

Industrial Systems

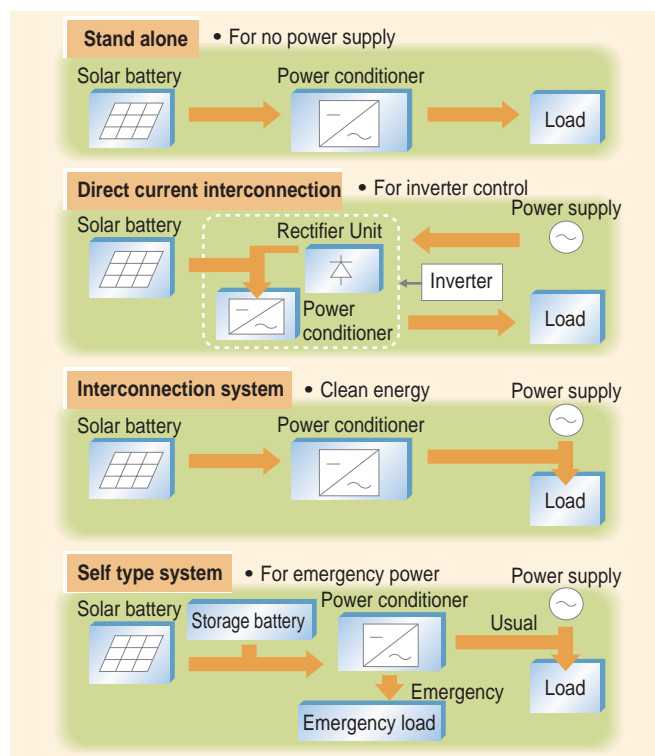
As we enter an era of mega-competition, saving energy and protecting the environment have become major issues in industrial fields. With the aim of solving these problems and responding effectively to customer and market needs, the Hitachi Group is putting a great deal of effort into the development and supply of high-efficiency and environmentally-friendly devices for industrial applications. The Group is also providing advanced solutions by systemizing these devices and developing and applying innovative IT.



Interconnection Inverter for New-energy Power-distribution System

The need to improve the environment has led to a demand for a power-supply system that uses new energy, such as solar power, wind force, fuel cells, and micro-gas-turbines. A voltage-type current-control interconnection inverter (power conditioner) has been developed for changing the electricity produced from these new power sources into a form suitable for a commercial power-distribution system. It has maximum electric-power control, a parallel operation function, and an external communication function.

This inverter conforms to the "Interconnection system technical requirements guideline" of Ministry of Economy, Trade and Industry of Japan for power-distribution systems. Reliability is ensured by an "interconnection system protection function," which prevents the voltage and frequency start-up and shutdown from affecting the system side.



Interconnection system with solar battery

New Series High-frequency Inverters for Ultra-high-speed Motors

Hitachi launched a new series high-frequency inverters (3-phase, 200-V class/3, 6, 12 kVA: three models) in September 2001.

(1) Achievement of high frequency

The new series inverters can achieve 5,000 Hz, the highest output frequency of inverters on the market, using the PAM (pulse amplitude modulation) method. An ultra-high speed of 300,000 min^{-1} can be obtained using a two-pole motor.

(2) Easy to use

Up to eight parameter sets for the V/f characteristic, ramp time, etc. can be set internally. The sets can be changed depending on the motor specifications.

(3) Easy to maintain

The inverters are designed so that the electrolytic capacitors and cooling fans, which have a comparatively shorter lifetime, can be easily replaced. Furthermore, they have a removable terminal block for the logic portion, so re-wiring is reduced in case of unit replacement.

(4) Variety of applications

Applications include machinery, spindles, vacuum pumps, hole-making systems for printed circuit boards, and textile machinery.



New series high-frequency inverter
PAM enables high-frequency output (up to 5,000 Hz).

World's First Ink Jet Printers with Large Liquid-crystal Color Touch Panel for Industrial Marking

The KX-E series ink jet printers are the world's first IJPs with a large liquid-crystal color touch panel (10.4 type) for industrial marking.

- User-friendly features

(1) All operations are done using the touch panel, and the printer's condition is displayed on the panel. User help messages are automatically displayed on the panel.

(2) The nozzle and gutter are automatically self-cleaned before shutting down.

(3) Ink and solvent can easily be added and the filter can easily be replaced through the front access door.

- New functions

(1) Password protection

Neither print content nor parameters such as font type and size can be changed without the password.

(2) Language selection

English, Chinese, Korean, and Thai can be selected.

- Reduced floor space

The downsized ink circulation (is not clear) and control circuit result in a smaller floor-space requirement.

- Notable design features

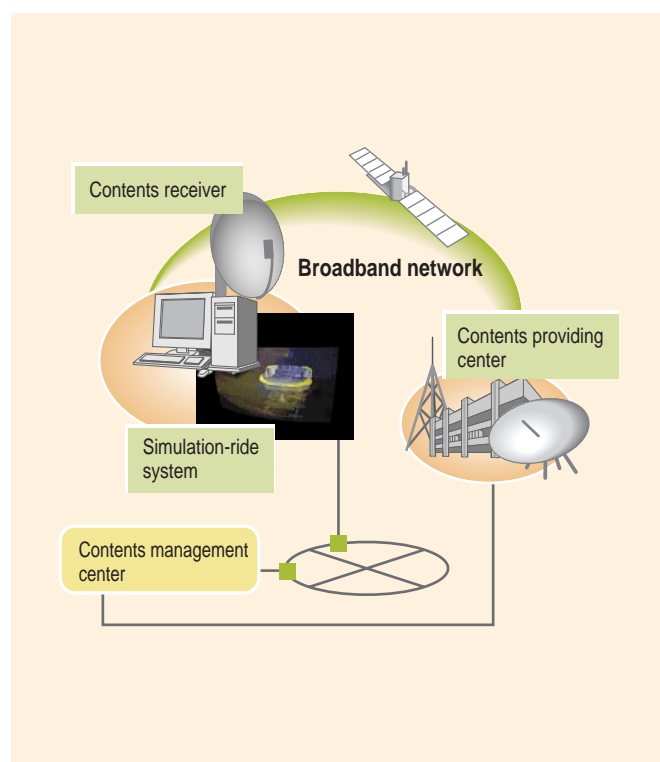
Solvent consumption is 5 cm³/h/head (at 20°C) or less. The new ink return system confines the mixing of ink and air.

The versatility of the KX-E series printers enables printing for a broad range of products.



KX-E series continuous ink jet printer

Next-generation Simulation-ride with Contents Provided over Broadband Network



System for providing ride contents

Simulation-rides are theater attractions in which the motion of the ride is synchronized with the displayed image, sound, and movement. They can be found in amusement parks, science museums and other public places. Demand for such systems is hindered by such problems as distribution of the contents, the quality of the motion, and the productivity of the contents' producers.

We have developed a next-generation simulation-ride based on information communication, robotics, mechatronics, and motion programming technology (learned in the USA).

The main features of this simulation-ride system are as follows.

(1) Till now, a programmer had to use gloves to program the motion. Now, with our virtual reality acceleration interface, motion data can be produced automatically. Its use reduces the production effort by about 90%.

(2) Our simulation-ride uses electromotive mechanism, miniature rods, a low floor, and a double-link mechanism. Even though it uses electromotive mechanisms, its movements are more natural than those of an oil pressure system.

(3) The image, sound, and motion data are transmitted using a satellite communication infrastructure. This enables the contents to be customized to meet client needs by the cooperation with the world famous contents owner and then be transmitted.

Oil-immersed Super-amorphous Distribution Transformer

The transformer is generally a highly important piece of electric equipment. It is also supposed to be the most highly effective piece of electric equipment. However, a large conversion energy results in a large power loss. Therefore, ensuring that transformers conserve energy is very important.

We have developed a super amorphous transformer with an amorphous core and improved winding system. It has very low no-load and load losses.

Features are summarized as follows:

- (1) Low losses: The no-load and load losses are reduced about 50% (compared with those of silicon steel transformers).
- (2) Environment: The total discharge of carbon dioxide is reduced about 50% (compared with that of silicon steel transformers).
- (3) Recycling: 90% of the material can be recycled (the same as for silicon steel transformers).
- (4) Installation: The installation area is almost the same as that of silicon steel transformers (500 kVA or less).

Specifications are as follows:

System voltage: 22 kV and below

Insulation class: A

Winding temperature rise: 55°C

Capacity: 500 kVA and below for single phase; 3,000 kVA and below for three phases



Oil-immersed super-amorphous transformer

Highly Reliable, Industrial-use Personal Computer



*A high-reliability, industrial-use personal computer
High reliability and high performance are attained at low cost.*

To satisfy the demand for long-term stable operation with high reliability and high performance at low cost, a new model of industrial-use personal computers has been launched.

Main features are below:

- (1) Highly reliable design provides 24-hour continuous operation over 10-year serviceable lifetime
- (2) Long-term delivery for three years after launch
- (3) Follows new trends in PC technology, such as a Pentium* III processor (850 MHz), a hot-swap disc, and cluster PC system
- (4) Supports Windows NT**, Windows** 2000, and PCI (peripheral component interconnection)/ISA (industry standard architecture) bus specifications
- (5) Inherits slim, 150-mm-high body
- (6) Accredited international standards: UL, CSA, FCC, and CE Marking

* Pentium is a trademark or registered trademark of Intel Corporation.

** Windows NT and Windows are registered trademarks of Microsoft Corp. in the U.S. and other countries.

Inverter-driven Variable-speed Drive Screw Compressors HISCREW V-type and DSP V-type

Air compressors are some of the biggest consumers of electrical power in the various industries. Our research revealed that 15 to 25% of the total electrical power used in many industries is consumed by conventional air compressors. The need to reduce the energy consumption of the factories is ever increasing, and how to reduce the energy consumed by the compressed air systems is becoming a key issue of leading manufacturers.

From the standpoint of compressor control technology, improving the energy efficiency at compressor partial loads is one way to reduce energy consumption, and how to lower the operating pressure to the minimum is traditional approach for compressor power saving on the other.

To meet the need for reduced energy consumption, Hitachi introduced the world's first inverter-driven oil-flooded screw compressor in 1993. It has since expanded its line-up from 7.5 to 75 kW.

Hitachi's inverter-driven variable-speed drive screw compressor (HISCREW V-type) saves power in two ways.

(1) Power is reduced in proportion to the air demand: when air demand is 40 to 60% of the rated capacity, the power required is 30 to 40% less compared with conventional inlet modulation control.

(2) The accurate constant pressure control of Hitachi's original PID (proportional, integral, derivative) function reduces the power required by an additional 7 to 8%.

The HISCREW 2000 series with its newly developed rotor profile, which maximizes the intake capacity and minimizes the mechanical loss during compression, provides 3% more capacity at the same power consumption (7.5 to 37 kW).

The V-M combi system and the Single-V system are other fea-

tures of Hitachi's screw compressors. The V-M combi system consists of one V-type compressor and one or two M-type (constant speed with motor stop-restart type) compressors; it enables utilization of the power saving features of the V-type compressors over the entire capacity range. These systems are not only maximize power savings, they reduce the initial investment because only one V-type compressor needs to be installed.

The HISCREW 2000 series compressors have options that make them environmentally friendly.

(1) A built-in condensate oil/water separator can be selected as an option.

(2) The HG-option with an RS485 communication port and adapter enables remote monitoring of the compressor's operating condition.

In the field of oil-free screw compressors, Hitachi is also pioneering variable-speed control technology. Variable-speed control for high-speed rotors (15,000 to 24,000 min⁻¹) in an oil-free screw compressor requires intensive rotor-shaft vibration analysis and special low-speed-area capacity control to maintain efficiency. The DSP-V type oil-free screw compressors with inverter-driven variable-speed control (37 to 75 kW) were developed by utilizing a unique two-step unloading function without inlet throttling and precise frequency control to avoid the rotor-shaft resonance. They reduce the power consumption by 15% at 60% air demand, compared with conventional control. Combination operation systems, such as V-M combi and Single-V system, can also be applied to the DSP V-type compressors.

Hitachi's V-type inverter compressors have been well accepted in various industries and are contributing to a large reduction in energy usage.



HISCREW screw compressors

Industrial X-ray CT for Digital Engineering

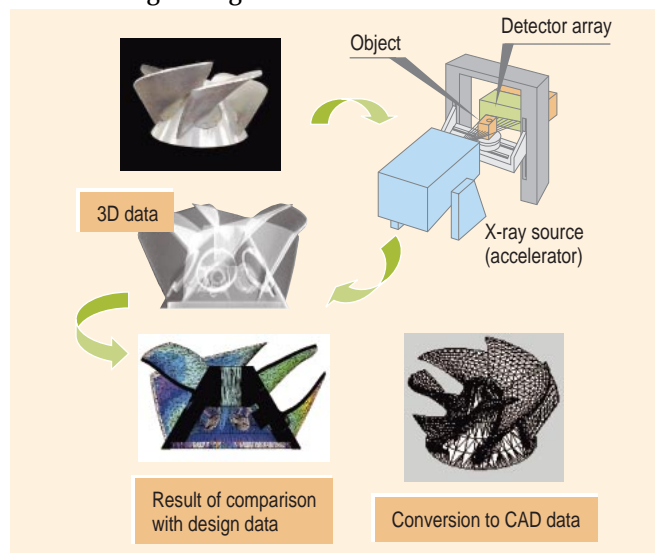
Hitachi X-ray computed tomography system ensures innovation in the designing and manufacturing processes of manufacturers. The system supports many engineering activities, not only non-destructive inspection but digitization of actual objects for utilizing and sharing their shape data. The CT hardware, which uses high-energy X-rays generated with a linear accelerator (1 to 12 MeV), can obtain precise cross-sectional image data from an inspected object quickly (10 seconds per section) and non-destructively. The maximum scanning thickness is 300 mm in aluminum, and the image resolution is 0.2 mm with a 1-MeV accelerator.

The original bitmap operation software can handle large three-dimensional bitmap data of objects obtained by piling up many cross-sectional data. The software has many functions for rendering the object (cut, surface, perspective), picking up its features, measuring its size (including the inside), and converting the bitmap to STL (standard triangulation language) data. Using the software, dimension accuracy is improved to a few times the image resolution by image processing or by comparing the image data with three-dimensional CAD data of the object.

Digitalization of an actual object is so easily achieved that the information of an actual object, i.e., size, density, feature, etc., can be obtained by the CT system. The digital data of an actual object are useful for development, quality assurance, productivity improvement, and inspection. Using 3D digital data acquired from a CT scan, a replica can be made using a rapid-prototyping

technique.

Use of an industrial X-ray CT system in manufacturing results in speed-up and cost reduction based on concurrent engineering and reverse engineering.



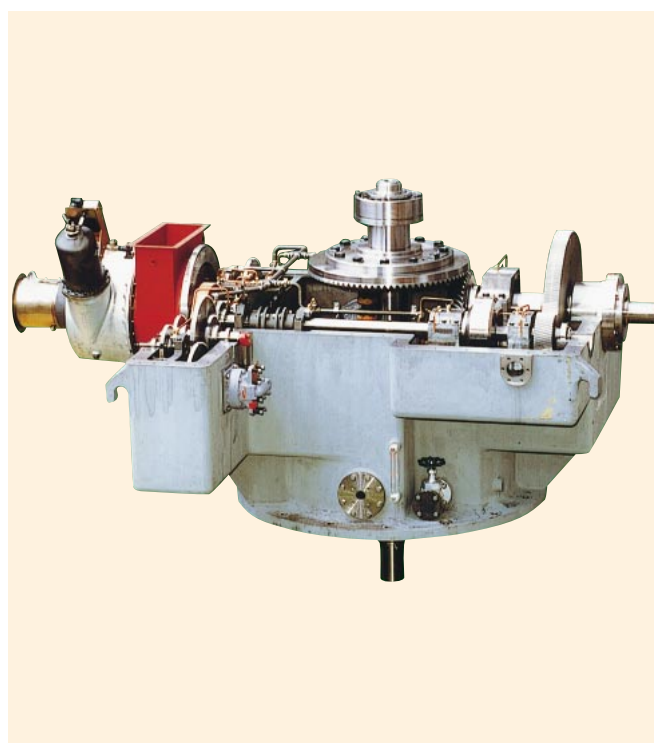
Example application to size measurement of a metal rapid-prototyping product
A slant-flow pump model was measured, compared with the design data for error estimation, and converted to CAD data.

Gear Reducer with Gas Turbine Drive Units (HYBRID) for Pump Drives

Drainage pumping stations have played an important role in preventing or minimizing damage from floods caused by heavy rain. In recent years, however, there has been a trend toward less construction of new pumping stations and increased renovation or rehabilitation of old facilities in existing stations instead. In such renovation or rehabilitation work, new technology is needed to minimize equipment size, simplify system operation, and enhance system functionality.

To meet this demand, Hitachi has developed a hybrid gear reducer with a gas turbine drive unit for pump drives. The new drive unit is provided as one package and includes a single-shaft gas turbine and a gear reducer with a fluid coupling for clutch and speed control.

This drive unit features space reduction, low noise [less than 85 dB (A)], and multifunctionality, such as an alternative application for the motor drive unit, or as a self-powered unit using its own internal generator for exhaust ventilation or oil supply to ensure anytime start-up/operation without an external electric power source.



Structure of gear reducer with gas turbine drive unit (HYBRID)
New type drive unit features space reduction and low noise.

Carbonized-fuel System Using Kiln-type Gasification Waste Furnace

Hitachi has developed a next-generation waste-treatment system that is environmentally friendly and that allows for the maximum exploitation of waste energy.

Waste is indirectly heated in a gasification furnace in an oxygen-free state at 450 to 500°C to break it down into cracking gas and cracking residue (char). Because cracking gas contains little chlorine, soot, or dust, it contributes to energy saving when it is used as heating fuel. The unoxidized metal in the char is collected (recycled), and the remaining char is sent to a melting furnace for swirling combustion at 1,300 to 1,400°C to render the ash molten and harmless when it is used as a heat source. The system significantly reduces the generation of dioxins due to the high-temperature combustion, reducing the dioxin concentration in the waste gases to 0.01 ng-TEQ/m³ (N) or less.

Because this system allows the gasification furnace and melting furnace to be operated separately, the gasification furnace can also be used as a carbonized-fuel system, which can be used to create carbonized fuel that has characteristics similar to coal by drying and carbonizing municipal waste. The system contributes to the goal of "zero emissions" because rather than incinerating municipal waste, it uses it effectively as an energy source. A system was delivered to the Itoigawa Area Broader Administrative Association

and started operation in April 2002. This system has attracted much public attention as one of the first circulation-type large-scale waste-treatment systems in Japan that makes good use of municipal waste.



System delivered to Itoigawa Area Broader Administrative Association
Scale: 70 t/d (35 t/d × two furnaces)

Deep-UV Laser-beam Recorder for Mastering Next-generation Optical Discs



Deep-UV laser beam recorder

Although various formats have been proposed and examined for next-generation DVDs with capacities over 25 GB* and track pitches around 300 nm, unification of the next-generation is desirable format. Agreement on the "Blu-ray Disc" format in February 2002, has opened a market for Blu-ray Discs that should spread gradually from an R&D base.

A reliable and stable laser-beam recorder (LBR) is the most important component of a disc mastering system. As recording capacities increase, the laser wavelengths used in LBRs are getting shorter and shifting to the deep-UV range. We have developed a deep-UV LBR for mastering the next-generation DVDs. Its 257-nm deep UV laser enables the production of high-quality DVD resist masters. It features a highly accurate and reliable auto-focus system, automatic re-alignment of the optical path, the ability to master both next-generation DVDs, such as the Blu-ray Disc, and current-generation ones, and a graphical user-friendly interface for the control system.

Hitachi plans to develop disc mastering systems with this deep-UV LBR as a key component.

* Nikkei Electronics, May 21, 2001 (No. 796) p. 49

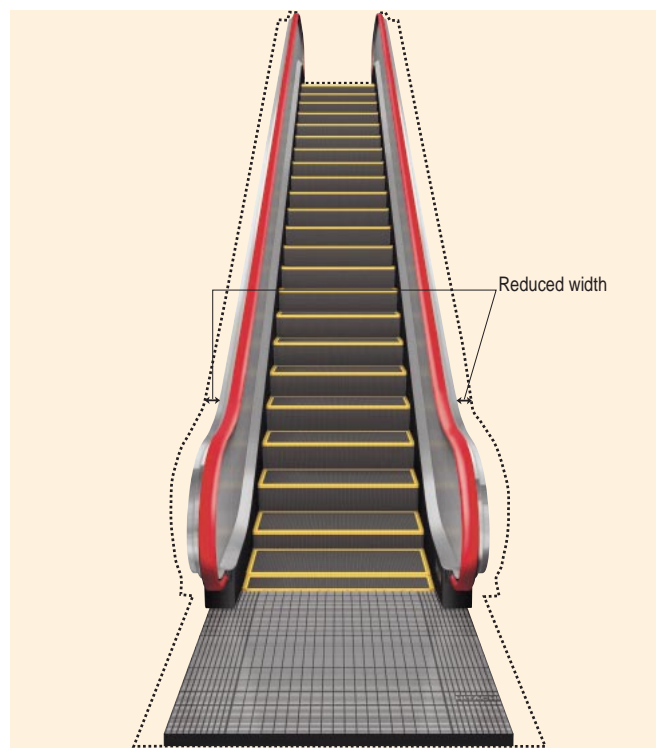
Space-saving Escalators with Reduced Overall Width

The Hitachi 1200EX Slim-Type Escalator incorporates a drive sprocket with a newly designed shape and a reduced-width truss frame that functions as the escalator mechanism. This has reduced the overall width of the escalator by about 15% (220 mm)* without changing the step width.

This allows for a stair area 440 mm wider when two units are installed in parallel on an existing staircase than with two of our conventional 1200 model escalators (two-person wide). In the space used by one of our conventional 1200 models or by one of our 800 models (one-person wide), we can install two of these new two-person models in parallel. These new escalators also increase layout flexibility. For example, one can be installed on an existing staircase that is too narrow for a conventional escalator and expanding the salesroom area.

* As compared with our conventional models

*Space-saving 1200 EX escalator
Space-saving 1200EX slim-type escalator with reduced overall
width without changing the step width.*



46 Elevators Delivered to Bank of China's Headquarters in Beijing

We delivered 46 elevators (including 30 of our latest-model inverter-controlled high-speed elevators having a speed of 150 m/min) to the Bank of China's headquarters (on Changan Avenue in Beijing), which opened in May 2001.

The headquarters building of the Bank of China was constructed to commemorate the 50th anniversary of the founding of the People's Republic of China. It is a low-rise building with 15 above-ground floors, 4 basements, and a total floor area of 170,000 square meters. The architecture and interior are of a novel design by a world-famous architectural designer, based on an ancient Chinese art called *feng shui*. The entrance jambs of the passenger elevators are made of mirror-finished stainless steel and a cage with double-laminate glass on the inside, a gorgeous, eye-catching design.



Exterior view of the Bank of China's Headquarters (lower right) and a passenger elevator (upper left)

Series E257 Limited-express Multiple-unit Train for East Japan Railway Company

The series E257 limited-express multiple-unit train began operation in December 2001 in place of the series 183 limited express train on the Chuo line, which has many curves, gradients, and tunnels.

The Series E257 was designed using two basic concepts of Hitachi's A-train system: aluminum double-skin construction and FSW welding method. These concepts make this train the environmentally and people friendly. Two train sets have basically 9 cars and 11 cars (9 cars and additional 2 cars).

Two VVVF inverters, a two-level-type inverter, control the two 4-traction motors and one 2-traction motors. IGBT elements are used to save energy through regenerative braking, restrain low-order harmonics, reduce the number of parts, and reduce the size and weight of the equipment. In addition, a brake chopper has been installed to permit even while regenerative braking is used.

The air-conditioning equipment is installed under the car bodies to lower the center of gravity. The outlet ducts for cooling air are positioned above the luggage carriers to improve circulation efficiency and equalize the temperature.



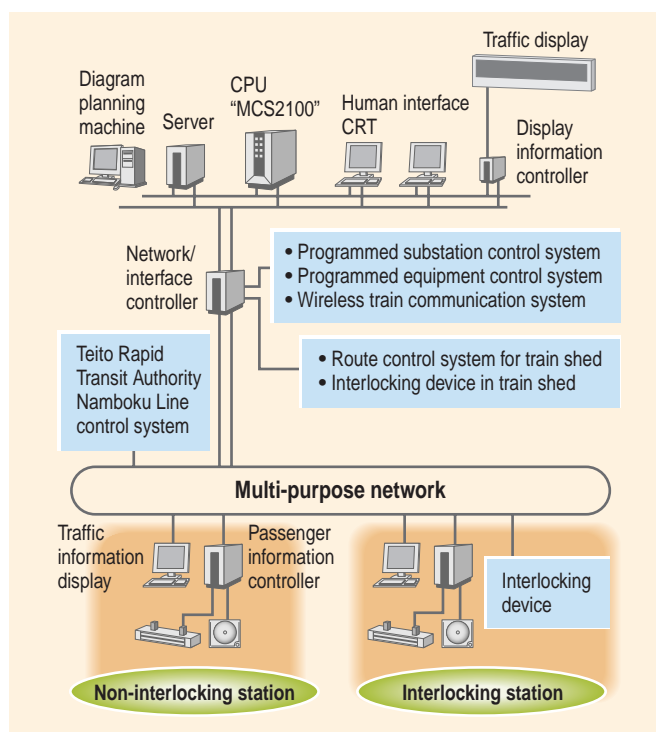
Series E257 limited-express multiple-unit train for East Japan Railway Company

Total Railway System for Saitama Railway Corporation

Saitama Railway Corporation began service on a new line in March 2001. Hitachi supplied a total railway system consisting of a Programmed Traffic Control System and a Programmed Substation Control System to automate the operator's job to enhance their efficiency and a Passenger Information Control System for the new line's passenger information service. Saitama Railway Corporation also has a Programmed Equipment Control System, a platform gate, and a one-man driving system.

Main features:

- (1) Small centralized duplex programmed traffic control system with RISC microcomputer on its CPU.
- (2) Programmed traffic control system including centralized train control function and passenger information system. This configuration makes the system compact.



Configuration of programmed traffic control system

Compact programmed traffic control system including centralized train control function and passenger information system.

301 Type Electronic Interlocking Device with Integrated Electronic Terminals

An interlocking device is an important component used in train signaling systems to keep trains safely separated. When upgrading a signaling system, it is strongly required that both the efficiency of a transport operation and the safety of maintenance work be improved.

To satisfy these requirements, we are continually developing new electronic interlocking devices that incorporate the latest information technology.

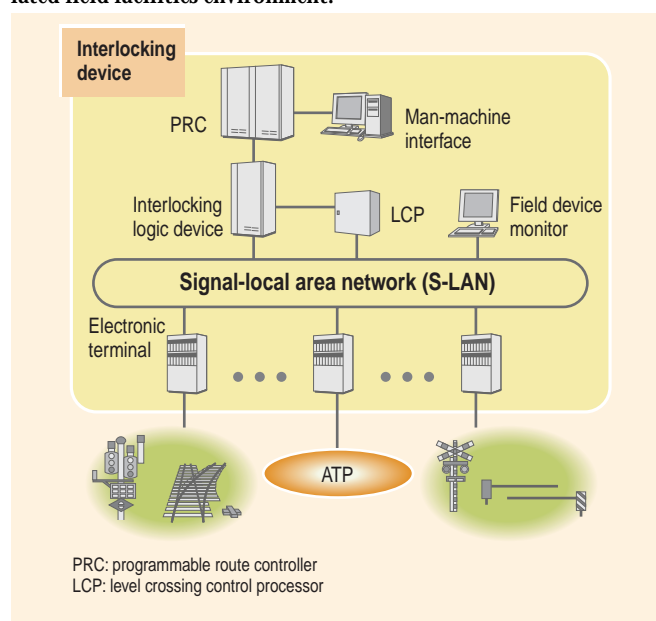
The latest interlocking device developed is of the scalable type. It has a distributed architecture with one CPU device, several electronic terminals, and an optical fiber LAN. This interlocking device was first put into operation in July 2001.

Features of developed interlocking device are as follows:

- (1) Established fail-safe architecture of 2 out of 3 type triplex structure using general-purpose controllers enhances the RAS (reliability, availability, serviceability) of the interlocking device.
- (2) Safety and efficiency of maintenance work can be improved. Because the interlocking device can be remotely controlled to set up a maintenance work area and to see the route for a maintenance car by a maintenance person in the field using a portable radio terminal.
- (3) The control response is faster because the electronic terminal directly controls the field signal facilities [signal lamps, point control units, level crossing, track vacancy detection equipment, automatic train protection (ATP) etc.].
- (4) An electronic terminal contains the control logic of ATP. The control logic of field signal facilities is described by means of a

visual definition data table as the same as the logic of the interlocking device, thus, becoming free from the wired logic.

(5) The quality of the interlocking device is assured and length of the interlocking test can be reduced because all necessary test cases can be extracted and executed automatically, as verified in a simulated field facilities environment.



Configuration of 301 type electronic interlocking device

New Ultra-high Resolution SEM: Model S-4800

Associated with higher circuit integration and density and multi-layers of semiconductor devices, higher performance SEMs have been required by the semiconductor industry. In response to these needs, we have developed a new ultra-high resolution cold field emission scanning electron microscope (FE-SEM), the S-4800. The S-4800 has ultra-high resolution nearly comparable to that available with an in-lens FE-SEM, the S-5200 which was introduced in August, 2000. Unlike the S-5200, the S-4800 allows microscopy of large samples (up to 8 inches).

The S-4800 has the following unique features: (1) Ultra-high resolution imaging comparable to the S-5200, namely 1 nm at 15 kV or 2 nm at 1 kV, guaranteed. (2) Variable signal mode that allows users to choose suitable imaging signals from among secondary electrons (SE), backscattered electrons (BSE) and a combination of the two, for their specific samples or for microscopy. (3) Choice of sample stages; type I for relatively small sample translations at X = 50 mm and Y = 50 mm, and type II for large translations at X = 110 mm and Y = 110 mm. Both of these stages are stable against external vibrations and allow ultra-high resolution microscopy.

We trust that the S-4800 is useful for advanced materials science applications including semiconductor devices.



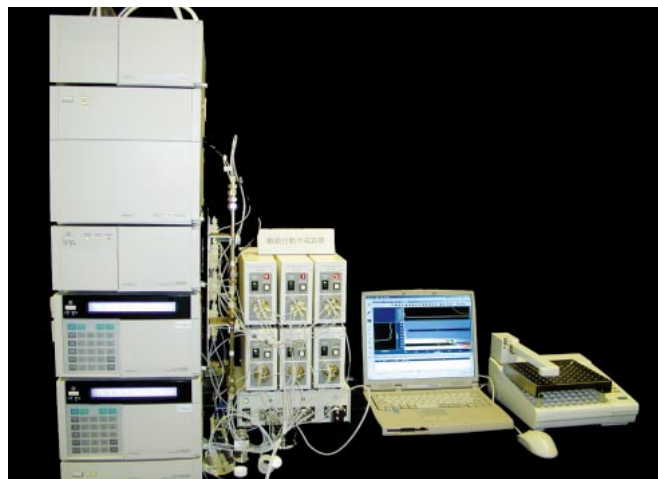
A general view of the S-4800 with a type II sample stage

Automated Glycoconjugate Synthesizer Using Immobilized Glycosyltransferases

Glycoconjugates are playing important roles in various biological events such as infection, fertilization, cell adhesion, cell differentiation, tumor progression, immune response, and so on. To elucidate their roles and functions in cell is one of the most important targets of the post-genome project.

Professor Shin-Ichiro Nishimura of Hokkaido University is leading the national project "Synthetic methods for biomolecules by controlled glycocluster technology." In collaboration with his group and the Toyobo Co., Hitachi recently developed a fully automated glycoconjugate synthesizer that is shown in the picture. It makes it possible to sequentially synthesize glycoconjugates, using a water-soluble polymer having glycosyl residues through a functional linker as the primer, sugar nucleotides, and immobilized glycosyltransferases. These tasks are performed in conjunction with a proper separation/purification process in each synthesis step.

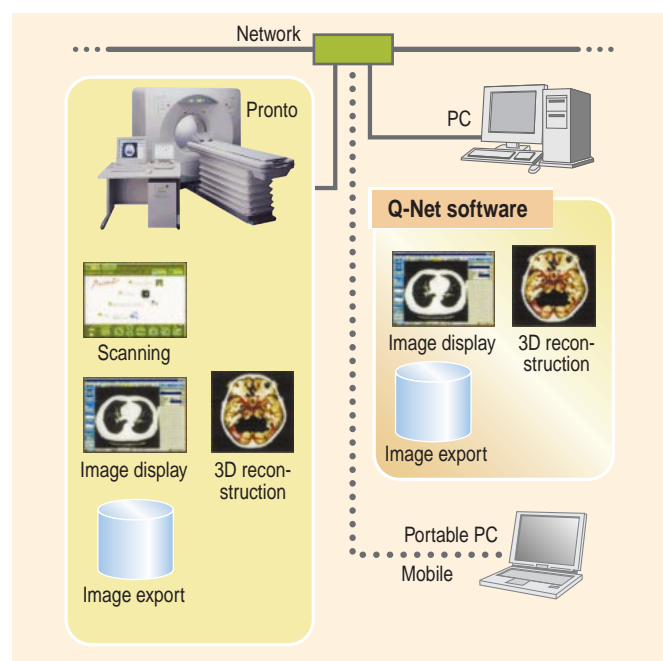
It is expected that this glycoconjugate synthesizer will assist and accelerate the study of glycoconjugates in biology and biotechnology.



Automated glycoconjugate synthesizer
The synthesizer consists of immobilized glycosyltransferase columns, a liquid chromatography setup that includes a PC-based controller, and valves.

Image Viewer of Q-Net

The need from the clinical front to connect CT systems to personal computers (PC) in the medical staff rooms and doctors' offices for quick image reading and explanation to patients has led



Network image reading system through Q-net

Hitachi to develop the Quick Net function (Q-Net).

Q-Net allows CT image data to be transferred from Hitachi CT system "Pronto" to your PC through a LAN and to be read by using the same viewer software as the one for Pronto. Q-Net permits network communication to a PC anywhere and realizes speedy image diagnosis. As compared with a DICOM network such as PACS, it allows easier connection between Pronto and PC.

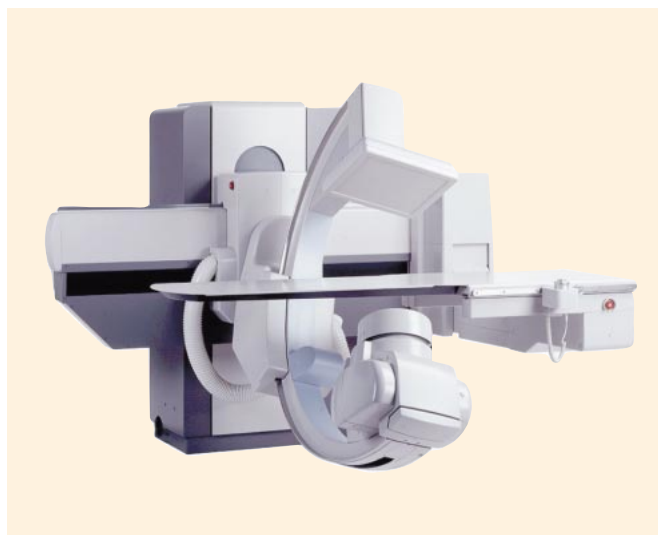
It is the system that automatically transfers images from Pronto to your PC by a single-touch operation through a LAN and allows you to read and analyze the images on your PC by using the same viewer software used in the Pronto system. Because it can run on Windows* OS, excellent operability can be realized to apply the system to various clinical fields in cooperation with other Windows applications.

Q-Net has the following advantages:

- (1) CT images can be speedily transferred to your Windows PC through a network.
- (2) Q-Net system can be reasonably built using your current Windows PC.
- (3) CT images can be exported to the JPEG and bitmap formats, thereby expanding the application fields for CT images.
- (4) Optional CT functions such as color 3D display can also be used.
- (5) The same smart interface used in the CT systems.

* Windows is a registered trademark of Microsoft Corp. in the US and other countries.

Multi-purpose Digital X-ray Imaging System with Flat Panel Detector



Multi-purpose digital X-ray imaging system with flat panel detector

Hitachi has developed a next-generation multi-purpose digital X-ray imaging system equipped with a flat panel detector (FPD) that enables both radiographic and fluoroscopic imaging of the region of interest with a large field of view and without distortion.

Conventional digital X-ray systems have an imaging area narrower than that of film-imaging systems due to their circular field of view. The use of an FPD in the developed system produces a rectangular field of view, attracting a lot of attention as the next-generation detector. The combination of an FPD and C-arm table widens the system's versatility, enabling it to be used for procedures ranging from digestive organ examination to interventional radiology (IVR).

Main features:

- (1) Large field of view (40 cm × 30 cm). Equipped with FPD for both radiography and fluoroscopy. Enables observation of large area in one view.
- (2) X-ray dose for radiographic images can be decreased by 1/3 to 1/2 when compared with that for conventional X-ray film systems; fluoroscopic images can be obtained with the same level dose.
- (3) The FPD makes it possible to improve the functions of the R/F table due to the remarkably reduced structural bulk compared to that of a conventional image receptor system. The result is easier system operation.

Surgical Operation-support Open MRI System AIRIS-II I-MR Model

The recent introduction of open MRI, such as with the AIRIS series of open MRI systems, has enabled the use of interventional MRI for minimal invasive therapy. It has had the same impact on neurosurgery. Because malignant tumors are difficult to discriminate from normal brain tissue with an optical view, surgical navigation systems assisted by MRI/CT have been developed to achieve more accurate and higher rate resection. However, conventional navigation systems using pre-operative images cannot solve the problem of brain shifts during surgery. An intra-operative MRI system consisting of the AIRIS-II I-MR model and a surgical navigation system provides real-time navigation, thereby reducing errors due to brain shifts.



Operation under navigation by operation-support open MRI system

42-V Motor Generator System

The automotive industry is under constant pressure to improve fuel consumption and reduce emissions because of concerns for the environment. Also it is necessary to generate a lot of electric power because an increasing number of electrical devices are used in motor vehicles. In order to meet these requirements, a 42-V motor generator system was developed. 14 V (12-V battery) is the current power supply and 42 V (36-V battery) is being considered for the next-generation high voltage systems.

The motor generator system is a kind of hybrid vehicle system. An electric motor is used as a part of the engine power-train. The engine, transmission, and motor generator are controlled by each control unit, and these units are connected under the total controller by the CAN (controller area network) bus line. Idling stop, regeneration, and acceleration assist functions are performed. A side-mount generator setup was selected to reduce installation difficulty. The wide range torque characteristics of the generator compensate for its small size.

Power MOSFET module and driver IC were newly developed for the motor controller/inverter.

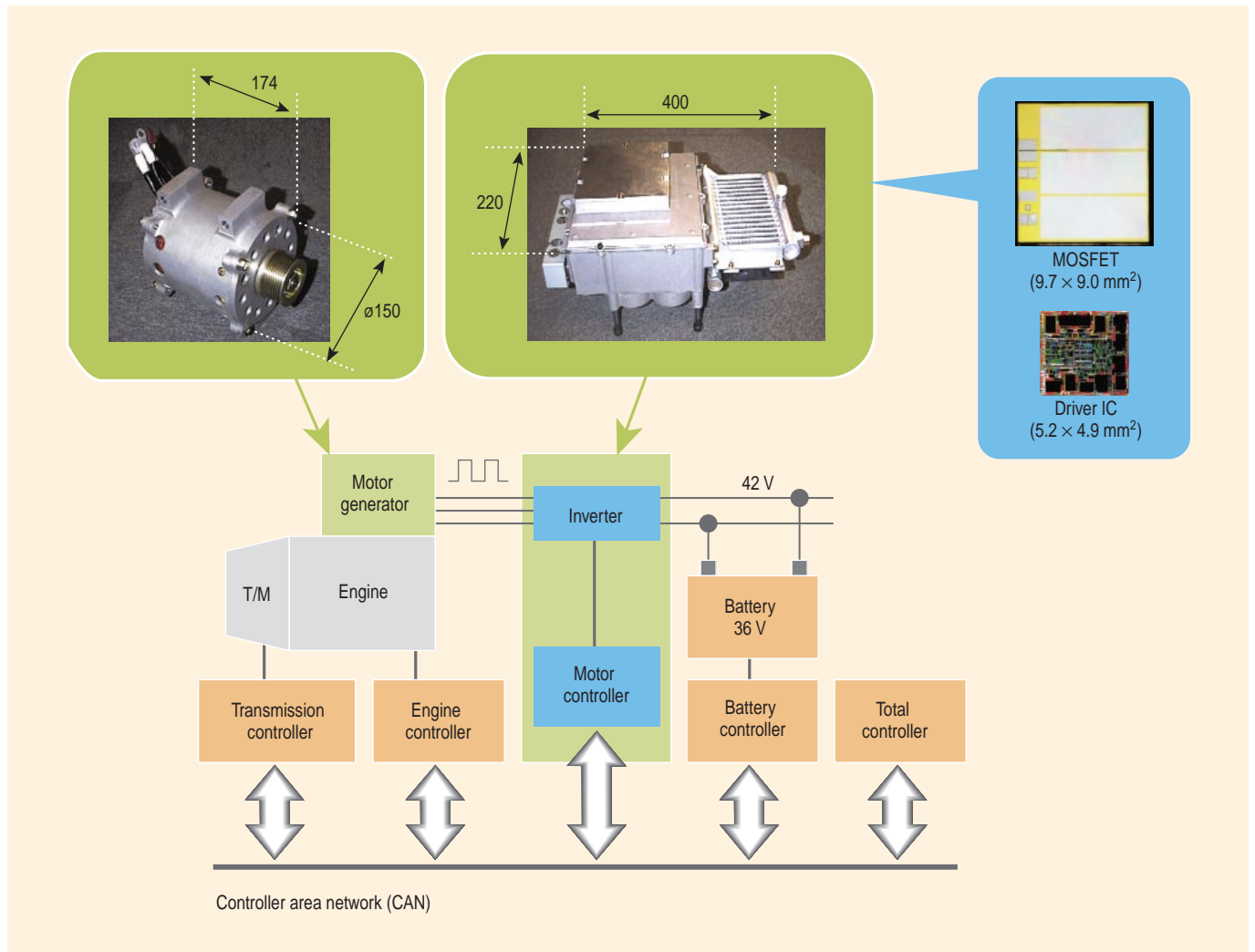
- Power MOSFET

To reduce the on-state resistance to improve efficiency and lower chip cost, a fine-pattern trench-gate 80-V 500-A MOSFET was developed for especially the 42-V motor generator application. Six MOSFETs are integrated in one module to drive a 6-kW motor generator.

- Driver IC

The drive IC features 3-phase gate driver with an integrated soft switching circuit and an active clamp circuit. By using soft switching and active clamp technology, peak voltage is kept to less than the MOSFET breakdown voltage. The fail-safe protection functions are also integrated.

By using this motor generator system, an improvement of about 20% in fuel efficiency can be achieved. We will be ready to produce of the motor generator system and related components by 2004.



Block diagram of 42-V motor generator system

76-GHz Millimeter-wave Radar

Hitachi has developed a small and lightweight 76-GHz millimeter-wave radar. This radar can be used as a sensor for a CWS (collision warning system), ACC (adaptive cruise control) system and future active safety-related systems by using following functions.

(1) Measure the distance, relative speed and azimuth direction of the target vehicle(s).

(2) Estimate the lane of the target vehicle(s).

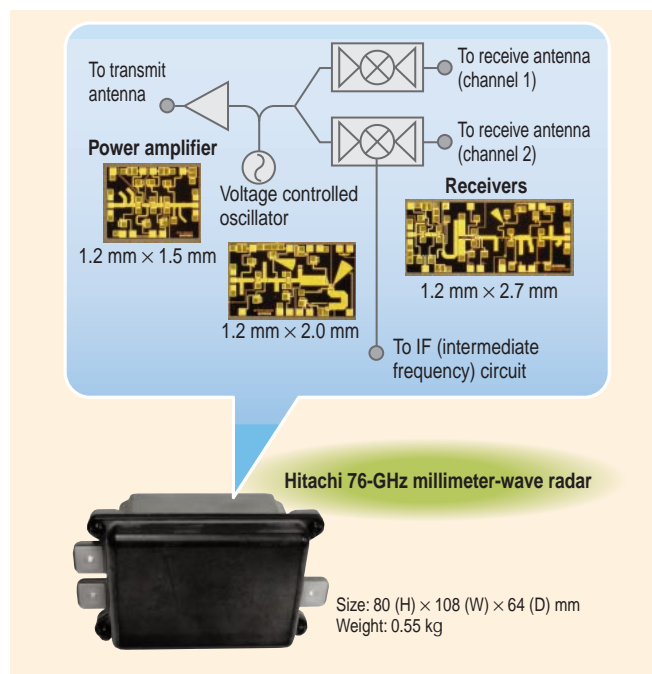
(3) Transmit the above information to the on-vehicle system(s) via CAN (controller area network) and/or serial interfaces.

To realize the above functions in the small one-body radar unit, Hitachi developed the following state-of-the-art technologies with Eaton VORAD Technologies, located in San Diego, California.

(a) Monopulse technology that uses two receive antennas to detect the azimuth angle of the target without any moving (scanning) mechanism to realize small size, low cost and high reliability.

(b) 76-GHz MMIC (microwave monolithic integrated circuit) chip set, which was designed using the 0.15 μm -gate GaAs-based PHEMT process to realize small, light weight transceiver having low power consumption and low cost.

This radar can be widely used around the world because the 76-GHz band is allocated to automotive use in the U.S.A., Europe, and Japan. Furthermore, it can be used under various environmental conditions because millimeter waves can propagate the reflection from the target in rain and fog.



Outer view of the 76-GHz millimeter-wave radar and block diagram of full MMIC transceiver for the radar

e-Learning Platform Based on International Standards and Its Application

Recently, Internet based e-learning systems are beginning to become the standard education and training tool used by corporations and academic facilities alike.

With regards to this, Hitachi Electronics Services Co., Ltd. developed an e-learning platform solution which is composed of three systems. The three systems work together and perform functions that range from the creation of learning materials to the management of the student education records, i.e., how much each student has studied and how well they understood the content.

All the materials used for education and training are created based on an internationally recognized standard, SCORM, which at the present is a must for developing e-learning materials.

The three systems that comprise Hitachi's e-learning platform solution are as follows.

(1) Content development system

This system enables the easy creation of learning-material content based on the SCORM standard.

(2) Learning system

The learning system enables students to access the learning materials via a web browser, and because it has mentoring and communication functions, students accessing the virtual classroom are (i) encouraged to continue their studies when their initiative wanes and (ii) to attain a high level of retention of the topic studied.

(3) Management support system

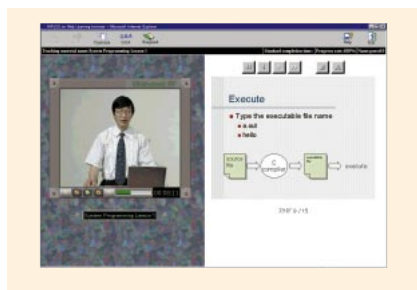
This system reduces the amount of manpower required for management tasks, such as announcements, recruitment, and processing of incoming applications. The system also maintains a student academic record database of learning history information that includes the

results of an analysis and evaluation of each student's performance.

This project was carried out as part of the "e-ASIA Support Demonstration Project with WBT (web based training)" under the auspices of the Japanese Ministry of Economy, Trade and Industry. The goal for this project was to conduct a trial course using the e-learning system and investigate the further needs for the system. The IT-related curriculum of Keio Univ. was used for the English content, which included MPEG-4 (Moving Picture Experts Group-4) animation.

The trial experiment was carried out at Chulalongkorn Univ. in Thailand and a great amount was learned from it. One of the greatest lessons learned from the trial was the need for a course credit system that can be internationally applied. Honestly speaking, the results of the trial were not all that positive, but we are very confident that e-learning system holds great potential as a new way of education.

We will continue to expand the e-learning materials, and as an extension of this will promote e-learning to business in other countries around the world.



Client screen image (lecture contents/learning materials) Hitachi's e-learning platform solution will realize full-scale e-learning based on international standards.

Top-loading Type Full Automatic Washer-dryer with Ion-permeable Washing Function Combined with Enhanced Washing Power

The fully automatic washer-dryer of this series that features the Ion-permeable Washing Function and Tangle-free Water Current to machine wash laundry both gently with high washing power is now on the market. This machine has a wash capacity of 8 kg and a tumble-dryable capacity of 4.5 kg. It can also serve as a wash only or dry only machine as well. It is about the same size as our conventional fully automatic washing machines.

The main features are summarized below:

(1) "Dehumidifying and drying system of the water-cooling type"

Now that the "dehumidifying and drying system of the water-cooling type" comes standard with this machine, it has become as compact in size as the commonplace fully automatic washing machines. Cooling down damp warm air by using a shower of water enables it to dry and dehumidify laundries fast and effectively, and it can contribute to maintaining an indoor environment at a comfortable level while limiting the rise in temperature and humidity. As in the case of electric clothes dryers, the adoption of a "humidity sensor" has resulted in a reduction in drying time. This humidity sensor can detect the degree of dryness of a load of laundry with high accuracy without being affected by the outside air temperature. This makes the drying performance attractive to laundries available which can vary depending on a degree of their dryness.

(2) "Ion-permeable washing" function

The penetration of highly concentrated detergent in liquid form (10 times as thick as the normal concentrated one) into laundry is much better than that of normally concentrated detergent, improving washing power by a factor of two or so. And besides, this highly concentrated detergent can remove most of the metallic ions from the wash water, helping the detergent to deliver its potential detergency thoroughly.

(3) Tangle-free water current

This tangle-free water current produced by rotating the entire washing tub in one direction and at the same time the big pulsator in the opposite direction can wash so gently and carefully thus preventing items from being damaged and becoming intertwined. In this water-current system, the entire inner wall surface of the wash tub is used to wash laundry in such a manner that washing power

is distributed evenly thus reducing damage to items by approx. 30% (in comparison with our older model).



Hitachi's fully automatic washer-dryer

Powerful, Clean Air Conditioner: The Fully Opening PAM Air Conditioner

In response to the recent demand for clean products, Hitachi has launched a new air conditioner, providing improved basic functions for heating and dehumidifying and aimed at all-year-round use.

Main features are below:

(1) A new louver configuration, with a surface area 1.7 times larger than that of a conventional one, and improved version of the PAM (pulse amplitude modulation) system enable it to widen the "comfortable zone" around the feet (that is, the area that should be kept above 23°C when the outside temperature is 2°C-by 1.5 times). Moreover, it has a "speed heating" function that can do this within five minutes.

(2) The "bone-dry dehumidifying" function, which decreases humidity without lowering temperature, reduces noise without detriment to power output. In addition, a "rapid laundry dehumidifier" function makes it quicker to dry clothes in the winter; namely, it takes 40% of the time taken by last year's equivalent model.

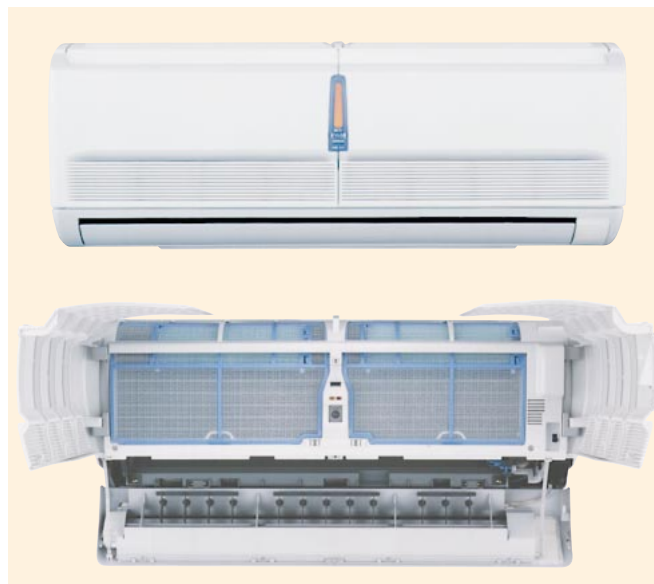
(3) In total pursuit of clean air:

(a) A powerful dehumidifier function, called "ticks and mold suppression," sets humidity to 40% by suppressing the source of dirt in the air.

(b) The right and left panels on the top and front of the body can be opened up completely and detached easily. This air conditioner has such a function, which allows places that could not easily be accessed before to be easily cleaned right up to the corners. Moreover, once the body is open, the heat exchangers can

be cleaned simply by using a special spray.

(c) High-electrostatic power air cleaning and negative-ions production result in improved air quality.



*The fully-opening PAM air conditioner (top); the completely open body (bottom)
All the panels and the air outlets can be fully opened up in this "completely open body" structure.*

Refrigerator with Novel Small Door as a New Concept

Hitachi developed a new refrigerator which incorporates a small door in the door of a refrigerator compartment. By using this small door, the volume of chilled air leaking decreases to about 1/10 of that of a conventional refrigerator compartment



Digital PAM refrigerator

door when the door is opened, thus it is energy saving. Moreover, since warm air cannot enter the refrigerator easily even if the door is open, it is hard to raise the temperature of the refrigerator compartment, hence foods stay fresh longer. Furthermore, if the customer puts foods that are used frequently in this easy opening small door, it's very convenient to access them.

The main features of this refrigerator are as follows.

(1) The small door in the refrigerator compartment door help save energy, extends freshness of perishables.

(2) The electricity consumption is reduced with the built-in energy-saving technology, such as digital PAM (pulse amplitude modulation) control. It is in the top-class of energy saving refrigerators. Annual electric costs are about 1/3 less than the refrigerators of ten years ago.

(3) Compared with the conventional models, deodorization speed was doubled by the use of a silver ion air filter and a cooling fan that has "catechin" in its position, an ingredient which is contained in the leaf of green tea.

(4) A high-speed cooling fan that circulates the cold air in the refrigerator compartment to cool food quickly without the risk of food freezing. Moreover, frozen food can be defrosted quickly using this fan.

New Vacuum Cleaner Variable as Cordless or AC Canister Type

Hitachi has put a new home use vacuum cleaner on the market. According to the cleaning situation, this vacuum cleaner can be varied in its style as either a canister type with a power cord, cordless stick type, or cordless hand-held type.

This model consists of four units: an AC main unit with a suc-



New vacuum cleaner

tion hose and power supply cord, a DC power head with the fan motor and power brush inside, hand grip with operating switches, and extension pipe to connect the power head to the handling grip. By combining these units suitably, one of three styles can be configured according to the situation.

The main features are as follows:

(1) The cordless stick consists of a DC power head, an extension pipe and a hand grip. The power head provides a dust case, two motors for the power brush, and a fan that can pick up dusts powerfully. This power head can be operated for about 25 minutes to 1 hour using rechargeable nickel metal hydride battery. It is convenient to carry from room to room, up stairs, and to use in places lacking an AC power source.

(2) The length of the extension pipe can be adjusted by manipulating the hand grip lever appropriately.

(3) By removing the extension pipe from cordless stick, the power head and the hand grip can be used as a cordless hand-held vacuum cleaner.

(4) The AC main unit is compact and a light 2.4 kg in weight. It has a highly efficient air filter system to clean the air exhausted.

(5) By combining the AC main unit and the cordless stick unit, an AC canister vacuum cleaner is realized.

New Hitachi Rotary Shaver that Senses Thickness of Beard Using "Beard Sensor"

In addition to the superior cutting performance and the built-in washing system of the Hitachi rotary shavers, to offer a more comfortable shave by reducing the burden imposed on the skin, we have developed a new Hitachi Rotary Shaver with a "Beard Sensor."

The "Beard Sensor" automatically controls the number of revolutions of the inner blade in three stages based on the thickness of the beard. The "Beard Sensor" senses the thickness of the beard and a microcomputer automatically controls the cutting speed accordingly as you shave. Hence, the burden on the skin is lessened.

The new shaver with the "Beard Sensor" shaves quickly in the "Powerful Mode" when first starting to shave. Next, it offers a comfortable shave in the "Normal Mode" and then finally a soft shave in the "Mild Mode" that is the most gentle on the skin. The shaver detects the thickness of a beard, and adjusts the shaving speed to the person. Furthermore, you can choose the cutting speed in three stages in the manual mode. The power indicator lamp indicates at which power you are shaving.

We developed "3-Dimension Moving Head" system that permits closer contact with skin and realizes a smoother and closer shave and produces a more comfortable shaving experience by moving the head freely back and forward, right and left, and up and down. The synergy effect of the "Swing Head" function increases the smoothness of a shave.

We lessened the burden on skin by developing and adopting a "Beard Sensor" and "a 3-Dimension Moving Head," thus a decrease of skin oil mixture of about 30 percent after finishing a shave has been achieved compared with our former model.



Hitachi rotary shaver