

ASAHI KASEI MICROSYSTEMS (AKM)

Asahi Kasei Microsystems Co., Ltd.
 TS Building
 24-10, Yoyogi 1-chome
 Shibuya-ku, Tokyo 151
 Japan
 Telephone: (81) (3) 3320-2060
 Fax: (81) (3) 3320-2074

IC Manufacturer

Regional Headquarters/Representative Locations

North America: AKM Semiconductor, Inc. • San Jose, California
 Telephone: (408) 436-8580 • Fax: (408) 436-7591

Financial History (\$M)

	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Sales	120	185	220	210
Employees				800

Company Overview and Strategy

Asahi Kasei Microsystems Co., Ltd. (AKM) was founded in 1983 as a joint venture between Asahi Chemical Industry Co., Ltd. and American Microsystems Inc. The venture became a wholly owned subsidiary of Asahi Chemical in 1986, though AKM and AMI still maintain a business relationship.

AKM designs and manufactures CMOS mixed-signal integrated circuits combining analog and digital functions on a single chip or chipset. Its devices are targeted at telecommunications, data acquisition, mass storage, audio, and multimedia applications. Approximately half of its IC sales are custom designed products.

Management

Asahi Kasei Microsystems Co., Ltd.

Hirotsugu Miyauchi President
 Kyoji Kurata Director and GM, Technical Marketing and Application Engineering

AKM Semiconductor, Inc. (U.S.)

Yoshihisa Iwasaki President
 Edward Boule Vice President, Sales
 Koji Goto Vice President, Marketing

Products and Processes

AKM specializes in custom and semicustom mixed-signal ASICs and ASSPs. When Asahi Kasei Microsystems was formed, AMI provided the mixed-signal design skills needed. In 1991, Hitachi transferred 0.8 μ m CMOS process technology to AKM.

AKM's product line includes:

Communication Products

- Analog cordless telephone ICs
- Digital cordless telephone ICs
- Two-way radio products
- Analog cellular telephone ICs
- Digital cellular telephone ICs
- Line telecommunication products
- Image processing ICs

Digital-to-Analog Converters

- Digital Audio DACs
- DACs with embedded EEPROM

CMOS Memories

- EEPROMs with densities ranging from 1K to 32K

Full-Custom IC Products

Semiconductor Fabrication Facilities

AKM opened its first wafer fab facility in 1987 in Atsugi, Japan. It was followed by an LSI research and development center in 1991. The company's Nobeoka submicron fab facility commenced operations in 1993.

Asahi Kasei Microsystems Co.
Nobeoka LSI Plant
Nobeoka-shi, Miyazaki Prefecture, Japan
Capacity (wafers/week): 2,000
Wafer size: 150mm
Process: CMOS
Products: ASICs, ASSPs, and custom ICs
Feature sizes: $\geq 0.8\mu\text{m}$

Asahi Kasei Microsystems Co.
Atsugi LSI Plant
Atsugi-shi, Kanagawa Prefecture, Japan
Capacity (wafers/week): 1,000
Wafer size: 125mm
Process: CMOS
Products: EEPROMs, ASICs
Feature sizes: $\geq 1.0\mu\text{m}$

Key Agreements

- In January 1996, AKM signed a six-year fab agreement with Peregrine Semiconductor Corporation (San Diego, California). AKM is fabricating wafers for Peregrine in exchange for process technologies. The two companies are also negotiating a joint development agreement for future products and technologies.
- AKM is licensed to use Advanced RISC Machines' ARM processor technology. AKM will embed the compact ARM7D 32-bit RISC processor design into its products.

DENSO

Denso Corporation
1-1, Showa-cho, Kariya
Aichi Prefecture 448, Japan
Telephone: (81) (566) 25-5858
Fax: (81) (566) 25-4537
Web Site: www.denso.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Denso International America, Inc. • Southfield, Michigan
 Telephone: (810) 350-7500 • Fax: (810) 350-7772

Europe: Denso International Europe B.V. • Weesp, The Netherlands
 Telephone: (31) (2944) 61361 • Fax: (31) (2944) 80970

Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥1,524	¥1,428	¥1,412	¥1,370	¥1,423
Net Income	¥42	¥27	¥37	¥38	¥50

Company Overview and Strategy

Denso Corporation (name changed from Nippondenso Co. in 1996), which has an association with Toyota Motor Corporation, has grown to become one of the world's leading manufacturers of automotive components and systems. Its automotive components business is supplemented by a growing line of diversified products, including factory automation systems, portable telephones, and hand-held bar-code readers.

Denso established its IC Research Center in 1968. Today, the company manufactures a variety of ICs for automotive applications, including fuel injection, braking control, and navigation systems. Approximately 70 percent of the ICs used by Denso are developed and manufactured internally. The value of the company's IC production is approximately \$150 million.

Management

Tsuneo Ishimaru	Chairman
Hiromu Okabe	President and Chief Executive Officer
Kazuhiro Ohta	Executive Vice President
Chosei Ujiiie	Executive Vice President

Products and Processes

Denso manufactures CMOS and bipolar ICs and sensors for automobile electronic equipment. Its IC product line consists of microcontrollers, gate arrays, logic chips, and full custom devices.

Semiconductor Fabrication Facilities

Denso Corporation Kariya Plant 1-1, Showa-cho, Kariya Aichi 448, Japan Telephone: (81) (566) 25-5511 Capacity (wafers/week): 5,500 Wafer sizes: 100mm, 125mm Processes: Bipolar, CMOS Products: MCUs, logic and custom ICs, discretetes Feature sizes: 1.5 μ m-3.0 μ m	Denso Corporation Kota Plant 5, Maruyama, Ashinoya, Kota-cho Nukata-gun, Aichi 444-01, Japan Telephone: (81) (564) 56-7711 Capacity (wafers/week): 2,500 Wafer size: 150mm Process: CMOS Products: MCUs, custom ICs Feature size: 0.85 μ m
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FUJI ELECTRIC

Fuji Electric Co., Ltd.
 Electronics Group, IC Division
 Shinjuku Koyama Building
 30-3, Yoyogi 4-chome
 Shibuya-ku, Tokyo 151, Japan
 Telephone: (81) (3) 5388-7621
 Web Site: www.fujielectric.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Fuji Electric Corp. of America • Saddle Brook, New Jersey
 Telephone: (20) 712-0555 • Fax: (201) 368-8258

Europe: Fuji Electric GmbH • Frankfurt am Main, Germany
 Telephone: (49) (69) 6690290 • Fax: (49) (69) 6661020

Asia-Pacific: Fuji Electric (Asia) Co., Ltd. • Hong Kong
 Telephone: (852) 2311-8282 • (852) 2312-0566

Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥909	¥900	¥834	¥856	¥890
Net Income	¥17	¥8	¥4	¥4	¥6
Semiconductor (\$M)*					
Sales	\$525	\$550	\$575	\$625	\$555
Discrete Sales	\$370	\$390	\$410	\$450	\$405
IC Sales	\$155	\$160	\$165	\$175	\$150
Capital Expenditures		\$30	\$50	\$65	\$85

*Calendar Year

Company Overview and Strategy

Fuji Electric Co., Ltd., founded in 1923, develops, manufactures, and markets a wide range of power and electronics equipment and components, including control systems, clean energy systems, information equipment, and consumer-related products. Although Fuji Electric does produce IC products, it is primarily known as a manufacturer of discrete power semiconductors. It is one of the world's largest producers of power transistor modules and other power discretes.

Fuji Electric's ASIC and ASSP devices are dedicated to certain Japanese manufacturers of products like cameras, VCRs, cellular telephones, and printers. The company is expanding its line-up of switching power supply controller ICs, which are used in a wide array of products such as personal computers, printers, and cellular telephones. Recent developments include products that employ advanced power semiconductor technology and IC technology, such as IGBT modules and intelligent power modules (IPMs) used in inverter and power supply units.

Management

Yoshihiko Nakazato President

Products and Processes

Fuji Electric manufactures power transistors, MOSFETs, IGBTs, high-voltage silicon diodes, high-speed silicon diodes, thyristors, ASICs and ASSPs, microcontrollers, DC-to-DC and AC-to-DC converters, power supply ICs, and custom ICs. Some of its custom IC products include auto-focusing chips for cameras and high-voltage driver ICs for flat-panel displays and thermal printheads.

For the manufacture of its custom and standard ICs, Fuji Electric utilizes high-voltage CMOS, DMOS, bipolar, and BiCMOS technologies. Hybrid ICs are also offered.

New products under development include IC-based micromachine devices such as actuators.

Semiconductor Fabrication Facilities

Fuji Electric postponed plans to install a 0.5 μ m power semiconductor processing line at its Matsumoto fab. Construction of the line was originally scheduled to start in 1996.

Fuji Electric Co., Ltd., Electronics Group
Matsumoto Factory
Matsumoto-shi, Nagano Prefecture, Japan
Capacity (wafers/week): 10,000
Wafer size: 150mm
Processes: CMOS, DMOS, BiCMOS, bipolar
Products: ASICs, ASSPs, power ICs, MCUs, linear ICs, custom ICs, discretes
Feature sizes: 0.8 μ m-2.0 μ m

FUJITSU

Fujitsu Limited
Electronic Devices Group
1015, Kamikodanaka
Nakahara-ku, Kawasaki 211, Japan
Telephone: (81) (44) 754-3753
Fax: (81) (44) 754-3332
Web Site: www.fujitsu.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

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 Telephone: (408) 922-9000 • Fax: (408) 432-9044 • Web Site: www.fmi.fujitsu.com

Europe: Fujitsu Mikroelektronik GmbH • Dreieich-Buchsschlag, Germany
 Telephone: (49) (6103) 690-0 • Fax: (49) (6103) 690-122

Asia-Pacific: Fujitsu Microelectronics Asia Pte. Ltd. • Singapore
 Telephone: (65) 336-1600 • Fax: (65) 336-1609

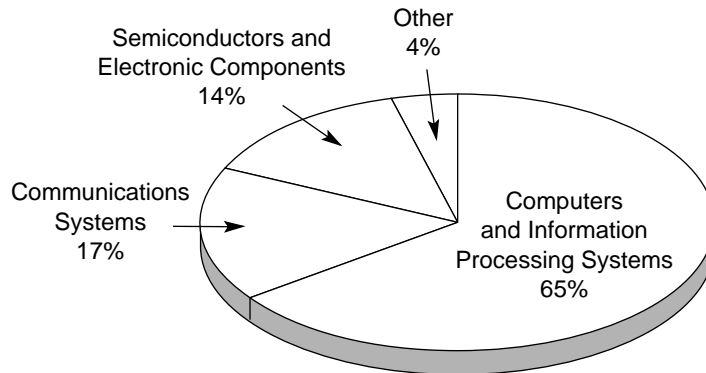
Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥3,442	¥3,462	¥3,139	¥3,258	¥3,762
Net Income	¥12	¥(33)	¥(38)	¥45	¥63
Semiconductor (\$M)*					
Sales	\$2,550	\$2,930	\$3,335	\$4,440	\$3,200
IC Sales	\$2,320	\$2,630	\$2,975	\$4,010	\$2,880
Discrete Sales	\$230	\$300	\$360	\$430	\$320
Capital Expenditures	\$445	\$590	\$905	\$1,505	\$1,435

*Calendar Year

Company Overview and Strategy

Fujitsu Limited was founded in 1935 as a telecommunications equipment manufacturer. Today, it is not only one of Japan's leading telecommunications companies, but also one of the world's largest manufacturers of computers, semiconductors, and electronic components. The company's Electronic Devices Group is responsible for the manufacture and marketing of integrated circuits, discrettes, hybrids, electromechanical devices, and plasma and liquid crystal displays.



1996 Corporate Sales by Business Group

Fujitsu's first semiconductor group was formed in the 1950's. In 1966, the company began volume production of integrated circuits. Today Fujitsu develops, manufactures, and markets a wide selection of semiconductors and other electronic components. Its semiconductor activities span a variety of advanced product and process technologies including high-performance ASICs, memory devices, microprocessors and microcontrollers, telecommunications and networking ICs, graphics chips, advanced Ethernet LAN devices, multichip module products, and flat-panel displays.

Management

Fujitsu Limited

Tadashi Sekizawa	President
Ken Katashiba	Special Assistant
Mikio Ohtsuki	Executive Vice President
Kimio Yanagida	President, Fujitsu AMD Semiconductor Ltd.

Fujitsu Microelectronics, Inc. (U.S.)

Yuji Ezura	President and Chief Executive Officer
Hikotaro Masunaga	General Manager, Semiconductor Division
John Herzing	Vice President, Sales
Tom Miller	Vice President, Marketing

Products and Processes

MOS MEMORY

<input checked="" type="checkbox"/>	DRAM
<input type="checkbox"/>	SRAM
<input checked="" type="checkbox"/>	Flash Memory
<input type="checkbox"/>	EPROM
<input type="checkbox"/>	ROM
<input checked="" type="checkbox"/>	EEPROM
<input type="checkbox"/>	Other (Including Non-Volatile RAM)

ANALOG

<input checked="" type="checkbox"/>	Amplifier
<input checked="" type="checkbox"/>	Interface
<input checked="" type="checkbox"/>	Consumer/Automotive
<input checked="" type="checkbox"/>	Voltage Regulator/Reference
<input checked="" type="checkbox"/>	Data Conversion
<input checked="" type="checkbox"/>	Comparator
<input checked="" type="checkbox"/>	Other (Includes Telecom)

MOS LOGIC

<input checked="" type="checkbox"/>	General Purpose Logic
<input checked="" type="checkbox"/>	Gate Array
<input checked="" type="checkbox"/>	Standard Cell
<input type="checkbox"/>	Field Programmable Logic
<input checked="" type="checkbox"/>	Other Special Purpose Logic

DIGITAL BIPOLAR

<input checked="" type="checkbox"/>	Bipolar Memory
<input checked="" type="checkbox"/>	General Purpose Logic
<input checked="" type="checkbox"/>	Gate Array/Standard Cell
<input type="checkbox"/>	Field Programmable Logic
<input type="checkbox"/>	Other Special Purpose Logic
<input type="checkbox"/>	MPU/MCU/MPR

MOS MICROCOMPONENT

<input checked="" type="checkbox"/>	MPU
<input checked="" type="checkbox"/>	MCU
<input checked="" type="checkbox"/>	MPR
<input checked="" type="checkbox"/>	DSP

OTHER

<input type="checkbox"/>	Full Custom IC
<input checked="" type="checkbox"/>	Discrete
<input checked="" type="checkbox"/>	Optoelectronic

ASICs

Fujitsu is among the world's leading producers of application-specific ICs (ASICs). The company's ASIC product line ranges from commodity gate arrays to sophisticated embedded arrays. In the gate array market, it was the world's second leading supplier in 1996, just behind NEC. Its gate array family consists of over 100 device types, including channelless "sea-of-gate" arrays and embedded gate arrays, with complexities ranging from 2,000 to 2,000,000 gates and over 1,000 I/O pins.

Fujitsu's ASICs family also includes standard cell products with up to 60,000 gates and functions not available in gate arrays, as well as very high speed ECL devices capable of operating at 100MHz to 3GHz.

In 1996, Fujitsu introduced its 0.35µm CMOS microembedded cell-based array ASIC series for use in the computer, networking, and multimedia markets. The series, dubbed the CE61, features two million raw gates, clock speeds of 200MHz, and I/O interfaces of 3.3V or 5V. The parts are available in a two-layer or three-layer metal process.

All of Fujitsu's ASIC devices are manufactured using CMOS, ECL, BiCMOS, or GaAs process technologies, with geometries ranging from 0.35µm to 2.0µm.

Microcomponents

Fujitsu's microcomponent family of products include general purpose 4-bit and 8-bit microcontrollers, 16-bit microprocessors, SPARC 32-bit RISC microprocessors (including the new 170MHz TurboSPARC™ MPUs), 32-bit RISC embedded controllers (SPARClite™ MPUs), and specialized ICs for peripheral control. Recently, the company has been increasing the emphasis on its SPARC processor business. New SPARC processors under development include a 2.5V 133MHz part, a 1.1V part for portable battery-operated equipment, and a 200MHz 300 MIPS version using a superscalar architecture.

Memories

Fujitsu's memory ICs include dynamic RAMs (4M and 16M), synchronous DRAMs (16M and 64M), 8M synchronous graphics RAMs (SGRAMs), flash memory devices (1M, 4M, and 16M), EEPROMs (up to 256K), and more. Application-specific memories, with an emphasis on graphic and cache applications, include video RAMs, tag memories, and STRAMs (self-timed RAMs). In 3Q96, Fujitsu announced its plans to discontinue production of SRAMs, EPROMs, and mask ROMs, markets the company was not a major force in. Fujitsu will continue to develop SRAM technology, which will be applied to on-board cache for microprocessors and to core-based ASICs.

Starting at the 64M density, the company will sell SDRAMs exclusively. Fujitsu has said it has developed a 256M SDRAM that it will start sample shipping in 1998. The device will be produced using a 0.24μm CMOS process.

Fujitsu's non-volatile memory efforts have been shifted to developing and producing flash memories with its partner AMD. In cooperation with AMD, Fujitsu offers single-voltage (5V, 3V, and 2.2V) NOR flash devices in 2M to 16M densities. However, the company is not ignoring the non-NOR type of flash memory. It is working separate from, and together with, AMD on flash products based on other architectures. In fact, the company plans to enter the NAND-type flash memory market in 1998 with a part jointly developed with AMD.

ASSPs/Analog ICs

Fujitsu's application-specific standard products (ASSPs) include ICs for a variety of applications including telecommunications, local-area networks (LANs), magnetic disks, audio, power supply control, and image/graphics processing. Fujitsu also supplies general purpose analog ICs such as op-amps, comparators, converters, and analog switches.

Standard Logic

Fujitsu's standard ICs include TTL, LSTTL, ALSTTL, FAST, ECL, and CMOS families. These ICs range from simple gates to complex arithmetic logic circuits.

Compound Semiconductors

Fujitsu is the world's largest producer of GaAs semiconductors. The company's compound semiconductor products include GaAs FETs, HEMTs, and MMICs for portable phones and satellite communication/broadcast applications; laser diodes and light receiving diodes for optical communications; and gate array ICs for high-speed computing/communications.

Discrete Devices

Fujitsu's discrete product line includes the GaAs products discussed above, as well as high-speed switching power transistors (RETs) and darlington transistor arrays.

Semiconductor Fabrication Facilities

In early 1997, Fujitsu announced that it had abandoned its plans to construct a second-phase memory production facility at its Durham plant in the U.K., citing the plunge in DRAM prices in 1996. Plans called for the facility to produce DRAMs using 0.35 μ m-0.25 μ m process technologies and 200mm wafers. Construction of Fujitsu's new memory fab being put up in Gresham, Oregon, was delayed for several months. Operations are scheduled to start in the second half of 1997 instead of early 1997 as originally planned. The delay will allow Fujitsu to launch production of 64M SDRAMs initially instead of 16M DRAMs.

On the flash memory front, Fujitsu AMD Semiconductor Ltd. (FASL) is building its second flash memory production facility in Aizuwakamatsu. The new FASL-2 facility will cost approximately \$1.2 billion (split 50-50 between the two firms) and will eventually produce at least 6,000 200mm wafers per week when fully ramped. Initial shipments should begin before the end of 1997.

In Japan, Fujitsu is constructing a \$1 billion fab for the production of advanced logic ICs with 0.25 μ m and 0.35 μ m geometries. Operations at the 200mm fab are scheduled to begin in the second half of 1998.

Fujitsu Limited, Iwate Plant
Kanegasaki-shi, Iwate Prefecture, Japan
Capacity (wafers/week): 13,500
Wafer sizes: 150mm, 200mm
Processes: CMOS, MOS
Products: DRAMs, ASICs, MCUs
Feature sizes: 0.35 μ m-1.0 μ m

Fujitsu Limited, Aizuwakamatsu Plant
Aizuwakamatsu-shi, Fukushima Prefecture, Japan
Capacity wafers/week: 37,000
Wafer sizes: 125mm, 150mm, 200mm
Processes: CMOS, MOS, bipolar
Products: DRAMs, MPUs, MCUs, ASICs,
logic and analog ICs, discretes
Feature sizes: 0.35 μ m-2.0 μ m

Fujitsu Limited, Mie Plant
Tado-shi, Mie Prefecture, Japan
Capacity (wafers/week): 5,000
Wafer size: 150mm
Processes: CMOS, MOS, bipolar
Products: DRAMs, MPUs, MCUs, ASICs
Feature sizes: 0.35 μ m-1.0 μ m

Fujitsu Quantum Devices Ltd.
Nakakoma-gun, Yamanashi Prefecture, Japan
Capacity (wafers/week): 1,250
Wafer sizes: 3in, 100mm
Process: GaAs
Products: Analog and logic ICs, discretes, opto
Feature sizes: 0.5 μ m-0.8 μ m

Fujitsu VLSI Ltd., Gifu Plant
Minokamo-shi, Gifu Prefecture, Japan
Capacity (wafers/week): 1,250
Wafer size: 150mm
Process: CMOS
Products: Prototype ICs

Kyushu Fujitsu Electronics, Ltd., Miyazaki Plant
Miyazaki-shi, Miyazaki Prefecture, Japan
Capacity (wafers/week): 1,250
Wafer size: 200mm
Process: CMOS
Products: DRAMs
Feature size: 0.5 μ m

Fujitsu Limited, Kanagawa Plant
 Kawasaki-shi, Kanagawa Prefecture, Japan
 Capacity (wafers/week): 250
 Wafer size: 125mm
 Process: CMOS
 Products: R&D

Fujitsu Limited
 Akigawa-shi, Tokyo Prefecture, Japan
 Capacity (wafers/week): 750
 Wafer size: 200mm
 Process: CMOS
 Products: Memory and ASIC R&D

Fujitsu Microelectronics, Inc.
 Gresham Manufacturing Division
 21015 Southeast Stark Street
 Gresham, Oregon 97030-2099
 Telephone: (503) 669-6000
 Fax: (503) 669-6109
 Capacity (wafers/week): 7,500
 Wafer size: 150mm (200mm in 1997)
 Process: CMOS
 Products: DRAMs, ASICs
 Feature sizes: 0.5 μ m, 0.8 μ m (0.35 μ m in 1997)

Fujitsu Microelectronics, Ltd., Durham Plant
 Newton Aycliffe
 Durham, England
 Capacity (wafers/week): 2,000
 Wafer size: 150mm
 Process: CMOS
 Products: DRAMs, ASICs
 Feature sizes: 0.35 μ m-0.8 μ m

Fujitsu-AMD Semiconductor Ltd. (FASL)
 Aizuwakamatsu-shi, Fukushima Prefecture, Japan
 FASL1
 Cleanroom size: 69,960 square feet (Class 1)
 Capacity (wafers/week): 5,000
 Wafer size: 200mm
 Process: CMOS
 Products: Flash memories
 Feature sizes: 0.35 μ m, 0.5 μ m
 (upgrading 0.5 μ m lines to 0.35 μ m)

Fujitsu AMD Semiconductor Ltd. (FASL)
 Aizuwakamatsu, Fukushima Prefecture, Japan
 FASL II
 Cleanroom size: 88,000 square feet
 Capacity (wafers/week): 6,000
 Wafer size: 200mm
 Process: CMOS
 Products: Flash memories
 Feature sizes: 0.25 μ m, 0.35 μ m
 (Expected to start production in early 1998.)

Key Agreements

- Fujitsu and Hyundai have a long-term partnership involving technology licensing, codevelopment, and joint manufacturing of DRAM products. Most recently, the two companies agreed to cooperate in the development of next-generation 64M SDRAMs.
- Fujitsu and AMD opened a large flash memory fabrication facility, called Fujitsu-AMD Semiconductor Ltd. (FASL), in Japan in September 1994. Production of flash memory chips began in 1Q95. FASL is currently building its second fab, also to be dedicated to flash memory production. The partnership also involves joint development of flash devices.

HITACHI

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IC Manufacturer

Regional Headquarters/Representative Locations

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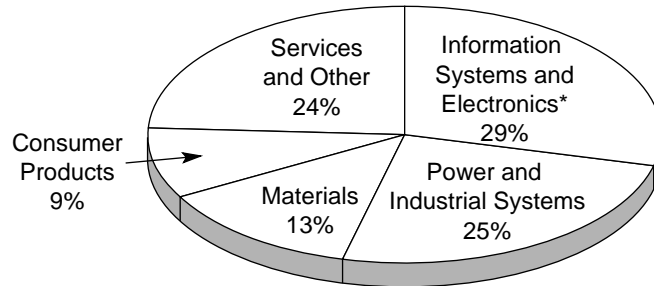
Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥7,766	¥7,536	¥7,400	¥7,592	¥8,124
Net Income	¥128	¥77	¥65	¥114	¥142
Semiconductor (\$M)*					
Sales	\$4,150	\$5,100	\$6,960	\$9,825	\$8,294
IC Sales	\$3,600	\$4,430	\$5,940	\$8,630	\$7,254
Discrete Sales	\$550	\$670	\$1,020	\$1,195	\$1,040
Capital Expenditures	\$515	\$785	\$1,115	\$1,755	\$1,388
Employees				15,000	15,000

*Calendar Year

Company Overview and Strategy

Hitachi, Ltd. is one of the largest companies in the world with about \$85 billion dollars in sales and over 330,000 employees around the world. Hitachi's product lines include automotive and computer equipment, semiconductors, office automation systems, power generation systems, consumer electronics, and telecommunications equipment. The company contributes nearly two percent of Japan's annual GNP and accounts for about six percent of the country's total R&D spending.



*Includes semiconductors

1996 Corporate Sales by Business Segment

Hitachi's semiconductor business emerged in the late 1950's and early 1960's when it started producing transistors. Production of integrated circuits followed in 1966. The Semiconductor and IC Division was established in 1969 and Hitachi has since grown into Japan's second largest semiconductor manufacturer, behind NEC, and the fourth largest in the world. It is among the world's leading SRAM and DRAM suppliers. The company's other semiconductor products include microprocessors and embedded controllers, ASICs, ASSPs such as telecommunications ICs and hard disk drive ICs, standard linear and logic ICs, and discrete devices.

Management

Hitachi, Ltd.

Tsutomu Kanai	President
Tsugio Makimoto	Executive Managing Director, Electronic Components Group
Kosei Nomiya	General Manager, Semiconductor and IC Division
Tokumasa Yasui	Deputy General Manager, Memory Business Operation, Semiconductor and IC Division

Hitachi America, Ltd.

William L. Gsand	General Manager, Semiconductor and IC Division
Hiromu Fukuda	President and Chief Executive Officer, Hitachi Semiconductor (America) Inc.
Jim Hartman	Vice President, Operations, Hitachi Semiconductor (America) Inc.
James F. Watson	President, TwinStar Semiconductor, Inc.

Products and Processes

Hitachi is decreasing its emphasis on the MOS memory IC market. In fact, 1996 marked the first year in which its MOS memory ICs were not the largest revenue generating product category. The company plans to increase its DRAM shipments at about the market's annual growth rate, allowing its memory business to shrink to about 28 percent of sales by 1999, down from 51 percent in 1995, while increasing sales of microprocessors/controllers and ASICs from 33 percent in 1995 to about 52 percent by 1999.

MOS MEMORY		ANALOG	
<input checked="" type="checkbox"/>	DRAM	<input checked="" type="checkbox"/>	Amplifier
<input checked="" type="checkbox"/>	SRAM	<input checked="" type="checkbox"/>	Interface
<input checked="" type="checkbox"/>	Flash Memory	<input checked="" type="checkbox"/>	Consumer/Automotive
<input checked="" type="checkbox"/>	EPROM	<input checked="" type="checkbox"/>	Voltage Regulator/Reference
<input checked="" type="checkbox"/>	ROM	<input checked="" type="checkbox"/>	Data Conversion
<input checked="" type="checkbox"/>	EEPROM	<input checked="" type="checkbox"/>	Comparator
<input type="checkbox"/>	Other (Including Non-Volatile RAM)	<input checked="" type="checkbox"/>	Other (Includes Telecom)
MOS LOGIC		DIGITAL BIPOLAR	
<input checked="" type="checkbox"/>	General Purpose Logic	<input checked="" type="checkbox"/>	Bipolar Memory
<input checked="" type="checkbox"/>	Gate Array	<input checked="" type="checkbox"/>	General Purpose Logic
<input checked="" type="checkbox"/>	Standard Cell	<input checked="" type="checkbox"/>	Gate Array/Standard Cell
<input checked="" type="checkbox"/>	Field Programmable Logic	<input type="checkbox"/>	Field Programmable Logic
<input checked="" type="checkbox"/>	Other Special Purpose Logic	<input type="checkbox"/>	Other Special Purpose Logic
<input type="checkbox"/>		<input type="checkbox"/>	MPU/MCU/MPR
MOS MICROCOMPONENT		OTHER	
<input checked="" type="checkbox"/>	MPU	<input checked="" type="checkbox"/>	Full Custom IC
<input checked="" type="checkbox"/>	MCU	<input checked="" type="checkbox"/>	Discrete
<input checked="" type="checkbox"/>	MPR	<input checked="" type="checkbox"/>	Optoelectronic
<input checked="" type="checkbox"/>	DSP		

Details concerning Hitachi's semiconductor products are provided below.

Memory ICs

As a leading MOS memory IC manufacturer and supplier, Hitachi provides a variety of memory solutions, including standard DRAMs, synchronous DRAMs, synchronous graphics RAMs, SRAMs, flash memories, mask ROMs, and EEPROMs. In early 1995, the company became one of the first to announce it had developed a 1G DRAM. The prototype chip is based on a 0.16 μ m process and is not expected to enter production until around the year 2000.

- DRAMs—available in 1M, 4M, 16M, and 64M densities.
- Synchronous DRAMs (SDRAMs)—available in 2M, 4M, 16M, and 64M densities.
- Synchronous graphics RAMs (SGRAMs)—available in 8M density (up to 125MHz).
- Video RAMs (VRAMs)—available in 256K, 1M, 2M, and 4M densities.
- BiCMOS fast SRAMs—available in 64K to 4M densities with access times as low as 6ns.
- CMOS fast SRAMs—available in 1M and 4M densities with access times as low as 8ns.
- CMOS standard SRAMs—available in 64K to 4M densities with access times as low as 55ns.
- Bipolar ECL SRAMs—available in 1K to 256K densities.
- Synchronous burst cache SRAMs—available in 1M to 4M densities with speeds as high as 167MHz.
- Pseudo SRAMs (PSRAMs)—available in 256K to 4M densities.
- Flash memories—available in 1M to 64M densities and based on DiNOR and AND technologies.

- EPROM/PROMs—available in 256K to 4M densities.
- Mask ROMs—available in 256K to 16M densities.
- EEPROMs—available in 64K to 1M densities.
- Ferroelectric RAMs (FRAMs)—available in 256K density.
- Frame memories.

Microcomponents

Hitachi's embedded controllers include its 4-bit HMCS400 Series, 8-bit H8/300 Series, and 16-bit H8/500 Series (including the new RISC-like H8S Series), as well as its popular 32-bit SuperH (SH) RISC Series. Since the introduction of the SuperH RISC engine series in 1992, the devices are claimed to have been designed into more than 1,000 applications, including video game systems, consumer electronics, office automation products, and industrial systems. As a result, Hitachi is now one of the world's leading suppliers of RISC controllers. The SH-3, which became available in 1995, is capable of 60MIPS at 3.3V. The next-generation SH-4 Series will reportedly include a floating-point unit and run at 300MIPS. Volume shipments of SH-4 chips is expected to begin in 2Q98.

Hitachi also offers microperipheral ICs, including low-power CMOS LCD drivers and controllers for flat panel displays, as well as stand-alone digital signal processors.

ASICs

Hitachi's ASIC products include gate arrays, embedded arrays, and digital/mixed-signal cell-based ICs fabricated in 0.8 μ m, 0.7 μ m, 0.5 μ m, and advanced 0.35 μ m CMOS technologies. Its three-layer-metal 0.5 μ m gate arrays provide up to 500,000 usable gates. In mid-1996, Hitachi unveiled a new series of standard cell ICs, the HG73C Series, which can incorporate a wide variety of cores and cells, including the company's SH 32-bit RISC microcontroller cores and high-speed, high-precision A/D and D/A converters. The HG73C ASICs provide up to five million gates using an advanced 0.35 μ m process.

ASSPs

The company's application-specific standard products include automotive ICs, graphics and imaging circuits, audio/video circuits, and wireless/cellular communications ICs.

Other Standard Products

Hitachi's other semiconductors include general purpose CMOS, bipolar, and BiCMOS logic ICs, standard linear ICs, smart power ICs, RF components, power management devices, keyboard controllers, discrete devices, and optoelectronic components.

Semiconductor Fabrication Facilities

In 1996, Hitachi began the construction of a \$1.2 billion DRAM production facility in Ibaraki. The plant, which is scheduled to open in the first half of 1998, will manufacture 64M DRAMs initially. In the U.S., Hitachi is building a \$400 million 32,000 square-foot cleanroom at its fab in Texas for the manufacture of its 32-bit RISC MPUs. Operations are expected to start in 1997.

Hitachi, Ltd., Kodaira Operation
 Kodaira-shi, Tokyo Prefecture, Japan
 Cleanroom size: 82,350 square feet
 Capacity (wafers/week): 17,500
 Wafer sizes: 100mm, 125mm, 150mm
 Processes: CMOS, MOS
 Products: MPUs, MCUs, SRAMs, DRAMs, ASICs, R&D
 Feature sizes: 0.35 μ m-2.0 μ m

Hitachi, Ltd., Kofu Operation
 Nakakoma-gun, Yamanashi Prefecture, Japan
 Capacity (wafers/week): 30,000
 Wafer sizes: 100mm, 125mm, 150mm, 200mm
 Processes: CMOS, MOS
 Products: SRAMs, DRAMs, EPROMs, flash ICs, MPUs, MCUs, logic ICs, discretetes
 Feature sizes: 0.4 μ m-3.0 μ m

Hitachi Hokkai Semiconductor, Ltd.
 Chitose-shi, Hokkaido Prefecture, Japan
 Cleanroom size: 20,000 square feet
 Capacity (wafers/week): 3,750
 Wafer size: 150mm
 Process: CMOS
 Products: DRAMs, SRAMs, EEPROMs, ROMs
 Feature sizes: 0.8 μ m, 1.0 μ m

Hitachi, Ltd., Instrument Division
 Hitachinaka-shi, Ibaraki Prefecture, Japan
 Capacity (wafers/week): 8,750
 Wafer sizes: 150mm, 200mm
 Process: CMOS
 Products: DRAMs, SRAMs
 Feature sizes: 0.35 μ m-0.8 μ m

Hitachi, Ltd., Takasaki Operation
 Takasaki-shi, Gunma Prefecture, Japan
 Cleanroom size: 80,000 square feet
 Capacity (wafers/week): 12,000
 Wafer sizes: 125mm, 150mm, 200mm
 Processes: CMOS, MOS, bipolar, BiCMOS
 Products: Telecom and linear ICs, EPROMs, SRAMs, DRAMs, MCUs, discretetes
 Feature sizes: 0.35 μ m-2.0 μ m

Hitachi, Ltd., Komoro Operation
 Komoro-shi, Nagano Prefecture, Japan
 Capacity (wafers/week): 3,750
 Wafer size: 3in
 Processes: CMOS, GaAs
 Products: Telecom ICs, optoelectronics
 Feature sizes: 0.5 μ m-1.5 μ m

Hitachi Yonezawa Electronics, Co., Ltd.
 Yonezawa-shi, Yamagata Prefecture, Japan
 Capacity (wafers/week): 2,000
 Wafer size: 150mm
 Process: CMOS
 Products: MPUs, MCUs
 Feature sizes: 0.5 μ m, 0.8 μ m

Hitachi, Ltd., Electron Tube and Devices Division
 Mobarashi, Chiba Prefecture, Japan
 Cleanroom size: 60,000 square feet
 Capacity (wafers/week): 22,500
 Wafer sizes: 125mm, 150mm
 Processes: CMOS, MOS
 Products: DRAMs, EPROMs, MCUs, ASICs
 Feature sizes: 0.8 μ m-1.5 μ m

Hitachi Semiconductor (Europe) GmbH
 Jenaer Strasse 1
 Landshut, Germany
 Telephone: (49) (871) 684-0
 Cleanroom size: 48,000 square feet
 Capacity (wafers/week): 5,000
 Wafer sizes: 150mm, 200mm
 Process: CMOS
 Products: SRAMs, DRAMs, ASICs, MCUs
 Feature sizes: 0.35 μ m, 0.5 μ m, 0.8 μ m

Hitachi Semiconductor (America) Inc.
 6431 Longhorn Drive
 Irving, Texas 75063-2738
 Telephone: (214) 580-1514
 Cleanroom size: 41,800 square feet
 Capacity (wafers/week): 7,000
 Wafer size: 150mm
 Processes: CMOS, BiCMOS
 Products: DRAMs, SRAMs, MCUs, MPUs, ASICs
 Feature sizes: 0.5 μ m, 0.6 μ m, 0.8 μ m

Hitachi Nippon Steel Semiconductor
 Singapore Pte. Ltd.
 Tampiness, Singapore
 Cleanroom size: 64,600 square feet
 Capacity (wafers/week): 6,250
 Wafer size: 200mm
 Process: CMOS
 Products: DRAMs
 Feature size: 0.3 μ m
 (Joint venture with Nippon Steel and the
 government of Singapore. Operations
 to start in 1998.)

TwinStar Semiconductor Inc.
 500 West Penner Road
 Richardson, Texas 75080
 Telephone: (214) 994-5800
 Cleanroom size: 48,000 square feet
 Capacity (wafers/week): 2,000
 Wafer size: 200mm
 Process: CMOS
 Products: DRAMs
 Feature size: 0.35 μ m
 (Joint venture with Texas Instruments.
 See Key Agreements.)

Key Agreements

- It was announced in early 1997 that Hitachi, Mitsubishi, and Texas Instruments will codevelop the cell architecture for a 1G DRAM as well as the process technology needed to manufacture it.
- Hitachi joined with Texas Instruments for 16M, 64M, and 256M DRAM development and production. The partners have built a joint 16M and 64M DRAM manufacturing facility in Texas. The \$500 million factory, called TwinStar Semiconductor Inc., began producing 16M DRAMs in July 1996 and production of 64M parts is expected to start during 1997. The output is shared equally between Hitachi and TI.
- Hitachi licensed its H8/300H microprocessor core to Analog Devices, which will use it in GSM chipsets and other wireless communications products.
- In mid-1995, Hitachi licensed CompCore Multimedia, Inc.'s MPEG 2 engine technology. New decoder ICs are being developed under a technology agreement between the companies. The first MPEG 2 chips were sampled in early 1997.
- Hitachi and VLSI Technology renewed and expanded their 1988 standard cell and process technology exchange agreement. The new pact adds gate array technology, and the two companies are jointly developing gate array families. In July 1996, Hitachi licensed its SuperH core to VLSI.

- Nippon Steel has been producing 4M DRAMs for Hitachi on an OEM basis. Hitachi and Nippon Steel are building a joint-venture 64M DRAM fab in Singapore. It is expected to begin production in 1998.
- Hitachi codeveloped a 16M flash memory device with Mitsubishi that is based on Mitsubishi's divided bitline NOR (DiNOR) design. The team has also developed a 64M version based on Hitachi's complementary AND cell.
- Hitachi and Ramtron are working together to develop ferroelectric RAMs (FRAMs), including parts with densities of 256K, 1M, and 4M.
- Hitachi expanded its OEM relationship with LG Semicon in 1994 by signing a new licensing pact that provides LG with Hitachi's 0.5 μ m process and 16M DRAM designs.

KAWASAKI STEEL

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LSI Division
Makuhari Techno Garden B5
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Fax: (81) (43) 296-7419
Web Site: www.kawasaki-steel.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Kawasaki LSI U.S.A. Inc. • Santa Clara, California
 Telephone: (408) 654-0180 • Fax: (408) 654-0198 • Web Site: www.ksli.com

Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥1,379	¥1,310	¥1,185	¥1,149	¥1,164
Net Income	¥14	¥(30)	¥(22)	¥(32)	¥24
Semiconductor (\$M)*					
Sales	55	80	110	100	90
Capital Expenditures					100
Employees	454	541	600	543	400

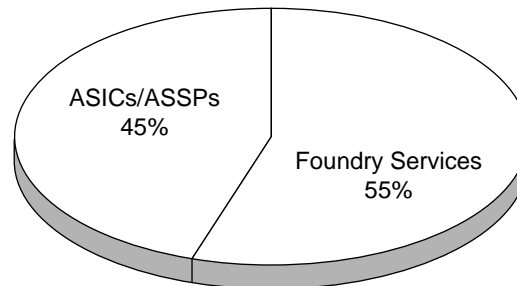
*Calendar Year

Company Overview and Strategy

Established in 1950, Kawasaki Steel Corporation is one of the world's largest steel makers. The company derives approximately three-fourths of its total sales from steel, and the rest from engineering/construction services, chemicals, LSI circuits, and integrated systems and electronics.

Kawasaki Steel organized its LSI Business Promotion Department in 1985 and established its LSI Research Center in 1986 to promote development of LSI devices, processes, and circuit design technology. In 1990, the company opened its LSI Design Center and completed construction of Utsunomiya Works. Commercial production of CMOS ASIC products began one year later.

In 1995, Kawasaki Steel shifted its LSI business strategy from foundry services to ASICs, and especially concentrated on the North American and European markets through Kawasaki LSI U.S.A., Inc., a wholly owned subsidiary established in December 1994. In addition to its ASICs, the company offers ASSPs that are suited for application in a variety of end markets, including telecommunications, multimedia, and image processing.



**1996 Semiconductor Sales
by Product Type**

Prior to January 1995, Kawasaki Steel owned 45 percent of Nihon Semiconductor Inc., a Japanese joint manufacturing venture with LSI Logic. However, the company decided to depart from the venture and sold its interest to LSI Logic. The company wanted to divert more operating resources toward its own in-house IC activities.

Management

Kenzo Monden	Chairman
Kanji Emoto	President
Takuo Imai	Executive Vice President, LSI Products
Susumu Hirano	General Manager, LSI Division
Frank Corbett	Vice President, Sales and Marketing, Kawasaki LSI U.S.A.

Products and Processes

Kawasaki Steel's product offerings include:

- 0.5 μ m, 0.8 μ m, 1.0 μ m CMOS gate arrays and embedded arrays with 2.5K to 2,030K usable gates.
- 0.5 μ m, 0.8 μ m, 1.0 μ m mixed-signal CMOS standard cells.
- 0.5 μ m, 0.65 μ m, 0.8 μ m CMOS cell-based arrays (CBAs) with up to 500K usable gates.
- ASSPs for image processing, telecommunications, and signal processing applications.
- Silicon foundry services.

The company has a variety of macrocells such as JPEG circuitry, embedded DRAMs and SRAMs, ADCs and DACs, CAMs (Content Addressable Memories), PCI buffers, PLLs, and a high-performance processor core, called the KC80, that can be incorporated in its ASICs. The KC80 processor core is based on the Zilog Z80 8-bit microprocessor. Additionally, Kawasaki and Zilog are developing ASSPs centered around the KC80.

Kawasaki Steel has developed its own leading-edge process technologies for use in the manufacture of its chips, including a 0.8 μ m CMOS process introduced in 1993, a 0.5 μ m CMOS process introduced in early 1995, and a 0.35 μ m CMOS process was brought on line in 1996.

Semiconductor Fabrication Facilities

Kawasaki Steel Corporation, LSI Division
Utsunomiya Works
Utsunomiya-shi, Tochigi Prefecture, Japan
Capacity (wafers/week): 3,000
Wafer size: 150mm
Process: CMOS
Products: ASICs, ASSPs, foundry services
Feature sizes: 0.35 μ m, 0.5 μ m, 0.65 μ m,
0.8 μ m, 1.0 μ m

Kawasaki Steel Corporation, LSI Division
LSI Research Center, Utsunomiya Works
Utsunomiya-shi, Tochigi Prefecture, Japan
Capacity (wafers/week): 1,600
Wafer size: 150mm
Process: CMOS
Products: ASICs, ASSPs
Feature sizes: 0.35 μ m, 0.5 μ m, 0.65 μ m

Key Agreements

- Kawasaki Steel has an agreement with Zilog, Inc. for the joint development of ASSPs based on Kawasaki Steel's KC80 microprocessor core.
- Kawasaki Steel has a license agreement with Silicon Architects. Under the agreement, Kawasaki Steel has rights to use the CMOS cell based array (CBA) core technology of Silicon Architects.

MATSUSHITA

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Semiconductor Group
1, Kotari-yaki-machi
Nagaokakyo-shi, Kyoto 617, Japan
Telephone: (81) (75) 951-8151
Web Site: www.mei.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Panasonic Industrial Co. Div., Matsushita Electric Corp. of America • Milpitas, California
 Telephone: (408) 946-4311 • Fax: (408) 946-9063

Europe: Panasonic Industrial Europe • Hamburg, Germany
 Telephone: (49) (40) 85492-048 • Fax: (49) (40) 85492-850

Asia-Pacific: Panasonic Industry of Asia Co. • Singapore
 Telephone: (65) 225-0444 • Fax: (65) 322-3997

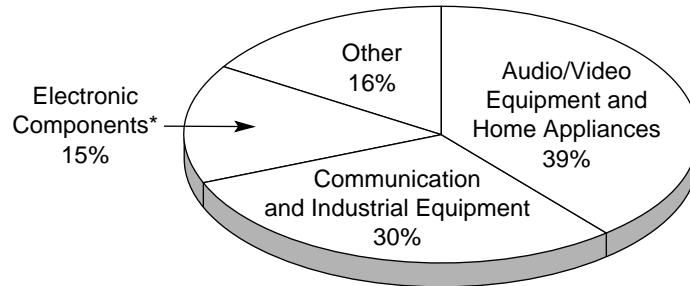
Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (MEI, ¥B)					
Sales	¥7,450	¥7,056	¥6,624	¥6,948	¥6,795
Net Income	¥133	¥37	¥24	¥90	¥(57)
Semiconductor (\$M)*					
Sales	\$2,085	\$2,320	\$2,925	\$3,520	\$3,110
IC Sales	\$1,555	\$1,670	\$2,145	\$2,600	\$2,325
Discrete Sales	\$530	\$650	\$780	\$920	\$785
Capital Expenditures	\$265	\$185	\$520	\$885	\$1,000

*Calendar Year

Company Overview and Strategy

Matsushita Electronics Corporation (MEC) is a wholly owned subsidiary of Matsushita Electric Industrial Company (MEI), a large conglomerate company involved in audiovisual equipment, home appliances, communication equipment, industrial equipment, semiconductors, electronic components, and batteries.



*Includes ICs, discretes, CCDs, picture tubes, tuners, speakers, and electric motors and lamps.

1996 Corporate (MEI) Sales by Business Segment

MEC was formed originally as a joint venture between MEI and Philips Electronics in 1952. In May 1993, Philips sold its 35 percent stake in MEC to MEI for \$1.67 billion. Its major products include integrated circuits, discrete devices, charge coupled devices (CCDs), cathode-ray tubes, image pickup tubes, and electric lamps.

In the past, MEC's semiconductor business was focused on bipolar ICs and discrete devices used primarily in household equipment. Today, however, the company is placing emphasis on the development and production of semiconductors for multimedia equipment, particularly 32-bit microcontrollers and DVD chipsets, and high-value-added memory products, such as flash memories and ferroelectric memory chips. MEC's semiconductor products are also marketed under the Panasonic name.

Management

Matsushita Electronics Corporation

Kazuhiro Mori	President
Koki Kato	Senior Managing Director, Semiconductor Group

Matsushita Semiconductor Corporation of America

Takashi Suyama	President
Frank Pfefferkorn	Vice President, Manufacturing and Engineering

Products and Processes

Matsushita's semiconductor products include analog ICs, DRAMs, mask ROMs, serial EEPROMs, FRAMs, MPUs, MCUs, DSPs, MOS logic ICs, ASICs, CCDs, and discrete and optoelectronic devices.

<p>MOS MEMORY</p> <input checked="" type="checkbox"/> DRAM <input checked="" type="checkbox"/> SRAM <input checked="" type="checkbox"/> Flash Memory <input type="checkbox"/> EPROM <input checked="" type="checkbox"/> ROM <input checked="" type="checkbox"/> EEPROM <input checked="" type="checkbox"/> Other (Including Non-Volatile RAM)	<p>ANALOG</p> <input checked="" type="checkbox"/> Amplifier <input checked="" type="checkbox"/> Interface <input checked="" type="checkbox"/> Consumer/Automotive <input checked="" type="checkbox"/> Voltage Regulator/Reference <input checked="" type="checkbox"/> Data Conversion <input checked="" type="checkbox"/> Comparator <input checked="" type="checkbox"/> Other (Includes Telecom)
<p>MOS LOGIC</p> <input checked="" type="checkbox"/> General Purpose Logic <input checked="" type="checkbox"/> Gate Array <input checked="" type="checkbox"/> Standard Cell <input checked="" type="checkbox"/> Field Programmable Logic <input checked="" type="checkbox"/> Other Special Purpose Logic	<p>DIGITAL BIPOLAR</p> <input type="checkbox"/> Bipolar Memory <input checked="" type="checkbox"/> General Purpose Logic <input type="checkbox"/> Gate Array/Standard Cell <input type="checkbox"/> Field Programmable Logic <input checked="" type="checkbox"/> Other Special Purpose Logic <input type="checkbox"/> MPU/MCU/MPR
<p>MOS MICROCOMPONENT</p> <input checked="" type="checkbox"/> MPU <input checked="" type="checkbox"/> MCU <input checked="" type="checkbox"/> MPR <input checked="" type="checkbox"/> DSP	<p>OTHER</p> <input checked="" type="checkbox"/> Full Custom IC <input checked="" type="checkbox"/> Discrete <input checked="" type="checkbox"/> Optoelectronic

Details concerning Matsushita's semiconductor products are provided below.

Memory ICs

- DRAMs in densities ranging from 1M to 16M.
- VRAMs in 256K, 512K, and 1M densities.
- Synchronous DRAMs (SDRAMs) in 16M density.
- Flash memories in 16M and 64M densities. The 64M part incorporates SanDisk's double-density flash technology for storing two bits of data per cell unlike conventional cells that store one bit of data.
- Mask ROMs in densities ranging from 1M to 16M.
- Serial EEPROMs in densities ranging from 512 bits to 4K.
- CMOS SRAMs in densities ranging from 64K to 512K.
- Ferroelectric memories.
- FIFO memories.

Microcomponent ICs

- 16-bit and 32-bit microprocessors.
- 4-bit, 8-bit, 16-bit, and 32-bit single-chip microcontrollers.
- Digital signal processors and audio signal processors.
- Microperipheral ICs, such as display drivers, disk drive controllers, clocks, memory controllers, and interface circuits.

Logic ICs

- General-purpose CMOS and bipolar logic ICs.
- CMOS and BiCMOS digital gate array ASICs with up to 1,500K max. gates.
- CMOS digital and mixed-signal standard cell ASICs.
- Full custom CMOS ASICs.

Dedicated Function ICs

- ICs for VCRs, cameras, televisions, audio equipment, industrial systems, home electronics, communications equipment, and multimedia systems.

Analog ICs

- General-purpose linear devices, such as amplifiers, data converters, and voltage regulators, based on CMOS, BiCMOS, bipolar, and GaAs technologies.

Bipolar Digital ICs

- Driver Arrays.
- Hall-effect ICs.
- Prescalers.

Other Products

- CCDs.
- GaAs microwave monolithic ICs (MMICs).
- Discretes.
- Optoelectronic devices.

Matsushita's semiconductors are manufactured using CMOS, BiCMOS, bipolar, and GaAs process technologies. The company's CMOS technology has reached the 0.35 μ m geometry level, while its BiCMOS technology is at the 0.8 μ m level. The company is also highly committed to GaAs for its communications devices.

Semiconductor Fabrication Facilities

Matsushita Electronics, Nagaokakyo Facility
 Nagaokakyo-shi, Kyoto Prefecture, Japan
 Capacity (wafers/week): 15,000
 Wafer sizes: 100mm, 125mm
 Processes: MOS, CMOS, bipolar
 Products: ASICs, logic and power devices,
 CCDs, discretes
 Feature sizes: 1.5 μ m-3.0 μ m

Matsushita Electronics, Tonami Facility
 Tonami-shi, Toyama Prefecture, Japan
 Capacity (wafers/week): 7,500
 Wafer sizes: 150mm, 200mm
 Process: CMOS
 Products: ASICs, MCUs, DSPs, flash memories,
 logic ICs, DRAMs, SRAMs
 Feature sizes: 0.35 μ m, 0.5 μ m (0.25 μ m in late 1997)

Matsushita Electronics, Arai Facility
 Arai-shi, Niigata Prefecture, Japan
 Capacity (wafers/week): 28,750
 Wafer sizes: 100mm, 125mm
 Processes: MOS, bipolar
 Products: DRAMs, SRAMs, ROMs, MPUs,
 logic and linear ICs, CCDs
 Feature sizes: 1.5 μ m-3.0 μ m

Matsushita Electronics
 Utsunomiya-shi, Tochigi Prefecture, Japan
 Capacity (wafers/week): 2,000
 Wafer size: 100mm
 Process: MOS
 Products: Discretes

Matsushita Electronics
 Kyoto Research Center
 Kyoto-shi, Kyoto Prefecture, Japan
 Capacity (wafers/week): 1,250
 Wafer size: 150mm
 Process: CMOS
 Products: R&D
 Feature sizes: 0.25 μ m-0.5 μ m

Matsushita Electronics, Uozu Facility
 Uozu-shi, Toyama Prefecture, Japan
 Capacity (wafers/week): 25,000
 Wafer sizes: 125mm, 150mm
 Processes: CMOS, MOS
 Products: DRAMs, EEPROMs, ROMs,
 MPUs, MCUs, ASICs
 Feature sizes: 0.5 μ m-1.5 μ m

Matsushita Electronics, Nagaokakyo Facility
 Nagaokakyo-shi, Kyoto Prefecture, Japan
 Wafer size: 3in
 Process: GaAs
 Products: MMICs and other GaAs ICs, discretes

Matsushita Semiconductor Corp. of America
 1111 39th Avenue SE
 Puyallup, Washington 98373-0900
 Telephone: (206) 841-6000
 Fax: (206) 841-6723
 Capacity (wafers/week): 8,000
 Wafer size: 150mm
 Processes: CMOS, BiCMOS
 Products: DRAMs, ASICs, MCUs, foundry services
 Feature sizes: 0.6 μ m-1.0 μ m
 (A 200mm wafer line is being added here for the
 production of DRAMs and MCUs with 0.25 μ m and
 0.35 μ m geometries. Operations to begin mid-1998.)

Key Agreements

- Matsushita and SanDisk jointly developed a 64M NOR-type flash memory chip using 0.5 μ m CMOS process technology and San Disk's double-density flash architecture for storing two bits of data in a single cell. The companies say the chip is only about 10 percent larger than 32M flash parts. Matsushita began producing the chips near the end of 1996.
- Matsushita is marketing Actel's FPGAs in Japan and is also acting as a foundry for the U.S. company's FPGA products. In 1994, the partners expanded their relationship to include the joint development of advanced semiconductor process technologies.

- Matsushita is working with C-Cube Microsystems, JVC, and Sharp to jointly develop MPEG-1 and MPEG-2 decoders. Matsushita also provides C-Cube with preferential access to its 0.5 μ m and 0.35 μ m manufacturing processes in return for the rights to use and sell a limited amount of the decoders.
- Matsushita is cooperating with National Semiconductor in the development of ICs for use in automobiles.
- Matsushita signed an RFID product agreement with Motorola and ferroelectric memory pioneer Symetrix Corp. Motorola's subsidiary Indala Corp. agreed to jointly produce a family of read/write RFID chips with Matsushita that incorporate Symetrix's ferroelectric memory technology (Matsushita has an equity stake in Symetrix and has the right to relicense its technology). Matsushita and Symetrix are also working to develop other ferroelectric-based semiconductors.

MITSUBISHI

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 Fax: (81) (3) 5573-8962
 Web Site: www.melco.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Mitsubishi Electronics America, Inc. • Sunnyvale, California
 Telephone: (408) 730-5900 • Fax: (408) 732-9382 • Web Site: www.mitsubishi.com

Europe: Mitsubishi Electric Europe GmbH • Ratingen, Germany
 Telephone: (49) (2102) 486-0 • Fax: (49) (2102) 486-367

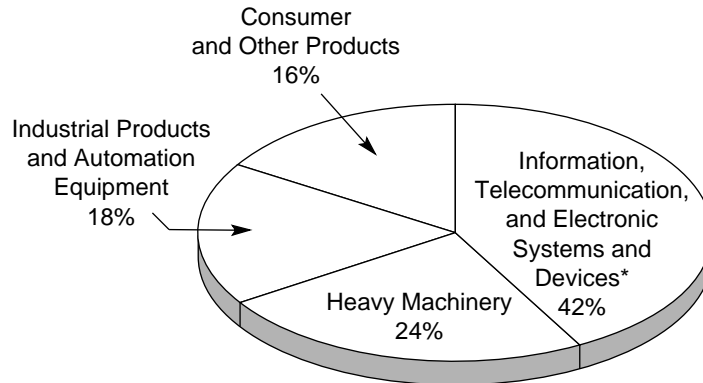
Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥3,343	¥3,260	¥3,105	¥3,251	¥3,511
Net Income	¥36	¥29	¥21	¥42	¥59
Semiconductor (\$M)*					
Sales	\$2,490	\$2,958	\$3,874	\$5,065	\$4,150
IC Sales	\$2,068	\$2,405	\$3,286	\$4,435	\$3,545
Discrete Sales	\$422	\$553	\$588	\$630	\$605
Capital Expenditures	\$480	\$455	\$690	\$1,120	\$1,055

*Calendar Year

Company Overview and Strategy

Founded in 1921, Mitsubishi Electric is a leading manufacturer of electronic and electrical equipment with sales of about \$33 billion in 1996 (fiscal year ending March 1996) and some 111,000 employees worldwide. The company's business is divided into four operational categories: information, telecommunication, and electronic systems and devices; heavy machinery; industrial products and automation equipment; and consumer and other products. Mitsubishi started mass production of integrated circuits in 1961.



*Includes semiconductors

1996 Corporate Sales by Business Segment

Management

Mitsubishi Electric Corporation

Takashi Kitaoka	President
Shoji Hirabayashi	Senior Managing Director and General Manager, Semiconductor Group
Tsuyoshi Toyama	General Manager, Memory Division, Semiconductor Group
Toyohiko Yoshida	General Manager, Mediaprocessor Product Division, Semiconductor Group

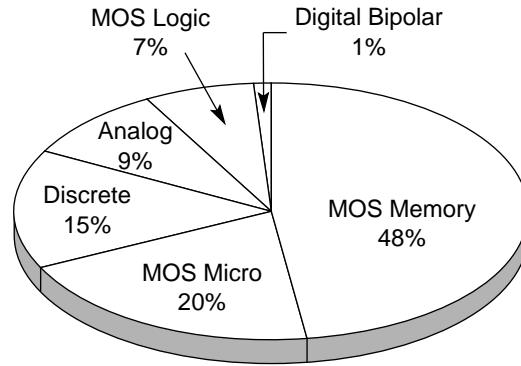
Mitsubishi Electronics America Inc., Electronic Device Group

Takao Nishimura	President
John Zucker	Executive Vice President

Products and Processes

Mitsubishi's semiconductor products include standard and application-specific memory ICs, gate and embedded arrays, ASSPs, JPEG and MPEG encoder/decoders, microcontrollers, digital and analog standard ICs, optoelectronic products, and microwave GaAs FET and RF power semiconductors.

DRAMs accounted for about 43 percent of Mitsubishi's semiconductor sales in 1996. That figure is expected to fall below 30 percent in 1998 as the company plans to put more energy into its embedded RAM products, microcontrollers, ASICs, and flash memory devices.



1996 Semiconductor Sales by Device Type

- | | |
|--|--|
| <p>MOS MEMORY</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> DRAM <input checked="" type="checkbox"/> SRAM <input checked="" type="checkbox"/> Flash Memory <input checked="" type="checkbox"/> EPROM <input type="checkbox"/> ROM <input type="checkbox"/> EEPROM <input type="checkbox"/> Other (Including Non-Volatile RAM) | <p>ANALOG</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Amplifier <input checked="" type="checkbox"/> Interface <input checked="" type="checkbox"/> Consumer/Automotive <input checked="" type="checkbox"/> Voltage Regulator/Reference <input checked="" type="checkbox"/> Data Conversion <input checked="" type="checkbox"/> Comparator <input checked="" type="checkbox"/> Other (Includes Telecom) |
| <p>MOS LOGIC</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> General Purpose Logic <input checked="" type="checkbox"/> Gate Array <input checked="" type="checkbox"/> Standard Cell <input type="checkbox"/> Field Programmable Logic <input checked="" type="checkbox"/> Other Special Purpose Logic | <p>DIGITAL BIPOLAR</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bipolar Memory <input checked="" type="checkbox"/> General Purpose Logic <input type="checkbox"/> Gate Array/Standard Cell <input type="checkbox"/> Field Programmable Logic <input type="checkbox"/> Other Special Purpose Logic <input type="checkbox"/> MPU/MCU/MPR |
| <p>MOS MICROCOMPONENT</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> MPU <input checked="" type="checkbox"/> MCU <input checked="" type="checkbox"/> MPR <input checked="" type="checkbox"/> DSP | <p>OTHER</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Full Custom IC <input checked="" type="checkbox"/> Discrete <input checked="" type="checkbox"/> Optoelectronic |

Mitsubishi's top strategic semiconductor products are as follows:

Memory ICs

The company's DRAM product line includes 1M, 4M, 16M, and 64M DRAMs; 16M and 64M synchronous DRAMs; 256K, 1M, and 2M VRAMs; 10M 3D RAMs; and 4M and 16M cache DRAMs. In 2Q97, Mitsubishi purchased a Rambus DRAM license to develop a successor technology to the SDRAM. Called Direct RDRAM technology, the new high-bandwidth memories are expected to enter volume production in 1999.

In flash memories, the company has a strategic alliance with Hitachi. The two companies offer 8M and 16M flash devices based on Mitsubishi's divided-bitline NOR (DiNOR) architecture and 64M parts based on Hitachi's AND technology. Mitsubishi also offers 1M NOR flash parts.

Mitsubishi's SRAM products include CMOS standard SRAMs in 1M and 4M densities, fast SRAMs in 256K, 512K, 1M, and 4M densities, and 1M and 2M synchronous pipeline burst SRAMs for high-speed cache applications (up to 133MHz).

Microcomponents

Mitsubishi is a second source for Digital Semiconductor's Alpha RISC microprocessor and is one of the world's leading suppliers of 16-/32-bit microcontrollers, with a broad portfolio that includes a 32-bit part with 1M of built-in flash memory. The company also produces 4-bit and 8-bit MCUs.

In mid-1996, Mitsubishi introduced its M32R 32-bit RISC microprocessor that includes an 8M or 16M DRAM on-chip, the first of its kind in the world. Besides DRAM integration, the M32R also features on-chip DSP functions and on-chip memory support. The RISC processor core in the M32R measures only 2mm x 2mm, allowing for the integration of the large DRAM.

In early 1997, the company announced its entrance into the media coprocessor market with the first generation of the D30V product family. The D30V is a dual issue, very-long-instruction-word (VLIW) RISC processor targeted at DVD players and other consumer electronic applications.

ASICs and ASSPs

The company's ASIC products include CMOS gate arrays, embedded arrays, and digital and mixed-signal standard cells. Its ASSPs focus on image processing applications (e.g., MPEG-2 and JPEG encoding and decoding). Mitsubishi also sells, through an agreement with IBM, ASSPs based on IBM's PowerPC embedded controller core.

GaAs ICs

Mitsubishi is experiencing strong demand for its gallium-arsenide mobile communications-related devices and optoelectronic products.

Semiconductor Fabrication Facilities

Mitsubishi's fab projects include the construction of the \$1.1 billion 64M DRAM facility at its Saijo site. The fab will have the capacity to produce 2,500 200mm wafers per week, beginning in late 1997 or early 1998. In addition, Mitsubishi plans to build a 300mm wafer fab at its Kochi site by 2000 for 64M and 256M DRAM production. Construction of the \$2.5 billion facility is expected to start in 1998. Mitsubishi has also indicated that it will build a future generation DRAM fab at its North Carolina site.

Mitsubishi Electric, Kochi Factory
Kami-gun, Kochi Prefecture, Japan
Capacity (wafers/week): 8,750
Wafer size: 150mm
Process: CMOS
Products: ASICs, MPUs, MCUs, MPRs,
 DRAMs, SRAMs, ROMs
Feature sizes: 0.6 μ m-1.0 μ m

Mitsubishi Electric, Saijo Factory
Saijo-shi, Ehime Prefecture, Japan
Capacity (wafers/week): 28,000
Wafer sizes: 100mm, 125mm, 150mm, 200mm
Processes: CMOS, BiCMOS
Products: DRAMs, SRAMs, MPUs, MCUs, ASICs,
 flash memories, DRAM/logic
Feature sizes: 0.35 μ m-1.0 μ m
(DRAM production to be terminated here by the
end of 1997. Flash memories and M32R-type
devices will be produced instead.)

Mitsubishi Electric, Kita-Itami Works
Itami-shi, Hyogo Prefecture, Japan
Capacity (wafers/week): 6,000
Wafer size: 100mm
Process: GaAs
Products: MMICs, optoelectronics, discretes
Feature size: 0.5 μ m

Mitsubishi Semiconductor America, Inc.
Three Diamond Lane
Durham, North Carolina 27704
Telephone: (919) 479-3333
Capacity (wafers/week): 2,000
Wafer size: 125mm
Process: CMOS
Products: DRAMs, SRAMs, MCUs
Feature sizes: 0.8 μ m-1.0 μ m

Mitsubishi Electric, Fukuoka Works
Fukuoka-shi, Fukuoka Prefecture, Japan
Capacity (wafers/week): 12,500
Wafer sizes: 100mm, 150mm
Process: Bipolar
Products: Logic and analog ICs, ASICs, discretes
Feature sizes: 2.0 μ m-3.0 μ m

Mitsubishi Electric, Kumamoto Works
Kikuchi-gun, Kumamoto Prefecture, Japan
Capacity (wafers/week): 32,250
Wafer sizes: 125mm, 150mm, 200mm
Process: CMOS
Products: EPROMs, DRAMs, SRAMs, MCUs,
 flash memories, ASICs, logic ICs
Feature sizes: 0.3 μ m-2.0 μ m

Mitsubishi Electric, Kita-Itami Works
Itami-shi, Hyogo Prefecture, Japan
Capacity (wafers/week): 1,625
Wafer sizes: 150mm, 200mm
Processes: CMOS, BiCMOS
Products: R&D
Feature sizes: 0.3 μ m-0.5 μ m

Mitsubishi Semiconductor Europe GmbH
Konrad-Zuse Strasse 1
52477 Alsdorf, Germany
Telephone: (49) (2404) 990-0
Capacity (wafers/week): 5,000
Wafer size: 200mm
Process: CMOS
Products: DRAMs
Feature size: 0.35 μ m

Powerchip Semiconductor Corporation
Hsinchu, Taiwan
Telephone: (886) (3) 5783-344
Capacity (wafers/week): 3,750
Wafer size: 200mm
Process: CMOS
Products: DRAMs, logic ICs
Feature size: 0.4 μ m
(Joint venture with UMAX-Elite Group and
Kanematsu Corporation. See Key Agreements.
Began production in 4Q96.)

Key Agreements

- It was announced in early 1997 that Hitachi, Mitsubishi, and Texas Instruments will codevelop the cell architecture for a 1G DRAM as well as the process technology needed to manufacture it.
- Mitsubishi and Lucent Technologies agreed in mid-1996 to jointly develop a set of ICs that together will perform all of the functions needed for next-generation high-definition television (HDTV) sets for the U.S. market. The first samples of the chips are expected to be available in early 1998.
- Mitsubishi and Stone Group Co., a leading private electronics manufacturer in China, formed a joint venture in Beijing for the assembly and test of Mitsubishi's ASICs, microcontrollers, and memories. Operations at Mitsubishi Stone Semiconductor Co., Ltd. began in May 1997. A wafer fabrication facility may be built at the site in the future.
- Motorola and Mitsubishi announced a couple of joint cooperation agreements in 1996. In October, Motorola agreed to exchange its 32-bit ColdFire RISC and 68EC000 embedded MPU technologies for Mitsubishi's M32R microprocessor with embedded DRAM technology. In December, the two companies agreed to jointly market MobileFlash™ memory devices based on the DiNOR flash technology developed by Mitsubishi. Motorola and Mitsubishi have said that their alliance in flash memories may be expanded in the future to include a joint venture fab dedicated to the manufacture of flash chips.
- In mid-1996, Mitsubishi announced an agreement with IBM that allows the company to sell IBM PowerPC embedded controller chips under the Mitsubishi brand name.
- Mitsubishi is cooperating with Rockwell in high-speed modem IC production. Under the partnership, Mitsubishi is producing 28.8kps modem ICs and supplying them to Rockwell on condition that it and its customers can preferentially procure such ICs.
- Mitsubishi joined with the Japanese trading firm Kanematsu Corporation and Taiwan's UMAX Elite Group to establish a new DRAM manufacturing company in Taiwan called Powerchip Semiconductor. Powerchip's fabrication facility began volume production of 16M DRAMs in the fourth quarter of 1996.

- Mitsubishi agreed to cooperate in development and production of Digital Semiconductor's Alpha 64-bit RISC microprocessor.
- SGS-Thomson signed on as a second source for Mitsubishi's flash memory products.
- Mitsubishi codeveloped a 8M and 16M flash memory device with Hitachi that is based on Mitsubishi's divided bitline NOR (DiNOR) design. The team has also developed a 64M version based on Hitachi's complementary AND cell.

NEC

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Electron Device Group
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Tokyo 108-01, Japan
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Fax: (81) (3) 3798-1510/1519
Web Site: www.nec.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

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 Telephone: (408) 588-6000 • Fax: (408) 588-6130 • Web Site: www.nec.com

Europe: NEC Electronics (Germany) GmbH • Düsseldorf, Germany
 Telephone: (49) (221) 650302 • Fax: (49) (221) 6503490

Asia-Pacific: NEC Electronics Hong Kong Ltd. • Hong Kong
 Telephone: (852) 2886-9318 • Fax: (852) 2886-9022

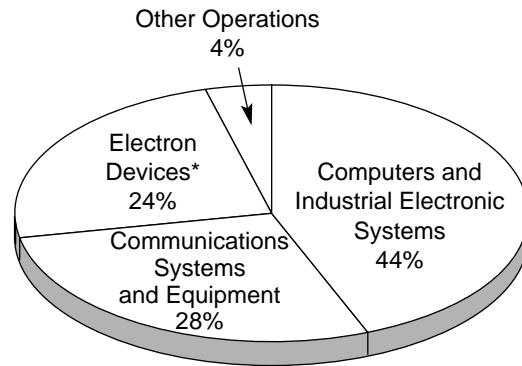
Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥3,774	¥3,515	¥3,580	¥3,769	¥4,397
Net Income	¥15	¥(45)	¥7	¥35	¥77
Semiconductor (\$M)*					
Sales	\$5,735	\$7,090	\$8,830	\$12,275	\$11,000
IC Sales	\$5,040	\$6,265	\$7,855	\$11,045	\$9,950
Discrete Sales	\$695	\$825	\$975	\$1,230	\$1,050
Capital Expenditures	\$620	\$705	\$1,115	\$2,010	\$1,700

*Calendar Year

Company Overview and Strategy

Founded as Nippon Electric Company, Ltd. in 1899, the company officially changed its name to NEC Corporation in 1983. Today, NEC is a leading international supplier of electronics products that comprise primarily communications systems and equipment, computers, industrial electronic systems, and electron devices.



*Semiconductors and electronic components

1996 Corporate Sales by Product Group

NEC operates primarily in a single industrial segment that it calls "C&C," the integration of computers and communications. Semiconductors are an integral part of C&C because they serve as the building blocks for combining technological innovations and products derived from each of the computers and communications areas.

The company's semiconductor business was initiated in 1950 with the start of transistor research and development. A decade later, integrated circuit R&D began. Today, NEC is the world's second largest integrated circuit (and semiconductor) manufacturer with a product line-up that features memory ICs, microprocessors and controllers, application-specific ICs (ASICs), linear ICs, compound semiconductors, optoelectronic devices, and discrete semiconductors.

Management

NEC Corporation

- | | |
|-----------------|--|
| Hisashi Kaneko | President |
| Hajime Sasaki | Senior Executive Vice President, Electron Devices |
| Yuichi Haneta | Executive Vice President, Semiconductor Group |
| Kunishiro Saito | Vice President, Worldwide Semiconductor Operations |

NEC Electronics Inc. (U.S.)

- | | |
|---------------------|---|
| Shigeki Matsue | President and Chief Executive Officer |
| Sadayuki Kishi | Senior Vice President, Operations and Plant Manager |
| Kuniyoshi Noritsugu | Senior Vice President, Marketing and Legal |
| Mike Desportes | Vice President, Sales |
| J. Giovanola | Vice President, Administration |
| Shin Kurata | Vice President, Finance and Chief Financial Officer |
| John Marck | Vice President, Memory |
| Hidesato Tanaka | Vice President, Corporate Planning |

Products and Processes

MOS MEMORY		ANALOG	
<input checked="" type="checkbox"/>	DRAM	<input checked="" type="checkbox"/>	Amplifier
<input checked="" type="checkbox"/>	SRAM	<input checked="" type="checkbox"/>	Interface
<input checked="" type="checkbox"/>	Flash Memory	<input checked="" type="checkbox"/>	Consumer/Automotive
<input checked="" type="checkbox"/>	EPROM	<input checked="" type="checkbox"/>	Voltage Regulator/Reference
<input checked="" type="checkbox"/>	ROM	<input checked="" type="checkbox"/>	Data Conversion
<input checked="" type="checkbox"/>	EEPROM	<input checked="" type="checkbox"/>	Comparator
<input checked="" type="checkbox"/>	Other (Including Non-Volatile RAM)	<input checked="" type="checkbox"/>	Other (Includes Telecom)
MOS LOGIC		DIGITAL BIPOLAR	
<input checked="" type="checkbox"/>	General Purpose Logic	<input checked="" type="checkbox"/>	Bipolar Memory
<input checked="" type="checkbox"/>	Gate Array	<input type="checkbox"/>	General Purpose Logic
<input checked="" type="checkbox"/>	Standard Cell	<input checked="" type="checkbox"/>	Gate Array/Standard Cell
<input checked="" type="checkbox"/>	Field Programmable Logic	<input type="checkbox"/>	Field Programmable Logic
<input checked="" type="checkbox"/>	Other Special Purpose Logic	<input type="checkbox"/>	Other Special Purpose Logic
<input type="checkbox"/>		<input type="checkbox"/>	MPU/MCU/MPR
MOS MICROCOMPONENT		OTHER	
<input checked="" type="checkbox"/>	MPU	<input type="checkbox"/>	Full Custom IC
<input checked="" type="checkbox"/>	MCU	<input checked="" type="checkbox"/>	Discrete
<input checked="" type="checkbox"/>	MPR	<input checked="" type="checkbox"/>	Optoelectronic
<input checked="" type="checkbox"/>	DSP		

Memory Devices

The company's group of memory products includes: DRAMs (1M, 4M, 16M, and 64M); 16M and 64M synchronous DRAMs (SDRAMs); 8M and 16M Rambus DRAMs (RDRAMs); low-power CMOS SRAMs (256K and 1M); fast CMOS SRAMs (1M, 4M, and low-voltage); fast BiCMOS SRAMs (256K, 1M, 4M, and low-voltage); 1M synchronous SRAMs; mask ROMs (1M-32M and low-voltage), EPROMs (1M, 2M, 4M, 8M, and 16M), OTPROMs (4M and 8M), EEPROMs (64K and 256K parallel and 1K, 2K, 4K, and 8K serial); flash memories (1M, 4M, and 16M); dual-port RAMs; synchronous graphics RAMs; and FIFOs.

NEC is the world's second largest producer of memory devices. NEC was among the first companies to sample 64M DRAMs, one of the first to sample a 256M DRAM, and one of the first to announce it had developed a 1G DRAM. In early 1997, NEC announced it had developed a 4G DRAM prototype.

NEC announced in 1996 that it would terminate the development of next-generation EPROMs in order to concentrate on flash memories. The company will continue to produce its existing line of EPROMs as long as there are users.

Microcomponents

NEC is one of the world's largest suppliers of microcontrollers. It offers a wide variety of 4-bit, 8-bit, 16-bit and 32-bit microcontrollers, including controllers with on-chip flash memory. NEC also supplies 16-bit, 32-bit, and 64-bit RISC microprocessors and controllers: the VR-Series based on the Mips Technologies architecture and the original V-Series family. Microperipheral ICs are also offered.

ASICs

NEC offers CMOS gate arrays and embedded arrays with up to 1.2 million usable gates, BiCMOS gate arrays with up to 267,000 usable gates, ECL gate arrays, standard cell ASICs based on 0.35µm, 0.5µm, and 0.8µm CMOS technologies, FPGAs, and bipolar analog arrays.

NEC announced that in October 1997 it will begin commercial production of ASICs with 0.25µm drawn gate lengths. The new CMOS-10 family of ASICs, with up to 20 million gates and operating speeds of 300MHz, will be targeted at high-end workstations and cellular base stations.

Dedicated ICs

These products include voice synthesis ICs, DSPs, communication ICs, image processing ICs, MPEG ICs, GPS equipment ICs, 3D graphics processors, consumer electronics circuits, automotive ICs, data converters, and display drivers.

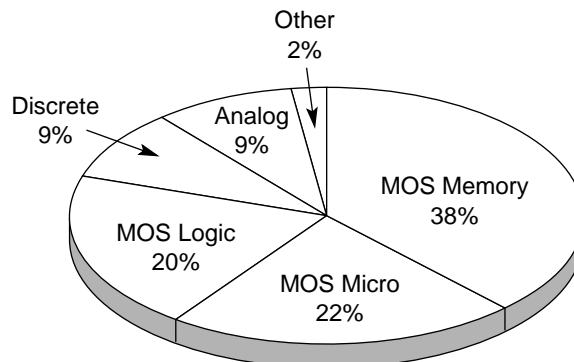
In early 1997, NEC unveiled its first IC to combine a microprocessor and a DRAM. The single-chip device has 16M of DRAM integrated with NEC's proprietary MicroPD microprocessor core. It is targeted at applications in PC graphics and high-end wireless communications systems.

General-Purpose Linear and Digital ICs

These products include operational amplifiers, comparators, voltage regulators, and standard logic ICs.

Other Semiconductors

NEC offers a range of other semiconductor products, including hybrid ICs, silicon discrete semiconductors, microwave ICs, power MOS ICs, GaAs ICs and discretes, and optoelectronic devices.



1996 Semiconductor Sales by Device Type

Semiconductor Fabrication Facilities

NEC's new fab facility activities include the construction of a 1G DRAM pilot production line capable of a 0.18 μ m process at its Sagamihara site. The plant will be built in three phases, the first of which is expected to begin operating in 1997 with a weekly capacity of 1,250 200mm wafers per week.

Additionally, NEC expected to begin the construction of a second wafer fab in Roseville, California, in the spring of 1997. The new \$1.1 billion fab will initially fabricate 64M DRAMs, starting in 1999. The fab was originally expected to undergo construction in 1996 but was postponed because of slow DRAM market conditions.

In 2Q97, NEC announced an agreement with Shanghai's Huahong Microelectronics to build a \$700 million joint venture fab in China that will use 0.35 μ m-0.5 μ m technology to process 200mm wafers. Production is scheduled to be launched in 1998.

NEC Kyushu, Ltd.
Kumamoto-shi, Kumamoto Prefecture, Japan
Capacity (wafers/week): 26,600
Wafer sizes: 125mm, 150mm, 200mm
Processes: MOS, CMOS, BiCMOS
Products: DRAMs, SRAMs, EPROMs, ROMs,
MPUs, MCUs, ASICs, CCDs, flash, R&D
Feature sizes: 0.25 μ m-1.5 μ m

NEC Yamaguchi, Ltd.
Asa-gun, Yamaguchi Prefecture, Japan
Capacity (wafers/week): 16,500
Wafer size: 150mm
Processes: CMOS, BiCMOS, MOS
Products: DRAMs, SRAMs, MPUs, MCUs, ASICs, flash
Feature sizes: 0.35 μ m-0.8 μ m

NEC Kansai, Ltd.
Otsu-shi, Shiga Prefecture, Japan
Capacity (wafers/week): 18,750
Wafer sizes: 100mm, 150mm
Processes: CMOS, MOS, bipolar
Products: Linear and logic ICs, CCDs, ASICs,
MPUs, MCUs, DRAMs, SRAMs
Feature sizes: 0.8 μ m-4.0 μ m

NEC Yamagata, Ltd.
Tsuruoka-shi, Yamagata Prefecture, Japan
Capacity (wafers/week): 25,000
Wafer sizes: 100mm, 125mm, 150mm
(200mm in 1997)
Processes: CMOS, MOS, bipolar
Products: Logic and linear ICs, SRAMs, ASICs,
MPUs, MCUs, discretes
Feature sizes: 0.5 μ m, 0.8 μ m, 2.0 μ m, 3.0 μ m

NEC Sagamihara Plant
Sagamihara-shi, Kanagawa Prefecture, Japan
Capacity (wafers/week): 11,875
Wafer sizes: 125mm, 150mm, 200mm
Processes: MOS, CMOS, BiCMOS
Products: DRAMs, EPROMs, SRAMs, ROMs,
MPUs, ASICs, R&D
Feature sizes: 0.35 μ m-1.4 μ m

NEC Kagoshima, Ltd.
Izumi-shi, Kagoshima Prefecture, Japan
Capacity (wafers/week): 1,000
Wafer size: 100mm
Processes: Bipolar, GaAs
Products: Linear and telecom ICs
Feature size: 0.8 μ m

NEC Tamagawa Plant
 Kawasaki-shi, Kanagawa Prefecture, Japan
 Capacity (wafers/week): 1,450
 Wafer size: 150mm
 Process: CMOS
 Products: MPU and DRAM R&D
 Feature size: 0.55 μ m

NEC Kansai, Ltd.
 Otsu-shi, Shiga Prefecture, Japan
 Capacity (wafers/week): 600
 Wafer size: 100mm
 Process: GaAs
 Products: ICs and discretos

NEC Semiconductors (UK) Ltd.
 Carnegie Road, Deans West Industrial Estate
 Livingston, West Lothian
 Scotland EH54 8QX, United Kingdom
 Telephone: (44) (506) 41-0000
 Fax: (44) (506) 41-5317
 Capacity (wafers/week): 13,250
 Wafer sizes: 150mm, 200mm
 Process: CMOS
 Products: DRAMs, MCUs, ASICs, DSPs
 Feature sizes: 0.25 μ m-0.8 μ m

NEC Hiroshima, Ltd.
 Higa-shi, Hiroshima Prefecture, Japan
 Capacity (wafers/week): 12,500
 Wafer sizes: 150mm, 200mm
 Process: CMOS
 Products: DRAMs, SRAMs, ROMs, MPUs, flash
 Feature sizes: 0.25 μ m-0.8 μ m

NEC Electronics Inc.
 7501 Foothills Boulevard
 Roseville, California 95678
 Telephone: (916) 786-3900
 Cleanroom size: 400,000 square feet
 Capacity (wafers/week): 17,750
 Wafer sizes: 125mm, 150mm, 200mm
 Processes: MOS, CMOS, BiCMOS
 Products: SRAMs, DRAMs, ASICs, MCUs, logic ICs
 Feature sizes: 0.35 μ m-1.0 μ m

Shougang NEC Electronics Co., Ltd.
 Postcode 100041
 A3 Futiansi, Shijingshan
 Beijing, China
 Telephone: (86) (1) 512-2288
 Fax: (86) (1) 886-2648
 Capacity (wafers/week): 2,000
 Wafer size: 150mm
 Processes: CMOS, bipolar
 Products: MCUs, linear ICs, ASICs, DRAMs
 Feature sizes: 0.5 μ m-3.0 μ m

Key Agreements

- NEC teamed up with Los Altos, California-based In-Chip Systems Inc. to develop a new gate array architecture with dramatically improved density. The resulting CMOS9HD process, which uses the In-Chip core cell architecture, has shown the ability to cut die cost by 20 to 50 percent compared with NEC's existing CMOS9 0.35 μ m arrays.
- NEC announced an agreement in early 1996 with Sun Microsystems to produce the U.S. company's UltraSPARC 64-bit RISC microprocessor on a contract basis. Later in 1996, NEC licensed Sun's PicoJava chip core for use in multimedia chips for Internet-ready TV sets.
- NEC has been collaborating with Lucent on the development of advanced CMOS process technologies since 1991. The team completed development of a 0.25 μ m process flow in early 1997 and are currently working on a successor 0.18 μ m program, which is targeted for completion in 1999.

- NEC linked up with Symetrix of Colorado to develop ferroelectric RAMs (FRAMs). NEC has already developed a 1M FRAM on its own.
- NEC licensed to Samsung its 78K series 16-bit microcontroller technology in October 1995. Samsung is now a second source for the devices and is allowed to use the 78K series as a 0.8 μ m 16-bit core.
- NEC jointly developed its high-performance PowerVR 3D graphics acceleration chip with VideoLogic Ltd. of the United Kingdom. The PowerVR enables 3D graphics games to be played on a PC.
- In September 1995, NEC licensed the ARM7 RISC microprocessor core of Advanced RISC Machines Ltd. NEC develops, manufactures, and markets ASICs based on the 32-bit RISC core.
- NEC has an agreement with Mips Technologies to second source all Mips RISC microprocessor architectures, including the R3000A, the R4000, the R4400, the R5000, the R4200, and the ECL version. The two firms are working closely to develop RISC devices for future needs.
- Samsung forged an alliance with NEC to exchange information about 256M DRAM cell technology. The companies have another agreement under which NEC supplies Samsung with DRAMs in wafer or die form from its fab in Scotland. Samsung packages and tests the devices at a site in Portugal and then sells them to European PC manufacturers.
- NEC established a relationship with flash memory developer SanDisk Corporation to manufacture 256M flash devices using NEC's 0.35 μ m process technology. NEC also purchased a one percent share of ownership in SanDisk.

NEW JAPAN RADIO (NJRC)

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 17th Floor Arco Tower
 8-1 Shimomeguro 1-chome
 Meguro-ku, Tokyo 153, Japan
 Telephone: (81) (3) 5434-8335
 Fax: (81) (3) 5434-8261

IC Manufacturer

Regional Headquarters/Representative Locations

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Financial History (\$M)

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Sales	310	350	430	525	440
R&D Expenditures	45	50	65	80	65
Capital Expenditures				70	50
Employees	1,530	1,560	1,640	1,706	1,710

Company Overview and Strategy

New Japan Radio Co. (NJRC) was founded in 1959 as a joint venture between Raytheon Company and Japan Radio Co., Ltd. (JRC). NJRC designs and manufactures bipolar and CMOS linear ICs, high-reliability microwave components, optoelectronic devices, and satellite broadcast receiving equipment for a wide range of applications in military, commercial, and consumer electronics equipment. The company claims to be the industry's largest supplier of operational amplifier ICs.

Products and Processes

Linear ICs are NJRC's primary product line. The company offers a broad range of bipolar linear ICs for such applications as audio, TV/video, communications, computer peripherals, office automation, and consumer electronics. Its CMOS linear ICs include operational amplifiers, comparators, voltage regulators, LCD drivers/controllers, data converters, analog switches, and special function devices.

In 1996, the company entered the digital signal processor market with 16-bit and 24-bit DSPs developed with California-based Medianix Semiconductor, in which it has a 51 percent stake. In addition, NJRC is bolstering its GaAs MMIC portfolio by introducing various amplifiers and mixers for cellular and PHS phones.

NJRC is also a supplier of microperipheral ICs (MPRs), custom designed ICs, SAW filters, optoelectronic devices, and microwave devices and equipment.

NJRC uses bipolar, CMOS, BiCMOS, and GaAs technologies in the processing of its semiconductor products. The company is shifting its focus from bipolar to CMOS ICs.

Semiconductor Fabrication Facilities

New Japan Radio Co., Ltd.
Kamifukuoka-shi, Saitama, Japan
Capacity (wafers/week): 10,500
Wafer sizes: 100mm, 125mm
Processes: Bipolar, CMOS, BiCMOS
Products: Linear ICs, MPRs, DSPs, custom ICs, discretes
Feature sizes: 0.8 μ m-1.2 μ m

New Japan Radio Co., Ltd.
Kamifukuoka-shi, Saitama, Japan
Capacity (wafers/week): 700
Wafer size: 75mm
Process: GaAs
Products: MMICs, optoelectronics
Feature sizes: 0.5 μ m-1.5 μ m

NIPPON PRECISION CIRCUITS (NPC)

Nippon Precision Circuits Inc. (NPC)

4-3, Fukuzumi 2-chome

Koto-ku, Tokyo 135, Japan

Telephone: (81) (3) 3642-6661

Fax: (81) (3) 3642-6698

Web Site: www.npcproducts.com

IC Manufacturer

Employees 450

Regional Headquarters/Representative Locations

North America: Infinite Technology Corporation • Richardson, Texas
Telephone: (972) 437-7800 • Fax: (972) 437-7810

Company Overview and Strategy

Nippon Precision Circuits, Inc. (NPC) was established in 1975 and operates under the Seiko Precision business of Japan's Seiko Group. NPC develops, fabricates, and markets high-speed, low-power CMOS ICs for applications in audio equipment, mobile communications, consumer electronics, clocks and watches, and computer and computer peripheral systems.

Key Management

Tabuchi Norio President

Products and Processes

NPC's products include a wide range of audio circuits, such as digital filters, sigma-delta D/A converters, and dedicated audio DSPs; frequency synthesizer PLLs that operate from a 0.95V power supply; oscillator ICs; 8-bit A/D and D/A converters; melody and voice synthesis ICs; a variety of clock and watch ICs; and peripheral ICs.

The company uses a proprietary molybdenum-gate CMOS process in the fabrication of its ICs. The process realizes high-speed operation and low power consumption.

Semiconductor Fabrication Facilities

Nippon Precision Circuits, Inc.
Shiobara Technology Center, S Building
531-1, Shimotano, Shiobara-machi, Nasu-gun
Tochigi 329-28, Japan
Telephone: (81) (287) 35-3111
Fax: (81) (287) 35-3116
Capacity (wafers/week): 3,250
Wafer size: 125mm
Process: CMOS
Products: Linear and logic ICs, ASSPs
Feature size: 2.0 μ m

Nippon Precision Circuits, Inc.
Shiobara Technology Center, H Building
531-1, Shimotano, Shiobara-machi, Nasu-gun
Tochigi 329-28, Japan
Telephone: (81) (287) 35-3111
Fax: (81) (287) 35-3116
Capacity (wafers/week): 5,000
Wafer size: 150mm
Process: CMOS
Products: Linear and logic ICs, ASSPs, DSPs
Feature size: 0.8 μ m

NIPPON STEEL SEMICONDUCTOR (NPNX)

Nippon Steel Semiconductor Corporation
 4F 25 Chuo Building
 2-8-3 Kandatsukasa-cho
 Chiyoda-ku, Tokyo 101, Japan
 Telephone: (81) (3) 5294-2701
 Fax: (81) (3) 5294-2707

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Nippon Steel Semiconductor U.S.A. Corporation • Santa Clara, California
 Telephone: (408) 524-8000 • Fax: (408) 524-8040

Financial History (\$M)

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Sales	160	257	305	580	200
Capital Expenditures	76	69	73	110	180
Employees	780	815	850	920	875

Company Overview and Strategy

Nippon Steel Semiconductor (NPNX) was founded as NMB Semiconductor in 1984 by Japan's Minebea Group. Suffering from huge losses and a lack of funding, Minebea decided that the rescue of NMB was too big a job and began searching for potential buyers. In early 1993, NMB was purchased by Nippon Steel Corp., the world's largest steel maker, who was looking to diversify its business by entering new markets such as electronics and data communications. The operation was renamed Nippon Steel Semiconductor Corp.

Since becoming Nippon Steel Semiconductor, the company's focus has been redirected from manufacturing ICs on an OEM basis for other companies to promoting its own DRAM business. A portion of NPNX's business remains OEM oriented; it manufactures DRAMs for Hitachi and enhanced DRAMs (EDRAMs) for Ramtron.

Management

Hidehiko Iwasaki President

Products and Processes

Nippon Steel Semiconductor's primary products are high-speed CMOS DRAMs (1M to 16M in density), developed with United Memories Inc. (UMI) of Colorado, a joint venture formed by NPNX and Ramtron, but now wholly owned by NPNX. The company plans to launch 64M DRAM production in the second half of 1998 at its newest fab in Tateyama and at a new joint venture fab it and Hitachi are building in Singapore.

In mid-1997, the company began producing a new line of synchronous graphics DRAMs (SGRAMs), the first of which was a 133MHz 8M part. Other graphics DRAMs as well as synchronous DRAMs are under development.

Semiconductor Fabrication Facilities

Nippon Steel recently completed construction of a new 200mm wafer manufacturing line to produce 16M DRAMs, and later 64M DRAMs. Production on the new N1 line, which replaced the company's original M1 line, began in late 1996. The fab has a capacity of 2,500 wafers per week.

Nippon Steel Semiconductor Corp.
Tateyama Facility
Tateyama-shi, Chiba Prefecture, Japan
Cleanroom size: 100,000 square feet
Capacity (wafers/week): 7,500
Wafer sizes: 150mm, 200mm
Process: CMOS
Products: DRAMs
Feature sizes: 0.4 μ m, 0.5 μ m, 0.6 μ m

Nippon Steel Semiconductor Corp.
R&D Center
Sagamihara-shi, Kanagawa Prefecture, Japan
Wafer size: 150mm
Process: CMOS
Products: Memory and logic IC R&D
Feature sizes: 0.35 μ m-0.5 μ m

Hitachi Nippon Steel Semiconductor
Singapore Pte. Ltd.
Tampines, Singapore
Cleanroom size: 64,600 square feet
Capacity (wafers/week): 6,250
Wafer size: 200mm
Process: CMOS
Products: DRAMs
Feature size: 0.3 μ m
(Joint venture with Hitachi and the government
of Singapore. Operations to start in 1998.)

Key Agreements

- In 1988, Nippon Steel Semiconductor (then NMB Semiconductor) and Ramtron entered into a product development and license agreement for conventional 1M and 4M DRAMs. Then, in 1990, the two companies established United Memories, Inc. (UMI) to design and develop advanced memory devices (not involving Ramtron's ferroelectric technology) for both companies. In 1995, Ramtron sold all its remaining interest in UMI to Nippon Steel. Now, Nippon Steel manufactures and sell 4M EDRAM products to Enhanced Memory Systems for resale to EMS's customers.
- Nippon Steel is producing DRAMs for Hitachi on an OEM basis. In addition, Hitachi and Nippon Steel are building a joint-venture DRAM fab in Singapore for the production of 64M DRAMs, starting in early 1998.

NKK

NKK Corporation
LSI Division
1-1-2 Marunouchi
Chiyoda-ku, Tokyo 100, Japan
Telephone: (81) (3) 3217-3119
Fax: (81) (3) 3217-3148
Web Site: www.tokyo.nkk.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: NKK Micro Devices, Inc. • Santa Clara, California
 Telephone: (408) 982-8277 • Fax: (408) 982-9809

Financial History, Fiscal Year Ends March 31

	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)			
Sales	¥1,778	¥1,802	¥1,806
Net Income	¥52	¥(38)	¥(40)

Company Overview and Strategy

NKK Corporation, a leading manufacturer of steel, ships, and industrial machinery, began expanding its business into electronic devices in late 1989. To do so, NKK established technology partnership and development agreements with Paradigm Technology for SRAMs, IDT for RISC MPUs, and Macronix International for mask ROMs and flash memories.

Since 1992, when the company's fab was opened for production, NKK has focused on the development and production of its high-speed SRAMs. While SRAMs remain an important product line for NKK, in 1995, the company's focus began shifting to microprocessors for embedded applications, such as game machines, printers, car navigation systems, and copiers. Additional SRAM capacity has been shifted to the production of flash memories and other LSI products.

Management

Yoichi Shimogaichi	President
Morio Saito	Director, LSI Division

Products and Processes

NKK's IC products include a variety of high-speed and low-power SRAMs, flash memories, mask ROMs, 32-bit and 64-bit Mips-derivative RISC microprocessors, and supporting chipsets.

Low-power SRAMs (256K and 1M densities)

High-speed SRAMs (256K, 512K, 1M, and 4M densities)

Processor-specific synchronous burst mode SRAMs (Intel, SPARC, Mips)

Mask ROMs (1M, 2M, 4M, 16M, and 32M densities)

Flash memories (1M, 4M, and 16M densities)

32-bit and 64-bit RISC processors based on the Mips R3000, R4000, and R5000 architectures

PCI bus controller and memory controller chipsets

ASSPs and ASICs (sea-of-gates arrays and standard cells) incorporating the Mips cores

Semiconductor Fabrication Facilities

NKK Ayase LSI Research Center

2596, Yoshioka

Ayase, Kanagawa Prefecture, Japan

Telephone: (81) (476) 70-5009

Cleanroom size: 35,500 square feet (Class 1)

Capacity (wafers/week): 1,500

Wafer size: 200mm

Process: CMOS

Products: SRAMs, flash memories, ROMs, MPUs, ASICs, ASSPs

Feature sizes: 0.35 μ m, 0.5 μ m

(NKK has plans to expand this facility.)

Key Agreements

- NKK Corporation jointly developed 4M and 16M flash memory devices and 4M ROMs with its Japanese partner Macronix.
- NKK licensed Mips Technologies' RISC microprocessor architecture. With it, NKK is developing a 150MHz enhanced floating point version of the R4600 (Orion) processor.

OKI

Oki Electric Industry Co., Ltd.
Electronic Devices Division
10-3, Shibaura 4-chome
Minato-ku, Tokyo 108, Japan
Telephone: (81) (3) 3454-2111
Fax: (81) (3) 3798-7042
Web Site: www.oki.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Oki America, Inc. • Hackensack, New Jersey
 Telephone: (201) 646-0011 • Fax: (201) 646-9229 • Web Site: www.oki.com

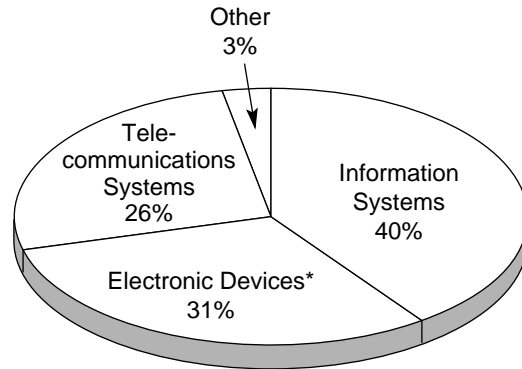
Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥681	¥640	¥652	¥657	¥748
Net Income	¥(0.5)	¥(33)	¥(2)	¥32	¥25
Semiconductor (\$M)*					
Sales	\$1,155	\$1,380	\$1,680	\$2,045	\$1,390
IC Sales	\$1,135	\$1,365	\$1,665	\$2,030	\$1,380
Discrete Sales	\$20	\$15	\$15	\$15	\$10
Capital Expenditures	\$150	\$125	\$205	¥410	¥375

*Calendar Year

Company Overview and Strategy

Oki Electric Industry Co. is a global manufacturer of telecommunication systems, information processing systems, and electronic devices. Oki manufactured its first integrated circuit devices in 1965. Since then, its semiconductor product portfolio has grown to include a full range of memory, ASIC, and telecommunications-related integrated circuits. These devices are sold primarily to customers in the computer, telecommunications, automotive, and consumer products industries.



*Includes ICs, optoelectronic devices, relays, switches, and solid-state disk cards.

1996 Corporate Sales by Business Group

Oki's semiconductor business in the U.S. is handled by the Oki Semiconductor Group within Oki America, Inc. Based in Sunnyvale, California, Oki Semiconductor is responsible for the sale of Oki's ASICs, memory products, display drivers and controllers, microprocessors, microcontrollers, microperipheral ICs, RF and fiber optic devices, speech synthesis and voice recognition ICs, telecom ICs, and other VLSI devices. Prior to 1996, Oki Semiconductor had only IC assembly capabilities at its manufacturing facility in Tualatin, Oregon. Its first IC fabrication facility underwent construction in 1994 and began operations in 1996 (see Semiconductor Fabrication Facilities).

The development and marketing of advanced multimedia and telecommunications ICs for the U.S. market are supported by the new Oki America division called Silicon Dynamics, headquartered in Sunnyvale. Silicon Dynamics specializes in developing ASSPs such as ATM/Ethernet network ICs, audio/video compression ICs, and DSP/RISC core products.

Oki's long term goal is to expand its memory business, while tightening its focus on value-added, highly integrated, system-level ASSPs for applications such as wired and wireless communications. In addition, Oki is aggressively expanding its GaAs production capabilities for devices targeted at personal communications equipment.

Management

Oki Electric Industry Company

Jun Jinguji	President and Chief Executive Officer
Kazuhiko Shimizu	Senior General Manager, Electronic Devices Sales and Marketing Group

Oki Semiconductor Group (U.S.)

Hisao Baba	President and Chief Executive Officer
Larry Chalfan	Executive Vice President, Manufacturing
Joe Baranowski	Vice President, Sales and Marketing
Andy Davis	Vice President, Engineering
Bharate Gupte	Associate Vice President, Marketing Development

Products and Processes

Oki manufactures a broad line of semiconductor devices and board-level products, including CMOS memory ICs and ASICs. Oki's product line also includes speech synthesis/voice recognition circuits, microcontrollers and processors, display drivers, and advanced communications devices for wireless and fiber optic applications.

MOS MEMORY		ANALOG	
<input checked="" type="checkbox"/>	DRAM	<input checked="" type="checkbox"/>	Amplifier
<input checked="" type="checkbox"/>	SRAM	<input type="checkbox"/>	Interface
<input checked="" type="checkbox"/>	Flash Memory	<input type="checkbox"/>	Consumer/Automotive
<input type="checkbox"/>	EPROM	<input type="checkbox"/>	Voltage Regulator/Reference
<input checked="" type="checkbox"/>	ROM	<input checked="" type="checkbox"/>	Data Conversion
<input checked="" type="checkbox"/>	EEPROM	<input type="checkbox"/>	Comparator
<input checked="" type="checkbox"/>	Other (Including Non-Volatile RAM)	<input checked="" type="checkbox"/>	Other (Includes Telecom)
MOS LOGIC		DIGITAL BIPOLAR	
<input checked="" type="checkbox"/>	General Purpose Logic	<input type="checkbox"/>	Bipolar Memory
<input checked="" type="checkbox"/>	Gate Array	<input type="checkbox"/>	General Purpose Logic
<input checked="" type="checkbox"/>	Standard Cell	<input type="checkbox"/>	Gate Array/Standard Cell
<input type="checkbox"/>	Field Programmable Logic	<input type="checkbox"/>	Field Programmable Logic
<input checked="" type="checkbox"/>	Other Special Purpose Logic	<input type="checkbox"/>	Other Special Purpose Logic
		<input type="checkbox"/>	MPU/MCU/MPR
MOS MICROCOMPONENT		OTHER	
<input checked="" type="checkbox"/>	MPU	<input type="checkbox"/>	Full Custom IC
<input checked="" type="checkbox"/>	MCU	<input checked="" type="checkbox"/>	Discrete
<input checked="" type="checkbox"/>	MPR	<input checked="" type="checkbox"/>	Optoelectronic
<input checked="" type="checkbox"/>	DSP		

Memory IC Products

Oki's memory IC products include standard DRAMs in 1M to 64M configurations, 16M synchronous DRAMs, 8M synchronous graphics RAMs, 4M burst DRAMs, mask ROMs and OTP ROMs up to 16M in density, CMOS SRAMs up to 1M, serial EEPROMs, 1M VRAMs, and flash memories in 1M to 4M densities.

Oki is a licensee of the Rambus architecture and is developing a 64M Rambus DRAM (RDRAM). In addition, Oki entered the multibank DRAM (MDRAM) market through an alliance with MoSys Inc. The MDRAMs, which are available in 4M to 10M densities, have multiple banks of memory providing bandwidth as high as 660 Mbytes/second.

With regard to future DRAM products, Oki claims to have developed a 1G SDRAM, designed using a 0.16µm process. The chip measures 572 square millimeters and operates at 150MHz on 2.5V.

Microcomponents

The company's MOS microcomponent IC products include microcontrollers (4-bit, 8-bit, and 16-bit), microprocessors (compatible with the Intel 80C85 and 80C88 families), digital signal processors (16-bit and 32-bit), and microperipherals such as PCMCIA controllers and real-time clocks.

ASIC Products

Oki offers sea-of-gates (SOG) and customer structured array (CSA) ASIC families in double- and triple-layer metal silicon-gate CMOS processes with up to 724K usable gates. These devices are available in 0.35 μ m, 0.5 μ m, and 0.8 μ m geometries. In early 1997, Oki signed an agreement with Silicon Architects of Synopsys to license Silicon Architects' cell based array (CBA) architecture to add to its 0.35 μ m ASIC offerings.

Oki's ASIC cell library includes clock management circuits, PCI-bus I/O chips, Ethernet media-access controllers (MACs), Universal Serial Bus (USB) controllers, and content-addressable memories (CAMs).

Other IC Products

Oki offers a wide range of telecommunications ICs for digital cordless telephones and data modems. The company also offers speech synthesizer chips and single-chip voice recognition devices. For liquid crystal or plasma displays, Oki offers driver circuits in multiple configurations.

In early 1997, Oki entered the graphics market with a multimedia accelerator with embedded DRAM codeveloped with partner Silicon Magic. The chip (MSM7680) integrates logic functions with a 10M SDRAM frame buffer and uses a 256-bit internal bus. A scalable expansion bus allows an additional 8M of memory.

Oki continues to be a leading supplier of GaAs RF and fiber optic components. Its GaAs ICs include amplifiers, mixers, prescalers, and filters.

Semiconductor Fabrication Facilities

Miyazaki Oki Electric Co., Ltd.
Miyazaki-gun, Miyazaki Prefecture, Japan
Capacity (wafers/week): 16,250
Wafer sizes: 125mm, 150mm
Process: CMOS
Products: DRAMs, SRAMs, EEPROMs, ROMs, MPUs, ASICs, linear and logic ICs
Feature sizes: 0.5 μ m-1.5 μ m

Miyagi Oki Electric Co., Ltd.
Kurokawa-gun, Miyagi Prefecture, Japan
Capacity (wafers/week): 18,750
Wafer sizes: 150mm, 200mm
Process: CMOS
Products: DRAMs, VRAMs, SRAMs, flash memories, logic ICs, ASICs
Feature sizes: 0.3 μ m-0.8 μ m

Oki Electric Industry Co., Ltd., Hachioji Plant
Hachioji-shi, Tokyo, Japan
Capacity (wafers/week): 7,250
Wafer sizes: 100mm, 150mm, 200mm
Processes: CMOS, BiCMOS, bipolar
Products: Logic and linear ICs, R&D
Feature sizes: 0.3 μ m-2.0 μ m
(All but a few of the production lines at this site were converted to be used for R&D purposes.)

Oki Electric Industry Co., Ltd., Hachioji Plant
Hachioji-shi, Tokyo, Japan
Capacity (wafers/week): 1,000
Wafer size: 3in
Process: GaAs
Products: Telecom ICs and discretes
Feature size: 0.5 μ m
(Plans to increase the wafer capacity at this fab to 3,750 per week by the end of 1998.)

Oki America, Inc.
Oki Semiconductor Manufacturing Group
11155 Southwest Leveton Drive
Tualatin, Oregon 97062
Telephone: (503) 692-9100
Fax: (503) 692-0967
Capacity (wafers/week): 3,750
Wafer size: 200mm
Process: CMOS
Products: DRAMs, ASICs
Feature size: 0.35 μ m

Key Agreements

- Oki entered the graphics market in early 1997 with a multimedia accelerator with embedded memory as part of a joint development alliance with Silicon Magic. The chip builds on a long-standing relationship between Oki and Silicon Magic and is part of a December 1996 deal that involved the exchange of Oki's foundry capacity for Silicon Magic's DRAM integration designs.
- In early 1997, Oki licensed the cell based array (CBA) ASIC architecture of Silicon Architects of Synopsys. Oki will add the CBA architecture to its 0.35 μ m CMOS ASIC offerings.
- In mid-1996, MoSys Inc. deepened its relationship with Oki giving the Japanese company worldwide distribution and marketing rights to MoSys' multibank DRAMs (MDRAMs). Fabless MoSys signed a foundry agreement with Oki in late 1995 for the production of its MDRAMs.
- Oki helped Nan Ya Plastics, Taiwan's largest printed-circuit board supplier, construct a 200mm wafer plant and start up its DRAM business. Oki's 16M DRAM technology was transferred to the new fab, which began making DRAMs in 1996. In addition, Oki receives 10 to 30 percent of the fab output.
- Looking to reduce costs, Oki and Sony linked together to jointly develop a 0.25 μ m process. Their goal is to finish development by 1998 so that each company can apply the process to memory and logic (including ASIC) products.
- Oki and Samsung entered a five-year technology exchange agreement for synchronous DRAMs.
- Oki jointly developed its 64M synchronous DRAM with design house Mosaid Technologies of Ontario, Canada. Oki started producing the SDRAMs in 1996.
- Oki has developed 1M, 2M, 4M, and 8M flash memory devices with California-based design firm Nexcom Technology. Oki also produces flash memory ICs for Catalyst Semiconductor.
- Oki signed a 32-bit RISC microprocessor code licensing agreement with Advanced RISC Machines (ARM) of the U.K. Under terms of the agreement, Oki will develop, manufacture, and sell ASICs based on the ARM core.

- HP licensed Oki to build an embedded-control version of its PA-RISC 32-bit microprocessor.
- Oki has a second-source agreement with Matra MHS for telecommunications ICs.
- Oki entered into a technology license agreement with Rambus in 1993 and is developing a 64M Rambus DRAM based on that technology.

RICOH

Ricoh Co., Ltd.
Electronic Devices Division
 13-1, Himemuro-cho
 Ikeda-shi, Osaka 563, Japan
 Telephone: (81) (727) 53-111
 Fax: (81) (727) 53-6011
 Web Site: www.ricoh.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Ricoh Corporation, Electronic Devices Division • San Jose, California
 Telephone: (408) 432-8800 • Fax: (408) 432-8375

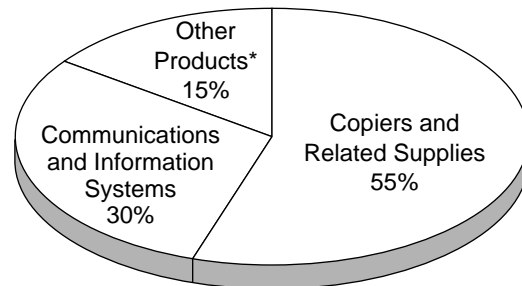
Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥1,017	¥1,022	¥968	¥1,020	¥1,113
Net Income	¥2	¥5	¥10	¥19	¥22
Semiconductor (\$M)*					
IC Sales	\$200	\$230	\$295	\$355	\$315

*Calendar Year

Company Overview and Strategy

Established in 1936, Ricoh Company is one of the world's top suppliers of office automation equipment, including copiers, facsimiles, and data processing systems. The company is also a leader in state-of-the-art electronic devices and is renowned for its photographic equipment. Ricoh's digital and color technologies are increasingly incorporated in multifunctional image processing equipment and systems used by businesses worldwide.



*Includes cameras, disk drives, thermal labels, and ICs.

1996 Corporate Sales by Business Segment

Ricoh began developing and producing semiconductors specifically for its own products in 1981. One year later, the company began selling ICs to external customers. Today, Ricoh's semiconductor efforts are focused primarily on image processing applications, in support of its corporate strategy called Image Processing Systems (IPS) integration. Its prominent ICs include controllers and digital signal processors for facsimile machines, JPEG image processors, and PCMCIA controllers.

Management

Hiroshi Hamada	President
Taisaburo Homae	Managing Director, Electronic Devices Division

Products and Processes

Ricoh manufactures ASICs and ASSPs, as well as other standard ICs and full custom devices.

Gate Array ASICs

- 5GU Series—0.8 μ m CMOS process, up to 194,400 gates and 384 I/Os, and gate delays of 0.38ns.
- 5GL Series—1.2 μ m CMOS process, up to 10,000 gates and 236 I/Os, and gate delays of 0.8ns.
- 5GV Series—1.2 μ m CMOS process, up to 16,100 gates and 204 I/Os, and gate delays of 0.8ns.
- 5GF Series—1.5 μ m CMOS process, up to 8,200 gates and 168 I/Os, and gate delays of 1.0ns.

Standard Cell ASICs

- RSC-08 Series—0.8 μ m CMOS process.
- RSC-12 Series—1.2 μ m CMOS process.
- RSC-15 Series—1.5 μ m CMOS process.
- Ricoh's cell library includes 8-bit, 16-bit, and 32-bit microcontrollers, peripherals, DSP cores, memory cells, and analog cells.

Programmable Logic Devices

- CMOS EPLDs.

Application Specific Standard Products

- Image compression/decompression chipsets compliant with the JPEG standard. MPEG image processing chips are being developed.
- Image filtering processors.
- Sound generators.
- Voice recognition ICs.
- Real time clocks.
- PC card controllers.
- CD-R system ICs.
- PWM generators.

Other Standard ICs

- Mask ROMs with densities of 64K, 128K, 256K, and 1M in NMOS technology and 256K, 1M, 2M, 4M, and 16M in CMOS technology.
- Single-chip 8-bit and 16-bit microcontrollers.
- Power management ICs based on CMOS technology.
- FIFO memories.

Semiconductor Fabrication Facilities

Ricoh Co., Ltd.

Ikeda Plant and LSI R&D Center

13-1 Himemuro-cho

Ikeda-shi, Osaka 563, Japan

Telephone: (81) (727) 53-1111

Capacity (wafers/week): 5,500

Wafer sizes: 100mm, 150mm

Processes: NMOS, CMOS, BiCMOS

Products: Mask ROMs, MCUs, ASICs, ASSPs,
linear ICs, foundry services, R&D

Feature sizes: 0.8 μ m, 1.0 μ m, 1.2 μ m, 1.5 μ m

Ricoh Co., Ltd.

Yasiro Plant

30-1 Saho, Yashiro-cho

Kato-gun, Hyogo 673-14, Japan

Telephone: (81) (795) 42-6111

Capacity (wafers/week): 2,500

Wafer size: 150mm

Process: CMOS

Products: ASICs, ASSPs

Feature sizes: 0.8 μ m, 1.2 μ m

ROHM

Rohm Co., Ltd.
21 Saiin Mizosaki-cho
Okyo-ku, Kyoto 615, Japan
Telephone: (81) (75) 311-2121
Fax: (81) (75) 315-0172
Web Site: www.rohm.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Rohm U.S.A. Inc. • San Jose, California
 Telephone: (408) 433-2225 • Fax: (408) 434-0531

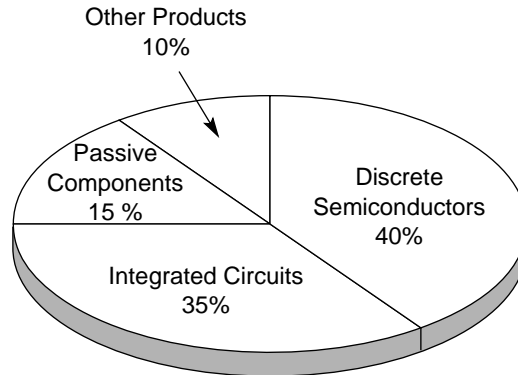
Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥205	¥187	¥200	¥241	¥292
Net Income	¥7	¥8	¥13	¥23	¥38
Semiconductor (\$M)*					
Sales	\$1,520	\$1,455	\$1,610	\$2,070	\$1,890
IC Sales	\$565	\$565	\$645	\$830	\$710
Discrete Sales	\$955	\$890	\$965	\$1,240	\$1,180
Capital Expenditures	\$140	\$125	\$190	\$310	\$195

*Calendar Year

Company Overview and Strategy

Rohm was originally called R. Ohm, with the R standing for resistor (the original product the company was based on). The company began developing ICs in 1969 and has since evolved into a major designer and manufacturer of ICs. Today, ICs, primarily large-scale integration (LSI) devices, have grown into one of the company's core businesses, accounting for about 35 percent of sales. Approximately 70 percent of Rohm's IC sales are custom products.



1996 Corporate Sales by Product Type

Management

Ken Sato	President and Chief Executive Officer
Junichi Hikita	Managing Director, LSI Products Headquarters, Manufacturing Headquarters I, Manufacturing Headquarters II
Kozo Sato	Managing Director, International Operations Headquarters
Takaaki Shigemitsu	Managing Director, Administrative Headquarters
Yukikazu Fujiwara	Director
Tokusaburo Hirata	Director, Eastern Japan Sales Headquarters
Akitaka Idei	Director, Marketing Division
Harukito Suematsu	Director, Western Japan Sales Headquarters

Products and Processes

The following is a breakdown of Rohm's semiconductor portfolio.

Integrated Circuits

Memory ICs (EEPROMs, SRAMs, FRAMs), application-specific microcontrollers, CMOS cell-based and gate array ASICs, standard ICs, power supply regulators, motor drivers, ICs for information processing and telecommunications, optical disc/multimedia-related ICs, ICs for audio applications, video processor ICs, and hybrid ICs.

Rohm continues to expand its presence in bipolar and CMOS devices, but is also developing BiCMOS devices and multi-time programmable (MTP) microcontrollers that utilize flash memory technology.

Discrete Semiconductors

Rohm produces a wide variety of transistors, diodes, resistors, capacitors, and light emitting diodes.

Rohm also manufactures and markets sensors, laser diodes, liquid crystal displays, and printheads.

Semiconductor Fabrication Facilities

Rohm Co., Ltd.
 21 Saiin Mizosaki-cho
 Ukyo-ku, Kyoto 615, Japan
 Cleanroom size: 27,000 square feet
 Capacity (wafers/week): 12,000
 Wafer sizes: 100mm, 150mm, 200mm
 Processes: Bipolar, CMOS, BiCMOS
 Products: SRAMs, MCUs, ASICs,
 EEPROMs, flash, FRAMs
 Feature sizes: 0.35 μ m-1.2 μ m

Exel Microelectronics, Inc. (a division of Rohm)
 2150 Commerce Drive
 San Jose, California 95131
 Cleanroom size: 18,000 square feet (Class 10)
 Capacity (wafers/week) 2,500
 Wafer size: 125mm
 Processes: CMOS, bipolar
 Products: EEPROMs, MCUs, foundry services
 Feature sizes: 1.0 μ m-2.0 μ m

Key Agreements

- In 1996, Rohm licensed the ARM7TDMI 32-bit RISC microprocessor core from Advanced RISC Machines. Rohm expects to begin producing ASICs based on the ARM core for cellular phones and PDAs in 2H97.
- Rohm joined Zycad Corporation's GateField Division to jointly develop FPGAs using Rohm's flash memory technology. In September 1996, the two companies expanded their agreement to include the fabrication of 0.6 μ m flash-based FPGAs for GateField. In April 1997, the agreement was expanded further to include Rohm's 0.35 μ m manufacturing process. Under the original agreement, Rohm manufactured devices only up to the 0.8 μ m level.
- Rohm signed a joint manufacturing, development, and marketing deal with Ramtron in 1993 that gave Rohm the right to produce and market Ramtron's line of ferroelectric memory (FRAM) products. In addition, the companies will jointly develop new ferroelectric-based devices, including microcontrollers. In 1995, the agreement was expanded to allow Rohm to redesign and modify Ramtron-designed FRAMs.
- Rohm formed a strategic agreement with Alliance Semiconductor Corporation. Under the deal Rohm is furnishing Alliance with 0.5 μ m wafer fab capacity for the production of SRAM devices. In return, Alliance is helping Rohm develop high-performance, low-power SRAMs.
- Rohm teamed up with Oak Technology, Inc. of Sunnyvale, California, to develop a next-generation video processor IC for multimedia applications.

SANYO

Sanyo Electric Co., Ltd.
Semiconductor Business Headquarters
180 Sakata Oizumi-Machi
Oura-gun, Gunma, Japan
Telephone: (81) (276) 61-8049
Fax: (81) (276) 61-2807
Web Site: www.sanyo.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Sanyo Semiconductor Corp. • Allendale, New Jersey
 Telephone: (201) 825-8080 • Fax: (201) 825-0163

Europe: Sanyo Semiconductor (Europe) GmbH • Eschborn, Germany
 Telephone: (49) (6196) 926-0 • Fax: (49) (6196) 926-266

Asia-Pacific: Sanyo Semiconductor (H.K.) Co., Ltd. • Kowloon, Hong Kong
 Telephone: (852) 2311-1198 • Fax: (852) 2311-0900

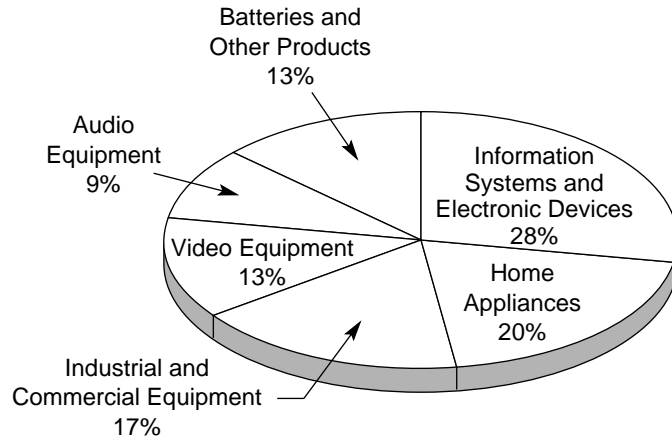
Financial History, Fiscal Year Ends November 30

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥1,537	¥1,527	¥1,660	¥1,707	¥1,650
Net Income	¥(1)	¥(2)	¥11	¥16	¥7
Semiconductor (\$M)*					
Sales	\$1,720	\$2,065	\$2,460	\$3,005	\$2,495
IC Sales	\$1,270	\$1,530	\$1,835	\$2,245	\$1,885
Discrete Sales	\$450	\$535	\$625	\$760	\$610
Capital Expenditures	\$275	\$360	\$365	\$560	\$625

*Calendar Year

Company Overview and Strategy

Founded in 1950, Sanyo Electric Co., Ltd. manufactures a broad range of electronic products, including video equipment, audio equipment, home appliances, industrial and commercial equipment, information systems, integrated circuits and discrete devices, and batteries.



1996 Corporate Sales by Business Segment

Sanyo entered the semiconductor business in 1958 with the initiation of transistor production. Development of ICs began in 1965 leading to mass production three years later. The company's semiconductor product portfolio has grown to include analog ICs, ASICs, memories, microcontrollers, CCDs, and discretes.

Management

Yasuaki Takano	President
Sadao Kondo	General Manager, Semiconductor Division
Motoharu Iue	President, Sanyo North American Corporation
Akifumi Goto	President, Sanyo Semiconductor Corporation (U.S.)

Products and Processes

Sanyo manufactures and markets a variety of semiconductor products, including CMOS gate array and standard cell ASICs, microcontrollers, MPRs, DRAMs, SRAMs, flash memories, ROMs, general-purpose logic and linear devices, LCD controllers and drivers, modem ICs, CD-ROM LSIs, audio/visual ICs, communications circuits, CCDs, sensors, discretes, and optoelectronics.

Sanyo's primary semiconductor products are discussed below.

ASICs

Sanyo continues to widen its portfolio of gate array and standard cell ASIC products. Its cell libraries include clocks, comparators, data converters, operational amplifiers, microcontroller and DSP cores, and memories. Sanyo also offers ASSPs, such as multimedia-related circuits, modem ICs, and communications chips.

Memories

Memory devices now in production include 16K to 1M standard SRAMs; 256K and 1M high-speed CMOS SRAMs; 256K pseudo-SRAMs; 1M to 32M flash memories; 1M and 4M mask ROMs; 256K to 4M EPROMs, and serial EEPROMs. The company is significantly expanding its flash memory output capacity, but currently much of the devices are supplied to Sanyo's partner Silicon Storage Technology.

The company's current DRAM production is mostly 1M and 2M parts, targeted at makers of CD-ROM and hard disk drives. Although the company has decided against committing funds for the commercial production of next-generation DRAMs, it will keep pace in the development of 64M DRAMs.

Analog ICs

Sanyo is one of the largest analog IC manufacturers in Japan and the world. Its A/D and D/A converters support a wide range of applications, including audio and video. Its other analog IC products include amplifiers, comparators, and voltage regulators.

Microcontrollers

Since starting to fabricate microcontrollers in 1980, Sanyo has expanded its line-up of 4-bit, 8-bit, and 16-bit single-chip microcontrollers for use in a wide range of industrial and consumer equipment. In 1995, Sanyo began shipping 8-bit and 16-bit microcontrollers with integrated flash memory.

<p>MOS MEMORY</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> DRAM <input checked="" type="checkbox"/> SRAM <input checked="" type="checkbox"/> Flash Memory <input checked="" type="checkbox"/> EPROM <input checked="" type="checkbox"/> ROM <input checked="" type="checkbox"/> EEPROM <input checked="" type="checkbox"/> Other (Including Non-Volatile RAM) 	<p>ANALOG</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Amplifier <input checked="" type="checkbox"/> Interface <input checked="" type="checkbox"/> Consumer/Automotive <input checked="" type="checkbox"/> Voltage Regulator/Reference <input checked="" type="checkbox"/> Data Conversion <input checked="" type="checkbox"/> Comparator <input checked="" type="checkbox"/> Other (Includes Telecom)
<p>MOS LOGIC</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> General Purpose Logic <input checked="" type="checkbox"/> Gate Array <input checked="" type="checkbox"/> Standard Cell <input type="checkbox"/> Field Programmable Logic <input checked="" type="checkbox"/> Other Special Purpose Logic 	<p>DIGITAL BIPOLAR</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bipolar Memory <input type="checkbox"/> General Purpose Logic <input type="checkbox"/> Gate Array/Standard Cell <input type="checkbox"/> Field Programmable Logic <input type="checkbox"/> Other Special Purpose Logic <input type="checkbox"/> MPU/MCU/MPR
<p>MOS MICROCOMPONENT</p> <ul style="list-style-type: none"> <input type="checkbox"/> MPU <input checked="" type="checkbox"/> MCU <input checked="" type="checkbox"/> MPR <input checked="" type="checkbox"/> DSP 	<p>OTHER</p> <ul style="list-style-type: none"> <input type="checkbox"/> Full Custom IC <input checked="" type="checkbox"/> Discrete <input checked="" type="checkbox"/> Optoelectronic

Semiconductor Fabrication Facilities

Sanyo Electric Co., Ltd., Oura-gun Facility
Oura-gun, Gunma Prefecture, Japan
Cleanroom size: 124,000 square feet
Capacity (wafers/week): 25,000
Wafer sizes: 100mm, 125mm
Processes: Bipolar, CMOS, MOS
Products: Analog and logic ICs, SRAMs,
MCUs, discretes
Feature sizes: 0.8 μ m-4.0 μ m

Sanyo Electric Co., Ltd., Tottori Facility
Tottori-shi, Tottori Prefecture, Japan
Cleanroom size: 32,300 square feet
Capacity (wafers/week): 5,000
Wafer size: 3in
Processes: GaAs, GaP
Products: Discretes, optoelectronics, MMICs
Feature sizes: 0.5 μ m-5.0 μ m

Niigata Sanyo Electronic Co., Ltd.
Ojiya-shi, Niigata Prefecture, Japan
Cleanroom size: 113,000 square feet
Capacity (wafers/week): 27,500
Wafer sizes: 125mm, 150mm, 200mm
Processes: CMOS, bipolar, BiCMOS
Products: DRAMs, SRAMs, MCUs, DSPs, ASICs,
analog and logic ICs, flash memories
Feature sizes: 0.35 μ m-2.0 μ m

Sanyo VLSI Engineering Co., Ltd.
Anpachi-gun, Gifu Prefecture, Japan
Capacity (wafers/week): 10,000
Wafer sizes: 125mm, 150mm
Process: CMOS
Products: CCDs, SRAMs, ROMs, ASICs
Feature sizes: 1.0 μ m-2.0 μ m

Key Agreements

- Sanyo formed an alliance in 1993 with U.S. ASIC design firm Aspec Technology with the goal of establishing a large-scale business supplying ASICs based on the U.S. firm's 0.8 μ m technology.
- Sanyo is working with Silicon Storage Technology Inc. of Sunnyvale, California, to develop flash memories. As part of the alliance, Sanyo is producing flash chips for SST.

SEIKO EPSON

Seiko Epson Corporation
Semiconductor Operation Division
 281 Fujimi-machi, Suwa-gun
 Nagano-ken 399-02, Japan
Telephone: (81) (266) 61-1211
Fax: (81) (266) 61-1270
Web Site: www.epson.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: S-MOS Systems, Inc. • San Jose, California
 Telephone: (408) 922-0200 • Fax: (408) 922-0238

Europe: Epson Europe Electronics GmbH • Munich, Germany
 Telephone: (49) (89) 14005-0 • Fax: (49) (89) 14005-110

Financial History (\$M)

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Semiconductor					
Sales	\$485	\$600	\$760	\$950	\$825

Company Overview and Strategy

Seiko Epson Corporation, a part of Japan's Seiko Group, commenced operations in 1942 as a watch manufacturer. Today, Seiko Epson has about \$4 billion in annual sales not only from watches but also from printers, personal computers, semiconductor devices, liquid crystal displays, manufacturing robots, and corrective lenses.

Seiko Epson's participation in semiconductor devices can be traced to the late 1960's with the development of small, energy-saving ICs for watches. The company commenced commercial production of semiconductors in 1980 at its Fujimi plant.

S-MOS Systems, Inc. in the U.S. and Epson Europe Electronics GmbH in Munich, Germany, are subsidiaries of Seiko Epson's Semiconductor Operation Division.

Management

Hideaki Yasukawa President
 Nobuo Hashizume General Manager, Semiconductor Operation Division

Products and Processes

Using mainly CMOS technology, Seiko Epson has a broad product portfolio including: ROMs, EEPROMs, SRAMs (densities up to 1M), 4-bit and 8-bit MCUs as well as a new 32-bit RISC MCU, power ICs, LCD driver ICs, and ASICs.

Seiko Epson is also heavily involved in foundry services. Over the past couple of years, Seiko Epson has accepted payments from companies like Lattice and Xilinx to go toward the construction of its newest fab in Sakata that is scheduled to begin operations in 3Q97. In return, the fabless companies receive a guaranteed portion of the fab output. Lattice agreed to invest up to \$150 million and Xilinx agreed to \$300 million.

Semiconductor Fabrication Facilities

Seiko Epson Corporation, Fujimi Plant
Suwa-gun, Nagano Prefecture, Japan
Cleanroom size: 83,000 square feet
Capacity(wafers/week): 16,250
Wafer sizes: 100mm, 125mm, 150mm
Processes: CMOS, BiCMOS, MOS
Products: SRAMs, EPROMs, EEPROMs, ROMs,
linear ICs, ASICs, foundry services
Feature sizes: 0.5 μ m-1.5 μ m

Tohoku Epson Corporation, Sakata Plant
Sakata-shi, Yamagata Prefecture, Japan
Cleanroom size: 100,000 square feet (Class 1)
Capacity (wafers/week): 7,500
Wafer sizes: 150mm, 200mm
Processes: CMOS, BiCMOS
Products: ASICs, SRAMs, logic ICs, MCUs,
foundry services
Feature sizes: 0.35 μ m-0.8 μ m

Seiko Epson Corporation
Sagamihara-shi, Kanagawa Prefecture, Japan
Cleanroom size: 70,000 square feet
Capacity (wafers/week): 1,250
Wafer size: 200mm
Process: CMOS
Products: R&D
Feature size: 0.25 μ m (0.15 μ m capability)

Key Agreements

- Seiko Epson and Chip Express signed a foundry and technology exchange agreement in early 1996. Under the agreement, Chip Express transferred its laser programming technology to Seiko. Seiko uses the technology for high volume gate array manufacturing for Chip Express as well as for prototyping its own ASIC products.
- Seiko Epson established a pact with SGS-Thomson that called for the cross licensing of each other's patents.
- Seiko Epson and Xilinx have enjoyed a close relationship since the mid 1980's. Seiko acts as a foundry for Xilinx's IC products.

SEIKO INSTRUMENTS

Seiko Instruments Inc.
1-8, Nakase 1-chome
Mihama-ku, Chiba-shi
Chiba 261, Japan
Telephone: (81) (43) 211-1111
Fax: (81) (43) 211-8021

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Seiko Instruments USA Inc., Electronic Components Division • Torrance, California
Telephone: (310) 517-7771 • Fax: (310) 517-7792 • Web Site: www.seiko-usa-eed.com

Company Overview and Strategy

Seiko Instruments manufactures a wide variety of products, including watches and watch components, liquid crystal displays (LCDs), CAD/CAE/CAM systems, analytical and measuring instruments, intelligent robots, and integrated circuits. Established in 1937, Seiko Instruments is part of the Seiko Group, which also includes Seiko Epson Corporation and Nippon Precision Circuits Inc.

Seiko Instruments' semiconductor products include a variety of ASSPs based on its technological and developmental capabilities cultivated with watch ICs, which require precision performance, accuracy, and low power consumption. The company's low-power CMOS ICs have applications in office and factory automation equipment, communications equipment, video and audio systems, and portable products.

Management

Seiko Instruments USA Inc.
Akira Shiraishi Chief Executive Officer
Greg Franklin Vice President, Administration
Laura Martinez Controller

Products and Processes

Seiko Instruments specializes in the manufacture of very-low-power CMOS integrated circuits.

Power Semiconductors

- Voltage detectors
- Voltage regulators
- Battery backup ICs
- Switching/inverting regulators
- DC-DC converters
- Power management ICs

Drivers

- LCD drivers
- Thermal print-head drivers

Timers

- Serial output timers
- Real time clocks
- CR timers

Telecommunications Circuits

- Paging decoders
- Tone generators
- Tone squelch ICs

Microcomputers

- 4-bit microcontrollers
- 8-bit microcontrollers

Memory Products

- Nonvolatile RAMs (NVRAMs)—64bit to 1K densities
- Serial EEPROMs—128bit to 4K densities
- Parallel EEPROMs—16K and 64K densities
- Fuse and mask ROMs—Up to 4M density
- SRAMs

Seiko Instruments also produces temperature sensors and lithium-ion battery protection ICs.

Semiconductor Fabrication Facilities

Seiko Instruments Inc.

Matsudo-shi, Chiba Prefecture, Japan

Capacity (wafers/week): 3,200

Wafer sizes: 100mm, 150mm

Process: CMOS

Products: Linear and power ICs, MCUs, SRAMs, EEPROMs, ROMs

Feature sizes: 1.25 μ m-2.0 μ m

SHARP

Sharp Corporation
Integrated Circuits Group
1 Asahi, Daimon-cho
Fukuyama, Hiroshima 721, Japan
Telephone: (81) (849) 43-3131
Web Site: www.sharp.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Sharp Electronics Corp., Microelectronics Group • Camas, Washington
 Telephone: (206) 834-2500 • Fax: (206) 834-8903 • Web Site: www.sharpmeg.com

Europe: Sharp Electronics (Europe) GmbH • Hamburg, Germany
 Telephone: (49) (40) 23760 • Fax: (49) (40) 230764

Asia-Pacific: Sharp Electronics (Singapore) Pte., Ltd. • Singapore
 Telephone: (65) 271-3566 • Fax: (65) 271-3855

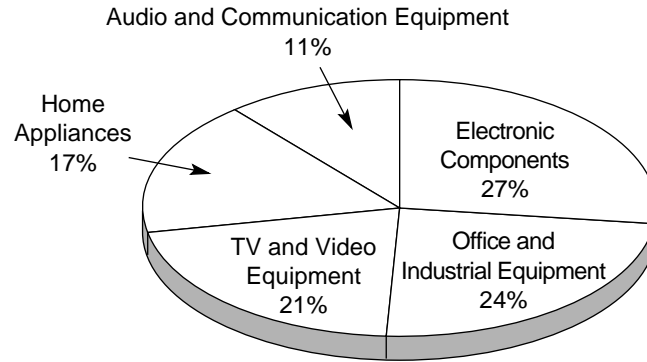
Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥1,555	¥1,508	¥1,518	¥1,618	¥1,651
Net Income	¥39	¥30	¥32	¥44	¥46
Semiconductor (\$M)*					
Sales	\$1,465	\$1,890	\$2,250	\$2,740	\$2,335
IC Sales	\$1,105	\$1,430	\$1,640	\$2,020	\$1,760
Discrete Sales	\$360	\$460	\$610	\$720	\$575
Capital Expenditures	\$230	\$270	\$340	\$385	\$735

*Calendar Year

Company Overview and Strategy

Sharp Corporation was established as a metal works operation in Tokyo in 1912. The company's name was derived from the Ever-Sharp mechanical pencil, invented by the founder in 1915. Today, Sharp is the world's largest producer of liquid crystal displays (LCDs), and uses advanced technology in many of its more than 45 product lines. The product lines include audio and video systems, electronic organizers, notebook computers and peripherals, copiers, calculators, integrated circuits, and optoelectronic devices.



1996 Corporate Sales by Business Group

Sharp began the mass production of LSIs in 1970. System applications for its semiconductor devices include PCs, office automation systems, telecommunications equipment, test and measurement products, industrial control systems, audio/visual and multimedia equipment, and consumer electronics products.

Management

Sharp Corporation

Haruo Tsuji President

Hiroshi Inoue Executive Director and General Manager, Integrated Circuits Group

Sharp Microelectronics Technology, Inc. (U.S.)

John Shroyer President

Frank Schneider Vice President

Products and Processes

Sharp's semiconductor products include: SRAMs; flash memories; high-performance microprocessors and controllers for high-volume data handling and image processing fields such as HDTV, digital camcorders, and multimedia and virtual reality systems; LCD driver ICs; ASICs; digital signal processors; and discrete devices. It is a leading supplier of optoelectronics, mask ROMs, and RF tuner components. Also, Sharp is the premiere supplier of three technologies that represent 95 percent of the flat panels displays now in use: active matrix color LCDs, passive matrix color LCDs, and electroluminescent (EL) displays.

MOS MEMORY		ANALOG	
<input checked="" type="checkbox"/>	DRAM	<input checked="" type="checkbox"/>	Amplifier
<input checked="" type="checkbox"/>	SRAM	<input checked="" type="checkbox"/>	Interface
<input checked="" type="checkbox"/>	Flash Memory	<input checked="" type="checkbox"/>	Consumer/Automotive
<input type="checkbox"/>	EPROM	<input checked="" type="checkbox"/>	Voltage Regulator/Reference
<input checked="" type="checkbox"/>	ROM	<input checked="" type="checkbox"/>	Data Conversion
<input type="checkbox"/>	EEPROM	<input checked="" type="checkbox"/>	Comparator
<input checked="" type="checkbox"/>	Other (Including Non-Volatile RAM)	<input type="checkbox"/>	Other (Includes Telecom)
MOS LOGIC		DIGITAL BIPOLAR	
<input type="checkbox"/>	General Purpose Logic	<input type="checkbox"/>	Bipolar Memory
<input checked="" type="checkbox"/>	Gate Array	<input type="checkbox"/>	General Purpose Logic
<input checked="" type="checkbox"/>	Standard Cell	<input type="checkbox"/>	Gate Array/Standard Cell
<input type="checkbox"/>	Field Programmable Logic	<input type="checkbox"/>	Field Programmable Logic
<input checked="" type="checkbox"/>	Other Special Purpose Logic	<input type="checkbox"/>	Other Special Purpose Logic
<input type="checkbox"/>		<input type="checkbox"/>	MPU/MCU/MPR
MOS MICROCOMPONENT		OTHER	
<input checked="" type="checkbox"/>	MPU	<input type="checkbox"/>	Full Custom IC
<input checked="" type="checkbox"/>	MCU	<input checked="" type="checkbox"/>	Discrete
<input checked="" type="checkbox"/>	MPR	<input checked="" type="checkbox"/>	Optoelectronic
<input checked="" type="checkbox"/>	DSP		

Memories

- Mask ROMs—NMOS and CMOS parts with 256K to 64M capacities
- SRAMs—CMOS low-power and high-speed versions with 16K to 1M capacities
- Pseudo SRAMs—256K to 4M capacities
- Flash memories—2M, 4M, 8M, 16M, and 32M densities. Sharp offers the world's largest Intel-standard flash capacity and produces approximately 25 percent of the world's flash supply under its own and Intel brand names. Sharp sells both its Intel-compatible dual-voltage and SmartVoltage NOR flash memories as well as its own single-voltage flash parts.
- DRAMs—256K, 1M, and 16M densities
- FIFOs—High-speed
- SF-ASIC RAM—Memory device containing a user-defined mix of RAM and ROM
- IC memory cards

Microcomponents

- 4-bit, 8-bit, and 16-bit single-chip microcontrollers (many with LCD interface)
- 32-bit RISC microprocessors (ARM)
- Digital signal processors (Butterfly). Sharp developed the high-performance Butterfly DSP architecture, spun the technology off in 1993 to form the private company Butterfly DSP Inc., and then reacquired the operation in early 1997.

Single-Chip Systems

- Embedded arrays with Z80 and V Series microprocessor cores
- Cell-based ICs with Z80, V Series, and ARM7D RISC microprocessor cores

ASICs

- Gate arrays—Broad range, including sea-of-gates types and low-voltage CMOS versions, with 300 to 200,000 available gates
- Cell-based ICs—CMOS and BiCMOS versions, as well as mixed-signal types

Special Function ICs

- CCD area sensors and CCD peripheral ICs
- LCD drivers
- ICs for audio and visual equipment, IR remote controls, laser diode drivers, and motor drivers
- Voice synthesis and recording/playback ICs
- ICs for telecommunications, facsimiles, and modems
- ICs for calculators and data banks

Industry Standard Bipolar ICs

- Current drivers
- Operational amplifiers and comparators
- Regulators and V/F converters
- LED/LCD level meter drivers

Other Products

- Variety of optoelectronic devices
- GaAs MMICs and HEMTs
- Hall-effect ICs
- LEDs
- RF and IR components
- Power devices such as voltage regulators and switching power supply circuits

Semiconductor Fabrication Facilities

At the company's Fukuyama site, Sharp announced that it would begin constructing a fourth facility for future 0.25 μ m flash production. The company has outlaid \$1 billion for the fab, which will initially produce 2,500 200mm wafers per week, and later ramp to 5,000 wafers per week. Sharp hopes to begin flash production using this line in early 1998.

Sharp Corporation
 Fukuyama-shi, Hiroshima, Japan
 Capacity (wafers/week): 25,750
 Wafer sizes: 125mm, 150mm, 200mm
 Processes: CMOS, NMOS
 Products: Flash memories, ROMs, SRAMs,
 MPUs, MCUs, ASICs
 Feature sizes: 0.35 μ m, 0.4 μ m, 0.6 μ m,
 0.8 μ m, 1.0 μ m

Sharp Corporation
 Tenri-shi, Nara, Japan
 Capacity (wafers/week): 13,000
 Wafer sizes: 125mm, 150mm
 Processes: MOS, CMOS, bipolar
 Products: ASICs, logic, linear, and memory ICs
 Feature sizes: 0.8 μ m-3.0 μ m

Sharp Corporation
 Yamato Koriyama-shi, Nara, Japan
 Capacity (wafers/week): 5,000
 Wafer size: 3in
 Process: GaAs
 Products: Discrettes and MMICs

Sharp Corporation
 Kita-Katsuragi-gun, Nara, Japan
 Capacity (wafers/week): 6,250
 Wafer size: 100mm
 Process: Bipolar
 Products: Discrettes

Sharp Microelectronics Technology, Inc.
 5700 NW Pacific Rim Boulevard
 Camas, Washington 98607
 (Outfitted for IC design, assembly, and test. May
 serve as a possible future fab site. Also serves
 as an LCD manufacturing site.)

Key Agreements

- In early 1997, Sharp and SanDisk reportedly signed a cross-licensing agreement that gives both companies worldwide rights to each other's flash memory patents.
- Sharp agreed to provide the process technology needed to get Malaysia-based Interconnect Technology's foundry-dedicated fabrication facility up and running in 1H98. Sharp will share its 0.35 μ m CMOS process in return for a portion of the new fab's output.
- Sharp formed a second-source and product development alliance with Quality Semiconductor in 1995 that covers a variety of specialty memory products for advanced networking, multimedia data communications, and high-performance I/O subsystem applications.
- In 1994, Sharp licensed technology from Advanced RISC Machines to produce the ARM 32-bit RISC microprocessor as well as ASSPs based on the core.
- In 1992, Intel and Sharp signed an agreement to develop their flash memory business jointly. Sharp is currently shipping Intel's 32M and smaller flash devices on an OEM basis, and the two firms have developed parts that Sharp markets under its own brand name. In 1995, Sharp was able to expand into the lucrative U.S. market after its initial licensing agreement with Intel, which restricted it to the flash market in Japan, expired.

SONY

Sony Corporation
Semiconductor Company
4-14-1, Asahi-cho
Atsugi-shi, Kanagawa 243, Japan
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Fax: (81) (462) 30-5160
Web Site: www.sony.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Sony Semiconductor Co. Of America • San Jose, California
 Telephone: (408) 955-6572 • Fax: (408) 955-5116

Europe: Sony Semiconductor Europe • Basingstoke, Hampshire, England
 Telephone: (44) (1256) 478771 • Fax: (44) (1256) 818194

Asia-Pacific: Sony Electronic Devices (Hong Kong) Ltd. • Kowloon, Hong Kong
 Telephone: (852) 2956-4540 • Fax: (852) 2956-4518

Financial History, Fiscal Year Ends March 31

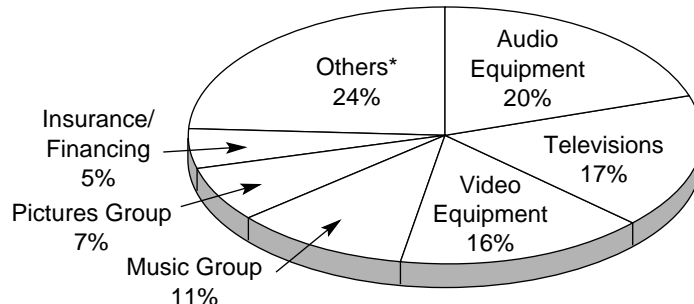
	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥3,932	¥4,001	¥3,744	¥3,991	¥4,593
Net Income	¥120	¥36	¥15	¥(293)	¥54
Semiconductor (\$M)*					
Sales	\$1,460	\$1,750	\$1,850	\$2,450	\$2,130
IC Sales	\$1,100	\$1,370	\$1,475	\$2,080	\$1,710
Discrete Sales	\$360	\$380	\$375	\$370	\$420
Capital Expenditures	\$385	\$365	\$390	\$460	\$460

*Calendar Year

Company Overview and Strategy

Sony Corporation was established in 1946 as Tokyo Tsushin Kogyo (Tokyo Telecommunications Engineering Corp.). Since its founding, Sony has developed into one of the world's leading manufacturers of audio and video equipment, televisions, displays, semiconductors, computers, and information-related products, such as CD-ROMs and micro floppy disk systems.

Sony is comprised of the following ten independent “companies”: Image & Sound Communication Co., Computer Peripherals & Components Co., Home AV Co., Personal AV Co., Information Technology Co., Personal & Mobile Communication Co., Recording Media & Energy Co., Broadcast Co., Semiconductor Co., and Display Co.



*Includes semiconductors, electronic components, and info-related equipment.

1996 Corporate Sales by Product Group

Sony produced its first transistors, back in 1954. Its first integrated circuits were produced in the mid-1960's. Sony has since grown into a leading supplier of semiconductors, including SRAMs, charge-coupled devices (CCDs), data converters, television and audio ICs, digital filters, communications ICs, and multimedia devices. The company's discrete components include laser diodes, variable capacitance diodes, and silicon and GaAs transistors.

The focus of Sony Semiconductor is currently on computer memory devices, bipolar and MOS ICs for home-use audiovisual (AV) equipment, and CCDs for camcorders and broadcast- and industrial-use video cameras. More than half (60 percent) of Sony's semiconductor sales in 1996 were to outside customers.

Management

Sony Semiconductor Company

Seiichi Watanabe President, Sony Semiconductor Company, and Director, Sony Corporation

Sony Semiconductor Co. of America

Travis White President, Sony Semiconductor Co. of America,
and Senior Vice President, Sony Semiconductor Company

Louis Chetaud Vice President, Central Operations

Todd Oseth Vice President, Business Development

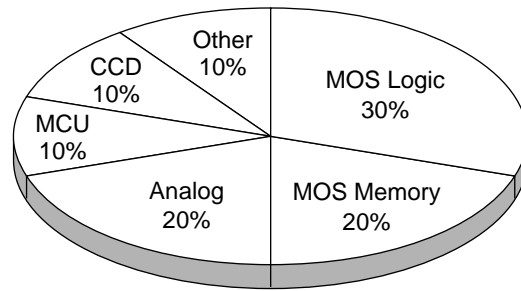
Osamu Yokoyama Vice President, Finance

Products and Processes

Sony manufactures SRAMs (64K to 4M), cache SRAMs, 1M synchronous burst SRAMs, charged-coupled devices (CCDs), LCD drivers, bipolar and CMOS data converters, MCUs (4-bit, 8-bit, and 16-bit), DSPs, and ASICs and ASSPs for applications such as image sensing, multimedia, audio-video, and digital cellular communications.

Sony, which has been focusing on SRAM production to advance its processing technology, predicts that demand for SRAMs will peak at the 16M level, and therefore plans to use non-memory products such as ASICs to drive technology development. The company is also placing greater emphasis on application-specific memory devices such as high-speed cache memories.

In addition, the company is actively pursuing the bipolar IC market with its advanced A/D and D/A converters and communications ICs.



1996 Semiconductor Sales by Device Type

<p>MOS MEMORY</p> <ul style="list-style-type: none"> <input type="checkbox"/> DRAM <input checked="" type="checkbox"/> SRAM <input type="checkbox"/> Flash Memory <input type="checkbox"/> EPROM <input type="checkbox"/> ROM <input type="checkbox"/> EEPROM <input type="checkbox"/> Other (Including Non-Volatile RAM) 	<p>ANALOG</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Amplifier <input checked="" type="checkbox"/> Interface <input checked="" type="checkbox"/> Consumer/Automotive <input type="checkbox"/> Voltage Regulator/Reference <input checked="" type="checkbox"/> Data Conversion <input type="checkbox"/> Comparator <input checked="" type="checkbox"/> Other (Includes Telecom)
<p>MOS LOGIC</p> <ul style="list-style-type: none"> <input type="checkbox"/> General Purpose Logic <input checked="" type="checkbox"/> Gate Array <input type="checkbox"/> Standard Cell <input type="checkbox"/> Field Programmable Logic <input checked="" type="checkbox"/> Other Special Purpose Logic 	<p>DIGITAL BIPOLAR</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bipolar Memory <input type="checkbox"/> General Purpose Logic <input type="checkbox"/> Gate Array/Standard Cell <input type="checkbox"/> Field Programmable Logic <input type="checkbox"/> Other Special Purpose Logic <input type="checkbox"/> MPU/MCU/MPR
<p>MOS MICROCOMPONENT</p> <ul style="list-style-type: none"> <input type="checkbox"/> MPU <input checked="" type="checkbox"/> MCU <input checked="" type="checkbox"/> MPR <input checked="" type="checkbox"/> DSP 	<p>OTHER</p> <ul style="list-style-type: none"> <input type="checkbox"/> Full Custom IC <input checked="" type="checkbox"/> Discrete <input checked="" type="checkbox"/> Optoelectronic

Semiconductor Fabrication Facilities

Sony announced in early 1997 that it would add a \$420 million 0.25 μ m process line at its Kokubu fab in Kagoshima that will partly be used for the manufacture of DRAM-embedded logic ICs for image processing applications. The new line will have a weekly capacity of 2,500 200mm wafers and will begin operations in mid-1998.

Sony plans to begin production at its first 300mm wafer fab in 1999. The new fab will be built at the company's site in Isahaya, Nagasaki.

Sony Kokubu Corporation
Kokubu-shi, Kagoshima Prefecture, Japan
Capacity (wafers/week): 24,250
Wafer sizes: 100mm, 125mm, 150mm, 200mm
Processes: CMOS, BiCMOS, bipolar, CCD, LCD
Products: ASICs, MCUs, CCDs, logic and
linear ICs, discretes, LCD, R&D
Feature sizes: 0.35 μ m-2.0 μ m

Sony Nagasaki Corporation
Isahaya-shi, Nagasaki Prefecture, Japan
Capacity (wafers/week): 25,125
Wafer size: 150mm
Process: CMOS
Products: ASICs, SRAMs, R&D
Feature sizes: 0.35 μ m-1.0 μ m

Sony Corporation, Atsugi Technology Center
Atsugi-shi, Kanagawa Prefecture, Japan
Wafer size: 3in
Process: GaAs
Products: Discretes, MMICs
Feature size: 0.5 μ m

Sony Corporation, Atsugi Technology Center
Atsugi-shi, Kanagawa Prefecture, Japan
Wafer sizes: 150mm, 200mm
Process: CMOS
Products: R&D
Feature sizes: 0.3 μ m-0.5 μ m

Sony Semiconductor Co. of America
San Antonio Operations
8611 Military Drive West
San Antonio, Texas 78245
Telephone: (512) 681-9000
Cleanroom size: 20,000 square feet
Capacity (wafers/week): 7,000
Wafer sizes: 125mm, 150mm
Processes: CMOS, bipolar
Products: SRAMs, logic ICs, PLDs, R&D
Feature sizes: 0.35 μ m-1.5 μ m

Sony's semiconductors are assembled at several factories in Japan and at a plant in Thailand.

Key Agreements

- In December 1995 it was announced that Sony and Oki would begin joint development of 0.25 μ m CMOS manufacturing technology that can be used for both ASICs and 256M DRAMs. Their goal is to finish development by 1998.
- Sony is producing bipolar ICs for AMD at its fab in San Antonio, which it bought from AMD in 1990.
- Through an architecture license from Mips Technology, Sony is designing an R3000 processor core to be embedded in its own multimedia and interactive consumer electronics systems.
- Sony licensed its 16-bit microcontroller core to TI Japan. In return, TI agreed to provide Sony with ASICs based on the core for use in Sony's video products. The companies will also work to adapt the core for office-automation and telecommunications equipment.

TOSHIBA

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Minato-ku, Tokyo 105-01, Japan
Telephone: (81) (3) 3457-4511
Fax: (81) (3) 3456-1631
Web Site: www.toshiba.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Toshiba America Electronic Components, Inc. • Irvine, California
 Telephone: (714) 455-2000 • Fax: (714) 859-3963 • Web Site: www.toshiba.com/taec

Europe: Toshiba Electronics Europe GmbH • Düsseldorf, Germany
 Telephone: (49) (211) 5296-0 • Fax: (49) (211) 5296-400

Asia-Pacific: Toshiba Electronics Asia, Ltd. • Kowloon, Hong Kong
 Telephone: (852) 2375-6111 • Fax: (852) 2375-0969

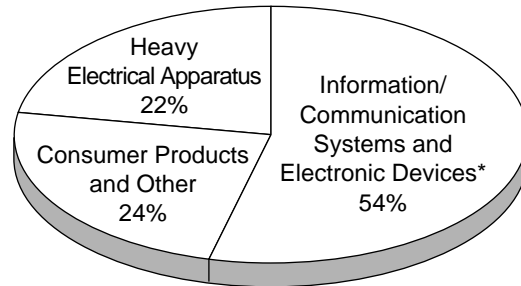
Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Corporate (¥B)					
Sales	¥4,722	¥4,628	¥4,631	¥4,791	¥5,120
Net Income	¥39	¥21	¥12	¥45	¥90
Semiconductor (\$M)*					
Sales	\$5,365	\$6,260	\$8,085	\$10,680	\$8,725
IC Sales	\$4,170	\$4,860	\$6,415	\$8,615	\$6,970
Discrete Sales	\$1,195	\$1,400	\$1,670	\$2,065	\$1,755
Capital Expenditures	\$680	\$725	\$930	\$1,545	\$1,560

*Calendar Year

Company Overview and Strategy

Toshiba Corporation is committed to the key fields of electronics and energy. Through these two fields, Toshiba brings its integrated capabilities to bear on a broad range of businesses, comprising Information and Communications Systems, Information Media and Consumer Products, Power Systems and Industrial Equipment, and Electronic Components and Materials.



*Includes semiconductor devices

1996 Corporate Sales by Business Segment

Toshiba entered the semiconductor business in the mid-1960's. In 1983, the company made semiconductors a mainstay of its activities, and in 1985, became the first company to mass produce 1M DRAMs. In 1995, Toshiba was the world's third largest merchant producer of semiconductors, offering a wide range of device types, including audio/video ICs, bipolar linear ICs, CMOS logic ICs, microprocessors and controllers, ASICs, DRAMs, SRAMs, ROMs, flash memories, discrete devices, CCDs, and optoelectronics.

Toshiba has been a leader in the strategy of forming complementary strategic alliances with international companies. Toshiba believes such collaborations encourage technological innovation through exchanges of world-class capabilities, share enormous investments, and dilute the risk inherent in developing advanced technologies and products (see Key Agreements).

Management

Toshiba Corporation

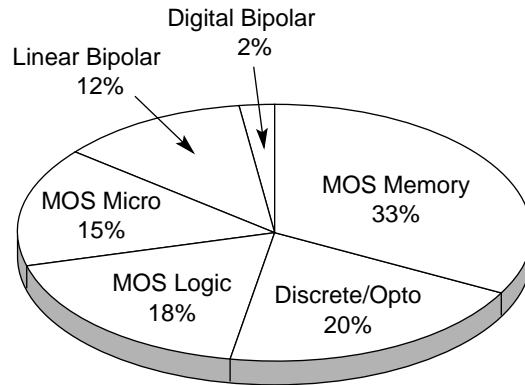
Taizo Nishimuro	President and Chief Executive Officer
Hideharu Egawa	Senior Executive Vice President and Director
Atsumi Uchiyama	Senior Executive Vice President and Director
Masanobu Ohyama	Senior Vice President and Group Executive, Semiconductor Group
Susumu Kohyama	General Manager, Logic IC Operations, Semiconductor Group
Kanto Sato	General Manager, Memory Operations, Semiconductor Group

Toshiba America Electronic Components, Inc.

Takeshi Nakagawa	Chief Executive Officer
Bob Brown	President and Chief Operating Officer
Larry T. Johnson	Senior Vice President and General Manager, Systems IC Division
Stephen McMinn	Vice President, Semiconductor Sales

Products and Processes

Toshiba places a balanced focus on four key areas of the semiconductor market: MOS memories, MOS logic ICs (including microcomponents), bipolar ICs, and discrete devices.



1996 Semiconductor Sales by Device Type (est)

- MOS MEMORY**
- DRAM
 - SRAM
 - Flash Memory
 - EPROM
 - ROM
 - EEPROM
 - Other (Including Non-Volatile RAM)

- ANALOG**
- Amplifier
 - Interface
 - Consumer/Automotive
 - Voltage Regulator/Reference
 - Data Conversion
 - Comparator
 - Other (Includes Telecom)

- MOS LOGIC**
- General Purpose Logic
 - Gate Array
 - Standard Cell
 - Field Programmable Logic
 - Other Special Purpose Logic

- DIGITAL BIPOLAR**
- Bipolar Memory
 - General Purpose Logic
 - Gate Array/Standard Cell
 - Field Programmable Logic
 - Other Special Purpose Logic
 - MPU/MCU/MPR

- MOS MICROCOMPONENT**
- MPU
 - MCU
 - MPR
 - DSP

- OTHER**
- Full Custom IC
 - Discrete
 - Optoelectronic

Memory ICs

Toshiba is a leader in the memory IC business. In DRAMs, Toshiba is focusing on high value-added models such as high speed and multi-bit versions. Approximately 60 percent of its DRAM line-up is multi-bit type models and the rest fast type versions, including synchronous and Rambus DRAMs.

Toshiba was one of the pioneers of flash memory in the early 1980's, but the company chose to focus most of its efforts on DRAMs. Now, the company is placing a great deal of effort on the flash memory business, offering both the original NAND-type and NOR-type flash devices. The company is also a major player in the solid-state file (SSF) business.

- DRAMs in 4M, 16M, and 64M densities.
- Synchronous DRAMs (SDRAMs) in 16M and 64M densities.
- Rambus DRAMs (RDRAMs) in 8M, 16M, and 18M densities.
- Video RAMs (VRAMs) in 2M density.
- Standard SRAMs in 256K, 1M, and 4M densities with access times as low as 55ns.
- High-speed SRAMs in 64K, 256K, 1M, and 4M densities with access times as low as 12ns.
- Synchronous pipeline burst SRAMs in 1M density with speeds as fast as 7.5ns (133MHz).
- Pseudo-static RAMs (PSRAMs) in 1M and 4M densities.
- Flash memories in 1M, 4M, 16M, 32M, and 64M densities.
- EPROMs in 256K, 1M, 4M, and 16M densities.
- Mask ROMs in 1M, 2M, 4M, 8M, 16M, and 32M densities.

Logic ICs

In ASICs, Toshiba offers a full range of advanced gate arrays, embedded arrays, and standard cell devices. Its highest performance gate arrays (TC220 Family) utilize triple-layer metal 0.3 μ m CMOS technology to provide up to two million usable gates.

In 1996, Toshiba unveiled its second generation of embedded DRAM ASIC (dDRAMASIC™) products. The 0.25 μ m TC230D (3.3V) and TC240D (2.5V) families utilize the same one-transistor DRAM cell used in the company's fourth-generation 64M DRAM products. Toshiba claims that the technology of the 230D and 240D families allows for the integration of up to 128M of memory. In addition to high-density DRAM, the company's ASIC core library includes CISC and RISC microprocessor cores, high density SRAM, MPEG decoder circuits, communications devices, and advanced I/O interfaces.

Toshiba is one of the world's largest suppliers of general purpose logic products for computing, telecom, and industrial applications. These devices include CMOS and BiCMOS technologies applied to families of 3V and 5V products. Technologies for advanced low-voltage logic products are developed jointly with Motorola and Fairchild Semiconductor.

Microcomponent ICs

For quite some time, Toshiba has been licensed to develop, manufacture, and sell Mips RISC microprocessors. The company's line of 32-bit and 64-bit Mips RISC-based processors include the 50MHz R3900, the 200MHz R4400, and the 133MHz R4600.

Toshiba also offers its TLCS series of 4-bit, 8-bit, and 16-bit CMOS microcontrollers, Zilog-licensed Z80 microprocessors and controllers, CMOS peripheral circuits, and neuron chips.

Multimedia and Networking ICs

Through a close alliance with Chromatic Research, Toshiba offers the Mpact™ media processor. The Mpact engine provides up to 3,600 MOPS (millions of operations per second) peak performance. Some of the functions the Mpact processor can handle are 2D and 3D graphics, MPEG video, audio, fax/modem, and telephony. Toshiba's other multimedia ICs include MPEG-2 video and audio decoders for set-top boxes and DVD systems.

For ATM networking applications, Toshiba offers physical layer controller and SAR products.

Bipolar ICs

Toshiba has developed several original process technologies for its linear and digital bipolar ICs, which are primarily used in audio-video and other consumer products. These devices include audio power ICs, linear CCD image sensors, and telephone circuits.

Discrete Devices

Toshiba is a world leader in discrete devices and optoelectronics. These products embrace high power, optoelectronic, small-signal, microwave, and RF devices.

Semiconductor Fabrication Facilities

Toshiba announced in late 1995 that it will invest \$1.3 billion to construct a 0.25μm logic IC fab at its Iwate site in Northern Japan. Production of ASICs and ASSPs (and possibly 64M DRAMs) at the fab is expected to begin in the spring of 1998. Capacity will be about 7,500 200mm wafers per week.

Building 4 at Toshiba's site in Oita is being completely converted from DRAM to system-on-a-chip production with 0.25μm geometries. Starting in October 1997, the lines will process chips integrating 32-bit MPUs with 64M of DRAM and a 3D image processing engine. In addition, Toshiba plans to start construction of a new Oita fab in 1998. The \$1.4 facility will process 256M DRAMs and system-on-a-chip ICs using a 0.25μm process.

Iwate Toshiba Electronics Co., Ltd.
 Kitakami-shi, Iwate Prefecture, Japan
 Capacity (wafers/week): 22,000
 Wafer sizes: 125mm, 150mm
 Processes: CMOS, BiCMOS
 Products: ASICs, logic ICs, EPROMs, ROMs,
 flash memories, MPUs, MCUs,
 CCDs, custom ICs
 Feature sizes: 0.35μm-1.5μm

Toshiba Corporation, Kitakyushu Works
 Kitakyushu-shi, Fukuoka Prefecture, Japan
 Capacity (wafers/week): 23,000
 Wafer sizes: 3in, 125mm, 150mm
 Processes: Bipolar, BiCMOS, GaAs
 Products: Analog and logic ICs, ASICs, discretes
 Feature sizes: 1.0μm-3.0μm

Toshiba Corporation, Oita Works
Oita-shi, Oita Prefecture, Japan
Capacity (wafers/week): 56,000
Wafer sizes: 100mm, 125mm, 150mm
Processes: CMOS, MOS
Products: DRAMs, SRAMs, EPROMs, ROMs,
flash memories, MPUs, MCUs,
ASICs, logic ICs
Feature sizes: 0.35 μ m-2.0 μ m

Toshiba Corporation, Tamagawa Works
Kawasaki-shi, Kanagawa Prefecture, Japan
Capacity (wafers/week): 6,325
Wafer sizes: 125mm, 150mm, 200mm
Processes: CMOS, bipolar
Products: R&D and pilot production
Feature sizes: 0.35 μ m-2.0 μ m

Toshiba Corporation, Ishikawa Works
Nomi-gun, Ishikawa Prefecture, Japan
Capacity (wafers/week): 10,000
Wafer size: 125mm
Process: Bipolar
Products: Discretes

Toshiba Corporation
Advanced Microelectronics Center
Yokohama-shi, Kanagawa Prefecture, Japan
Capacity (wafers/week): 450
Wafer size: 200mm (300mm by 1999)
Process: CMOS
Products: R&D
Feature size: 0.25 μ m

Toshiba Corporation, Yokkaichi Works
Yokkaichi-shi, Mie Prefecture, Japan
Capacity (wafers/week): 12,500
Wafer size: 200mm
Process: CMOS
Products: DRAMs
Feature sizes: 0.35 μ m-0.7 μ m

Toshiba Corporation, Himeji Semiconductor Works
Himeji-shi, Hyogo Prefecture, Japan
Capacity (wafers/week): 18,500
Wafer sizes: 100mm, 125mm
Processes: CMOS, bipolar
Products: Discretes
Feature sizes: 0.8 μ m, 1.0 μ m

Toshiba Components
Kimitsu-shi, Chiba Prefecture, Japan
Capacity (wafers/week): 10,000
Wafer sizes: 100mm, 125mm
Process: Bipolar
Products: Discretes

Tohoku Semiconductor Corporation
Izumi-ku, Sendai-shi,
Miyagi Prefecture, Japan
Capacity (wafers/week): 13,750
Wafer sizes: 150mm, 200mm
Processes: CMOS, BiCMOS
Products: DRAMs, SRAMs, MPUs, MCUs, MPRs
Feature sizes: 0.5 μ m-0.8 μ m
(Joint venture with Motorola.)

Dominion Semiconductor LLC
9600 Godwin Drive
Manassas, Virginia 22110
Telephone: (703) 367-3280
Fax: (703) 367-3271
Cleanroom size: 90,000 square feet
Capacity (wafers/week): 7,500
Wafer size: 200mm
Process: CMOS
Products: DRAMs
Feature size: 0.35 μ m
(Joint venture with IBM. Scheduled to begin production in early 1998. See Key Agreements.)

Key Agreements

- In April 1997, Toshiba extended its existing technology agreement with Mips Technologies by licensing the Mips16 instruction set architecture, which Toshiba will use in microprocessors and ASICs based on the Mips16 core.
- Motorola, Toshiba, and Fairchild Semiconductor announced in early 1997 they would jointly develop next-generation high-speed CMOS logic ICs. The three companies will work to develop 2.5V and 3.3V devices with a propagation delay time of 2ns.
- Winbond and Toshiba entered into an alliance in late 1995 for the manufacture and cooperative development of leading-edge semiconductor memory products. The agreement called for Toshiba to provide Winbond with production technologies for 16M DRAMs and next generation 1M high-speed SRAMs. In addition, Toshiba is using Winbond as a foundry for a portion of its 16M and 64M DRAM capacity. Winbond will market the DRAMs under its own logo, beginning in 1997 or 1998. In 4Q96, Toshiba and Winbond extended their partnership to the 64M level.
- In 1995, Toshiba announced a partnership agreement with Chromatic Research Inc. As part of the agreement, Toshiba licensed the Mpack media processor. The single-chip media processor, along with the Mediaware software driver, offers seven multimedia functions for PC applications.
- In late 1995, IBM and Toshiba began building a new 64M DRAM plant at the site of a closed IBM fab in Manassas, Virginia. IBM and Toshiba will each own 50 percent of the facility, which will operate under the name Dominion Semiconductor. First silicon is expected from the fab in late 1997 with volume production beginning in early 1998.
- Toshiba signed an agreement in August 1995 with Ramtron to jointly develop and manufacture ferroelectric RAMs (FRAMs) in densities of 256K and above. Toshiba will have the right to make and sell the devices under its own brand name.

- Toshiba established a pact with Samsung concerning Toshiba's NAND-flash architecture. Under the agreement, Toshiba transferred the technology to Samsung, which is designing and making devices compatible with those of Toshiba. In April 1995, the two companies expanded the alliance to the 64M level.
- Toshiba is jointly developing with IBM and Siemens, 0.25 μ m technology for shrink-version 64M DRAMs and 256M DRAMs. Additionally, in 3Q96, Toshiba, IBM, and Siemens agreed to jointly develop system-on-a-chip devices.
- Toshiba has a long-term partnership with Fairchild Semiconductor for the development, licensing, design, and manufacture of NAND and NOR flash memories. The agreement was signed by Toshiba and National Semiconductor in 1992.
- Toshiba acquired a small equity stake in Synergy Semiconductors as part of an alliance for the development of ECL arrays. Toshiba will also act as a foundry for the bipolar and BiCMOS ASICs to be designed.

YAMAHA

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Fax: (81) (539) 62-5054
Web Site: www.yamaha.co.jp

IC Manufacturer

Regional Headquarters/Representative Locations

North America: Yamaha Systems Technology, Inc., Yamaha Corporation of America • San Jose, California
 Telephone: (408) 467-2300 • Fax: (408) 437-8791 • Web Site: www.yamahayst.com

Europe: Yamaha Europa GmbH • Hamburg, Germany
 Telephone: (49) (40) 4101-303-0 • Fax: (49) (40) 4101-319-45

Financial History (\$M)

	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
Semiconductor				
Sales	\$245	\$345	\$515	\$490

Company Overview and Strategy

Founded in 1887, Yamaha Corporation's first products were musical instruments. In 1955, Yamaha initiated a diversification process that, over time, led the company into many other product areas, including, motorcycles, audio products, sporting goods, furniture, metals, and integrated circuits.

Yamaha Corporation produced its first integrated circuits in 1971 for use in its musical instruments and audio equipment. In the intervening years and as technology developed, Yamaha expanded this to include LSI circuits for other consumer electronics applications. In 1983, Yamaha further expanded its IC production to include devices for CD players, computers, and color graphics products.

Today, using its own sound-oriented semiconductor technology, Yamaha provides sophisticated integrated circuits for CD players, digital audio, graphics processing, communications, and custom applications. Its customers can be found in the computer and computer peripherals, audio, video game, industrial, and medical industries.

With a new fabrication facility due to come on-line in 2Q98, Yamaha is bolstering its efforts in the development of system-on-a-chip devices for multimedia applications. Such devices will integrate a microprocessor, digital signal processor, and memory.

Products and Processes

ASICs

Yamaha's ASIC products include sea-of-gates (SOG) array, embedded array, and standard cells based on 0.65 μ m double-layer- and triple-layer-metal CMOS technology. These devices offer up to 100,000 usable gates and 240 I/O pins.

Digital Audio Products

Yamaha offers a variety of audio ICs and board-level products, including FM music synthesizers, wavetable synthesizers, special effects and surround sound processors, sound generators, and single-chip solutions that integrate several functions, such as a PC audio chip with integrated FM synthesizer, audio codec, and D/A converter circuitry.

Graphics Processing Products

Yamaha's graphics processing products include: single-chip and board-level graphics controllers for desktop PCs, notebook PCs, workstations, medical equipment, and industrial instrumentation; and video processors for a variety of applications, including computers, video game machines, navigation systems, and toys.

Audio Visual System Products

Yamaha has developed a wide range of programmable digital surround processors to improve the sound of audio visual systems. Yamaha also offers ICs for new media such as CDV, CDI, CD-ROM, and CDG.

Multimedia PC Sound Products

All sound parts for multimedia PCs are available from Yamaha including sound synthesizers, ADPCM/PCM voice record/play-back devices, MIDI chips, CD-ROM controllers, and digital audio interface receiver/transmitters.

Communications Products

The combination of Yamaha's digital signal processing technology and experience in MIDI (musical instrument digital interface) circuits has created a line of fax/voice/data modems and networking chips for a variety of applications, including messaging systems, computers, facsimile machines, portable systems, printers, LANs, ISDN networks, factory automation, and process control.

Semiconductor Fabrication Facilities

Yamaha Kagoshima Semiconductor Inc.
Aira-gun, Kagoshima Prefecture, Japan
Capacity (wafers/week): 4,000
Wafer sizes: 100mm, 150mm
Processes: CMOS, MOS
Products: ASICs, ASSPs, linear ICs, MPRs
Feature sizes: 0.5 μ m-1.2 μ m

Yamaha Corporation, Toyooka Plant
Iwata-gun, Shizuoka Prefecture, Japan
Capacity (wafers/week): 1,500
Wafer size: 150mm
Process: CMOS
Products: ROMs, ASICs, ASSPs
Feature size: 0.8 μ m

In 1996, Yamaha began construction of a 200mm 0.25 μ m-0.35 μ m plant in Hamamatsu, Shizuoka, Japan, for the production of system-on-a-chip devices and ASSPs for PCs, game machines, cellular phones, and other communications equipment. Production at the fab will begin in April 1998 with a capacity of 2,500 wafers per week.

Key Agreements

- In early 1997, Yamaha teamed up with Xicor in the EEPROM business. The partnership calls for Yamaha to produce Xicor's EEPROMs and supply them to cellular phone makers under the Xicor name beginning in May 1998. The two companies also agreed to jointly develop process technology.

