

TOSHIBA REVIEW

2000. VOL.55 NO.4

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Recent Achievements of the Corporate Manufacturing Engineering Center

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Optical Submarine Cable Systems

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Special Reports I

Recent Achievements of the Corporate Manufacturing Engineering Center

*Toward the Realization of Digital Manufacturing Systems

ATSUMI Koichiro

*Research and Development Trends in Manufacturing Engineering

KINOSHITA Masaharu

The simultaneous development of product technology and manufacturing technology has become indispensable for the reduction of product development lead time. Three major standpoints exist with respect to research and development in the manufacturing engineering field: upgrading and strengthening of core technologies, manufacturing innovation by means of information technology, and development of environmentally conscious manufacturing technologies. The dry process for semiconductor and liquid crystal display (LCD) devices is an important core technology. The 3D CAD/CAM/CAT and manufacturing management system is the key information technology. And in the area of environmentally conscious manufacturing technologies, there is demand for plastic resin recycling and the reduction of chemical reagent consumption.

*Management Information and Control System

SUMIDA Satoshi FUJITAKE Koji Norbert JUNGBAUER

We have developed a concept for a manufacturing information management system which controls the shop floor with a minimum number of supervisors, agilely dealing with a constantly changing environment. An on-line database and multidimensional data analysis provide fast and accurate methods to grasp information on the progress and quality of products. By visualizing the situation on the shop floor from a number of viewpoints, management action plans, which are defined beforehand, enable the managers to act quickly against problems.

This system concept has been applied to assembly lines for personal computers, medical equipment, and DVD-ROMs, and has proven to be effective in reducing labor hours for line management, improving product quality, and providing greater customer satisfaction.

*Thermal Design Technology for Small and Slim Notebook PCs

KOYANAGAWA Takashi INOUE Michinobu SHIBASAKI Kazuya

In order to realize PCs with high performance and mobility, it is necessary to package a high-speed CPU and other components in a small and slim case while providing the maximum functions possible. An important issue in achieving these objectives is solving the thermal problem, since components that generate high heat flux are packaged at high density and the temperature of the PC rises. Thermal design technology therefore plays a significant role in reducing the development cycle time.

We have investigated thermal and fluid flow by numerical simulation and developed a thermal design technology that can be used to estimate thermal properties at an early design stage. This technology has contributed to the development of slim notebook PCs including the Libretto series, as well as other high-performance PCs equipped with the Pentium# processor.

*Development of Production Equipment and Metallic Molds for Product Development

HARADA Tanemasa ADACHI Mitsuaki

A reduction in the lead time of production equipment and mold die development is required, which should be synchronized with a reduction in the production development cycle time. In cooperation with production development, we focused on the value-added processing points of equipment design, applied a 3D concept design, standardized the design process, and employed numerical analysis. A reduction in the lead time for mold die design and manufacturing was realized by applying 3D product design data as much as possible to mold die design, CAM, and measurement, and by implementing information exchange with electronic data. The electronic discharge machining of a rib slot shape was replaced with high-speed cutting.

*High-Density Plasma Sources for Semiconductors and TFT-LCD Processes

AOKI Katsuaki SUZUKI Hiroyuki YAMAUCHI Takeshii

Microprocessing is necessary to realize the high-density integration of semiconductor devices and the high performance of thin-film transistor liquid crystal display (TFT-LCD) substrates. As one of the techniques for achieving this, we use a dry process to which we apply high-density plasma sources with an electron density of approximately 1011 to 1013 cm⁻³. However, many problems must be solved in order to use such plasma sources in actual production.

We have newly developed several high-density plasma sources, including surface wave plasma (SWP) and inductively coupled plasma (ICP), and practically applied them to etching and ashing processes. To improve the controllability of plasma sources for large-size substrates and ion and radical species, we have also developed advanced plasma sources called slot-antenna plasma and inner-antenna ICP.

*Laser-Diode Pumped Nd:YAG Lasers

YUASA Hiroshi AKIYAMA Yasuhiro NAKAYAMA Michio

Laser-diode pumped Nd:YAG lasers are expected to be applied to laser processing fields such as welding, cutting, drilling, and marking due to their potential for high efficiency and compactness.

We are designing and developing laser-diode pumped Nd:YAG lasers using numerical analysis simulation techniques such as ray tracing and thermal analysis. We have succeeded in achieving a laser power of more than 3 kW with 20% efficiency, which is the best ever obtained. In addition, we have developed a laser-diode pumped green laser by second harmonic generation, for precision machining on silicon wafers.

*Motors and Inverters for Home Appliances

TANIMOTO Shigeyai NAGATAKE Kazuo

The motor and inverter play an important role in improving the product functions of washing machines and refrigerators, such as noise reduction and power consumption.

We have developed high-performance motors and low-priced, high-performance inverters by applying advanced numerical analysis to their design. For direct-drive (DD) washing machines, noise reduction was achieved by using a DD motor having lower torque ripple and an inverter controlled by an advanced motor-driving software. For refrigerators, power saving was achieved by using an inverter to drive the compressor motor and fan motors together with a control methodology making best use of the product's features.

Special Reports II

Optical Submarine Cable Systems

*Toward a New International Submarine Cable Network System

TAKAOKA Hiroshi

*Trends in Ring Systems for Submarine Cable Systems

SHIBAGAKI Taro FUJIMA Harumi KONDO Toshinori

In the domain of optical submarine cable systems for international networks, the construction of large-capacity systems has been continuously undertaken as a backbone for the information society of the 21st century. This has taken place due to the rapid growth in demand for the Internet over the past several years, coupled with the advancement of technologies for large-capacity, high-speed transmission which have made it possible to realize this demand. Abundant information exchange increases business opportunities and changes the forms of conducting business. This demand pushes technology advancement, which also creates new demand causing a mutual accelerating effect, so that capacity expansion is progressing with increasing speed. This progress is advancing much faster than the prospects for our technical progress.

This paper presents recent trends in technologies for realizing large-capacity optical transmission as the basis of optical submarine cable systems having a total network capacity of several hundred Gbps, as well as network protection technology of high reliability and high efficiency which deals with network failure, and network supervising technology.

*STM-16 Optical Ring System

KISHINO Fuminori TAKAMATSU Yoko WATANABE Shinsuke

Communication traffic is constantly increasing in submarine optical fiber cable network systems used for international telecommunications, and the provision of complementary detouring transmission lines for these networks by means of satellite transmission is becoming difficult. The need has therefore arisen for an optical ring system with a self-healing type protection function in order to handle large-capacity communication traffic without service interruptions.

We have developed the STM-16 network protection equipment (NPE), which has the line protection function defined by the International Telecommunication Union—Telecommunications (ITU-T), and are supplying it to various networks such as the TPC-5 cable network as kernel equipment in the first self-healing type optical ring system in the world currently in commercial service. This paper describes the major features and technical engineering services related to this submarine optical fiber cable network system.

*STM-64 Optical Ring System

NAGANO Masaaki DOBASHI Kyosuke BABA Kenji

Recently, with the rapid increase in telecommunications demand, large-capacity submarine cable optical fiber systems utilizing high-density wavelength division multiplexing (WDM) technologies have been constructed, and development work to further increase transmission capacity has also been accelerated.

To cope with this, based on the former 2.5 Gbps STM-16 network protection equipment (NPE) optical ring system, we have developed and commercialized the 10 Gbps STM-64 NPE optical ring system with interfaces of 150 Mbps, 600 Mbps, 2.5 Gbps, and 10 Gbps as low-speed side interfaces. This system is being supplied to the TAT-14 cable network system, and is scheduled to be put into service at the end of 2000.

*STM-64 Network Protection Equipment for Optical Ring System

OTANI Mitsuru IWAHORI Hitoshi KATSUMURA Hajime

We have developed the STM-64 network protection equipment (NPE) for optical ring system use. It has the STM-64 interfaces defined by ITU-T recommendation, and provides a large-capacity and highly reliable network. The STM-64 NPE has many features, including 200% add/drop capability, many types of low-speed interfaces, flexibility of path configuration, handling of concatenated AU-4 signals, and built-in functions for operation, administration, and maintenance (OAM).

Through verification tests, the STM-64 NPE was confirmed to be compliant with all design specifications such as compatibility of the STM-64 interface, functions, electromagnetic compatibility (EMC), etc. The newly developed STM-64 NPE is being introduced into the TAT-14 cable network, which traverses the Atlantic Ocean.

*Supervisory System for Optical Ring Network

AYAME Shogo IZAWA Shinichi HAGIWARA Michiko

In the domain of submarine optical fiber systems, the type of network is changing from the point-to-point type to the ring type. For the supervisory system of such networks, systems that can supervise the entire optical ring system are being introduced to be adopted to place of equipment supervision.

Recently, with the increased demand for international telecommunication traffic and the advances in dense wavelength division multiplexing (DWDM) technology, optical ring systems are being composed of plural optical rings. If the conventional type of supervisory system were applied to such a system, however, maintenance would become complicated from the viewpoints of capability and operability. In order to solve these problems, we have developed a new supervisory system that can provide unified management for a large-capacity optical ring network by structured function allocation.

*Control Function for Optical Ring System

OZAKI Takahiro KOBASHI Kazuhiro SUETSUGU Hiromune

In a high-capacity optical submarine system, it is difficult to switch the service traffic to another communication system such as a satellite system when a failure occurs. Toshiba's optical ring system has a network protection function conforming to ITU-T recommendations and can rapidly switch service traffic to the shortest protection path.

As a response to the demand for high capacity and various types of transmission, we have developed a new network protection function that can support STM-64, STM-16, STM-4, and STM-1 interfaces and concatenated AU-4 paths. An optical ring system with this protection function has been applied to the TAT-14 cable network system, which spans the Atlantic Ocean.

*Power Feeding Equipment for Optical Submarine Cable Networks

HASEGAWA Hiroyuki HASEGAWA Tetsuya IWASAKI Hidetoshi

Power feeding equipment for optical submarine cable networks is used to feed electric power to submerged optical amplifiers. Recently, requirements for power feeding equipment have changed as the transmission capacity of networks has increased with the use of wavelength division multiplexing (WDM) technology.

In response to these requirements, Toshiba has developed power feeding equipment with high reliability and high efficiency. This power feeding equipment is about to start operating in various optical submarine cable networks around the world, including the Japan-US Cable Network, Pacific Crossing-1(PC-1), and Trans Atlantic Cable Network-14(TAT-14) networks.

Feature Articles

*Business-to-Business Electronic Commerce Systems and Services—SmartEC Solution™

SETOGUCHI Tatsuya MANCHU Yutaka KATSUMATA Masato

Toshiba provides a range of information technology (IT) solutions called SmartEC Solution™, which includes business-to-business electronic commerce systems and services based on international standards and industrial know-how, especially our electronic data interchange (EDI) know-how as a manufacturer. These IT solutions are supplied as services covering strategy planning, system integration, and application service provider based on five types of business-to-business electronic commerce.

*Advanced Chemistry Management System for Nuclear Power Plants

MAEDA Katsujii KOBAYASHI Yasuhiro NAGASAWA Katsumi

Chemistry control in a boiling water reactor (BWR) plant has a close relationship with radiation field buildup, fuel reliability, integrity of plant components and materials, performance of the water treatment systems and radioactive waste generation. Chemistry management in BWR plants has become more important in order to maintain and enhance plant reliability. Adequate chemistry control and management are also essential to establish, maintain, and enhance plant availability.

For these reasons, we have developed the advanced chemistry management system for nuclear power plants in order to effectively collect and evaluate a large number of plant operating and chemistry data.

*Multislice CT System Provides Unrestricted Observation of the Human Body's Internal Structure

ARADATE Hiroshi SAITO Yasuo

A newly developed multislice X-ray CT system includes a two-dimensional multislice detector with 30,000 elements, a data acquisition system permitting 4 slices to be scanned simultaneously, a new reconstruction algorithm, and a high-speed reconstruction system. The new multislice CT system, which provides fast, high-resolution scanning over large areas, makes it easy to obtain 3D images, sectional images of arbitrary orientation. The axial multislice CT system will enable the further evolution of CT diagnosis, resulting in the more frequent use of 3D images in diagnosis and the development of new therapy applications.

Techno Notes

*Fuel Cell

Epoch-Making Toshiba Technologies

*3. Automatic Washing Machine with Direct Drive Inverter Motor