

Special Reports

Reliability Technologies for Safety and Customer Satisfaction

Safety and Soundness Based on Reliability

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Trends in Reliability Technologies for Safety and Customer Satisfaction

KAWAKAMI Takashi / FUJIYAMA Kazunari

Safety has recently come to be recognized as a matter of key importance from the political, economic, and technological viewpoints. The principle of reliability is similar to that of safety, and reliability is the primary characteristic of quality. Industrial products must provide not only safety but also reliability in order for customers to be satisfied with their cost performance.

This paper introduces the conception of safe and satisfactory products, and the role of reliability technologies in realizing such conception as hardware products.

Reliability Design of Electronics Packaging for High-Performance Digital Equipment

HIROHATA Kenji / TAKUBO Chiaki / TAKAHASHI Kuniaki

Successive improvements in the performance of consumer electronic products are spurring demand for high-speed design technologies and high-density packaging technologies. In electronics packaging design, the growing complexities in conjunction with the decrease in design margins are driving the need for a new reliability design method applicable to quality problems.

To improve design review in terms of reliability, Toshiba has developed a multidisciplinary reliability design method based on statistical and probabilistic methods for electronics packaging in order to reveal the reliability relationships among packaging solutions and to identify failure risks. This paper presents our activities in the field of electronics packaging reliability design technologies.

Reliability Assurance Technologies for Advanced Semiconductor LSI Devices

SETOYA Takashi / WADA Akira / DOHI Yasuhiro

Advanced semiconductor LSI devices utilizing the 90 nm process rule are now being mass-produced and applied to DVD recorders, thin TVs, and digital cameras. The demand for even greater miniaturization and higher performance is driving the development of 65 nm process devices, whose prospect is in sight in 2005, where reliability assurance technologies at the margins of physical sensitivity are indispensable.

Toshiba has developed a testing method to eliminate defective materials and a pointing method to identify defect locations. Quality is designed so as to be embedded in products when they are manufactured. We have completed a quality accreditation system to satisfy customers' requirements with the shortest possible delivery times.

New Method of Reliability Evaluation for Air-Conditioner Compressor Bearings

HATTORI Hitoshi / ITOH Yasutaka / MIURA Kazuhiko

Toshiba has applied numerical analysis to mixed lubrication in order to evaluate the reliability of journal bearings for rotary compressors in air conditioners. In this analysis, the modified Reynolds equation and the elastic contact equation, taking the effect of surface roughness into consideration, are solved as a coupled problem, and the effect of elastic deformation of the bearing surface is also considered. The appearance of solid contact in hydrodynamic lubrication can be captured by the analysis. Reliability evaluation is achieved by a comparison between the solid contact force obtained by the analysis and a reference value obtained by an examination.

We are carrying out rotary compressor development using this reliability evaluation method in the design process.

Technologies Enhancing Reliability and Profitability of Thermal Power Plants

FUJIYAMA Kazunari / IINO Yutaka / WATANABE Shunzo

Toshiba is devoting efforts to the improvement of thermal power plant reliability and efficiency using system technologies integrating sensing, vibration mechanics, thermal-fluid dynamics, material engineering, structural reliability engineering, information engineering, and management engineering. We have developed several systems to realize safer and more efficient equipment such as turbines; namely, a remote monitoring and diagnosis system, a life assessment system, a risk management system, and an operation and asset management system. A total solution service can be provided by integrating these systems to meet the user's requirements.

Constant Improvements in Structural Reliability of Nuclear Power Generation System Components

WATANABE Yukio / ASANO Masayuki

In recent years, demand has been increasing for nuclear power generation systems with higher structural reliability to play an important role as a basic resource for a clean and steady energy supply, against the background of the need to reduce fossil fuel consumption and protect the global environment.

To meet these requirements, Toshiba has been making constant efforts to improve equipment, material, manufacturing, and water chemistry technologies, in order to develop reliable nuclear power generation systems based on the optimal understanding of operating conditions measured and estimated by a systematic analytical approach.

High-Reliability Technologies for World's Fastest Elevators

NAKAGAWA Toshiaki / NISHIKAWA Takashi / KIMURA Hiroyuki

Toshiba supplied the two fastest elevators in the world to the Taipei 101 Building, which opened on December, 2004. The most important aspects in the development of these elevators were securing safety and reliability as well as a comfortable ride. To realize these requirements, we studied confirmation methods for inspection processes and tools, carried out tests by trial manufacturing, and made estimations by simulations. The final measurement data at Taipei 101 corresponded to the data obtained in the development tests and simulations. As a result, the safety and reliability were verified and it was confirmed that a comfortable ride was achieved.

Feature Articles

Sub-picosecond Optical Switches Utilizing Intersubband Transition in GaN

SUZUKI Nobuo / IIZUKA Norio / KANEKO Kei

It is necessary to introduce optical signal processing technologies into optical fiber networks to cope with the continuous increase in digital data. Toshiba has developed a novel ultrafast semiconductor optical switch based on the intersubband transition (ISBT) in GaN/AlN quantum wells, as one of the key devices for this purpose. Crystalline defects, which cause strong background absorption in GaN waveguides, were successfully reduced, and a gate width as short as 0.24 ps was achieved. The potential for such GaN switches to operate at 1.5 Tbit/s, the fastest speed among waveguide-type semiconductor optical switches, was verified.

Application of Diamond Films to Discharge Cathodes

SAKAI Tadashi / ONO Tomio / SAKUMA Naoshi

Toshiba has proposed polycrystalline diamond film as a new cathode material in cold-cathode discharge lamps. Boron-doped polycrystalline diamond film was grown by chemical vapor deposition (CVD), and the glow-discharge characteristics were tested using an open cell discharge measurement system. The diamond film showed a 30 % reduction in cathode fall voltage compared to conventional cathode materials such as molybdenum and nickel. Furthermore, the cathode fall voltage decreased to 50 % that of Mo when the diamond surface was treated with hydrogen plasma.

These results indicate that B-doped polycrystalline diamond film is a promising new candidate for use as a discharge cathode material, particularly in cold-cathode fluorescent lamps (CCFLs).

Protocol for Carrying Authentication for Network Access (PANA)

OHBA Yoshihiro / KATSUBE Yasuhiro

A network access authentication protocol is required before a user connects to a secure network.

Toshiba's research and development activities in this area are focused on the Protocol for carrying Authentication for Network Access (PANA), which is a next-generation network access authentication protocol. These activities are based on standardization of the PANA protocol by the Internet Engineering Task Force (IETF) and open-source development of PANA protocol software to contribute to deployment of the fundamental technologies required for providing secure network access.

V603T Personal Digital Cellular Phone

SHIOMI Junichi / SUZUKI Shigeru / SONE Kazutaka

In April 2004, Toshiba released the V401T personal digital cellular (PDC) phone on the domestic Japanese market. This was the first model in Japan that enabled users to watch terrestrial analog TV broadcasts on a QVGA LCD. Our new domestic PDC model, the V603T, has been developed to make watching TV easier and improve the functions related to TV. It is the first cellular phone designed with two hinges placed in parallel, allowing the terminal to be opened and closed over a range of 360 degrees. In ordinary use the normal clamshell style can be employed. Then, when watching TV, the phone can be configured into a compact style with the main LCD outside by opening the terminal 360 degrees. This model also has various functions in addition to TV broadcast reception, including the ability to capture pictures from TV programs, record programs on a memory card, and link to an electronic program guide (EPG).

IC Card System for Takamatsu-Kotohira Electric Railroad Co., Ltd.

NAKAJIMA Hirotaka / NARUSE Tomoaki

JR Group companies and other private and public railroad companies in urban areas have already introduced large-scale automatic ticketing systems including IC card systems. Railroad companies in rural areas, on the other hand, have not yet introduced high-technology ticketing systems due to the poor return on investment. Despite this trend, Takamatsu-Kotohira Electric Railroad Co., Ltd. (abbreviated "Kotoden") has introduced an IC card ticketing system with the aim of providing convenience and amenity to its users while maintaining the investment cost at a sustainable level for a provincial railroad with many unmanned stations and a relatively low number of passengers.

Toshiba proposed, developed, and designed the entire IC card ticketing system and provided support to ensure its smooth operation.

Xario™ SSA-660A Routine-Examination-Oriented Diagnostic Ultrasound System with Premium Image Quality and Ergonomics

AKAMA Terufumi / SATO Takeshi / KAKEE Akihiro

Toshiba Medical Systems Corp. has developed the Xario™ SSA-660A diagnostic ultrasound system, aiming for advanced routine diagnosis with uncompromising image quality, excellent ergonomics, and outstanding productivity. These features are realized by our latest original technologies including ApIIPure™, Advanced DYNAMIC FLOW™, QuickScan, and IASSIST™.

The Xario™ SSA-660A is highly compact, so the system can be easily moved to the bedside or emergency room and can be ready to start examinations there in only a minute using the standby mode.

Low-Position Expressway Lighting

KOTANI Tomoko / SOUMA Ryuji

In expressway lighting, light is conventionally irradiated from a high position. We have developed a low-position road lighting system for safer nighttime driving. In this new lighting system, the luminaires are installed at a height of less than 1 m from the road surface, and light is irradiated in the advance direction of the vehicles in order to supplement the function of the vehicular headlamps.

We examined the visibility of fallen objects and the glare from luminaires, set up an experimental system on the Dai-ni Keihan Expressway, and verified the effects of the system.

Frontiers of Research & Development

"Global Communicator" Tool to Support Multilingual Communication

S-DD Motor Technology for Drum Type Washer-Dryer