Completion of Type Test for 230 MVA-400/√3 kV Converter Transformer

Toshiba has successfully completed the type test of a converter transformer for a high-voltage DC (HVDC) line (±500 kV–1 200 MW) running between Italy and Montenegro. We were awarded a contract for this converter transformer by Terna Rete Italia S.p.A.

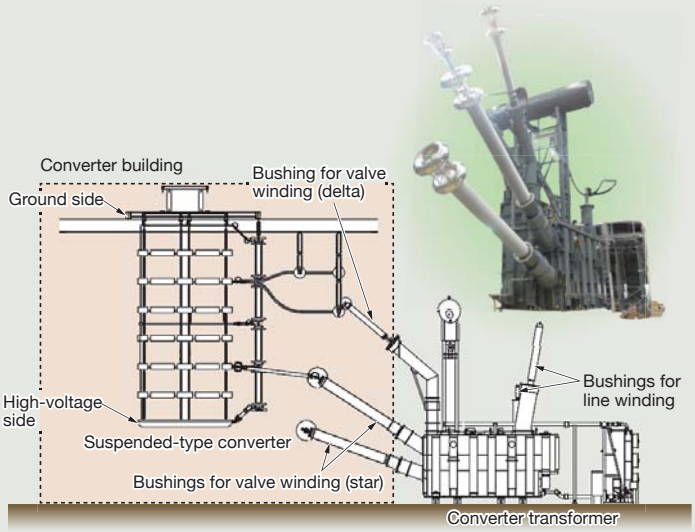
The transformer is a single-phase type and has three windings, consisting of one line winding and two valve windings (with star and delta connections). The valve windings were designed taking the combined load stress of the AC and DC voltages into consideration. The connections between the transformer and the converter are shown in the figure at right.

We successfully performed the type test in accordance with the relevant International Electrotechnical Commission (IEC) standard as well as a short-circuit test. In addition, we conducted a polarity reversal test in a special sequence in which the duration of the test was set to four times longer than that required by the IEC standard.

We are shipping seven units of the converter transformer each to Italy and Montenegro, starting in July 2016.

Ratings of converter transformer

Characteristic		Rating
Rated power		230 MVA
Number of phases		1
Connection symbol (after connection of three phases)		YNy0d1
Rated voltage	Line winding	400/√3 kV, +11.25/-6.75%
	Valve winding (star)	205/√3 kV
	Valve winding (delta)	205 kV
Frequency		50 Hz
Type of cooling		Oil-directed air-forced (ODAF)
Standard compliance		IEC 61378-2



Connections between converter transformer and converter

New Online Partial Discharge Monitoring System for GIS

Toshiba has delivered a new type of online partial discharge monitoring system to the Az Zour North (Z) Substation operated by the Ministry of Electricity and Water of Kuwait, the Al-Wadi Substation operated by Saudi Electricity Company of Saudi Arabia, and the Huainan Substation operated by the State Grid Corporation of China. The features of the new online partial discharge monitoring system are as follows:

- The use of appropriate band-pass filters with an ultra-high frequency (UHF) detection band reduces the effects of external noise, improving the partial discharge signal detection sensitivity.
- High-resolution signals are imported from an optical network connected between the signal converter box (SCB) mounted near a gas-insulated switchgear (GIS) and the human-machine interface (HMI) unit to improve the accuracy of diagnosis of the cause of partial discharge.
- The IEC 61850 protocol is applied to data communications between the interface panel and the substation control system.

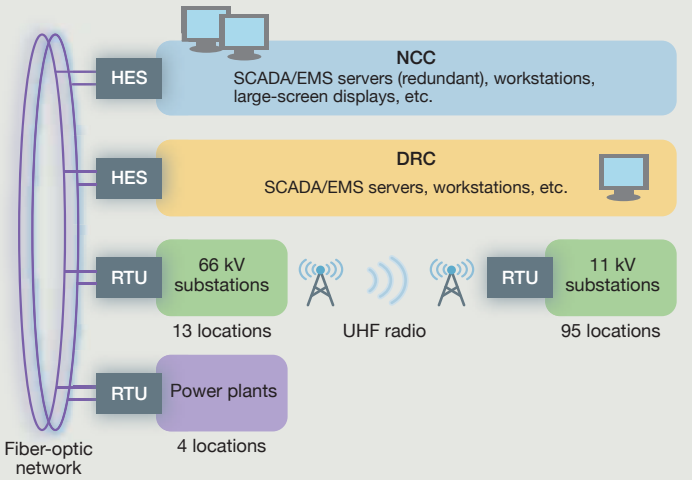
HMI panel for new online partial discharge monitoring system

Introduction of SCADA/EMS System in Brunei Utilizing Common Platform for Overseas Markets

Toshiba has developed a supervisory control and data acquisition (SCADA) system and an energy management system (EMS) that run on a common platform newly developed for power grid control and monitoring systems in overseas markets. We have supplied this SCADA/EMS system to the Department of Electrical Services (DES) of Brunei, the public power utility of the country, and site commissioning is currently underway.

The SCADA/EMS system is installed at the National Control Center (NCC) secured by redundant servers and the Disaster Recovery Center (DRC), which form a redundant configuration with the DRC serving as a backup master station for the NCC in the event of a natural disaster or a system failure at the NCC.

The SCADA system facilitates the real-time monitoring and control of the equipment at substations and records its data. It provides both a single line diagram (SLD), which shows the detailed topology of each substation, and a geographical line diagram (GLD), which shows the geographical network on a map of Brunei. The EMS provides functions for demand forecasting, power generation planning based on demand forecasts, supply-and-demand control, voltage control, and power flow optimization.



Configuration of SCADA/EMS for DES, Brunei

The SCADA/EMS system for the DES, which is scheduled to commence operation in 2016, will greatly improve the visualization, operating efficiency, and reliability of the power grid in Brunei.

Completion of Substation Construction for Electrification and Double Double-Tracking of Main Line Railway in Java, Indonesia

Accompanying the remarkable economic development of Indonesia, traffic congestion has become a serious problem in urban areas of the country. To address this problem, the Bekasi Line has been double double-tracked from Jakarta to Bekasi and electrified from Bekasi to Cikarang. This project was financed by official development assistance (ODA) funds from Japan.

In this project, Toshiba received an order for the equipment for four traction power substations and four signal cabins in June 2013. The installation, testing, and commissioning of the equipment were completed smoothly in December 2015. Transformers and switchgears were delivered from our overseas factory.

Following a test run of the entire railway, the Bekasi Line will begin commercial service in August 2016. This project is expected to greatly reduce traffic congestion in Jakarta.

We will continue to contribute to the development of railway infrastructure in various countries.

DC switchgear installed at DC feeding substation in conjunction with double double-tracking of Blue Line (Jakarta Kota-Bekasi), Indonesia

12 kV Air-Insulated Switchgear with Two Stacked VCBs Compliant with IEC Standard

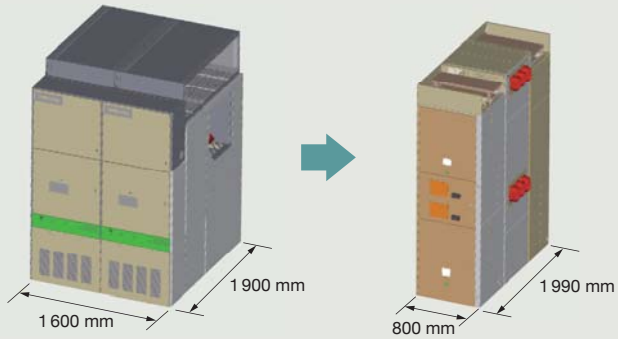
Toshiba has developed a 12 kV air-insulated switchgear equipped with two stacked vacuum circuit breakers (VCBs), mainly for use in substations at oil and gas plants in the Middle East and Southeast Asia. This switchgear has a much smaller floor footprint per VCB than the conventional switchgear equipped with one VCB, while providing the same internal arc performance.

We have also developed a 12 kV VCB with a molded vacuum interrupter to reduce the size of the unit and improve its resistance to humidity and dust.

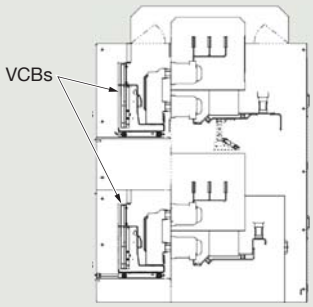
The newly developed switchgear is designed to allow the installation of a fused contactor (vacuum combination unit) so that it can be used for loads requiring frequent opening and closing of the breaker.

Moreover, the bus structure is designed to allow mixed use of the new and conventional models. The new switchgear can therefore be used as a replacement for an existing model and for the expansion of existing facilities.

The new switchgear conforms with the latest version of the IEC 62271-200 standard (2011) and is certified by the Japan Short-Circuit Testing Committee (JSTC), a member of the Short-Circuit Testing Liaison (STL).



Reduction of switchgear footprint by stacking two VCBs



Side view of switchgear with two stacked VCBs

Development of Smart Electricity and Gas Meters for the Netherlands

The Netherlands is planning to install a smart meter for every household by 2021. Landis+Gyr, a member of the Toshiba Group, has been developing smart electricity and gas meters compliant with Version 5 of the Dutch Smart Meter Requirements (DSMR5). These are Landis+Gyr's first smart meters to utilize a mobile communication technology based on code division multiple access (CDMA) in the 450 MHz frequency band in order to increase the communication channel capacity.

The smart meters to be installed in the Netherlands will be equipped with a communications port, which will make it possible for consumers to visually monitor their energy consumption on an in-home display and to connect smart meters to a home EMS (HEMS). This functionality will provide consumers with the ability to have direct feedback and control of their energy consumption.

The smart meters will be provided for four distribution grid operators in the Netherlands, and 3 million smart meters will be deployed in the period from 2016 to 2020.

Smart electricity meter　　Smart gas meter

Smart electricity meter and smart gas meter compliant with DSMR5 smart meter specifications

Completion of Mega Solar Power Plants in Arao and Abira, Japan

Toshiba has completed the construction of two mega solar power plants in Japan: the Softbank Kumamoto Arao Solar Park in Arao, Kumamoto, and the Softbank Tomatoh Abira Solar Park in Abira, Hokkaido. We received engineering, procurement, and construction (EPC) contracts for these plants from a special-purpose company (SPC) established for the projects.

The Arao Solar Park has a DC output of 22.5 MW, while the Abira Solar Park has a DC output of 111 MW.

The Abira Solar Park has the second highest power generation capacity in Japan as of May 2016. The Arao Solar Park began commercial operation in February 2015, followed by the Abira Solar Park in December the same year.

SoftBank Kumamoto Arao Solar Park and SoftBank Tomatoh Abira Solar Park mega solar power plants

We have also received a contract for operation and maintenance (O&M) of these solar parks from the SPC.

The main features of the Arao and Abira Solar Parks include the following:

- Our high-performance monocrystal 250 W solar module is utilized.
- The systems are equipped with a high-efficiency power conditioning system (PCS) supplied by Toshiba Mitsubishi-Electric Industrial Systems Corporation (TMEIC).
- The DC/AC design has been optimized to reduce power loss and thus obtain higher power output.
- We have been providing comprehensive services from plant construction to O&M.

We will engage in the O&M of the systems for the next 20 years. Through this experience, we will accumulate the know-how necessary for the solar power generation business and contribute to the successful continuation and growth of the renewable energy sector.

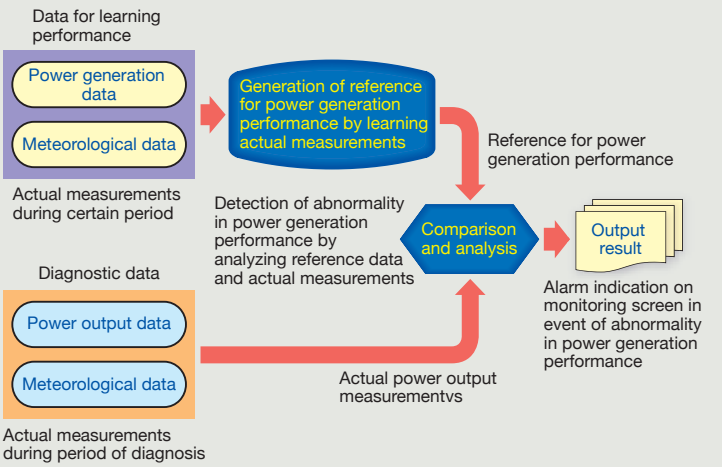
Detection of Abnormalities in Power Generation Performance Using Cloud Monitoring System

Toshiba has developed a new function for detecting abnormalities in power generation performance that cannot be detected with general failure monitoring systems. This function is offered as an additional service for our cloud-based solar power remote monitoring system.

The main feature of the new function lies in the generation of reference data based on past records of actual power generation and meteorological data gathered from solar plants. Statistical analysis using reference and actual data provides higher accuracy in the detection of abnormalities than typical simulation-based methods.

This function is automatically invoked every day, and an alarm indication appears on the monitoring screen in the event that an abnormality in power generation performance is detected.

Following a trial at a solar power plant, we commercialized the new service in April 2016. We will promote this service as a tool to minimize power generation loss, in conjunction with O&M services.



Mechanism for detecting abnormality in power generation performance

Delivery of Electrical Equipment for MRT Purple Line in Bangkok, Thailand

Toshiba has supplied electrical equipment, including propulsion systems, auxiliary power supply systems, train control and monitoring systems (TCMS), and air-conditioning systems, for 21 three-car trains (63 cars in total) on the Purple Line of the Mass Rapid Transit (MRT) railway system in Bangkok, Thailand. We were awarded a contract for this electrical equipment in the autumn of 2013 and began its shipment in the spring of 2015.

On-site testing started in the autumn of 2015. Following trial runs using multiple-car trains, the Purple Line will start revenue service operations in the summer of 2016.

Our electrical equipment was designed to meet the customer's requirement for energy saving. The propulsion inverter of the propulsion system and the auxiliary converter of the auxiliary power supply system are equipped with natural air-cooling systems that do not need an external power supply, in order to reduce power consumption. The propulsion and auxiliary power supply systems calculate their power consumption on a daily basis (taking the regenerative energy produced into consideration), and the TCMS displays their daily and cumulative power consumption in the driver's cab.

Propulsion inverter

Traction motor

TCMS

Traction Converter Equipment Using SiC Devices for Central Japan Railway Company

Toshiba has jointly developed traction converter equipment using high-voltage 3.3 kV silicon carbide (SiC) devices with Central Japan Railway Company for trial deployment on N700 series Tokaido Shinkansen trains.

Trial deployment was carried out, marking the first trial runs of a high-speed railway equipped with a traction converter using SiC devices in the world(*) and representing a major step toward realizing the practical application of this equipment in the railway industry. The running, control, and temperature performance characteristics of the system were evaluated during these trial runs.

The newly developed SiC device has many advantages such as an extended operating temperature range and lower heat generation, with a consequent reduction in thermal loss. These characteristics of our SiC device make it possible to reduce the size and weight of traction converter equipment for high-speed railways.

We will continue with the development of power electronics devices as well as their application systems.

(*) As of June 2015 (as researched by Toshiba)

Traction converter equipment for N700 series Shinkansen trains

Development of Permanent Magnet Synchronous Motor and 4-in-1 Propulsion Inverter Unit

Toshiba has developed a permanent magnet synchronous motor (PMSM) and a 4-in-1 propulsion inverter unit that can be utilized in various train systems.

Compared with other motors, our PMSM has a number of advantages including significant energy-saving performance due to its high efficiency, easy maintenance realized by a totally enclosed structure, and low noise.

Our 4-in-1 propulsion inverter unit is smaller and lighter than our previous inverter unit, and can not only be installed in new trains but also replace conventional inverter units for the retrofitting of existing trains.

Our PMSM and 4-in-1 propulsion inverter unit have been adopted by a number of railway companies including Hankyu Corporation, Keio Corporation, JR Kyushu Railway Company, and Hanshin Electric Railway, contributing to energy conservation and environmental friendliness.

PMSM

4-in-1 inverter unit

Totally enclosed PMSM and 4-in-1 inverter unit

Delivery of EL120 Type DC Electric Locomotives to Nagoya Railroad Co., Ltd.

Toshiba delivered newly developed EL120 type DC electric locomotives to Nagoya Railroad Co., Ltd. in January 2015 to replace the DeKi600 type DC locomotives designed and manufactured by us in 1943, which have been used for track maintenance work and deadheading of trains.

The EL120 is a four-axle locomotive with cab boxes at both ends. It has a maximum service speed of 100 km/h and a maximum output of 8 000 kgf at the wheel rim. Furthermore, the EL120 provides constant-speed control at speeds as low as 5 km/h for ballast dispersion and a double-heading control function. The reliability of the EL120 has been improved through the adoption of an inverter, master controller, and other devices proven on commuter trains and by applying the same rigging method as for commuter trains. In addition, the use of totally enclosed induction motors contributes to quiet operation.

EL120 type DC electric locomotive of Nagoya Railroad Co., Ltd.

Totally enclosed induction motor for EL120

Delivery of Electrical Equipment for 227 Series DC EMUs of West Japan Railway Company

West Japan Railway Company introduced the 227 series DC electric multiple units (EMUs) in the Hiroshima area in March 2015. For the 227 series, Toshiba provided the main motors, vehicle control devices, air-conditioning equipment, surge arresters, train control and monitoring systems, and on-vehicle units of the ATS-DW automatic train stop system.

By incorporating a 100 Mbit/s Ethernet(†) network compliant with an international standard into the train control and monitoring system and also providing the first coach with central control, it has become possible to simplify the overall system and reduce car body wiring and relays.

The on-vehicle control unit of the ATS-DW system has a database, making it possible to simplify the ground equipment. This control unit generates speed collation patterns based on the information in the database and information on train positions, and applies the brakes automatically when the speed limit is exceeded. Furthermore, the control unit provides controls taking the train length into consideration, as well as driving assistance using the database.

Ethernet is a trademark of Fuji Xerox Co., Ltd.

227 series DC EMU

Driver's cab of 227 series DC EMU

Central unit of train control and monitoring system

Control unit of ATS-DW system

Equipment for 227 series DC EMUs of West Japan Railway Company

Launch of Mass Production of SCiB™ 23 Ah High-Capacity Rechargeable Lithium-Ion Battery Cell

High-energy-density lithium-ion batteries are in demand for various applications including electric vehicles, energy storage systems for electrical grids, and hybrid locomotives.

In response, Toshiba has launched mass production of the SCiB™ 23 Ah cell at Kashiwazaki Operations. This cell has 15% greater energy density than the currently mass-produced SCiB™ 20 Ah cell.

The SCiB™ 23 Ah cell maintains the superior characteristics of the 20 Ah cell such as rapid charging, good low-temperature performance, durability (long life), and high safety, while providing a higher energy density. With these features, the new cell further enhances the usability of the SCiB™ lineup.

In addition, the 23 Ah cell has the same dimensions as the 20 Ah cell. This means that customers who are currently using the 20 Ah cell or considering its use for their applications do not need to redesign their system and can smoothly transition to the 23 Ah cell.

Through our SCiB™ product range, we will continue to provide battery solutions for automotive, stationary, industrial, and other applications.

23 Ah SCiB™ cell (identical in size to the 20 Ah cell)

Specifications of 23 Ah SCiB™ cell

Characteristic	Specifications
Nominal capacity	23 Ah
Nominal voltage	2.3 V
Dimensions	116 (W) × 106 (H) × 22 (D) mm
Weight	550±20 g
Weight-energy density	96 Wh/kg
Volume-energy density	202 Wh/L
Input and output power characteristics	Approx. 1 000 W (SOC: 50%, 10 s, 25°C)

SOC: state of charge

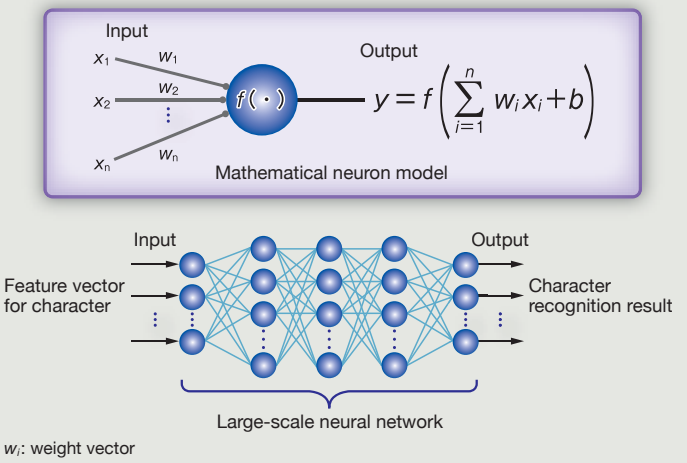
Postal Automation System Applying Deep Learning Method for PE Post of Serbia

Toshiba has delivered automatic letter/parcel sorting systems to three major post offices of PE Post of Serbia. This is the first deployment of postal automation systems in the country.

Since people in Serbia are not very familiar with postal codes, less than half of the mail sent is addressed with the correct postal code. Therefore, in addition to postal code recognition, accurate character-by-character address recognition was necessary.

To resolve this issue, we employed "deep learning," a state-of-the-art machine learning method that makes it possible to efficiently train a large neural network for high-performance pattern recognition.

By combining an existing preprocessing method with a classifier designed using deep learning, we successfully reduced the error rate of individual character recognition by one-third. In addition, we utilized database recognition, area detection, and other new technologies. As a result, an address recognition rate of 92% was achieved.



Outline of address character recognition for letter sorting machine using deep learning method

Delivery of Postal Automation Systems to Brazilian Post and Telegraph Corporation

Toshiba delivered a total of 10 letter sorting systems called delivery bar code sorters (DBCS) to four letter sorting centers of Empresa Brasileira de Correios e Telégrafos (Brazilian Post and Telegraph Corporation) between November 2014 and February 2016. The DBCS reads barcodes containing information on the ZIP code and destination printed on the address side of each piece of mail.

The main features of our DBCS include a high throughput of 42 000 pieces per hour and a barcode recognition rate of 99.5% or higher. In addition, the newly developed model provides considerably higher picking and feeding performance than the previous model. The new system also offers enhanced environmental friendliness such as low noise and low power consumption.

Our DBCS makes it possible to reduce the workload of human sorting operators. Due to its high daily throughput, our DBCS is contributing to improvements in the work efficiency and service level of Brazilian Post and Telegraph Corporation, shortening mail delivery times.

Postal automation system for Brazilian Post and Telegraph Corporation

FA2100SS Model 400 Slim Type Industrial Computer

Toshiba's industrial computers are widely used for the monitoring and control of industrial automation and social infrastructure systems as well as for embedded applications in various types of industrial equipment.

As a new addition to the FA2100 series, we have developed the FA2100SS model 400 slim type industrial computer, which measures 100 mm in width by 310 mm in height by 340 mm in depth. These dimensions are the same as those of all models of the FA2100 series housed in a compact chassis.

Furthermore, the FA2100SS model 400 has the same platform as that of the proven higher-end model, and delivers 24/7 operation due to its high-reliability robust design margins, a reduction in product lifecycle cost due to its long-term product cycle and maintenance, and quick parts replacement from the front of the computer. Various options allow the optimal configuration to be selected for specific applications.

With these features, the FA2100SS model 400 represents the arrival of a new cost-competitive product in our industrial computer lineup.

FA2100SS model 400 slim type industrial computer

T-PDS Conversion Tool

Since its release in 1991, Toshiba's PROSEC T series programmable controller has been used in the electrical, mechanical, and other fields. The PROSEC T series has reached the time of its renewal to a new controller. It is therefore important for us to provide support for migration to its successor model, the Unified Controller nv series type1 light.

In software migration, users need to efficiently port the following system data from the programming tool of the PROSEC T series, T-PDS, to the nV-Tool4 engineering tool of the nv series type1 light:

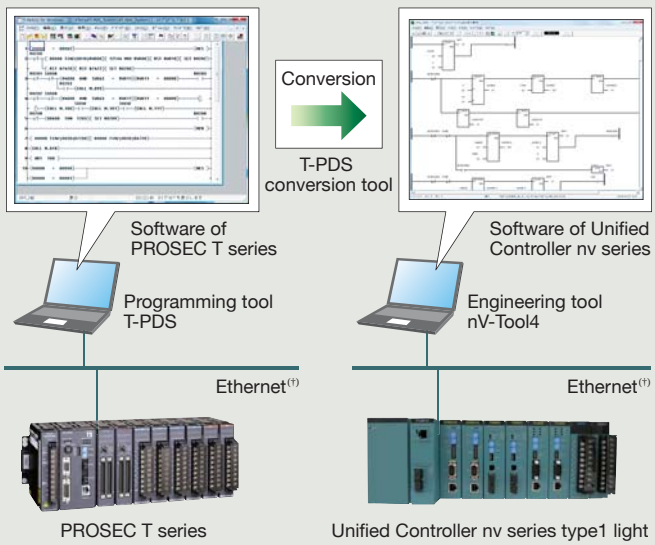
- system configuration information
- program information.

To address this need, we have developed the T-PDS conversion tool to automatically convert these system data into the format of the nV-Tool4.

For program conversion, nV-Tool4 by default supports the program instructions available with the PROSEC T series. This makes it possible for the type1 light to achieve program operations equivalent to those of the PROSEC T series.

The T-PDS conversion tool thus helps to reduce the workload required for software migration.

Ethernet is a trademark of Fuji Xerox Co., Ltd.



Example of migration from PROSEC T series controller to Unified Controller nv series type1 light using T-PDS conversion tool

Early Warning System for Local Torrential Downpours Using Phased-Array Weather Radar

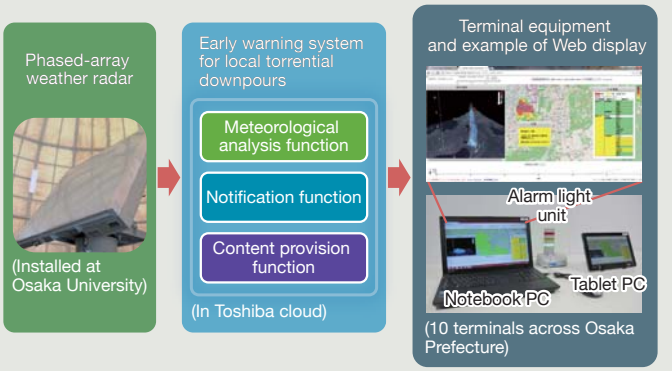
Toshiba has developed an early warning system for local torrential downpours using phased-array weather radar as part of its weather disaster reduction solutions in cooperation with Osaka University and Osaka Prefecture.

There have been many weather disasters in Japan in recent years caused by severe local weather events such as sudden local torrential downpours. This has become a social issue because it is extremely difficult to observe such weather events with conventional weather radars.

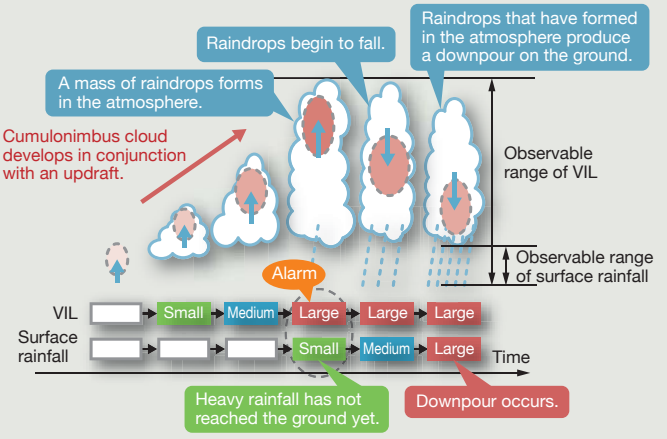
Our early warning system using phased-array weather radar, which can complete high-speed three-dimensional (3D) observations in 30 seconds, issues alert messages for an area prior to the occurrence of a downpour based on the principle of vertically integrated liquid (VIL). VIL is the total amount of water content in a specific layer of the atmosphere obtained by the phased-array weather radar system.

In 2015, we installed 10 weather information terminals across Osaka Prefecture to support the prefecture's disaster reduction activities.

We will make efforts to further improve the early warning system and apply it to evacuation guidance and other disaster reduction solutions.

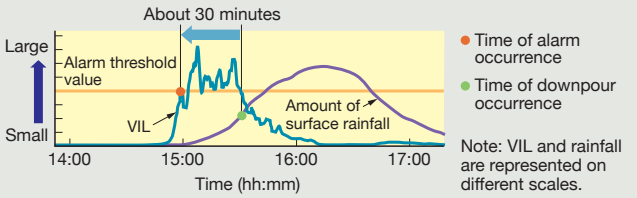


Outline of early warning system for local torrential downpours



Surface rainfall: estimated amount of rainfall near the ground surface

Mechanism of downpour detection using VIL for alarm determination



Example of downpour detection

Compact High-Power Generator for Portable Microwave Surgical Instruments

Microwave surgical instruments are used for coagulation and hemostasis by means of dielectric heating through the application of microwave power to the targeted living tissues. In comparison with similar surgical instruments using ultrasound or high-frequency current, microwave surgical instruments minimize damage to tissues around the treatment target and emit less smoke and mist during operation because of reduced heat generation in the treatment target area.

Compact high-power generator for portable microwave surgical instruments

Certain portable microwave surgical instruments powered by a prototype high-power generator developed by Toshiba in 2014 experienced the problem of power degradation when impedance mismatch occurred due to coagulation. In 2015, we developed a new compact high-power generator with an output power of 30 W and an overall efficiency of 52% at 2.45 GHz. An isolator was used to absorb reflected power to solve the impedance mismatch.

To reduce the size of the generator, monolithic microwave integrated circuits (MMICs) were utilized for the microwave oscillator and variable-gain amplifier. A hybrid IC with a gallium nitride (GaN) power high-electron-mobility transistor (HEMT) and bias circuits was used in the final stage of the generator. In addition, we engineered a matching circuit for the GaN HEMT using a harmonic tuning design to further improve circuit efficiency. Bias circuits were embedded into the hybrid IC to reduce the enclosure size. As a result, we realized a compact high-power generator measuring only 98 × 32 × 13 mm.

A handheld microwave surgical device is being developed by Fukushima Medical University. Our new compact generator will make it possible to realize integrated microwave surgical instruments incorporating a battery, a control circuit, and a treatment device.

Development of Railway Driving Advisory System for Energy Saving

In recent years, increasing attention has been focused on railway energy-saving technologies. Although railways are more energy efficient than other means of transportation, improving the energy efficiency of railways is becoming more important because the number of railway passengers is expected to rise in the near future due to population growth in urban areas.

The key to energy conservation lies in reducing the power consumed by running trains. To address this need, Toshiba has developed an algorithm for a driving advisory system (DAS) designed to optimize the running profiles of trains. The DAS receives information on the speeds, positions, and times of a train, and directs its driver to change the speed via images and sound. If a train is running faster than the recommended speed, the DAS directs the driver to slow down, whereas if a train is running slower than the recommended speed, the DAS directs the driver to speed up.

In cooperation with Nomad Tech Lda., a Portuguese railway system integrator, we conducted trial runs in 2015 on the lines of Portuguese railway operator Comboios de Portugal using the DAS. The results of these trials showed a 7% reduction in power consumption on average compared with a year earlier in urban train operations. Additionally, trial operations using the DAS achieved a reduction in service delays.

Driving advisory device (demarcated by blue line)

Trains used for trial runs

Start of Demonstration of Positive Energy Building in Lyon, France

Since June 2012, Toshiba has been involved in a smart community demonstration project in France's Lyon Confluence redevelopment district, supported by the New Energy and Industrial Technology Development Organization (NEDO) of Japan.

The project is utilizing energy solution technologies that the Toshiba Group and other Japanese companies have developed as a means of creating demonstration models of sustainable cities, buildings, and transportation systems.

We have been delivering key technologies, including several types of EMS that assist consumers in making smart use of energy; locally generated, locally consumed energy models using photovoltaic (PV) power generation; and a system that supports city planning. Car-sharing services using PV-charged electric vehicles, the use of an EMS at an existing public housing complex, and a community EMS (CEMS) are already being demonstrated.

Demonstration of positive energy building implemented at Hikari Building in Lyon, France

In September 2015, a positive energy building that generates more energy than it consumes on a yearly basis was completed, marking the launch of the final task of the demonstration project. The effectiveness of the equipment and systems for building EMS (BEMS) and home EMS (HEMS) will be evaluated during the demonstration period.