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Special Reports

Advanced 3D TV: Glasses-Free 3D REGZA

Development of Glasses-Free 3D REGZA Offering Unprecedented 3D Images
ITO Shinichi

Advent of Glasses-Free 3D REGZA in First Year of New 3D TV Era
MATSUMOTO Kenji / SAKAMOTO Tsutomu
The third boom of stereoscopic three-dimensional (3D) imaging in Japan started in 2010. With the wide dissemination of 3D contents including broadcast programs and Blu-ray™ titles, as well as the advancement of technologies for the conversion of two-dimensional (2D) images to 3D images in real time, 2010 was worthy of being called the first year of 3D TV, in contrast to the previous 3D imaging booms. However, sales of 3D TV sets still accounted for only about 4% of all sales of flat-screen TV sets in 2010, with the need to wear dedicated 3D glasses acting as an obstruction factor.
To overcome this situation, Toshiba has developed and commercialized the glasses-free 3D REGZA series, which eliminates the need for dedicated glasses. This has been achieved by employing an integral imaging system and various advanced technologies such as a multiparallax conversion algorithm, an image-processing technology that realizes a large viewing area, and high-quality image-processing technologies applied in the existing REGZA series.

Glasses-Free 3D REGZA: World's First 3D LCD TV without Dedicated Glasses
FUJITA Koichi/ NISHIDA Yoshihiro
Toshiba has developed the glasses-free 3D REGZA series, the world's first three-dimensional (3D) liquid crystal display (LCD) TV sets without the need for dedicated glasses, incorporating an integral imaging system that offers smooth and natural 3D images based on the principle of simultaneously displaying multiple images from several positions and angles and delivering separate images to the left and right. We have also applied our proprietary image-processing technology to create nine parallax images from the original contents in real time, and reproduce high-quality 3D images through a vertical lenticular sheet on the LCD irrespective of the viewing angle within the viewing zone.

Integral Imaging System and LCD Panel Technologies for Glasses-Free 3D REGZA
HIRAYAMA Yuzo / HASHIMOTO Takeshi / SASABAYASHI Takashi
In conventional three-dimensional (3D) imaging systems without dedicated glasses, it is necessary to overcome various technical issues including the upgrading of liquid crystal display (LCD) panels, suppression of moiré fringes, and improvement of symmetrical resolution characteristics.
As a solution to this situation, Toshiba has developed the glasses-free 3D REGZA that eliminates the need for dedicated glasses, utilizing an integral imaging system and incorporating the following 3D LCD panel technologies: a vertical lenticular sheet for symmetrical resolution characteristics, a newly developed slanted pixel structure to suppress moiré fringes, a super-high-resolution LCD panel with approximately four times the pixels of a standard full high-definition (full HD) panel, a panel module structure using high-precision alignment technology, and a hign-luminance light-emitting diode (LED) backlight.

Viewing Area Optimization Technology for Glasses-Free 3D REGZA
FUKUSHIMA Rieko / NAKAMURA Norihiro
Viewing area optimization technology, which can maximize the viewing area of three-dimensional (3D) images at arbitrary viewing positions by changing only the image information, allows for increased flexibility of hardware design, However, exacerbation of a feeling of discomfort beyond the boundaries of the viewing area is a serious issue accompanying the application of viewing area optimization technology.
As a solution to this issue, Toshiba has developed an image processing technology that can realize a large viewing area, as one of noteworthy characteristics of the glasses-free 3D REGZA, eliminating the origin of the feeling of discomfort.

Multiparallax Conversion Algorithm for Glasses-Free 3D REGZA
MITA Takeshi / KIKUCHI Yoshihiro / YAMAUCHI Himio
The glasses-free 3D REGZA series enable users to watch high-quality three-dimensional (3D) images by generating nine parallax images from regular two-dimensional (2D) TV programs and stereoscopic 3D contents such as Blu-ray 3D™ movies without the need for dedicated glasses.
As a key technology to realize these products, Toshiba has developed a multiparallax conversion algorithm consisting of two processing technologies: a depth generation technology that makes it possible to convert any contents into 3D images with a combination of motion estimation, face detection, and scene classification; and a parallax image creation processing technology that allows users to adjust the amount of disparity according to personal preference in order to comfortably watch 3D contents.

Construction of Software Platform to Improve Development Efficiency and Quality of Glasses-Free 3D REGZA
NISHIOKA Tatsuhiro / MIYAKE Tatsuya / IKEDA Nobuyuki
To offer comprehensive three-dimensional (3D) capabilities without the need for dedicated glasses, the glasses-free 3D REGZA series, the world□s first glasses-free liquid crystal display (LCD) TVs, require dramatically different types of additional processing compared with conventional two-dimensional (2D) TVs. Another important issue is improvement of development efficiency for concurrent design of the 20GL1 and 12GL1 models with different hardware engines, and for acceleration of the design of the subsequent lineup of glasses-free 3D REGZA models with new features and large LCDs.
In order to overcome these issues, Toshiba has constructed a new software platform, which is based on that for conventional 2D TVs, using a software product line engineering approach. This software platform makes it possible to improve the development efficiency and quality of glassesfree 3D REGZA models by responding to the various features of different models.

FEATURE ARTICLES

Design for Manufacturability Technology to Accelerate Advanced Semiconductor Lithography Processes
KOBAYASHI Sachiko / KOTANI Toshiya / KYOH Suigen
Lithography is a key technology supporting the development of large-scale integrations (LSIs) in the process of manufacturing semiconductor devices. Various techniques have been introduced to extend its resolution limit, as typified by shortening the wavelength of the light source and the use of a higher numerical aperture (NA) in the exposure apparatus. Consideration of manufacturability at the design stage, referred to as design for manufacturability (DFM), is becoming increasingly essential to achieve a high yield rate in advanced semiconductor manufacturing processes.
With this as a background, Toshiba is promoting the development and acceleration of DFM technology making full use of computational lithography to establish design and manufacturing processes with a high yield rate in a shorter period of time.

Topography Simulation Technology for BiCS Ultrahigh-Density Flash Memory
ICHIKAWA Takashi / ICHINOSE Daigo / TAMAOKI Naoki
Accompanying the ongoing miniaturization of semiconductor devices and the increase in the number of process steps in their manufacture in recent years, cost reductions utilizing simulation technologies are required.
Toshiba has been developing a physical and chemical topography simulator to predict the performance of semiconductor devices without trial production. We have now introduced this topography simulation to memory hole etching as a key process for our proprietary bit-cost scalable (BiCS) ultrahigh-density flash memories. As a result, we have confirmed that the simulation model can describe the experimental topography of BiCS memory holes, including taper angles and undercuts of stacked films, applying appropriate modeling of physical phenomena as typified by the removal of adsorbed oxygen atoms on the silicon surface caused by reflected ions from the tapered silicon dioxide (SiO_2) sidewall. By utilizing this simulation model in the manufacturing of multilayer film structures, we can predict the precise topography and performance of semiconductor devices without the need for trial production.

High-Power Converters with High Switching Frequency Using Hybrid Pairs of SiC-PiN Diodes and Si-IEGTs
TAKAO Kazuto / SHINOHE Takashi / KANAI Takeo
High-power semiconductor devices are key devices for MVA-class power converters supporting various social infrastructures, including power systems, industrial systems, and railway systems. In particular, high-voltage silicon carbide (SiC) power devices are expected to improve the characteristics of high-power semiconductor devices.
The Toshiba Group has been engaged in research and development aimed at realizing a high-power hybrid pair module using high-voltage SiC p-intrinsic-n (SiC-PiN) diodes and Si injection enhanced gate transistors (Si-IEGTs). We have now developed a 4.5 kV-400 A-class hybrid pair module, and demonstrated a 50% switching loss reduction compared with conventional modules and 4 kHz high switching frequency operation. The highpower hybrid pair module can contribute to the realization of high-efficiency MVA-class power converters with smaller size and lighter weight in the social infrastructure field.

Force-Sensorless Control Technology Based on Dynamic Model for Industrial Robot Arms
OGA Jun'ichiro / NISHIHARA Yasunori / OAKI Junji
Automated production lines have been increasingly introduced to reduce production costs, accompanying the globalization of manufacturing industries in recent years. Particularly in high-mix, low-volume production, there is a need for cell manufacturing systems using robots that can precisely estimate and control external forces and moments to accomplish assembly tasks, including parts mounting and insertion. However, the introduction of force-controlled robots into manufacturing systems is hindered by the fact that force sensors are costly and fragile.
Toshiba has developed a force-sensorless control technology that can estimate external forces from differences between joint-driven torques calculated based on a robot dynamic model and commanded values of motor-driven torques. The control algorithm of this technology has been implemented in six degrees of freedom (6DOF) vertical articulated robots produced and commercialized by Toshiba Machine Co., Ltd.

Ka-Band 20 W-Class GaN Power HEMT
MATSUSHITA Keiichi / TAKAGI Kazutaka / TAKADA Yoshiharu
Aluminum gallium nitride/gallium nitride (AlGaN/GaN) high electron mobility transistors (HEMTs), which are promising candidates for nextgeneration microwave power devices, are attracting increasing research interest due to their inherent advantage of high power characteristics. In Ka-band satellite communication systems, AlGaN/GaN HEMT devices are expected to be adopted for solid-state power amplifiers instead of gallium arsenide (GaAs) pseudomorphic HEMT (pHEMT) devices because of the low output power of the latter devices.
Toshiba has already developed and released high-power AlGaN/GaN HEMTs for X-band and Ku-band applications. We have now developed a 20 W-class Ka-band AlGaN/GaN HEMT high-power device for Ka-band satellite communication systems applying a fine gate layer structure and epitaxial structure.

New Equipment for Replacement of Aged 550 kV Gas-Insulated Switchgears
HOSOKAWA Osamu / NAKANO Osamu / FUKANO Takato
A large number of aged switchgears are now operating in the field. However, it is difficult to obtain maintenance parts for air-blast breakers (ABBs) with old technology and early gas-insulated switchgears (GIS), and the main components are manifesting signs of degradation due to their longtime operation. As a solution to this issue, systematic replacement of aged switchgears is being planned to maintain their reliability. One the other hand, the replacement equipment must fulfill certain requirements such as minimization of the outage area, shortening of the replacement period, maximization of the usage of existing facilities such as equipment foundations, and easy connection with existing equipment.
In response to these circumstances, Toshiba is promoting the development of replacement equipment applying various new technologies, and has now developed a 550 kV gas-insulated busbar (GIB) and an ultrahigh-withstandvoltage arrester for this purpose.

FS5000S Model 2000 High-Speed and High-Maintainability Industrial Server
SUWABE Satoru / HAYANO Toru / HIROTA Tatsuo
Toshiba has developed the FS5000S model 2000 industrial server, its top-of-the-line 2U rack-mounted compact server. This model is equipped with up to two quad-core CPUs and up to 12 GB of double-data-rate three synchronous dynamic random access memory (DDR3-SDRAM) supporting error check and correct (ECC) functions, allowing it to perform high-speed processing of large amounts of data. Peripheral Component Interconnect (PCI) and PCI Express slots, as well as hot-swap hard disk drives (HDDs) supporting various redundant array of independent (inexpensive) disk (RAID) patterns, are implemented. To enhance convenience, the redundant power source unit can be replaced from the front side.
We will supply this model for five years from its release and respond to maintenance requirements for 10 years to assure long, safe, and secure operation as the core of mission-critical systems.

Frontiers of Research & Development

High-Reliability Long-Life Technology for Random Number Generator with SiN MOSFET Noise Source Device