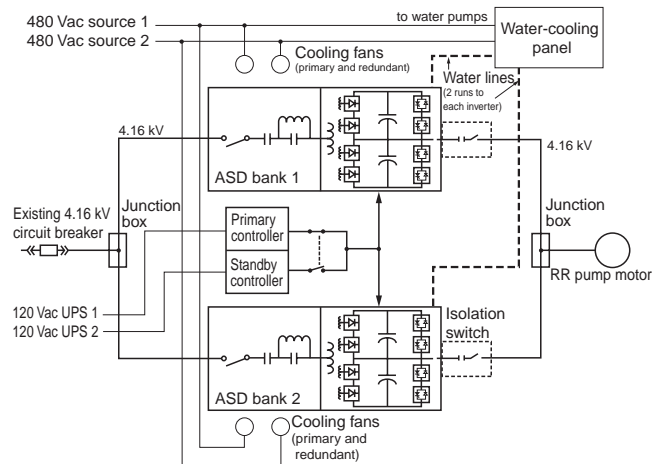


In the field of power, Toshiba is focusing on construction of nuclear and thermal power plants including combined cycle power generation, development of the largest scale of variable speed pumped storage power generation system in the world, repair techniques for devices and piping and promotion of service. In the field of rail transport, Toshiba provides up-to-date control systems, power electronics, total systems in which IT technologies are merged, device systems and information services. For social infrastructure and network infrastructure, Toshiba provides excellent solutions utilizing Toshiba's accumulated system construction and hardware development capability. In the field of elevators, Toshiba pursues energy/space saving and passenger comfort, and promotes development with the concept of providing an elevator that is capable of inspiring awe in the customer.

## Adjustable Speed Drive Application for Reactor Recirculation Pump of Boiling Water Reactor in North America

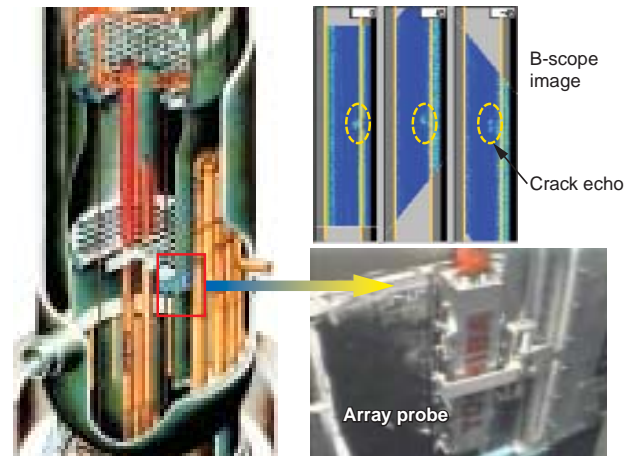


UPS: Uninterruptible Power Supply system  
 Vac : Alternating Current Voltage  
 RR : Reactor Recirculation

### ASD system overview

Motor generator (MG) sets with fluid couplers mechanically converting electrical power to a driving motor are frequently used in the power supply for the reactor recirculation system (RRS) pumps of boiling water reactors (BWRs) in North America. Many of these units have been in operation for more than 25 years and are reaching their replacement time. Toshiba has supplied domestic nuclear power plants with electronically controlled adjustable speed drives (ASD), which can reduce house load due to their much higher efficiency than the existing MG set. To meet the renewal demand, Toshiba has launched a 5-level insulated gate bipolar transistor (IGBT) ASD, which complies with US codes and standards, on the North America market. Toshiba applies redundancy design in each section of power converter, controller, and cooling auxiliaries, and provides the highest degree of reliability and tolerance to single failure that would shut down the ASD.

## Application of Phased Array Ultrasonic Testing Technique on Reactor Internals



Example of application of phased array ultrasonic testing (UT) technique on core shroud

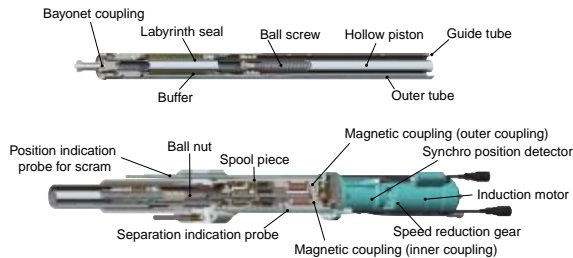
Toshiba has developed a phased array ultrasonic testing (UT) technique and applied it in the UT inspection of reactor internals of operating boiling water reactors (BWRs) for the first time in Japan.

Toshiba succeeded in measuring the depth and profile of the defects found in core shrouds and a control rod drive housing stub-tube, which were previously difficult to examine by UT.

A newly developed robotics technology made it possible to locate the UT sensors accurately at the required position in the reactor.

Moreover, in a round robin UT for the piping, among all overseas and domestic participants, Toshiba obtained the best results in terms of accuracy of the defect depth and showed a high degree of capability in UT technology.

## Development of S-FMCRD for Hamaoka NPS Unit No.5, ABWR Plant



Configuration of S-FMCRD

Recently the expectations on nuclear power plants for enforcement of reliability, operability and maintainability have become even higher than before.

In order to respond to these demands for ABWR (Advanced Boiling Water Reactor), both induction motor and magnetic coupling power transfer systems are adopted in a Sealless Fine Motion Control Rod Drive (S-FMCRD)\*. With magnetic coupling, S-FMCRD makes FMCRD sealless and eliminates the need for a seal structure and leakage detection system. This world's first S-FMCRD has excellent performance and supplies enhanced reliability, maintainability and reduced occupational radiation exposure.

After performance and durability had been verified through joint studies and design assurance tests, S-FMCRD manufacturing for the Hamaoka NPS (Nuclear Power Station) Unit No. 5 (H-5) started so that it could satisfy specifications such as those for scram (urgent insertion) characteristics, drive characteristics, and homogeneous characteristics under a well-organized design-to-manufacture system. This manufacture was accomplished based on highly reliable designs, development technologies, computerized production management, fully-automated and highly advanced manufacturing technologies, tests and inspections.

For H-5, the main assemblies such as the body, spool-piece, motor unit, etc. were successfully manufactured and shipped from August to September in 2003. At present

this world's first S-FMCRD is achieving favorable results in start-up tests moving towards commercial operation in January 2005.



View of installed S-FMCRD

\*The S-FMCRD controls reactivity via the connection to the control rod (CR). In Chubu Electric Power Co., Inc. Hamaoka NPS Unit No. 5 (H-5), 205 S-FMCRDs are installed in each control rod drive housing. This provides fine rod motion using the induction motor for normal operation and scram using hydraulic pressure.

## 410 MVA Generator Rehabilitation for Sulcis Thermoelectric Power Station in Italy



Generator stator ready for shipment

Toshiba completed the manufacturing, inspection, and shipment of a 410 MVA steam turbine driven generator for Sulcis Thermoelectric Power Station (Section 2) for Enel Produzione SpA in Italy, that was a remarkable experience for the European market. The Sulcis Thermoelectric Power Station rehabilitation project included the re-powering, replacement and modernization of the non-operational steam turbine and generator. Toshiba made a contract with Enelpower SpA, part of the Enel group, for the new 410 MVA generator, which was to be installed in place of the existing generator supplied by another manufacturer.

The first priority of the owner's requirements was the up-rating (approx. 45% increase as compared with the original rating), and the re-use of the generator foundation.

The compact structural design was the key to meeting these requirements. In order to achieve the compact structural design, our technologies, such as the 410 kPa hydrogen gas pressure, high thermal conductivity (HTC) insulation system, compact and light-weight frame were all brought into play.

Toshiba demonstrated its ability to offer this kind of solution not only for machines manufactured by ourselves, but also for the replacement of another manufacturer's machine on the after-service market.

## Completion of Runner for Kannagawa Pumped Storage Power Station



Splitter runner for Kannagawa Pumped Storage Power Station



Long blade (front) and short blade (rear)

A splitter runner for Kannagawa Pumped Storage Power Station (482 MW/464 MW-675 m/728 m-500 min<sup>-1</sup>) of Tokyo Electric Power Company has been completed and delivered to the power station.

The splitter runner is a newly designed runner, in which long runner blades and short blades are arranged in turn and it's main features are as follows:

- Efficiency is improved over the entire range of operation.
- Cavitation characteristics are improved allowing expansion of the turbine operation range.
- Pressure fluctuation is reduced.

No. 1 pump-turbine of Kannagawa Pumped Storage Power Station is planned to be put into commission in July 2005.

## Shinagawa 1,140 MW Power Station Commenced Full Commercial Operation



Shinagawa Power Station of Tokyo Electric Power Company

Shinagawa combined cycle Power Station of Tokyo Electric Power Company is located in the Tokyo metropolitan area. The power station can produce 1,140 MW in total, consisting of 3 power trains of 380 MW and achieved remarkably high thermal efficiency of 50% under rated operation conditions. A power train consists of a gas turbine, a steam turbine, a generator and a heat recovery steam generator. Toshiba took the responsibility for all the work of design, manufacturing, construction and commissioning of the power generation plant for Shinagawa Power Station.

We were completely accident free for the 4 years and 10 months from construction start to the commercial operation date (COD) of the 3rd unit, and this earned us a prize of excellence from the Ministry of Health, Labor and Welfare.

The COD of each unit is as below:

Unit 1: July 12, 2001

Unit 2: March 6, 2002

Unit 3: August 20, 2003

## Toshiba Completed Three Combined Cycle Power Plants in Taiwan



Chiahui Power Station, Taiwan

Three combined cycle power stations started commercial operation in Taiwan between late 2003 and early 2004.

Chiahui-670 MW, Fong Der-2×480 MW and Chang Bin-480 MW, IPP (Independent Power Producer) power generation plants consist of gas turbine (GT), heat recovery steam generator (HRSG) and steam turbine (ST) in sophisticated generating systems as 3GT-3HRSG-1ST (670 MW) and 2GT-2HRSG-1ST (480 MW) aiming at the materialization of efficient heat consumption and reliability of plant operation. The plants were also designed for environmental requirements and two of them adopted air-cooled condensers to minimize effluence from the power plant.

Toshiba received the order as an EPC (Engineering, Procurement, Construction) contract and executed all engineering, procurement and construction on a full turnkey basis with our highly reliable techniques derived from our plentiful experience in power plant construction.

The duration of construction is always a prime concern in the private sector. All three plants were completed within 26 months and one of them was put into commercial operation 3 months ahead of the contracted completion date.



Feng Der Power Station, Taiwan



Chang Bin Power Station, Taiwan

## Propulsion and Auxiliary Power System for LRV



LRV for Hiawatha Corridor Light Rail Transit

LRV (Light Rail Vehicles) are used increasingly in both Europe and America as a means of transportation that is environmentally friendly and can easily provide barrier-free access. Toshiba has developed a propulsion and auxiliary power system for LRV with the first delivery to Hiawatha Corridor Light Rail Transit in Minnesota, U.S.A.

The main features of the propulsion and auxiliary power system are as follows.

- The system uses the most recent IGBT (Insulated Gate Bipolar Transistor) and vector control technologies to provide a low-noise, highly responsive system.
- Without increasing the size, weight or wiring from previous technologies, duplication of vital functions has been achieved in order to increase the redundancy of the system. As a result, the system will allow continuous service even in the event of some equipment failure.
- Maintenance frequency has been greatly reduced with the use of a totally enclosed main motor.

Hiawatha Corridor Light Rail Transit is a line of 18.6 km and 17 stations, which connects the downtown of Minneapolis through the airport to the suburbs. Currently, testing is progressing smoothly with cars that use our system. Commercial operation for a 12 station section will begin in June of 2004.



IGBT power conversion unit

## Electrical Equipment for Wuhan Rail Transit Line No. 1 Trains



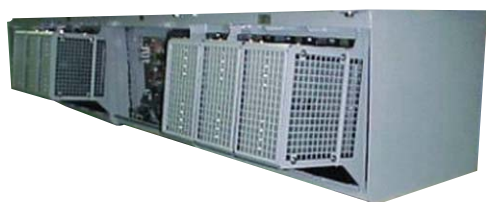
Train for Wuhan Rail Transit Line No. 1

Electrical equipment for 12 train sets (48 cars) for Wuhan Rail Transit Line No. 1 in Wuhan City, China has been delivered. Approximately 10 km of new line utilizing a 750 VDC third-rail system has been constructed for Wuhan Rail Transit Line No. 1 from Zongguan Station to Huangpu Road Station. The body of the new trains is made of aluminum, a first on urban rails in China.

The electrical equipment was newly developed for trains on a 750 VDC third rail system. When compared to previous technology, this equipment is lightweight and compact, and possesses quick control response and high redundancy. For the propulsion system, an IGBT traction inverter using vector control technologies controls each bogie with two traction motors of 180 kW. And an IGBT inverter of 140 kVA is provided as an auxiliary power supply system.

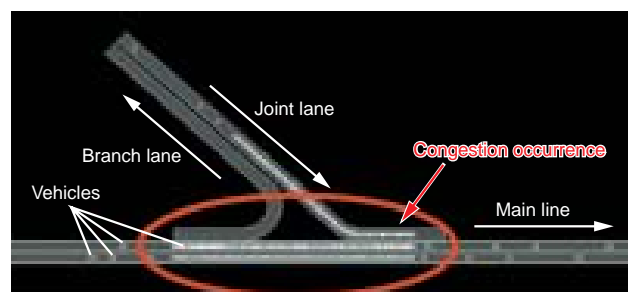
Currently, improvement of infrastructure for urban rail is rapidly being implemented in China. The developed electrical equipment for the trains of the 750 VDC third rail system is well designed to meet with the requirements of China urban rail.

VDC: Volt Direct Current



Outline of traction inverter

## Microscopic Traffic Simulator for Highway Junction Design



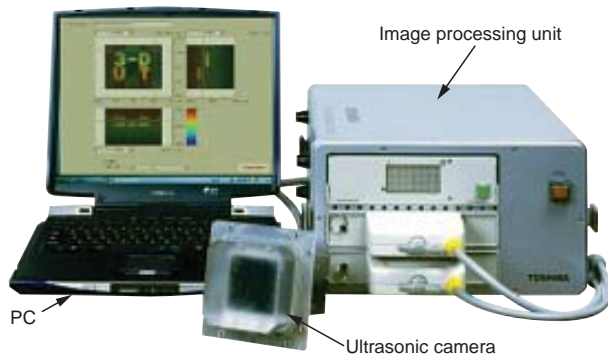
Occurrence of congestion at highway junction

Toshiba is developing a microscopic traffic simulator for use in evaluating the functions of intelligent transport systems (ITS) and in assisting traffic management.

This simulator is based on molecular dynamics simulation technology where acceleration and deceleration of individual cars is calculated like the movement of gaseous atoms influencing each other. This technology makes it possible to simulate the natural occurrence of traffic congestion at merging sections as well as at sags with a small number of model parameters.

The figure shows a snapshot of the simulation at a highway junction. The traffic flow in the main line is strongly disturbed at the merging section, showing the occurrence and propagation of traffic congestion. By changing such input parameters as the quantity of traffic flow and the length of the merging section, different congestion states can be reproduced, showing the applicability of this simulator in actual road design.

## Matrixeye 3D Ultrasonic Testing System



Picture of 3D ultrasonic testing system Matrixeye

3D ultrasonic testing system Matrixeye, with visual performance significantly superior to that of existing ultrasonic testing equipment, is released on the market. Matrixeye can visualize structures inside materials easily and speedily compare them with X-ray testing systems including X-ray CT (Computed Tomography). The ultrasonic camera, in which matrix-arrayed piezoelectric elements are arranged, has the capability to acquire more than ten thousand ultrasonic echo data within a second. The image-processing unit realizes speedy processing of 3D image synthesis using parallel processing technique.

As a result, Matrixeye can visualize small porosities (>0.3 mm) and oxide layers within casing parts and defects and can visualize delaminations within resin materials like CFRP (Carbon Fiber Reinforced Plastics) within about 10 seconds. And it can save the resulting 3D image data. Matrixeye has been utilized for field-testing e.g. railroad inspection using direct contact method with jell couplant and inline-tests e.g. automobile parts inspections using the water immersion method. Finally it allows the realization of an automatic inline inspection system that can judge whether there is interference between the defect position and processed surface by comparing with 3D structural data on the parts.

## C-Band 90 W High Power FET



Micrographs of the package  
Package size: 24.5 mm×17.4 mm

The rapid growth in microwave communication systems in recent years has produced a demand for much higher power microwave devices on the market.

Toshiba has already produced a 60 W GaAs FET (Gallium-Arsenide Field Effect Transistor)

on 6 GHz band for microwave communications' use. Now we have developed a C-band 90 W GaAs FET with greatly improved output power, and started delivery of sample devices.

Toshiba achieved output power of 90 W on C-band through work in the following areas:

- Revision of wafer and element structures
- Improvement of the power density
- Optimization of the package structure

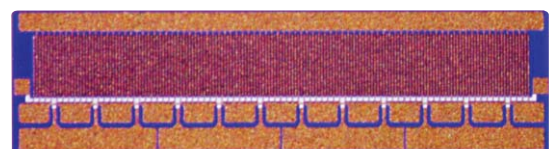
This development will make a great contribution to microwave communication systems with higher performance.

### RF performance specifications

(Ta= 25°C)

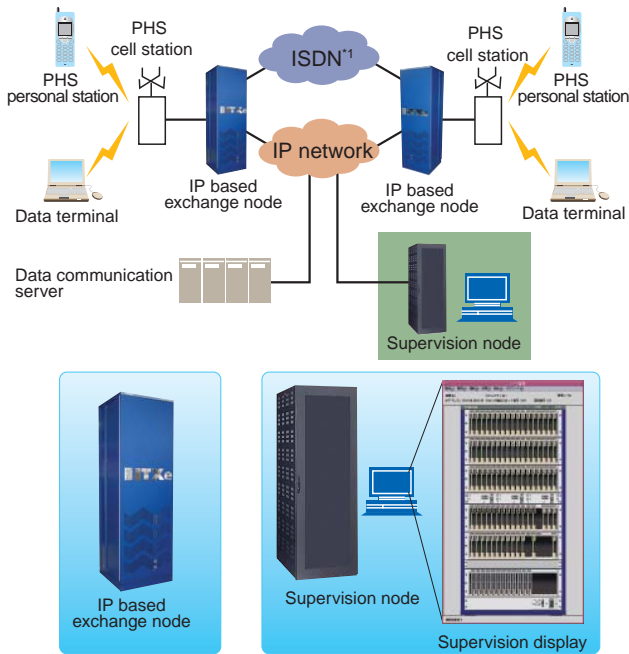
Characteristics	Symbol	Condition	Unit	Min.	Typ.	Max.
Output power at 1dB gain compression point	P1dB	V <sub>DS</sub> =10 V f=5.9 to 6.4 GHz (I <sub>DSset</sub> =10 A)	dBm	48.5	49.5	-
Power gain at 1dB gain compression point	G1dB		dB	6.0	7.0	-
Drain current	I <sub>DS1</sub>		A	-	18.0	20.0
Gain flatness	ΔG		dB	-	-	±0.8
Power added efficiency	η <sub>add</sub>		%	-	40	-
3rd order intermodulation distortion	IM3	Two-tone test P <sub>0</sub> =42.5 dBm (Single carrier level)	dBc	-	-30	-
Drain current	I <sub>DS2</sub>		A	-	-	16.0
Channel temperature rise	ΔT <sub>ch</sub>	(V <sub>DS</sub> ×I <sub>DS</sub> -P <sub>out</sub> ) ×R <sub>th</sub> (c-c)	°C	-	-	100

Recommended gate resistance (Rg): Rg=28 Ω (Max.)  
RF: Radio Frequency



Micrograph of the chip  
Chip size: 3.36 mm×0.96 mm

## IP based Exchange System for Telecommunication Network Operators



\*1 Integrated Services Digital Network

Network configuration with the IP based exchange system

Toshiba has developed an IP (Internet Protocol) based exchange system for a telecommunication network operator, which carries voice and data traffic from/to PHS\*2 cell stations over IP transport. The system realizes network cost reduction and the flexibility for traffic increase, by bypassing the existing ISDN network and routing communication traffic via the IP network. In addition, it can be enhanced to be connected directly with another operator's network by the IP telephony interface, and to support high-speed data service in future.

Based on the switching and PHS technology, it also employs the following state-of-the-art technologies:

- IP related technologies such as packet multiplex/demultiplex, VoIP (Voice over IP)
- High reliability technologies such as duplex and N+1 redundancy
- Monitoring and control technology managing several thousand switching nodes via SNMP (Simple Network Management Protocol) protocol

\*2: PHS (Personal Handy phone System): A type of mobile communication system developed as a Japanese Radio Standard and adopted by a number of countries including China, India, Thailand and so on.

## Video Server System



VIDEOS™

MediAvail™

Toshiba's audio video server system is widely used in transmission facilities for digital terrestrial TV broadcasting. For commercial spot servers and video and audio file (VAF) systems, which store and broadcast television commercials and sponsor logos (display of sponsor logos and announcement of company names) respectively, the VIDEOS™ video server that uses flash memory as a storage medium is adopted. Because television commercials and sponsor logos are relatively short, only small storage capacity is required. Therefore, the system using VIDEOS™ has far higher reliability and almost the same cost performance compared with using HDD (Hard Disk Drive). In program servers for broadcasting television programs, the MediAvail™ video server that uses HDD is adopted, which is suitable for large-capacity storage. The system consists of a combination of these video servers to bring their respective characteristics into full play. The system is equipped with numerous functions suitable for digital broadcasting. For example, both video servers are capable of handling HDTV (High Definition TV) and SDTV (Standard Definition TV) even if they are both present. In addition, VIDEOS™ is also adopted for news servers and has gained a favorable reputation, winning much acclaim for its highly stable performance. Also, the scope of application of VIDEOS™ is expanding in line with the increase in the storage density of flash memory.

## TOSHIBA USIM for Mobile Phones



TOSHIBA USIM for mobile phones

Toshiba has developed a plug-in type smart card (USIM), supporting GSM/3GPP (the 2nd/3rd generation standard for mobile phones) and Java Card™ 2.1.1/GlobalPlatform 2.0.1'. Toshiba's LSI, JT6N94 is used for the USIM.

The advantage of the USIM is that 1.8 V as well as 5 V/3 V is supported as supply voltage and that "T=1" is supported as well as "T=0" which is dominant in the communication protocol of Europe.

The USIM supports SmartTrust WIB™1.2, and using (U)SAT functionality, Java Card™ or WIB1.2 applications can be downloaded to the USIM via mobile network.

In terms of third-party evaluation, the USIM has passed the SmartTrust Certified™ Program, which mainly evaluates GSM and WIB functionalities.

We have a plan to sell the USIM to domestic and international mobile phone operators.

USIM : Universal Subscriber Identity Module

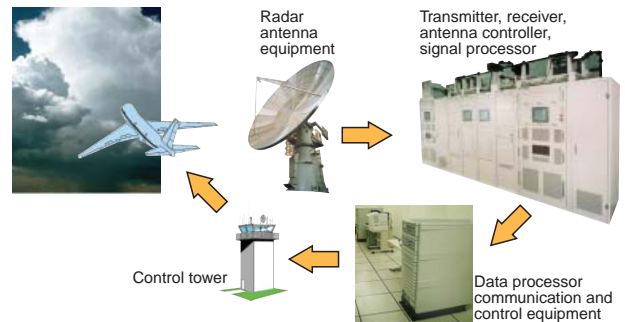
WIB : Wireless Internet Browser. A type of interpreter whose specifications were devised by SmartTrust AB in Sweden. Deployed in over 120 million SIM (GSM) cards worldwide.

(U)SAT: (Universal) SIM Application Toolkit

*"Java Card" is a trademark of Sun Microsystems, Inc. in the United States and other countries.*

*"SmartTrust", "SmartTrust WIB" and "SmartTrust Certified" are trademarks of SmartTrust AB.*

## Okinawa Naha Airport Doppler Radar for Airport Weather



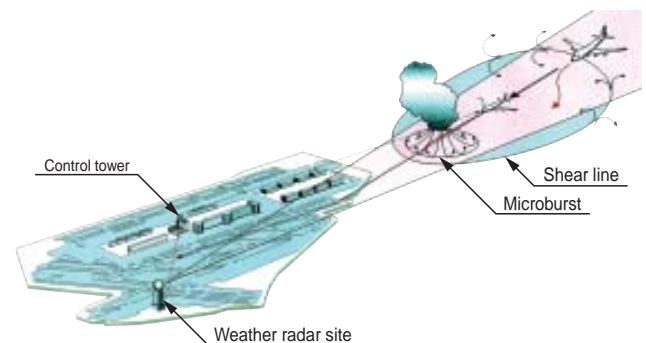
Equipment configuration and weather information flow

The Doppler Radar for Airport Weather (DRAW) has the function not only of rainfall mapping for the surrounding region within a radius of a hundred kilometers around the airport, but for detecting and locating the sudden occurrence of hazardous storm spots accompanying steep changes in wind-flow vectors, so-called microbursts or shear-lines, which are deemed a potential cause of aircraft crashes.

Warning notices of the weather anomalies detected by the DRAW are forwarded to the airport control tower to ensure safe aviation traffic.

Toshiba has developed and delivered the DRAW for Okinawa Naha airport.

The radar is characterized by the enhanced performance in the measurable extent of wind-velocity so as to observe Okinawa's typhoon-class severe storms along with eco-conscious considerations such as suppression of transmitter spurious radiation, non-use of carbon dioxide gas and replacement of electronic components containing radioactive materials with toxic-free functional equivalence.



Aircraft encounter with hazardous weather near airport



## Enhanced-Security Wireless LAN Access Points



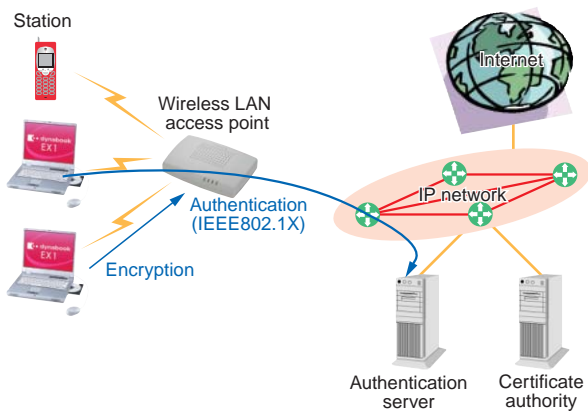
Wireless LAN access point

Wireless LANs have rapidly progressed in recent years as higher communication speeds have become available in addition to the advantage of portability. However, because they use radio frequency technology, wireless networks are more at risk from tapping and hacking compared to a hard-wired network. Secure wireless LANs are therefore in urgent demand.

To meet these requirements, Toshiba has developed the enhanced-security wireless LAN access point by using the highest level of authentication and encryption. It realizes flexible network management by remote control and remote software upgrading with a simple management tool. The access point operates simultaneously in both 2.4 GHz and 5 GHz band and realizes transfer rates of up to 54 Mbps in both bands.

It is suitable for users requiring high security including corporations, public offices, and communication common carriers.

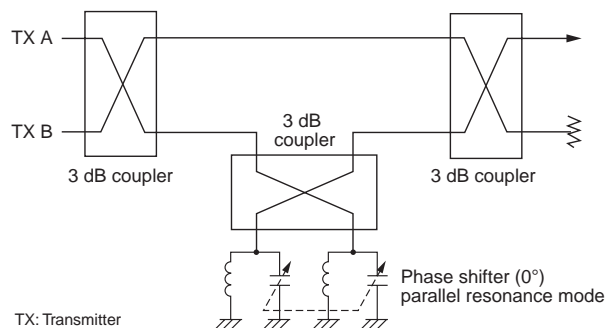
Toshiba will work on the development of new features, such as QoS (Quality of Service) and PoE (Power over Ethernet), to satisfy users' needs in the future



Concept of security function

IP: Internet Protocol

## Digital Terrestrial Broadcasting Transmitter System



Configuration of crossover exchanger

Because the phase shifter is 180° variable, switching between parallel resonance and series resonance is possible and reflection phase shifting is realized.

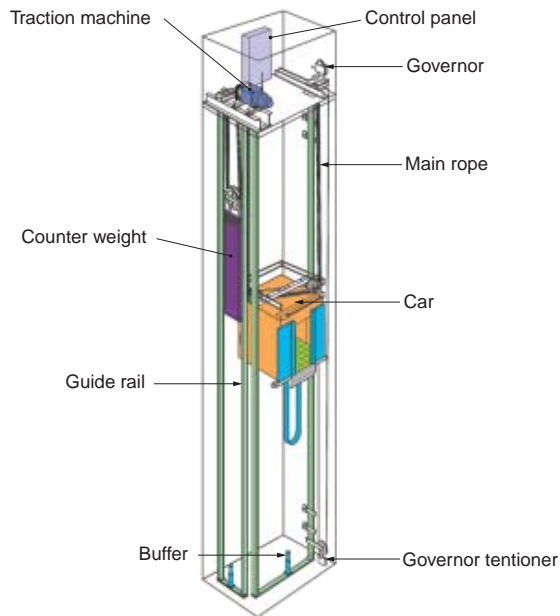
Digital terrestrial broadcasting services (ISDB-T: Integrated Services Digital Broadcasting-Terrestrial) have started in the three largest urban areas in Japan. Toshiba supplied digital terrestrial broadcasting transmitter systems as well as the studio equipment used in the broadcasting systems. Regarding the cooling system, in addition to air cooling, liquid cooling is available with a plug-in PA (Power Amplifier) unit equipped with a one-touch cooling water coupler. Adoption of a feedback-type pre-distortion nonlinear compensator realizes intermodulation of -50 dB and minimizes deterioration of the carrier to noise ratio. Also, a crossover exchanger has been developed that switches the transmitter output seamlessly by varying the inner resonance and shifting the reflection phase by means of a 180° variable phase shifter. As a result, equipment maintenance during operation is possible. Devices developed for monitoring equipment include an OFDM

(Orthogonal Frequency Division Multiplexing) squelch that identifies noise by symbol timing detection of OFDM and an OFDM quality monitor equipped with an OFDM receiver and a noise generator to measure BER (Bit Error Rate) and monitor deterioration of the carrier to noise ratio. As a result, highly precise monitoring of transmission signals is possible.



Crossover exchanger

## ELCOSMO™ Small Machine Room Elevator



Overview of the ELCOSMO™

Toshiba Elevator and Building System Corporation has commercialized and begun sales of the space-saving machine room elevator ELCOSMO™, which was developed aiming at the global market, including China.

Toshiba adopts a PMSM (Permanent Magnet Synchronous Motor) traction machine as a new drive system, while realizing a 30% power consumption saving, a machine-room area reduction ratio of 70% compared to Toshiba's conventional type is realized by the minimization of the traction machine and controller and the optimal arrangement of machine room apparatus.

Moreover, the specifications of this elevator comply with the Chinese standard GB7588-2003, and also the car dimensions and the loading mass match the ISO (International Organization for Standardization) standard.

## Kindmover™ Universal Design Escalator



Overview of the Kindmover™

Toshiba Elevator and Building System Corporation has commercialized and begun sales of a newly designed escalator named the Kindmover™ of which the main concept is "Kind for Mankind" based on the principle of universal design.

An operation monitor (ESNAVI™) can be installed on the handrail inlet of the Kindmover™. This displays an arrow scrolling in the direction of travel and also a flashing no entry mark to warn against entering via an exit. A useful feature for speedy maintenance is the display of the causes of emergency stops.

Moreover, automatic start and stop operation is possible. The escalator accelerates gently when people approach the entrance. There is a built in passenger detector, so when there is nobody on board, it usually runs at low speed in energy-saving operation mode. This makes it a simple design together with ESNAVI™.