

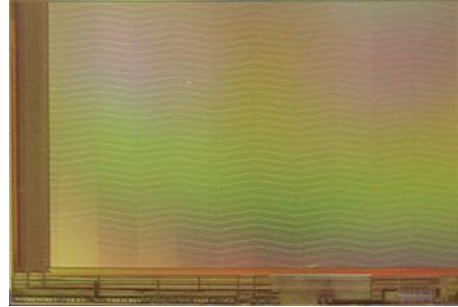
Electronic Devices and Storage Products

64 Gbit NAND Flash Memory Using 19 nm CMOS Technology

The market for NAND flash memories has been rapidly expanding due to the increase in their applications, including mobile devices, tablets, and solid-state drives (SSDs) in addition to existing applications such as memory cards.

Toshiba, in cooperation with SanDisk Corporation, has jointly developed a 64 Gbit 2-bit multilevel-cell (MLC) NAND flash memory with the world's smallest^(*) chip size of 112.8 mm² using 19 nm process technology.

The leading-edge 19 nm complementary metal-oxide semiconductor (CMOS) technology and innovative architecture have made it possible to reduce the chip area by about 30% compared with that using 24 nm process technology. Degradation of performance caused by miniaturization has also been overcome, realizing the same writing performance of 15 Mbytes/s as that using 24 nm process technology. In addition, a toggle-



World's smallest 64 Gbit NAND flash memory chip using 19 nm process

mode interface with a data rate of 400 Mbits/s per pin is employed to speed up the memory interface.

(*) As of November 2011 (as researched by Toshiba)

Highly Sensitive BSI CMOS Image Sensor

The wide dissemination of smartphones in recent years has created demand for thinner camera modules to downsize devices, requiring image sensors with higher sensitivity. In response to this market need, Toshiba has developed a back-side illumination (BSI) CMOS image sensor with a pixel pitch of 1.12 μm, the world's smallest^(*) size on a mass-production basis, and has started to produce it in commercial quantities.

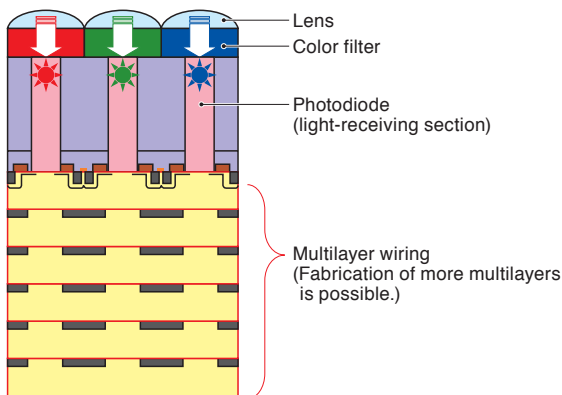
As the miniaturization of pixel pitch for the realization of a thin camera module decreases light-use efficiency, we placed wiring layers on the back of the light-incident surface when developing the 1.12 μm pixel pitch BSI CMOS image sensor. As a result, the new image sensor

achieves 125% higher sensitivity per unit area as well as higher resolution compared with a 1.4 μm pixel pitch surface illumination structure. Furthermore, a partially introduced 40 μm process technology to expand the photodiode area increases the number of saturated electrons per unit area to 118%, and optimization of the transistor sharing method and photodiode isolating structure realizes both increased speed and reduced noise and crosstalk.

The 8 Mpixel product in a 1/4-inch optical format features an industry-leading frame rate (8 Mpixel output at 30 fps and 1 080p output at 60 fps) and includes a high dynamic range (HDR) function.

fps: frames per second

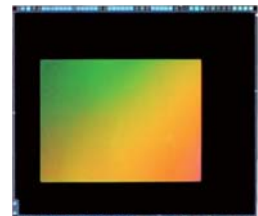
(*) As of December 2011 (as researched by Toshiba)



Structure of BSI CMOS image sensor



Image obtained by BSI sensor

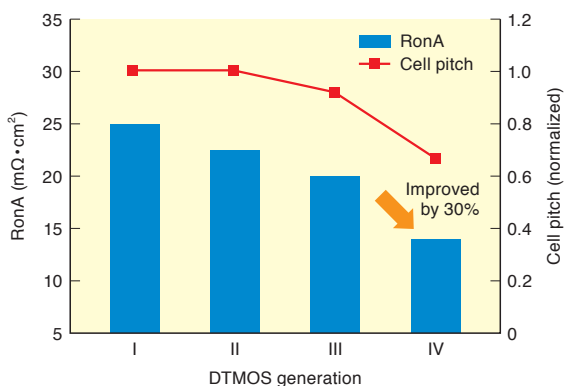


8 Mpixel BSI sensor

DTMOS Series Fourth-Generation Products

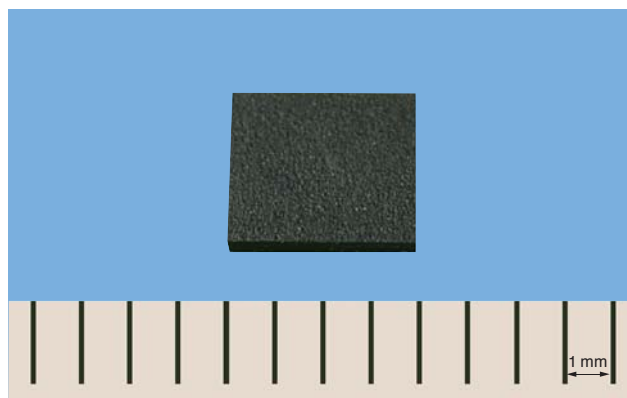
Toshiba has developed the DTMOS IV as the fourth generation of its deep trench metal-oxide-semiconductor (DTMOS) series of high-voltage power MOS field-effect transistors (MOSFETs) featuring a superjunction structure, for application to switching power supplies of electric devices and inverters of solar power systems.

The new DTMOS IV uses a single epitaxial technology for the first time in the DTMOS series to establish the superjunction structure. It achieves further miniaturization and the reduction of on-resistance per unit effective area (RonA) by approximately 30% compared with the DTMOS III third-generation products. Furthermore, the improvement in noise controllability of the DTMOS IV through optimization of the gate structure makes it possible to achieve low loss and facilitates measures against noise.



Reduction in RonA and cell pitch of Toshiba DTMOS series

TC35420 Wireless IC Compliant with TransferJet™ Standards



TC35420 wireless IC compliant with TransferJet™ standards

With the progressively higher capacity and the diversification of contents such as images, videos, and so on, easy and high-speed content transfer between various devices is required. TransferJet™ is a close-proximity wireless transfer technology featuring secure communication with a connection distance of a few centimeters. It has a user-friendly interface, allowing connection to be automatically established to start high-speed transmission between devices by simply touching them together.

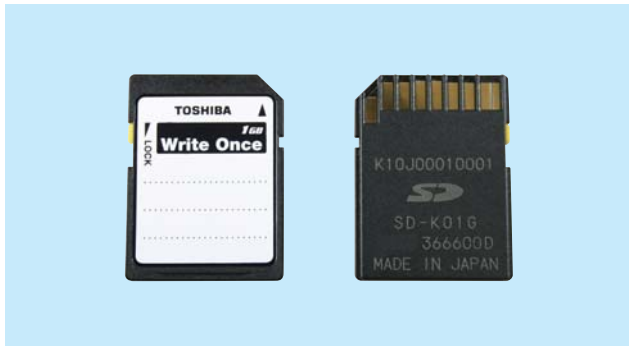
The TC35420 is a single-chip transceiver integrated circuit (IC) compliant with TransferJet™ standards that implements wireless functions, digital signal processing, a host interface, and a memory interface using a mixed-signal (RF CMOS) process.

TC35420 provides handheld devices, including smartphones and tablets, with new possibilities for dealing with information and contents through close-proximity wireless as a technology to achieve innovation in the new era.

RF: radio frequency

TransferJet is a trademark of Sony Corporation.

“Write Once Memory Card” SD Memory Card with Anti-Tampering Function



Write Once Memory Card SD memory card with anti-tampering function

Accompanying the widespread diffusion of digital still cameras, demand has been growing in recent years for the storage of evidence images as electronic data. Toshiba has developed the “Write Once Memory Card,” a secure digital (SD) memory card with an anti-tampering function for public offices and business enterprises to store image data to be used as evidence.

The newly developed SD memory card stores images taken by any digital still camera that is capable of using conventional SD memory card available on the market, and incorporates a function to prevent alteration of the stored data by such means as editing, processing, deleting, revising of the shooting date, and formatting of the card.

One model with a capacity of 1 Gbyte is available, and data stored in this SD memory card can be read and printed in the same manner as data stored in a conventional SD memory card using an SD card-compatible PC and printer. In addition, the card has a label on the surface on which information such as the shooting date can be written.

Self-Encrypting 2.5-inch HDD Equipped with Wipe Technology



MK6461GSYG 2.5-inch HDD equipped with wipe technology

Toshiba has developed the world’s first^(*) series of self-encrypting drive (SED) 2.5-inch hard disk drives (HDDs) equipped with wipe technology that instantaneously invalidates stored data when a SED HDD is removed from its housing and connected to an unauthorized host system.

The wipe technology is a suite of our proprietary security functions that bring an unsurpassed level of data protection to IT equipment and allow users to determine a range of security settings including invalidation of encryption keys and data invalidation.

SED HDDs equipped with wipe technology can be incorporated into existing system architectures and integrated into various units of IT equipment for which users demand a high level of data security, including multifunctional peripherals and PCs.

(*) As of April 2011 (as researched by Toshiba)

1 Tbyte Recording Capacity 2.5-inch HDD with 9.5 mm-Height Form Factor



MQ01ABD100 9.5 mm-height 2.5-inch HDD with 1 Tbyte capacity

Toshiba has released the MQ01ABD100 dual-platter 2.5-inch HDD featuring a capacity of 1 Tbyte in a chassis with the industry-standard 9.5 mm-height form factor. We have also released four other models with capacities of 750, 500, 320, and 250 Gbytes.

In order to achieve an areal density of 1 153 Mbits/mm² (744.1 Gbits/in²), which realizes a storage capacity of 500 Gbytes per platter, we have developed the following technologies: a low-density parity check (LDPC) coded modulation technology applying a new read channel architecture, a new write head structure, a smaller track pitch achieved by refining the disk media magnetic grain, and a newly designed mechanism and servo filtering technology to improve the head positioning accuracy. Furthermore, the shock resistance is enhanced by a high stiffness mechanism applied to the arm, suspension, and base.

The MQ01ABD100 is targeted at high-performance notebook PCs and desktop PCs, in addition to audiovisual devices such as TVs, recorders, and external HDDs.

These five models comply with the European Union's Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment, which has been in effect since July 2006, and are also halogen-free and antimony-free products^(*).

^(*) Toshiba defines halogen-free and antimony-free HDD products as those meeting all of the following requirements: (a) containing not more than 900 parts per million (ppm) by weight of either bromine or chlorine, and containing bromine and chlorine in an aggregate amount not exceeding 1500 ppm by weight; and (b) containing no more than 1000 ppm antimony by weight. For the avoidance of doubt, halogen-free and antimony-free HDD products may not be entirely free of bromine, chlorine, or antimony, and may contain any other element of the halogen family.

2.5-inch Small-Form-Factor HDD with 300 Gbyte Capacity and 15 000 rpm Rotation Speed for Enterprise Use



MK3001GRRB 2.5-inch HDD for enterprise use

In recent years, it has become necessary for HDDs for enterprise use to support not only high-speed data processing, but also low heat output and space saving in order to realize high-density packaging, low power consumption, and so on. Because of these trends, expectations have been focused on 2.5-inch HDDs with smaller size and more efficient power consumption compared with conventional 3.5-inch HDDs.

In response to these needs of the market, Toshiba has developed the MK3001GRRB/R series 2.5-inch small-form-factor (SFF) HDDs for enterprise use with an industry-leading^(*) capacity of 300 Gbytes and a rotation speed of 15 000 rpm, equipped with a 6 Gbits/s Serial Attached SCSI (SAS). In addition, the MK3001GRRR series offer drive-based encryption to measure information leakage and manage data security in companies.

SCSI: Small Computer System Interface

^(*) As of October 2011, for 2.5-inch HDD products with a rotation speed of 15 000 rpm or higher for enterprise use (as researched by Toshiba)

Note:

1 Gbyte is $10^9 = 1\,000\,000\,000$ bytes and 1 Tbyte is $10^{12} = 1\,000\,000\,000\,000$ bytes. A computer operating system, however, reports storage capacity using powers of 2 for the definition of 1 Gbyte = $2^{30} = 1\,073\,741\,824$ bytes and 1 Tbyte = $2^{40} = 1\,099\,511\,627\,776$ bytes, and therefore shows less storage capacity. Available storage capacity (including examples of various media files) will vary based on file size, formatting, settings, software, and operating system.

Biologically Friendly White LED Lighting with Same Spectral Class as Sunlight

Toshiba Materials Co., Ltd. is now developing a white light-emitting diode (LED) with an ideal spectral distribution to offer high-quality lighting.

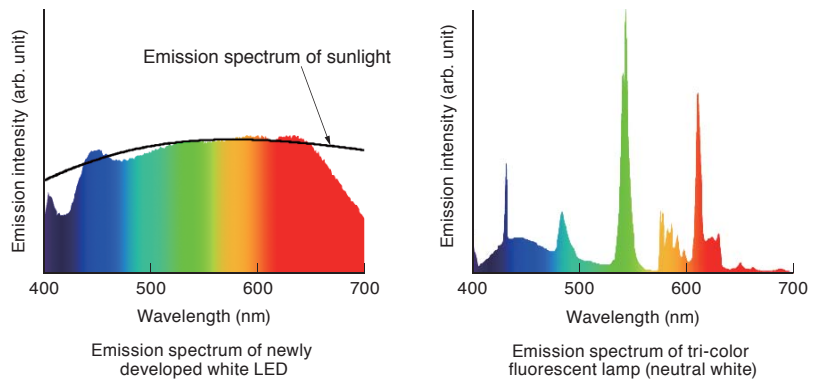
Conventional energy-saving fluorescent lamps and so-called white LED lamps have a spectral distribution that differs significantly from that of sunlight. In terms of neutral white light, for example, their sunlight spectral reproducibility(*) is only 15% and 80%, respectively, in the whole range of visible light. In specific wavelength ranges, it falls to as low as 40%.

To overcome this incompatibility, we have been developing a new type of phosphor that can emit light similar to sunlight and optimizing the optical design of light sources using simulation technology. As a result, we have succeeded in fabricating a white LED light source that emits light very similar to sunlight. The spectral reproducibility is more than 90% in the color range of purple, blue, green, and red, and exceeds 96% overall in the range of visible light. The average color rendering index, which is a measure of the ability to reproduce the colors of objects, is as high as 95 points or higher, similar to that

of sunlight. The color temperature is adjustable to the changes in sunlight occurring on a particular day.

The newly developed white LED is expected to be a biologically friendly light source corresponding to the human circadian rhythm.

(*) A numerical index of spectral adjustment for sunlight (area ratio under the same luminance)



Comparison of emission spectra of light sources

Thermal Print Head with High Coloration Efficiency

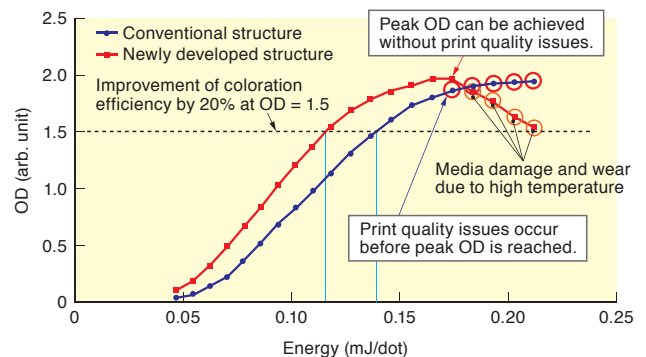
The thermal print head is a key device of thermal printers such as dye-sublimation photo printers and similar equipment. Demand has been growing in recent years for improvement of energy saving in thermal printers.

Toshiba Hokuto Electronics Corporation has developed a new thermal print head with high power efficiency that achieves the same optical density with a 20% reduction in impressed energy compared with our conventional products by applying a new heater design. We investigated heat distribution around the heater, especially around the heater line, required for dye-sublimation media. As a result, we extracted the functions required for photo printing using the dye-sublimation method and optimized the design around the heater line.

As existing heaters cannot use a high optical density (OD) area due to the occurrence of print quality issues, including local wear of the protective film and damage to the thermal recording media, they use the OD area before the peak OD is reached. This results in poorer contrast in the printing method using such heaters compared with



High-coloration-efficiency thermal print head



Comparison of OD characteristics of high-coloration-efficiency and conventional thermal print heads

other printing methods. The newly developed heater with optimized heat distribution ensures optimal print quality using the peak OD of each medium.