

## 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  
 Founded: 1983

### 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>	<u>1997</u>
Sales	120	185	220	210	217
Employees	—	—	—	800	760

### Company Overview and Strategy

Asahi Kasei Microsystems Co., Ltd. (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.

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.

### 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 $\mu$ 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: 0.8 $\mu$ 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: 1.0 $\mu$ 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](http://www.denso.co.jp)**

**IC Manufacturer**  
**Founded: 1962**  
**(1996 - Renamed DENSO from Nippondenso)**

## Regional Offices/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>	<u>1997</u>
Corporate (¥B)						
Sales	¥1,524	¥1,428	¥1,412	¥1,370	¥1,423	¥1,625
Net Income	¥42	¥27	¥37	¥38	¥50	¥71
R&D	—	—	—	—	¥131	¥152
Capital Investment	—	—	—	—	¥97	¥125
Employees	—	—	—	—	56,960	56,390

Ownership: Publicly held. Listed on stock exchanges in Tokyo, Nagoya and Osaka.

## Company Overview and Strategy

DENSO Corporation has grown to become one of the world's leading manufacturers of automotive components and systems. Since its inception DENSO has had a close association with Toyota Motor Corporation. Its automotive components business is supplemented by a growing line of diversified products, including factory automation systems, portable telephones, and handheld 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.

ICs are included in the Other Automotive Products sector – this sector accounts for ¥28B in revenues, representing 1.7 percent of net sales in 1997. Other automotive products include intelligent transport system products (i.e., car navigation, electronic toll collection, advanced vehicle operations systems); ICs; automotive sensors.

## Management

Tsuneo Ishimaru	Chairman
Hironu 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, discrettes Feature sizes: 1.5µm-3.0µm	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: 0.85µm
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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) 5388-7622  
 Fax: (81) (3) 5388-7975  
 Web Site: [www.fujielectric.co.jp](http://www.fujielectric.co.jp)

### IC Manufacturer

#### Regional Headquarters/Representative Locations

North America: Fuji Electric Corp. of America • Saddle Brook, New Jersey  
 Telephone: (201) 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>	<u>1997**</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	—
Employees	—	—	—	—	—	12,861

\*Calendar Year

\*\*Company did not disclose.

## 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's Electronics Group consists of the following: Semiconductor Sales Division; ICs Division; Power Semiconductor Division; Photoconductors and Electronics Specialty Appliances Division; Technology Planning Division; the Matsumoto Factory (Semiconductor Device R&D Center); the Yamanashi Factory; and Group Administration Division.

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 inverters and uninterruptible power supply equipment.

## Management

Yoshihiko Nakazato	President
Naoki Nakamura	Executive Vice President
Kunihiko Sawa	Executive Vice 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 $\mu$ 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 $\mu$ m-2.0 $\mu$ 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](http://www.fujitsu.co.jp)**

**IC Manufacturer**  
**Founded: 1935**

## Regional Offices/Representative Locations

North America: Fujitsu Microelectronics, Inc., Semiconductor Division • San Jose, California  
 Telephone: (408) 922-9000 • Fax: (408) 432-9044 • Web Site: [www.fujitsumicro.com](http://www.fujitsumicro.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

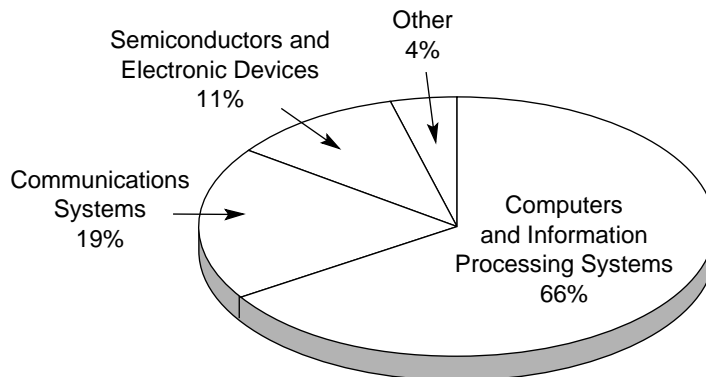
## Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Corporate (¥B)						
Sales	¥3,442	¥3,462	¥3,139	¥3,258	¥3,762	¥4,503
Net Income	¥12	¥(33)	¥(38)	¥45	¥63	¥46
Semiconductor (\$M)*						
Sales	\$2,550	\$2,930	\$3,335	\$4,440	\$3,200	\$3,315
IC Sales	\$2,320	\$2,630	\$2,975	\$4,010	\$2,880	\$2,984
Discrete Sales	\$230	\$300	\$360	\$430	\$320	\$334
Capital Expenditures	\$445	\$590	\$905	\$1,505	\$1,435	\$1,548

\*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, discretes, hybrids, electromechanical devices, and plasma and liquid crystal displays.



**1997 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.

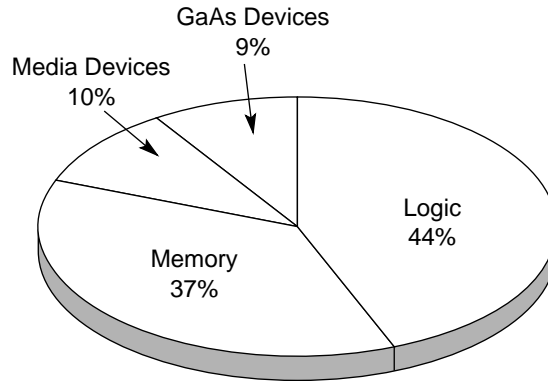
## Management

### Fujitsu Limited

Tadashi Sekizawa	Chairman
Michio Naruto	Vice Chairman
Naoyuki Akikusa	President
Takesi Maruyama	Senior Executive Vice President
Masuo Tanaka	Senior Executive Vice President
Keizo Fukagawa	Senior Executive Vice President

### Fujitsu Microelectronics, Inc. (U.S.)

Yuji Ezura	President and Chief Executive Officer
Rammy Rasmussen	Vice President and Chief Financial Officer
Bami Bastini	Executive Vice President, System LSI Group
John McElroy	Vice President, Marketing
Mark Van Zanten	Vice President, Sales



1997 Semiconductor Sales by Device Type

Products and Processes

- 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

### ASICs

Fujitsu's range of Application-Specific ICs (ASICs) are made using low-power consumption CMOS technologies. Fujitsu's ASIC family consists of more than 100 device types with complexities of over 2,000,000 gates. The family includes macro-embedded cell array products with specialized functions not normally available in gate arrays. Fujitsu's easy to use computer-aided ASIC design system speeds up development and improves product reliability.

### Micro-P/C

Fujitsu's range of microprocessor ICs includes general purpose 8-bit microcontrollers (F2MC-8L family), 16-bit microcontrollers (F2MC-16L/-16F families), 32-bit microprocessors (SPARC lite and FR20 families) and controllers as well as specialized ICs for peripheral control. Fujitsu also provides tools for software development.

### ASSPs/Analog ICs

Fujitsu's range of Application-Specific Standard Products (ASSPs) include ICs for use in a variety of applications such as VCO and SAW filters, magnetic disks, audio, power control and image processing. Fujitsu also supplies general-purpose analog ICs such as op-amps, comparators, converters, and analog switches.

### Standard Logic

Fujitsu's standard logic ICs range from simple gates to complex arithmetic logic circuits.

### Memory LSIs

Fujitsu memory products, including memory LSI devices, memory modules and memory cards, are famous worldwide for their high performance, quality and reliability. Fujitsu offers a wide range of memory LSI devices covering DRAMs, SRAMs and flash memory products. The DRAM product line covers, 4Mbit, 16Mbit and 64Mbit DRAMs with FPM (First Page Mode) and EDC (Extended Data Cut) functions as well as high-speed (more than 100MHz) SDRAMs (synchronous DRAMs) for high performance graphic memory and high speed main memory systems. The SRAM product line covers high performance SSRAM (synchronous SRAM) for high speed Cache memory systems, and the flash memory product line includes 2Mbit, 4Mbit, 8Mbit, and 16Mbit flash memory devices which are all single supply voltage type devices. Fujitsu further offers 30-pin/72-pin/168-pin JEDEC standard DRAM SIMM/DIMM module products, and 68-pin/88-pin JEIDA/PCMCIA standard DRAM, SRAM and flash memory card products.

### Compound Semiconductor Devices

Fujitsu also provides a wide range of Compound Semiconductor products: Microwave devices such as high power GaAs FETs and low noise HEMTs ranging from 0.8 to 23GHz for satellite mobile communications and DBS. MICs and MMICs for handheld phones and VSAT. Ultra high speed GaAs digital LSIs for use in super computers. Light wave devices such as laser diodes and photo-detective diodes for multichannel video transmission systems and high bit-rate optical fiber communications up to 2.5Gb/sec.

### Interconnect Technology

Fujitsu's Interconnect capabilities embodies several years of leading edge experience in advanced packaging technology which typically sets the industry standards. Some of their capabilities include: a complete line-up of multi-chip modules ranging from high-volume, low-cost, MCMs to high-performance, leading-edge MSMs. A custom PCMCIA card.

### Piezoelectric Devices

Fujitsu piezoelectric devices are based on piezoelectric single crystals (lithium tantalate [LiTa<sub>3</sub>] and lithium niobate [LiNb<sub>3</sub>]) with a large electromechanical coupling coefficient. They are used in a broad range of applications, including resonators for microcomputer clocks, VCOs for digital equipment, filters for telecommunication's equipment, and SAW filters used in mobile communication systems such as cellular phones. Fujitsu manufactures piezoelectric devices using consistent in-company processes, from the formation of single crystals through to the assembly of final products.

### 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 $\mu$ m-0.25 $\mu$ m process technologies and 200mm wafers. Construction of Fujitsu's new memory fab in Gresham, Oregon, was delayed for several months. It was officially opened in September of 1996. The delay allowed Fujitsu to launch production of 64M SDRAMs initially instead of 16M DRAMs. The Gresham facility, which is among the most advanced of its kind, processes 8-inch wafers using 0.32 micron technology. When in full operation, about 600 highly skilled technicians and professionals will work at the facility, which will operate 24 hours a day, seven days a week.

On the flash memory front, Fujitsu AMD Semiconductor Ltd. (FASL) built 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.

In Japan, Fujitsu is constructing a \$1 billion fab for the production of advanced logic ICs with 0.25 $\mu$ m and 0.35 $\mu$ 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 $\mu$ m-1.0 $\mu$ 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 $\mu$ m-2.0 $\mu$ 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 $\mu$ m-1.0 $\mu$ 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,  
optoelectronics.  
Feature sizes: 0.5 $\mu$ m-0.8 $\mu$ 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 $\mu$ 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 $\mu$ m, 0.8 $\mu$ m (0.35 $\mu$ 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 $\mu$ m-0.8 $\mu$ 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 $\mu$ m, 0.5 $\mu$ m  
 (upgrading 0.5 $\mu$ m lines to 0.35 $\mu$ 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 $\mu$ m, 0.35 $\mu$ m  
 (Expected to start production in early 1998).

## Key Agreements

- In November of 1997, Fujitsu Limited, Fujitsu Microelectronics, Inc. and Sun Microsystems, Inc., announced that Fujitsu Limited and Sun Microsystems signed an agreement in which Fujitsu will license the PicoJava™ I microprocessor core from Sun. Fujitsu will incorporate the Sun™ technology into its own PicoJava-based microprocessor designs which it will provide to the merchant market as well as use in its own system offerings.

Fujitsu's intent to provide PicoJava I-based processors increases the momentum behind Java™ -enabled devices. In addition, it reinforces Sun's strategy of enlisting world-class semiconductor manufacturers in bringing Java™ processors and Java-enabled products to the marketplace.

- Fujitsu and Hyundai have a long-term partnership involving technology licensing, co-development, and joint manufacturing of DRAM products. Most recently, the two companies agreed to cooperate in the development of next-generation 64M SDRAMs.
- In September of 1994, Fujitsu and AMD opened a large flash memory fabrication facility, called Fujitsu-AMD Semiconductor Ltd. (FASL), in Japan. In 1996, construction of a newer facility was completed at this location.

# HITACHI

**Hitachi, Ltd.**  
**Semiconductor and IC Division**  
**Nippon Building**  
**6-2, Otemachi 2-chome**  
**Chiyoda-ku, Tokyo 100, Japan**  
**Telephone: (81) (3) 3212-1111**  
**Web Site: [www.hitachi.co.jp/Sicd](http://www.hitachi.co.jp/Sicd)**

**IC Manufacturer**  
**Founded: 1969**

(See Top Ten)



## KAWASAKI STEEL

**Kawasaki Steel Corporation**  
**LSI Division**  
**Makuhari Techno Garden B5**  
**1-3 Nakase, Mihama-Ku**  
**Chiba 261-01 Japan**  
**Telephone: (81) (43) 296-7411**  
**Fax: (81) (43) 296-7419**  
**Web Site: [www.kawasaki-steel.co.jp](http://www.kawasaki-steel.co.jp)**

**IC Manufacturer**  
**Founded: 1985**

### Regional Offices/Representative Locations

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

### Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Corporate (¥B)						
Sales	¥1,379	¥1,310	¥1,185	¥1,149	¥1,164	¥1,232
Net Income	¥14	¥(30)	¥(22)	¥(32)	¥24	¥8
Semiconductor (\$M)*						
Sales	55	80	110	100	90	95
Capital Expenditures	—	—	—	—	100	106
Employees	454	541	600	543	400	422

\*Calendar Year

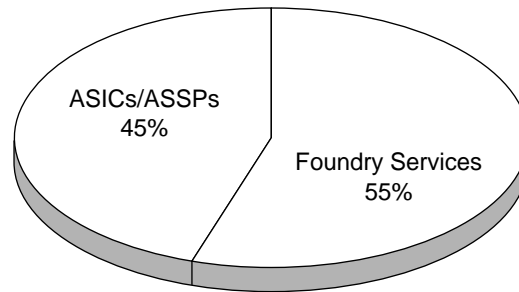
### Company Overview and Strategy

Kawasaki Steel's LSI Division is involved in foundry services and ASICs in CMOS technology. The company also offers ASSPs that are suited for application in a variety of end markets, including telecommunications, multimedia, and image processing.

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.



**1997 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 of the Board of Directors
Kanji Emoto	President and Director
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 $\mu$ m, 0.8 $\mu$ m, 1.0 $\mu$ m CMOS gate arrays and embedded arrays with 2.5K to 2,030K usable gates.
- 0.5 $\mu$ m, 0.8 $\mu$ m, 1.0 $\mu$ m mixed-signal CMOS standard cells.
- 0.5 $\mu$ m, 0.65 $\mu$ m, 0.8 $\mu$ 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 $\mu$ m CMOS process introduced in 1993, a 0.5 $\mu$ m CMOS process introduced in early 1995, and a 0.35 $\mu$ 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 $\mu$ m, 0.5 $\mu$ m, 0.65 $\mu$ m,  
0.8 $\mu$ m, 1.0 $\mu$ 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 $\mu$ m, 0.5 $\mu$ m, 0.65 $\mu$ 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

**Matsushita Electronics Corporation**  
**Semiconductor Group**  
 1, Kotari-yaki-machi  
 Nagaokakyo-shi, Kyoto 617-8520, Japan  
 Telephone: (81) (75) 951-8151  
 Web Site: [www.mec.panasonic.co.jp](http://www.mec.panasonic.co.jp)

**IC Manufacturer**  
**Founded: 1952**

## Regional Offices/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

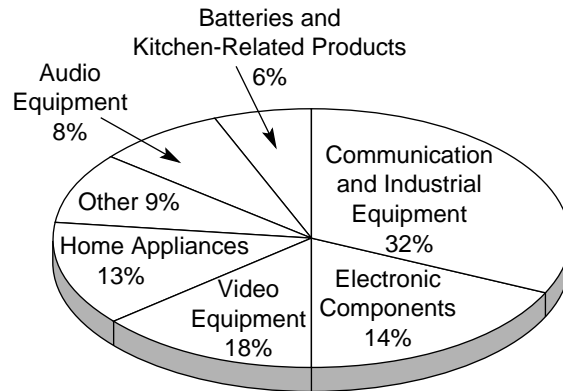
	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Corporate (MEI, ¥B)						
Sales	¥7,450	¥7,056	¥6,624	¥6,948	¥6,795	¥7,676
Net Income	¥133	¥37	¥24	¥90	¥(57)	¥138
Semiconductor (\$M)*						
Sales	\$2,085	\$2,320	\$2,925	\$3,520	\$3,110	\$3,328
IC Sales	\$1,555	\$1,670	\$2,145	\$2,600	\$2,325	\$2,488
Discrete Sales	\$530	\$650	\$780	\$920	\$785	\$840
Capital Expenditures	\$265	\$185	\$520	\$885	\$1,000	\$998

\*Calendar Year

Ownership: Privately held – 100% Matsushita Electric Industrial Co., Ltd.

## 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.



**1997 Corporate 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.

<b>MOS MEMORY</b>		<b>ANALOG</b>	
<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 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)
<b>MOS LOGIC</b>		<b>DIGITAL BIPOLAR</b>	
<input checked="" type="checkbox"/>	General Purpose Logic	<input type="checkbox"/>	Bipolar Memory
<input checked="" type="checkbox"/>	Gate Array	<input checked="" type="checkbox"/>	General Purpose Logic
<input checked="" type="checkbox"/>	Standard Cell	<input 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 checked="" type="checkbox"/>	Other Special Purpose Logic
		<input type="checkbox"/>	MPU/MCU/MPR
<b>MOS MICROCOMPONENT</b>		<b>OTHER</b>	
<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 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.
- GaAs Power FETs.

Matsushita's semiconductors are manufactured using CMOS, BiCMOS, bipolar, and GaAs process technologies. The company's CMOS technology has reached the 0.35 $\mu$ m geometry level, while its BiCMOS technology is at the 0.8 $\mu$ 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 $\mu$ m-3.0 $\mu$ 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: 0.25 $\mu$ m, 0.35 $\mu$ m, 0.5 $\mu$ m

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 $\mu$ m-3.0 $\mu$ 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 $\mu$ m-0.5 $\mu$ 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 $\mu$ m-1.5 $\mu$ m

Matsushita Electronics, Nagaokakyo Facility  
 Nagaokakyo-shi, Kyoto Prefecture, Japan  
 Wafer size: 3 in.  
 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 $\mu$ m-1.0 $\mu$ m  
 (A 200mm wafer line is being added here for the  
 production of DRAMs and MCUs with 0.25 $\mu$ m and  
 0.35 $\mu$ m geometries. Operations to begin mid-1998).

## Key Agreements

- In March 1998, Matsushita Electronics Corporation and Matsushita Electric Industrial Co., Ltd. made an agreement to license Rambus, Inc.'s high-bandwidth semiconductor-interface technology. The Rambus interface technology is a high speed method of transferring data between semiconductor chips. Matsushita will incorporate this technology in semiconductors for consumer products and other applications. Both MEI and MEC will begin to develop, produce and distribute chips with this technology.
- In October 1997, Matsushita and Motorola Inc. signed an agreement to develop semiconductors for high-performance noncontact-type smartcards. Under this agreement, Matsushita will license its production technology for the memory to Motorola. Both companies will jointly develop chips combining Matsushita's FeRAM with Motorola's microprocessors for use in noncontact-type smartcards and the two companies will have marketing rights. The global marketing of both the chips and the cards is to begin starting in 1999. With this agreement, Matsushita expects FeRAM products and its microprocessors to grow into a 100 billion Yen (\$826 million) business in 2005.



- Matsushita and SanDisk jointly developed a 64M NOR-type flash memory chip using 0.5 $\mu$ m CMOS process technology and SanDisk'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 $\mu$ m and 0.35 $\mu$ 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**

**Mitsubishi Electric Corporation  
Semiconductor Group  
5-2-20, Akasaka, Minato-ku  
Tokyo 107, Japan  
Telephone: (81) (3) 5573-3398  
Fax: (81) (3) 5573-8962  
Web Site: [www.melco.co.jp](http://www.melco.co.jp)**

**IC Manufacturer  
Founded: 1921**

(See Top Ten)

# MURATA MANUFACTURING COMPANY, LTD.

Murata Manufacturing Company, Ltd.

26-10, Tenjin 2-chrom,

Nagaokakyo-shi,

Kyoto 617-8555 Japan

Telephone: (075) 955-6502

Web Site: [www.murata.co.jp](http://www.murata.co.jp)

IC Manufacturer

Founded: 1950

## Regional Offices/Representative Locations

Asia: Murata Manufacturing Co., Ltd. • Kawasaki, Japan  
Telephone: (044) 422-5151

Murata Manufacturing Co., Ltd. • Seoul, Korea  
Telephone: (82) 2-561-2347

Murata Manufacturing Co., Ltd. • Yokaichi, Japan (Plant)  
Telephone: (0748) 22-5500

Murata Manufacturing Co., Ltd. • Yasu, Japan (Plant)  
Telephone: (077) 587-5111

Murata Manufacturing Co., Ltd. • Yokohama, Japan (R&D Center)  
Telephone: (045) 931-7111

## Financial History, Six months ended Sept. 30 (¥M)

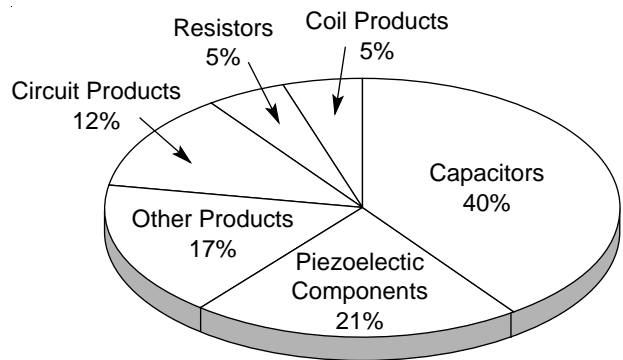
	<u>1995</u>	<u>1996</u>	<u>1997</u>
Net Sales	¥164,153	¥162,236	¥179,034
Net Income	¥19,953	¥16,177	¥18,845
Capital Expenditures	(¥21,128)	(¥23,711)	(¥20,138)
Employees	—	24,282	23,848

Ownership: Publicly-held. Stock Exchange Listings: Tokyo Stock Exchange, Osaka Securities Exchange, Kyoto Securities Exchange, Stock Exchange of Singapore, Frankfurt Stock Exchange.

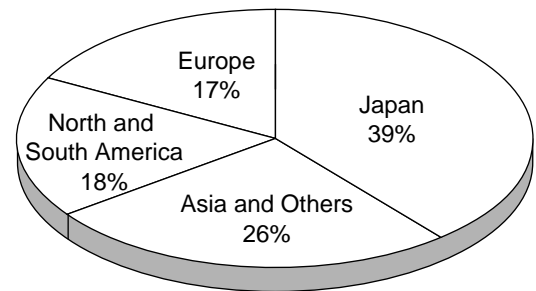
## Company Overview and Strategy

Murata Manufacturing Company, Ltd. manufactures integrated electronic components for communications apparatus, computers, automotive electronics, measuring instruments, TV, VCR, and other related video instruments.

Since its establishment in 1944, it has pursued research and development into a broad spectrum of functional ceramics and their potential applications, and has introduced to the market a diverse range of electronic components that effectively exploit the unique electrical properties of ceramic materials.



1997 Sales by Product



1997 Sales by Geographic Region

## Products and Processes

Murata offers the following products.

- Capacitors
- Thermistors/Resistors
- Coil/Delay Lines/Ferrite Cores
- Noise Suppression Products/EMI Filters
- Resonators
- Piezoelectric Sound Components
- Microwave Components for Communication Equipment
- Filters for Audio Visual Equipment
- Functional Modules/Hybrid ICs
- Power Supplies
- Sensors
- GaAs Field Effect Transistors

## Semiconductor Fabrication Facilities

Murata has two semiconductor fabrication and assembly plants located in Japan – Yakaichi-shi and Yasu-cho prefectures. They also operate a R&D center in Yokohama.

## NEC

**NEC Corporation**  
**Electron Device Group**  
**7-1, Shiba 5-chome, Minato-ku**  
**Tokyo 108-01, Japan**  
**Telephone: (81) (3) 3454-1111**  
**Fax: (81) (3) 3798-1510/1519**  
**Web Site: [www.nec.co.jp](http://www.nec.co.jp)**

**IC Manufacturer**  
**Founded: 1950**

(See Top Ten)

## NEW JAPAN RADIO (NJRC)

New Japan Radio Co., Ltd. (NJRC)  
 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

North America: NJR Corporation • Mountain View, California  
 Telephone: (650) 961-3901 • Fax: (650) 969-1409

### Financial History (\$M)

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Sales	310	350	430	525	440	475
R&D Expenditures	45	50	65	80	65	75
Capital Expenditures	—	—	—	70	50	56
Employees	1,530	1,560	1,640	1,706	1,710	1,846

### 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, discretetes  
Feature sizes: 0.8 $\mu$ m-1.2 $\mu$ 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 $\mu$ m-1.5 $\mu$ 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](http://www.npcproducts.com)

**IC Manufacturer**  
**Founded: 1975**

### **Representative Location**

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

### **Company Overview and Strategy**

Nippon Precision Circuits, Inc. (NPC) 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**

Norio Tabuchi                      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.



Products include the following:

Peripheral LSIs – high speed FIR filters with built-in multipliers, high speed advanced adder, imaging 2D digital filter, advanced shift registers, programmable baud rate generators, high speed SIPO and PISO converters, decimal math processor, standard bus interface decoders, EL drivers, crystal oscillator guitar tuner, real time clock modules.

Communications Controllers – POCSAG decoders, calling number ID receiver, DTMF generator, synchronous/asynchronous converter.

Frequency Synthesizers PLL – CMOS based, high frequency, low current PLLs. Operating from 0.95V for battery powered equipment in mobile communications.

A/D and D/A Converters – CMOS based, high speed and low current ICs.

Audio LSIs – Digital filters, interpolation filters, audio D/A converters, audio DSPs, digital Dolby Prologic Surround decoder, shock proof memory controllers.

Melody and Voice Synthesis – high efficiency multifunction and single function devices used for voice synthesis, greeting cards, toys, telephone tunes/tones, etc.

Clock and Watch ICs – for analog timepieces. Features may include alarms, snooze, ascending alarms. These devices are CMOS based, and operate at low voltage and low current.

Oscillator ICs – from 22MHz to 100MHz, at output currents 3.2 to 16mA. Offered at 3V or 5V.

### **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 $\mu$ 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 $\mu$ 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) (35) 294-2701  
 Fax: (81) (35) 294-2707

IC Manufacturer  
 Founded: 1984

### 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>91.Oct-92.Sept</u>	<u>92.Oct-93.Sept</u>	<u>93.Oct-94.Mar</u>	<u>94.Apr-95.Mar</u>	<u>95.Apr-96.Mar</u>	<u>96.Apr-97.Mar</u>
Sales	¥19,028	¥26,935	¥15,480	¥35,509	¥58,432	¥19,211
Capital Expenditures	¥9,077	¥4,680	¥5,347	¥6,525	¥9,951	¥12,870
Employees	820	814	825	883	905	948

### 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 Corporation, 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 Corporation.

Since becoming Nippon Steel Semiconductor, the company's focus has been to continue shipping a wide range of DRAM products for PCs, PC peripherals, graphics and various other purposes.

### Management

Sumio Takemoto                      President

## Products and Processes

NPNX's primary products are high-speed CMOS DRAMs (1M to 16M in density) developed with United Memories Inc. (UMI), a wholly owned Colorado subsidiary of NPNX. In early 1998, NPNX will introduce 64M DRAM production manufactured by a new joint venture fab it and Hitachi built in Singapore.

By the end of 1997, NPNX began producing a new line of synchronous graphics DRAMs (SDRAMs), the first of which is an 8M SGRAM. Other SDRAMs are under development.

## Semiconductor Fabrication Facilities

Nippon Steel Semiconductor Corp.  
Tateyama Facility  
Tateyama-shi, Chiba Prefecture, Japan  
Cleanroom size: 100,000 square feet  
Capacity (wafers/week): 7,000  
Wafer sizes: 150mm, 200mm (future)  
Process: CMOS  
Products: DRAMs  
Feature sizes: 0.35 $\mu$ m-0.6 $\mu$ 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 $\mu$ m-0.5 $\mu$ m

Hitachi Nippon Steel Semiconductor  
Singapore Pte. Ltd.  
Tampines, Singapore  
Cleanroom size: 64,600 square feet  
Capacity (wafers/week): 4,600  
Wafer size: 200mm  
Process: CMOS  
Products: DRAMs  
Feature size: 0.3 $\mu$ m  
(Joint venture by Nippon Steel, Hitachi and government  
of Singapore: Mass production 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.

# NKK

**NKK Corporation**  
**LSI Division**  
**1-1-2 Marunouchi**  
**Chiyoda-ku, Tokyo 100, Japan**  
**Telephone: (81) (33) 217-3119**  
**Fax: (81) (33) 217-3148**  
**Web Site: [www.tokyo.nkk.co.jp](http://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>	<u>1997</u>
Corporate (¥B)				
Sales	¥1,778	¥1,802	¥1,806	¥1,878
Net Income	¥(40)	¥(38)	¥(52)	¥17

### 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 and Toshiba 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 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, 1M, 2M and 4M densities)
- High-speed SRAMs (256K, 512K and 1M densities)
- Mask ROMs (1M, 2M, 4M, 16M, 32M and 64M 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, MPUs, ASICs, ASSPs

Feature sizes: 0.35 $\mu$ m, 0.5 $\mu$ 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 175MHz enhanced floating point version of the R4700 processor.

## NTT ELECTRONICS CORPORATION

NTT Electronics Corporation  
Shibuya INFOSS Tower, 17th Floor  
20-1 Sakuragaoka-machi, Shibuya-ku  
Tokyo 150-0031 Japan  
Telephone: (81) (3) 5456-4156  
Fax: (81) (3) 5456-4155  
Web Site: [www.nel.co.jp/index-e.html](http://www.nel.co.jp/index-e.html)

### IC Manufacturer

Employees: 722

Ownership: Privately held.

### Company Overview and Strategy

NTT Electronics Corporation (NEL) was formed in 1982 to develop design, manufacture and market advanced semiconductor and optical components.

### Management

Toshimasa Suzuki	President
Hyo Ikawa	Senior Managing Director

### Products and Processes

The present line of products include:

1. Silicon Integrated Circuits, SSI and LSI;
2. GaAs Integrated Circuits; and
3. Optical Devices.

NEL is ISO 9001 certified.

# 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](http://www.oki.co.jp)**

**IC Manufacturer**  
**Founded: 1949 / 1977**

## 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](http://www.oki.com)

## Financial History, Fiscal Year Ends March 31

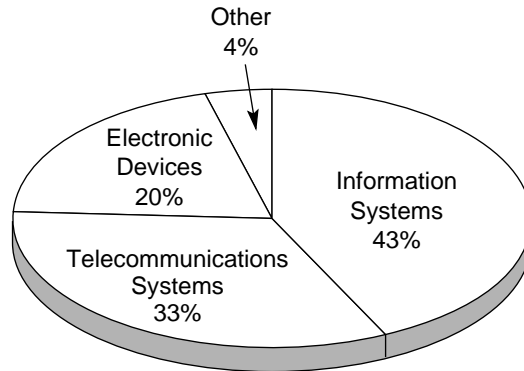
	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Corporate (¥B)						
Sales	¥681	¥640	¥652	¥657	¥748	¥732
Net Income	¥(0.5)	¥(33)	¥(2)	¥32	¥25	¥3
Semiconductor (\$M)*						
Sales	\$1,155	\$1,380	\$1,680	\$2,045	\$1,390	\$1,181
IC Sales	\$1,135	\$1,365	\$1,665	\$2,030	\$1,380	\$1,172
Discrete Sales	\$20	\$15	\$15	\$15	\$10	\$9
Capital Expenditures	\$150	\$125	\$205	\$410	\$375	\$318

\*Calendar Year

Ownership: Publicly held: Tokyo Stock Exchange.

## 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, micro-controllers, microprocessors, voice synthesis, opto-electronic devices, read relays and switches, solid-state disk cards, and telecommunications-related integrated circuits. These devices are sold primarily to customers in the computer, telecommunications, automotive, and consumer products industries.



**1997 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. Oki is an ISO 9001 certified company.

## Management

### Oki Electric Industry Company

Shiko Sawamura	President and Chief Executive Officer
Shintaro Ushio	Corporate Director and Manager, Electronic Device Operations

### Oki Semiconductor Group (U.S.)

Hisao Baba	President and Chief Executive Officer
Keiichi Ota	Vice President and Chief Financial Officer
Thiermond Dobbs	Vice President, Sales and Marketing
Len Distaso	Vice President, Acting Director of Administration, General Counsel
Bharate Gupte	Vice President and General Manager, Standard Business Products
Jamshed Qamar	Vice President and General Manager, Application Specific Business Unit



## 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.

<b>MOS MEMORY</b>		<b>ANALOG</b>	
<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)
<b>MOS LOGIC</b>		<b>DIGITAL BIPOLAR</b>	
<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
<b>MOS MICROCOMPONENT</b>		<b>OTHER</b>	
<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 bandwidths as high as 660 Mbytes/second.

With regard to future DRAM products, Oki claims to have developed a 1G SDRAM design using a 0.16 $\mu$ m 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 (SOGs) 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 $\mu$ m, 0.5 $\mu$ m, and 0.8 $\mu$ 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 $\mu$ 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 $\mu$ m-1.5 $\mu$ 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 $\mu$ m-0.8 $\mu$ 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 $\mu$ m-2.0 $\mu$ 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: 3 in.  
Process: GaAs  
Products: Telecom ICs and discretes  
Feature size: 0.5 $\mu$ 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 $\mu$ m

### Key Agreements

- In April 1998, Catalyst Semiconductor announced that in two separate agreements reached with Oki Electronics Industry Co. Ltd. and Trio-Tech International PTE Ltd., the company will receive additional credit to purchase wafers. Catalyst currently has over \$9 million in backlog, a significant portion of which is delinquent to the customer's requested delivery date.
- 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 $\mu$ 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 $\mu$ 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.

- In January 1996, 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.
- Burr-Brown is jointly developing with Oki, 20-bit BiCMOS A/D and D/A converter chips for business digital audio equipment.

# 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](http://www.ricoh.co.jp)

**IC Manufacturer**  
**Founded: 1936**

## Regional Headquarters/Representative Locations

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

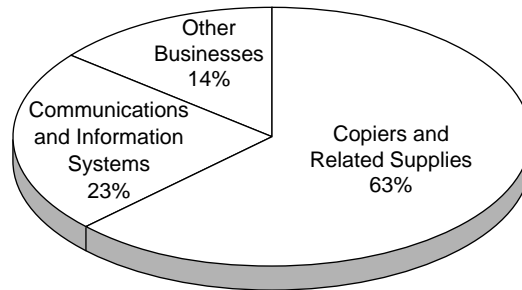
## Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Corporate (¥B)						
Sales	¥1,017	¥1,022	¥968	¥1,020	¥1,113	¥1,316
Net Income	¥2	¥5	¥10	¥19	¥22	¥29
Semiconductor (\$M)*						
IC Sales	\$200	\$230	\$295	\$355	\$315	\$372

\*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.



**1997 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 $\mu$ m CMOS process, up to 194,400 gates and 384 I/Os, and gate delays of 0.38ns.
- 5GL Series — 1.2 $\mu$ m CMOS process, up to 10,000 gates and 236 I/Os, and gate delays of 0.8ns.
- 5GV Series — 1.2 $\mu$ m CMOS process, up to 16,100 gates and 204 I/Os, and gate delays of 0.8ns.
- 5GF Series — 1.5 $\mu$ 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 $\mu$ m CMOS process.
- RSC-12 Series — 1.2 $\mu$ m CMOS process.
- RSC-15 Series — 1.5 $\mu$ 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 $\mu$ m, 1.0 $\mu$ m, 1.2 $\mu$ m, 1.5 $\mu$ 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 $\mu$ m, 1.2 $\mu$ m

Ricoh Co., Ltd.  
 General Electronics & R&D Center  
 5-10 Aza-Yokata-lami  
 Kumanodo, Takadate Natori  
 Miyagi 981-02, Japan  
 Telephone: (81) 3 5742-6\5644  
 Products: Thin-Film silicon devices and chemical  
 compound semiconductor devices, R&D.

# 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](http://www.rohm.co)

IC Manufacturer  
 Founded: 1958

## Regional Headquarters/Representative Locations

North America: Rohm U.S.A. Inc. • Sunnyvale, California  
 Telephone: (408) 222-3800 • Fax: (408) 222-3840

## Financial History, Fiscal Year Ends March 31

	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Corporate (¥B)					
Sales	¥187	¥200	¥241	¥292	¥298
Net Income	¥8	¥13	¥23	¥38	¥46
Semiconductor (¥B)*					
Sales	¥187	¥200	¥241	¥292	¥298
IC Sales	¥58	¥65	¥82	¥102	¥115
Discrete Sales	¥98	¥102	¥122	¥147	¥141
Capital Expenditures	¥22	¥27	¥38	¥58	¥38

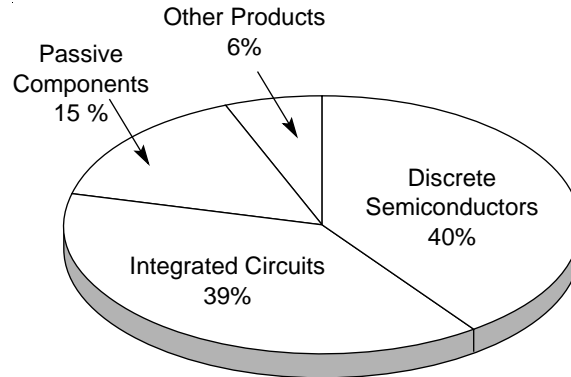
\*Fiscal Year

## Company Overview and Strategy

Rohm Co., Ltd., designs and manufactures integrated circuits (ICs) as well as other electronic components such as hybrid ICs, transistors, diodes, light emitting diodes (LEDs), sensors, laser diodes, liquid crystal displays (LCDs), thermalhead, image sensorhead, LED display, resistors, and capacitors.

Rohm is a leader in nonvolatile memory as well as full-fledged linear and mixed-signal technologies. The company is committed to playing a major role in the multimedia age, and is focusing its resources on the development of mobile communications, PC peripherals and other multimedia-related products and technologies.





**1997 Corporate Sales by Product Type**

## Management

Ken Sato	President
Junichi Hikita	Managing Director, LSI Product Development Headquarters, ULSI Research and Development Headquarters, LSI Operations Headquarters, Module Products Headquarters
Akitaka Idei	Director, Japan Sales Headquarters
Tokusaburo Hirata	Director, Marketing Division and General Manager
Nobuo Hatta	Director, Overseas Sales Headquarters
Hidemi Takasu	Director, ULSI Research and Development Headquarters
Sumio Jida	Corporate Auditor
Ichiro Kondo	Corporate Auditor
Akira Okutani	Corporate Auditor

## 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, sensors, laser diodes, and light emitting diodes.

Rohm also manufactures and markets resistors, capacitors, liquid crystal displays, and printheads.

**Semiconductor Fabrication Facilities**

Rohm Co., Ltd.

21 Saiin Mizosaki-cho

Ukyo-ku, Kyoto 615, Japan

Wafer sizes: 100mm, 150mm, 200mm

Processes: Bipolar, CMOS, BiCMOS

Products: SRAMs, MCUs, ASICs,  
EEPROMs, FLASH, FRAMs.

Feature sizes: 0.35 $\mu$ m-1.2 $\mu$ m

**Key Agreements**

- In 1997, 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 2H97/1H98 timeframe.
- 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.

## SANKEN ELECTRIC COMPANY, LTD.

Sanken Electric Company, Ltd.  
 3-6-3 Kitano, Niiza-shi,  
 Saitama-ken 352-8666,  
 Japan  
 Telephone: (048) 472-1111  
 Web Site: [www.sanken-ele.co.jp](http://www.sanken-ele.co.jp)

IC Manufacturer  
 Founded: 1946

### Regional Offices/Representative Locations

U.S.: Allegro Microsystems, Inc. • Worcester, Massachusetts  
 Telephone: (508) 853-5000

Asia: Sanken Electric Company, Ltd. • Seoul, Korea  
 Telephone: (2) 776-4206

### Financial History, Fiscal Year Ends March 31

	<u>1996</u>	<u>1997</u>
Corporate (¥M)		
Net Sales	¥114,544	¥118,057
Net Income	¥3,321	¥4,000
Semiconductor		
Sales	¥73,100	¥73,467

### Company Overview and Strategy

Sanken Electric Company, Ltd. is a vertically integrated electronic product integrator. They manufacture semiconductor devices for external and internal consumption. Sanken's ICs and discrete devices are primarily used for electrical equipment and telecommunication systems.

Sanken evolved from the Toho Industrial Research Laboratory. In April 1939, the Toho Industrial Research Laboratory was established and commenced research and trial manufacture of selenium rectifiers. The laboratory was dissolved at the end of World War II, and the late Tetsuji Kotani, who was the chief of the semiconductor laboratory at the time, inherited the engineers and facilities, and established Toho Sanken Electric Co., Ltd. In June 1962, the company's name was changed to Sanken Electric Co., Ltd. Sanken now operates two main divisions: the Semiconductor Division and the Power Supply Division.

**Management**

Koichi Kotani	President
Takao Anzai	Senior Managing Director
Yoshito Matsui	Senior Managing Director
Hiroyuki Hayashida	Senior Managing Director
Sueji Shimazu	Managing Director
Shinya Tanaka	Managing Director
Yuji Morita	Managing Director
Jin Ishibashi	Director
Hirohito Sekine	Director

**Products and Processes**

Sanken's products include hybrid ICs, monolithic ICs, hall-effect ICs, MOSFETs, thyristors, rectifier diodes, Schottky barrier diodes, and light emitting diodes.

# 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](http://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

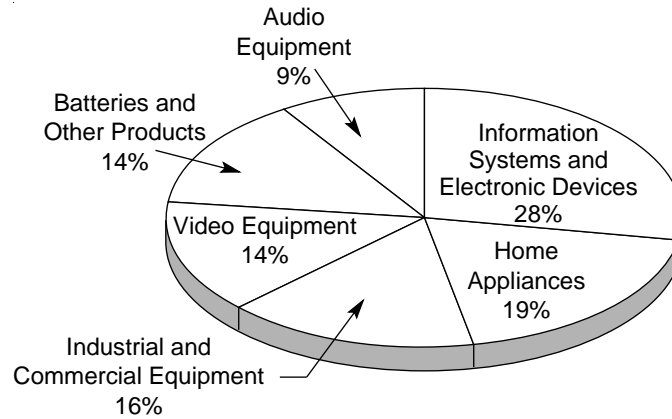
	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Corporate (¥B)						
Sales	¥1,537	¥1,527	¥1,660	¥1,707	¥1,650	¥1,793
Net Income	¥(1)	¥(2)	¥11	¥16	¥7	¥18
Semiconductor (\$M)**						
Sales	\$1,720	\$2,065	\$2,460	\$3,005	\$2,495	\$2,017
IC Sales	\$1,270	\$1,530	\$1,835	\$2,245	\$1,885	\$1,650
Discrete Sales	\$450	\$535	\$625	\$760	\$610	\$367
Capital Expenditures	\$275	\$360	\$365	\$560	\$625	\$427

\*Fiscal year changed to April 1, 1996 - March 31, 1997.

\*\*Calendar Year for Semiconductor

### 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.



**1997 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

Satoshi Iue	Chairman
Masaru Yamono	Vice Chairman
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 many 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.

<b>MOS MEMORY</b>		<b>ANALOG</b>	
<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)
<b>MOS LOGIC</b>		<b>DIGITAL BIPOLAR</b>	
<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"/>		<input type="checkbox"/>	MPU/MCU/MPR
<b>MOS MICROCOMPONENT</b>		<b>OTHER</b>	
<input 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		

### 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 $\mu$ m-4.0 $\mu$ 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: 3 in.  
 Processes: GaAs, GaP  
 Products: Discretes, optoelectronics, MMICs  
 Feature sizes: 0.5 $\mu$ m-5.0 $\mu$ 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 $\mu$ m-2.0 $\mu$ 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 $\mu$ m-2.0 $\mu$ 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 $\mu$ 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.
- LSI Logic established a joint development agreement with Sanyo Electric to design the core of an HDTV system.



## 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](http://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, Fiscal Year Ends March 31

	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Corporate (¥B)					
Sales	431¥	445¥	511¥	601¥	623¥
Semiconductor (\$M)					
Sales	\$600	\$760	\$950	\$825	\$650
Exchange Rate (¥/\$)	—	—	—	94	124

Ownership: Privately held.

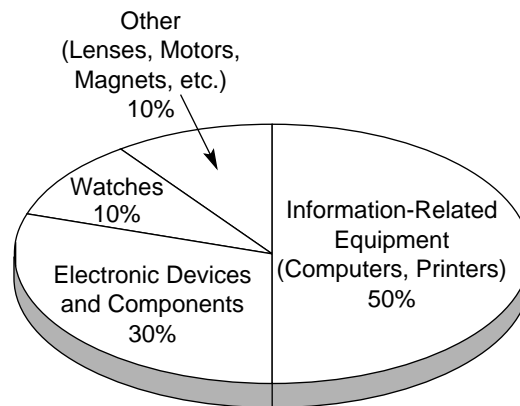
### Company Overview and Strategy

Seiko-Epson was formed in 1986 through the merger of Suwa Seikosha Co., Ltd., a famous maker of watches (established in 1942) and Epson Corporation. The combined company has 13,300 employees in Japan and 11,000 in 27 other countries including the US. Products include printers, personal computers and laptops, memories, semiconductors, motors and rare earth magnets, and, of course, watches. The company also makes LCD displays, some of which it uses in its laptops, and manufactures and sells a line of accurate assembly robots.

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. Seiko Epson has earned a reputation for its high quality large-scale integrated circuits (LSIs) and are particularly specialized in the field of complementary metal oxide semiconductor (CMOS LSIs), which feature low power consumption and low voltage and thus are especially suited to portable, battery-powered products.

In the field of application-specific integrated circuits (ASICs), Seiko Epson has dedicated design centers in Japan, the US, Germany, Taiwan, Canada and Hong Kong. These centers are focused on perfecting design and production work to match individual user needs.

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.



**1997 Sales by Product Segment**

## Management

Hideaki Yasukawa  
Nobuo Hashizume

President  
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, power ICs, LCD driver ICs, VGA controllers, color palette 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. 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 $\mu$ m-1.5 $\mu$ 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 $\mu$ m-0.8 $\mu$ m

Seiko Epson Corporation  
 Sagami-hara-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 $\mu$ m (0.15 $\mu$ m capability)

## Key Agreements

- In November 1997, Seiko Epson and Hitachi, Ltd., announced an agreement concerning licensing of Hitachi's 32-bit SH-3 RISC microprocessor core technology to Seiko Epson. By combining Seiko Epson's saving technology and low-power semiconductor technology with Hitachi's SH-3 core, this agreement will lead to new ASICs and ASSPs able to better meet system requirements.
- 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 Epson has a licensing agreement with Catalyst Semiconductor.

## SEIKO INSTRUMENTS

**Seiko Instruments Inc.**  
**Electronic Components Division**  
**1-8, Nakase 1-chome**  
**Mihama-ku, Chiba-shi**  
**Chiba 261, Japan**  
**Telephone: (81) (43) 211-1111**  
**Fax: (81) (43) 211-8021**  
**Web Site: [www.seiko.com](http://www.seiko.com)**

**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](http://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' Electronic Components Division is primarily responsible for development and manufacturing semiconductors, liquid crystal displays, quartz crystals, batteries, and fiber optic components. 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.

Seiko Instruments' products are marketed and sold by its sister company, Seiko Corporation, based in Tokyo.

### **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
- Lithium-ion battery protection ICs

### Drivers

- LCD drivers
- Controller for reflecting ECB Color LCD
- Thermal print-head drivers

### ASSP ICs

- Paging Decoder ICs
- Real time clocks
- 4-bit Microcomputer for Telephone set
- CR timers

### Sensor Products

- Temperature Sensor ICs
- Receiver ICs for Infrared Remote Controller
- Linear Image Sensor ICs

### Microcomputers

- 4-bit microcontrollers
- 8-bit microcontrollers

### Memory Products

- Nonvolatile RAMs (NVRAMs) — 64bit to 1K densities
- Serial EEPROMs — 1Kbit to 16K densities
- Parallel EEPROMs — 16K and 64K densities
- Fuse ROMs — 64-bit density

## 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 $\mu$ m-2.0 $\mu$ 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](http://www.sharp.co.jp)**

**IC Manufacturer**  
**Founded: 1912**

## Regional Offices/Representative Locations

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

**Europe:** Sharp Electronics (Europe) GmbH • Hamburg, Germany  
 Telephone: (360) (40) 23760 • Fax: (360) (40) 230764

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

**Japan:** Sharp Corporation • Osaka, Japan  
 Telephone: (61) 621-1221 • Fax: (61) 17-725300

## Financial History, Fiscal Year Ends March 31

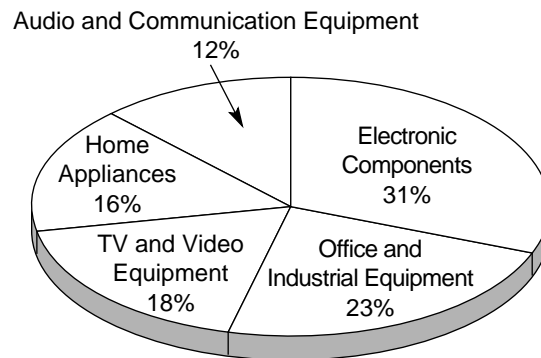
	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Corporate (¥B)						
Sales	¥1,555	¥1,508	¥1,518	¥1,618	¥1,651	¥1,770
Net Income	¥39	¥30	¥32	¥44	¥46	¥25
Semiconductor (\$M)*						
Sales	\$1,465	\$1,890	\$2,250	\$2,740	\$2,335	\$2,136
IC Sales	\$1,105	\$1,430	\$1,640	\$2,020	\$1,760	\$1,745
Discrete Sales	\$360	\$460	\$610	\$720	\$575	\$391
Capital Expenditures	\$230	\$270	\$340	\$385	\$735	\$542

\*Calendar Year

Ownership: Publicly held: Tokyo Stock Exchange.

## 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 50 product lines. The product lines include audio and video systems, electronic organizers, notebook computers and peripherals, copiers, calculators, integrated circuits, and optoelectronic devices.



**1997 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
Shieeo Misaka	Executive Director and Group General Manager, Electronic Components Group

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

John Manning	President
John Marck	Executive Vice President
Ed Chow	Vice President

### Sharp Labs of America (U.S.)

John Clemens	President
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## 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 panel displays now in use: active matrix color LCDs, passive matrix color LCDs, and electroluminescent (EL) displays.

MOS MEMORY

<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 type="checkbox"/>	EEPROM
<input checked="" 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 type="checkbox"/>	Other (Includes Telecom)

MOS LOGIC

<input 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 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

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

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 $\mu$ 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 $\mu$ m, 0.4 $\mu$ m, 0.6 $\mu$ m, 0.8 $\mu$ m, 1.0 $\mu$ 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 $\mu$ m-3.0 $\mu$ m

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

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

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 $\mu$ 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  
 Telephone: (81) (46) 230-5111  
 Fax: (81) (46) 230-5160  
 Web Site: [www.sony.co.jp](http://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

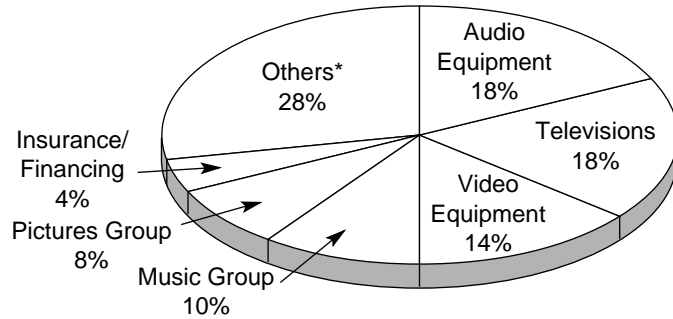
### Financial History, Fiscal Year Ends March 31

	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Corporate (¥B)	FY91	FY92	FY93	FY94	FY95	FY96
Sales	¥3,932	¥4,001	¥3,744	¥3,991	¥4,593	¥5,663
Net Income	¥120	¥36	¥15	¥(293)	¥54	¥139
Semiconductor (\$M)	FY92	FY93	FY94	FY95	FY96	FY97
Sales	\$1,460	\$1,750	\$1,850	\$2,450	\$2,000	\$2,000
IC Sales	\$1,100	\$1,370	\$1,475	\$2,080	\$1,600	\$1,500
Discrete Sales	\$360	\$380	\$375	\$370	\$400	\$500
Capital Expenditures	\$385	\$365	\$390	\$460	\$460	\$580

### 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” — Broadcasting of Professional Systems Co., Computer Peripherals & Components Co., Home AV Co., Personal AV Co., Information Technology Co., Personal & Mobile Communication Co., Recording Media & Energy Co., Digital Network Solutions Co., Semiconductor Co., and Display Co.



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

**1997 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 bipolar and MOS ICs for home-use audiovisual (AV) equipment, and CCDs for camcorders and broadcast- and industrial-use video cameras. About 60 percent of Sony's semiconductor sales in 1997 were to outside customers.

**Management**

**Sony Semiconductor Company**

Seiichi Watanabe                      President, Sony Semiconductor Company, and  
 Corporate Vice President, Sony Corporation

**Sony Semiconductor Co. of America**

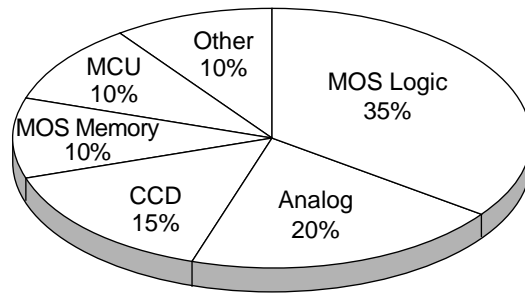
Travis White                              President, Sony Semiconductor Co. of America,  
 and Senior Vice President, Sony Semiconductor Company

Osamu Yokoyama                      Vice President, Finance

**Products and Processes**

Sony manufactures Fast 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.

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



1997 Semiconductor Sales by Device Type

- 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

**Semiconductor Fabrication Facilities**

Sony announced in early 1997, that it would add a \$420 million 0.25µm 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 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, discretets, LCD, R&D.  
 Feature sizes: 0.25 $\mu$ m-2.0 $\mu$ 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 $\mu$ m-1.0 $\mu$ m

Sony Corporation, Atsugi Technology Center  
 Atsugi-shi, Kanagawa Prefecture, Japan  
 Process: R&D  
 Products: R&D

Sony Shiroishi Semiconductor Inc.  
 Shiroishi-shi, Miyagi Prefecture, Japan  
 Process: GaAs  
 Products: Semiconductor Laser

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, linear ICs  
 Feature sizes: 0.35 $\mu$ m-1.5 $\mu$ m

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

### Key Agreements

- In April 1998, Microsoft Corporation and Sony Corporation announced plans to begin collaboration to create a convergence of the personal computer and consumer AV electronics platforms.

To facilitate the fusion of the PC and AV platforms, the two companies plan to cross-license key software technologies. Sony intends to license Microsoft's Windows CE operating system for use in certain future products. Similarly, Microsoft intends to license Sony's Home Networking Module for use with certain versions of Window's CE.

- In March 1998, LSI Logic announced that it will supply Sony Corporation with a single-chip DVD decoding engine for Sony's recently announced second-generation DVD video players.
- In December 1995, it was announced that Sony and Oki would begin joint development of 0.25 $\mu$ m CMOS manufacturing technology that can be used for both ASICs and 256M DRAMs. Their goal is to finish development by 1998.

- 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.
- ARM license.

# **TOSHIBA**

**Toshiba Corporation**  
**1-1, Shibaura 1-chome**  
**Minato-ku, Tokyo 105-01, Japan**  
**Telephone: (81) (33) 457-4511**  
**Fax: (81) (33) 456-1631**  
**Web Site: [www.toshiba.co.jp](http://www.toshiba.co.jp)**

**IC Manufacturer**

(See Top Ten)



# YAMAHA

Yamaha Corporation  
Semiconductor Division  
203 Matusnokijima, Toyooka-mura  
Iwata-gun, Shizuoka-ken 438-01, Japan  
Telephone: (81) (539) 62-4918  
Fax: (81) (539) 62-5054  
Web Site: [www.yamaha.co.jp](http://www.yamaha.co.jp)

## IC Manufacturer

### Regional Headquarters/Representative Locations

North America: Yamaha Systems Technology, Inc., • San Jose, California  
Telephone: (408) 467-2300 • Fax: (408) 437-8791

Europe: Systems Technology Singapore Pte., Ltd. • Singapore, 069538  
Telephone: (65) 225-0050 • Fax: (65) 225-3669

### Financial History (\$M)

	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Semiconductor					
Sales	\$345	\$382	\$445	\$320	\$240

### 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 0.35 $\mu$ m double-layer- and triple-layer-metal CMOS technology. These devices offer up to 600,000 usable gates and 256 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, 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, computers, facsimile machines, portable systems, 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: 150mm

Processes: CMOS, MOS

Products: ASICs, ASSPs, linear ICs, MPRs

Feature sizes: 0.5 $\mu$ m-1.2 $\mu$ m

Yamaha Corporation, Toyooka Plant

Iwata-gun, Shizuoka Prefecture, Japan

Capacity (wafers/week): 4,000

Wafer size: 150mm

Process: CMOS

Products: ASICs, ASSPs, MPRs

Feature size: 0.35 $\mu$ m-0.65 $\mu$ m

In 1996, Yamaha began construction of a 200mm 0.25 $\mu$ m-0.35 $\mu$ 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 June 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.