size and light weight**
The TOSNIC-9400 UPS (500 kVA) requires 34.9% less installation space and is 26.6% lighter than a conventional lead-acid battery system, thanks to the high-output characteristics of the SCiB™.
- **Long life**
Conventional lead-acid batteries (with a lifespan of seven to nine years) must be replaced at least once during the service life of a UPS system (15 years). In contrast, the SCiB™ provides a long life, eliminating the need to replace batteries during the service life of the UPS system. We are continuously working on improving the performance of the newly developed UPS system and further reducing its size and weight.

VIDEOS neo 4K Playout Video Server



VIDEOS neo video playout server for 4K UHD broadcasting services



Basic architecture of VIDEOS neo

Toshiba Infrastructure Systems & Solutions Corporation provides VIDEOS neo, a video server for TV stations that stores video and audio contents and plays them out according to a schedule. VIDEOS neo, which incorporates our proprietary memory management technologies and highly reliable flash memory, has been implemented at many TV stations in Japan.

To meet the requirements of the new 4K8K satellite broadcasting service that was inaugurated in Japan in December 2018, we have developed a new model of VIDEOS neo that supports 4K ultra-high-definition (UHD) (3 840 × 2 160 pixels) broadcasting. The new model has been delivered to four major TV stations in Japan that provide satellite broadcasting services.

The standard video bitrate for 4K content is 600 Mbps, whereas the new 4K8K satellite broadcasting employs compression technology to reduce the video bitrate to 200 Mbps.

To make it possible to decode and play 4K content, we have developed a 4K decoder unit and implemented it in the new VIDEOS neo model. The bit rate of 4K content is four times that of conventional HD content. To accommodate this four-fold increase, we have developed a 4K content transfer technique that makes it possible to allocate sufficient bandwidth without changing the internal architecture by increasing the number of data streams that can be transferred in parallel from the storage to the decoder unit. We have also developed a file transfer unit capable of inputting and outputting both 4K and HD content via Ethernet.

We have been developing flash memory video servers since 1996. Drawing on our technology and expertise accumulated through this long experience, we will continue to provide products with high reliability, scalability, and flexibility.

MC2210 Series Compact High-Definition Pan-Tilt-Zoom Camera for Outdoor Use

Toshiba Infrastructure Systems & Solutions Corporation has developed the MC2210 series of compact high-definition (HD) pan-tilt-zoom surveillance cameras for outdoor use, aiming to increase its market share. We have optimized the camera structure to achieve competitive pricing, reducing the size and power consumption of the MC2210 series by roughly 50% compared with conventional products.

Two models are available that conform to the standard equipment specifications of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) of Japan. The MC2214 with a video signal output has a high-sensitivity Full HD camera (with a minimum object brightness of 0.00035 lux and a 30x optical zoom lens) in a housing that can be mounted upside down. The MC2218 with a cable network output provides video encoding compliant with the H.264^(*1) and JPEG^(*2) standards and allows images to be recorded on a Secure Digital (SD) memory card.

Combined with newly developed camera-mounted white and near-infrared light-emitting diode (LED) lights, the MC2214 and MC2218 models allow surveillance in dark conditions. These cameras will contribute to safety and security.



MC2210 series compact HD pan-tilt-zoom camera



Example of MC2210 series mounted upside down

(*1) H.264 standard: A standard of the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) related to advanced video coding for generic audiovisual services

(*2) JPEG standard: A standard of the Joint Photographic Experts Group (JPEG) of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) related to digital compression and coding

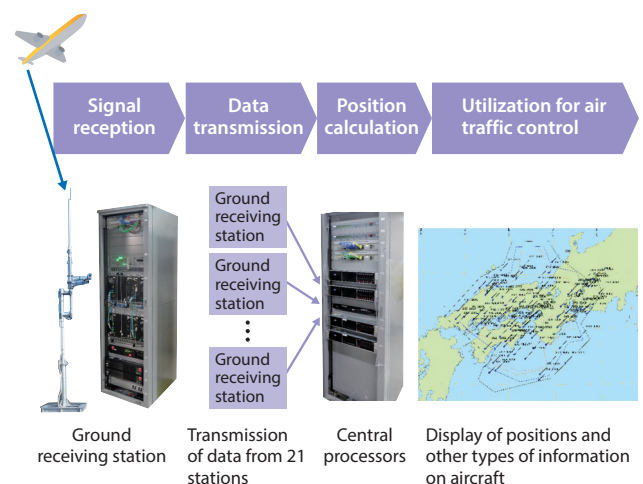
Delivery of Wide-Area Multilateration En-Route Surveillance System to Japan Civil Aviation Bureau

Toshiba Infrastructure Systems & Solutions Corporation has delivered a wide-area multilateration (WAM) en-route surveillance system for aircraft to the Japan Civil Aviation Bureau.

A WAM surveillance system consists of central processors and at least four ground receiving stations. The ground receiving stations relay signals from air traffic control transponders on aircraft to the central processors, which in turn calculate the positions of aircraft based on the differences in the arrival times of the signals at multiple stations. Since WAM provides higher accuracy and update frequency than conventional surveillance radars, it is expected to enhance the safety of air traffic control.

We have installed 21 ground receiving stations in the Chubu, Kinki, and Setouchi regions to cover a wide air route area. We are now working to deliver a WAM surveillance system covering the area from southern Hokkaido to northern Tohoku in 2020.

We will continue to develop aviation products that will further improve the safety of air traffic.



Outline of WAM system for en-route surveillance of aircraft

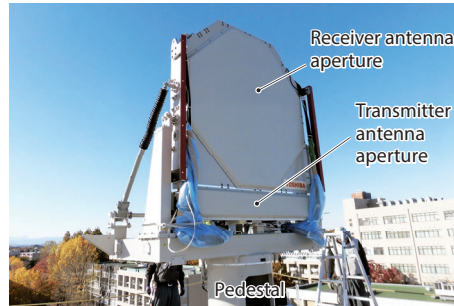
Commencement of Demonstration Experiment on Heavy-Rain Detection Using Multi-parameter Phased Array Weather Radar

Toshiba Infrastructure Systems & Solutions Corporation installed the world's first practical multi-parameter phased array weather radar (MP-PAWR)^(*) at Saitama University in November 2017 and commenced a demonstration experiment on heavy-rain detection in July 2018.

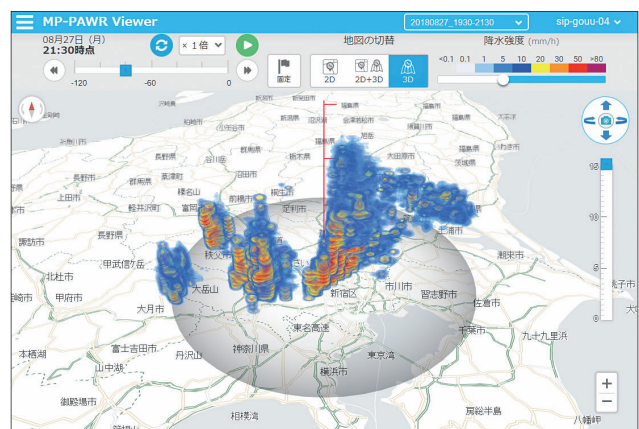
Conventional parabolic weather radars require more than five minutes for three-dimensional (3D) observation whereas the MP-PAWR provides 3D observation in only 30 seconds through electronic scanning using an array antenna, increasing observation spatial density by 2.5 times. This is equivalent to making observations at 25 times the speed of a conventional radar. Furthermore, dual-polarized (multiparameter) observation using horizontally and vertically polarized waves provides highly accurate data on the amount of rainfall and types of precipitation particles. The MP-PAWR is expected to be capable of predicting extreme weather phenomena such as torrential rainfall and wind gusts.

At present, the MP-PAWR is used to observe clouds within a 60 km radius from Saitama University and deliver information on the observed clouds to users as 3D images via a web browser. In the summer of 2018, we succeeded in capturing the occurrence of sudden rainfall due to the development of cumulonimbus clouds.

This project was sponsored by the Cross-ministerial Strategic Innovation Promotion Program (SIP) on the Enhancement of Societal Resiliency against Natural Disasters led by the Cabinet Office of Japan.



MP-PAWR



Example of MP-PAWR viewer display showing 3D view of clouds

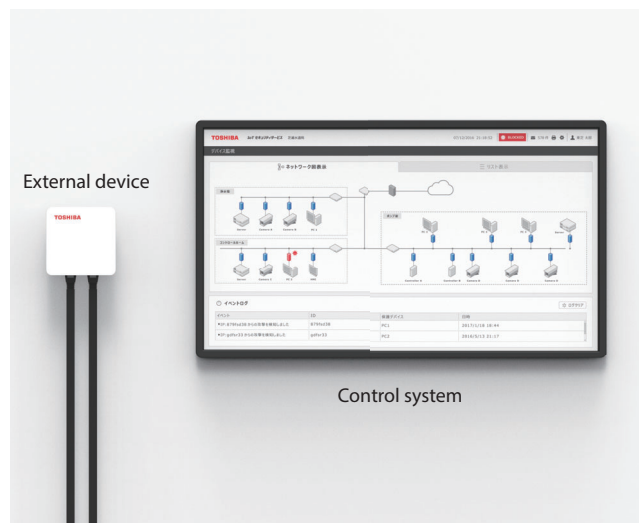
(*) As of November 2017 (as researched by Toshiba Infrastructure Systems & Solutions Corporation)

CYTHEMIS IoT Security Solution

With the rapid advancement of the Internet of Things (IoT), network security for industrial equipment and infrastructure facilities is becoming increasingly crucial. However, security patches and anti-virus software cannot be used for many of the legacy control systems in infrastructure facilities and factories.

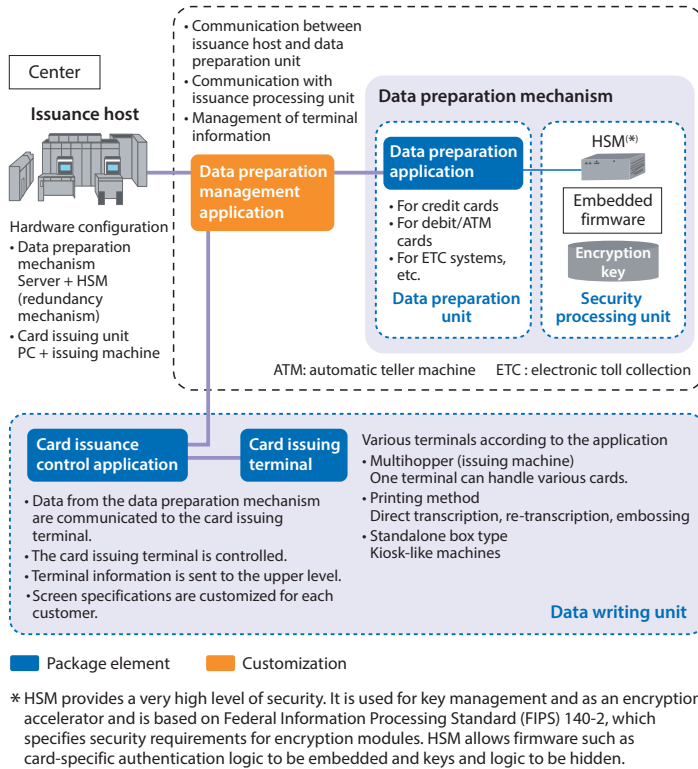
To solve this problem, Toshiba Infrastructure Systems & Solutions Corporation has developed the CYTHEMIS IoT-based security solution for infrastructure facilities and factories. Consisting of external devices and a control system, CYTHEMIS is designed to be connectable to legacy control systems via a simple plug-in procedure so as to realize visualization of security incidents.

CYTHEMIS received the Good Design Award 2018 in recognition of these features. We will apply this IoT security solution so as to contribute to the safety and security of society.

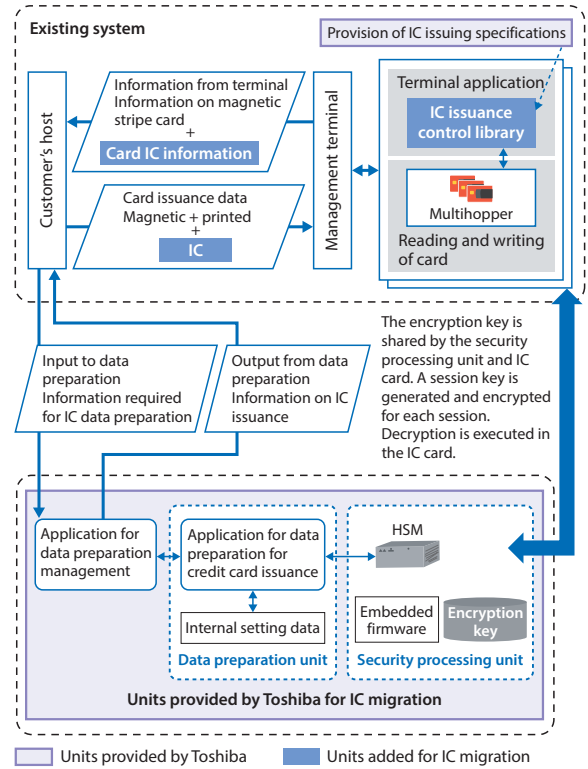


CYTHEMIS for IoT-based control systems and industrial IoT systems

Application of Issuance Solution to Credit Card Instant Issuance System



Configuration of card instant solution



Example of application to credit card instant issuance system

Issuing an integrated circuit (IC) card (also known as a smart card) means writing individual and common data into the card to make it ready for commercial use. It is necessary to implement appropriate security controls in the writing process, taking the functions, performance, and place of issuance of the card into consideration. In order to achieve both security and convenience, it is essential to have a moderately balanced design according to the system requirements.

Toshiba Infrastructure Systems & Solutions Corporation provides an issuance solution that consists of data preparation, security processing, and data writing units that can be provided individually, depending on the system requirements. In particular, the security processing unit allows a hardware security module (HSM) to be customized so as to provide optimal security reliability through encryption key management and data signature.

The customer requirement for the newly developed credit card issuance system was to convert the existing magnetic credit card instant issuance system so as to conform with EMV, a set of international standards for smart payment

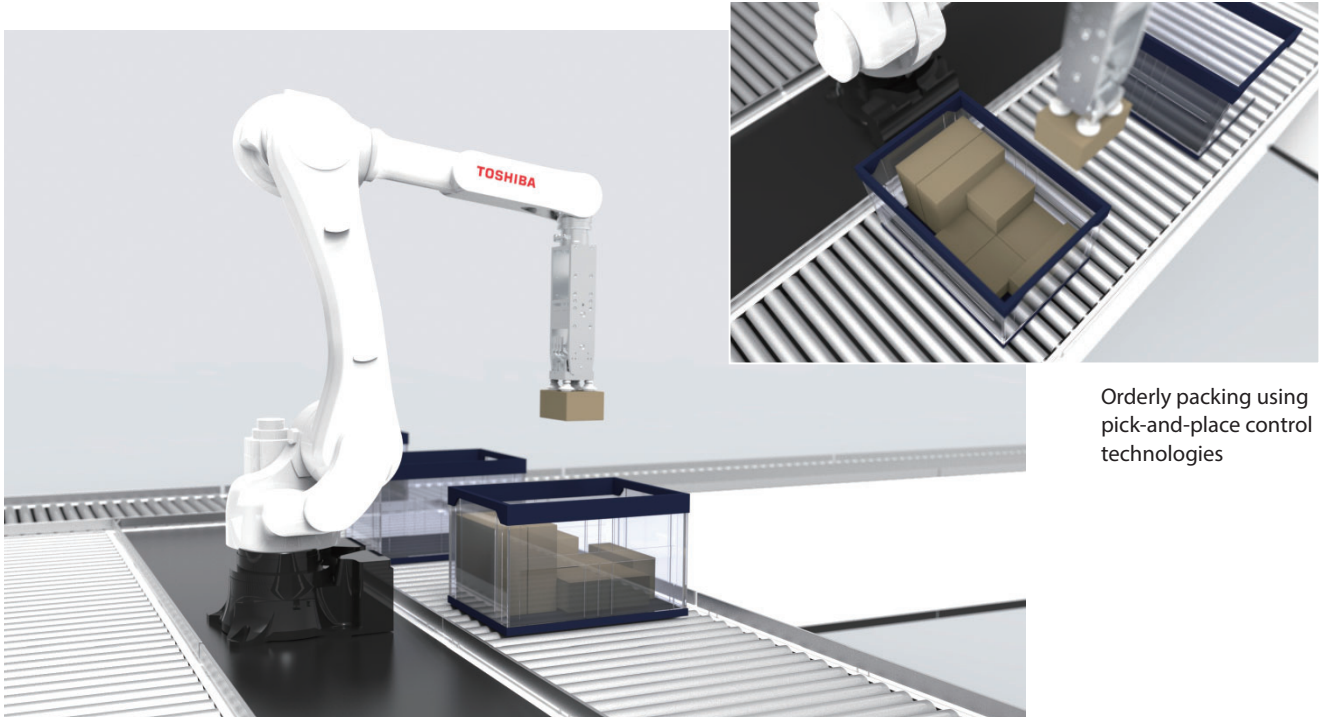
cards. This would have required a huge investment, including changes to the data writing unit, if all units had been combined in one package as with other system solutions. To overcome this problem, we integrated the data preparation and security processing units of our issuance solution into the customer's existing system.

The security processing unit, which was incorporated into the customer's host system, communicates with the encryption function of the IC card to decouple other units from security concerns. In addition, we customized only the customer interface of our proven data preparation application for credit card issuance, reducing the development cost of the data preparation unit while ensuring its reliability. As a result of these innovations, we have received no maintenance calls since the commencement of system operation(*).

We plan to apply this solution to a wide range of similar systems and other types of projects.

(*) As of June 2019 (as researched by Toshiba Infrastructure Systems & Solutions Corporation)

Piece-Picking Robot Technology for Logistics Operations



Orderly packing using pick-and-place control technologies

Piece-picking robot for logistics operations

The labor shortage in the logistics industry in Japan is being compounded by the dissemination of e-commerce and the aging of the population combined with the declining birthrate. Because of the great variety of sizes, shapes, weights, and other characteristics of the items handled, the logistics industry considerably lags in robotic automation compared with the manufacturing sector, which has been introducing automation and robot systems to overcome the labor shortage.

Toshiba Infrastructure Systems & Solutions Corporation has been devoting efforts to the development of automated labor-saving machines such as postal and parcel sorters, leveraging its technologies and expertise accumulated in the fields of mechatronics and image recognition. To address the labor shortage in the logistics industry, we have developed a piece-picking robot for use in logistics warehouses that sorts e-commerce items and other merchandise into delivery containers according to the orders received. This robot incorporates technologies to recognize and grip items and to plan and control its robot arm motions.

Computerized virtual simulations are conducted to optimally integrate these technologies into a robot. However, virtual images based on the information captured by cameras include slight computational errors, which sometimes result in picking failures, damaging items. To solve this problem, we have developed pick-and-place technologies to correct computational errors using force sensors. For pick-and-place operations, the robot captures images of the items and container, recognizes the positions of the items in the container, and calculates preferable placing motions. In order not to damage any items during the placing motions, feedback control is executed in real time by sensing the force applied to each targeted item. Careful item handling through force control enhances the quality of pick-and-place operations. We will continue to contribute to labor-saving in the logistics industry.

Delivery of Electrical Equipment for Series 2000 EMUs of Tokyo Metro Co., Ltd.



Electrical equipment for Series 2000 EMUs of Tokyo Metro Co., Ltd.

Toshiba Infrastructure Systems & Solutions Corporation has delivered variable-voltage, variable-frequency (VVVF) traction inverters using all-silicon carbide (SiC) power devices^(*), totally enclosed permanent magnet synchronous motors (PMSMs), emergency-running battery systems using SCiB™ lithium-ion rechargeable batteries, and air-conditioning systems for the Series 2000 electric multiple units (EMUs) of Tokyo Metro Co., Ltd.

The use of all-SiC devices provides advantages such as an extended operating temperature range and lower heat generation, with a consequent reduction in thermal loss, and an increase in motor current. We have leveraged these advantages to reduce the size of the traction inverter unit while also reducing the size of the control unit and contactors. Consequently, we have succeeded in reducing the size of the VVVF traction inverter by 38% compared with the conventional model, making more space available for the SCiB™-based emergency-running battery system.

We have also developed a new totally enclosed PMSM using all-SiC power devices, making it possible to increase motor current, improve the performance of the regenerative braking system (which converts the kinetic energy of braking into electric power), and further enhance efficiency.

In addition to the emergency-running function of the battery system, we are planning to evaluate its regenerative energy absorption function as well as its power assisting function (which assists in accelerating a vehicle by supplying additional electric power), with the aim of further enhancing energy efficiency.

The new air-conditioning system, which is designed to be compatible with the system installed in the Series 1000 EMUs, provides improved maintainability.

We will evaluate the energy-saving performance of the electrical equipment through commercial operations and continue to contribute to the safety and stability of railway transportation.

Part of this development effort was conducted under the “Research and Development of High-Efficiency, Compact Inverter System with All-SiC Power Devices” project supported by the New Energy and Industrial Technology Development Organization (NEDO) of Japan.

(*) Power devices using SiC for both the diodes and switching elements

Obstacle Detection Technology for Advanced Train Driver Assistance Systems



Installation of camera unit on train

Prototype camera unit

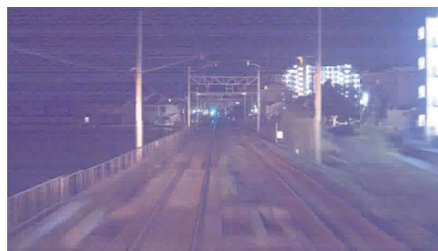


Overview of camera unit

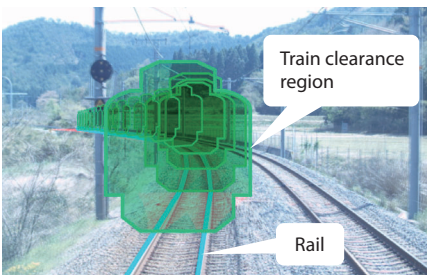


Original image

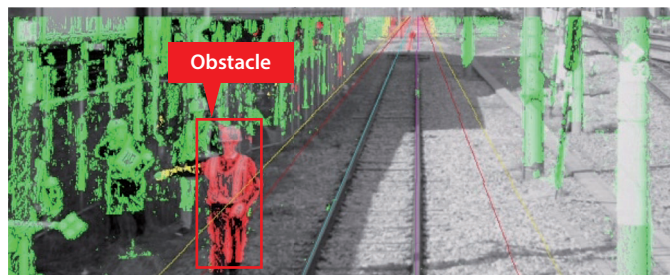
Image enhancement effect of camera unit



Processed image



Detection of train clearance region



Detection of obstacle

Toshiba Infrastructure Systems & Solutions Corporation has developed an obstacle detection technology for train driver assistance systems using forward monitoring cameras.

Trains require robust obstacle detection at distances of as much as 200 m and in an illumination of less than 2 lux. We have fabricated a prototype camera unit consisting of a stereo camera and a processing module incorporating an image recognition processor of the Visconti4 series specifically designed for automotive applications. The camera unit is installed in the upper part of the front windshield of the driver's cabin.

The stereo camera has automatic brightness and sharpness control functions to improve obstacle detection performance

under low-visibility conditions (e.g., at night, in fog, or in backlit situations). The image processing module measures the distance to an object ahead captured by the stereo camera while calculating the amount of 3D clearance available from the vehicle body to determine the risk of colliding with the detected object.

A real-world experiment has shown that the image processing module for real-time obstacle detection provides a nighttime detection accuracy exceeding 90%.

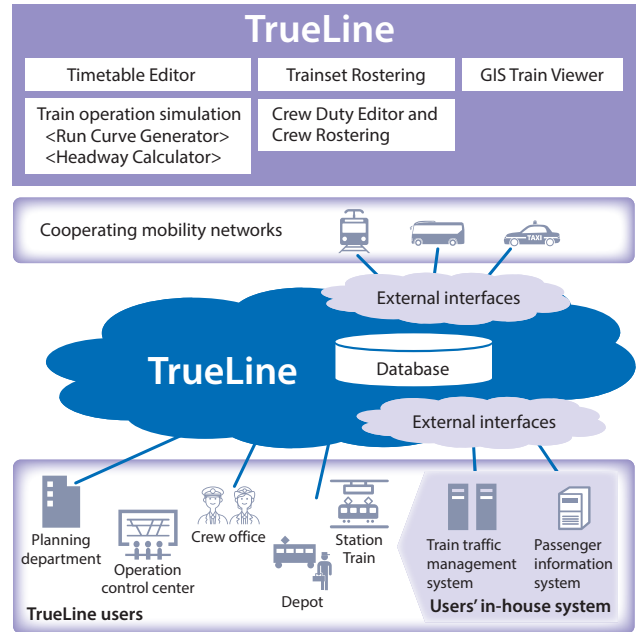
We will further improve the obstacle detection performance of the system and develop additional functions such as traffic signal detection to realize automatic train operating systems.

Development of TrueLine Railway Transit Planning Cloud Service and Its External Interfaces

Urban mobility is undergoing dramatic changes throughout the world. In these circumstances, railways and other means of public transportation, which play an important role as the backbone of urban development, must be able to accommodate the mobility revolution in a flexible manner.

To help solve the current problems with public transportation, Toshiba Infrastructure Systems & Solutions Corporation has developed the TrueLine cloud-based transit scheduling service equipped with a planning function. In addition, we have developed highly versatile interfaces with the global market in mind. These interfaces can be connected to various information and communication technology (ICT) systems, facilitating the implementation of plans and connections with other mobility systems.

We have now concluded an agreement with Bangkok Mass Transit System Public Co., Ltd. for subscription to the Timetable Editor Service of TrueLine.



Overview of TrueLine railway transit planning cloud service and its external interfaces

Delivery of Scott Connected Transformers for Dedicated Freight Corridor in India

Railway freight corridors are under construction in India to improve the efficiency of transportation. Toshiba Infrastructure Systems & Solutions Corporation has delivered 100 MVA Scott connected transformers for substations located along the 922 km section between Rewari and Vadodara of a freight corridor called the Western Dedicated Freight Corridor (Western DFC). The Scott connected transformer is a type of transformer specifically designed for railway applications to convert three-phase AC power from a power company into single-phase AC power.

These transformers were designed based on technology that had already been used for high-speed railways in Japan and Taiwan. At the same time, this technology was transferred to Toshiba Transmission & Distribution Systems (India) Private Limited (TTDI), a local subsidiary in India. As a result, 14 units were manufactured in Japan and 10 units in India. The shipped Scott transformers have been installed on-site and will be put into operation in cooperation with TTDI. These transformers are the key to the power supply to the Western DFC, which will contribute to the development of India. Therefore, there are strong expectations for the high quality of Toshiba's products.



Scott connected transformer installed on-site in dedicated freight corridor, India

We will utilize this experience to further expand the application of these products in the Indian railway substation market.

FR2100T Model 700 2U Rackmount Industrial Computer



FR2100T model 700

Main specifications of FR2100T model 700

Item	Specification
Processor	Intel® Xeon® E3-1268L v5 (2.4 GHz, quad core)
Main memory	4 GB min. (4 GB × 1), 16 GB max. (8 GB × 2) DDR4 SDRAM (DDR4-2133/PC4-17000*) with error check and correct (ECC) function
Expansion interface	Full size PCI: 1 slot, PCI Express (× 16): 1 slot Half size PCI: 1 slot, PCI Express (× 4): 1 slot
Interface	LAN (1000BASE-T/100BASE-TX/10BASE-T) × 3 ports (backplane), etc.

SDRAM: synchronous direct random-access memory

PCI: Peripheral Component Interconnect

* A memory chip and memory module standard

Industrial computers with a height of 2U (rack units) can be mounted on a 19-inch rack together with control or network devices. Such industrial computers have been widely used as process data servers, gateways, operating terminals with a human-machine interface (HMI), and other devices for industrial and social infrastructure applications.

With the dissemination of IoT technology, industrial computers are becoming increasingly smart. The edge computers for such smart systems need to process huge amounts of data so as to connect with multiple sensors and other IoT devices.

To meet this requirement, Toshiba Infrastructure Systems & Solutions Corporation has developed the FR2100T model 700 industrial computer that can be used not only for conventional purposes but also for edge computing applications. The FR2100T model 700 provides the same features necessary in the industrial and social infrastructure fields as the previous model, including robustness, ease of maintenance resulting from the front placement of mechanical components with a relatively short life such as fans, and long-term serviceability due to five-year product provision and maintenance service subsequently available for up to 10 years.

Furthermore, the FR2100T model 700 incorporates a sixth-generation quad-core Intel® Xeon® processor with a Double Data Rate 4 (DDR4) main memory. As a result, the new processor provides approximately double the computing performance(*) and a memory transfer rate 1.6 times as high as that of the conventional machine.

The FR2100T model 700 is also equipped with three local area network (LAN) ports, increasing the number of networks that can be connected, as well as expansion interfaces to support even larger systems.

The high-reliability, high-performance FR2100T model 700 can be used for various industrial and social infrastructure applications to meet the demands of the new era.

(*) In comparison with the adjusted peak performance value released by Intel Corporation; performance may differ depending on the actual system.

Intel and Xeon are trademarks of Intel Corporation in the United States and/or other countries.

Commencement of Generator Supply for e-POWER Minivans

Toshiba Infrastructure Systems & Solutions Corporation is supplying the generator for the Serena e-POWER, a minivan that Nissan Motor Co., Ltd. commercialized in March 2018. This generator is driven by the engine to provide electric power to a high-voltage battery and other systems when the remaining battery level becomes low. Our generator also helps to achieve low fuel consumption because the engine is constantly controlled at an efficient operating speed during electricity generation.

This generator is an improved version of the previous type for Nissan's Note e-POWER launched in November 2016, and provides higher performance to match the increased vehicle size and class. To achieve this improvement, we have performed simulations for more stringent conditions based on our experience as well as severer durability tests while fully utilizing the design of the Note e-POWER generator.

We have maintained zero field defects (as of January 2019) for the 250 000 generators that have been shipped since the generator supply for the Note e-POWER began. We will continue to develop products that satisfy customers' needs.



Courtesy Nissan Motor Co., Ltd.



Parameter	Specification
Max. torque	108 Nm
Electric power output	55 kW
Max. speed	11 000 rpm
External dimensions	Diameter: 210 mm, length: 240 mm

Generator for electric vehicles and its main specifications

Construction of Plant under Joint Venture with Suzuki and Denso for Production of Lithium-Ion Batteries in India

Toshiba Corporation, Suzuki Motor Corporation, and Denso Corporation established a joint venture company in India for the production of automotive lithium-ion batteries, including cells, modules, and packs, and commenced the construction of a plant in 2018. Located in the State of Gujarat in western India, this plant will have double the area of Kashiwazaki Operations, Toshiba's battery plant in Japan, and is scheduled to start mass production in 2020.

In India, lithium-ion batteries are attracting strong interest as a means of improving automotive energy efficiency and satisfying new fuel consumption regulations, in order to solve the serious environmental problems there.

Our lithium-ion batteries use lithium titanium oxide for the anode electrode to improve durability under high temperatures, which helps to reduce aging degradation in high-temperature areas such as India and thus sustain improved fuel efficiency for many years.

This facility, the first lithium-ion battery plant in India, is aimed at stabilizing the supply of lithium-ion battery products so as to promote green cars in the country and contribute to the "Make in India" initiative of the Indian government.



Rendering of automotive lithium-ion battery plant currently under construction in India

New Models of e-STUDIO series Medium- to High-Speed Multifunctional Peripherals



e-STUDIO 2510AC/5015AC/5018A series medium-speed and 7516AC/8518A series high-speed MFPs

Toshiba Tec Corporation has developed five new models in the e-STUDIO series of color and monochrome medium- to high-speed multifunctional peripherals (MFPs). As in the previous models, we applied the platform design concept to the new models so as to improve development efficiency, using common parts for all of the models including the scanner, operation panel, and software controller.

The new medium-speed models are the e-STUDIO 2510AC/5015AC series compact A3 full-color MFPs and the e-STUDIO 5018A series A3 monochrome MFPs, while the new high-speed models are the e-STUDIO 7516AC series durable high-specification A3 color MFPs and the e-STUDIO 8518A series A3 monochrome MFPs.

To improve ease of use, these models have a 10.1-inch control panel, larger than the 9-inch control panel of the previous models. In addition, the new models incorporate unique applications that help to improve work productivity and allow mobile work, including an application that directly connects the MFP to a cloud service without a PC and another application that enhances the optical character recognition (OCR) function. The OCR enhancement application allows users to intuitively highlight the areas in a form to be scanned using a pen, reducing the data processing load.

Unique applications can also be developed using the optionally available software development kit, which allows the development of third-party applications, to further enhance the value of the MFP.

MP-10 Multifunctional Terminal Suitable for Tenant Stores in Shopping Centers

There is a growing need for various services at supermarkets, shopping centers, and other retailers, including support for credit card readers that parse out unnecessary data from IC credit cards and payment terminals that allow customers to make cashless payments using barcodes or two-dimensional codes.

To meet these needs, Toshiba Tec Corporation has developed the MP-10 multifunctional terminal for tenant stores in shopping centers, which provides daily sales management, various payment methods, groupware, and other functions.

The MP-10 is compact, has a 7-inch LCD display with a capacitive touchscreen, runs on the latest operating system, and provides ease of use equivalent to that of a smartphone. The MP-10 also provides both wireless and wired LAN links as well as seven general-purpose interface ports, allowing connections to various networks and peripheral devices. In addition, the MP-10 has a wired LAN port that functions as a hub, eliminating the need to add either a power supply or a network line and thus improving extendibility.



MP-10 multifunctional terminal

Elevate Solution for Easy Customization of MFPs

Toshiba Tec Corporation has developed the Elevate application, which allows users of its MFPs to customize the user interface (UI) and functions, as well as Elevate Composer, which makes it possible for MFP dealers to create Elevate application packages as a cloud service. These tools are designed for MFPs incorporating our e-Bridge Next architecture.

Key features of the Elevate application include (1) a UI that allows users to intuitively run MFP applications, (2) customizable background images and logos, and (3) application settings customizable to fit users' specific workflows.

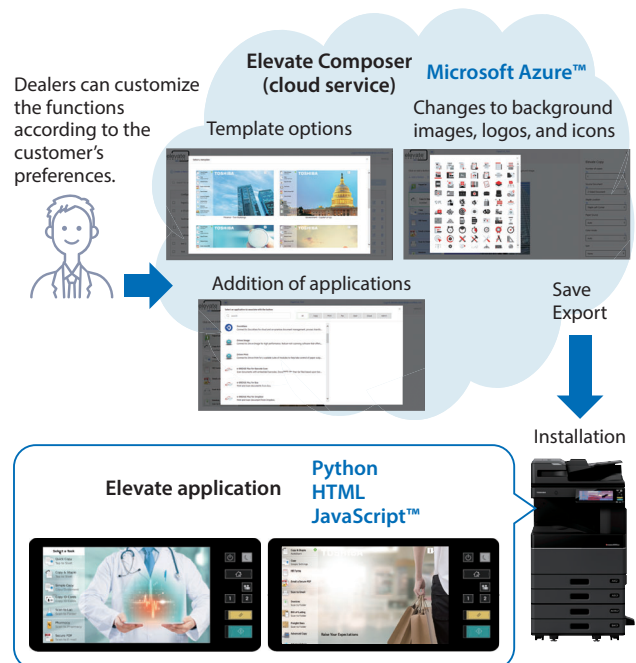
Key features of Elevate Composer include (1) creation and export of packages that combine background images, logos, and applications; and (2) management of package templates in the cloud, allowing reuse of background images, logos, and applications.

The Elevate solution is currently available in North America and will be made available elsewhere in the future.

Microsoft and Azure are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Python is a registered trademark of the Python Software Foundation.

JavaScript is a registered trademark of Oracle and/or its affiliates.



HTML: Hypertext Markup Language

Outline of Elevate solution for easy customization of MFPs

CC1 Compact Ink Recirculation System for Inkjet Heads

Toshiba Tec Corporation has developed the CC1 compact ink recirculation system for the CF1 and CF3 series of inkjet heads. The CC1 incorporates our unique piezoelectric pump and in-line heater technologies to realize several functions in a single compact body, including ink temperature control (60°C maximum), flow rate control, negative pressure control (0 to -3 kPa), automatic ink filling, and maintenance purging. Furthermore, the CC1 can be easily connected directly to the CF1 and CF3 series using mounting brackets that come with the CC1.

The CC1 provides the CF1 and CF3 series with such features as quick removal of air bubbles and unwanted particles from the nozzle for the automatic recovery of failing nozzles, and stable jetting of high-viscosity and high-specific-gravity ink.

Since the CC1 recirculates ink in small amounts, it helps to reduce ink wastage and is therefore environmentally friendly.

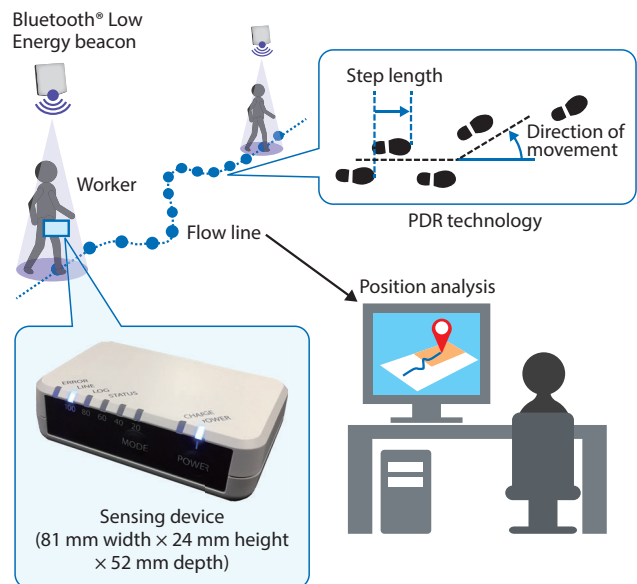


CC1 compact ink recirculation system with CF3R inkjet head

Pedestrian Dead Reckoning Technology Improving Estimation Accuracy of Position Visualization System

The Toshiba Group has released a position visualization system (PVS) that analyzes workers' positions and flow lines at factories to improve their work efficiency.

The conventional type of PVS that uses the received signal strength indicator (RSSI) of Bluetooth® Low Energy beacons to estimate workers' positions is subject to estimation errors, depending on the radio wave conditions. To improve estimation accuracy, we have developed a pedestrian dead reckoning (PDR) technology that uses sensing devices worn by workers to calculate their step lengths and movement directions from acceleration and angular velocity data. We have developed a walking model that accommodates different walking styles to improve the accuracy of step length calculations. The PVS incorporating this new PDR technology, which is already in use at multiple factories, is expected to contribute to the improvement of work efficiency.



PVS incorporating PDR technology

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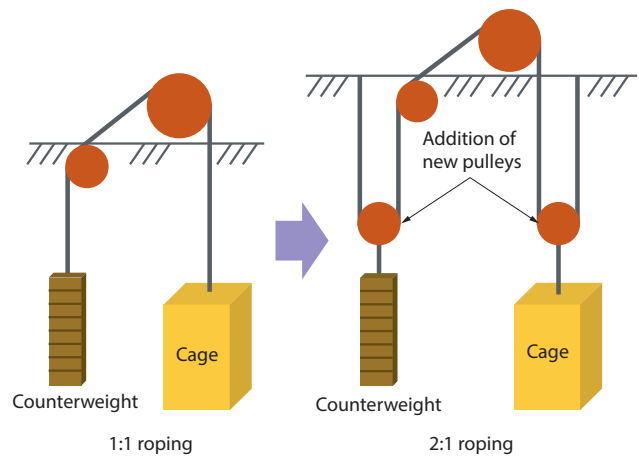
Low-Cost Modernization Models for Chinese Elevator Market

The elevator market in China has been dominated by the construction of new buildings in rapidly urbanizing areas. Nowadays, however, there is increasing demand for the replacement of old elevator models with models offering enhanced safety complying with the latest regulations.

Toshiba Elevator and Building Systems Corporation has commercialized modernization models for the Chinese market, targeting 30 000 elevators that have been in operation for 10 years or more since their installation.

One of the major differences between the Japanese and Chinese elevator markets is market prices. With regard to the costs of elevator equipment and of removal and installation work, we have changed the type of roping from the existing 1:1 roping to 2:1 roping. Although 2:1 roping takes more time for construction, we have realized economically priced modernization models, which are suitable for use with the existing models and compliant with the latest regulations, by using cost-competitive devices.

We will continue to actively release optimal products and services targeted at the modernization market as well as the new construction market.



Change in type of roping for modernization of elevators in Chinese market

Modernization Models for Japanese Elevator Market Realizing Reduction in Installation Period

Despite the fact that elevators are designed to retain their level of performance with regular and appropriate maintenance, their performance eventually drops to the lower limit because of aging. The useful life of the main equipment of an elevator is roughly 20 years, although elevators are depreciated based on a useful life of 17 years under the tax laws of Japan.

With a large number of elevators having reached the end of their useful life, the elevator modernization market is growing year by year in Japan. However, even though building owners need to modernize their elevators to ensure safety and the availability of spare parts, elevator replacement work causes inconvenience to users during downtime.

To alleviate this problem, Toshiba Elevator and Building Systems Corporation has released new main components specifically designed to reduce the period required for elevator modernization, including control panels, operation panels, and motors.

The newly developed modernization method requires two days of all-day downtime and 1.5 days of temporary downtime preceding and following the two-day downtime period. This is a 30 to 50% reduction compared with the conventional method requiring an installation period of five to seven days. In addition, with the new modernization method,



Antibacterial convex character buttons
Antibacterial buttons with convex-shaped characters on control panel that are easy to use for the visually impaired

Replacement of car operation panel for modernization of elevator

a hoist-machine brake is replaced with a double brake to enhance safety. As a result of these innovations, we have realized an elevator modernization method that provides enhanced safety with a short installation period.

Color Changing and Dimming System for Theater LED Downlights



DMX: digital multiplex RDM: remote device management

Configuration of dimming and color changing system for LED downlights

List of color temperature and output ceiling combinations

Mode No.	Color changing and fixed color	Color temperature (K)	Output ceiling (%)
0	Color changing	1 800 to 3 000	100
1			70
2			50
3			30
4	Color changing	1 800 to 2 700	100
5			70
6			50
7			30
8	Fixed color	3 000	100
9			70
A			50
B		30	
C		2 700	100
D			70
E	50		
F		30	

To save energy, LED luminaires have been rapidly replacing halogen luminaires on auditorium ceilings and acoustic reflection plates in theaters. These LED luminaires are required to provide artistic rendering comparable to that of existing halogen lamps.

Various manufacturers supply LED downlight systems with smooth dimming control from 0% to 100% equivalent to that of halogen lamps. However, many theater operators emphasize the importance of producing dramatic effects when opening and closing the curtains that are achieved by changes in the color temperature of halogen lamps at the time of controlling the light intensity.

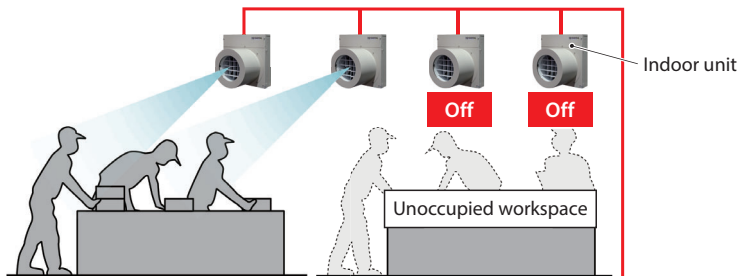
To fulfill this requirement, Toshiba Lighting & Technology Corporation has developed a new color changing system for theater LED downlights that is capable of changing both the light intensity and color temperature. This system comprises color changing downlight fixtures, power supply units, and lighting consoles. The color temperature and output ceiling settings, which can be selected by means of switches on the power supply units, have the following features:

- **Color temperature setting**
The color temperature of the light has been made variable by using two LEDs of different colors. At low output, woody interiors glow in reddish light whereas whitish interiors do not. Therefore, the new color changing system is designed to allow the color changing function to be enabled or disabled according to the theater interior. The color temperature at full intensity can be selected from two settings: 3 000 K and 2 700 K.
- **Output ceiling setting**
To make the levels of illumination on the theater floors uniform, it is necessary to adjust the light output in areas such as under balconies according to the ceiling-to-floor distance. The newly developed system allows the output ceiling to be selected from settings of 100%, 70%, 50%, and 30%. Once the output ceiling is set, fine-tuned dimming is possible without any constraints on the operating range of lighting consoles.
The new LED downlight system has been in operation at theaters since October 2018. We will expand the customer base and sales of the system by leveraging its unique color changing function.

Large-Airflow Type FLEXAIR Spot and Zone Air-Conditioning System

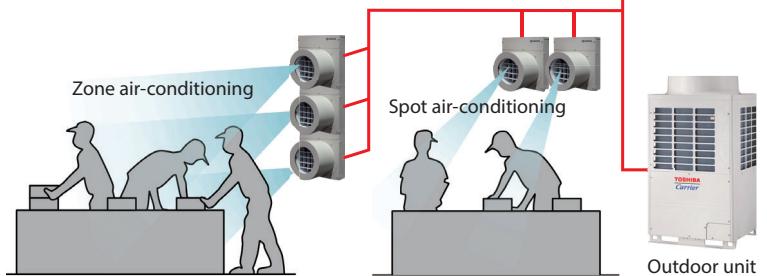


Indoor unit of FLEXAIR large-airflow type spot and zone air-conditioning system



Main specifications of FLEXAIR

Parameter		Large-air-flow type	Standard-airflow type (conventional model)
Rated capacity	Cooling (kW)	2.5	2.5
	Heating (kW)	2.8	2.8
Standard air volume (m ³ /min)		15.2	10.3
Outside dimensions	Width (mm)	500	500
	Height (mm)	500	500
	Depth (mm)	352	337
Weight (kg)		19	18



Example of configuration of FLEXAIR system

In July 2018, Toshiba Carrier Corporation added a large-airflow type to the FLEXAIR series air-conditioning system featuring both spot and zone air-conditioning capabilities, providing optimal performance for assembly factories and other large areas.

There has been growing demand for improved work environments in Japan in recent years. Although the prevention of summer heat stress is necessary, particularly in factories, many factories do not have enough space to install new cooling facilities. To address this problem, we released the FLEXAIR series air-conditioning system in April 2016 consisting of indoor units with 1 hp capacity and a multi-type outdoor unit.

The compact design of the FLEXAIR system provides a high degree of flexibility in both installation and operation, as follows:

- Installation
FLEXAIR can be suspended from the ceiling or beams or attached to unused wall areas or pillars.
- Operation
Two methods of air conditioning are available: spot air conditioning for specific workers and zone air conditioning for specific areas such as production lines.
These and other features make FLEXAIR an energy-saving system. For example, FLEXAIR can be operated with

minimal fan power because of the absence of air supply ducts. It also allows individual units to be turned on or off according to the presence of workers or the ambient temperature so as to avoid unnecessary operation. Furthermore, the combination of spot and zone air conditioning can fulfill cooling and heating requirements with less power consumption than air conditioning for an entire building.

We have developed the new large-airflow type to meet customers' requirements for a greater airflow rate than the conventional model. The large-airflow type uses a slim and light fan motor unit, achieving an increase of approximately 50% in airflow volume with little increase in size and weight. In addition, the large-airflow type has an optional aluminum honeycomb air straightener that increases air velocity by approximately 40%(*).

The newly developed large-airflow type is expected to increase the demand for the FLEXAIR series and contribute to a reduction in the environmental load of users. In 2018, FLEXAIR received the Minister of Economy, Trade and Industry Prize from the Energy Conservation Center of Japan, which is awarded annually to products recognized as having excellent energy efficiency.

(*) In comparison with Blower mode, at a distance of 5 m from the center of an air outlet nozzle

Outdoor Unit of SMMS-e Refrigerant-Saving Series Air-Conditioning System for European Market

Against the background of a rapid rise in the price of fluorinated greenhouse gases (F-gases) due to quota allocations under the European Union F-Gas Regulation, Toshiba Carrier Corporation has developed a new outdoor unit for the SMMS-e air-conditioning system for large buildings that makes it possible to greatly reduce the total amount of charged refrigerant.

To reduce the amount of refrigerant charged prior to shipment by about 50%, we have developed a refrigerant-suppressing function that controls refrigerant idling in indoor units during heating operation, eliminating the need for a liquid refrigerant tank. In addition, to reduce capacity losses caused by the reduction in refrigerant, we have modified the circuit for refrigerant oil level detection.

As a result of these measures, the specified seasonal energy efficiency ratio (SEER) and seasonal coefficient of performance (SCOP) values of the newly developed outdoor unit are up to 7.6% higher than those of conventional models. In addition, all models of the new outdoor unit satisfy the Tier 3 requirements of the Lot 6 and Lot 21 regulations of the European Energy-related Products (ErP) Directive that will come into effect in 2021.



Outdoor unit of SMMS-e refrigerant-saving series air-conditioning system for European market

Furthermore, to improve amenity, we have improved the accuracy of the frost formation detection function so as to reduce the number of outdoor defrosting operations during heating.

Super Digital Inverter Series Air-Conditioning System for Light Commercial Use in European Market

In March 2018, Toshiba Carrier Corporation released the new Super Digital Inverter Series air-conditioning system for stores and offices in the European market that provides the industry's highest SEER and SCOP values(*).

To comply with Europe's ever-tightening restrictions on F-gases, the new series uses R32, a refrigerant with low global warming potential (GWP). The new series also consumes less power than conventional models due to the use of a new outdoor chassis, a compact and lightweight compressor with high performance and energy efficiency, a high-efficiency heat exchanger with a small tube diameter, and a high-efficiency fan propeller. We have also developed a new control system to reduce standby power by up to 50% compared with the previous model.

Due to these features, the 5 hp model has achieved the industry's highest SEER and SCOP values(*) of 8.80 and 5.00, respectively. The new series also provides the industry's most extensive outdoor operating temperature range(*) (52°C maximum and -27°C minimum).

To avoid an increase in the number of indoor unit models, we have also developed indoor units that can be used with both R32 and R410A systems. In addition, the remote con-



Outdoor units of Super Digital Inverter Series air-conditioning system for stores and offices in European market (2 to 5 hp)

troller incorporates an energy monitoring function, allowing easy visualization of the energy savings achieved.

(*) As of March 2018 (as researched by Toshiba Carrier corporation)

Universal Smart X EDGE Series and Series 3 Air-Cooled Heat Pump Chilling Units for Asian Market

Toshiba Carrier Corporation has developed the 60 and 70 hp Universal Smart X EDGE Series and the 30, 40, and 50 hp Series 3 air-cooled heat pump chilling units with specifications for the Asian market based on the models sold in Japan.

Although the Universal Smart X Series 2 is already on sale in Asia, the EDGE Series and Series 3 offer higher efficiency, contributing to reduced running costs and expanding the lineup of large-capacity models.

Furthermore, all models incorporate a harmonic suppression function to improve immunity to harmonics in the power supply, which helps to reduce adverse effects on other equipment and decrease the size of the power supply system. In addition, we have modified the cooling structure for the electrical components to address the need for improved tolerance of the high outdoor temperatures in Asia, increasing the upper limit of the outdoor operating temperature range to 48°C, up from 43°C for the models sold in Japan.

The widespread use of heat source units with these features will contribute to a reduction in the environmental load in Asia.



Universal Smart X EDGE Series air-cooled heat pump chilling unit for Asian market (4 modules)



Universal Smart X Series 3 air-cooled heat pump chilling unit for Asian market (4 modules)

Outdoor Unit of SMMS-7 Multi-Split Air-Conditioning System for Asian Market

Toshiba Carrier Corporation has developed the low-cost SMMS-7 multi-split air-conditioning system for the Asian market, which provides both installation flexibility and high capacity.

We focused on cooling-only models to reduce the number of compressors and dispense with tanks and other components for the refrigerant cycle, reducing the installation space requirement of the 20 hp model by 24% and its production cost by 20%. In addition, we reduced the unit size and decreased the number of models from three to two, providing up to 60 hp per system. We also increased the size of the compressor suction pipe, modified the circuit for detection of the refrigerant oil level, designed a cooling-only heat exchanger, and reduced pressure loss in the accumulator.

As a result of these enhancements, energy efficiency has been increased by up to 16% under the rated conditions and up to 26% under intermediate conditions. We have also modified the compressor motors to reduce the rise in component temperatures under high outside air-temperature conditions so as to achieve an extended operating temperature range of up to 52°C.



Outdoor unit of SMMS-7 multi-split air-conditioning system for Asian market

Consequently, the SMMS-7 multi-split air-conditioning system combines the advantages of improved product quality and reduced product cost.