

PRODUCT GUIDE

BCE0012A

90nm (Ldrawn=70nm) CMOS ASIC TC300 Family



**2003 semiconductor**  
<http://www.semicon.toshiba.co.jp/eng>

# SoC Solution for a Wide Range of Ultra-High-Performance and Ultra-Low-Power Applications

## TC300 Family

Featuring unparalleled CMOS performance, the Toshiba TC300 family can satisfy the demanding requirements of complex system-on-chip (SoC) designs. The TC300 family is ideally suited as an SoC platform for broadband infrastructure applications using xDSL, wireless and optical fiber technologies as well as high-performance and high-quality multimedia information systems.

While offering outstanding logic speed, the TC300 family also features ultra-low power consumption. The combination of high performance and low power broadens the capabilities of the TC300, enabling feature-rich mobile products with extended battery life.

The new CMOS4 process technology not only offers unprecedented embedded DRAM capability, but also permits easy mixing of analog and application-specific IP cores on the same chip. Each logic cell is available in three versions that operate at different threshold voltages; the optional multi-threshold process allows selective use of high-speed and low-power cells on and off critical paths.

The TC300 family capitalizes on copper technology, low-k dielectric and the industry's most aggressive 90-nm (70-nm-drawn gate) CMOS process. The process supports up to 11 levels of copper metal interconnect.

With the TC300 family, Toshiba offers a robust, state-of-the-art design environment geared to shorten the development time for large and complex SoC designs.

Toshiba's TC300 family offers an ideal solution for multimedia and high-speed networking applications, or any other application where both speed and low power consumption are important such as PDAs and portable devices.



## Features and Benefits

### Ultra-High Density and Ultra-Low Power

The TC300 family is fabricated using Toshiba's new CMOS4 process.

#### Design Rule

World-class 90-nm (70-nm-drawn gate) CMOS process

#### Copper Interconnect

Up to 11 levels of copper wiring combined with low-k dielectric

Improvements over the TC280 Family ( $L_{\text{drawn}} = 0.11 \mu\text{m}$ )

- ▶ x2 improvement in logic density
- ▶ 50% power savings per gate
- ▶ 20% reduction in gate delay

### Cell Library

#### Primitive Cells

The TC300 family offers synthesis-friendly primitive cells for both high-performance- and low-power-intended chip designs. The multi-threshold process provides the ability to mix and match the cells of both high-speed and low-power libraries.

#### I/O Cells

The TC300 family offers I/O cells in two shapes: standard-height I/O cells for high-pin-count designs and low-height I/O cells for core-limited designs.

#### SRAMs

Performance- and density-optimized SRAMs

## IP Cores

Toshiba supports an ever-growing selection of IP cores compliant with the VSI standard.

MPU	TX System RISC, ARM processors
Protocol Controllers	IEEE1394, USB, IrDA
High-Speed I/O	PCI, AGP, USB, LVDS, Direct RAC, HSTL
Multimedia	NTSC/PAL Video Encoder, JPEG, MPEG
Networking	Ethernet
Analog Functions	ADC, DAC, PLL
Memory	DRAM, SRAM, FIFO, ROM, EEPROM

### DRAM Core Overview

The embedded DRAM cores based on Toshiba's leading trench capacitor technology provide many features, such as high memory bandwidth with a bus width selectable from 64, 128 and 256 bits, low power dissipation due to lower-capacitance connections and low switching noise on the data bus between memory and logic. The high-bandwidth SD-DRAM cores are upward compatible with those of the previous ASIC families. The fast-access FA-DRAM cores are being developed.

#### SD-DRAM with High Bandwidth

(Compliant with the synchronous DRAM standard)

Max. Clock Rate	300 MHz
Max. Data Rate	9.6 GB/s
I/O Bit Width	256 bits
Size	4 to 32 Mbits per macro

#### FA-DRAM with Fast Random Access Times

(High-density design for SRAM replacement)

Random Access Time	6 - 8 ns
I/O Bit Width	288 bits
Size	4 to 9 Mbits per macro

## Design Methodology for SoC Designs

Production-proven tools and methodology ensure predictable results for SoC ASICs and reduce design time and iterations.

### Hierarchical Design

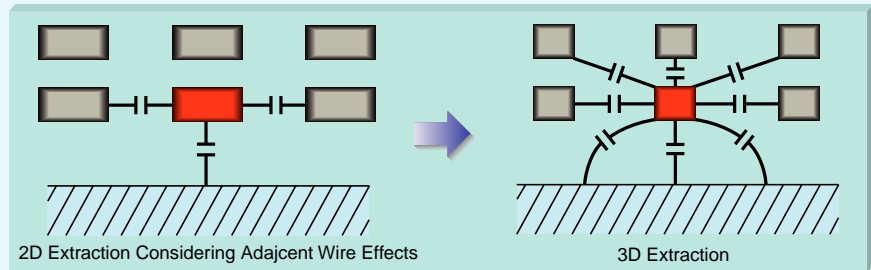
Toshiba provides support for hierarchical design approaches combined with a timing-driven design flow. This allows a design team to create sub-blocks in parallel and resolve timing problems at the block level.

### Predictable Timing Closure

The advanced synthesis technique utilizes physical information to generate accurate wire models during RTL synthesis. This ensures a close correlation between pre-layout and post-layout delays. Accurate delay information is leveraged throughout the design flow, including design optimization (gate sizing), timing-driven routing and repeater insertion. The outcome is the ability to quickly achieve timing closure.

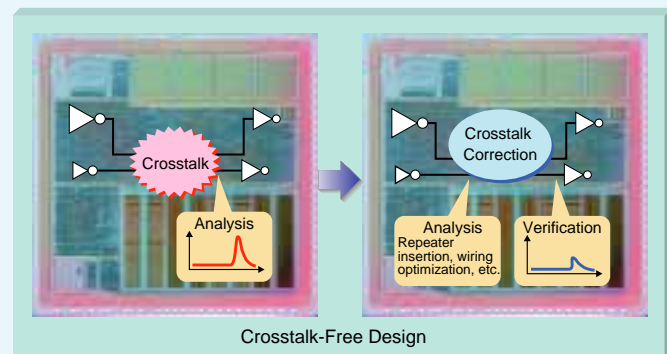
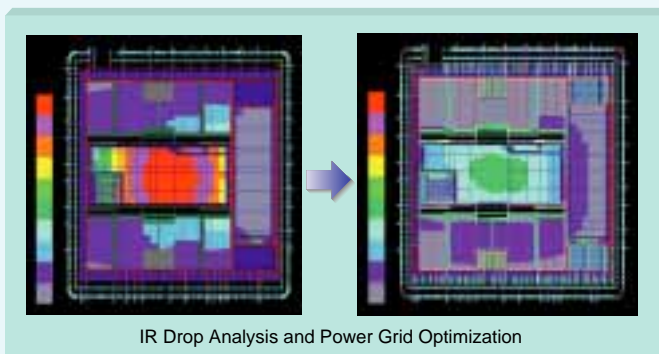
### 3D Capacitance Extraction

In today's deep-submicron ASICs, delays caused by interconnect are becoming increasingly dominant over gate delays. To accurately calculate deep-submicron delays, new techniques must be used. Toshiba employs 3D capacitance extraction to improve the accuracy of timing estimates for multi-layer metal processes.



### Signal Integrity Analysis and Repair

To ensure signal integrity, Toshiba optimizes power grid routing, based on IR drop estimation, early in the design cycle. Additionally, electromigration, antenna effects, hot-carrier injection (HCI) and negative bias temperature instability (NBTI) are all considered. The TC300 design flow also embraces crosstalk analysis and elimination.



## Packaging

Toshiba offers a complete range of packaging options, satisfying the requirements of advanced systems-on-chip (SoCs). For designs requiring high pin counts (600 to over 2000), Toshiba's flip-chip BGA packaging (PBGA[FC]) offers the highest I/O density and electrical performance available today. PFBGAs with 109 to 265 pins have a package body size no larger than 15 x 15 mm and are optimal for applications requiring minimal form factor. TBGAs and PBGAs with 256 to 868 pins are cost-effective solutions for mid-range I/O pin count requirements. In addition, Toshiba offers multi-layer PBGA[4L] packaging with excellent electrical performance for the 256 to 868 pin range.

Toshiba provides the electrical models for its packages to help you select an optimal one that satisfies your design specification.

## General Product Specifications

Design Rule	90 nm (70-nm-drawn gate), CMOS process, 11-layer Cu
Power Supply	Core = 1.2 V; analog = 2.5 V; I/O: 2.5 / 3.3 V (1.8-V option)
Gate Delay (F/O=1, CIVX4 Gate)	14 ps (Low-Power Library), 11 ps (High-Speed Library), 9.5 ps (Very-High-Speed Library) * Three types of transistors are available with different threshold voltages.
Gate Density	403 k gates/mm <sup>2</sup> or more
Power Dissipation	7 nW/MHz/gate (CIVX1 gate)

OVERSEAS SUBSIDIARIES AND AFFILIATES

**Toshiba America Electronic Components, Inc.**

**Headquarters-Irvine, CA**  
9775 Toledo Way, Irvine, CA 92618, U.S.A.  
Tel: (949)455-2000 Fax: (949)859-3963

**Boulder, CO (Denver)**  
3100 Arapahoe #500,  
Boulder, CO 80303, U.S.A.  
Tel: (303)442-3801 Fax: (303)442-7216

**Wellington**  
PBM 337, #22, 11924 Forest Hill Blvd.,  
Wellington, FL 33414, U.S.A.  
Tel: (561)733-4949 Fax: (561)753-1489

**Deerfield, IL (Chicago)**  
One Pkwy., North, #500, Deerfield,  
IL 60015-2547, U.S.A.  
Tel: (847)945-1500 Fax: (847)945-1044

**Duluth, GA (Atlanta)**  
3700 Crestwood Pkwy, #160,  
Duluth, GA 30096, U.S.A.  
Tel: (770)931-3363 Fax: (770)931-7602

**Edison, NJ**  
2035 Lincoln Hwy, #3000, Edison,  
NJ 08817, U.S.A.  
Tel: (732)248-8070 Fax: (732)248-8030

**Beaverton/Portland, OR**  
1700 NW 167th Place, #240,  
Beaverton, OR 97006, U.S.A.  
Tel: (503)629-0818 Fax: (503)629-0827

**Raleigh, NC**  
3120 Highwoods Blvd., #108, Raleigh,  
NC 27604, U.S.A.  
Tel: (919)859-2800 Fax: (919)859-2898

**Richardson, TX (Dallas)**  
777 East Campbell Rd., #650, Richardson,  
TX 75081, U.S.A.  
Tel: (972)480-0470 Fax: (972)235-4114

**San Jose Engineering Center, CA**  
1060 Rincon Circle, San Jose, CA 95131, U.S.A.  
Tel: (408)526-2400 Fax: (408)526-8910

**Wakefield, MA (Boston)**  
401 Edgewater Place, #360, Wakefield,  
MA 01880-6229, U.S.A.  
Tel: (781)224-0074 Fax: (781)224-1095

**Toshiba do Brasil, S.A.**

**Electronics Component Div.**  
Estrada dos Alvarengas 5500,  
São Bernardo do Campo, S.P. 09850-550, Brasil  
Tel: (011)4358-7144 Fax: (011)4358-7179

**Toshiba India Private Ltd.**  
6F DR. Gopal Das Bhawan 28, Barakhamba Road,  
New Delhi, India  
Tel: (011)331-8422 Fax: (011)371-4603

**Toshiba Electronics Europe GmbH**

**Düsseldorf Head Office**  
Hansaallee 181, D-40549 Düsseldorf,  
Germany  
Tel: (0211)5296-0 Fax: (0211)5296-400

**München Office**  
Büro München Hofmannstrasse 52,  
D-81379, München, Germany  
Tel: (089)748595-0 Fax: (089)748595-42

**Toshiba Electronics France S.A.R.L.**  
Immeuble Robert Schuman 3 Rue de Rome  
F-93561, Rosny-Sous-Bois, Cédex, France  
Tel: (1)48-12-48-12 Fax: (1)48-94-51-15

**Toshiba Electronics Italiana S.R.L.**  
Centro Direzionale Colleoni,  
Palazzo Perseo 3,  
I-20041 Agrate Brianza, (Milan), Italy  
Tel: (039)68701 Fax: (039)6870205

**Toshiba Electronics España, S.A.**  
Parque Empresarial, San Fernando, Edificio Europa,  
1ª Planta, E-28831 Madrid, Spain  
Tel: (91)660-6798 Fax: (91)660-6799

**Toshiba Electronics (UK) Ltd.**  
Riverside Way, Camberley Surrey,  
GU15 3YA, U.K.  
Tel: (01276)69-4600 Fax: (01276)69-4800

**Toshiba Electronics Scandinavia A.B.**  
Gustavslundsvägen 18, 5th Floor,  
S-167 15 Bromma, Sweden  
Tel: (08)704-0900 Fax: (08)80-8459

**Toshiba Electronics Asia (Singapore) Pte. Ltd.**

**Singapore Head Office**  
438B Alexandra Road, #06-08/12 Alexandra  
Technopark, Singapore 119968  
Tel: (6278)5252 Fax: (6271)5155

**Toshiba Electronics Service (Thailand) Co., Ltd.**  
135 Moo 5, Bangkadi Industrial Park, Tivanon Road,  
Pathumthani, 12000, Thailand  
Tel: (02)501-1635 Fax: (02)501-1638

**Toshiba Electronics Trading (Malaysia) Sdn. Bhd.**

**Kuala Lumpur Head Office**  
Suite W1203, Wisma Consplant, No.2,  
Jalan SS 16/4, Subang Jaya, 47500 Petaling Jaya,  
Selangor Darul Ehsan, Malaysia  
Tel: (03)5631-6311 Fax: (03)5631-6311

**Penang Office**  
Suite 13-1, 13th Floor, Menara Penang Garden,  
42-A, Jalan Sultan Ahmad Shah,  
10050 Penang, Malaysia  
Tel: (04)226-8523 Fax: (04)226-8515

**Toshiba Electronics Philippines, Inc.**  
26th Floor, Citibank Tower, Valero Street, Makati,  
Manila, Philippines  
Tel: (02)750-5510 Fax: (02)750-5511

**Toshiba Electronics Asia, Ltd.**

**Hong Kong Head Office**  
Level 11, Tower 2, Grand Century  
Place, No.193, Prince Edward Road West,  
Mongkok, Kowloon, Hong Kong  
Tel: 2375-6111 Fax: 2375-0969

**Beijing Office**  
Room 714, Beijing Fortune Building,  
No.5 Dong San Huan Bei-Lu, Chao Yang District,  
Beijing, 100004, China  
Tel: (010)6590-8796 Fax: (010)6590-8791

**Chengdu Office**  
Suite 403A, Holiday Inn Crown Plaza 31, Zongfu Street,  
Chengdu, 610016, Sichuan, China  
Tel: (028)8675-1773 Fax: (028)8675-1065

**Shenzhen Office**  
Room 3010-3013, Office Tower Shun Hing Square,  
Di Wang Commercial Centre, 5002 ShenNan  
East Road, Shenzhen, 518008, China  
Tel: (0755)246-3218 Fax: (0755)246-1581

**Qingdao Office**  
Room B707, Full Hope Plaza,  
12 Hong Kong Central Road, Qingdao,  
Shandong, 266071, China  
Tel: (0532)502-8105 Fax: (0532)502-8109

**Toshiba Electronics Korea Corporation**

**Seoul Head Office**  
14F, KEC Building, 275-7 Yangjae-dong,  
Seocho-ku, Seoul, 137-739, Korea  
Tel: (02)589-4300 Fax: (02)589-4302

**Gumi Office**  
6F, Goodmorning Securities Building,  
56 Songjung-dong, Gumi-shi,  
Kyeongbuk, 730-090, Korea  
Tel: (054)456-7613 Fax: (054)456-7617

**Toshiba Electronics (Shanghai) Co., Ltd.**

23F, HSBC Tower, 101  
Yin Cheng East Road, Pudong New Area, Shanghai,  
200120, China  
Tel: (021)6841-0666 Fax: (021)6841-5002

**Tsurong Xiamen Xiangyu Trading Co., Ltd.**

8N, Xiamen SEZ Bonded Goods Market Building,  
Xiamen, Fujian, 361006, China  
Tel: (0592)562-3798 Fax: (0592)562-3799

**Toshiba Electronics Taiwan Corporation**

**Taipei Head Office**  
17F, Union Enterprise Plaza Building, 109  
Min Sheng East Road, Section 3, Taipei,  
105, Taiwan  
Tel: (02)2514-9988 Fax: (02)2514-7892

**Kaohsiung Office**  
16F-A, Chung-Cheng Building, 2, Chung-Cheng 3Road,  
Kaohsiung, 800, Taiwan  
Tel: (07)237-0826 Fax: (07)236-0046

(As of November 20, 2002)

The information contained herein is subject to change without notice. 021023\_D

TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.

In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc. 021023\_A

The Toshiba products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These Toshiba products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury. ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc. Unintended Usage of Toshiba products listed in this document shall be made at the customer's own risk. 021023\_B

Toshiba does not take any responsibility for incidental damage (including loss of business profit, business interruption, loss of business information, and other pecuniary damage) arising out of the use or disability to use the product. 021023\_K

The products described in this document may include products subject to the foreign exchange and foreign trade laws. 021023\_F

The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others. 021023\_C

90nm ( Ldrawn=70nm ) CMOS ASIC TC300 Family

**TOSHIBA**

**TOSHIBA CORPORATION**  
Semiconductor Company

Website: <http://www.semicon.toshiba.co.jp/eng>