TOSHIBA REVIEW

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Special Reports

System and Electronics Technologies to Support Automotive Society in Era of Revolutionary Innovation

Aiming at Environmental Harmony and Improvement of Safety and Comfort
MORIYASU Toshinori

Energy and Electronics Technologies for Realization of Environmentally Friendly Automotive Society with Safety and Comfort
EIMOTO Yasunobu
Toshiba has been contributing to the expansion of an environmentally friendly automotive society through the development of driving systems with energy management technologies and electric motors for the reduction of carbon dioxide emissions, in addition to the construction of clean energy generation plants such as nuclear power plants, photovoltaic power generation systems, and so on, as well as power management systems such as smart grids. With the aim of realizing advanced vehicles offering enhanced safety and comfort, we are also developing a broad variety of technologies ranging from social infrastructure systems and equipment, including intelligent transport systems (ITS), roadside telecommunication systems, and transportation control systems, to advanced semiconductors, parts, and materials for onboard products.

Advanced Technologies Supporting Drive Systems for HEVs and EVs
ARAKI Kuniyuki / ONO Motoharu / YUKI Kazuaki
In recent years, hybrid electric vehicles (HEVs) and electric vehicles (EVs) have become a focus of expectations as energy-efficient and environmentally friendly vehicles that can play a significant role in reducing carbon dioxide emissions.
Toshiba has been developing and releasing motors and inverters for automotive use as well as motor control technologies since its introduction of the world's first commercialized HEV electric drive system in 1991. We are now expanding our product lineup to key devices that form the heart of the electric drive system with the addition of power modules for the inverters, and batteries. We are also engaged in the research and development of core technologies to realize the next-generation electric drive system, with the aim of optimizing the entire system.

Advanced Driver Assistance Systems
OZAKI Nobuyuki / MIYAMORI Takashi / TANIGUCHI Yasuhiro
National projects and legislation related to the construction of advanced driver assistance systems (ADAS) are being implemented in Japan, the United States, and Europe, with the aim of widely disseminating ADAS in order to realize safer and more secure driving. To prevent accidents between cars and pedestrians, it is necessary to provide early pedestrian crossing information at intersections from the driver's point of view by alerting drivers through the collaboration of roadside and onboard equipment.
Toshiba has been promoting the construction of onboard ADAS consisting of sensors, an image- and signal-processing unit, a display control unit, and displays, based on its key technologies such as image-processing large-scale integrations (LSIs).

Software Technologies Supporting Automotive Electric and Electronic Systems
YAMAUCHI Nobuyuki / FUKAYA Tetsuji / KOMORI Seiji
With the expanding use of in-vehicle electronics and electroactuation in recent years, built-in software technologies have become increasingly important. A software platform with portability and efficiency is key to improved productivity. In control units such as application domains of an automotive powertrain, the best use of hardware intellectual property (IP) is essential to elicit real-time performance. At the same time, in multicore platforms such as an automotive information system, implementation of the optimal cost-effective solution is a strong requirement. In recent software development, conformance with international standards is also required based on a preliminary investigation of the system architecture.
Toshiba is promoting the development of functional safety systems according to the AUTOSAR (AUTomotive Open System ARchitecture) and ISO (International Organization for Standardization) 26262 standards.

Battery Installation Type Charging System for Electric Vehicles Providing Advantages for Both EV Users and Electricity Customers
ENDO Tamotsu / FUJIWARA Jun / ISHIURA Ryoichi
Both the promotion of electric vehicles (EVs) and photovoltaic (PV) power generation systems using natural energies, and the realization of smart grids to maintain the balance between energy supply and demand, are essential for the achievement of a low-carbon society.
As an application of electricity storage systems, which will play a critical role in the construction of the future social infrastructure, Toshiba has developed a prototype battery installation type charging system incorporating the following technological advancements: (1) the SCiB$_{TM}$ battery with excellent life performance and high safety, (2) a high-speed charging function for EVs, (3) a control function for the stabilization of output fluctuations in accordance with the widespread dissemination of PV power generation systems, and (4) useful functions for customers, such as a peak cut function, utilization of nighttime power, and an emergency power supply.

Practical Realization of ITS Spot Services
SHIBATA Yasuhiro / NAKAGAWA Atsushi
Research aimed at the development of intelligent transport systems (ITS) spot services, the so-called Smartway, for practical use has continued since FY2004. The installation of roadside units to provide vehicles with various types of information, mainly along national highways in Japan, began in FY2010 following proof tests conducted from FY2006. Information-provision services, including road traffic and safe driving information, are expected to be available in the winter of FY2010.
Toshiba has developed dedicated short-range communications (DSRC) wireless communication equipment for ITS spot services, based on both DSRC technologies acquired through development of the Electronic Toll Collection (ETC) system and image-processing technologies acquired through research and development of the Advanced Cruise-Assist Highway System (AHS). Further growth of ITS spot services is expected, due to the extensibility of the system.

Automotive Semiconductor Technologies Contributing to Eco-Friendliness, Safety, and Convenience
ITO Kenji / YAMAKAWA Isao / ARAKAWA Norimasa
Semiconductors for automotive use are not only essential for basic vehicle functions such as driving, turning, and braking, but have also become necessary to satisfy growing requirements for eco-friendliness, safety, and comfort in recent years.
In response to the changing needs of automotive markets, Toshiba has been consistently engaged in the development of leading-edge semiconductor technologies that can contribute to environmental preservation and improvements in safety and comfort. These technologies include metal-oxidesemiconductor
field-effect transistors (MOSFETs) for a broad range of automotive applications, light-emitting diodes (LEDs) for lighting, microcontroller units (MCUs) for motor control, BiCD process and functional safety technologies, graphic- and image-recognition technologies to meet new safety requirements, and voice synthesis and communication technologies for enhanced convenience.

TFT-LCD Technologies for Automotive Use Supporting Evolution of Vehicles
GOHARA Yoshihiro / KONDO Junji
The use of thin-film transistor liquid crystal displays (TFT-LCDs) in automotive applications has been expanding due to changes required for a broad array of functionalities ranging from mobile navigation to rear seat entertainment (RSE), and more recently, automotive safety equipment including instrument panels and rearview mirrors. Furthermore, TFT-LCDs with an input function, as typified by the touch panel, to achieve a human-machine interface (HMI) for driver assistance are expected to serve as effective information terminals.
In response to these changing needs of the automotive market, Toshiba Mobile Display Co., Ltd. has been consistently developing advanced TFTLCD technologies for automotive use.

Low-Power Automotive HID Lamp and Technologies for LED Interior Lighting
DEGUCHI Makoto / OKI Masahiro / SHIRAISHI Hiromitsu
Before the full-fledged arrival of the new era of electric vehicles (EVs) and hybrid electric vehicles (HEVs), lighting products with both advanced performance and originality for automotive interior and exterior applications are required.
To meet these requirements, Harison Toshiba Lighting Corporation has been making continuous efforts to develop and commercialize distinctive next-generation lighting products utilizing its own technologies and experience in automotive lighting applications. These products include a lowpower mercury-free high-intensity discharge (HID) headlamp offering safety, eco-friendliness, and comfort, and a broad range of light-emitting diode (LED) interior lighting products that optimally match individual vehicle model designs, taking advantage of our optical design capabilities to realize advanced lighting quality and value-added functions.

Material and Component Technologies Contributing to Expansion of Automotive Society
NABA Takayuki / YAMADA Taiju / SATO Akira
Various functional materials and components including semiconductors are required for the power electronics systems that are essential for electric vehicles (EVs) and hybrid electric vehicles (HEVs). Furthermore, new functional materials are beginning to be applied to the improvement of user-friendliness and comfort in vehicles of all types.
Toshiba Materials Co., Ltd. is promoting the development of state-of-the-art automotive functional materials and components based on its advanced level of technological potential, including highly reliable substrates for semiconductors providing high strength and high thermal conductivity, high-sensitivity amorphous thin antennas for smart keys, and the RENECAT$_{TM}$ high-activation photocatalyst with high reactivity under visible light.

FEATURE ARTICLES

Nanocarbon Interconnect Technologies for Future LSIs and Memories
SAKAI Tadashi / YAMAZAKI Yuichi / KATAGIRI Masayuki
With the higher integration of large-scale integrations (LSIs) and memories in recent years, finer and three-dimensional (3D) interconnects are becoming essential. However, the decrease in current carrying capacity and increase in resistance of existing metal interconnects are serious issues accompanying the thinning of interconnects. As a solution to these issues, so-called nanocarbon materials, such as carbon nanotubes (CNTs) and graphene, are expected to overcome the technical limitations of conventional interconnects.
Through a project of the New Energy and Industrial Technology Development Organization (NEDO), Toshiba has developed nanocarbon interconnect technologies for future LSIs and memories that provide the following results: (1) low-temperature growth of CNTs as well as (2) high-density growth compatible with semiconductor processes, and (3) selective growth into fine via-hole arrays. These results are applicable to the realization of a high-aspect-ratio vertical contact plug, which is required for future 3D memory interconnects.

SCiB$_{TM}$ Battery System for Electric Motorcycles
ITO Yasuyuki / SUZUKI Morio / MIZUTANI Mami
There is a strong need for the practical realization of electric vehicles (EVs) to reduce carbon dioxide emissions. Lithium-ion batteries, offering reduced size and weight, are playing an important role as key components in the promotion of EVs.
In cooperation with Honda R&D Co., Ltd., Toshiba has overcome various technical issues and developed a battery system for electric motorcycles applying the highly safe SCiB$_{TM}$ battery. The SCiB$_{TM}$ battery system is installed in the EV-neo electric scooter that was released by Honda Motor Co., Ltd. in December 2010. The EV-neo, designed for commercial use, makes best use of the features of the SCiB$_{TM}$ battery; namely, safety, long life, high power output, good performance even in low-temperature environments, and fast charging.

3.5-inch Hard Disk Drive with High Capacity of 2 TB for Nearline Storage Applications
ABE Yukio / ISHIZAKI Hirokazu / TAKAISHI Kazuhiko / KAWASAKI Kazuo
Toshiba Storage Device Corporation has developed a high-capacity 3.5-inch hard disk drive (HDD) suitable for nearline storage applications, which require high capacity, high reliability, and high performance, in order to expand its position in the enterprise storage server market following the consolidation of its HDD business unit.
This model features a storage capacity of 2 TB with four 3.5-inch disks, a rotation speed of 7,200 rpm, and a mechanical design offering high reliability. The servo controller incorporates a method for reducing disk flutter as well as rotational vibration feedforward control. The firmware for hard disk control achieves high performance by optimizing the reordering and queuing interface commands, and supports a data recovery function in the event of adjacent track interference.

Frontiers of Research & Development

Keyword Extraction Technology for Analysis of Large Volumes of Documents