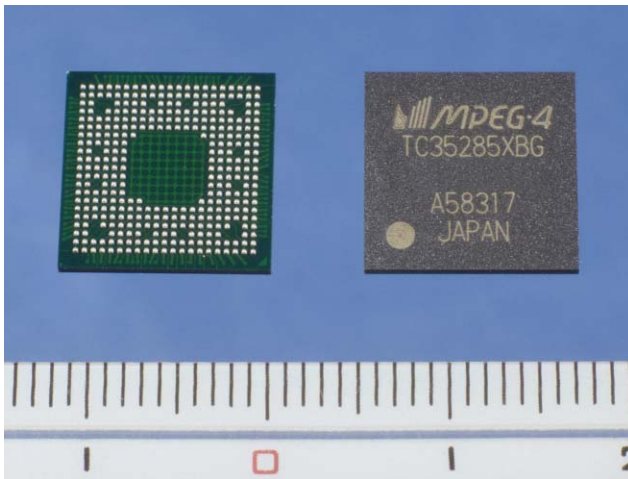


The ubiquitous network age is approaching with rapid progress in mobile devices and digital household appliances. Toshiba is developing system LSI, memory, semiconductor devices such as discrete devices, liquid crystal display devices and key materials, which are the key components of these devices and appliances in cooperation with Group companies and is providing products to device manufacturers throughout the world.

## MPEG-4 Encoder and Decoder LSI Integrates High Performance 3D Graphics Engine



MPEG-4 encoder and decoder LSI TC35285XBG

Toshiba has developed a powerful MPEG-4 encoder and decoder LSI the T4G (part number TC35285XBG) that brings video-game-grade high-resolution 3D (three-Dimensional) graphics to mobile phones.

Most of today's advanced mobile phones render 3D graphics with software, an approach that severely burdens the CPU and increases power consumption.

The T4G instead integrates a dedicated circuit for high-grade 3D graphics. At a time when mobile phones are diversifying to become games platforms and personal GPS (Global Positioning System) systems, the T4G delivers a timely solution that supports improved graphics and renders video sources with a drawing performance of 125-million pixels a second. Alongside its 3D graphic processor, the T4G incorporates a JPEG (Joint Photographic Experts Group) codec for a 2-megapixel camera and an LCD control circuit for a QVGA (320×240) panel.

Power consumption (at 125 MHz operation) is between 170 mW and 230 mW, and the chip is packaged in a 12mm×12 mm ball grid array (BGA).

QVGA : Quarter Video Graphics Array

## Single-Chip LSI for DVD Player

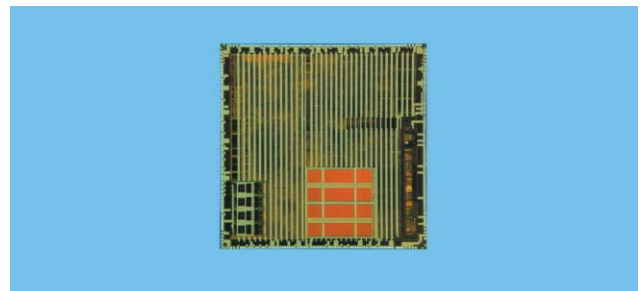


TC90600FG single-chip LSI for DVD player

Toshiba has developed the TC90600FG single-chip LSI for DVD player systems. The LSI integrates the front-end processor, back-end processor, and TX19 control processor into one chip.

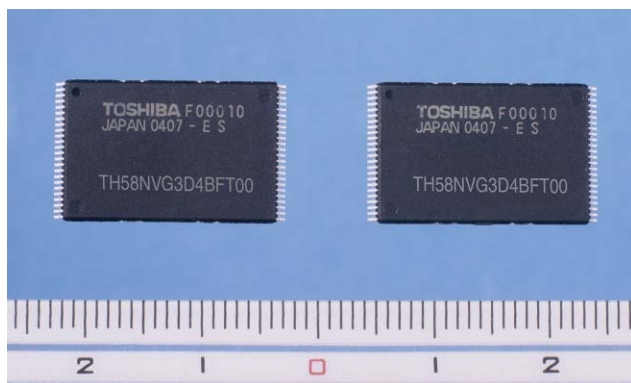
As a back-end processor, two MeP (Media embedded Processor) modules are carried in the object for video signal processing, and audio signal processing. By incorporating a MeP module in the back-end processor, expansion becomes possible simply by rewriting the firmware and compliance with a new algorithm becomes easy. Playback of digital photographs in JPEG format is also available.

As a result, the LSI facilitates a reduction in both the number of parts in a DVD player system and in the board-mounting area required.



Micrograph of TC90600FG chip

## 4 Gbit NAND Flash Memory



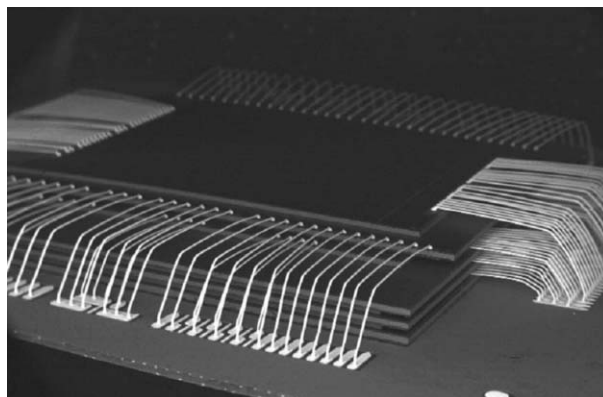
4 Gbit NAND flash memory

NAND flash memory offers high density, non-volatile data retention and is widely employed both in flash memory cards and as embedded memory in digital consumer products.

Toshiba has developed the semiconductor industry's first 4 Gbit single-die, multi-level-cell, NAND flash memory. Fabricated with 90-nanometer process technology, the new chip offers double the capacity of Toshiba's largest previous single-die NAND flash memory, and realizes higher capacity flash memory cards capable of supporting a wide range of applications. The 4 Gbit NAND flash memory enables faster write performance through implementation of advanced design concepts and adjustment of the control system of the memory cell.

Toshiba has also announced an 8 Gbit NAND flash memory IC that stacks two of the 4 Gbit NAND flash memory cells in a single package. The 4 Gbit NAND flash memory was developed by Toshiba and SanDisk Corporation, under their 1999 comprehensive agreement on joint development of NAND flash memory.

## Multi Chip Package Stacking 9 Layers



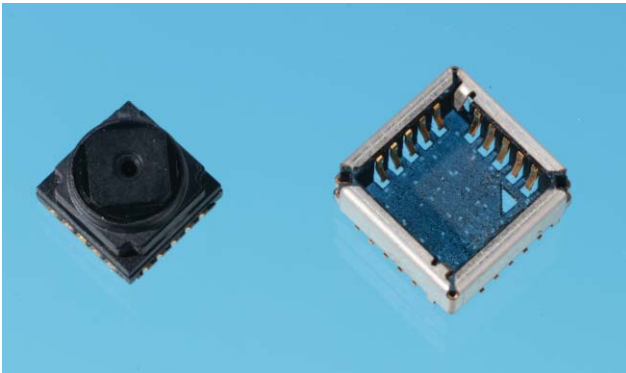
Multi chip package structure photos

In advanced mobile equipment such as cellular phones the demand is for high capacity memory of various types. However, board-mounting area is restricted. Therefore, the need for high capacity MCP (Multi Chip Package) is increasing. In response to these needs, Toshiba has developed a new MCP that stacks a total of nine layers of components.

Toshiba has utilized advanced process and mounting technology to reduce the thickness of each memory chip to 70  $\mu\text{m}$ , then bonded the chips together in one package with wires, and has realized an MCP that allows stacking of nine layers in the 1.4 mm high package. The new MCP can accommodate and combine a full range of memory chips, including SRAM, NAND flash memory and other types, in one small and slim package at 11 mm  $\times$  14 mm  $\times$  1.4 mm.

Also in order to optimize data transfer between CPU and MCP, Toshiba has adapted a "triple-data bus system" that matches the chip type to the right kind of bus. The new MCP will bring higher capacity and, denser memory capabilities to digital mobile equipment.

## VGA Camera Module Features CMOS Image Sensor Inside



VGA camera module TCM8230MD

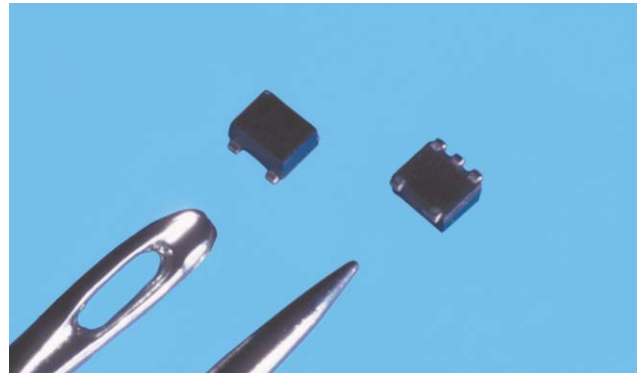
Toshiba has developed a series of small and slim VGA camera modules, the TCM8230MD series, which feature a smaller CMOS (Complementary Metal-Oxide Semiconductor) image sensor inside.

Advances in sensor process technology and design optimization have allowed Toshiba to reduce individual pixels from 5.4  $\mu\text{m}$  to 3.75  $\mu\text{m}$ . The miniaturization allows a total of 330,000 pixels arranged in a 492 by 660 array on a single chip with a 1/6 of an inch optical format. The resulting camera module is slimmer, smaller and consumes less power, but continues to offer 330,000-pixel image quality. The camera module incorporates an optical lens and the CMOS sensor, and is embedded with a DSP (Digital Signal Processor) that supports the VGA format. The module is designed for cellular phones with camera.

The camera module is 6 mm(W) $\times$ 6 mm(D) $\times$ 4.5 mm(H) excluding the socket. Power consumption is 40 mW at 30 frames per second, a two-thirds reduction from Toshiba's existing series. The module can also be separated from the socket for assembly using reflow soldering.

VGA: Video Graphics Array

## World's Smallest Single-Gate CMOS Logic Devices



World's smallest single-gate CMOS logic devices

Toshiba has developed the world's smallest and slimmest single-gate CMOS logic devices.

The devices, supplied in the new super-miniature style package, measure just 1.0 mm $\times$ 1.0 mm $\times$ 0.48 mm. These are initially available for seven basic logic gates in Toshiba's TC7SH $\times$  LMOS (Logic-MOS) series. Adopting design and assembly technology optimization, the devices offer flat leads contained within the 1.0 mm $\times$ 1.0 mm footprint of the device. As a result, the board-mounting area is 76% lower than previous generation USV (Standard SOT-353) packages.

The devices feature high speed, low power consumption, and low switching noise, making them ideally suited for use in portable electronics. The devices can now be arranged, within a 1mm<sup>2</sup> space in a surface mount package as thin as 0.48 mm, for original design or last-minute modifications of smaller circuit boards.

### TC7SHxx series

| Part No.  | Function           |
|-----------|--------------------|
| TC7SH00FS | 2-Input NAND Gate  |
| TC7SH02FS | 2-Input NOR Gate   |
| TC7SH04FS | Inverter           |
| TC7SH08FS | 2-Input AND Gate   |
| TC7SH14FS | Schmitt Inverter   |
| TC7SH32FS | 2-Input OR Gate    |
| TC7SH86FS | 2-Input EX-OR Gate |

## High Thermal Conductive Aluminum Nitride Package



AIN substrate for power transistor



AIN package for high frequency transistor

Aluminum nitride (AlN) ceramics are known for their properties of high thermal conductivity on the one hand, and high electric insulation properties on the other, which makes them an ideal material for semiconductor packages. Conventional package materials have a thermal conductivity of 200 W/m·K, but the development of higher output devices has led to the need for materials with an even higher thermal conductivity. In response to this challenge, Toshiba Materials Co. Ltd. has succeeded in the development of an AlN material with a thermal conductivity of 250 W/m·K, well above that of metallic aluminum. The key factor was the strict control of oxygen and impurity content in the AlN. This went hand in hand with the development of a new metallizing technique for forming circuits on the AlN ceramic to achieve an AlN package with a high thermal conductivity. The new material and technology will be used in applications such as high-powered high frequency transistors and high-powered light emitting diodes.

## Novel Input Display with New Concept Image Capture



The world's first "input display" with color image capture function

Toshiba Matsushita Display Technology Co., Ltd. has developed a brand new concept display that can both capture and display images. This display enables the capture, saving and redisplay of images without scanning, editing, or conversion in any other scanner device.

The prototype displays are 260,000-color transparent type LCDs (Liquid Crystal Displays) with a diagonal size of 3.5 inches (8.9 cm), 320×240 dots (QVGA). With SOG (System-On-Glass) technology based on low-temperature poly-Si TFT (Thin Film Transistor), image capture function has been realized by integrating an optical sensor in every pixel on the glass substrate without degrading the display performance. Furthermore, with the procedure of reading-out of the image and signal processing technology, we have succeeded in reproduction of a high quality color image.

Future refinement of the input display will support image storage with the same feeling as taking a memo or reading a bar code for catalog shopping.

QVGA: Quarter Video Graphics Array