

TOSHIBA REVIEW

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Special Reports I

Power Electronics Technologies for Power Systems in the 21st Century

*Power Electronics Technologies Leading the Evolution of Electric Power Systems

KAWAI Michio

*Power Electronics Technologies in Future Power Systems

YOKOTA Takeshi KOBAYASHI Sumio ARAI Junichi

With the progress of deregulation in the electric power field, more economical systems are being demanded in all areas from power generation to power consumption. On the other hand, demand related to environmental issues and to the maintenance and improvement of supply reliability is also expected to continue increasing.

Power electronics (PE) technologies can be used to satisfy these demands. In addition to developing PE technologies that have long been applied to electric power systems, such as DC power transmission systems and static var compensators (SVCs), Toshiba has also been developing various equipment applying PE technologies with higher functionality by improving self-turn off type components. Further developing these technologies in the future, we plan to expand their application to electric power systems which are expected to undergo major changes from now on.

*High-Voltage, Large-Capacity Power Electronics Equipment Applied Widely to Trunk Lines

HORIUCHI Tsuneo NORO Yasuhiro TANABE Shigeru

Three large-capacity power electronics equipment systems have commenced operation recently. The Kii Channel high-voltage DC (HVDC) transmission system is the first 500 kV HVDC project in Japan, and its first stage of ± 250 kV – 1,400 MW was commissioned in July. The Minami-Fukumitsu 300 MW asynchronous tie links two 60 Hz systems. And a static var compensator (SVC) with a unit rating of 250 MVA has been installed in Australia.

This paper introduces the new control and thyristor valve technologies applied to these projects.

*Expanded Application of Power Electronics to Electric Power Systems by Self-Commutated Converters Incorporating IEGTs

TAKEDA Hideo YOSHINO Teruo KUWABARA Takashi

The situation of the electric power business is undergoing significant and rapid changes as a result of environmental issues and deregulation. Moreover, high-quality electric power is necessary for society due to the strong reliance on information systems. These requirements are contrary to each other. However, power electronics is able to offer a single solution to these difficult problems.

Toshiba has recently developed a large power self-extinction device, the Injection Enhanced Gate Transistor (IEGT). We are now providing the means to meet the social requirements for energy saving and lower costs by the application of power electronics, such as IEGT converters.

*Application of Power Electronics Technologies to Voltage Regulation in Power Distribution Systems

YAMAMOTO Hajime TAKAGI Kikuo SEKI Nagataka

Power electronics technologies have been applied to various equipment for power transmission systems, such as DC transmission systems and frequency converters. However, there have been few reports of the application of power electronics to power distribution systems.

In recent years, the thyristor voltage regulator (TVR) has been commercialized as a high-performance and high-reliability voltage regulator for power distribution lines, thus paving the way for the spread of power electronics technologies in power distribution systems. Moreover, in order to further enhance voltage regulation performance, we propose a distribution system voltage compensator (DVC) as a type of equipment in which a reactive power compensation function is added to a voltage regulator.

*Power Electronics Technologies Bridging Electric Power Systems and Dispersed Generation

SHINOHARA Hirofumi WATANABE Masahito TANOMURA Ken-ichi

Renewable, dispersed, and utility-interactive power generation systems such as fuel cells, photovoltaic systems, and wind power systems, as well as battery energy storage systems (BESSs), are being developed and constructed today to demonstrate their performance. In the near future, these systems are expected to be connected to utility grids in large numbers.

In dispersed power generation systems, the power conditioning system (PCS), which is the part containing power electronics, plays an important role interfacing between the utility grid and the energy source. The PCS is equipped with insulated gate bipolar transistor (IGBT) inverters and reliable control and protection functions.

Toshiba PCSs have been installed in various systems, in which operating experience is being obtained.

Special Reports II

BS Digital HDTV Receivers

*Digital Television, the Leading Home Information Platform in the IT Revolution Age

KAI Minoru

*Trends and Future Prospects of Digital Broadcasting Services via Satellite in Japan

NIO Koichi SAKURAI Masaru

Digital satellite broadcasting services will start in Japan on December 1, 2000. All necessary preparations, including government regulations and civil standards as well as licensing of broadcasters, are in progress toward that date. The key service in satellite broadcasting will be high-definition television (HDTV) programs, which offer high image quality. In addition, data broadcasting will play an important role in enhancing the merit of digital broadcasts with the provision of interactive services.

It is expected that digital broadcasts by broadcast satellite (BS) will lead to a new era of digital broadcasting including terrestrial services.

*BS Digital HDTV Receivers

TOKUMITSU Shigenori TAKAKU Kazumitsu KAMEMOTO Kazuhiro

The first digital broadcast services in Japan by broadcast satellite (BS) will commence on December 1, 2000. Two major events, the Okinawa Summit in July and the Sydney Olympic Games in September, will be broadcast using an experimental signal before regular services start. In addition to NHK and WOWOW, six new broadcasters will participate in providing these BS digital broadcasting services. Their services will be mainly based on high-definition television (HDTV) services and data broadcasting services.

We have developed two types of BS digital receivers: a BS digital tuner (TT – D2000) and a digital HDTV set (32D2000, 36D2000). These receivers meet the digital BS specifications and have a variety of original features.

*BS Digital HDTV Software

KIKUDA Yukio YASUKI Seijiro INOUE Sakae

Digital broadcasts by broadcast satellite (BS) are scheduled to start in December 2000 as the first step in large-scale digital broadcasting in Japan. Among the features of digital broadcasting are (1) high sound and image quality, (2) an increased number of TV program channels, (3) multifunctionality provided by additional information such as text, still images, and so on, and (4) fusion of broadcasting and communications networks. BS digital broadcasts will provide such digital TV services. BS digital TV receivers are therefore required to have sufficiently high performance to handle these digital TV services.

We have developed BS digital TV receiver software for the new services provided by BS digital broadcast TV programs.

*LSI Chip Set for BS Digital HDTV Receivers

SAKURAI Masaru SAWA Shigetaka ISHIKAWA Tatsuya YOSHIOKA Kenji KAI Naoyuki

NAGOYA Tetsuo IKEDA Kazumasa MANAKA Shigeyuki OKUYAMA Takehiko ARAFUNE Takeo

Broadcast satellite (BS) digital broadcasts offer high-quality video (i.e., HDTV) and audio, and a variety of multimedia data broadcast services. Digital signal processing LSIs are key components of BS digital broadcast receivers.

Toshiba has developed an LSI chip set that conforms to the specifications of the Association of Radio Industries and Businesses (ARIB) as well as TV receiver set requirements. It consists of an 8-PSK demodulator (TC90A54F), an MPEG audio/video decoder (TC90A55TB), a video/graphics processor (TC90A56TB), an IEEE1394 interface (MB86617), and a copy protection processor (TC81501F). A 32-bit RISC processor (TX3927) controls the whole chip set.

This LSI chip set can be used not only for BS broadcast receivers, but also for communications satellite (CS) broadcast receivers and U.S. DTV/DBS receivers by changing the firmware.

Feature Articles

*High-Sensitivity Inorganic Trace Analysis in Semiconductor Materials

KOZUKA Shoji YAMADA Yuji

This paper introduces inorganic trace analysis methods for recent semiconductor materials using chemical techniques. Trace impurities are considered to influence yield and reliability in semiconductor materials and devices. Recently, such components have become more complex and diverse, so that new methods for their analysis are required.

We have developed several novel trace analysis methods for semiconductor materials that are necessary for ULSI development. These include depth analysis with vapor phase decomposition, a high-quality fluororesin vessel and associated analysis methods, high-sensitivity metal measurement methods, dopant analysis methods, and ion analysis methods.

*PCX1100 Cable Modem Supporting QoS Functions

UCHINO Masashi FURUTA Tetsuro

In recent years, demand for a high-speed, wideband network to the home has increased rapidly with the expansion of the Internet. Use of the cable television (CATV) network is an excellent solution to provide a high-speed, bidirectional network to the home. For this reason, CableLabs® standardized the Data-Over-Cable Service Interface Specification (DOCSIS) communication protocol for the CATV network at the end of 1997.

Toshiba was the first vendor to develop a cable modem product for the CATV market. This time we have developed the new PCX1100 cable modem, which supports quality of service (QoS) functions corresponding to the latest DOCSIS 1.1 specification.

*Monolithic Integrated Two-Wavelength Laser Diode for DVD-ROM/CD-ROM

SHIOZAWA Hideo KOHMOTO Satoshi SHIMADA Naohiro

We have developed a two-wavelength (650 nm and 780 nm) integrated laser diode array (TWIN-LD) for DVD system use. This is effective in reducing the number of parts in pickups, making the pickup size small and saving costs. Both of the laser diode elements have a selective buried ridge (SBR) waveguide structure with an InGaAlP common cladding layer. This structure makes the wafer processed of the two-wavelength laser diode array very simple and productive. The interval between the DVD laser element and the CD laser element can be flexibly decided to meet the customer's requirements. The relative intensity noise (RIN) with a high-frequency superposition circuit is -136 dB/Hz on each side of the laser element.

The newly developed TWIN-LD was applied to a new type of DVD optical pickup, and showed suitable characteristics for both DVDs and CDs.

Epoch-Making Toshiba Technologies

*7. Advanced Boiling Water Reactor