Dataquest

I.C. Start-Ups 1987
The Next Generation

Semiconductor Industry Group

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I. INTRODUCTION

The next generation in semiconductors has arrived! Since the late 1970s the semiconductor industry has witnessed an explosion of start-up activity unequaled in its 30-year history. Fueled by the emergence of silicon foundries, new applications, venture capital, and advances in computer-aided design (CAD) tools, this boom represents the "third wave" of start-up activity.

Dataquest has noted 127 start-up companies worldwide in this "third wave," a period from 1977 to 1985. We expect this number to increase more each year. These start-ups are developing new niche markets and technologies that did not exist only a few years ago. Several companies have already become hundred-million-dollar companies. In the 1990s, some may well become billion-dollar companies. Although several start-ups have failed, these have been quickly replaced by newcomers. As new technologies and applications emerge, Dataquest expects to see many more start-ups in Europe, Asia, and the United States by the year 2000.

For this reason, Dataquest believes it is crucial to watch these swiftly moving start-ups--the industry's barometers of change--because they represent emerging new technologies, markets, and applications.

For your convenience, Dataquest has prepared IC Start-Ups 1987, a compendium of information about these start-ups, information gathered through surveys, telephone interviews, and publicly available material. Some of the text was integrated verbatim from background information provided by the companies, and this may or may not reflect Dataquest's view of these companies. This report, to be updated annually, provides the following information:

- Historical trends in start-up activity
- Key factors of successful start-ups
- Venture capital financing
- Strategic alliances
- Technology trends (memory, microprocessors, digital signal processing, semicustom, gallium arsenide, and linear/analog)
- Company profiles

Definition of Start-Ups

Dataquest defines start-ups as semiconductor manufacturers that design and ship finished products under their own labels; they need not have in-house wafer fabrication facilities. Due to the high cost of state-of-the-art plants and equipment, we observed that most start-ups use silicon foundries to reduce up-front costs. They complete the circuit designs, send the masks to foundries for fabrication, then package the chips in-house. Unlike custom design houses, they offer regular product lines.

II. IC START-UP HISTORY

Historical Trends

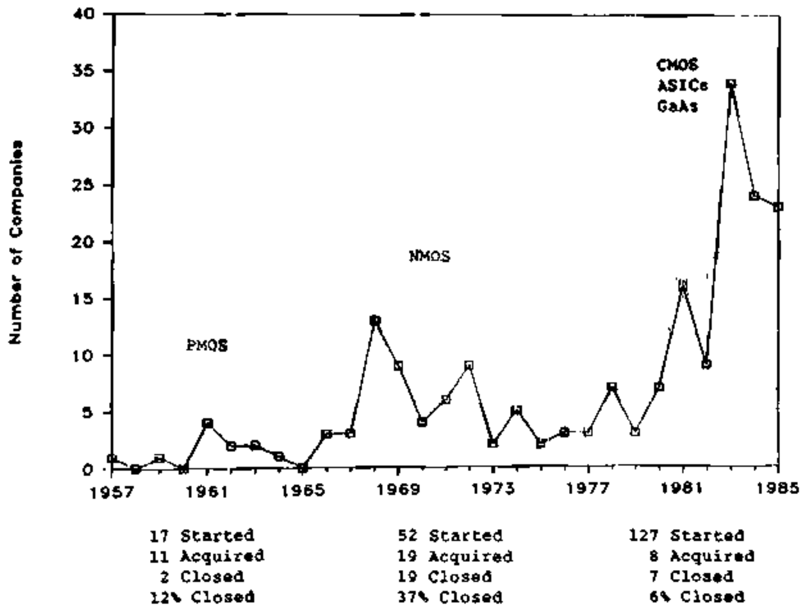
The semiconductor industry is a vibrant industry that has gone through numerous business cycles and technology developments during its 30-year history. Since the early 1950s, Dataquest has observed six distinct phases:

- Establishment of the industry under Bell Labs and Schockley Transistor (1947-1957)
- Domination by Fairchild, National Semiconductor, Raytheon, Signetics, and other early start-ups (1957-1967)
- A boom in start-up companies such as AMD, Intel, and MMI that offered NMOS standard products (1968-1974)
- Consolidation of the industry through mergers and acquisitions (1975-1979)
- A boom in application-specific IC start-ups in 1982 and 1983; high-performance CMOS and GaAs start-ups in 1984; and HCMOS, DSP, ASICs, and telecommunications IC start-ups in 1985 and 1986
- A second consolidation of the industry through mergers, acquisitions, and fab agreements

As shown in Figure 1, there have been three waves of semiconductor start-ups, each triggered by new process technologies. During the mid-1950s, we saw the rise of companies such as Schockley Transistors, Texas Instruments, and Fairchild, all specializing in transistors and PMOS technology. In the late 1960s, Intel, National, AMD, and others introduced NMOS technology. Since the late 1970s, a third wave of start-ups has developed next-generation technologies: high-performance CMOS and gallium arsenide (GaAs) processes; gate arrays, standard cells and silicon compilers for IC design; digital signal processing (DSP), power transistors, graphics, and telecommunications ICs.

Figure 1

SEMICONDUCTOR COMPANIES FORMED BY YEAR
1957-1985



Source: Dataquest

Historically, Dataquest has observed major trends in semiconductor start-up activity:

- A 12- to 15-year period between start-up waves, suggesting a technology life-cycle that progresses from initial research to commercialization and then to gradual decline.

- Technological and market leadership by key start-ups within a decade of existence.

- Consolidation, acquisition, and a shake-out of start-ups following each peak of start-up activity.

- A rapid loss of market share among older companies that are unable to compete with start-ups in emerging technologies.

- Successively larger waves of start-up companies and increasing competition.

- An emphasis on niche market strategies involving proprietary designs, CAD software, and excellent service.

- Dispersion of start-up activity outside Silicon Valley due to the growing role of noncomputer applications, venture capital newcomers, and foreign government sponsorship.

The latest wave of start-ups, which peaked in 1983, is slowing down as existing start-ups commercialize their products and seek new rounds of financing. Dataquest expects to see another phase of consolidations, mergers, and failures during the next ten years. However, in the mid-to-late 1990s, we anticipate a fourth wave of start-ups that will be involved with gallium arsenide (GaAs), optoelectronics, artificial intelligence (AI), parallel processors, three-dimensional ICs, voice recognition and synthesis, bioelectronics, and other emerging fields. These start-ups will become the major technology drivers as we enter the 21st century.

The Driving Factors

Why was there such a strong surge in semiconductor start-up activity in the late 1970s and early 1980s? Semiconductor start-ups faced increasingly expensive plant and equipment costs, growing competition from Asia, and a depressed market in 1981 and 1982. Dataquest believes that there were several driving factors:

- The infusion of venture capital.
- The strong start-up activity in computers, telecommunications, design workstations, and consumer electronics, all of which required state-of-the-art ICs.
- The proliferation of specialized market niches that required fast turnaround times.
- A growing number of experienced engineers and managers frustrated by the slowness of larger firms to innovate.
- More user-friendly computer-aided design (CAD) systems and support software.
- Worldwide fabrication facility over-capacity and silicon foundries that allowed start-up companies to defer fabrication investments.
- The entry of U.S., Japanese, Korean, and Taiwanese companies with sizable financing.
- The growing demand for higher-performance ICs with reduced power consumption (CMOS).

During the early 1980s, Dataquest has observed a mismatch between U.S. and foreign vendors specializing in NMOS processes and the growing demand for CMOS ASICs, memory, and logic devices, and other new products. Start-ups were quickly able to fill these market gaps by emphasizing advanced process technologies, design, and focused marketing.

The Third Wave

The third wave differs from previous start-up generations because of its sheer variety and number of start-ups, making generalization difficult. However, Dataquest notes several trends that will have a major impact on the industry:

- More start-ups outside Silicon Valley (58), especially in the Southwest and East Coast of the United States, and in Europe.

- Rapid ramp-ups since start-ups are not burdened with expensive plant capacity, but are using silicon foundries to allow focused expenditures on IC design, product development, and marketing.

- Increasing use of Asian silicon foundries because of their high-quality wafers and an apparent lack of interest among major U.S. vendors to compete.

- Numerous strategic alliances (over 70) between start-ups and Asian companies to jointly develop, manufacture, market, and distribute products.

- More corporate investors and government backers throughout the world.

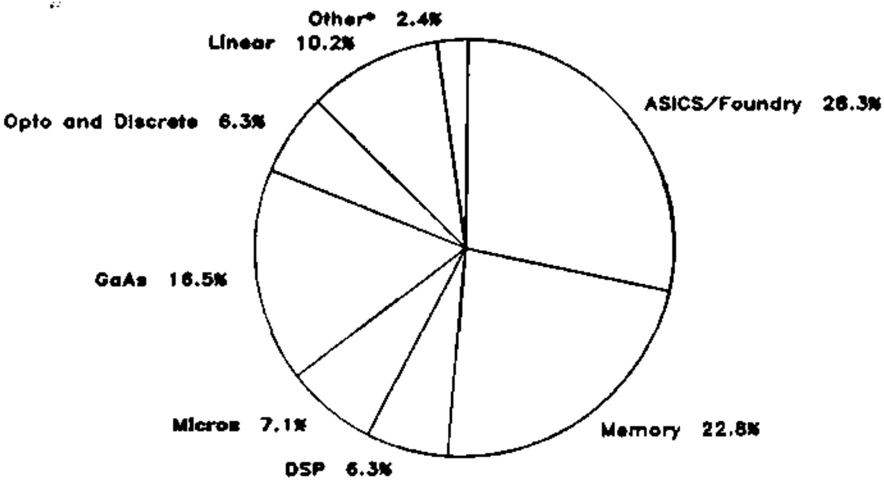
The third wave of start-up companies offers a wide variety of products, as shown in Figure 2. Application-specific ICs (ASICs) and high-performance CMOS memory and logic are attracting most of the attention. ASIC companies accounted for 28 percent of all start-ups established between 1977 and 1984 but represent a smaller percentage of start-ups in recent years because of market overcrowding. We expect to see a shake-out in ASIC companies during the next few years.

High-performance CMOS memory companies accounted for 23 percent of all start-ups, because of the growing necessity of niche-market strategies to withstand the Japanese domination of commodity memories.

Gallium arsenide (GaAs) accounted for 17 percent and linear technology accounted for about 10 percent of the start-ups. GaAs start-ups are largely focused on monolithic microwave ICs (MMICs), digital memory and logic, and standard microwave products. Linear start-ups are developing telecommunications ICs, linear arrays, and specialized linear products.

Figure 2

SEMICONDUCTOR START-UP PRODUCT LINES



*Josephson Junction
WaferScale
Bioelectronics

Source: Dataquest

The third-wave start-ups share many common characteristics. In general, the more successful companies tend to be:

- Highly focused, flexible, and able to move quickly out of stagnant markets and into high-growth markets.

- Willing to develop new markets and educate users about their products and design services.

- Positioned at the leading edge because of their advanced process technologies and proprietary CAD software.

- Resourceful in attracting venture capital from U.S. and foreign venture capitalists, corporate investors, and OEMs.

- Aggressive in building strategic alliances to jointly develop new applications and secure wafer fab capacity, especially in Asia.

Of course, not all recent start-ups fit this profile. Some companies are failing and are being acquired because of faulty management, weak finances, or poor product planning and marketing. Table 1 is a list of companies in this third wave that are no longer operating or have filed for Chapter 11.

Table 1

START-UP COMPANIES THAT ARE NOT OPERATING
OR HAVE FILED FOR CHAPTER 11 PROTECTION

Company	Status
Array Devices	Closed
Hyundai America	Closed
Iridian Microwave	Not Operating
Sahni Corporation	Not Operating
Si-Fab	Filed Chapter 11
Texet	Filed Chapter 11 in October 1985
Trilogy	Sold Semiconductor Operations
Wafer Technology	Not Operating
Zytrex	Filed Chapter 11 in 1985

Source: Dataquest
October 1986

However, these companies represent only six percent of all companies formed in the 1977-1985 period. We note that start-ups generally are much more aggressive, flexible, and strategically better positioned than larger U.S. vendors. For example, whereas larger U.S. vendors are hesitant to enter alliances with Asian companies, start-ups are jumping into alliances en masse. Of the 127 start-ups, we estimate that 43 companies have over 70 agreements with Asian companies.

A few companies just recently came to our attention and are not included in the company profiles section of this directory. These are:

Advanced Power Technology
405 SW Columbia Avenue
Bend, Oregon 97702
503/382-8028

Advanced Power Technology was formed in 1984 to manufacture low-cost, high-power, high-reliability MOS transistors for advanced industrial power switching applications.

BT&D Technologies, Inc.

In 1985, British Telecommunications plc and DuPont Company joined forces to form BT&D Technologies, which will manufacture optoelectronic components and devices at a plant in Ipswich, England. The Company will start with an 80,000-square-foot plant and expects to employ 150 people by the end of 1987.

Krysalis Corp.
4200 Osuna NE
Box 106, Suite 102
Albuquerque, New Mexico 87109
505/345-1953

Krysalis Corp. was formed in late 1984 to design and manufacture memory products. Founders are President, Joe Evans, and Vice-President, Bill Miller. Mr. Miller was formerly process engineer at Signetics. Richard Womack, who was on Texas Instrument's 4-megabit DRAM design team has joined the company. It is presently in its development stage and is working on unique approaches to its memory products. Krysalis will disclose more information on its process and products in mid-1987.

Level One Communications Inc.
105 Lake Forest Way
Folsom, CA 95630
916/985-3670

Level One Communications Inc. was formed to design and manufacture integrated CMOS transceivers and associated circuits for telecommunications and datacom applications. The Company was founded in November 1985, by Daniel L. Ray and James Gorecki formerly with Intel Corp. and Terry McCoy formerly with American Continental Corp. It is presently in its development stage and plans to offer products early next year. Level One has leased a 21,000-square-foot facility where it does its research and development and design and has arranged for foundry subcontracting.

Opto Diode Corp.
914 Tourmaline Drive
Newbury Park, CA 91320
805/499-0335

Opto Diode Corp. (OCD) was formed in 1981 by James Kim formerly with Rockwell's Collins division in Dallas. ODC offers semicustom high-reliability devices made to customers specifications. ODC had $1 million in sales in 1985 from GaAs infrared LEDs for solid state relay and optoelectronics markets. Future plans are to penetrate the U.S. military market and the European market. The Company is occupying a 10,000-square-foot facility.

Spectrum Semiconductor Inc.
885 Bon Mills Road
Toronto, Ontario
Canada M3C 3H1
416/449-9260

Charles M. Keough
VP Marketing & Sales
312/571-6665

Spectrum Semiconductor Inc. is an application-specific start-up founded in Toronto, Ontario, to serve the central Canadian market and has formed a subsidiary in Illinois that will do design and sales and marketing for the central and northeast United States. The Company is focusing on design, prototyping, and low-volume quantity manufacturing of customer specific ICs (CSICs). Its product line allows engineers to create systems solutions in silicon by implementing Spectrum programmable logic devices, microcontrollers, gate arrays, and standard cells within weeks. Products will be fabricated in Spectrum's Toronto facilities, which produce 6-inch, 2-micron CMOS devices. The products will be fully compatible with, and provide automatic second-sourcing for, its major technology partner, National Semiconductor Corporation. Spectrum is offering design services at this time, and National will provide fabrication services until Spectrums' facilities come on-line in the second or third quarter of 1987. Spectrum will target the telecommunications, military, and industrial application markets.

Telcom Devices Corp.
914 Tourmaline Drive
Newbury Park, CA 91320
805/499-0611

Telcom Devices was founded in early 1986 to offer indium gallium arsenide (InGaAs) photodiodes and indium gallium phosphide (InGaP) light emitting diodes. Telcom is a subsidiary of Opto Diode Corp. (ODC) and is operating from ODC's facilities, sharing clean room and manufacturing space. Larry Perillo, formerly with Rockwell, is director of optoelectronic materials. Telcom started volume production of its first product in May 1986, an InGaAs PIN photodiode for fiber optic applications.

1985 Slowdown and New Investment Opportunities

Historically Dataquest has observed sharp "spikes" in semiconductor start-up activities (1968, 1983-1985) followed by a period of mergers, acquisitions, and repositioning. We believe that the slowdown in start-up activity since 1985 results from the following:

- Reluctance of U.S. venture capitalists to finance new start-ups during this industry recession and the necessity to increase funding for existing start-ups.

- The impending shake-out in crowded market niches (ASICs, GaAs, CMOS memories).

- Pressures for rapid commercialization rather than new company formation and initial research.

Despite this slowdown, Dataquest believes that there is still room for new start-ups, particularly in the following technologies and application areas:

- Optoelectronics (lasers, sensors, optocouplers)

- High-Speed CMOS and ECL logic ICs

- Gallium arsenide (microwave, optoelectronics, and digital ICs)

- Digital signal processing (DSP)

- Erasable programmable logic devices (EPLDs)

- Telecommunications

- Specialized linear arrays

- Graphics

- High-performance microprocessors (floating-point processors, parallel processors, RISC processors)

- Specialized silicon compilers

- Speech recognition and synthesis

- Artificial intelligence (AI)

- Bioelectronics (biosensors, biochips)

While these fields offer many opportunities, some are still in an infancy stage. Start-ups entering these fields will be required to develop basic design technologies and to educate users about potential applications. Unlike in the past when technology-driven companies could succeed because markets and users already existed, Dataquest believes that future start-ups will have to be more innovative about applications, creating and developing entirely new markets.

Geographic Dispersion of Start-Up Companies

Silicon Valley still leads in the number of semiconductor start-ups, but other areas are beginning to attract more start-ups. As shown in Table 2, Silicon Valley has 69 of the 127 start-ups established since 1977, or 54 percent. In recent years however, almost half of the start-ups are being formed outside Silicon Valley due to the increased availability of local financing and government support.

Table 2

GEOGRAPHIC DISPERSION OF START-UP COMPANIES

Silicon Valley	69
Southwest	20
Northwest	6
Midwest	3
Northeast	7
Southeast	2
Canada	2
Europe	10
Japan	4
Taiwan	2
Australia	1
Brazil	1

Source: Dataquest
October 1986

Dataquest anticipates more worldwide start-up activity due to growing public and private interest in promoting venture capitalism and entrepreneurialism. In the future, we expect the following regions to become increasingly active:

- East Coast of the United States, especially New Jersey ("Gallium Gulch"), Maryland ("Bioelectronics Center"), and North Carolina (Research Triangle)

- Midwest of the United States, especially Austin, Texas (Microelectronics & Computer Research Corporation)

- Europe, especially Scotland, Munich, and France (Grenoble)

- Israel

- Asia; especially Taiwan, China, Singapore, Malaysia, and India

By the year 2000, we expect to see a semiconductor industry that is not so concentrated in existing areas but is much more global in scope. The trend toward closer vendor-user ties will accelerate this global shift. Because of the grassroots nature of start-ups, they will have a significant impact on the direction of regional industries and economies.

Table 3

START-UP COMPANIES AND LOCATION BY REGION

Company	Location	Date Formed
SILICON VALLEY		
ABM Semiconductor	San Jose	1985
ACTEL	Sunnyvale	1985
Acrian	San Jose	1978
Acumos	San Jose	1985
Adaptec	Milpitas	1981
ALD	Sunnyvale	1985
Altera	Santa Clara	1983
ATMEL Corp.	San Jose	1984
Barvon Research	Milpitas	1981
California Devices	Milpitas	1978
Calogic	Fremont	1983
Catalyst Semiconductor	Santa Clara	1985
Celeritek	San Jose	1984

(Continued)

Table 3 (Continued)

START-UP COMPANIES AND LOCATION BY REGION

Company	Location	Date Formed
SILICON VALLEY (Continued)		
Chips & Technologies	Milpitas	1985
Cirrus Logic	Milpitas	1981
Custom Arrays	Sunnyvale	1984
Custom MOS Arrays	Milpitas	1982
Cypress Semiconductor	San Jose	1983
Elantec	Milpitas	1983
Exel (Acquired)	San Jose	1983
Harris Microwave	Milpitas	1980
Hyundai America (Closed)	Santa Clara	1983
ICI Array Technology	San Jose	1982
IC Sensors	Milpitas	1982
ICS	Sunnyvale	1984
IDT	Santa Clara	1980
Intercept	San Jose	1985
ICT	Santa Clara	1983
IMP	San Jose	1981
IXYS	San Jose	1983
Laserpath	Sunnyvale	1983
Linear Technology	Milpitas	1981
Logic Devices	Sunnyvale	1983
LSI Logic	Milpitas	1981
Maxim	Sunnyvale	1983
Micro Linear	San Jose	1983
Microwave Technology	Fremont	1982
Modular Semiconductor	Santa Clara	1983
MOSel	Sunnyvale	1983
Novix	Cupertino	1984
Orbit Semiconductor	Sunnyvale	1985
Pacific Monolithics	Sunnyvale	1984
Panatech	Santa Clara	1981
Performance Semiconductor	Sunnyvale	1984
Quasel, Inc.	Santa Clara	1984
Sahni	Sunnyvale	1984
Samsung Semiconductor	Santa Clara	1983
Saratoga Semiconductor	Cupertino	1985
SEEQ Technology	San Jose	1981
Sensym	Sunnyvale	1982
Sierra Semiconductor	San Jose	1984

(Continued)

Table 3 (Continued)

START-UP COMPANIES AND LOCATION BY REGION

Company	Location	Date Formed
SILICON VALLEY (Continued)		
Si-Fab	Scotts Valley	1981
Silicon Macrosystems (Acquired)	San Jose	1984
S-MOS Systems, Inc.	San Jose	1983
TMMIC	Mountain View	1984
Telmos	Sunnyvale	1981
Topaz Semiconductor	San Jose	1985
Trilogy (Sold Semi Opns)	San Jose	1980
Universal	San Jose	1978
Visic, Inc.	San Jose	1983
Vitelic Corp.	San Jose	1983
VLSI Technology (VTI)	San Jose	1980
WaferScale Integration	Fremont	1983
Weitek Corp.	Sunnyvale	1980
Xicor, Inc.	Milpitas	1978
Xilinx	San Jose	1984
Zoran	Santa Clara	1983
ZyMOS	Sunnyvale	1978
Zytrex (Chapter 11)	Sunnyvale	1981
SOUTHWEST		
Applied Micro Circuits	San Diego, CA	1979
Array Devices (Closed)	San Diego, CA	1982
Brooktree	San Diego, CA	1981
Crystal Semiconductor	Texas	1984
Dallas Semiconductor	Texas	1984
GigaBit Logic	Newbury Park, CA	1981
Integrated Logic Systems	Colorado	1983
Iridian (Closed)	Chatsworth, CA	1983
Krysalis	New Mexico	1985
Microwave Monolithics	Simi Valley, CA	1982
Molecular Electronics	Torrence, CA	1983
Opto Diode		
Signal Processor (Acquired)	Utah	1981
Silicon Systems Inc.	Tustin, CA	1981
III-V Semiconductor	Arizona	1985
Telcom Devices	Newbury Park, CA	1986

(Continued)

Table 3 (Continued)

START-UP COMPANIES AND LOCATION BY REGION

Company	Location	Date Formed
SOUTHWEST (Continued)		
Texet (Chapter 11)	Texas	1983
Vatic (Acquired)	Arizona	1983
Vitesse Electronics	Camarillo, CA	1984
Wafer Technology (Closed)	Rancho Palos Verdes, CA	1984
NORTHWEST		
Advanced Power Technology	Oregon	1984
Bipolar Integrated Tech	Oregon	1983
Lattice Semiconductor	Oregon	1983
Level One Communications	Folsom, CA	1985
Micron Technology	Idaho	1978
TriQuint Semiconductor	Oregon	1984
MIDWEST		
Electronic Technology	Iowa	1983
VTC	Minnesota	1984
XTAR	Illinois	1982
NORTHEAST		
Anadigics, Inc.	New Jersey	1985
Custom Silicon	Massachussetts	1983
GAIN Electronics	New Jersey	1985
Hittite Microwave	Massachussetts	1985
Hypres	New York	1983
Lytel	New Jersey	1983
Tachonics	New York	1985
SOUTHEAST		
Insouth Microsystems	Alabama	1980
MCE Semiconductor	Florida	1977

(Continued)

Table 3 (Continued)

START-UP COMPANIES AND LOCATION BY REGION

Company	Location	Date Formed
CANADA		
Calmos Systems	Kanata, Ontario	1983
Spectrum Semiconductor	Toronto, Ontario	1985
EUROPE		
BT&D Technologies	United Kingdom	1985
Dolphin Integration	France	1985
European Silicon Structures	West Germany	1985
Inmos Ltd.	United Kingdom	1978
Integrated Power Semiconductor	Scotland	1984
Isocom	United Kingdom	1982
Matra-Harris	Belgium	1979
Mietec	Belgium	1983
Triad Semiconductor	Holland	1985
Wolfson	United Kingdom	1985
JAPAN		
A&D Company		1977
Kyoto Semiconductor	Japan	1980
Nihon Information Center	Japan	1977
NMBS	Japan	1984
TAIWAN		
Opto Tech	Taiwan	1983
United Microelectronics	Taiwan	1979
OTHER		
Austek Microsystems	Australia	1984
SID Microelectronics	Brazil	1984

Source: Dataquest
October 1986

III. SUCCESS FACTORS

As competition intensifies in the semiconductor industry, building a successful start-up company will become increasingly difficult. What are the key factors that will distinguish the winners from the losers? Based on the track records of existing companies and our discussions with venture capitalists, Dataquest believes that the following factors are critical:

Management

- A strong management team, top-notch engineers, and an excellent marketing manager(s)
- A unique business strategy with achievable goals
- A stable source of financing

Product Development

- Leading-edge processing expertise
- Proprietary CAD software and support tools
- Joint R&D with customers and strategic partners
- A diversified portfolio with main product families

Manufacturing

- An experienced operations manager and strong in-house manufacturing knowledge
- A silicon foundry agreement during initial years
- A plan for in-house state-of-the-art wafer fabrication facility (modular approach)

Marketing

- Global marketing perspective
- Highly-focused marketing plan
- Asia-monitoring capability (especially Japan)
- Overseas sales, marketing, and distribution agreements

Absolutely critical for success is the building of a strong management team. Successful new companies are those that attract talented and experienced personnel to fill positions in key areas, including leadership (president/CEO), marketing, finance, process development, manufacturing, and international operations. Companies with only one or two of these positions filled with first-rate managers usually have trouble during the product commercialization phase. In general, start-ups most likely to fail are those strong in technology but weak in marketing, manufacturing, and general management. Many companies are built around engineers who do not have the breadth of management and marketing experience required to run a company successfully.

The lack of marketing intelligence is another common pitfall. Most start-ups concentrate on the U.S. market and ignore overseas markets until they attain a certain sales volume. Unfortunately, these companies overlook significant sales opportunities and emerging foreign competitors. Dataquest believes that a global posture is critical for start-up companies, especially with the growing competition from European and Asian companies.

In evaluating start-up companies, we believe the following questions should be asked:

- What are the prior achievements of key officers and managers?
- Is the product line unique or a significant improvement over its competitors? Is it diversified enough to withstand fierce price competition?
- How much is the start-up investing in R&D?
- Does the start-up have plans to conduct joint research with universities and strategic partners?
- What is the start-up's marketing strategy? Is it domestic only or a global strategy?
- Is the start-up planning foundry agreements and/or plant construction? What is the timing?
- If the start-up has an agreement with an Asian company, is it giving away the store?
- Is the company prepared to respond to rapid technological innovation?

IV. VENTURE CAPITAL

One of the major reasons for the upswing in semiconductor start-up activity is the rapid growth of venture capital sources. The flow of venture capital disbursements increased from $450 million in 1969 to $3.4 billion in 1983.

Venture capital for start-up companies appeared in large amounts when the capital gains tax law was revised in 1978, lowering corporate tax rates from 30 percent to 20 percent and individual tax rates from 50 percent to 20 percent. The flood gates opened even more in 1981 when up to 10 percent of pension fund capital gains could be invested. The seed funding continued right through the recession of 1980 to 1982, buoyed also by the faith in the electronics industry growth. 1983 was the peak year of high technology funding; in the first three months alone, more than $800 million in venture capital was invested in Silicon Valley start-up companies.

The availability of venture capital funding has tightened however, since the latter part of 1983. Venture capital disbursements in 1984 were $3.2 billion and $2.6 billion in 1985. The decline in the semiconductor industry investments was primarily due to the high number of start-ups. New companies are now under more pressure to be unique or superior in product and technology strategies in order to receive seed or additional funding. As a result, more funding is being provided by corporations, foreign governments, and state development agencies.

The start-ups in this directory have raised approximately $2 billion in venture capital so far. Table 4 contains a list of start-up companies and information as to whether funding was provided by corporations, governments, or venture capital firms.

Table 4

IC START-UP FUNDING

Company	Total $M	Sources
ABM	1.0	Corporate
Acrian	5.0	Venture Capital
ACTEL	9.6	Venture Capital, Corp., Private
Altera	23.2	Venture Capital, Corporate
Anadigics	20.0	Venture Capital
AMCC	11.0	Venture Capital, Corporate
Austek	6.7	Venture Capital, Australian Govt.
BRI	1.7	Venture Capital, Corp., Private
BIT	17.4	Corp., Oregon State, Venture Cap.
CDI	16.5	Venture Capital
Calmos Systems	5.0	Private
Calogic	N/A	Private
Catalyst	4.5	Private
Celeritek	8.4	Venture Capital
Chips & Technologies	2.8	Venture Capital, Private
Cirrus Logic	12.1	Corporate, Venture Capital
Crystal Semi	11.2	Venture Capital
Custom Arrays	0.3	Corporate
CMA	4.0	Corporate
CSI	4.0	Private, Venture Capital
Cypress	115.3	Venture Capital, Corp., IPO
Dallas	33.1	Venture Capital
Dolphin	0.6	Corporate, Venture Capital
Elantec	8.3	Venture Capital
ETC	2.0	Iowa State, Venture Capital
ESS	30.0	Venture Capital, Corporate
Exel	36.0	Venture Capital
GAIN	23.0	Venture Capital, Corporate
GigaBit	30.1	Venture Capital, Corporate
Harris Microwave	4.0+	Corporate
Hypres	8.6	Venture Capital
Inmos Ltd.	100.0	British Government
ICS	0.5	Venture Capital
IDT	25.1	Venture Capital, Corporate, IPO
ILSI	5.0	OTC Offering
IPS	48.0	Venture Capital, British Govt.
ICT	5.0	Corporate
IMP	29.2	Venture Capital

(Continued)

Table 4 (Continued)

IC START-UP FUNDING

Company	Total $M	Sources
IXYS	7.5	Venture Capital, Private
Kyoto	62.0	
Laserpath	8.3	Venture Capital
Lattice Semi	5.2	Corporate, Venture Capital
LTC	35.0	Venture Capital
Logic Devices	2.9	Venture Capital, Private
LSI Logic	204.7	Venture Capital, IPO
Lytel	20.0	Corporate
Maxim	23.3	Venture Capital
MCE Semiconductor	N/A	Private
Micro Linear	41.0	Venture Capital, Corporate
Micron Technology	50.0	Public Offering
Microwave Monolithics	N/A	Private
Microwave Technology	10.1	Venture Capital
MOSel	3.0	Corporate, Private
NMBS	11.1	Private, Venture Capital
Novix	1.0	
Opto Tech	2.5	Taiwan Bank, Corporate
Pacific Monolithics	5.0	Venture Capital
Performance	17.9	Venture Capital, Corporate
Quasel, Inc.	38.5	Taiwan Banks, Venture Capital
Sahni	N/A	Private
Samsung	13.0	Corporate
Saratoga	11.2	Venture Capital
SEEQ Technology	49.0	Venture Capital, Public Offerings
Sensym	2.5	Venture Capital, Corporate
SID	14.2	Private
Sierra	48.1	Venture Capital, Corporate
Silicon Macro	1.1	Private, Corporate
Tachonics	15.0	Corporate
Telmos	27.7	Venture Capital, Corporate
Topaz Semiconductor	0.6	Private
Triad	20.0	Venture Capital, Dutch Government
TriQuint	N/A	Corporate
UMC	20.0	Taiwan Govt., Venture Capital, Corp.

(Continued)

Table 4 (Continued)

IC START-UP FUNDING

Company	Total $M	Sources
Universal	5.0	Venture Capital, Corporate
Visic, Inc.	12.0	Venture Capital
Vitelic Corp.	14.2	Venture Capital, Corporate
Vitesse Electronics	30.0	Corporate
VLSI Technology	150.0	Venture Capital, Corp., IPO
VTC	111.5	Corporate, Venture Capital
WSI	37.6	Venture Capital, Corporate
Weitek Corp.	7.5	Venture Capital
Xicor, Inc.	100.0	
Xilinx	12.6	Venture Capital
XTAR	N/A	Private
Zoran	27.0	Private, Israel Corporation
ZyMOS	65.9	Corporate

Source: Dataquest
October 1986

V. WAFER FABRICATION CAPACITY

Obviously a major concern within the U.S. semiconductor industry is that U.S. start-ups may be "giving away the store" because of their willingness to use Asian wafer suppliers. Because of high equipment costs and worldwide over-capacity, many start-ups are not building wafer fabrication plants. Instead, U.S. design technologies are being traded for Asian fab capacity. Moreover, some evidence exists to indicate that major U.S. manufacturers are unwilling to share leading-edge and under utilized wafer fab capacity (sub-1.5-micron CMOS processes) with the start-up companies.

VI. STRATEGIC ALLIANCES

An important development in the start-up area is the proliferation of licensing and joint-development agreements with established companies. At a time when venture capital has become increasingly scarce, small companies are often under pressure for near-term funding. In addition to seeking funds, start-ups are entering strategic alliances for a variety of other reasons:

- To avoid the prohibitive costs of a fab
- To increase production capacity
- To defray increasing product development costs
- To strengthen product portfolios
- To increase a worldwide presence
- To insure that technological advances do not exceed depreciation limits
- To provide alternate sources and establish standards

Technology is the dominant competitive factor of the 1980s, and the intensification of technology-based competition is pushing large firms outside proprietary in-house R&D labs into partnerships, particularly with small, technology-rich start-ups.

Table 5

ADVANTAGES OF STRATEGIC START-UP ALLIANCES

Offense	Defense
Secure technologies	Work with potential rivals
Gain access to markets	Keep out competitors
Rapid market entry	Avoid "boomerang effect"
Fill in product portfolios	Monitor technology & market trends
Foundry capacity	Cut production costs
Cash infusions	Financial viability
Greater product acceptance	
Ease trade frictions	

Source: Dataquest
October 1986

Pitfalls and Problems of Alliances

Management

- Language and cultural differences
- Management styles
- Conflicting business goals
- Unequal levels of commitment
- Differing negotiating styles

Technology

- Giving away the store
- Receiving little in return
- Stuck with a nonindustry standard

Market

- Quarrels over territory
- Loss of overseas expansion potential
- Encroachment into U.S. market

Until recently, companies seeking access to new technologies or markets would often resort to acquisition. However, acquisition arrangements can be ill-conceived, inefficient, and unsuccessful. Acquisitions frequently trigger a flight of top engineers and lower employee morale in the acquired company.

Corporate partners are seeking something more than mere dollar gains. Agreements include access to technology, designs, and guaranteed production. To accomplish strategic objectives, companies are considering a broader range of limited and focused cooperative agreements. Such as:

- Minority equity investments
- Technology licensing
- Joint marketing
- Joint ventures
- All or part manufacturing

Start-up companies have agreed to affiliations or acquisitions, and have even acquired the assets of former companies for the following reasons:

- To gain financial backing
- To exploit technologies developed at parent companies
- To gain mobility to enter new product markets
- To enlarge product lines
- To penetrate markets in other areas

Table 6, is a list of start-up companies that have either been acquired, are affiliated with other companies, or have acquired other companies:

Table 6

START-UP COMPANY AFFILIATES OR SUBSIDIARIES OF LARGER COMPANIES

Company	Affiliation
Acrian	Acquired Communication Transistor (1982)
Austek	Acquired Silicon Macrosystems (1986)
California Devices	Affiliated with California Testing
Crystal Semiconductor	Acquired Texas Micro-Circuit (1984)
Custom Arrays	Subsidiary of Atac
Custom MOS Arrays (CMA)	A sister company of California Micro Devices
Exel Microelectronics	Acquired by Exar (1986)
Harris Microwave	Subsidiary of Harris Corp.
ICI Array Technology	Acquired by ICI plc (1986)
Insouth Microsystems	Acquired by Fairchild (1983)
Integrated CMOS Systems	Acquired by Fairchild (1986)
Orbit Semiconductor	Comdial Semiconductor was acquired by Orbit Instruments in 1985 and renamed Orbit Semiconductor
Panatech Semiconductor	Subsidiary of Panatech R&D
Samsung Semiconductor	Subsidiary of Samsung Semiconductor and Telecommunications Ltd.
Signal Processor Circuits	Acquired by Analog Devices (1983), and operating under the Analog Devices name as its DSP division

(Continued)

Table 6 (Continued)

START-UP COMPANY AFFILIATES OR SUBSIDIARIES OF LARGER COMPANIES

Company	Affiliation
S-MOS	Affiliated with Seiko Epson
Tachonics	Subsidiary of Grumman Corp.
Telecom Devices	Subsidiary of Opto Diode Corp.
Teledyne Monolithic Microwave	Subsidiary of Teledyne
Topaz Semiconductor	Subsidiary of Hytek Microsystems
TriQuint Semiconductor	Subsidiary of Tektronix
Vatic Systems	Merged into Thomson Components-Mostek Corporation in 1986, and operates as a design house
ZyMOS	Acquired by Daewoo in 1986

Source: Dataquest
October 1986

Asian Ties With IC Start-Ups

During 1986 Dataquest has observed a continuing increase in agreements between U.S. start-ups and Asian companies. Why the rush to Asia, especially Japan? We believe that there are several reasons:

- Japan's emergence as the largest IC consumption market
- Availability of high-quality, state-of-the-art wafer fab capacity in Asia and its unavailability in the United States
- Desire to leverage R&D funds by jointly developing new products
- Ability to secure a steady future cash-flow through royalty fees

Of course there is the risk of "giving away the store," but we believe that most of the start-ups are fast enough to move on to newer technologies and niche markets, leaving the commodity markets to major companies. Moreover, U.S. start-ups can actually leverage Asian fab capacity to their advantage.

However, Dataquest believes that many U.S. start-ups will build their own U.S. wafer fabs in 1987 and 1988 because of the risk of losing their Asian fab allocations during the next industry upturn. Companies building or planning new fabs include Cypress, Integrated Device Technology (IDT), and Vitelic.

Table 7 is a list of start-up companies and the respective agreements with Asian companies.

Table 7

ASIAN TIES WITH START-UPS

Start-up	Partner	Date	Agreement
ABM	Kodenshi (Japan)	Nov. 1985	Kodenshi participated in initial funding.
AMCC	Seiko Epson/ S-MOS (Japan)	May 1985	Gate array exchange agreement.
ATMEL	Hyundai (Korea)	March 1986	Agreement with GI and ATMEL for GI's CMOS OTP EPROM and 64K EEPROMs.
BRI	Ricoh (Japan)	N/A	Ricoh provides HCMOS and BiCMOS processes.
	GoldStar (Korea)	N/A	Foundry services and technology license.
Brooktree	Toshiba (Japan)	1985	Brooktree technology license.
Calogic	Koki (Japan)	Dec. 1984	Sale of CMOS data bus driver ICs in Japan.
Catalyst	Oki Electric (Japan)	1986	R&D agreement for ASICs, CMOS EPROMS, and EEPROMS and nonexclusive marketing agreement.
CDI	Olympus Optical (Japan)	Jan. 1983	CMOS gate array transfer agreement.
Chips & Tech.	Fujitsu/Toshiba/ Yamaha (Japan)	Nov. 1985	Foundry services for CMOS and bipolar arrays. Yamaha also participated in second-round financing.
CMA	Ricoh (Japan)	1982	Ricoh provided all wafers.
		1983	CMOS & BiCMOS gate arrays and cell-based agreement.
		March 1884	Joint development of CMA's CMOS gate array designs and Ricoh's process & production.
ETC	Exar (Japan)	1983	Foundry services.
Exel	Samsung (Korea)	1983	Second source for Exel's 16K EEPROMs.
		May 1985	Agreement extended to cover 64K EEPROMs.

(Continued)

Table 7 (Continued)

ASIAN TIES WITH START-UPS

Start-up	Partner	Date	Agreement
Exel	Oki Electric (Japan)	1985	Exel 16K EEPROM license.
	Exar (Japan)	Feb. 1986	Exar completed acquisition of Exel for $5M.
GAIN	Mitsui (Japan)	1985	Mitsui participated in seed funding.
Inmos	NMBS (Japan)	June 1984	Inmos licensed its 256K CMOS DRAM to NMBS.
	Hyundai (Korea)	Dec. 1984	Hyundai paid $6M for Inmos 256K DRAM technology.
ICS	Toshiba (Japan)	1985	Toshiba is providing foundry services.
ICT	Hyundai (Korea)	Oct. 1983	Hyundai funded for $5 million; joint development of EPROMS, EEPROMs, and SRAMs.
IDT	Internix (Japan)	N/A	Sales in Japan.
IMP	Iskra (Japan)	April 1985	Foundry; codeveloped a CMOS analog cell library.
IXYS	Ricoh (Japan)	1984	IXYS power MOSFET HDMOS process for wafers.
	Samsung (Korea)	Jan. 1986	Samsung received IXYS power MOS technology.
Lattice	Seiko Epson/S-MOS (Japan)	Jan. 1986	Lattice licensed its 64K SRAM design and technology.
LTC	Teijin (Japan)	June 1983	Distribution in Japan.
LSI Logic	Toshiba (Japan)	Aug. 1981	Joint development of CMOS gate arrays; Toshiba supplied wafers.
		June 1983	Joint development of channelless Compacted Arrays.
		June 1985	Joint venture to develop 50,000-gate "Sea-of-Gates."

(Continued)

Table 7 (Continued)

ASIAN TIES WITH START-UPS

Start-up	Partner	Date	Agreement
LSI Logic	Fujitsu (Japan)	1982	Agreement for HCMOS gate arrays.
	LSI Logic K.K.	1984	LSI Logic formed a subsidiary in Japan.
	C. Itoh (Japan)	April 1985	LSI Logic K.K. sales agreement to sell in Japan.
	Kawasaki Steel (Japan)	Sept. 1985	Joint venture to form Nihon Semiconductor in Japan.
Micro Linear	Kyocera (Japan)	1985	Kyocera participated in second-round financing.
	Nihon Teksel (Japan)	Sept. 1985	Contract to sell semi-custom linear ICs in Japan.
	Toko (Japan)	Oct. 1985	Toko will produce bipolar devices at Saitama plant.
Micron	Samsung (Korea)	June 1983	Micron licensed its 64K DRAM design.
Modular	Ricoh (Japan)	Nov. 1984	Modular licensed its CMOS 256K DRAM, 16K SRAM design and technology.
MOSel	Taiwan Government	April 1985	MOSel initially planned a production facility in Taiwan.
	UMC (Taiwan)	Oct. 1985	MOSel transferred rights to a high-speed SRAM, EEPROM, and 1.5- and 2-micron process to UMC.
MOSel	Fuji Electric (Japan)	Sept. 1985	MOSel provided 1.5- and 2-micron processes.
	Lien Hua (Taiwan)	Sept. 1985	Joint venture to develop a 64K SRAM in Taiwan.
	Hyundai (Korea)	Feb. 1986	MOSel provided 64K SRAM in exchange for foundry capacity.
	Sharp	May 1986	MOSel provided a 256K SRAM design and 1.2-micron CMOS process.

(Continued)

Table 7 (Continued)

ASIAN TIES WITH START-UPS

Start-up	Partner	Date	Agreement
NMBS	Minebea	1984	Minebea funded NMBS in Japan.
Panatech	Ricoh (Japan)	Sept. 1984	Joint development for 256K DRAMs.
		April 1985	Ricoh acquired 15 percent of Panatech R&D; the two companies will share technologies.
Quasel	Taiwan investors	Sept. 1984	Initial funding; Quasel planned to establish a manufacturing subsidiary in Taiwan.
	ERSO (Taiwan)	May 1985	Technology license.
Samsung	SST (Korea)	1983	Initial funding and manufacturing.
SEEQ	Amkor (Korea)	1981	Assembly.
Silicon Macro	GoldStar (Korea)	N/A	Undisclosed
S-MOS Systems	Seiko Epson (Japan)	1983	S-MOS is affiliated with Seiko Epson.
Telmos	Dainichi Seigyo (Japan)	1983	Dainichi Seigyo is Telmos' exclusive sales agent in Japan.
UMC	ERSO (Taiwan)	1979	License for design and process technology for 4-inch wafers.
Vitelic	Kyocera (Japan)	March 1984	Kyocera participated in first-round financing.
	ERSO (Taiwan)	May 1984	Cooperative agreement to develop EPROMs, 64K and 256K CMOS DRAMs.
		May 1985	Manufacturing agreement.
	Sony (Japan)	June 1985	Joint venture for Vitelic's 256K DRAMs and 64K SRAMs in exchange for fab capacity; Sony also invested $2M.

(Continued)

Table 7 (Continued)

ASIAN TIES WITH START-UPS

Start-up	Partner	Date	Agreement
Vitelic	NMBS (Japan)	July 1985	Vitelic granted a license to its 1Mb DRAM technology for one-third of NMBS's plant capacity.
	Hyundai (Korea)	July 1985	Hyundai received a license to Vitelic's memory products for manufacturing capacity.
	Tokyo Sanyo	Oct. 1986	Joint development of 64K SRAM family.
VLSI	Amkor (Korea)	1980	IC assembly.
	Ricoh (Japan)	1982	Ricoh provided all wafers.
		1983	Technology exchange and second-source for ROMs.
	KIET (Korea)	1983	Technology and production agreement.
	Nihon Teksel (Japan)	June 1985	Sale contract to sell in Japan.
WSI	Sharp (Japan)	Dec. 1984	Cooperative contract to use WSI's 64K CMOS EPROM in exchange for manufacturing capacity.
		Oct. 1985	Agreement expanded to include WSI's 1.6-micron process for royalties and plant capacity.
		March 1986	RCA/Sharp and WSI signed a cooperative manufacturing and technology agreement that included development of a next generation 1.0-micron cell library.
Weitek	Toshiba (Japan)	1980	Weitek provided its graphics chips in exchange for wafers.

(Continued)

Table 7 (Continued)

ASIAN TIES WITH START-UPS

Start-up	Partner	Date	Agreement
Xilinx	Seiko Epson/S-MOS (Japan)	1986	Joint development covering Xilinx's logic cell arrays and Seiko Epson's process.
ZyMOS	Daewoo (Korea)	April 1986	Daewoo acquired 47 percent of Zymos.
Zytrex	Samsung (Korea)	1985	Each company acts as an alternate source for products; Samsung also provides manufacturing support.

Source: Dataquest
October 1986

Table 8, gives a list of companies and annual sales where available.

Table 8

START-UPS AND ANNUAL SALES
(Millions of Dollars)

Company	1978	1979	1980	1981	1982	1983	1984	1985
A&D								31.3
Acrian				2.0	17.0	18.0	21.0	23.0
Altera								4.0
AMCC			0.6	2.4	2.0	8.0	18.0	21.0
CDI		0.5	1.1	2.4	4.0	7.6	8.0	12.0
Calogic							1.0	3.0
CMA					0.4	2.8	4.0	7.5
Cypress							4.0	18.0
ETC								1.0
Exel							1.0	4.0
IDT				0.2	3.0	10.0	33.0	47.0
IMP					4.5	16.0	28.0	25.0
Inmos	.006	0.066	0.042	4.4	26.0	58.0	146.0	85.0
Lattice								3.0
Logic Devices						0.6	2.3	
LSI Logic				2.0	6.0	32.0	84.0	140.0
LTC						4.0	16.0	22.0
Matra-Harris			6.0	13.5	13.0	41.0	42.0	
MCE						4.0	10.0	13.0
Micron			0.4	1.1	5.0	24.0	117.0	36.0
Samsung					27.0	40.0	60.0	95.0
SEEQ					0.2	9.2	53.0	33.0
Si Systems			10.5	13.0	16.0	28.0	64.0	51.0
Telmos					0.6	3.0	3.9	6.0
UMC					5.0	27.5	27.0	35.0
Universal				1.6	2.4	1.6	7.1	8.9
Visic								1.0
VLSI			0.08	15.0	21.2	35.8	69.5	78.7
Xicor			0.1	0.3	3.5	16.0	39.0	32.0
ZyMOS			1.5	7.5	10.5	10.0	22.0	17.0

Source: Dataquest
October 1986

VII. TECHNOLOGY TRENDS

General Trends

Start-up companies in the United States have historically been at the leading edge of new product and process technology trends. The newest wave of start-up companies follows the same pattern. Following a prevalent trend, these companies are offering faster circuits with more functions per chip.

CMOS requires less power and generates less heat than bipolar and NMOS. Designers can therefore pack more circuits and functions onto a single chip, providing better price-performance. Other advantages of CMOS that make it applicable for very-large-scale-circuits (VLSI) are broad operating temperature ranges, superior noise immunity, and improved electrostatic discharge protection. It is also a very versatile process technology that can be applied to both analog and digital circuits and can be combined with bipolar technologies to result in hybrid technologies such as BiCMOS.

Some of the other innovative technologies include bipolar ECL, BiMOS, and the Josephson junction that IBM abandoned. Many of the companies are also taking a systems approach to designing ICs, an activity that mainline companies have not traditionally pursued.

Current changes in the marketplace present the following challenges:

- Technology barriers as the industry approaches 0.5-micron design rules;
- A demand for specialized chips with smaller overall markets;
- Development costs of memory products that will reach as much as $100 million; and
- Rising costs for manufacturing equipment.

To meet these challenges, companies are:

- Developing increasingly sophisticated computer and software tools;
- Focusing on end use markets; and
- Emphasizing service.

Table 9 shows the product markets the start-up companies are participating in.

Table 9

ALPHABETICAL LIST OF START-UP COMPANIES AND PRODUCT LINES

Company	Memory	ASICs Std. Logic	MPU	DSP	Linear	GaAs	Other
A&D Co., Ltd.					X		
ABM Semiconductor						X	
Acrian							Discrete
ACTEL		X					
Acumos		X					
Adaptec Inc.			X				
Advanced Linear					X		
Advanced Power							Discrete
Altera		X					
AMCC		X					
Anadigics						X	
ATMEL	X	X					
Austek			X				
BRI		X					
BIT				X			
Brooktree					X		
BT&D							Opto
C&T			X				
CDI		X					
Calmos			X	X			
Calogic					X		Discrete
Catalyst	X						
Celeritek						X	
Cirrus Logic			X				
Crystal Semicon					X		
Custom Arrays		X					
CMA		X					
CSI		X					
Cypress	X	X	X	X			
Dallas	X						
Dolphin				X			
Elantec					X		
ETC		X					
ESS		X					
Exel	X	X	X				
GAIN						X	
GBL						X	
HMS						X	
Hittite						X	

(Continued)

Table 9 (Continued)

ALPHABETICAL LIST OF START-UP COMPANIES AND PRODUCT LINES

Company	Memory	ASICs Std. Logic	MPU	DSP	Linear	GaAs	Other
Hypres							JJ*
ICI Array Tech		X					
IC Sensors					X		
ICS		X					
ICT	X	X	X				
IDT	X	X	X	X			
ILSI		X					
IMP		X					
Inmos	X		X	X			
Insouth		X					
Intercept		X					
IPS					X		
Isocom							Opto
IXYS							Discrete
Krysalis	X						
Kyoto						X	
Laserpath		X					
Lattice	X	X					
Level One Commun.					X		
Logic Devices	X		X	X			
LSI Logic		X					
LTC					X		
Lytel						X	
Matra-Harris	X	X	X				
Maxim					X		
MCE		X			X		
Micro Linear		X					
Micron Technology	X						
M/W Monolithics						X	
M/W Technology						X	
Mietec		X					
Modular Semicon	X		X				
Molecular Elec							Bioelec
MOSel	X						
Nihon Information			X				
NMBS	X						
Novix			X				
Opto Diode						X	

*Josephson Junction

(Continued)

Table 9 (Continued)

ALPHABETICAL LIST OF START-UP COMPANIES AND PRODUCT LINES

Company	Memory	ASICs Std. Logic	MPU	DSP	Linear	GaAs	Other
Opto Tech						X	
Orbit							Foundry
Pacific Monolithics						X	
Panatech		X					
Performance	X	X					
Quasel	X						
Samsung	X	X			X		Discrete
Saratoga	X						
SEEQ	X		X				
Sensym					X		
SID Micro					X		Discrete
Sierra	X	X	X		X		
Si-Fab	X						
Silicon Macro	X						
Silicon Systems			X		X		
S-MOS Systems	X	X	X				Opto
Spectrum Semi		X					
III-V						X	
Tachonics						X	
Telcom Devices						X	
Telmos		X			X		Discrete
TMMIC						X	
Topaz					X		Discrete
TRIAD	X						
TriQuint						X	
UMC	X	X	X		X		
Universal		X	X		X		
Visic	X						
Vitelic	X						
Vitesse						X	
VLSI	X	X		X			
VTC		X					
WSI	X	X	X				
Weitek			X	X			
Wolfson				X			
Xicor	X						
Xilinx		X					
XTAR			X				
Zoran				X			
ZyMOS		X			X		

Source: Dataquest
October 1986

Memories

The conventional wisdom is that start-ups cannot compete with the majors in a commodity market such as in memory devices. Several companies, however, have chosen to ignore this concept and have entered the market anyway. Some, like INMOS and Samsung, have substantial government or parent company backing. They are efficient high-volume, production-oriented manufacturers. These companies put less emphasis on design and more on manufacturing efficiency to be successful.

Most of the memory start-ups, however, are taking advantage of a fundamental change in the memory market to position their companies. And instead of appealing to the large general-purpose memory market, they are targeting niche markets. Companies such as Vitelic, Integrated Device Technology, and Cypress are addressing markets that include fast SRAMs, EEPROMS, some EPROMs, and nonvolatile memories. Users are demanding high-speed devices and novel architectures for specific functions. As memory capacities have become larger, users are requesting application-specific memories such as video RAMs. Growth in the engineering workstation market has created a need for devices designed specifically for storing and retrieving the information needed to create an image on a CRT.

In addition, companies are taking advantage of the inconspicuous markets for "specialty memory" devices. Specialty memories tend to be design-intensive, with low-volume demand, and potentially provide high yields and stable profit margins. This market has grown to meet the requirements from a system user's viewpoint. Specialty memory companies offer synergistic product sets that are focused at specific application areas (e.g., graphics, DSP, parallel processing, speech, and imaging) that have special-purpose memory requirements. In the specialty memory markets, the key factors for success are device-feature content and product definition.

Major manufacturers are moving into this market area less rapidly, and where they have entered, they have not been as successful. The start-up companies have been able to remain very competitive.

Dynamic Random Access Memories (RAMs)

Manufacturers such as Vitelic, Visic, and Quasel are offering high-performance DRAMs that are primarily based on CMOS technology. There is a general feeling that the DRAM market is starting to lose some of its homogeneity and is breaking into market segments that can be approached without the risk and exposure that staying in the middle of the broad-range market requires. Both Visic's and Quasel's products are extremely niche-oriented. Vitelic's are general-purpose products, although also processed in CMOS. The companies in the DRAM market believe that the market will proceed through two stages: first NMOS will be replaced over time by CMOS and second, there will be a finer degree of segmentation for very application-specific types of DRAMs.

SRAMs

There are many opportunities in the fast static RAM (SRAM) market to differentiate products by adding features to enable users to enhance system performance. Examples are dual-port RAMs, resetting RAMs, and special high-density RAM modules. The market also offers many opportunities to serve protected niches. The SRAM market is very applications-oriented and frequently users can define special features on a SRAM (e.g., separate I/Os or innovative packaging arrangements, such as skinny DIPs and modules) forms to address the very dominant performance requirements. Virtually all of the new SRAM start-ups use CMOS technology, not only to capitalize on the CMOS trend, but, because the fastest parts are derived by using leading-edge CMOS processes. Some manufacturers, such as Cypress Semiconductor, have developed advanced CMOS technology and have entered the lower-density 1K and 4K fast SRAM market where performance is the critical factor. In this way, companies such as Cypress replace older parts, evolving the replacement effort into a new business. Many other manufacturers, including MOSel, VLSI, Lattice, IDT, and Performance Semiconductor, have all expressed intentions of competing in the fast SRAM market.

ROMs

The few start-ups that have gone after the read only memory (ROM) business have been motivated primarily by the design capabilities of the founders rather than by any particular market opportunity. These companies include VLSI Technology and Silicon Macrosystems. The ROM market is well established and promises to have substantial longevity. It is, however, under great pressure from EPROMs.

EPROMs

The past year has brought several new suppliers to the electrically programmable ROM (EPROM) market, a market that historically has featured a narrow supplier base. Several of these manufacturers offer outstanding new technical approaches to the market. ATMEL, founded by a group of ex-SEEQ employees, was spun out to develop EPROM, EEPROM, and EPLD products. The company has an extensive technology licensing and product development fab arrangement with General Instrument in Chandler, Arizona. Cypress is emphasizing a unique four-transistor-per-cell approach to produce high-speed bipolar PROM replacements using EPROM technology. S-MOS has offered 64K and 256K CMOS EPROMs and 128K NMOS EPROMs since late 1985, and Waferscale Integration has offered a 64K high-speed CMOS EPROM.

Cypress Semiconductor was the first to introduce EPROM-based CMOS PROMs designed to be bipolar replacements. Access times are 30- to 35ns for its 4K to 16K CMOS PROMs, times that are as fast as a significant portion of the bipolar PROMs on the market. Exel and WaferScale Integration have joined Cypress in this product area.

EEPROMs

The electrically erasable programmable ROM (EEPROM) market has been emerging for several years. EEPROMs are replacing EPROMs in many applications with SRAM replacement apparently the next EEPROM challenge, since 64K EEPROM devices now match the capacity of 64K SRAMs. New entrants such as Sierra Semiconductor, International CMOS Technology, SEEQ, Xicor, and Exel, hope to establish early positions in this niche market, to be instrumental in developing the design fundamentals and feature-content of the products serving that market, and to profitably participate before the market becomes very commodity-oriented. Few EEPROM companies operate under the delusion that they can continue to compete once the market takes on the characteristics of a high-volume commodity market such as exists in slow static RAMs, dynamic RAMs, EPROMs, or ROMs. To date, the EEPROM market remains very highly differentiated in technical and product direction.

High-speed EEPROMs such as those offered from Exel Microelectronics and Lattice Semiconductor target a new application for EEPROMs. With address access times of 55ns to 70ns, these devices are designed to offer new degrees of flexibility for replacing bipolar PROMs in high-speed rewritable control store applications.

Another dimension is represented by the EE seed cells in compiler libraries. Combined with macrofunctions, they can be compacted and proven functional in a matter of weeks instead of years.

NVRAMs

Nonvolatile RAMs (NVRAMs) are a niche market, and Xicor has exerted great effort to establish itself in this market. Nonvolatile RAMs, typically configured as static RAMS with an EEPROM backup on the same die, are now available in densities of 256-bits up to 4K bits. Xicor has pioneered most of this market with its broad line of low-density devices. The Xicor devices are far superior in terms of defining the product needs of NVRAM users, and Xicor is exploiting the superiority with a wide variety of product offerings. At the right price and performance levels, NVRAMs have the potential to dominate over the fast and slow static RAMs as well as the EPROM and EEPROM markets.

Table 10 shows the memory products the start-up companies are offering.

Table 10

MEMORY MARKET POSITIONING OF THE START-UP COMPANIES

	DRAM	SRAM	ROM	EPROM	EEPROM	NVRAM	OTHER
ATMEL				X	X		
Catalyst		X					Serial RAM
Cypress		X		X			FIFO
Dallas						X	FIFO
Exel				X	X		
Inmos	X	X					
ICT				X	X		
IDT		X					FIFO, Dual-Port RAM
Lattice		X			X		
Logic							Shift Registers
MHS		X					
Micron	X						
Modular		X					
MOSel		X					Dual-Port RAM
NMBS	X	X					
Performance		X					
Quasel	X						
Samsung	X	X			X		
Saratoga		X					BiCMOS Process
SEEQ				X	X		
Sierra					X		
SMI		X	X	X			
S-MOS		X	X	X	X		
TRIAD		X					
UMC		X	X				
Visic	X						HRAM
Vitelic	X	X					Video RAM Dual-Port RAM
VLSI	X	X	X	X			Dual-Port RAM
WSI				X			
Xicor					X	X	

Note: Si-Fab is believed to be offering memory products; Krysalis Corp. is a new company that announced it will offer memory products in mid-1987.

Source: Dataquest
October 1986

Application-Specific Integrated Circuits and Logic Devices

The application-specific integrated circuit (ASIC) market has seen strong growth because of:

- Advancements in computer-aided-design (CAD) tools
- The slump in demand for commodity devices
- The shift from bipolar to CMOS technologies
- Competitive pressures on systems manufacturers for higher levels of integration
- Narrow market windows for electronic products that have spurred the demand for faster design times

We have seen an increase in alternate-source and licensing agreements and closer user-supplier relationships in the ASIC marketplace in which cooperation has become essential. It is much more difficult to alternate-source a gate array than to alternate-source a microprocessor or a standard logic part. Design tools have to be compatible, and the customer has to be able to interface with both companies in the same way. Another area where cooperation is important is between the customer and the vendor. Many mutual decisions have to be defined to make a program run smoothly. And obviously in the end, the objective is to establish a mutually satisfactory method of working together as opposed to the more traditional vendor-purchaser quasi-adversarial spirit.

The successful ASIC companies will be those that:

- Continue to develop advanced process technologies, reducing feature size which in turn results in smaller chip size, ultimately yielding a lower manufacturing cost. Increasing the number of layers of metal interconnect also results in reduced chip cost.
- Build cell libraries with specialized functions intended for specific end-use markets.
- Exploit the state of IC CAD tools by integrating tools and making them user friendly.
- Anticipate end-use applications.
- Provide outstanding service by staffing design centers with personnel who are knowledgeable about system solutions and end-use applications and by providing the fastest possible turnaround times during development and prototyping.

There are three types of ASICs addressed in this report--gate arrays, cell-based ICs, and programmable logic ICs. In addition, the silicon compilation-based design methodology is discussed. Each alternative design type offers trade-offs related to architectural flexibility, development cost, and prototype lead time. The cell-based design provides larger circuit volume and higher complexities whereas array-based designs provide lower circuit volume per circuit type and faster design times. Time-to-market and system costs represent the criteria on which a customer must base a decision for selecting between the device types.

Gate Arrays are defined as digital or mixed linear/digital ICs containing a configuration of uncommitted elements. They are customized by interconnecting these elements with one or more routing layers.

Cell-based ICs (CBICs) are digital or mixed linear/digital ICs that are customized using a full set of masks and that are comprised of pre-characterized cells or macros (including standard cells, megacells, and compilable cells).

The term "cell-based IC" is an outgrowth of "standard cells." Historically, IC cells had fixed heights and fixed widths and were thus called standard cells. Today, cell-based ICs have variable heights and widths, allowing for added dimensional flexibility far beyond that of fixed cells.

Silicon compilers are very sophisticated IC computer-aided design (CAD) systems that employ a top-down, hierarchical design methodology that accepts high-level specifications and automatically generates the mask tooling. Included in this category are specialized IC CAD systems that work at the cell level.

Programmable logic devices (PLDs) are integrated circuit arrays of logic gates that can be programmed by the user to perform complex logic functions by electrically opening on-chip fuses. The overwhelming majority of products today are fuse-programmable and may not be erased and then reprogrammed.

Table 11 lists start-up companies that are positioned in specific market areas, rather than in many general product areas.

Table 11

ASIC MARKET POSITIONING OF THE START-UP COMPANIES

	PROCESS			PRODUCTS			
				STD	ASICs		
	CMOS	Other MOS	Bipolar	Logic	Gate Arrays	Cell Based	PLD
ACTEL	X						
Acumos	X				X		
Altera	X						X
AMCC	X		X		X	X	
Atmel	X						X
BRI	X		X		X	X	
CDI	X				X	X	
CMA	X				X	X	
CSI	X		X		X	X	
Custom Arrays			X		X		
Cypress	X						X
ESS	X						
ETC	X		X		X	X	
Exel	X						X
ICI Array	X				X	X	
ICS	X				X		
ICT	X						X
IDT	X			X			
ILSI	X				X		
IMP	X				X	X	
Insouth	X				X	X	
Intercept	X				X		
Laserpath	X				X		
Lattice	X			X			X
LSI Logic	X				X	X	
Matra-Harris	X				X		
MCE	X		X		X	X	
Micro Linear	X		X		X	X	
Mietec	X	X	BiMOS		X	X	
Panatech	X						X
Performance	X			X			

(Continued)

Table 11

ASIC MARKET POSITIONING OF THE START-UP COMPANIES

	PROCESS			PRODUCTS			
	CMOS	Other MOS	Bipolar	STD Logic	ASICs Gate Arrays	Cell Based	PLD
Samsung	X			X			
Sierra	X					X	
S-MOS	X				X	X	
Telmos	X				X	X	
UMC	X				X		
Universal	X				X	X	
VLSI	X				X	X	X
VTC	X		X	X	X	X	
WSI	X					X	
Xilinx	X						X
ZyMOS	X					X	

Note: Spectrum Semiconductor Inc. will be offering its ASIC products in 1987.

Source: Dataquest
October 1986

Gallium Arsenide

Gallium arsenide (GaAs) based ICs have engendered immense interest in the last few years, spawning 20 new companies since 1983. Among the benefits of GaAs devices are operation speeds much faster than comparable silicon devices. GaAs ICs can also operate at higher temperatures, use less power, and offer more radiation resistance. On the negative side is the cost of the materials, that can be as much as 20 times that of silicon and the technological difficulties inherent in making defect-free GaAs wafers.

Harris Microwave was the first company to offer GaAs ICs on the merchant market. GigaBit Logic was the first venture capital-backed company to be established specifically to make gallium arsenide devices.

GaAs has potentially wide-range applications in the military, communications, and data processing market segments. Although GaAs is not likely to replace silicon in the foreseeable future as the workhorse semiconductor material, we do expect substantial growth in the GaAs market. Some engineers believe GaAs to be currently in the same state of development as silicon technology was about 15 years ago.

The following are potential GaAs IC applications:

- Telecommunications: Opto and microwave electronics
- Computers and peripherals
- Instrumentation
- Consumer electronics
- Robotics
- Automotive
- Military/government

GaAs products are segmented into the following classifications:

- Analog ICs: MIC amps, MIC converters, frequency multipliers, ASICs
- Digital ICs: Logic, memory, ASIC, dividers, cost models
- Optoelectronics: LEDs, lasers, detectors, photovoltaic cells, isolators, couplers, integrated opto devices
- Discretes: Small signal transistors, power FETs

Table 12 shows the gallium arsenide products the start-up companies are offering.

Table 12

GALLIUM ARSENIDE MARKET POSITIONING OF THE START-UP COMPANIES

	Linear/Analog		Digital			Discretes	
	MMICs	Linear	RAMs	ASICs	Standard Logic	FETs	OPTO
ABM							X
Anadigics		X			X		
Celeritek		X					
GAIN				X			
GigaBit		X	X		X		
HMS	X			X	X		
Hittite	X						
Kyoto							X
Lytel							X
M/W Monolithics	X						
M/W Technology	X	X				X	
Opto Diode							X
Opto Tech							X
Pacific	X	X					
III-V							X
Tachonics		X					
Telcom Devices							X
TMM	X	X					
TriQuint		X		X	X		
Vitesse			X		X		

Source: Dataquest
October 1986

Microdevices

Another exciting area of growth is microperipherals (MPRs). MPRs are a strong and lucrative segment of the microdevice business. MPRs have grown out of the need to displace TTL logic for complex I/O interfaces or restructure common system software to VLSI hardware solutions. MPRs offer multiple opportunities for start-up companies to become established in a rapidly developing market. These products generally demand higher selling prices, are frequently sole-sourced, and have proliferated the development of high-end niche markets. Start-up companies are offering graphics controllers, hard and floppy disk controllers, and CRT controllers, the fastest growing segments, for graphics, mass storage, and LAN applications. Companies are also offering what previously have been board-level solutions to several peripheral applications with ICs.

One of the more exciting applications promises to be in electronic publishing, a market segment we believe has the potential to outdistance the CAD/CAM industry segment in growth over the next few years.

In addition, peripherals are employing an application-specific approach for determining the functions on a given chip.

Table 13 indicates the microdevice products the start-up companies are offering.

Table 13

MICROCOMPONENT MARKET POSITIONING OF THE START-UP COMPANIES

	MPU	Bit Slice	MCU	MPR Communication	Keyboard Display	Mass Storage	Special Function	System Support
Adaptec						X		
Austek							X	X
Calmos								X
Chips & Tech.				X	X			
Cirrus Logic				X	X	X		
Cypress		X						
Exel				X				
ICT				X	X			
IDT	X						X	
INMOS	X							
Logic Devices		X					X	
Matra-Harris	X		X		X			
Modular				X				
NIC					X			
Novix	X							
SEEQ			X	X				
Sierra				X				
S-MOS	X			X	X			
SSI				X				
UMC	X		X	X		X		X
Universal							X	
VLSI	X			X	X	X		X
Weitek				X			X	
WSI	X							
XTAR					X			

Source: Dataquest
October 1986

Digital Signal Processing

The demand for digital signal processing (DSP) devices represents an extremely high-growth market. The compounded annual growth rate from 1983 to 1990 is expected to be 24.8 percent, ultimately reaching $769 million in sales in 1990. The DSP arena is one in which start-up companies can establish dominant positions in what today is still a niche area.

DSP refers to two types of products: digital signal processors and building blocks that are used primarily to assemble circuits for DSP. The start-up companies offering DSP products fall into the building-block category. Building blocks include bit slices, multipliers and multiplier/accumulators, filters, and others such as delay lines and correlators.

Table 14 indicates the DSP products the start-up companies are offering.

Table 14

DIGITAL SIGNAL PROCESSING MARKET POSITIONING OF THE START-UP COMPANIES

	Multipliers	Multipliers/ Accumulators	FIR Filters	FFT Filters	Other
BIT	X				
Calmos			X		
Cypress	X				
IDT	X	X			
INMOS					X
Logic Devices	X	X			
VLSI		X			
Weitek	X	X			
Zoran			X	X	

Note: Dolphin Integration is planning to offer signal processing ICs; Wolfson is planning to offer FIR filters.

Source: Dataquest
October 1986

Linear

There are several new companies valued in the linear area. Some specialize in offering enhanced versions of existing products and in developing new standard products, as does Linear Technology.

Application-specific linear ICs, another linear approach, is expected to be a key growth area with Dataquest forecasting a 30 percent compound annual growth rate from now until 1989. CMOS will be the new era for linear IC technology. New firms participating in this trend are Electronic Technology, Micro Linear, Crystal Semiconductor, and ZyMOS. Standard cell and silicon compiler techniques, including CAD tools that fully simulate linear/digital functions, are being developed to meet the design demands of the new linear era.

SIGNIFICANT DIRECTIONS AND CHANGES IN THE LINEAR MARKET

- The market continues steady growth at a rate of 12 percent per year.
- A significant shift from strictly bipolar to CMOS and mixed bipolar-CMOS technologies is taking place in linear devices.
- The move to merge linear with digital technology is under way.
- Continued emphasis on increasing the range of functionality, with speed and performance upgrades is still the driving force for linear improvements.
- High integration levels in linear devices are creating LSI subsystems.
- The emerging standard cell approach to design along with a growing number of CAD tools marks a long-term movement toward application-specific linear arrays and cells.
- There is an increasing number of semicustom linear suppliers.

Linear trends represent attempts to simplify systems with improved performance and lower system costs.

In North America, linear circuits sell (in descending order of importance) into these end markets: military; industrial; telecommunications; computers; automotive/transportation; and consumer electronic products.

SIGNIFICANT FACTORS

- The linear business is highly fragmented and offers many niche-market opportunities.
- Linear devices are manufactured using a variety of processes.
- There is an existing customer base for linear ICs.
- Linear circuits, except for commodity types, usually are required in small volumes representing higher average sales prices and excellent profit margins.
- Linear manufacturers are considered specialized suppliers.
- Linear ICs require smaller capital investments than do memory or ASIC products.
- The basic wafer fabrication process for linear ICs is less vulnerable to obsolescence.
- With linear devices, the emphasis is on circuit precision and matching circuit elements with circuit features, rather than toward very large scale integration.
- Linear circuits operate over a wider and higher voltage range than digital circuits.
- Engineering talent is crucial to success in the linear market.

THE LINEAR MARKETPLACE--PRODUCT SEGMENTS

- Operational Amplifiers
- Voltage Regulators/Voltage References
- Voltage Comparators
- Data Conversion Products
- Interface Products
- Consumer Circuits
- Specialized Circuits

Table 15 indicates the linear products the start-up companies are offering.

Table 15

LINEAR/ANALOG MARKET POSITIONING OF THE START-UP COMPANIES

	OP AMPS	VOLT REG	DATA CONV	CONSUMER	VOLT REF	COMP	INTER FACE	TELECOM	SPEC FUNC	OTHER
A&D Co.			X							
ALD									X	
Brooktree			X							
Calogic							X			
Crystal			X					X		
Elantec	X						X			
IC Sensors										X
IPS		X					X			
Level One								X		
LTC	X	X	X		X	X	X	X		
Maxim	X	X	X				X	X		X
MCE	X	X	X			X				
Mietec							X			
Samsung	X	X	X			X	X	X		X
Sensym										X
SSI			X						X	X
S-MOS			X					X		
Telmos			X				X			
UMC			X	X				X		
Universal	X					X				
VTC	X									
ZyMOS	X		X			X				

Source: Dataquest
October 1986

Other

Discrete

The companies in the discrete area are offering transistor products. SID Microelectronics is offering small-signal and medium-power transistors for the Brazilian market. Acrian, Calogic, IXYS, Samsung, Telmos, and Topaz are offering power transistors. Power transistors are one of the fastest growing areas and sales are expected to reach $1,675 million in 1990, an 8 percent CAGR from 1985 through 1990. The growth is mainly due to the escalated use of power MOSFETs as an alternative for some bipolar power transistor applications. Power transistors have been optimized for use in applications such as switch-mode power supplies, power inverters, regulators, and motor controls.

Optoelectronics

Isocom Limited is offering a range of optocouplers. Optocouplers (also called optoisolators) are composed of an LED separated from a photodetector by a transparent, insulating dielectric layer, all mounted in an opaque package. These optocouplers have many applications--such as for high-performance relays, position sensors, optical encoders, and voltage isolators for connecting logic circuits to power devices.

S-MOS Systems, Inc., is offering LCD drivers and controllers, VFD drivers, and image sensors. BT&D Technologies plans to manufacture optoelectronic components and devices in Ipswich, England.

Josephson Junction

Hypres, Inc., is developing commercial superconductive devices using Josephson junctions, a technology developed at IBM. The Josephson junction technology is an experimental advanced technology that could offer very high-performance in the future.

Bioelectronics

Bioelectronics research is being conducted by the U.S. Department of Defense and several universities. Dataquest estimates that about 30 Japanese corporations are developing biosensors and other bioelectronic technologies. Molecular Electronics Corporation (MEC) was formed to develop and commercialize molecular electronics and molecular film technology. MEC has completed a full-size preproduction machine tradenamed MonoFab and has developed two commercial applications of MonoFab. The first is an ultrathin uniform high-resolution e-beam resist (MonoResist) for lithography on masks and wafers (direct-write). The second is a thin corrosion protective lubricant for rigid disk magnetic media. MEC's long-term plans include forming corporate partnerships and development contracts to develop device applications.

Foundry

Orbit Semiconductor is offering foundry services for NMOS, PMOS, HMOS, and CMOS process technologies. Orbit guarantees single-poly and single-metal CMOS or HMOS in 10 working days or fewer and double-poly or double-metal CMOS in 15 working days or fewer.

A&D Co., Ltd.
Shintaiso-Bldg., No. 5-1052
10-7 Dogenzaka, 2-chome
Shibuya-ku, Tokyo 150
Japan
TEL 03/476-4741
TLX 02422816 AANDD J

ESTABLISHED: 1977
NO. OF EMPLOYEES: 280

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President	Hikaru Furukawa
Dir Intl Div	Shoichi Sekine

FINANCING: Not available

BACKGROUND

A&D Co., Ltd., produces electronic balances, weighing indicators/ controllers, FFT analyzers, and data converters.

The Company's actual 1985 annual sales were $31.3 million, and its estimated sales for 1986 are $46.9 million. Exports are 30 percent of total sales. The Company's sales breakdown is as follows: electronic balances, 40 percent; weighing instruments, 30 percent; FFT/test and measuring instruments, 20 percent; and ultrafast A/D, D/A converters, 10 percent.

ALLIANCES: Not available

SERVICES: Not available

PROCESS TECHNOLOGY: Not available

PRODUCTS

Electronic balances
Weighing indicators/controllers
FFT analyzers
Data converters

FACILITIES

A&D Company has three factories in Japan and sales offices in Japan, the United States, and West Germany.

ABM Semiconductor, Inc.
442 Queens Lane
San Jose, CA 95112
408/297-7477

ESTABLISHED: February 1985
NO. OF EMPLOYEES: 4

BOARD

Position	Name	Affiliation
Chairman	Hirokazu Nakajima	Kodenshi Corp.
Exec Director	Yoshiji Kanekiyo	Kodenshi & ABM

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Yoshiji Kurahashi	Exar	VP Engineering
Acting President	Zak Kadah	Solid State Optronics	Founder/Current President
Marketing	Sid Kadah	Solid State Optronics	Mktg/Current

FINANCING

Date	Round	Sources	Amount
1985	Initial	Kodenshi Corp. and others.	$1.0M

BACKGROUND

ABM Semiconductor was founded by Yoshiji Kurahashi to design and develop optoelectronics products for the U.S. and Japanese merchant markets. The Company also distributes optoelectronic devices and modules for Kodenshi Corp. in the United States, and it offers assembly services by Kodenshi in Korea. Kodenshi provided about 50 percent of the initial funding, which was under $1 million.

ABM has established local design capability for gallium arsenide and silicon. Kodenshi provides low-cost manufacturing in Korea in addition to some subcontracting of fab services in the United States.

The Company's main line of products include infrared LEDs, silicon photo detectors, interrupters, and sensors using GaAlAs and GaAs technology.

ALLIANCES

Kodenshi	Nov. 1985	ABM and Kodenshi entered a joint venture under which ABM will sell 200 Kodenshi products. Kodenshi provided funding and wafer fabrication.

SERVICES

GaAs Design for special application custom/standard ICs
Silicon Processing for detectors and sensors
Optical and infrared packaging

PROCESS TECHNOLOGY

GaAs and GaAlAs

PRODUCTS

Interrupters
Photodiodes
Photo arrays
Silicon photo detectors
Hybrid optoelectronic modules

Applications: TVs, stereos, VCRs, printers, robotics, power sources, infrared emitters and sensors in disk drives, optical encoders, laser detectors, and automotive

FACILITIES

San Jose, CA	1100 sq. ft.	Research and development, design, and sales

Acrian Inc.
490 Race Street
San Jose, CA 95126
408/294-4200
TWX: 910 338 2172
FAX: 408 279 0161

ESTABLISHED: May 1978
NO. OF EMPLOYEES: 250

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President	Jack Harris
Executive VP	Steven R. Weich
VP Finance	William Ruehle
VP Sales/Mktg	Bert Berson
VP Engineering	Arthur Woo

FINANCING

Date	Round	Sources	Amount
1978	Round 1	Sutter Hill, Bank of America	$5.0M

BACKGROUND

Acrian Inc. is a vertically integrated supplier of application-specific RF power transistors, subsystems, and semiconductor devices and provides wafer fabrication for all basic bipolar circuit forms. Acrian also conducts research and development in GaAs.

The privately held Company merged with Communication Transistor Corp. in 1982 to accelerate vertical integration into modules and value-added areas. Acrian later acquired and upgraded an existing fab line.

Almost 100 percent of Acrian's products are custom designed, providing an edge with its "matched hybridization" (custom chips duplicated in large quantities). The Company's product mix is 60 percent military and 40 percent commercial.

ALLIANCES

Bharat, India	1983	Under terms of a $1.5M technology transfer agreement with India's state-run semiconductor company, Acrian provided 20 standard devices, design technology, a design transfer, and manufacturing technology to India. The Company provided device-manufacturing training in the United States.

SERVICES

Microwave Power Design
Bipolar Manufacturing

PROCESS TECHNOLOGY

1.0-micron MOS and Bipolar on Silicon

PRODUCTS

Processed Bipolar wafers
Power FETs
Radio Frequency transistors
Microwave Power transistors
Subassemblies

Applications: Telecommunications, avionics, radar, broadcast, and solar energy

FACILITIES

San Jose, CA	65,000 sq. ft.	Administration and manufacturing
	25,000 sq. ft	Clean room

ACTEL Corporation
320 Soquel Avenue
Sunnyvale, CA
408/734-1562

ESTABLISHED: October 1985
NO. OF EMPLOYEES: 13

BOARD

Name	Affiliation
William H. Davidow	Mohr, Davidow Ventures
Carver Mead	California Institute of Technology
Amr Mohsen	ACTEL Corporation
Ralph Nunziato	Advanced Technology Ventures
Vahe Sarkissian	Data General Corp.

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman/Pres	Amr Mohsen	Intel	Program Manager, Adv Tech Group
VP Finance/Admin	Bill Wall	Visic	VP Finance
VP Operations	Paul Franklin	MMI	General Manager

FINANCING

Date	Round	Sources	Amount
Oct. 1985	Initial	Private; Advanced Technology Capital; Shaw Venture Partners	$0.5M
June 1986	Round 1	Advanced Technology Ventures; Brentwood Associates; Mohr, Davidow Ventures; Norwest Venture Capital; Oak Associates; Shaw Venture Partners; Data General	$9.1M

BACKGROUND

ACTEL Corporation was formed to provide design, development, and manufacturing services, and is initially focusing on CMOS application-specific ICs. ACTEL announced it is developing novel technologies, architectures, and software that will radically change the approach to system design.

The Company was founded by Amr Mohsen, a former Intel program manager of advanced technology development.

ACTEL has signed a three-year joint development agreement with Data General which also includes a commitment for manufacturing in the United States. Data General will incorporate resulting semiconductor technology into its products, and both companies will design and develop semiconductor products based on ACTEL's technology.

ACTEL moved to a 10,000-square-foot facility in August of this year and does design and test there.

ALLIANCES

Data General	June 1986	ACTEL and Data General announced a joint development agreement.

SERVICES

Design
Test

PROCESS TECHNOLOGY

CMOS

PRODUCTS

ASICs

FACILITIES

Sunnyvale, CA	10,000 sq. ft.	Design and test

Acumos, Inc.
1971 North Capitol Avenue
San Jose, CA 95132
408/946-1067

ESTABLISHED: 1985
NO. OF EMPLOYEES: 6

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Man Shek Lee	GTE	Mgr IC Design
VP	Chieh Chang	GTE	Sr Design Engr

FINANCING: Not Available

BACKGROUND

Acumos, Inc., is a gate array start-up company that purchased Semi Processes Inc.'s gate array assets, including inventory, wafers, and test equipment. The Company is servicing SPI's customer base for low-density CMOS gate arrays in the 50- to 700-gate range.

Acumos has developed an analog/digital array which is a PLD replacement and will offer it by the end of the third quarter. It also plans later introductions of specialty high-voltage products.

Acumos subcontracts manufacturing and assembly with U.S. and off-shore companies. The Company plans to sell into the Japanese and U.S. markets.

ALLIANCES: None

SERVICES

Design
Test

PROCESS TECHNOLOGY

3.0- and 5.0-micron Silicon-Gate CMOS

PRODUCTS

Gate Arrays

7001-7005	5-micron	50- to 700-gates	SPI Line
D315-D360	3-micron	150- to 600-gates	Acumos-developed

FACILITIES

San Jose, CA	1000 sq. ft.	Design and test

Adaptec, Inc.
580 Cottonwood Drive
Milpitas, CA 95035
408/946-8600

ESTABLISHED: May 1981
NO. OF EMPLOYEES: 148

BOARD

Name

Lawrence B. Boucher
John J. Breeden
Robert J. Loarie
David F. Marquardt
B.J. Moore
W. Ferrell Sanders

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
CEO	Laurence B. Boucher	Shugart	Dir Dsn Svcs
President	John G. Adler	Amdahl	VP Prod Dev
VP Engr	Philip J. Breeden	Clemens & Assoc	Consultant
VP Mktg	Jeffrey A. Miller	Intel	Mktg Mgr/MPU Opns
VP Fin/Admin	F. Judson Mitchell	Finnigan	CFO
VP Systems	Bernard G. Nieman	Shugart	Project Mgr
VP Sales	Henry M. O'Hara	Intel	VP WW Sales
VP Mfg	Gary J. Weitz	Finnigan	General Manager
Corp Ctlr	Paul G. Hansen	Raychem	Asst Controller

FINANCING: Not available

BACKGROUND

Adaptec, Inc., develops and supplies input/output components used to control the flow of data between microprocessor-based computers and high-speed Winchester disk and tape storage systems. The Company's products include proprietary VLSI circuits and a broad line of controller boards that incorporate the Company's circuits and extensive proprietary software. The Company sells ICs and hybrids that simplify the design of specific controller types and offers gate arrays that incorporate the random logic to support the IBM PC bus interface.

It designs full custom, semicustom, and gate array circuits in NMOS, CMOS, and bipolar technologies in geometries ranging from 4.0- to 2.0-micron. Several of the Company's key IC products are produced by International Microelectronic Products in San Jose, California. It also purchases components used in its low-volume board products. High-volume board products are assembled in Singapore by SCI Manufacturing Singapore PTE, Ltd. SCI purchases all components except the proprietary ICs which are supplied by Adaptec. The Company performs final test on all products.

Products are targeted to customers in three segments of the microcomputer market: the personal computer market; the multi-user systems, network file server, and engineering workstation market; and the supercomputer market for scientific and business applications.

Adaptec filed an initial public offering of 1.3 million shares of common stock on May 8, 1986. The proceeds will be used for working capital and general corporate purposes.

Adaptec, Inc., was in its development stage from its inception through the fiscal year ended March 31, 1986. In March 1986, Adaptec introduced a disk-controller chip set, ACB-4520 ESDI, and a single-ended and differential line driver SCSI card. By the quarter ended March 31, 1984 shipments reached $2.7 million. Its first profitable quarter ended September 30, 1984.

Adaptec markets and distributes controller boards and circuits to a broad spectrum of computer and disk drive manufacturers, as well as to a number of computer retailers. The Company also has about 15 manufacturers' representative organizations, five industrial and 19 international distributors. Foreign sales accounted for 8 percent of net sales in fiscal 1984, 26 percent in 1985, and 18 percent in 1986.

ALLIANCES

IMP Several of Adaptec's key IC products are produced by International Microelectronic Products in San Jose, California.

SERVICES

- Design
- Manufacturing
- Assembly
- Test

PROCESS TECHNOLOGY

4.0- to 2.0-micron NMOS, CMOS, Bipolar

PRODUCTS

AIC-100	Winchester Disk Controller
AIC-010	Programmable Storage Controller
AIC-250	MFM Encoder/Decoder
AIC-270	RLL Encoder/Decoder
AIC-300	Dual-Port Buffer Controller
ACB-2000 Series	IBMPC/XT Controllers
ACB-350 Series	Tape Controller
ACB-4000 Series	SCSI Hard Disk Controllers
ACB-5000 Series	SCSI Hard Disk Controllers

FACILITIES

Milpitas, CA	48,000 sq. ft.	Offices, development, and manufacturing

Advanced Linear Devices, Inc.
1030 W. Maude Avenue
Suite 501
Sunnyvale, CA 94086
408/720-8737
Telex: 510 100 65 88

ESTABLISHED: January 1985
NUMBER OF EMPLOYEES: 8

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Robert Chao	Supertex	VP Product
VP Product Opns	Larry Iverson	Supertex	Mgr Process Engr
Dir R&D	Ping Li	Siemens	Consultant
VP Mktg/Sales	Michael O'Neal	Micropower	VP Mktg/Sales

FINANCING: Not available

BACKGROUND

Advanced Linear Devices, Inc. (ALD), was formed to develop, manufacture, and market high-performance linear ICs in silicon-gate CMOS technology. The Company is developing standard linear circuits which include timers, comparators, matched pairs, and operational amplifiers for the instrumentation, medical, telecommunications, military, and industrial markets. Its standard linear products are easily customized with its function-specific product line which can produce multiple standard products on one chip.

ALD was founded by Robert Chao, formerly with Supertex, with private funds.

The company's first product, the ALD555 monolithic CMOS timer, was offered in April 1986 and features 500ns monostable mode and 2MHz astable mode operation. Future products will include two MOSFET pairs, a CMOS comparator, operational amplifiers, voltage references, and data converters.

Advanced Linear has appointed manufacturers' representatives in the United States and Canada.

ALLIANCES: Not Available

SERVICES

- Design
- Manufacturing
- Assembly
- Test

PROCESS TECHNOLOGY

3.0- to 5.0-micron Silicon-Gate CMOS

PRODUCTS

ALD 555	Monolithic CMOS Timer

FACILITIES

Sunnyvale, CA	2,000 sq. ft.	Design

Altera Corporation
3525 Monroe Street
Santa Clara, CA 95051
408/984-2800

ESTABLISHED: June 1983
NO. OF EMPLOYEES: 90

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Rodney Smith	Fairchild	GM/Linear Div
VP Mktg	David A. Laws	AMD	VP Bus Dev
VP Finance	Paul Newhagen	Source III	Controller/CFO
VP Sales	John Duffy	Fairchild	VP Sales/Mktg
VP Opns	James Sansbury, PhD	Hewlett-Packard	Production Mgr
VP/IC Engr	Robert F. Hartmann	Source III	President
VP Software Engr	Chacko Neroth, PhD	Zilog	Dir Dev Sys/CAD

FINANCING

Date	Round	Sources	Amount
June 1983	Round 1	Alpha Venture Partners	$1.3M
April 1984	Round 2	Allstate Investments; Alpha Venture Partners; Cable, Howse & Cozadd; F. Eberstadt & Company Inc.; John F. Shea; Technology Venture Investors; Welsh, Carson, Anderson & Stowe; Venture Growth Associates	$6.0M
	Lease	Bank of America	$2.0M
March 1985	Round 3	Original investors; Analog Devices Ent.; Citibank N.A.; DeMuth, Folger, & Terhune Venture Capital; Parker Drilling Company	$9.9M
	Lease	Bank of America	$4.0M

BACKGROUND

Altera Corporation designs, manufactures, and markets user-configurable EEPROM-based programmable logic devices (EPLDs) and computer-aided engineering tools and is focused entirely on developing these growing market areas. Altera invented and was the first company to ship EPLDs.

The Company's EPLDs were developed to provide an alternative to gate arrays for the replacement of TTL and CMOS SSI/MSI devices. EPLDs are distinguished from such devices by their ability to be programmed by the user in his facility. They offer benefits of reprogrammability, low CMOS power consumption, and significantly higher density over older bipolar PLDS.

The company was founded by Robert Hartmann, Michael Magranet, and Paul Newhagen, all formerly with Source III, and Dr. James Sansbury, formerly with Hewlett-Packard Company.

The company's goals are to achieve $100 million in annual sales in 1990 and to be recognized as the technology leader in the user-configurable IC market.

Altera's facility space totals 52,500 square feet after the February 1986 addition of 29,000 square feet adjacent to the existing facility. The additional facility is being used for marketing and sales, test, administration, and warehouse space.

Wafers are provided by Intel and other foundries. Volume assembly is done in the Far East, and prototype assembly is done locally for quick turnaround.

ALLIANCES

Intel	Aug. 1984	Altera entered 5-year technology exchange agreement with Intel. Intel is providing CHMOS EPROM design technology and foundry services; Altera is providing its EPLD technology and software. Intel will alternate source the CHMOS EPLDS, and both companies will cooperate on developing support tools for an EPLD development system.
	June 1985	The agreement with Intel was extended to include alternate sourcing of Altera's EPLDs using Intel's CHMOS process.
Personal CAD Systems, Inc.	Feb. 1985	Altera entered a marketing agreement which called for combining P-CAD's PC-CAPS, used for schematic capture, and PC-LOGs, a logic simulator, with Altera's A+PLUS and LogicMap software.
Data I/O-FutureNet	May 1985	Altera entered an OEM marketing agreement with Data I/O's FutureNet for the DASH series of schematic capture packages.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

2.0-micron CHMOS

PRODUCTS

EPLDs

EP300	300 gates
EP310	300 gates
EP320	300 gates
EP600	600 gates
EP900	900 gates
EP1200	1,200 gates
EP1210	1,200 gates
EP1800	2,100 gates

Design Tools

PLDS2	Development Systems for programmable logic
A+Plus	Software Logic Compiler for programmable logic
NetMap	Design Capture
LogicMap II	Software Program to verify and examine existing parts
PC-CAPs	Schematic Capture
DASH 2	Schematic Capture-PLSME State Machine Software
DASH 3	Schematic Capture-PLFSIM Simulation

Applications: Computer peripherals, instrumentation, military, telecommunications, and industrial markets.

FACILITIES

Santa Clara, CA	52,500 sq. ft.	Marketing, administration, and development

COMPANY HIGHLIGHTS

July 1984 — Altera offered the industry's first EPLD, the EP300, and the EP300 Development System four months ahead of schedule.

Aug. 1984	Altera signed a 5-year technology agreement with Intel Corp. Intel provided CHMOS EPROM design technology for the option to manufacture Altera's family of EPLDs. The agreement also included the joint development of a complete line of high-performance, low-power EPLDs and EPLD software tools.
Oct. 1984	Altera offered its EP1200 with 1200 equivalent gates, manufactured with CMOS EPROM technology. Altera also offered A+PLUS, a PC-compatible advanced programming development system that included software and hardware to program the EPLD. The A+PLUS was made available on the IBM PC and Daisy Logician workstations.
March 1985	Altera completed its third round of financing for $9.9 million
April 1985	Altera cut prices on its EP300 and EP1200 products. The Company also offered its first logic device based on Intel's CHMOS sub-2-micron process and the PLDS2 design tool. The Company introduced a new 300-gate part, the EP310, an enhanced version of the EP300. It is 50 percent faster than equivalent parts at 25-65ns in a 20-pin DIP.
June 1985	Intel and Altera extended the prior agreement to include alternate-sourcing of Altera's EPLDs using Intel's CHMOS process. The first product was a high-performance 1200-gate CMOS EPLD.
July 1985	Altera introduced the EP600, a high-speed, high-density EPLD with programmable registers to serve as a replacement for TTL or 74HC standard logic. At 25ns, it can replace more than 20 SSI/MSI packages.
Aug. 1985	Altera introduced the PLDS2, a programmable logic development system which allows individual users to design, program, and produce EPLDs. The Company also brought out PLSIM1, an enhanced version of P-CAD's PC-LOGS logic simulation software package which includes complete library models for Altera's entire line of EPLDs and fully simulates designs before the development of hardware prototypes.
Oct. 1985	Altera offered EP1210, a 40 percent smaller CHMOS version of the EP1200 with the same logical functions. It offers a 50ns I/O delay in either a 40-pin DIP or a 44-pin J-lead surface mount package in a commercial grade.

Nov. 1985	Altera offered an Intel CHMOS-based EP900, which has over 1,000 equivalent gates, 24 macrocells, and a 30ns delay.
Feb. 1986	Previously available only in ceramic windowed packages, Altera's EPLD family became available in one-time-programmable (OTP) plastic surface mount and plastic DIP packages.
Feb. 1986	Altera doubled its facility space with an addition of 29,000 square feet adjacent to the company's existing facility to total 52,500 sq. ft. The additional space will be used for marketing & sales, test, and administration as well as warehouse space.
Feb. 1986	Altera also cut prices up to 22 percent on its EPLD family, including the EP310, EP600 and EP1210 logic devices. The lower prices are attributed to higher volumes.
April 1986	Altera began production of the EP1800, which it sampled in April. It is the first in the off-the-shelf VLSI EPLD family. Based on Intel's CHMOS sub-2-micron technology, the EP1800 is second-sourced by Intel. It uses 43,000 EEPROM transistors to implement more than 2,000 equivalent gates, 48 macrocells, and the "Mizer" Mode with 50ns delay. It is available either in a windowed ceramic 68-pin J-lead package or an OTP plastic package.
May 1986	Altera introduced PLSME, an advanced software package for the design of state machines using the Company's line of CMOS EPLDs.
July 1986	Altera introduced a third-generation EP320 EPLD, fabricated with a CHMOS II-E sub-2-micron process and offering 35ns delay. A 25ns version is expected later in 1986.

Anadigics, Inc.
35 Technology Drive
Warren, NJ 07060
201/668-5000
TLX: 510-600-5741
FAX: 201/668-5068

ESTABLISHED: January 1985
NO. OF EMPLOYEES: 40

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
CEO	Ronald Rosenweig	Microwave Semicon	President
COO	George Gilbert	Microwave Semicon	Exec VP Opns
VP Eng	Dr. Charles Huang	Avantek	Dir GaAs R&D
Dir Mktg/Sales	Michael P. Gagnon	TRW LSI Products	Mgr Strat Plan
Comptroller	Matthew C. Perez	General Instrument	Dir Corp Fin Analysis

FINANCING

Date	Round	Sources	Amount
April 1985	Initial	Alan Patricof Associates, NY; Alex Brown & Sons; Fairfield Ventures; General Electric Venture Capital; Orange Nassau; Rothschild Inc.; Smith Barney Venture Capital	$10.0M
	Lease	GE Credit Corp.; EQUITEC, and others	$10.0M

BACKGROUND

Anadigics, Inc., is focusing on gallium arsenide analog and digital ICs for the telecommunications, military, and instrumentation markets. The Company promises to emphasize high quality, high performance and reliability.

The founders are Ronald Rosenweig and George Gilbert, who co-founded Microwave Semiconductor Corp., and Dr. Charles Huang, who was director of GaAs R&D and wafer fabrication services at Avantek.

Anadigics released prototypes in the first quarter of 1986 including op amps, microwave amplifiers, and A/D converters which serve as the "lynchpin" between microwave receivers and digital processors. In June 1986, Anadigics introduced the AOP1510 high-frequency amplifier.

ALLIANCES: Not available

SERVICES

- Foundry
- Design
- CAD
- Manufacturing
- Assembly
- Test

PROCESS TECHNOLOGY

GaAs MESFET (3-inch wafers)

PRODUCTS

- Foundry
- DC Amplifiers
- Operational Amplifier
- Digital DSP (Q4 1986)

Applications: Military, telecommunications, and high-speed instrumentation

FACILITIES

Warren, NJ	50,000 sq. ft.	Design, test, manufacturing, and administration
	10,000 sq. ft.	Class 100 Clean room

Anadigics is planning an additional $10 million wafer fab investment within the next three-year period.

Applied Micro Circuits Corporation
5502 Oberlin Drive
San Diego, CA 92121
619/450-9333
TWX: 182754 HQ LJLA

ESTABLISHED: April 1979
NO. OF EMPLOYEES: 225

BOARD

Name	Affiliation
William K. Bowers, Jr.	U.S. Venture Partners
F.K. Fluegel	Matrix Partners, L.P.
Franklin P. Johnson	Asset Management Corporation
Daniel C. O'Neil	Adler & Company
Arthur C. Patterson	Accel Capital
Roger A. Smullen	Applied Micro Circuits Corp.
Jeffrey D. West	Oak Investment Partners
Jonathon K. Yu	Applied Micro Circuits Corp.

COMPANY EXECUTIVES

Position	Name
Chairman/CEO	Roger A. Smullen
President/COO	Jonathon K. Yu
VP Finance/Admin	Joel O. Holliday
VP Mktg/Sales	A. C. D'Augustine
VP Operations	Don Schrock

FINANCING

Date	Round	Sources	Amount
April 1979	Round 1	Fred Adler & Co.; Ampersand Associates; International Industrial Investments Inc.; Kimball Organ; Timex	$5.0M
March 1983	Round 2	Accel Capital; Asset Management Associates; Harrison Capital; International Industrial Investments (France); Kemper; Matrix Partners; Oak Investment Partners II; Prime Capital; Robert Fleming Ltd.; Robertson, Colman & Stephens; US Ventures; Venture Growth Associates; Adler & Co.	$5.0M

FINANCING (Continued)

Date	Round	Sources	Amount
	Round 3	Adler & Co.; US Ventures; International Industrial Interests (France); Olivetti	$1.0M

BACKGROUND

Applied Micro Circuits Corporation (AMCC) specializes in the design and manufacture of high-speed, high reliability CMOS and bipolar gate arrays and CAD tools. AMCC has been delivering products to the commercial and military markets since 1980.

AMCC, a privately held company, was formed by Howard Bobb and Joe Mingione, who had previously been AMI Chairman of the Board and Marketing Manager, respectively. They were later joined by three additional principals: George Cone, Tom Zades, and Dan Yoder. AMCC was founded in Cupertino, California, but later acquired Solitron Devices' 32,000-square-foot facility in San Diego. After converting it to run 4-inch wafers, AMCC's fab facility became operational late in 1981.

AMCC's military business share was approximately 50 percent in 1984 and 40 percent in 1985.

Fourteen sales representative organizations with more than 75 sales people handle AMCC's gate arrays in the United States. Thomson-CSF is licensed to sell AMCC gate arrays in France.

ALLIANCES

Timex	April 1979	Timex participated in first-round financing.
Signetics	May 1981	Signetics and AMCC agreed to allow Signetics to provide alternate-sourcing of the Q700 Quick-Chip series. AMCC was licensed to market designs for Signetics' 8A-1200 gate array family.
	Sept. 1983	AMCC and Signetics signed an extension of the prior agreement, which covered a technology transfer of future families of gate arrays and junction-isolated and oxide-isolation processes.
Sorep	Jan. 1982	AMCC and Sorep agreed to participate in a joint venture to design, assemble, test, and market gate arrays in France.

Thomson CSF	July 1982	AMCC signed an agreement with Thomson-CSF under which Thomson-CSF will provide alternate-sourcing and will develop AMCC's high-performance, bipolar Q-700 series of gate arrays. AMCC received $1M over five years.
Daisy	Feb. 1983	Daisy offered support for AMCC's Q-700 gate array family on its Gatemaster gate array development system; AMCC provided the design software.
Olivetti	March 1983	Olivetti participated in round 2 of financing.
Honeywell	Aug. 1984	Honeywell signed to second-source AMCC's Q700 series, and to be an alternate source for AMCC's bipolar logic arrays.
Sanders	Feb. 1985	Sanders signed to develop prototype ECL gate arrays by customizing AMCC base wafers for in-house use only.
Seiko Epson/ S-MOS	May 1985	S-MOS signed to second-source AMCC's Q6000 Series of sub-2-micron CMOS logic arrays from 1,400- to 56,600-gates, with 1.0ns delay. Seiko Epson licensed its SLA 6000 Series of high-performance gate arrays and its 2-micron silicon-gate, dual-metal process to AMCC. Products initially made in Japan are made in the United States in 1986.

SERVICES

Design	CMOS Gate Arrays, Cell Libraries
CAD tools	
Manufacturing	

PROCESS TECHNOLOGY

1.5-micron CMOS
2.0-, 3.0-, and 5.0-micron Bipolar

PRODUCTS

ECL Gate Arrays

Family	Process (micron)	Linewidth (ns)	Delay	Gates
Q700	Bipolar	5.0	0.9	250 to 1,000
Q1500	Bipolar	5.0	0.9	1,500 to 1,700
Q3500	Bipolar	3.0	0.6	1,300 to 3,500

CMOS Gate Arrays

Family	Process	Linewidth	Delay	Gates
Q6000	Si-Gate	1.8	1.3	1,394 to 6,206
Q9000	Si-Gate	1.5	1.0	2,200 to 16,500

Cell Libraries

Family	Process	Linewidth (micron)	Delay (ns)	Cells
MacroMatrix	Bipolar	5.0	0.9	Custom Macros
MacroMatrix	Bipolar	5.0	0.9	320-gates, 18 MSI
MacroMatrix	Bipolar	3.0	0.6	220-gates, 4 MSI

CMOS Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
MacroMatrix	Si-Gate	1.8	1.3	80-gates, 40 MSI
MacroMatrix	Si-Gate	1.5	1.0	80-gates, 40 MSI

FACILITIES

San Diego, CA	43,000 sq. ft.	Administration, marketing, development, and manufacturing
	5,000 sq. ft.	Class 10 Clean Room

COMPANY HIGHLIGHTS

March 1981 — AMCC acquired Solitron Devices' 32,000-square-foot facility in San Diego, and converted it to run 4-inch wafers, the fab facility became operational year-end 1981.

May 1981 — Alternate-source agreement with Signetics.

Sept. 1981	AMCC introduced the Q-700 Quick Chip bipolar gate array.
Jan. 1982	AMCC offered the Q-700 Array Evaluation Chip which tests the performance range of the Q-700 Quick-Chip series of bipolar gate arrays, ECL, TTL or both.
Jan. 1982	Joint venture with Sorep to manufacture gate arrays in Europe.
July 1982	Agreement with Thomson-EFICS to alternate source and develop AMCC's high-performance, bipolar Q-700 Series of gate arrays.
Feb. 1983	Daisy will support AMCC's Q700 gate array on its Gatemaster gate array development system.
Sept. 1983	Agreement with Signetics extended for transfer of customized mask layers from one company to the other.
Nov. 1983	AMCC introduced the Q1500A and QH1500A bipolar gate arrays with 1,500 gates, for TTL, ECL, or TTL/ECL systems, at 0.9ns.
Aug. 1984	AMCC offered the Q3500 Series Logic Array.
Aug. 1984	Honeywell will second source AMCC's Q700 Series.
Jan. 1985	AMCC introduced the QM1600S RAM Array, a high-speed, high-density logic array with on-chip RAM. It has 1,600 configurable logic gates and 1,280 bits of dedicated high-speed SRAM, TTL, ECL, or mixed TTL/ECL.
Feb. 1985	Technology exchange agreement with Sanders which allows Sanders to design, develop, and manufacture prototype quantities of ECL gate arrays using AMCC supplied base wafers, ECL macro array libraries, and CAD software.
May 1985	Seiko Epson licensed its SLA 6000 Series of high-performance gate arrays, and its 2-micron silicon-gate dual-level metal process to AMCC.
June 1985	AMCC introduced its Q6000 Series of CMOS Logic Arrays, which include six CMOS arrays with densities from 1400 to 6600-gates. Manufactured with a sub-2-micron process, it offers a 1.0-ns delay, with military and commercial versions available. S-MOS is the second source.

June 1985	AMCC offered the SLA 6000 Series of CMOS arrays. Manufactured with 2-micron silicon-gate, dual-level CMOS, it offers 1,400- to 4,300-gates and 1.0ns delay.
Jan. 1986	The Company reported sales of $5.4 million, an increase of 15 percent over the third quarter of fiscal year 1986.
Feb. 1986	AMCC and S-MOS jointly introduced a new line of mutually second-sourced high-performance 1.8-micron CMOS logic arrays with propagation delays of 1.5ns. AMCC's Q6000A Series and S-MOS' SLA 6000A family include 10 CMOS arrays with densities ranging from 500- to 6,200-gates. Cell utilization is greater than 85 percent. The series is supported on Daisy and Mentor workstations by both companies, and is supported on the IBM PC-XT/AT by S-MOS.
March 1986	AMCC completed its full line of high-performance logic arrays--the Q3500 Series of bipolar products with equivalent gate counts of 1,300 and 2400. The parts target OEMs of instrumentation, computer, electronic warfare, test, graphics, and telecommunications equipment.
March 1986	AMCC reported sales of $20.3 million for the fiscal year ending March 31, 1986. After-tax profits are $0.9 million. This marked AMCC's second profitable fiscal year and tenth profitable quarter.

ATMEL Corp.
2095 Ringwood Avenue
San Jose, CA 95131
408/434-9201

ESTABLISHED: December 1984
NO. OF EMPLOYEES: 40

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	George Perlegos	Seeq	VP Engr
VP Technology	T.C. Wu, PhD	Seeq	Process Dev Mgr
VP/GM	Gust Perlegos, PhD	Seeq	Engr Manager
VP Finance	Raymond Ostby	Intel	Ctlr Europe Opns
Dir Sales	Jack Peckham	Semi Processes	Dir Sales/Mktg
Dir Inf Sys/CAD	Mikes Sisois	Qronos	VP Prod Dev

FINANCING: Not available

BACKGROUND

ATMEL (Advanced Technology-Memory & Logic) was formed to design, develop, manufacture, and market high-speed, nonvolatile semiconductor memory and logic products. The products use primarily CMOS technology with geometries as low as one-micron, combined with two-layer metal and silicide processes. The company plans to produce very high-speed and high-density EPROMs, EEPROMs, and EPLDs that will extend into the peripherals and communications areas.

The Company was founded by George Perlegos, Gust Perlegos, and T.C. Wu with private funds. In order to expedite development and release of products to market, ATMEL entered into a joint development and technology exchange agreement with General Instrument Corporation, which provided funding and manufacturing capacity, as well as second-sourcing for ATMEL's products for a small interest in ATMEL. GI has rights to second-source the products developed. Six ATMEL process people reside in Chandler, Arizona and work at the GI fab there.

ATMEL's first product was an NMOS 256K EPROM offered to gain market acceptance, followed by a CMOS 256K EPROM operating at 150-350ns, and a CMOS 512K EPROM operating at 125-250ns. The Company is planning a 1Mb CMOS part in the third quarter of 1986.

ATMEL offered the first 64K EEPROM which was functional on first silicon and has qualified for military 883.

The Company has been shipping since December 1985 and is experiencing acceptance of its product in the market. It is now ramping production and investigating the possibility of adding a fab.

The Company has a full rep force in place and also sells directly to OEMs. Plans to expand product offerings are underway.

ALLIANCES

General Instrument	Jan. 1985	Atmel provided technology for its OTP EPROM, UV EPROM, and EEPROM in exchange for fab capacity at GI's plant in Chandler, Arizona.
Hyundai	March 1986	An agreement between GI, Atmel, and Hyundai called for Hyundai to obtain a license to manufacture GI's CMOS OTP EPROM and 64K EEPROMs.

SERVICES

Design
Test

PROCESS TECHNOLOGY

NMOS and CMOS
1.25-micron Design Rules
2-layer metal

PRODUCTS

EPROM

Device	Configuration	Process	Speed
27256	32KX8	NMOS	150-350ns
27C256	32KX8	CMOS	150-350ns
27C512	64KX8	CMOS	150-250ns
27C515	4x16KX8	CMOS	150-250ns
27C1024	N/A	CMOS	N/A

EEPROM

AT28C64	8KX8	CMOS	150ns

Applications: Standard commercial, industrial, telecommunications, and military markets

FACILITIES

San Jose, CA	20,000 sq. ft.	Design and test

COMPANY HIGHLIGHTS

May 1985	Seeq charged ATMEL with trade secret appropriation and corporate raiding following the departure of George and Gust Perlegos and T.C. Wu from Seeq.
Oct. 1985	Moved to 20,000 sq. ft. facility housing R&D, engineering, and test operations
Nov. 1985	Achieved first silicon for 64K CMOS EEPROMS, 150-250ns Sampling in December 1985, production in first quarter 1986
Jan. 1985	Joint technology and second source agreement with General Instrument to design EEPROMs. General Instrument provided floating-gate production technology, fab, and undisclosed amount of cash to second source the part
Dec. 1985	ATMEL shipped its first products, a 256K EPROM, the 27C256 32KX8 NMOS and CMOS EPROMs with delays of 150ns. The devices were fabricated at General Instrument's Chandler facility using 1.25-micron technology.
Feb. 1986	ATMEL offered a 64K CMOS EEPROM, the AT28C64, the first of a family of eight devices. The device is organized as 8KX8, operates at 150ns, and is available in military, industrial, and commercial grades. It was developed under an agreement with General Instrument using silicon made at GI's fab with 1.25-micron technology.

Austek Microsystems
2065 Landings Drive
Mountain View, CA 94043
415/964-9800
FAX: 415 964 9809

ESTABLISHED: July 1984
NO. OF EMPLOYEES: 55

BOARD

Name	Affiliation
Sir Gordon Jackson	Interscan, Chairman
John G. Balletto	Austek Microsystems, CEO
Dr. J. Craig Mudge	Austek Microsystems, President
A.G. Summers	Bennett and Fisher Ltd., President
Dr. Ivan Sutherland	Evans & Sutherland, Co-founder

COMPANY EXECUTIVES

Position	Name
CEO/Managing Dir	John G. Balletto
President	Dr. J. Craig Mudge
VP/GM Australian Opns	Howard E. Robinson
VP/GM US Opns	James R. W. Clymer
Bytestream SBU	Denis Redfern
Microstream SBU	Dr. Robert J. Potter
Bitstream SBU	Roger Fisher

FINANCING

Date	Round	Source	Amount
July 1984	Round 1	Advanced Technology Ventures, Boston & San Francisco; Hambrecht & Quist, San Francisco; Rothschild Ventures, New York; Cazenove/Newmarket, UK; Australian Industry Development Corp. (AIDC); Bennett & Fisher, Australia; and other individuals	$6.7M

BACKGROUND

Austek Microsystems was formed to design and manufacture high-performance VLSI custom ICs for customers in the United States, Japan, and Australia. The Company has developed computer arithmetic chips, application-specific memories, and 32-bit co-processors. Austek produces such devices in volumes as low as a thousand for the signal processing, high-performance graphics, communications, high-end workstations, and high-performance micro-based computer systems. In addition to the Company's standard products, Austek will undertake chip development programs for customers.

Austek's Microstream Strategic Business Unit is developing products for high-end 32-bit microprocessors such as floating-point arithmetic processors and cache and MMU controllers. Austek designs ICs with 50,000 to 250,000 transistors. The Bytestream SBU develops products that are complete subsystems for applications that require byte-wide data paths. The Bitstream SBU develops products for bit-serial and analog interfaces for either high-performance or high-complexity computer and communications applications.

Austek's president, Dr. Mudge, was employed with Digital Equipment Corporation for eight years and developed central processors for the VAX-11 and PDP-11 computer systems. He also founded and led Digital's VLSI Advanced Development Group. In 1981, Dr. Mudge returned to his native South Australia to found the VLSI Program at the Commonwealth Scientific and Industrial Research Organization (CSIRO), a $350 million a year research organization similiar to NSF and DARPA in the United States. The VLSI Program successfully developed the technology to design and produce a 102,000-transistor speech recognition chip.

The Company's wafer fabrication is done in the United States and in Japan. It has developed an international network, Teknet, which ensures reliable information flow between Austek and its fabrication plants, and is an important component of Austek's commitment to quality control. Prototype and low-volume packaging is done in its wafer test and package facilities in Australia, the United States, and Japan. Production assembly, packaging, and test of high-pin-count packages is done in the United States and Japan. High-volume plastic packaged chips are subcontracted to Asian suppliers.

In September 1986, Austek purchased Silicon Microsystems, Inc. who will operate as a value-added design operation concentrating on memory products.

Austek's choice of location, people, technology, markets, and communications all reflect its international outlook. Austek has positioned itself for direct market access to the Pacific rim community, with offices in the United States, Japan, Southeast Asia, and Australia.

ALLIANCES: None

SERVICES

Design
Prototype Manufacturing
Low-volume Production
Test
Packaging

PROCESS TECHNOLOGY

2.5-micron HMOS
2.0-micron HMOS
3.0-micron CMOS
2.0-micron CMOS (1986)
1.5-micron CMOS (Late 1986)

PRODUCTS: To be announced third quarter 1986.

FACILITIES

Mountain View, CA	20,000 sq. ft.
Australia	20,000 sq. ft.

Barvon Research, Inc.
1992 Tarob Court
Milpitas, CA 95035
408/262-8368

ESTABLISHED: May 1981
NO. OF EMPLOYEES: 18

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Raymond Chow	Universal Semicon	Dir Engr
VP Design Engr	Paul Chan	AMD	Program Mgr
VP Mktg	Bob Pecotich	Universal Semicon	VP Mkt/Sales
VP Finance	Donald Shu	ATS, Inc.	Exec VP COO/CFO
VP CAD Engr	David Lin	Control Data	Mgr Dsn Automation

FINANCING

Date	Round	Sources	Amount
May 1981	Seed	Private Investors	$0.3M
	Round 1	Small Venture Capital Groups	$0.4M
	Round 2	Private Investors	$0.6M
	Round 3	Corporate Investors	$0.4M

BACKGROUND

Barvon Research, Inc. (BRI), offers gate array and standard cell products and BiCMOS design capabilities. BRI's initial product entry was its family of CMOS gate arrays. Recognizing the need for a more cost-effective product with multi-functional design capabilities, BRI developed its own CAD standard cell design program.

The Company's strategy is to exploit its advantages in high-performance and high-speed digital and analog/digital standard cell design using proprietary CAD techniques and advanced analog design capabilities in both HCMOS and BiCMOS process technologies. The Company plans to complete 10 designs a month by the end of 1987. BRI's wafers are supplied by Goldstar and Ricoh.

Micron Technology, reflecting its interest in the ASIC market, purchased 16 percent of BRI in November 1985.

BRI achieved $2.4 million in sales in fiscal year 1986 and $3.3 million in sales in fiscal year 1985, during which time the Company developed advanced technology with limited funding and resources.

ALLIANCES

Ricoh	Ricoh provides foundry services for BRI's 2-micron dual-metal HCMOS and BiCMOS processes.
Micron Technology	Micron acquired 16 percent of BRI in November 1985, to diversify its product line.
Goldstar	Goldstar provides foundry services for BRI. The companies are jointly developing an analog/digital CAD.

SERVICES

Design
CAD capability

PROCESS TECHNOLOGY

2.0- to 1.5-micron double-metal CMOS
BiCMOS 500- to 2500-gates

PRODUCTS

CMOS Gate Arrays

Family	Linewidth (micron)	Delay (ns)	Gates
BC4XX	4.0	3.5ns	500 to 5,000
BC5XX	5.0	3.5ns	500 to 5,000

Cell Library

Process	Linewidth (micron)	Delay (ns)	Cells
Si-Gate CMOS	3.0	3.0	100 MSI, RAM, ROM, A/D, D/A
Si-Gate CMOS	2.0	1.4	250 MSI, RAM, ROM, ALU
Si-Gate CMOS	2.0	1.2	250 MSI, RAM, ROM, ALU
Si-Gate CMOS	1.5	0.9	250 MSI, RAM, ROM, ALU
Si-Gate Bipolar & CMOS	2.0	0.9	250 MSI, RAM, ROM, ALU, 38 CMOS Analog Cells and 10 Bipolar Analog Cells

PRODUCTS (Continued)

CAD Tools

Proprietary Design Software: Compact, standard cell; supercell capabilities; DRC; ERCN; NCC; and back annotation.

NetList Translator: Converts gate array designs into standard cell devices.

Analog and Digital CAD: Automatic place and route and mixed-made simulation.

Product Development Plans:

Analog/digital standard cell CAD capabilities
BiCMOS standard cell CAD capabilities
Special function products

FACILITIES

Milpitas, CA	10,000 sq. ft.	Administration, design, and marketing

BRI plans to add another 10,000 sq. ft. and will purchase major CAD and test equipment for the facility.

Design Centers:

San Jose	Gate Arrays, Analog/Digital Standard Cell

BRI plans additional design centers in Southern California and Boston.

COMPANY HIGHLIGHTS

Dec. 1984	Barvon offered 2-micron, 2-layer metal CMOS gate arrays ranging from 500- to 2,500-gates with 883 capability. Also offered were 1.5- to 2.0-micron, 2-layer metal standard cells, with RAM, ROM, and analog functions, along with standard cell software.
Nov. 1985	Micron Technology purchased 16 percent of BRI's common stock. BRI will utilize Micron's fabrication, assembly, and test facilities for the manufacture of certain ICs. BRI will design a number of specialized ICs which will be manufactured and sold by Micron.

Bipolar Integrated Technology
1050 Northwest Compton Drive
Beaverton, OR 97006
503/629-5490

ESTABLISHED: July 1983
NO. OF EMPLOYEES: 73

BOARD

Name	Affiliation
George Wilson	Bipolar Integrated Technology
Larry Sullivan	Analog Devices Enterprises
Wayne Kingsley	InterVen Partners
John Ulrich	Union Venture Corp.
Bill Oldham	U.C. Berkeley
George Rutland	Ultratech Stepper

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	George Wilson	Tektronix	Sr Eng/Bipolar Dsn
VP Engr	Dr. Ken Schlotzhauer	Tektronix	Sr Engr
VP Mktg	Les Soltesz	Intel	Prod Mktg Mgr
VP Finance	Ken Giles	Columbian Co.	VP Finance
VP Mfg	Jim Pickett	Tektronix	Process Engr
VP Sales	Ralph J. Kaplan	Harris	VP Europe Opns

FINANCING

Date	Round	Sources	Amount
1983	Seed	Analog Devices, Inc.	$0.3M
		Oregon State Revenue Bond	$3.9M
	Lease	Firstbank Financial Corp.	$3.0M
May 1984	Round 1	Adventures L.P.; Analog Devices Enterprises; BancBoston Ventures; InterVen Partners, Inc.	$4.5M
May 1986	Round 2	Round 1 Investors; Harvard Management Co.; Union Venture Corp.; Republic Venture Group; Raytheon Corp.	$5.7M

BACKGOUND

Bipolar Integrated Technology, Inc. (BIT), was formed to design and develop high-speed bipolar ICs that target the high-end digital signal processing and data processing markets.

The Company's founders include George Wilson, Kenneth Schlotzhauer, James Pickett, Kenneth Giles, and Les Soltesz.

BIT has developed a VLSI bipolar process which can result in input clock rates of 200MHz. The Bit1 VLSI process used to produce the new family of chips is based on 2-micron lithography and polysilicon self-aligning techniques similar to those used in modern MOS fabrication. Resulting speeds are comparable to those of ECL devices, with BIT devices using less power. BIT1 density is comparable to 1.5-micron CMOS and is five times denser than existing bipolar ECL.

The Company plans to introduce ten products in 1986, all DSP building blocks. These products include: multiplier/accumulators; floating point multipliers and ALUs; and multi-port register files. The first BIT product, a 200MHz 16x16 integer multiplier, was offered in April.

A nationwide network of sales representatives has been established and BIT is opening a sales office in Atlanta for serving the eastern United States.

ALLIANCES

Analog Devices	1983	Analog Devices participated in all rounds of BIT financing.
Raytheon	July 1986	Raytheon and BIT agreed to jointly develop VLSI ECL gate arrays and standard cell devices using the BIT1 process. Raytheon will use its CAD/CAE facilities, and BIT will perform wafer fabrication with Raytheon marketing the resulting products. While initial products are expected to offer 3,500 to 5,000 equivalent gates, Raytheon believes the new BIT1 technology will allow subsequent designs of low-power ECL arrays of up to 10,000 gates.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

Bipolar

PRODUCTS

B3018	16x16 Integer Multiplier

Applications: FIR and IIR filters, fast Fourier transforms (FFTs), image processing, and graphics for the DSP, computer, workstation, and data communications markets.

FACILITIES

Beaverton, OR	44,000 sq. ft	Design and manufacturing
	6,000 sq. ft.	Class 10 Clean Room

COMPANY HIGHLIGHTS

Feb. 1985 — BIT opened its manufacturing plant in Beaverton, Oregon. It was financed with a $3.9 million industrial revenue bond.

April 1986 — BIT sampled its first product, the B3018 16x16 Integer Multiplier with a clock multiply time of 5ns.

May 1986 — BIT completed second-round financing for $5.7 million which provides capital to manufacture and market a family of computational building blocks for digital signal processing applications.

July 1986 — Raytheon and BIT will develop a product line of high-speed computer chips. Design will be conducted in Raytheon's Mountain View facility. BIT will fabricate the chips, Raytheon will market them. Chips will be designed for use in super microcomputers and minicomputers, mainframes, signal processors, workstations, and graphics terminals.

Brooktree Corp.
9950 Barnes Canyon Road
San Diego, CA 92121
619/452-7580

ESTABLISHED: 1981
NO. OF EMPLOYEES: 99

BOARD

Name	Affiliation
Myron Eichen	Brooktree, Chairman
James Bixby	Brooktree, President
Ellsworth Rosten	Roston and Schwartz
Sid Webb	Titan Corporation
Jack Savidge	Venture Strategies
Alan Ross	Fairchild Semicondcutor
F. Duwaine Townsend	Ventana Corporation

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman	Myron Eichen	Eichen Stevens	President
President	James Bixby	Spin Physics	Dir Eng
VP/Ch Sci	Henry Katzenstein	Quantrad	VP/Ch Sci
VP/CFO	William Peavey	Monitor Labs	VP Finance/CFO
VP	Steve Ou	Rockwell	Dir Dev Eng
VP	Joseph Santen	Burr-Brown	GM Data Conv
VP	Joseph Patridge	Silicon Systems	VP Sales

FINANCING: Not available

BACKGROUND

Brooktree was founded to develop, design, manufacture, and market high-performance data converters (digital-to-analog and analog-to-digital) and mixed analog-digital (mixed-signal) products.

These products are based on proprietary algorithms, invented by company co-founder Dr. Henry Katzenstein, and on state-of-the-art circuit design technology. Other founders are Myron Eichen, Ellsworth Roston, and William Norgren. The Company began operation in May 1983 and introduced its initial products in May 1985.

Brooktree is presently targeting high-performance data conversion and mixed-signal components for applications in computer graphics and imaging, automatic test equipment, and instrumentation markets. Planned future products include: mixed-signal ASICs for the telecommunications, automotive, and aerospace markets; and high-reliability components for military applications.

The Company provides all aspects of semiconductor design and manufacturing except for wafer fabrication which it contracts to outside vendors. Brooktree design and test technologies represent the integral proprietary portions of the final products. Brooktree's headquarters, located in San Diego, houses design, development, and test facilities as well as management and sales offices.

Brooktree has established a world-wide sales and distribution network.

ALLIANCES

Toshiba	1985	Toshiba signed a royalty-bearing licensing agreement to utilize Brooktree technology for consumer digital audio applications.
Fairchild	1986	Brooktree and Fairchild entered into a comprehensive set of agreements under which manufacturing will be done by Fairchild and Fairchild will make investments in Brooktree. Brooktree will design certain standard cells for Fairchild and give second source and buy/resale rights on certain products.

SERVICES

Design
Test

PROCESS TECHNOLOGY

3.0- and 2.0-micron Silicon-Gate double-metal CMOS
2.0-micron ECL

PRODUCTS

Part Number	Device Type	Speed
Bt101	Monolithic Triple 8-bit VIDEODAC	50, 30 MHz
Bt102	Monolithic Single 8-bit VIDEODAC	75 MHz
Bt103	Monolithic Triple 4-bit VIDEODAC	75, 30 MHz
Bt104/5	Monolithic Single 12-bit DACs	35ns
Bt106	Monolithic Single 8-bit VIDEODAC	50, 30 MHz
Bt108	Monolithic Single 8-bit VIDEODAC	300, 200 MHz
Bt109	Monolithic Triple 8-bit VIDEODAC	200 MHz
Bt110	Monolithic Octal 8-bit DAC	100ns
Bt444	Hybrid Triple 4-bit VIDEODAC	40 MHz
Bt450	Monolithic 19x12/Triple 4-bit RAMDAC	70, 50, 30 MHz
Bt452	Hybrid 16x12/Triple 4-bit RAMDAC	40 MHz
Bt453	Monolithic 259x24/Triple 8-bit RAMDAC	40 MHz
Bt458	Monolithic 259x24/Triple 8-bit RAMDAC	125, 100, 75 MHz

FACILITIES

San Diego, CA	73,000 sq. ft.	Headquarters, design, and test

Brooktree presently occupies one-half of the building and will incrementally increase the occupied area over the next five years.

California Devices, Inc.
1051 South Milpitas Blvd.
Milpitas, CA 95035
408/945-5000
FAX: 408 945-6123

ESTABLISHED: 1978
NO. OF EMPLOYEES: 172

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Douglas Ritchie	NSC	VP
Sr VP Mktg/Sales	David H. Esto	Arrow Electronics	VP NW Region
VP Finance/Admin	Dave Campbell	PMI	CFO
VP Dsn Tech	James R. Tobias	Gould AMI	Dir Tech Sys
Mgr Foundry Svcs	George Maheras	IBM	Engr
GM Colorado	Mike Gulett	Intel	New Tech Engr
Mgr Process Engr	Richard Morley	Sprague Solid State	Process Engr Mgr
Dir QA/Rel	Nicholas Ortenzi	United Technologies	QA Engr

FINANCING

Date	Round	Sources	Amount
Aug. 1985	Round 1	Alan Patricof Associates; Bay Partners; Brentwood Associates; Dougery, Jones, & Wilder; InnoVen Group; Merrill Lynch Venture Capital; Oxford Partners; Xerox Venture Capital	$13.5M
Sept. 1986	Round 2	Alan Patricof Associates; Bay Partners; Brentwood Assoc.; Dougery, Jones & Wilder; Drexel Burnham Lambert; John Hancock Ventures; InnoVen; Merrill Lynch Ventures	$ 3.0M

BACKGROUND

California Devices, Inc. (CDI), designs, manufactures, and markets CMOS application-specific products. CDI's service approach combines state-of-the-art technology, quick turnaround manufacturing facilities, and leading-edge design automation tools for customer ease of use.

The Company's product lines include gate arrays and standard cells, both of which are manufactured in its proprietary CHANNELLESS architecture. The products are based on silicon-gate CMOS which utilizes two-layer metal interconnection technology. Product development is focused around a CHANNELLESS core cell design, which CDI pioneered. This architecture achieves twice the circuit density of comparable existing gate array products and is therefore much less expensive to manufacture. CDI will announce a 50,000-gate count gate array based upon its CHANNELLESS technology later this year.

ALLIANCES

California Testing	1978	CDI is affiliated with California Testing, a firm that provides electrical test services.
AMI	1980	CDI licensed its HC Series to AMI.
LSI Logic	July 1981	CDI exchanged its HC Series of gate arrays for LSI Logic's LDS1 CAD system.
Giltspur Microsystems	Nov. 1981	Giltspur, a supplier of microprocessors, agreed to establish a U.K. design center for CDI gate arrays and to distribute CDI semiconductors.
Telmos	1982	Telmos licensed CDI's linear CMOS products.
Corintech	Oct. 1982	Corintech, a thick-film manufacturer, will make and sell CDI gate arrays in Britain.
Olympus Optical	Jan. 1983	Announced the first portion of a 3-year transfer agreement under which CDI's CMOS gate array technology and new product developments are to be transferred to Olympus Optical Co., a manufacturer of cameras, for sale in Japan.
Western Microtechnology	1983	CDI agreed to allow Western Microtechnology to sell CDI's gate arrays through the company's design center.

SERVICES

Foundry	Silicon-Gate CMOS and NMOS
Design	
Assembly	
Test	

PROCESS TECHNOLOGY

1.5-, 2-, and 3-micron gate equivalent core cell CMOS

PRODUCTS

CMOS Gate Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
DLM	Si-Gate	2.0	2.0	200 to 10,152
CHA	Si-Gate	2.0	1.1	200 to 13,230

Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
CHB	Si-Gate	3.0, 2.0	1.0	60-gates, RAM, ROM, PLA

FACILITIES

Milpitas, CA	55,821 sq. ft.	Headquarters and design
Colorado	60,000 sq. ft.	Wafer fab
	12,000 sq. ft.	Class 10 and 100 Clean rooms
Design Centers:		
Milpitas, CA	MOS	Gate Arrays

COMPANY HIGHLIGHTS

1980	CDI licensed its HC Series to AMI
July 1981	Agreement to exchange CDI's HC Series of CMOS 300 to 1,700-gate arrays for LSI Logic's LDS1 CAD system.

Sept. 1981	CDI opened a design and training center for gate arrays in Grass Valley, California.
Nov. 1981	Agreement with Giltspur Microsystems to establish a U.K. design center for CDI gate arrays and distribute CDI semiconductors. Giltspur designs microprocessors
1982	Telmos licensed CDI's linear CMOS products.
Oct. 1982	Agreement with Corintech, a thick film manufacturer to make and sell CDI's gate arrays in Britain
Jan. 1983	Agreement with Olympus Optical Co., a Japanese manufacturer of cameras, to transfer CDI IC design technology
May 1983	CDI offered bipolar and CMOS silicon-gate linear gate arrays.
Nov. 1983	CDI introduced "Sea-of-Gates" architecture for 3-micron, CHANNELLESS, 2-layer metal CMOS gate arrays, the DLM (Dual-Layer Metal) Series.
Oct. 1984	CDI introduced WISE I, a workstation-based software package for schematic capture, logic simulation, and timing analysis of CDI's DLM gate arrays supported on Daisy, Mentor, and Valid Logic Systems workstations.
July 1985	CDI purchased Storage Technology's 65,000 sq. ft. main semiconductor plant in Colorado for $6.5 million.
Aug. 1985	Completed $13.5 million in financing
Nov. 1985	CDI moved to new Milpitas, California facility.

Calmos Systems, Inc.
20 Edgewater Street
Kanata, Ontario
Canada K2L 1V8
613/836-1014
Telex 053-4501

ESTABLISHED: April 1983
NO. OF EMPLOYEES: 19

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Dr. Adam Chowaniec	Commodore	VP Technology
VP R&D	John Roberts	Mosaid	Dir Mktg
VP Sales/Mktg	William Woodley	Mosaid	VP/Bus Mgr
VP Finance/GM	Niall Quaid	Leigh Instr.	VP Finance

FINANCING

Date	Round	Sources	Amount
Not available	Round 1	Private	$1.0M
	Round 2	Private	$0.4M
	Round 3	Private and Grants	$3.6M

BACKGROUND

Calmos Systems, Inc.'s, custom design capabilities include custom-packed ICs, standard cell ICs, and radiation-hardened design techniques. Its standard line includes MPUs, MPRs, memory/DSP, and VHSIC level products. The Company has invested about $2.5 million in product development over the last two years. Calmos is expanding its design team to further develop proprietary products and plans to add test and packaging capabilities.

Calmos, an emerging growth company, expects to be profitable in 1986 from its design fee revenue and sales of new products.

ALLIANCES: Not Available

SERVICES

Design
Assembly
Test

PROCESS TECHNOLOGY

2.0- and 3.0-micron CMOS
0.9- to 1.5-micron CMOS VHSIC

PRODUCTS

Macrocell custom design
DSP FIR filters
(Finite impulse response)
80C85 MPU
CA 01C50 Real-Time Clock
CMOS 8000 series (Sept. 1986)
VHSIC 2KX8 & X9 SRAM (Sept. 1986)
VHSIC 8KX8 & X9 SRAM (Dec. 1986)

FACILITIES

Ontario, Canada	13,000 sq. ft.	
Design Centers:		
Ottawa, ON	CMOS	Cell Libraries and custom design

COMPANY HIGHLIGHTS

March 1984	Calmos began designs for a range of macro functions in both gate array and standard cell libraries; ROM and RAM are available.
Nov. 1985	Calmos offered a real-time clock calendar, the CA 01C50, in a commercial grade 24-pin plastic DIP.
Dec. 1985	Calmos offered a CMOS 8-bit MPU, the CA80C85B, in a 40-pin DIP and 44-pin LCC, commercial grade version.

Calogic Corporation
237 Whitney Place
Fremont, CA 94539
415/656-2900

ESTABLISHED: July 1983
NO. OF EMPLOYEES: 28

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Manny del Arroz	Semi Processes	Process Manager

FINANCING

Date	Round	Sources	Amount
1983	Initial	Private	$0.025M

BACKGROUND

Calogic is organized into two divisions: a division to build fabrication facilities and market semiconductor equipment, and a semiconductor division to design, develop, and manufacture DMOS analog switching devices and gate arrays. The semiconductor division is also developing CMOS logic parts.

Calogic, founded without venture capital, achieved a positive cash flow within its first year of operation and continues to grow and be profitable.

In October 1985, Calogic offered Quad DMOS Switching Arrays, the SD 5000/5002/5200, and single DMOS Transistors, SD211/213/215, for military applications.

ALLIANCES

Koki Company	Dec. 1984	Calogic and Koki reach agreement regarding the sale of Calogic's CMOS data bus driver ICs by Koki in Japan.

SERVICES

Consulting
Design
Foundry

PROCESS TECHNOLOGY

DMOS
5.0- to 3.0-micron Silicon-Gate CMOS
(1.5-micron planned for 1987)

PRODUCTS

DMOS FET
CMOS MPR
DMOS switching arrays

FACILITIES

Fremont, CA	15,000 sq. ft.	Design, manufacturing and test

Catalyst Semiconductor
4051 Burton Drive
Santa Clara, CA 95054
408/980-9144

ESTABLISHED: October 1985
NO. OF EMPLOYEES: 28

BOARD

Name	Affiliation
B.K. Marya	Catalyst Semiconductor, President
George Pottorff	Pottorff, MacFarlane & Assoc., Inc.

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	B.K. Marya	Exel	President
Dir Sales	Bob Simon	Exel	Dir Sales
VP Corp Dev	Hideyuki Tanigami	Exel	Bus Dev/Japan

FINANCING

Date	Round	Sources	Amount
Oct. 1985	Round 1	Private Placement	$4.5M

BACKGROUND

Catalyst Semiconductor was formed to design, develop, and manufacture application-specific and peripheral ICs utilizing NVRAMS for the telecommunications, commercial, industrial, and military markets.

The Company was founded in the fourth quarter of 1985 by B.K. Marya, previously the founder and CEO of Exel Microelectronics, Inc.

Catalyst's initial strategy was to form strategic alliances with companies such as Zilog to develop EPROMs on the Z8 MCU. In December of 1985, Catalyst signed a 2-year agreement with Zilog to jointly develop and produce NVRAM memory products. This agreement gives Catalyst market entry with a line of proprietary products and a production commitment at Zilog facilities. When initial production begins, much of Catalysts' technical staff will be housed at Zilog's headquarters in Campbell, California, and at Zilog's Nampa, Idaho fab facility.

The Company's long-term strategy is to gain ASIC leadership utilizing nonvolatile memories. The Company also plans for a wafer fab in Santa Clara in the next two years.

Two nonvolatile CMOS SRAMs were sampled in May 1986. The CAT22C10 and CAT22C12, configured 64x4 and 256x4, respectively, follow the Xicor format for NVRAMs with an 18-pin package. Production is slated for June 1986.

ALLIANCES

Zilog	Dec. 1985	Catalyst and Zilog entered into a joint development and second-source agreement for user-programmable standard products. Initial efforts will be a version of Zilog's Z8 microcontroller with on-chip electrically-alterable capabilities using Zilog's 1.25-micron n-well CMOS process.
Thomson CSF	1986	Catalyst and Thomson will conduct research and development in France.
Oki Electric	1986	Catalyst and Oki entered into an agreement calling for long-term research and development efforts of NVRAMs for ASICs using CMOS EPROMs and EEPROMs. Terms include a non-exclusive marketing agreement.

SERVICES

Design
Test

PROCESS TECHNOLOGY

1.2-micron Design Rules
Double-metal, double-poly CMOS

PRODUCTS

CMOS SRAM

CAT22C10	64x4
CAT22C12	256x4
24C44	16x16 Serial RAM

FACILITIES

Santa Clara, CA	1000 sq. ft.	Offices

Celeritek, Inc.
617 River Oaks Parkway
San Jose, CA 95134
408/433-0335

ESTABLISHED: 1984
NO. OF EMPLOYEES: 60

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Tamer Husseini	Avantek	GM-M/W Trans
VP Amp Opns	Gary Policky	Avantek	Mgr Adv Dev M/W
VP SC Opns	Ross Anderson	Avantek	Mgr GaAs Dev
VP Finance	John Beman	Avantek	Ctlr/Treasurer
VP Mktg/Sales	Robert Jones	Avantek	Dir Mktg

FINANCING

Date	Round	Sources	Amount
March 1985	Initial	Greylock Management; Sutter Hill; Venrock Associates	$3.2M
Aug. 1985	Follow-on	Original investors	$1.0M
Aug. 1986	Round 1	Original investors; Burr, Egan, Deleage; Glynn Ventures; Mayfield Fund; Morgan Stanley	$4.2M

BACKGROUND

Celeritek was formed to design and manufacture GaAs FET amplifiers. The Company's products presently consist of multi-octave broadband low-noise amplifiers for electronic warfare applications.

The Company is named for the high-speed (celerity) GaAs technology in which it specializes. Founders and key persons are from Watkins-Johnson and Avantek. Celeritek is delivering production quantities of 6-18 GHz GaAs FET amplifiers and many other amplifiers from .5-18 GHz with up to +23 dBm output power over military temperature ranges. Its GaAs FETs and thin film amplifier circuits are manufactured in-house with a high-energy sputtering process for repeatable and reliable metal adhesion. The Company's facility houses a Class 100 clean room.

Future plans include the development of microwave monolithic circuits to serve both the military and commercial markets, a line of GaAs FET transistors, and a line of communications and radar amplifiers.

ALLIANCES: None

SERVICES

Design
Manufacturing
Assembly

PROCESS TECHNOLOGY

GaAs

PRODUCTS

CMA Series of Low-noise Amplifiers
CMT Series of Low-noise Amplifiers, temperature compensated

Applications: Military electronic countermeasures targeting the satellite communications markets

FACILITIES

San Jose, CA	23,000 sq. ft.	Research and development, and manufacturing
	1,000 sq. ft.	Class 100 Clean room

Chips & Technologies, Inc.
521 Cottonwood Drive
Milpitas, CA 95035
408/434-0600

ESTABLISHED: January 1985
NO. OF EMPLOYEES: 58

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Gordon Campbell	Seeq	Founder/President
VP Engr	Diosdado P. Banato	Seeq	Dir Engr
VP Sales	Dave Bowman	Apple	Natl Sales Dir
VP CAE	Morris E. Jones	Amdahl	
VP Finance	Gary P. Martin	Apple	VP Finance
VP Opns	James F. Stafford	Seeq	Dir Materials
VP Mktg	Ronald T. Yara	Intel	Mktg Mgr

FINANCING

Date	Round	Sources	Amount
1984	Round 1	Bill Marocco; other individuals	$1.0M
1984	Round 2	Yamaha; Kyocera; Mitsui; ASCII	$1.8M
Oct. 1986		Initial Public Offering	$10.3M

BACKGROUND

Chips & Technologies utilizes a macrofunctional design approach to provide application-specific standard products for integrating into microcomputer system architectures.

Phase one was to develop application-specific standard products, including an integrated chip set for the IBM PC/AT, LAN controllers, an enhanced graphics chip set, and mass storage controllers. Phase two will involve developing user-specific semicustom products to include mainframe-based CAD tools and library functions derived from the Company's standard product development.

Chips and Technologies (C&T) offers four products:

> System Logic: The PC-AT CHIPSet replaces 63 glue logic devices with 5 VLSI components, reducing the 94 AT system board devices to 36 components plus memory.

Graphics: The Enhanced Graphics CHIPSet for the PC-AT, which replaces 25 devices with 4 ICs, reduces the number of devices needed for a fully configured EGA implementation from 76 to 32, including 256K of display memory.

LAN: The Starlan Hub chip is a serial interface and token ring single-chip controller.

CAE: The computer-aided environment enables the mapping of existing technology into vendors' products.

ALLIANCES

Toshiba Fujitsu Yamaha	Nov. 1985	C&T is subcontracting foundry services from these companies for CMOS and bipolar arrays.

SERVICES

Design
Test

PROCESS TECHNOLOGY

1.5 and 2.0-micron CMOS and bipolar

PRODUCTS

PC-AT CHIPSet
EGA CHIPSet for the PC-AT
Ethernet-based CSMA/CD LAN controllers
82C550, a serial interface
82C551, a hub controller
CAD tools and macrofunction libraries

Applications: System logic, graphics/display, LAN communications, and mass storage control

FACILITIES

Milpitas, CA	30,000 sq. ft	Design

Chips & Technologies plans to add sort and final test equipment.

COMPANY HIGHLIGHTS

Nov. 1985	Fujitsu, Toshiba, and Yamaha are providing exclusive foundry services for C&T.
March 1986	C&T reported profitability on a monthly run rate of $1 million.
June 1986	C&T introduced two StarLAN local area network CMOS chips. The 82C550 is a serial interface that offers full compatibility with the IEEE 802.3 and Intel's NMOS 82586 LAN coprocessor. It has both Manchester encoder/decoder and transceiver functions in one IC. The 82C551 is a hub controller that replaces up to 80 devices typically required to perform hub functions.
July 1986	C&T introduced a PC-AT-compatible chip set for 10 MHz system operation. The 82C201-10 and 82C202 are CMOS parts with CPU control and memory-select logic, respectively. The bipolar 2A203, 82A204, and 82A205 devices provide most of the driver and buffer functions.

Cirrus Logic, Inc.
1463 Centre Pointe Drive
Milpitas, CA 95035
408/945-8300

ESTABLISHED: 1981
NO. OF EMPLOYEES: 75

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Michael Hackworth	Signetics	Sr VP
Exec VP Intl Opns	Kamran Elahian	CAE Systems	President
VP R&D	Suhas Patil	Patil Systems	Founder
VP Eng	Kenyon Mei	Intel	GM Adv Prod
VP Mfg	Michael L. Canning	Teledyne Semi	President/GM
VP Sales	Eugene Parrott	Intel	Mgr Strat Accts
Dir Finance	Marilyn Guerrieri	Zitel	Dir Finance

FINANCING

Date	Round	Sources	Amount
March 1984	Seed	Nazem & Co., New York	$1.6M
May 1985	Round 1	Nazem; New Enterprise Associates; Brentwood Associates; Robertson, Colman & Stephens; Technology Venture Investors	$7.5M
May 1986	Round 2	Previous investors; Institutional Venture Partners	$3.0M

BACKGROUND

Cirrus Logic, Inc., was formed to design and manufacture custom VLSI microperipheral circuits using a proprietary silicon compilation technique.

The Company was originally founded in 1981 as Patil Systems and operated as a research and development lab until the end of 1983. In 1984, Patil Systems was renamed Cirrus Logic, Inc., and received financing from Nazem & Co. of New York.

Cirrus Logic developed a proprietary IC design method called "Storage/ Logic Array" (S/LA) to design custom ICs in design times equivalent to those for standard cells while offering full-custom capability. Suhas Patil invented the S/LA concept, a type of silicon compilation technology with supporting CAD tools for logic design, simulation, and automatic layout.

Products fall into three categories:

Mass memory controllers MSPC 100
Display/Graphics Controllers DGCC 100
Data Communication Controllers DCOM 100

ALLIANCES

AMD	Sept. 1985	Cirrus and AMD agreed to a technology exchange wherein Cirrus will use silicon-compiled 1.6-micron double-metal CMOS processed wafers to develop a micro-controller for AMD. AMD will provide foundry services.

SERVICES

Design
Test

PROCESS TECHNOLOGY

3.0-micron NMOS and CMOS
1.6 and 2.0-micron double-metal CMOS

PRODUCTS

Mass storage controllers
Communication controller
Display controller

FACILITIES

Milpitas, CA	50,000 sq. ft	Administration, engineering, design, and marketing
	10,000 sq. ft.	Class 1000 Clean room

Crystal Semiconductor Corp.
2024 St. Elmo Road
P.O. Box 17847
Austin, TX 78760
512/445-7222
TWX: 910-874-1352

ESTABLISHED: October 1984
NO. OF EMPLOYEES: 70

BOARD

Name	Affiliation
H. Berry Cash Chairman	Berry Cash Southwest Partnership
L.J. Sevin	Sevin/Rosen
James H. Clardy	Crystal Semiconductor
Michael J. Callahan	Crystal Semiconductor
Dietrich R. Erdmann	Sevin Rosen

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	J. H. Clardy	Harris	VP WW Opns
VP Engr	M. J. Callahan	Texas Micro	Founder/Pres
VP Mktg	Craig H. Ensley	Rockwell	Director Mktg
Tlcm Eng Mgr	Eric J. Swanson	AT&T Bell Labs	Tech Supv VLSI Grp

FINANCING

Date	Round	Sources	Amount
Oct. 1984	Round 1	Berry Cash Southwest Partnership; Dietrich Erdmann; Hambrecht & Quist; InterWest Partners; The Hill Partnership; Republic Investment Co.; Sevin, Rosen Management Company	$4.5M
Feb. 1986	Round 2	Original investors; Kleiner, Perkins, Caufield & Byers; Crown Associates; Rho Management Company; Coronado Venture Fund; Rust Ventures	$6.7M

BACKGROUND

Crystal Semiconductor develops, manufacturers, and markets advanced Smart Analog ICs that combine analog and digital functions on a single CMOS device for the telecommunication/data communication, instrumentation, and industrial automation market segments.

Crystal is a privately held company founded by Michael J. Callahan and James H. Clardy. Crystal acquired the assets and technology of Texas Micro-Circuit Engineering, a company which Michael Callahan founded and served as president.

Crystal is developing three product lines for a variety of niche markets: Telecommunications/data communications including PCM transceivers and data communication transceivers; digitally enhanced analog-to-digital and digital-to-analog data acquisition products; and signal conditioning and application-specific filters.

In April 1986, Crystal Semiconductor announced its first product, the CSC8870B, a DTMF Receiver. The circuit can be used in telephone answering machines and credit card verification systems. In June, 1986, the CSC7008 Universal Filter and Crystal-ICE Filter Development System was offered. The development system is a PC-based system incorporating filter synthesis, coefficient generation software, and an in-circuit emulator (ICE).

Orbit Semiconductor, Mitel, Seeq, and subcontractors in Singapore are providing foundry services. Test is performed in Austin.

Crystal Semiconductor markets its products through the combined efforts of a direct sales force and a worldwide network of manufacturers' representatives and distributors.

SERVICES

Research and development
Design

PROCESS TECHNOLOGY

3.0-micron CMOS Silicon-Gate
2-layer poly structure with single-layer of metal.
Mixed analog/digital process, standard cell approach

PRODUCTS

Components

CSC8870B	DTMF Receiver
CSC7008	Universal Filter

Development System

Crystal-ICE Filter Development System: A PC-based system that supports filter applications using Crystal's CSC7008 universal filter.

Applications: Telecommunications, industrial, test/instrumentation, military, and medical markets

FACILITIES

Austin, TX	12,000 sq. ft.	Design and test

Crystal is planning a fab in 1988.

Custom Arrays Corporation
525 Del Rey Avenue
Sunnyvale, CA 94086
408/749-1166
Telex: 510 600 51 19

ESTABLISHED: October 1984
NO. OF EMPLOYEES: 5

BOARD

Name	Affiliation
B. Bornette	Elf Aquitaine, France
P. Irissou	Custom Arrays Corporation
H. Camenzind	CX Inc.

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Pierre R. Irissou	Atac Diffusion SA	Mgr Dir

FINANCING

Date	Round	Sources	Amount
Oct. 1986	Round 1	Integration SA	$0.030M
		Hans Camenzind	$0.007M
April 1985	Round 2	Integration SA	$0.027M
		Atac Diffusion	$0.120M
Sept. 1985	Round 3	Atac Diffusion	$0.123M

BACKGROUND

Custom Array Corporation was formed to design and manufacture analog bipolar linear arrays and to offer low-cost, high-performance IBM PC-AT-based workstations and software. The Company is also offering short turnaround times for prototypes and low-volume orders. The founder is Pierre R. Irissou, who also serves as the president and the vice president of research and development.

Custom Arrays is a subsidiary of Atac, a semiconductor manufacturer in Paris, France.

The Company's short-term strategy is to offer quick turnaround on prototypes based on its new MM Family of linear arrays and designed on the Company's low-cost IBM AT-based workstations, which were introduced in May 1986. The MM Family consists of nine arrays in incremental sizes from MMA (14-pins and 5,589 square mils) to MMJ (48-pins and 22,477 square mils). Custom Arrays is also second-sourcing existing analog bipolar semicustom designs. Its long-term strategy is to expand its bipolar analog arrays to include a 40-volt analog bipolar family, adding high-voltage precision resistors and combined analog and digital BiMOS arrays. Products are targeting the instrumentation, industrial, telecommunications, automotive, computer peripherals, and avionics markets. First products were offered in May 1986.

The MM Family is the result of a joint development venture with Ferranti Interdesign, Inc., in Scotts Valley, California.

Custom Arrays will be adding test and assembly later this year and precision resistors with laser trimming next year.

ALLIANCES

Atac	Custom Arrays is a subsidiary of Atac.
Ferranti	Joint development agreement

SERVICES

- Design
- Prototype Manufacturing
- Low-Volume Manufacturing
- Assembly
- Test

PROCESS TECHNOLOGY

- Bipolar

PRODUCTS

- MM Family of Linear Arrays

FACILITIES

Sunnyvale, CA	1,800 sq. ft.

Custom MOS Arrays, Inc.
215 Topaz Street
Milpitas, CA 95035
408/263-3214

ESTABLISHED: July 1982
NO. OF EMPLOYEES: 50

BOARD

Name	Affiliation
Chan M. Desaigouder	Custom MOS Arrays

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Handel H. Jones, PhD	Rockwell	VP Eng
VP Finance	Steven J. Henke	Midland-Ross	Controller
VP Mktg/Sales	Henri De Roule	IMP	Sales Mgr
VP Eng	Ian Liu	Interdesign	Sr Eng
VP CAD Software	Shi-Ping Fan, PhD	NSC	N/A

FINANCING

Date	Round	Sources	Amount
1982	Startup	California Micro Devices	$4.0M

BACKGROUND

Custom MOS Arrays designs and manufactures low-cost, high-performance HCMOS application-specific ICs. CMA offers fast turnaround design services for gate arrays, standard cells, or full-custom ICs and uses proprietary CAD tools and extensive macrocell libraries.

CMA was incorporated by California Micro Devices (CMD), a developer of high-quality thin-film products. CMD has announced that it has agreed to merge with CMA, subject to CMA shareholders approval. Dr. Handel Jones will be the president and chief operating officer of the combined Company. The new company will be organized into two divisions: A thin film division, and an ASIC division that will continue to offer the CMA line of products.

CMA's integrated CAD allows 100 percent routing and conversion to standard cells or full custom products for high-volume production. Metal commitment of masterslices is done at CMA. Volume production and assembly is done by foundries.

The Company's products are Mil-Std 883, Class B and Class S qualified, and are radiation-hardened.

ALLIANCES

California Micro Devices	1982	CMA was incorporated by California Micro Devices.
Ricoh	1982	Ricoh provided all wafers for CMA.
	1983	Ricoh was granted an exclusive licensing agreement for CMA's CMOS silicon-gate and BiMOS gate arrays and standard cells.
	Mar. 1984	Ricoh and CMA entered into a joint venture for development of CMA's CMOS gate array designs and Ricoh's 1.5-micron wafer processing technology and production.
NCR	1982	Under the terms of a technology exchange agreement, NCR provided CMOS and NMOS technologies. The companies agreed also to jointly develop 2.0- and 2.5-micron HCMOS gate arrays as well as design rules for macros for standard cell. CMA provides designs and is NCR's exclusive sales agent in New England. NCR provides dedicated wafer fabrication for CMA.
Racal	Jan. 1982	CMA and Racal announced a joint development and exclusive licensing agreement that calls for CMA to design, manufacture, and sell Racal's new 5.0-micron silicon-gate CMOS gate arrays in the United States. These products are not offered now.
Micro Innovators	Jan. 1983	CMA merged with Micro Innovators, Inc., to acquire a team of seasoned custom MOS/LSI designers and expand its product line to include standard cell and full-custom designs in silicon-gate CMOS at both 5.0- and 3.0-micron geometries.
TRW	July 1985	TRW agreed to manufacture HCMOS gate arrays of from 500- to 25,000-gates in its JAN-qualified fab using CMA's 1.0-micron design rules. TRW will use the rules internally for its DSP products; CMA will sell the DSP products commercially.

SERVICES

Design
Prototype Manufacturing
Packaging
Test

PROCESS TECHNOLOGY

1.5, 1.25, 2.0, and 2.5-micron HCMOS
Silicon-Gate single- and dual-layer metal
(4-inch wafers with 6-inch wafers soon)

PRODUCTS

CMOS Gate Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
C1000	Si-Gate	1.5	0.8	5000 to 18,000
C2000	Si-Gate	2.0	2.0, 1.25	200 to 3,100
C3000	Si-Gate	2.5	2.5	1500 to 10,500
C5000	Si-Gate	1.25	0.4	500 to 25,000

CMOS Cell Library

Process	Linewidth (micron)	Delay (ns)	Cells
Si-Gate	1.25	0.25	120-gates, 200 MSI, RAM, ROM, PLA, 2901 family, DMA controllers, UART, USART
Si-Gate	2.0	1.2	Same as above
Si-Gate	2.5	2.5	Same as above

FACILITIES

Milpitas, CA	50,000 sq. ft.	
	1,500 sq. ft.	Class 1000 Clean room

Design Centers:

Milpitas, CA	MOS	Gate Arrays, Standard Cell

COMPANY HIGHLIGHTS

Dec. 1982	CMA signed an exclusive agreement to use Racal's integrated CAD software to design and Racal's family of 5-micron, silicon-gate CMOS gate arrays of from 448 to 1,550 gates. CMA will sell the arrays.
Jan. 1983	Merger with Micro Innovators, Inc., to acquire a team of seasoned custom MOS/LSI designers and expand product line to include standard cell and full custom design in silicon-gate at both 5- and 3-micron geometries.
May 1983	CMA shipped its initial product.
July 1983	CMA offered the CMA 2000 Series of CMOS gate arrays (3.0-micron HCMOS; 400- to 2,400-gates; 40- to 110-pins; 4.5ns gate speed; and military and commercial grades).
March 1984	CMA completed an agreement with Ricoh that combines Ricoh's wafer processing technology with CMA's circuit design and development capabilities for gate arrays.
April 1985	CMA offered gate array-to-standard cell design conversion using a macrolibrary.
July 1985	CMA signed an agreement with TRW to design and market a series of gate arrays with TRW's 1.25 micron VHSIC HCMOS process. Gate densities range from 500- to 25,000-gates, with 0.6 to 0.9ns gate delays. CMA will develop a full library of macros and will use TRW's foundry.

Custom Silicon Inc.
600 Suffolk Street
Lowell, MA 01854
617/454-4600
FAX: 617/458-4931

ESTABLISHED: April 1983
NO. OF EMPLOYEES: 25

BOARD

Name	Affiliation
Albert P. Belle Isle	Custom Silicon Inc.
Richard A. Charpie	Paine Webber Ventures
David W. Guinther	Custom Silicon Inc.
Sumner Kaufman	Kaufman & Co.
Kenneth J. Revis	Turner Revis Associates
Henry Shean	Custom Silicon Inc.

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	A.P. Belle Isle	Wang	VP
VP R&D	Donald L. Gay	Wang	Program Mgr
VP Marketing	David W. Guinther	Wang	Program Dir
VP Finance	Henry R. Shean	Wang	Controller R&D
VP Sales	Robert J. Brown, Jr.	SGS	VP Sales

FINANCING

Date	Round	Sources	Amount
April 1983	Seed	Kaufman & Co.; Private investors	$0.1M
Feb. 1984	Round 1	Turner Revis Associates; First Chicago; Bank of New England	$1.1M
June 1985	Round 2	Original investors; Paine Webber Ventures; Massachussetts Capital Resource Company	$2.8M

BACKGROUND

Custom Silicon Inc. (CSi) was formed to serve the low-volume and high-complexity ASIC markets by acting as a "time-shared captive semiconductor division" to companies in regional markets. It acts as a "value-added reseller" of wafer fabrication capacity through its strategic relationships with major semiconductor manufacturers.

CSi is the ASIC distribution channel for NCR Corp. for both New England and the Pacific Northwest, and the Northeast independent design center for Motorola.

CSi's approach is one of extremely vertical marketing that focuses on applications. CSi offers 2- and 3-micron CMOS gate arrays and standard cells that are supported on Mentor, Daisy, FutureNet, and VIEWlogic workstations. CSi is currently producing devices up to 14,000 gates and plans to add a family of CMOS and bipolar linear arrays in the first quarter of 1987.

CSi's sales strategy is to build a network of regional operations to act as distribution channels for major manufacturers into the engineering-intensive segments of the ASIC market.

ALLIANCES

NCR	Nov. 1983	CSi and NCR entered into an exclusive technology licensing and sourcing agreement, under which CSi will design and re-sell cell-based and gate array products in New England. The products use NCR's 3.0-micron CMOS and NMOS technologies. NCR provides manufacturing.
	Sept. 1986	CSi agreed to license it proprietary cell libraries to NCR.
Motorola	Aug. 1986	CSi agreed to act as the Northeast independent design center for Motorola.

SERVICES

Design	CMOS & Bipolar Gate Arrays (Motorola) CMOS Standard Cell Libraries (NCR)

PROCESS TECHNOLOGY

3.0- and 2.0-micron processes
(All-implanted, oxide-isolated, twin-well CMOS single- and double-metal, with and without silicides)
Bipolar

PRODUCTS

CMOS Standard Cells

MicroBlocks Family	277 cells: ALUs; adders; multiplexers; dual-port RAMs; shift registers; and three-state bus drivers

CMOS Gate Arrays

Family	Linewidth (micron)	Delay (ns)	Gates
HCA 6200	2.0	1.9	2,430 to 4,860
HCA 6300	3.0	2.5	648 to 2,295
HCA 62A00	2.0	1.1	600 to 8,558

Bipolar Gate Arrays

Family	Technology	Delay (ns)	Gates
MCA ECL	ECL	0.5	652 to 2,500
MCA ALS	TTL	1.1	500 to 2,800
MCA ETL	Mixed ECL/TTL	1.1	2,950

Product Development Plans:

CSi will make significant additions to its proprietary CAE/CAD software tools, develop a 10,000-gate cell library, and port its tools and library to additional CAE workstations.

FACILITIES

Lowell, MA	12,000 sq.ft.	Design

Design Centers:

Lowell, MA	Gate Arrays, Standard Cell, Full Custom
Bellevue, WA	Gate Arrays, Standard Cell

COMPANY HIGHLIGHTS

Nov. 1983	Agreement with NCR that makes CSi the exclusively licensed design center for NCR in the New England states. The agreement covers NCR's 3-micron CMOS standard cell and gate array technology and 3-micron NMOS family.
Feb. 1984	CSi completed $1.1 million in venture capital and equipment financing, which will be used to expand its CAD system and as working capital.
March 1984	CSi offered its standard cell library on FutureNet DASH design system.
June 1985	CSi completed $2.75 million second round venture capital and long-term debt financing.
Oct. 1985	CSi offered its standard cell library on Viewlogic's Workview PC-based workstation. The library includes 165 digital primitives and 7400/TTL Macrocells.
April 1986	An expanded agreement with NCR included provisions for a design center in the Pacific Northwest (Washington, Oregon, Idaho, British Columbia, and Alberta).
May 1986	CSi opened an ASIC design center in Bellevue, Washington that has been designated as the authorized NCR design facility for the Pacific Northwest and western Canada. John Barney was named president of the new Pacific Northwest Division. This move was made to expand CSi's relationship with NCR.
July 1986	The MicroBlocks family was introduced by CSi as the latest addition to its standard cell libraries. It contains 277 cells, including ALUs, adders, multiplexers, dual-port RAMs, shift registers, and three-state bus drivers, with the largest cell containing over 4000 gates.

Cypress Semiconductor Corp.
3901 North First Street
San Jose, CA 95134
408/943-2600

ESTABLISHED: April 1983
NO. of EMPLOYEES: 405

BOARD

Name	Affiliation
L.J. Sevin	Sevin-Rosen Management
Pierre Lammond	Sequoia Fund
L. John Doerr	Kleiner, Perkins, Caufield & Byers
T.J. Rodgers	Cypress Semiconductor Corp.

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	T.J. Rogers	AMD	Mgr MOS SRAM Grp
VP TX Opns	Clive Barton	AMD	Plant Director
VP R&D	Fred Jenne	AMD	Mgr SRAM Tech Dev
VP MKtg/Sales	Lowell Turriff	AMD	Dir MOS RAM Mktg
VP Finance/Admin	Stanley J. Meresman	Synapse	VP Finance/Admin
VP Assembly/Test	Fritz Beyerlein		Consultant
VP Wafer Fab	R. Michael Starnes	Intel	Mgr Wfr Fab Grp
VP Engr	Steve Kaplan	AMD	Mgr Prod/Process
VP Prod Dev	Richard Gossen	SDL	President/CEO

FINANCING

Date	Round	Sources	Amount
April 1983	Round 1	Mayfield Fund; Kleiner, Perkins, Caufield & Byers; Merril, Pickard; Anderson & Eyre; Sequoia Fund; Sevin Rosen; J.H. Whitney	$7.3M
	Lease	Bank of America; Omni, San Diego	$12.5M
April 1984	Round 2	First Round investors; Crown Management; Glynn Capital; Robert Fleming; Robertson, Colman & Stephens	$11.7M
March 1985	Round 3	First and Second Round investors; T.R. Berkeley; Manufacturers Hanover Trust; Harvard Management; Security Pacific; Yamaichi; Newtek Anderson & Eyre; Stanford University	$10.5M

Aug. 1985	Round 4	Manufacturers Hanover; Security Pacific; Harvard Management; Caufield & Byers; Capital Management; Mayfield Fund; J.H. Whitney; Merrill, Pickard, Anderson & Eyre; Glynn Capital Management; Robert Fleming Investment Management; Robertson, Colman & Stephens.	$10.5M
June 1986	Initial Public Offering		$72.8M

BACKGROUND

Cypress designs, develops, manufactures, and markets a broad line of high-performance digital ICs that are fabricated using proprietary 1.2- and 0.8-micron CMOS technologies.

Cypress currently offers products that feature high-speed, low-power consumption, and packaging to any specifications. The Company's products are generally used as critical components to enhance the performance of advanced electronic systems manufactured in four market sectors: military and aerospace, telecommunications, instrumentation, and computation.

Through July of 1984, the Company was in its development stage and had minimal revenue from product sales. The Company's first product was a CMOS-equivalent bipolar RAM, the 93422. With delays at 15ns, the 93422 emphasized speed, power-reduction, quality, and reliability. For the next six months ending December 30, 1984, the company began production and sales of its first SRAM products. In 1985 and the first quarter of 1986, Cypress revenue increased in part because of the introduction of both PLDs and logic products and new SRAM and PROM memory products.

Cypress in mid-1986 completed a $72.8 million public offering to raise funds for its new wafer fab in Texas. The San Jose location will be turned into a manufacturing center with headquarters, engineering, marketing and sales, and administration moving into a new facility at 100 American Way in San Jose. Out-of-state manufacturing will be done in Round Rock, Texas, at the new facility, which is scheduled to open in the first quarter of 1987.

ALLIANCES

MMI	June 1983	Monolithic Memories received Cypress' 1.2-micron, high-performance, nonvolatile, programmable CMOS process and warrants for loan guarantees. The companies will also jointly develop CMOS PLDs.
Matra-Harris	Oct. 1985	Cypress transferred masks for its 25ns 4K and 16K SRAMs and provided its 1.2-micron CMOS technology to Matra-Harris. Matra-Harris will receive 2 percent of Cypress' stock for $25 million. A joint development agreement for Cypress' future 0.8-micron process and an ultra-high-speed 64K SRAM is also included.
Weitek	Oct. 1985	Weitek and Cypress will jointly develop a series of high-performance VLSI logic circuits that are designed by Weitek and manufactured with Cypress' 1.2-micron CMOS process

SERVICES

Design
CAD Development
Manufacturing
Assembly
Test

PROCESS TECHNOLOGY

0.8- and 1.2-micron N-Well CMOS
(5-inch wafers)

PRODUCTS

Memory

CMOS Fast SRAMs

Part Number	Organization	Delay (ns)
CY7C147	4Kx1	25-35
CY7C150	1Kx4	15
CY7C167	16Kx1	25-35
CY7C168/169	4Kx4	25-35
CY7C171/172	4Kx4	25
CY7C189/190	16Kx4	15-55

CMOS PROMs

Part Number	Organization	Delay (ns)
CY7C225	512x8	30
CY7C235	1Kx8	30
CY7C281/282	1Kx8	30
CY7C291/245	2Kx8	35, 50
CY7C261	8Kx8	35

Other Memory

Device Type	Organization	Speed
Dual-port CMOS FIFO	64x4, 64x5	10-25 MHz

Microprocessors

Part Number	Description
CY7C901	4-bit Slice Processor
CY7C909/11	Microprogram Sequencer

Logic

Part Number	Description	Delay (ns)
CY7C516/517	16x16 Multipliers	45

Programmable Logic Devices

Part Number	Linewidth (micron)	Delay (ns)
PAL C20	1.2	25-35
22V10	1.2	25-35
PLDC20G10		25

Applications: EDP, instruments, military, and telecommunications

FACILITIES

3901 North First Street San Jose, CA	61,500 sq. ft.	Manufacturing
	8,000 sq. ft.	Class 10 Clean room
100 American Way San Jose, CA	60,000 sq. ft.	Headquarters, marketing/ sales, and administration
Round Rock, TX	60,000 sq. ft.	Manufacturing Operational early 1987

COMPANY HIGHLIGHTS

June 1983 — Cypress and MMI entered a technology agreement for joint development and fabrication of CMOS PALs. Cypress will develop a 1.2-micron CMOS process using MMI facilities; MMI will license PAL technology to Cypress to jointly develop a PAL family using the 1.2-micron process. MMI gains an equity position in Cypress.

March 1983 — Cypress moved to its new 61,000 sq. ft. facility in San Jose.

1984 — Cypress began production with a 1.2-micron process. Cypress offered 16x4 CMOS SRAMs, 18 and 25ns versions; CY7C189, inverting, and CY7C190, non-inverting, in commercial and military grades.

Jan. 1985 — Cypress offered 64x4 and 64x5 FIFOs. The CY7C401/402/403/404/CY3341 in 16- and 18-pin plastic DIP or CERDIP packages in commercial, and military versions.

Cypress offered 4KX4 SRAMs, the CY7C168/169, in 20-pin CERDIP or plastic DIP packages.

Jan. 1985	Cypress offered an 4KX1 CMOS SRAM, the CY7C147, packaged in an 18-pin plastic DIP or CERDIP.
Feb. 1985	Cypress offered Series 20 1.2-micron CMOS PALs, the PAL C20, in 20-pin CERDIP, windowed CERDIP, or plastic packages.
March 1985	Cypress offered the CY7C901 CMOS 4-bit Slice Processor in 40-pin plastic DIP or CERDIP packages.
April 1985	Cypress introduced the CY7C167 16KX1 SRAM in 20-pin plastic or CERDIP packages.
May 1985	Cypress offered the CY7C225 4K Registered CMOS PROM in 24-pin plastic and CERDIP packages.
	Cypress also offered the CY7C235 1KX8 PROM in 24-pin CERDIP or plastic DIP packages.
June 1985	Cypress offered the CY7C281/282 1KX8 CMOS PROM in either 24-pin CERDIP or plastic DIP packages.
Sept. 1985	Cypress announced a groundbreaking for a $6.5 million, 60,000 sq. ft. headquarters adjacent to their existing factory in San Jose, CA. The new facility will house all nonmanufacturing activities, and will double Cypress' corporate and manufacturing space.
	Cypress offered the CY7C909/11 Microprogram Sequencers to complement the CY7C901 processor. The sequencer is 25 percent faster than CMOS versions of the bipolar 2909 and 2911, and is packaged in a 20-pin and 28-pin plastic DIP, CERDIP, or LCC.
Oct. 1985	Cypress offered 2 CMOS Reprogrammable PROMs, the CY291/245, with and without registered outputs, in either 24-pin CERDIP, windowed CERDIP, or plastic packages.
Nov. 1985	Round Rock, Texas was selected as the site for Cypress' new manufacturing facility.
Late 1985	By the end of 1985, Cypress offered 61 products and 27 designs.
Jan. 1986	Cypress offered the industry's first windowed CMOS erasable and reprogrammable 22V10 PAL device that uses a 1.2-micron CMOS floating-gate process.

Feb. 1986 Cypress ordered an undisclosed number of ASM's PAS 2500 optical wafer steppers, after placing a $10 million order for GCA Model 8000 steppers.

Cypress announced the industry's fastest CMOS 16x16 multiplier, the CY7C516 and CY7C517. The multipliers are the first to break the 20 MHz barrier and perform a clock multiply in as few as 45ns.

March 1986 Cypress offered the CY7C261, a 35ns 8KX8 CMOS PROM that utilizes a 1.2-micron CMOS floating-gate process.

Cypress upgraded its CMOS 16x16 multipliers to perform a clocked multiply in 38ns.

May 1986 Cypress is producing in volume a 4K SRAM with an access time of 15ns and gate delay of 132ps using 0.8-micron CMOS process. The CY7C150, a TTL-compatible 1KX4 I/O SRAM, is available in commercial and military grades.

Also introduced the following devices: The CY7C910-40, a CMOS 12-bit Microprogram Sequencer with a 40ns clock-cycle time; the CY7C910 fast 16-bit slice MPU with an access time of 24ns in commercial and military grades; the PLDC20G10, a 25ns generic 24-pin reprogrammable PLD; and the CY7C171/ CY7C1722, 4KX4 separate I/O SRAMs with maximum access times of 25ns in commercial and military grades.

June 1986 Cypress raised $72.8 million in an initial public offering of 7.5 million shares of common stock at $9 per share.

Dallas Semiconductor Corp.
4350 Beltwood Parkway
Dallas, TX 75244
214/450-0400

ESTABLISHED: February 1984
NO. OF EMPLOYEES: 120

BOARD

Name	Affiliation
C. Vin Prothro Chairman	Dallas Semiconductor

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	John Smith, Jr	Mostek	Facilities Dir
VP R&D	Chao Mai	Mostek	VP R&D
VP Mktg	Michael Bolan	Southwest Ent.	Mgr Tech Planning

FINANCING

Date	Round	Sources	Amount
1984	Seed	Ventech Partners; New Enterprises Associates; Abingworth Ltd.; Southwest Enterprises Associates	$2.0M
June 1984	Round 1	Original investors; Arscott, Norton & Associates; Crossroads Capital; 1st Source Capital Corporation; John Hancock Venture Capital Fund L.P.; Merrill, Pickard, Anderson & Eyre; New Venture Partners; Oak Investment Partners; J.F. Shea & Company; Republic Venture Group; Venture Growth Associates;	$9.6M
	Industrial Bond	Republic Bank, Dallas	$6.5M
March 1986	Round 2	Original investors; BP Ventures; Alex Brown & Sons; Emerging Growth Stocks; HLM; Merifin N.V.	$15.0M

BACKGROUND

Dallas Semiconductor Corp. (DSC) designs, manufactures, and markets low-power CMOS products that use a proprietary late-definition technique to customize chips after test and characterization of the wafer. The Company has an applications-oriented, multiproduct strategy that includes memory and logic ICs.

The late-definition technologies used to tailor chips are lithium, laser, and ion implant. Lithium energy sources, which will outlast the useful life of equipment, are packaged with chips producing devices that adapt during use. Dallas engraves unique digital patterns on completed circuits with a laser. High-energy ion-implant technology to be available in 1987 will allow nearly finished wafers to be defined to meet specific customer requirements in a matter of days.

Initial products included six lithium-battery-powered, nonvolatile CMOS memory chips. The memories were designed to be replacement parts and enhanced versions of competing products. By June 1986, 20 products had been introduced. An additional 30 products are planned to target the industrial, medical, ASIC, and telecommunications applications.

Dallas' manufacturing is done in the Company's Texas facility. Some assembly is done by independent contractors in Appleton, Wisconsin and Taiwan. Orbit Semiconductor provides prototype chips.

In June 1986, Dallas began construction of a six-inch wafer fabrication plant that is to open in January 1987. It is located next to the Company's headquarters in north Dallas and houses a sub-class 10 clean room.

Dallas markets to OEMs in the United States, Canada, Europe, and Asia. The Company uses a direct sales force, and worldwide distributors and authorized manufacturers' representatives.

ALLIANCES

Thomson-Mostek	Jan. 1986	Thomson-Mostek will second source Dallas' multiport memory system and have royalty-free rights to the part. Dallas will be allowed to buy a percentage of the products from Thomson. Dallas also obtained laser production equipment from Thomson and technical information on TCMC's MK4501, a FIFO memory device.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

1.2-micron CMOS
Ion Implantation
Laser
Embedded-lithium

PRODUCTS

Nonvolatile SRAMs

DS 1220 16K NVRAM
DS 1225 64K NVRAM

Intelligent Sockets

DS 1213 SmartSocket
DS 1216 SmartWatch

Silicon Timed Circuits

DS 1000 Silicon Delay Line
DS 1030 DRAM Timer

User Insertable Memory

DS 1201 Electronic Tag
DS 1217 256K NVRAM Cartridge
DS 1217M 1-million-bit NVRAM Cartridge

Integrated Battery Backup

DS 1210 Single-RAM Nonvolatile Controller
DS 1212 16-RAM Controller/Decoder
DS 1221 Four-RAM Controller/Decoder
DS 1260 SmartBattery
DS 1231 Power Monitor

Software Authority

DS 1204 Electronic Key
DS 1250 KeyRing

Telecommunications

DS 2180 T1 Transceiver

Systems Extension

DS 1223 Configurator
DS 1222 Bank Switch

Memory Peripherals

DS 2001 2KX9 FIFO

Applications: Computers and communications

FACILITIES

Dallas, TX	65,000 sq. ft.	Manufacturing
	10,000 sq. ft.	Class 10 Clean room
	15,000 sq. ft.	Class 5000 Clean room

COMPANY HIGHLIGHTS

Aug. 1984 DSC purchased Commodore's Texas plant for $3.5 million.

Nov. 1984 DSC shipped its first products, the DS 1220 16K nonvolatile SRAM and the DS 1225 64K nonvolatile SRAM. The DS 1225 is offered as an 8KX8, 220ns, 4.5V SRAM with a lithium battery in a commercial version 28-pin DIP package.

Feb. 1985 DSC announced its initial product line. The line includes nonvolatile SRAMs, intelligent sockets, and user insertable memories.

DSC shipped the DS1213 NVRAM SmartSocket. It is designed to be mated with a 2Kx8 or 8Kx8 CMOS SRAM to make the memory nonvolatile at a nominal 5V, commercial grade.

March 1985 DSC shipped the DS1201 1K CMOS NVRAM Electronic Tag (128x8, 250ns, with a lithium source, commercial grade).

July 1985 DSC shipped the SmartWatch DS1216. The DS1216 requires a nominal 5V, has a lithium source, and is available in a commercial grade 28-pin DIP.

Oct. 1985	DSC announced a CMOS Time Delay Device, the DS1000, at 20-500ns in a 14-pin DIP or 8-pin surface mount package.
Feb. 1986	DSC introduced a three-part chip set, the Integrated Battery Backup, which protects critical information in MPU-based systems for industrial automation applications. The chip set allows a system to restart a task where it stopped as if a power disruption had not occurred. The chip set includes the DS1231 Power Monitor, the DS1212 Nonvolatile Controller, and the DS1260 Smart Battery.
March 1986	DSC completed Round 2 of financing for $15 million of venture capital funds. $2 million will be used to build a subclass 10 clean room, and $7.5 million to purchase equipment.
April 1986	DSC introduced the DS1217A, a 1-megabit nonvolatile (NV) memory cartridge.
	DSC shipped its first telecommunications product, the DS 2180, a T1 Transceiver that links to Bell System's high-speed digital lines.
June 1986	DSC ordered three GCA wafer steppers, a Varian sputterer, and a pair of Eaton ion implanters for its planned manufacturing facility.

Dolphin Integration SA
Chemin des clos
Zirst 38240 MEYLAN
33 (76) 41-10-96

ESTABLISHED: January 1985
NO. OF EMPLOYEES: 20

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Michel Depeyrot	Thomson Semiconductors	VP Engr

FINANCING

Date	Round	Sources	Amount
1985	Initial	Sagem, EPICEA and Soginnove, and venture capitalists	$0.6M

BACKGROUND

Dolphin is providing design and marketing and fabrication subcontracting for selected niche market ICs and related software. The Company was launched as a design center and has developed a set of portable design rules for 2-micron CMOS technology that adapt to any silicon foundry's process. Dolphin plans to enlarge its catalog of design rules to other technologies and to develop image and signal processing ICs for market niches.

ALLIANCES: None

SERVICES

Design

PROCESS TECHNOLOGY

2.0-micron double-metal CMOS

FACILITIES: Not available

Elantec, Inc.
1996 Tarob Court
Milpitas, CA 95035
408/945-1323

ESTABLISHED: July 1983
NO. OF EMPLOYEES: 70

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Al Vindasius	NSC	Dir Hybrid Div
VP Mktg	Dean Coleman	NSC	Analog Mktg Mgr
VP Sales	Ralph Granchelli	Teledyne Semi	Ntl Sales Mgr
VP Engr	Barry Siegel	NSC	Std Hybrid Design

FINANCING

Date	Round	Sources	Amount
July 1983	Round 1	Venture Capital	$2.7M
Aug. 1984	Round 2	ALTA-Berkeley Eurofund; Associated Venture Investors; BNP Venture Capital Corp.; Burr, Egan, Deleage & Co.; International Industrial Interests; Murray Electronics; Pacific Technology Ventures; Paribaven; Thorn EMI Venture Fund; Walden Capital Corp.	$3.1M
Aug. 1985	Round 3	Original Investors; Paribas Technology; Jean Claude Asscher; Hytec Investment	$2.5M

BACKGROUND

Elantec designs, manufactures, and markets high-performance analog circuits using monolithic and hybrid technologies. The devices are designed to be used in military and high performance commercial applications. Elantec's hybrid products are fully compliant with Revision C of MIL-STD-883 and the Company supplies products to more than 25 military OEMs. Elantec was awarded the "Small Supplier of the Year" rating by Texas Instruments Government Products Division.

Initially, Elantec offered an alternate source for National Semiconductor's high-performance multichip amplifiers. In 1985, Elantec introduced its first proprietary monolithic IC that uses both dielectric and junction-isolation processing techniques. Early in 1986, Elantec expanded into alternately-sourced versions of Harris Semiconductor's components that use a complementary bipolar dielectric isolation (DI) process.

Elantec manufactures all military products on-shore, with some commercial assembly done overseas.

The Company's devices are fully compliant with MIL-STD 883C and MIL-STD 1772, with thorough testing at AC parameters.

ALLIANCES

NSC	1983	Elantec became an alternate source for NSC's high-performance multichip amplifiers.
Harris	Nov. 1985	Harris and Elantec complete a second-source agreement.
Micro Power		Elantec reached a joint agreement under which Micro Power will market Elantec's FET Power buffers.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

Thick-film hybrid process
Dielectric isolation monolithic process
Standard bipolar and CMOS capabilities through vendors

PRODUCTS

Product Number	Description
EL2003	Video Line Driver
EL2005	FET Amplifier/Buffer
EL2006	Operational Amplifier
EL2007	Servo Driver
ELH0021	1.0 Amp Power Operational Amplifier
ELH0041	0.2 Amp Power Amplifier
ELH0101	5 Amp Power Amplifiers
EHA2500/2600	Operational Amplifiers

Application markets: Military, aerospace, medical, test instruments, telecommunications, process control, computer peripherals

Planned Future Developments:

- Monolithic ICs
- Building block buffers
- High efficiency/high capacity servo amps for hard disk drives
- Monolithic building blocks for military and commercial markets

FACILITIES

Milpitas, CA	16,000 sq. ft.	Corporate offices and manufacturing
	4,500 sq. ft.	Class 1000 Clean room

The Company plans to add a wafer fab in the United States in 1986.

COMPANY HIGHLIGHTS

April 1984	Elantec shipped its first ICs.
Sept. 1985	Elantec offered the EL 2007 Servo Driver for 4.5 to 20V operation in a 24-pin DIP industrial grade version.
	Elantec introduced the EL 2005 FET Amplifier/Buffer in a TO-8 metal can in industrial and military versions.
Nov. 1985	Elantec will enter the DESC program to obtain military qualification of its line of second-sourced hybrids and proprietary amplifiers.
	Elantec introduced the EL 2003 Video Line Driver for high-resolution television and other video applications.

March 1986 — Elantec introduced the EL2006 FET-input Op Amp designed for high-speed data acquisition systems.

Elantec was named as the first source approved by the Defense Electronics Supply Center (DESC) for three widely used amplifiers: The ELH0021, a 1.0 Amp Power Op Amp; the ELH0041, a 0.2 Amp Power Amplifier; and the ELH0101 and ELH 0101A 5.0 Amp Power Amplifiers.

June 1986 — Elantec introduced a family of operational amplifiers, the EHA2500 and EHA2600 Series, which are pin-for-pin replacements for the Harris 2500 and 2600 Series.

Electronic Technology Corp.
2037 North Towne Lane NE
Cedar Rapids, Iowa 52402
319/395-0567
Telex: 753611

ESTABLISHED: December 1983
NO. OF EMPLOYEES: 22

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Robert C. Carr	Norand Data Sys	Director
VP Engr	Charles Grimm	Rockwell	Dir VLSI Lab
VP Mktg	Kathleen Kelly	Texas Instruments	PSR Mgr
VP Opns	Christopher Kelly	Rockwell	IE Mgr

FINANCING

Date	Round	Sources	Amount
1983	Initial	State & Venture capital	$2.0M

BACKGROUND

Electronic Technology Corp. (ETC), a full service company, offers gate arrays, standard cell, and full custom ICs as well as engineering, assembly, and test. The company is focusing its efforts on bipolar linear arrays and will subsequently develop CAE tools for those arrays.

ETC was initially funded by a midwestern consortium of venture organizations. ETC's primary customer base is the midwestern corridor (extending from the eastern slopes of the Rockies to the Ohio Valley) with plans to become the midwest's major supplier.

ETC has agreements for foundry services with Exar and Gould Semiconductor. In October 1985, the Company signed an agreement with NCR to establish design centers for standard cell ICs.

ALLIANCES

Exar	Dec. 1983	Exar is providing foundry services for ETC
AMI	1984	ETC and AMI signed agreements covering 3.0- and 5.0-micron single-layer metal CMOS gate arrays. AMI is providing foundry services.
NCR	Oct. 1985	ETC agreed with NCR to establish design centers for standard cell ICs and to design standard cells for NCR.

SERVICES

Design	CMOS Gate Arrays CMOS Cell Library Bipolar Linear Arrays
CAD Capability	
Manufacturing	
Packaging	
Test	

PROCESS TECHNOLOGY

2.0- and 5.0-micron CMOS
Bipolar

PRODUCTS

CMOS Gate Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
D2D	Si-Gate	2.0	1.0	500 to 5,000

Bipolar Linear Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
A5S	Bipolar 01	5.0	N/A	37 to 298 active components

CMOS Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
ETC	Si-Gate	2.0	2.15	52-gates, 7 MSI, RAM, ROM, 65C02

FACILITIES

Cedar Rapids, Iowa	12,000 sq. ft.	
	2,000 sq. ft.	Class 100 Clean room

Design Centers:		
Cedar Rapids, Iowa	MOS, Bipolar	Gate Arrays
Chicago, IL	MOS	Standard Cell and Linear Arrays

European Silicon Structures
Headquarters
IndustriestraBe 17
8034 Germering
West Germany
089/8 49 39 0
Telex: 089/8 49 39 20

ESTABLISHED: September 1985
No. OF EMPLOYEES: 20

Hollybank House
Mount Lane
Bracknell, Berkshire
United Kingdom
0344/525252
Telefax: 0344/59412

72-78 Grande Rue
92310 Sevres
France
01/46264495
Telefax: 01/45071423

BOARD

Name	Affiliation
Robert Wilmot	European Silicon Structures
Robert Heikes	European Silicon Structures
Jean-Luc Grand-Clement	European Silicon Structures
Pierre Lesieur	European Silicon Structures
Viscount Etienne Davignon	Societe Generale de Belgique
Albert Kloezen	EuroVenture, Benelux
Elserino Piol	Ing. C.Olivetti & Co.
Klaus Volkholz	Philips International

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Co-Chairman	Robert Heikes	NSC	Corp VP
Co-Chairman	Robert W. Wilmot	STC Intl	Chairman
CEO/Mgr Dir	J.L. Grand-Clement	Motorola	VP Europe Group
VP Fin/Admin	Pierre Lesieur	Motorola	Dir Finance
Dir Mfg Opns	Bernard Pruniaux	Thomson CSF	Dir Opns
Dir Process	Eric Demoulin	Thomson CSF	Dir Tech MOS
Dir Wfr Fab	Francis Courreges	Sierra Semi	Prod Eng Mgr
Dir Design	John Gray	Lattice Logic	Founder/Mng Dir

FINANCING

Date	Round	Sources	Amount
1985	Initial	Advent, London; Techno-Venture Management Corp., Munich	$5.0M
Dec. 1985		Brown Boveri and CIE of Switzerland; Ing. C.Olivetti & Co. (Italy); N.V. Philips (Netherlands); Saab-Scania AB (Sweden)	$25.0M
Jan. 1986		British Aerospace	$5.0M

BACKGROUND

European Silicon Structures (ES2) was formed to design and offer quick-turn silicon prototyping of application-specific ICs for the European marketplace. ES2 has targeted the markets for custom-designed chips, those small-volume, low profit areas that are of no interest to the large-volume commodity chip producers. It will use silicon compilers for design and direct-write electron beam lithography, a technology that permits chips to be produced by direct writing, thus eliminating the costly and time-consuming process of producing a mask for etching the silicon.

ES2 will be incorporated in Luxembourg and headquartered in West Germany. Initial plans involve developing its design automation technology in Britain where it has already created a link with Lattice Logic, an Edinburgh-based design company. A production plant near Aix-en-Provence in southern France is planned in late 1986. Its Bracknell-based design center was officially opened on April 15, 1986, and additional design centers are planned for Paris, Munich, Stockholm, and Edinburgh.

ALLIANCES

Lattice Logic	1985	ES2 signed an agreement with Lattice Logic to market Lattice's logic compiler in Europe.
British Aerospace	Jan. 1986	British Aerospace invested $5 million in ES2.

SDA Systems	Jan. 1986	ES2 signed a key marketing agreement with Solomon Design Associates (SDA) Systems. Under this agreement, ES2 will market SDA design systems throughout Europe and will also use them in a number of planned design centers. SDA's Designer Edge series of EDA systems will be installed in all ES2 design center locations.
Philips TI	May 1986	Initial discussions took place between ES2, Philips, and Texas Instruments regarding the possibilities of joining forces in a cooperative standard cell agreement. ES2 would provide a resource for small-quantity production. No firm agreement has been made to date.

SERVICES

Foundry
Design
Silicon Compiler Tools
Manufacturing
Packaging
Test

PROCESS TECHNOLOGY

2.0-micron double-metal CMOS
E-beam on 5-inch wafers
1.25-micron double-metal (1986)

PRODUCTS: To be announced

FACILITIES

Munich, West Germany	Headquarters
Aix-En Provence, France	Production facility in 1987

COMPANY HIGHLIGHTS

Dec. 1985	Six European companies invested $25 million, representing 39 percent of ES2.
Jan. 1986	British Aerospace invested $5M in ES2.
	ES2 signed a key marketing agreement with Solomon Design Associates (SDA) Systems. Under this agreement, ES2 will market SDA design systems throughout Europe and will also use them in a number of planned design centers. SDA's Designer Edge series of EDA systems will be installed in all ES2 design center locations.
April 1986	ES2 announced its first contract--a $60,000 deal with a Belgian design center to supply two solo electronic CAE systems based on the Whitechapel workstation and the Lattice Logic compilation software tools.
May 1986	Initial discussions took place between ES2, Philips, and Texas Instruments regarding the possibilities of joining forces in a standard cell cooperation. ES2 would provide a resource for small-quantity production. No firm agreement has been made to date.
June 1986	Two unique services offered by ES2 were announced. These are the ability to design circuits at transistor level using SDA software tools, and a standard cell optimized array service that can take a customer all the way through the design process, including route and place, to software simulation for £2,000.
Q1 1986	ES2 received its first orders and made its first shipment, with the shipments coming from the sale of software and design services. The Company plans, by the second half of 1987, to have an ES2 proprietary software product that will represent the first step toward the "behavioral computer." A complete behavioral computer will be introduced one year later. Expected worldwide sales for the company is $5 million in the first 12 months of operation.

Exel Microelectronics Inc.
2150 Commerce Drive
San Jose, CA 95131
408/942-0500

ESTABLISHED: February 1983
NO. OF EMPLOYEES: 600

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President	Steve Sharp
Mktg Mgr	Jim Adams

FINANCING

Date	Round	Sources	Amount
Feb. 1983	Round 1	Sirjan L. Tandon	$1.0M
	BaseLine		$11.0M
Sept. 1984	Round 2	BancBoston Ventures; Bay Partners; CH Partners; Chase Manhattan; Crown Advisors, Ltd.; Hambrecht & Quist; Horsley Keogh & Associates; Hutton Venture; IBM Retirement Fund; Montgomery Securities; Orange Nassau; Paribas Technology; Prudential Bache; Riordan Venture Mgmt; Rothschild, Unterberg & Towbin Ventures; J.F. Shea & Company.; TA Associates; 3i Ventures	$10.5M
Aug. 1985		Cable, Howse, & Cozadd; Hambrecht & Quist; Horsley Keogh & Assoc.; TA Associates	$13.5M

BACKGROUND

Exel Microelectronics Inc. designs, develops, and manufactures LSI circuits comprising nonvolatile memory, microcomputer, and microperipheral components for the EDP, industrial controls, automotive, telecommunications, military, and robotics markets.

The Company's first products, a 16K NMOS EEPROM and a 32K high-speed CMOS EEPROM, were introduced in February 1984. Exel was the first to offer high density, 55ns CMOS 16K EEPROMs and was one of the first to move into 6-inch wafer production.

In February 1986, Exel Microelectronics was acquired by Exar Integrated Circuits. Exel operates as a wholly owned subsidiary of Exar and maintains an independent fabrication facility and research and development staff.

Exar is a publicly owned company headquartered in Sunnyvale, California. Exar designs, manufactures, and markets a wide variety of standard, custom, and semicustom linear and digital circuits for the telecommunications, data communications, computer peripherals, instrumentation, and industrial controls markets.

ALLIANCES

Samsung Semiconductor	1983	Samsung entered into a joint development project to act as a second source for Exel's forthcoming 16K EEPROMs.
	May 1985	Prior Samsung agreement was extended to include second-sourcing for 64K EEPROMs
Paribas Technology	Sept. 1984	Paribus took part in second-round financing.
Oki Electric	March 1985	Oki is a second-source for Exel's 2KX8 NMOS EEPROM and will produce 64K EEPROMs in mid-1985.
Exar	Feb. 1986	Exar completed a $5 million acquisition of Exel.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

NMOSE2	2.0-micron design rules
CMOSE2	1.5-micron design rules
EXCMOS3	1.5-micron dual-metal
(5-inch wafers)	

PRODUCTS

EEPROM

Part Number	Organization	Technology	Delay (ns)
XL2804A	512X8	NMOS	250
XL2816A	2KX8	NMOS	250
XL2817A	2KX8	NMOS	200
XL2864A	8KX8	NMOS	200
XL2865A	8KX8	NMOS	200
XL28C256	32KX8	CMOS	150 (1Q87)
XL28C64	8KX8	CMOS	120 (1Q87)
XL28C65	8KX8	CMOS	120 (1Q87)
XL29C512	64KX8	CMOS	150

CMOS PROM

XL46C15	2KX8	CMOS	55
XL46C16	2KX8	CMOS	55

DUART

XL88C681	CMOS Dual Channel UART
XL68C681	CMOS Dual Channel UART

Programmable Logic Devices

ERASIC Family

78C800	CMOS	500- to 800-gates

FACILITIES

San Jose, CA	62,500 sq. ft.	
	12,000 sq. ft.	Class 10 Clean room

COMPANY HIGHLIGHTS

Aug. 1983	Exel set up a prototype production line at Nitron and agreed to jointly develop CMOS silicon-gate technology for a communications controller using 2.5-micron, 2-layer, double-metal CMOS.
Feb. 1984	Exel sampled the XL2816A 16K NMOS EEPROM, a Xicor 2816A-compatible 2KX8, 250-450ns, 5V, 24-pin DIP, in commercial and military versions.
	Exel opened a new 62,000 sq. ft. headquarters for design, manufacturing with a 5-inch line, and marketing.
	Exel lowered 16K EEPROM prices more than 20 percent due to reduced manufacturing costs from successful operation of its 5-inch line.
Mar. 1985	Exel and Oki completed an agreement allowing Oki to second-source 16K and 64K EEPROMs, devices Oki will also use for smart card applications.
	Exel laid off 60 members of its nontechnical staff or 20 percent of its work force and plans a two-week shutdown in March.
May 1985	Exel offered foundry services.
May 1985	Exel made an additional second-sourcing agreement with Samsung for 16K and 64K EEPROMs.
Sept. 1985	Exel introduced its XL46C15/46C16, 16K EEPROMs (2048X8, sub-100ns, 5V, CERDIP, commercial).
Oct. 1985	Hambrecht & Quist arranged for a merger of Exel and ZyMOS which did not occur. Exel sought funding after the layoff of 100 employees.
	Exel announced that it was designing ERASIC, a semicustom device employing memory cells.
Oct. 1985	President and vice chairman of the board, B.K. Marya "agreeably and voluntarily" left the company.

Nov. 1985	Exel introduced CMOS DUARTS, the XL68C681, XL88C681/28, and XL88C681/40 in either 40-pin or 28-pin plastic or CERDIP packages in commercial grade.
Dec. 1985	Exar signed a letter of intent to acquire Exel.
Feb. 1986	Exar completed its $5 million acquisition of Exel.

GAIN Electronics
22 Chubb Way
Sommerville, NJ 08876
201/526-7111

ESTABLISHED: October 1985
NO. OF EMPLOYEES: 25

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President/CEO	Dr. Raymond Dingle	Bell Labs
VP Dev	Dr. James C.M. Hwang	GE
VP Opns	Dr. R. Russ Buckley	Bell Labs
VP Finance	Michael Conlee	Portescap
Dir Process Dev	Dr. Rudi Hendel	Bell Labs
Dir Mktg	Michael D. Logan	AT&T

FINANCING

Date	Round	Sources	Amount
1985	Seed	Mitsui & Company, Japan; Edelson Technology Partners, Saddlebrook, NJ; United Capital Ventures of Houston	$23.0M

BACKGROUND

GAIN Electronics, formed to develop and market the highest performance GaAs ICs to the merchant market, is presently in the design phase. The Company's first products will consist of customized devices using gate array and standard cell technologies.

The start-up Company plans to utilize the HEMT (high-electron-mobility-transfer) process, also called SDHT (selectively-doped heterostructure transistor). Applications for the devices include high-speed computers, communication satellites, fiber optics, instrumentation, and defense electronics.

GAIN was founded by Dr. Raymond Dingle, formerly of AT&T Bell Labs, who invented the SDHT process. GAIN formerly operated as Pivot III-V.

A consortium of investors has made capital commitments of $23 million. The Company will use the funds to set up a 55,000 square-foot fabrication facility. Located in Branchburg, New Jersey, the facility is slated for completion in the third quarter of 1986.

Mitsui & Co., a Tokyo-based trading company, owns 30 percent of the company, and will distribute the GaAs chips in the Far East.

ALLIANCES

Mitsui	1985	Mitsui made investments worth 30 percent of GAIN.

SERVICES

Design

PROCESS TECHNOLOGY

GaAs

PRODUCTS: To be announced

Applications: military and commercial

FACILITIES

Sommerville, NJ	55,000 sq. ft.	Design and manufacturing
	25,000 sq. ft.	Clean rooms

GigaBit Logic
1908 Oak Terrace Lane
Newbury Park, CA 91320
805/499-0610

ESTABLISHED: August 1981
NO. OF EMPLOYEES: 132

BOARD

Name	Affiliation
Heinrich F. Krabbe	Analog Devices
Richard C. Eden	GigaBit Logic, Inc.
David B. Jones	InterVen Partners, Inc.
Lawrence T. Sullivan	Analog Devices, Inc.
Gordon C. McKeague	Amoco Corp.
James J. Fitzpatrick	G.E. Venture Corp.
Mark C. Masur	Interfirst Venture

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	John Heightly	INMOS	President
VP R&D	Richard C. Eden	Rockwell	Principle Scientist
VP Prod Dev	Zelimer Diel	MMI	Director
VP Mktg/Sales	Anthony Livingston	Intel	Mktg Manager
VP Finance	Spencer Brown	CR Technology	VP Finance/CFO
VP Mfg	Bryant M. Welch	Rockwell	N/A

FINANCING

Date	Round	Sources	Amount
Mar. 1982	Seed	First Interstate Capital; Riordan Venture Group; Wood River Capital Corp.	$1.0M
Nov. 1982	Round 1	Analog Devices Ent.; First Interstate Capital Corp.; and others	$8.1M
	Leases		$3.5M
	R&D Partnership	Kidder, Peabody & Co.	$6.1M

Sept. 1985	Round 2	Analog Devices Ent.; GE Venture Corp.; First Interstate Capital; Interfirst Venture Corp.; Standard Oil Company; Union Venture Corp.	$11.4M

BACKGROUND

GigaBit Logic (GBL) was founded to design, develop, and manufacture digital GaAs ICs capable of 1-5 GHz operation. GBL's goal is to be the leader in the commercial digital GaAs IC market and the Company is targeting product segments in the military, mainframe computers, RF communication and instrumentation and test equipment markets. GigaBit's sales goal for 1990 is $50 million.

GBL uses sales representatives, distributors, and a direct sales force to sell its products on a worldwide basis. Currently GBL has sales representatives nationwide and franchised distributors in Japan, Germany, Italy, France, the United Kingdom, Israel, Canada, and Sweden.

ALLIANCES

Kidder, Peabody & Co.	1981	GBL and Kidder, Peabody formed a research and development partnership to develop four ultra-high-speed GaAs SRAMs.

SERVICES

Foundry
Assembly
Test

PROCESS TECHNOLOGY

0.8-micron GaAs MESFET
GaAs D-MESFET (Depletion-mode)
1.0-micron lithography (direct-step-on wafer equipment on 3-inch wafers)

PRODUCTS

1K and 4K RAMs
Combinational logic
Sequential logic
4-bit GaAs flash A/D converter (for DARPA)

1987 Products:

4-bit slice MPUs
8x8 Multipliers
Low-Power Logic
4K GaAs SRAM

Applications: Supercomputers, fiber optic communications, high-speed instrumentation, military/aerospace, UHF and microwave communications systems. Cray Research will be using GigaBit chips in their next generation of supercomputers.

FACILITIES

Newbury Park, CA	60,000 sq. ft.	
	6,800 sq. ft.	Class 10 Clean room

COMPANY HIGHLIGHTS

June 1984 — GigaBit shipped its first products--the PicoLogic digital GaAs ICs, a family of divider circuits for high-frequency radio applications.

Oct. 1984 — GBL signed Tokyo Electron to market its GaAs ICs in Japan.

Dec. 1984 — GigaBit opened an office in Boston.

Mar. 1985 — GigaBit's second-round funding totals over $11M.

April 1985 — GigaBit cut GaAs IC prices by 38 percent.

Dec. 1985	GigaBit offered a prototype development kit to accelerate test and prototyping of its PicoLogic and NanoRAM GaAs ICs.
March 1986	GigaBit founder, chairman, CEO, and president, Dr. Fred Blum left the company. Board member Heinrich Krabbe took over as CEO, president, and chairman while retaining his position as vice president of Analog Devices, Inc. Analog Devices holds a minority interest in GigaBit.

Harris Microwave Semiconductor, Inc.
1530 McCarthy Blvd.
Milpitas, CA 95035
408/262-2222

ESTABLISHED: June 1980
NO. OF EMPLOYEES: 215

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President/CEO	John T. Hartley
VP/GM Microwave Div	Jay A. Davis
VP/GM GaAs Opns	Joseph Barrera
VP/GM Components Opns	Richard Soshea
Mgr Sales/Mktg	Victor Kovacevic

FINANCING: Not available

BACKGROUND

Harris Microwave Semiconductor (HMS) was formed to develop and manufacture gallium arsenide-based FETs, GaAs FET amplifiers, and digital ICs including gate arrays. HMS is a merchant market supplier and additionally offers full custom ICs and foundry services. The Company is a vertically-integrated, wholly owned subsidiary of Harris Corporation, which has provided 100 percent of the Company's funding since 1980.

In February 1984, HMS introduced the world's first commercially available digital ICs based on gallium arsenide. The Company has capabilities for manufacturing GaAs crystals and wafers as well as ICs, packaged products, and subsystems. HMS has the world's largest high-purity GaAs ingot-growing capacity that produces single-crystal GaAs ingots up to 7-inches.

ALLIANCES: Not available

SERVICES

Foundry	1.0- to 0.5-micron GaAs D-MESFET
Design	GaAS D-MESFET Cell Library, 1- and 2-volt, 1.0-micron; Three 0.5-micron MMIC Design Rule Families; One 1.0-micron RF/Analog Design Rule Family
Manufacturing	
Packaging	
Test	

PROCESS TECHNOLOGY

1.0- to 0.5-micron GaAs MESFET
(2- and 3-inch wafers)

PRODUCTS

FET, MMIC and DIGIC Standard Products

Part Number	Description
HMD-12141-1	4-bit Universal Shift Register
HMM11810-0	MMIC Amplifier in Die Form, 6 to 18 GHz

GaAs Digital Cell Array

HMD-11100	1.0-micron	0.15ns delay	300-gates
HMD-11113-2	GaAs OR gate	650ps delay	

GaAs Digital IC Evaluation Kits

Application markets: Digital signal processing, microwave radar, military electronic systems, test equipment

FACILITIES

Milpitas, CA	150,000 sq. ft.	
	6,000 sq. ft.	Class 100 Clean room
	9,000 sq. ft.	Class 1000 Clean rooms (3)

COMPANY HIGHLIGHTS

Feb. 1984	HMS offered the first commercially-available GaAs ICs.
July 1984	HMS broke ground for $4 million GaAs facility that will offer 0.5-micron MMIC custom foundry services with T-gate technology and 20 GHz speeds.
June 1985	HMS added the HMD-11100, a 300-gate GaAs Digital Cell Array that operates at 3 GHz.
Aug. 1985	HMS added the HMD-12141-1, GaAs 4-bit Universal Shift Register with a 1.30 GHz clock input speed for DSP applications.
Aug. 1985	HMS cut prices for the HMD-11100 GaAs IC.
June 1986	HMS announces the HMM11810-0 GaAs MMIC amplifier in die form that spans 6 to 18 GHz and includes 0.5-micron gate length.
June 1986	HMS introduced the HMD-11113-2, a GaAs exclusive-OR gate with a typical propagation delay of 650 picoseconds.
June 1986	HMS cut pricing for its GaAs FET HMD-11100.

Hittite Microwave Corporation
21 Cabot Road
Woburn, MA 01801
617/933-7267

ESTABLISHED: January 1985
NO. OF EMPLOYEES: Not available

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Pres/CEO	Yalcin Ayasli	Raytheon	Mgr R&D Monolithic ICs
CFO	Ronald Kaplan	Wang	Controller

FINANCING: Not available

BACKGROUND

Hittite Microwave was formed to design and develop custom and proprietary GaAs MMICs for military and commercial applications. President Yalcin Ayasli was formerly with Raytheon Research. The Company has U.S. Air Force contracts for circuit design and development. Initial and present costs are funded by the government contracts.

Initially Hittite is providing in-house design, layout, verification, and test capabilities and is using foundries for wafer fabrication.

ALLIANCES: Not available

SERVICES

- Design
- Test

PROCESS TECHNOLOGY

0.5 and 1.0-micron GaAs MESFETs

PRODUCTS: Proprietary

FACILITIES

Woburn, Massachussetts	Office, research and development, and test

Hypres, Inc.
175 Clearbrook Road
Elmsford, NY 10523
914/592-1190

ESTABLISHED: October 1983
NO. OF EMPLOYEES: Not available

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Sadeg Faris	IBM	Scientist
VP Sales/Mktg	Ravi Ghai	Gould PCD	Dir Prod Mktg Plan
Controller	Richard Kjeldsen	Fingermatrix	VP Finance

FINANCING

Date	Round	Sources	Amount
Aug. 1983	Round 1	Adler & Co.; Asset Management Associates;E.M. Warburg, Pincus & Co.	$2.2M
Dec. 1985	Round 2	Original investors; Morganthaler Ventures; Century Four Partners; BancBoston Ventures	$6.4M

BACKGROUND

Hypres, Inc. (HYper Performance RESearch), is the only company attempting to commercialize superconductive devices using Josephson junctions and Quiterons, a device invented by founder Sadeg Faris while at IBM. In 1983, Hypres licensed IBM's Josephson junction research for $7.5 million. Quiterons are three-terminal superconducting switching devices that operate at cryogenic temperatures (-459 F) with little power dissipation.

Hypres is focusing on small-scale integration (SSI) applications, such as test and measurement signal processing in the short term and will focus on LSI and VLSI digital signal processing in the long term.

Properties of the Hypres superconducting devices include:

- Extremely fast (5X to 10X faster than GaAs)
- Presently switching at 1.5 picoseconds
- Projecting switching at 0.1 picoseconds
- Very low power dissipation
- Extreme radiation sensitivity limited only by quantum effects

Hypres is in its development stage and plans to introduce its first product in 1986. Presently, it is working on government contracts.

ALLIANCES: Not available

SERVICES

- Design
- CAD Development
- Manufacturing

PROCESS TECHNOLOGY

2.5-micron linewidths integrating up to 30 Josephson junctions

PRODUCTS: To be announced

Applications: High-speed digital data processing, wideband communications, analog signal processing, high-speed A/D converters, ultra-sensitive sensors

FACILITIES

Elmsford, NY 22,000 sq. ft.

ICI Array Technology, Inc.
1297 Parkmoor Avenue
San Jose, CA 95126-3448
408/297-3333
FAX: 408/297-3763

ESTABLISHED: 1982
NO. OF EMPLOYEES: 97

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President	Bill Robson
Executive VP Mktg/Sales	David Sear
VP Product Assurance	Terry Rutlin
VP Technology Development	Randall Braun
Controller	Mike Cleland

FINANCING: Not available

BACKGROUND

ICI Array Technology's primary thrust is to offer semicustom board line solutions by creating new and smaller boards from existing products that include gate arrays, standard cell designed chips, and standard products on the same board. Array Technology offers a 12- to 15-week turn-around time from design to system board.

The Company was founded by William Robson without venture capital as Array Technology, Inc. In January 1986, it was acquired by Imperial Chemical Industries PLC (ICI), a large U.K. chemical company. Its name was changed at that time from Array Technology to ICI Array Technology. Prior to the acquisition, Array Technology funded all activities from its design and consulting fees.

One of the Company's major strengths is the surface mount technology (SMT) offered as part of its totally integrated system.

Two offshore and two U.S. sources are providing CMOS silicon wafers.

ALLIANCES

NCR	July 1982	Under terms of a second-source and sales agreement for standard cells, Array Technology gained access to NCR's design and fab facilities to produce semicustom logic circuits; Array Technology provided designs, library, and designed additional cells for NCR's standard cell library.
ICI	Jan. 1986	Imperial Chemical Industries PLC (ICI), a large U.K. chemical company, acquired Array Technology.

SERVICES

Design	CMOS Gate Arrays, Cell Library Linear and digital circuits Surface mount module designs

PROCESS CAD TECHNOLOGY

1.3, 2.0, and 3.0-micron, single- and double-layer metal, Silicon-Gate CMOS

PRODUCTS

CMOS Gate Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
DHS*, HCD*	Si-Gate	2.0, 3.0	2.0	300 to 2,650
VC2	Si-Gate	2.0	1.8	600 to 1,500
	Si-Gate	2.0	1.4	600 to 6,000
	Si-Gate	1.3	1.0	10,000

*DHS = Digital High Speed
**HCD = High Current Drive

CMOS Cell Libraries

Process	Linewidth (micron)	Delay (ns)	Cells
Si-Gate	2.0, 3.0	2.0	RAM, ROM

Linear and Digital Gate Arrays (150- to 4,000-gates)

Semicustom Subsystems

10,000-gate 2-micron family (under development)

FACILITIES

San Jose, CA	25,000 sq. ft.	Administration, design, and production
Design Centers:		
San Jose	MOS	Gate Arrays, Standard Cell, Full Custom

COMPANY HIGHLIGHTS

1983	Array Technology completed designs for a family of CMOS gate arrays with 150- to 4,000-gates.
Dec. 1983	Array Technology established design and manufacturing capability for surface mount assembly.
Nov. 1985	Array Technology offered its HCD Series of digital gate arrays of up to 1,500-gates for interface applications.
Jan. 1986	Imperial Chemical Industries PLC (ICI), a large U.K. chemical company, acquired Array Technology.

IC Sensors
1701 McCarthy Blvd.
Milpitas, CA 95035
408/946-6693

ESTABLISHED: 1982
NO. OF EMPLOYEES: 65

BOARD: Not available

COMPANY EXECUTIVES: Not available

FINANCING: Not available

BACKGROUND

IC Sensors designs, develops, and manufactures both standard and application-specific piezoresistive pressure sensors, transducers, and transmitters for the medical instrumentation, pneumatic control, and automotive markets.

IC Sensors spun off from Foxboro/ICT of San Jose. The company is 75 percent financed by the founders.

ALLIANCES

Borg-Warner Corp.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY: Not available

PRODUCTS

PC Board Mountable Pressure Sensors	0 to 250 PSI
OEM High Pressure Sensor	0 to 5000 PSIA
OEM Pressure Transducers	0 to 250 PSIG
Process Control Transmitters	
Disposable Pressure Sensors	

Applications: Medical blood pressure, pneumatic control, automotive

FACILITIES

Milpitas, CA	36,000 sq. ft.	
	6,000 sq. ft.	Fabrication area

INMOS International plc
Worldwide Headquarters
1000 Aztec West
Almondsbury
Bristol BS12 4SQ
United Kingdom
Tel: 454 616616
TWX: 444723

ESTABLISHED: July 1978
NO. of EMPLOYEES: 1,850 Total
950 U.S.

INMOS Corporation
1110 Bayfield Drive
P.O. Box 16000
Colorado Springs, CO 80935
303/630-4000

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Mng Dir	Iann Barron
Chief Executive	Douglas Stevenson
Dir Micros	Peter Cavill

FINANCING

Date	Round	Sources	Amount
July 1978	Round 1	National Enterprise Board	$50.0M
Aug. 1980	Round 2	National Enterprise Board	$50.0M

BACKGROUND

INMOS International plc was formed to develop, manufacture, and sell memory and microprocessor devices. INMOS Corporation in Colorado Springs, Colorado, is a subsidiary of INMOS International. From its inception, INMOS has been engaged in microprocessor development. The first results were OCCAM, a new programming language and its associated programming tools. In November 1983, INMOS unveiled the Transputer, a device that combines all aspects of a computer onto a single chip, thus becoming an "intelligent" component for building systems. INMOS introduced 16K and 64K CMOS SRAMs and a 64K DRAM in 1984. INMOS is a participant in the British ESPRIT supercomputer research and development project.

INMOS was founded by Richard Petritz, Paul Schroeder, and Iann Barron. The company was funded by the National Enterprise Board (NEB) in the United Kingdom, later renamed the British Technology Group, and consists of a holding company in Bristol, England, that manages INMOS U.S.A. and INMOS U.K. In 1984, Thorn EMI plc of London acquired the British Government's majority shareholding in INMOS. The purchase price was $124 million. Currently, 95 percent of the capital stock is owned by Thorn EMI with the remainder held by employees.

In September 1984, INMOS broke ground for a 160,000-square-foot facility at Coed Rhedyn, Newport, South Wales. The plant was to have been completed by the summer of 1985, but preparations were postponed. In June 1986, INMOS resumed the building of the semiconductor facility with plans to open the new test and assembly operations, thus bringing assembly operations back from subcontractors in the Far East.

Thorn EMI began restructuring the company due to continuing losses, stopping CMOS manufacturing at Cheyenne Mountain facility in Colorado Springs and reduced employment from 800 to 350. All CMOS production was transferred to Newport while the Colorado Springs facility continues to manufacture NMOS products. The facility also retains a sales and marketing staff, a research and development team, and a pilot line for a 1.0-micron CMOS process that is in development. The Company will develop a new line of products based on one-micron CMOS, the first of which is a 25ns 256K SRAM.

INMOS also has a facility in Harrison Park in Colorado Springs that conducts assembly and test for INMOS' military products.

ALLIANCES

Texas Instruments	Oct. 1981	INMOS and TI reach an agreement for 64K DRAMs.
General Instrument	Oct. 1983	INMOS licensed GI to be a second-source for an 8Kx8 EEPROM. The pact included a complete technology transfer including masks and processing information.
Intel	Dec. 1983	Intel and INMOS signed an agreement to develop methods for achieving consistent specifications on 64K and 256K CHMOS DRAMs. Each company will develop, introduce, and market its own products independently.

NMBS	June 1984	NMBS obtained a 5-year license to produce the INMOS 256K CMOS DRAM. NMB paid an initial sum and agreed to continuing royalties. NMBS will also cooperate on the technology for the INMOS 64K DRAM and a 1Mb DRAM.
	March 1985	Minebea agreed to ship 50 percent of its 256K DRAM output to INMOS.
Thorn EMI	1984	Thorn-EMI acquired 76 percent of INMOS.
Hyundai	Dec. 1984	Hyundai paid $6 million for the INMOS 256K DRAM technology and planned for production in late 1986.

SERVICES

Design
Manufacturing
Assembly
Test

PROCESS TECHNOLOGY

1.5-micron double-metal, twin-well CMOS

PRODUCTS

MEMORY

	Device	Organization	Process	Access Times (ns)
DRAM				
	IMS2600	64Kx1	NMOS	80,100,120,150
	IMS2620	16Kx4	NMOS	100,120,150
	IMS2630	8Kx8	NMOS	120,150,200
	IMS2800	256Kx1	CMOS	60,80,100,120,150
	IMS2801	256Kx1	CMOS	60,80,100,120,150

SRAM				
	IMS 1400	16Kx1	NMOS	35,45,55,70,100
	IMS 1420	4Kx4	NMOS	45,55,70,100
	IMS 1421	4Kx4	NMOS	40,50
	IMS 1423	4Kx4	CMOS	25,35,45,55
	IMS 1424	4Kx4	CMOS	35,45
	IMS 1403	16Kx1	CMOS	35,45,55
	IMS 1600	64Kx1	CMOS	45,55,70
	IMS 1620	64Kx4	CMOS	45,55,70
	IMS 1624	16x4	CMOS	45,55,70
	IMS 1601	64Kx1	CMOS	55,70
	IMSG170	Video Lookup Table		
DSP	IMS A100	Digital Transversal Filter		
MPU				
	IMS T414	32-bit 10 MIPS Processor, 2K SRAM		
	IMS T212	16-bit 10 MIPS Processor, 2K SRAM		
	IMS C001/C002	Link Adapter		
	IMS B001/B002/B004	Transputer Evaluation Board		
	IMS D100	Transputer Development Station		
	IMS D600	VAX-VMS Transputer Development System		
	IMS D700	IBM-PC Transputer Development System		

FACILITIES

Colorado Springs, CO	177,000 sq. ft.	Includes front and back end
	25,000 sq. ft.	Class 100 Clean room
Newport, South Wales	160,000 sq. ft.	Includes front and back end
	30,000 sq. ft.	Class 100 Clean room

COMPANY HIGHLIGHTS

Feb. 1980	The first INMOS wafer fab became operational in Colorado Springs, Colorado.
Dec. 1980	INMOS sampled the 45 and 55ns NMOS Fast 16Kx1 SRAM.
Feb. 1981	INMOS added two additional wafer fabs in Colorado Springs, Colorado and Newport, Gwent, South Wales.

Q181	INMOS sampled a 64Kx1 MOS 64K DRAM with 100 to 150ns access times.
Q281	INMOS began production quantities of its MOS 16Kx1 Fast SRAM.
Q381	INMOS sampled an MOS 4Kx4 Fast SRAM.
Oct. 1981	Texas Instruments acquired INMOS technology for 64K DRAMs.
Q481	INMOS began quantity production of 4Kx4 Fast SRAM.
March 1982	The NEB reduced its interest in INMOS from 75 percent to 25 percent and merged with the National Research Development Corporation to form the British Technology Group.
Q282	INMOS began production quantities of its MOS 64Kx1 DRAM.
June 1982	INMOS issued new stock to finance its next development stage.
July 1982	INMOS reported a $29.9 million loss from 1981 operations on sales of $3.6 million for the fiscal year ending December 31, 1981.
Jan. 1983	INMOS introduced OCCAM, a programming package.
Jan. 1983	The British Technology Group invested an additional $23 million in INMOS. Founder Richard Petritz, INMOS chairman, is replaced by Malcolm Wilcox, director of the Midland Bank, a European investment bank.
Q183	INMOS sampled the MOS 16Kx4 DRAM.
Q283	INMOS began production quantities of the MOS 16Kx4 DRAM.
Aug. 1983	INMOS and Intel signed a codevelopment agreement for the 16K Fast SRAM.
Oct. 1983	General Instrument signed to provide second-sourcing for the 200ns 64K EEPROM, which had not yet been introduced.
Dec. 1983	The Intel agreement was extended to cover both 64K and 256K CHMOS DRAMs.

Q184	INMOS sampled the CMOS 16Kx1 Fast SRAM.
Q284	INMOS sampled its MOS 64K EEPROM.
June 1984	INMOS offered a 4Kx4 CMOS SRAM with an access time of 25ns.
Aug. 1984	INMOS offered the 35ns 16K SRAM.
Oct. 1984	INMOS introduced the 100-150ns 8Kx8 DRAM.
Nov. 1984	INMOS cut pricing on its 120ns 8Kx8 DRAM to $17.70 each in 100-piece quantities.
March 1985	INMOS laid off 86 employees.
July 1985	INMOS laid off 220 employees in Newport, Wales, dropped DRAMs, and concentrated on SRAMs and transputer products. Thorn EMI acquired 76 percent of INMOS.
Oct. 1985	Production began on the INMOS Transputer, IMS T414. It is the first of this family which integrates 10 MIPS, a 32-bit MPU, four interprocessor links, 2K SRAM, and 32-bit memory interface and memory controller on a single VLSI chip with over 20,000 transistors.
May 1986	INMOS added four RISC MPUs: IMS 1212 16-bit transputer with on-chip 2K of 50ns SRAM, external memory I/O, and 4 inter-transputer links; IMS M1212 Disk Processor with 16-bit processor, 1Kbyte of SRAM, 2 inter-transputer links, and external memory interface hardware; and IMS C011 and C012 link adapters that allow connection of transputers to other processors and peripherals. INMOS also offered the P700 concurrency starter kit which introduces the OCCAM language and concurrent programming The D711 supports C and runs in conjunction with the D01 Transputer Development System INMOS introduced new memory products with 45ns commercial versions and 55 and 70ns military versions of the IMS 1620 and IMS 1624 16Kx4 SRAMs, and the IMS 1601 64Kx1 SRAM. The SRAMs are intended for high-speed graphics, large cache memories, data acquisition, and buffer memory.

June 1986	INMOS resumed plans to build a semiconductor assembly plant at Coed Rhedyn and to occupy it by the end of this year.
June 1986	INMOS introduced the IMS A100 Digital Transversal Filter that cascades 32 multiply/accumulate modules onto a single CMOS chip using 16-bit accuracy.

Insouth Microsystems
P.O. Box 1209
Auburn, AL 36831-0601
205/821-5300

ESTABLISHED: 1980
NO. OF EMPLOYEES: 6

BOARD: Not available

COMPANY EXECUTIVES: Not available

FINANCING: Not available

BACKGROUND

Fairchild is moving its Insouth Microsystems unit from Auburn, Alabama to Germantown, Maryland and is laying off all but six of the employees. The remaining management and design group, including the president, Marvin Harding, is being transferred to more closely coordinate component manufacturing with Fairchild's Communications & Electronics, Inc., division in Maryland.

In 1983, Fairchild acquired a 51 percent share of Insouth, a company that makes large-scale ICs, hybrids, and gate arrays. Fairchild has since increased its holdings to 90 percent. The Germantown division, Insouth's major customer, manufactures avionics and telecommunications equipment. The closing of the Alabama unit is part of a major corporate reorganization that Fairchild began last year and that has included the sale of assets.

Insouth will continue to operate and plans to hire 30 to 50 people after the move is completed in September 1986.

SERVICES

- Design
- Manufacturing
- Assembly
- Test

PROCESS TECHNOLOGY

2.0-micron CMOS

PRODUCTS

CMOS Gate Array

Process	Linewidth (micron)	Delay (ns)	Gates
Si-Gate	2.0	1.4	500 to 10,000

Cell Library

Process	Linewidth (micron)	Delay (ns)	Cells
Si-Gate	2.0	1.4	36-gates, 25 MSI, user-defined register, counters

Applications: High-reliability military and commercial

FACILITIES: Insouth's new location to be announced.

Integrated CMOS Systems
440 Oakmead Parkway
Sunnyvale, CA 94086
408/735-1550

ESTABLISHED: October 1984
NO. OF EMPLOYEES: 28

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Lin Wu	STC Computer Rsch Corp.	Sr VP Opns/COO
VP R&D	Simon Chang	STC Computer Rsch Corp.	Sr Eng Mgr
VP Engr	Larry Cooke	STC Computer Rsch Corp.	Dir Dsn Automation

FINANCING

Date	Round	Sources	Amount
1985	Start-up	Hambrecht & Quist	$0.5M

BACKGROUND

Integrated CMOS Systems was formed to design, develop, and manufacture high-end application-specific components and subsystems for the commercial computation, military, mainframe, and telecommunication markets.

ICS was founded by a team from the semiconductor unit of Storage Technology's computer research group to provide high-performance gate arrays. The Company purchased Storage Technology's CAD equipment, software, and gate array masks. ICS subcontracts wafer fabrication to VLSI, Toshiba, and Universal Semiconductor.

In August 1986, ICS was acquired by Fairchild Semiconductor.

ALLIANCES

VLSI Technology Toshiba	1985	VLSI and Toshiba began to provide foundry services for ICS.

Universal Semiconductor	1985	Universal Semiconductor and ICS made a cooperative agreement to personalize wafers and designs supplied by ICS. Universal also provides foundry services.
Fairchild	Aug. 1986	ICS was acquired by Fairchild.

SERVICES

Design
Assembly
Test

PROCESS TECHNOLOGY

1.5-micron CMOS

PRODUCTS

Gate Arrays (2,000 to 30,000 gates)
Multiport RAM Arrays (structured on-chip)

FACILITIES

Sunnyvale, CA	12,500 sq. ft.	Headquarters and design
Design Center Sunnyvale, CA	MOS Gate Arrays	

Integrated Device Technology
3236 Scott Boulevard
Santa Clara, CA 95054-3090
408/727-6116

ESTABLISHED: May 1980
NO. OF EMPLOYEES: 700

BOARD

Position	Name	Affiliation
Chairman	D. John Carey	IDT
Director	Norman Godinho	IDT
Director	George F. Hwang	IDT
Director	Carl E. Berg	Berg & Berg Industrial Developers
Director	Louis B. Sullivan	Investor

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	John Carey	AMD	VP Opns
VP/COO	Maurice C. Chidlow	AMD	VP Bipolar Mem
VP Engr	George F. Hwang	H-P	Process Engr Mgr
VP/GM SRAM Div	Leonard C. Perham	Western Digital	Process Mgr
VP/GM Subsystems	Joseph F. Santandrea	Monosil	President
VP/GM DSP Div	Norman Godinho	Zilog	Manager
VP Div Mgr	Luc O. Bauer	Telmos	Founder/Pres
Corp Dir Mktg	Ralph O. Cognac	AMD	Mktg Bipolar Mem
CFO	Jay R. Zerfoss	Maruman	Finance Dir

FINANCING

Date	Round	Sources	Amount
June 1983	Round 3	First Boston Corp.; First Interstate Capital; Inco Securities; Montgomery Bridge Fund; North American Partners; Sysorex International; Touche Remnant; Union Venture; West Coast Venture; Whitehead Associates	$6.0M
June 1983	Lease		$3.0M
Feb. 1984		Initial Public Offering	$16.1M

BACKGROUND

Integrated Device Technology (IDT) designs, manufactures, and markets high-speed CMOS fast SRAMs, high-density modules, CMOS logic families, MICROSLICE bit-slice MPU product families, and digital signal processing products for the military, EDP, industrial, and telecommunications markets.

IDT was founded by George Hwang, Frank Lee, and Chun Chiu, all formerly with Hewlett-Packard, and Norman Godinho, formerly with Zilog. Early development phase operations were started in a Cupertino, California office. After securing venture funding, IDT moved to its Santa Clara, California facility in August 1981. John Carey was elected chairman of the board in April of 1982 and takes an active role in the Company's management.

IDT's goals are to become a large, multiproduct line company. The Company is attempting to exploit its leading-edge position in fast, high-performance CMOS processing technology with niche markets. IDT's initial product offerings consisted of CMOS SRAMs that were specifically targeted to replace older NMOS SRAMs made by a number of companies, and bipolar digital signal processors. IDT's products are attractive to end-users, because those products they replace require greater power to operate and dissipate more heat than IDT's CMOS parts.

The Company's products are targeted at the high-performance, high-reliability military and commercial markets and face little, if any, Japanese competition.

IDT is organized into three divisions: The Static RAM Division, the Subsystems Division, and the Digital Signal Processing Division.

SRAM manufacturing is done in Salinas, California; subsystems and digital signal processing products are manufactured at the Santa Clara facility.

IDT markets and distributes its products through a direct sales force and through independent representatives and distributors in the United States, Canada, and Europe.

ALLIANCES

Internix	IDT has signed a sales contract with Internix to sell high-speed 16K and 64K SRAMS and 8K and 16K dual-port SRAMs in Japan. Sales goals are targeted at $1.2M for the first year and $4M over the following three years.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

Complementary-Enhanced MOS (CEMOS)

CEMOS I	2.5-micron	All Projection
CEMOS IIA	2.0-micron	Projection and Steppers
CEMOS IIB	1.5-micron	All Steppers
CEMOS IIC	1.2-micron	All Steppers
CEMOS III	Sub-micron	In Development

PRODUCTS

MEMORY

CMOS SRAM

Part Number	Organization	Access Time
IDT6116	2Kx8	35-45ns
IDT6120	2Kx8	18-20ns
IDT6167A	16Kx1	15-25ns
IDT6168A/1681A/1682A	4Kx4	20-25ns
IDT6169	4Kx4	12-15ns
IDT7164/7165/7174	8Kx8	30-45ns
IDT7187	64Kx1	30-35ns
IDT7188/7198	16Kx4	45-85ns
IDT1981/1982	16Kx4	25-35ns
IDT7126	32Kx8	45-55ns
IDT71257	256Kx1	35-45ns
IDT1258	64Kx4	35-45ns

DUAL-PORT RAMs

Part Number	Organization	Access Time
IDT7130	1Kx8	45-70ns
IDT7132	2Kx8	45-70ns
IDT140	1Kx8	45-70ns
IDT142	2Kx8	45-70ns
IDT71322	2Kx8	45-55ns
IDT7133/7143	2Kx16	70-90ns
IDT7134	4Kx8	45-55ns
FIFO		
IDT7201	512x9	35-45ns
IDT7202	1024x9	35-40ns
IDT7203/72103	2Kx9	50ns
IDT7204/72104	4Kx9	50ns
MODULES		
IDT7M464/8M464	16Kx4	55-65ns
IDT7M164	64Kx1	60-70ns
IDT8M628/8MP628	8Kx16	50-60ns
IDT7M656	16Kx16/32Kx8/64Kx4	25-35ns
IDT7M856	32Kx8	50-55ns
IDT7M812/7M912	64Kx8	45-55ns
IDT8M612/8MP612	32Kx16	60-75ns
IDT7M624/7MP624	64Kx16/128Kx8/256Kx4	30-55ns
IDT8M824/8MP824/7M824	128Kx8	60-75ns
IDT8M624/8MP624	64Kx16	60-75ns

CMOS DSP

Multipliers		
IDT7212/7213	12x12	30-40ns
IDT7216/7217	16x16	35-40ns
Multipliers/Accumulators		
IDT7209	12x12	30-40ns
IDT7210/7243	16x16	35-40ns
Floating Point Products		
IDT72064/72264	64-bit Multiplier	
IDT72065/72265	64-bit ALU	

MICROSLICE PRODUCTS

	Part Number	Description
Microprocessors		
	IDT39C01/03/203	4-bit Micro Slice
	IDT49C401/402/403	16-bit Micro Slice
	IDT49C404	32-bit Micro Slice
Sequencers		
	IDT39C09/11	4-bit Sequencer
	IDT39C10	12-bit Sequencer
	IDT49C410	16-bit Sequencer
Register Files		
	IDT39C705/707/	16x4 Register File Extension
	IDT49C470	64x16 Register File
Error Detection/ Correction Unit		
	IDT39C60	16-bit Cascadable EDC
	IDT49C460	32-bit Cascadable EDC
Other		
	IDT39C02	Carry Lookahead Generator
	IDT49C25	Clock Generator

CMOS LOGIC PRODUCTS

Part Number	Description
IDT54/74FCT138	1-of-8 Decoder
IDT54/74FCT139	Dual 1-of-4 Decoder
IDT54/74FCT161/163	Synchronous Binary Counter
IDT54/74FCT182	Carry Lookahead Generator
IDT54/74FCT191/193	Up/Down Binary Counter
IDT54/74FCT240/244	Octal Buffer
IDT54/74FCT245/640/645	Octal Bidirectional Transceiver
IDT54/74FCT273/374/377/534	Octal Flip-Flop
IDT54/74FCT299	Octal Universal Shift Register
IDT54/74FCT373/533/573	Octal Transparent Latch
IDT54/74FCT521	8-bit Comparator
IDT54/74FCT574	Octal D Register
IDT39C821	10-bit Noninverting Register
IDT39C822	10-bit Inverting Register

CMOS LOGIC PRODUCTS (Continued)

Part Number	Description
IDT39C823	9-bit Noninverting Register
IDT39C824	9-bit Inverting Register
IDT39C825	8-bit Noninverting Register
IDT39C826	8-bit Inverting Register
IDT39C841	10-bit Noninverting Latch
IDT39C842	10-bit Inverting Latch
IDT39C843	9-bit Noninverting Latch
IDT39C844	9-bit Inverting Latch
IDT39C845	8-bit Noninverting Latch
IDT39C846	8-bit Inverting Latch
IDT39C861	10-bit Noninverting Transceiver
IDT39C862	10-bit Inverting Transceiver
IDT39C863	9-bit Noninverting Transceiver
IDT39C864	9-bit Inverting Transceiver

Applications: Military, high-reliability, telecommunications, aerospace, high-performance minicomputers and mainframes

FACILITIES

Santa Clara	40,000 sq. ft.	Research and development, product development, and some assembly
Salinas, CA	97,000 sq. ft.	Engineering, design, test, production, administration
	25,000 sq. ft.	Class 1 Clean room

COMPANY HIGHLIGHTS

Q4 1981 IDT sampled Byte-wide CMOS 16K SRAM.

Q1 1982 IDT began production quantity Byte-wide 16K SRAM.

Sept. 1982	IDT sampled IDT6167, a CMOS 16Kx1 Fast SRAM, 45-85ns commercial, 55-100ns military, 5V, 20-pin DIP or 20-pin LCC.
Q3 1982	IDT offered production quantities of 16Kx1 CMOS fast SRAMs.
Q4 1982	IDT sampled IDT6168/S71681 CMOS 4Kx4 Fast SRAMs in four military grade speeds, 45-85ns, 5V operation.
Q1 1983	IDT offered production quantities of CMOS 4Kx4 fast military SRAMs at 45-85ns.
Aug. 1983	IDT offered 7M164/464/864/8M864 64K SRAM Modules: 8Kx8/16Kx4/64Kx1; 55-200ns, in military and commercial grades.
Sept. 1983	IDT offered the IDT6116 2Kx8 CMOS SRAM in a skinny-DIP (THINDIP) hermetic package.
Nov. 1984	IDT announced the IDT7216/7217 CMOS 16x16 parallel multiplier; 200ns, 5V, TTL-compatible, in a 64-pin DIP.
Feb. 1984	IDT announced an initial public offering of common stock at $10.75 per share and raised $16.1 million.
June 1984	The IDT54HCT138/IDT72T338, CMOS Logic Decoder Series was offered.
July 1984	IDT began construction of its Salinas, California plant.
Jan. 1985	IDT offered the IDT7201/7202 CMOS Parallel FIFO: 1024x9 and 512x9; 50-120ns commercial/55-120ns military; 5V; in a 28-pin CERDIP or a 32-pin Contact LCC.
Feb. 1985	IDT offered the IDT7188/7198 64K CMOS SRAM: 6Kx4; 45ns; 5V; 22-/24- or 28-pin DIP; commercial, industrial, and military grades.
	IDT offered its IDT7130/7132 CMOS DUAL-Port SRAMs: 2Kx8/1Kx8; 90-120ns; 48-pin DIP or 48-pin LCC; commercial and military grades.
April 1985	IDT offered the IDT7210/7243, 16x16 Parallel CMOS Multipliers/Accumulators at 65ns, in DIP and LCC, commercial and military grades.

April 1985	IDT offered the IDT7M656/7M856 256 SRAM Memory Modules (RAMPACKS): 55-75ns; 28- and 40-pin Sidebrazed DIP; commercial and military.
July 1985	IDT began operating the Salinas plant.
	IDT introduced the IDT54/74 FCT products that replace AMD's bipolar AM2900 family. They are fabricated in 1.2 micron technology and are CMOS and TTL-compatible. The devices operate at 7 to 15ns and are available in 20-pin DIP or 20-pin LCC packages in commercial and military grades.
Oct. 1985	IDT offered the IDT7M203/204 CMOS FIFO Module: 2Kx9; 28-pin DIP; in commercial and military grades.
	IDT offers the MICROSLICE, a bit-slice MPU family.
Nov. 1985	IDT sampled the IDT7212/7213 12x12 Parallel Multipliers: 45ns; 5V; commercial and military grades.
	IDT introduced the IDT7209 12x12 Multiplier/Accumulator; 55ns; 5V; in commercial and military grades.
Mar. 1986	IDT offered 39C800, a new high-performance CMOS logic series including: the IDT39C823 Bus Interface Register, with a 7.5ns throughput time; the IDT39C843 Bus Interface Latch, with 5.5ns non-inverting propogation times; and the IDT39C863 Bus Transceiver with a 5.5ns noninverting access time.
April 1986	IDT added the IDT49C460A and IDT49C460 CMOS 32-bit Error Detection and Correction (EDC) Units to its CMOS MICROSLICE family.
	IDT offered three 16-bit Error Detection Correction devices to its CMOS MICROSLICE family, the IDT39C60A, IDT39C60-1, and IDT39C60. All are pin-compatible and performance-functional replacements for all versions of the AM2960.
May 1986	The DSP Division of IDT announced the IDT72064/72065 and IDT72264/72265, two 64-bit CMOS floating-point processor chip sets.
June 1986	IDT offered the IDT7130 1Kx8 and IDT7132 2Kx84 dual-port SRAMs that feature access times of 55ns over commercial temperature ranges.
July 1986	IDT added the IDT7201/7202 CMOS parallel I/O FIFOs with 35ns access times.

Integrated Logic Systems, Inc.
4445 Northpark Drive, Suite 102
Colorado Springs, CO 80907
303/590-1588

ESTABLISHED: August 1983
NO. OF EMPLOYEES: 25

BOARD

Name	Affiliation
David L. Taylor	ILSI
Frank Gasparik	ILSI
Christopher K. Laytom	Consultant

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	David L. Taylor	UTC	Logic Design Mgr
VP Engr	Frank Gasparik	Insouth	VP Engineering
VP Mktg/Sales	Jeffrey Jacobson	GE	Dir Western Sales

FINANCING

Date	Round	Sources	Amount
Jan. 1984	Initial	OTC Offering	$5.0M

BACKGROUND

Integrated Logic Systems (ILSI) was formed to design and develop a family of silicon-gate CMOS and bipolar ECL logic arrays and software-based design aids.

In May 1985, ILSI introduced a new architecture, called the P2L for Programmable Performance Logic. P2L achieves standard cell gate densities while retaining gate array turnaround times. It offers up to 9000 equivalent gates and includes large complex functions--ROM, RAM, PLA, PAL, and the AM2900 family. The P2L devices are available in both plastic and ceramic packages.

The Company has worldwide foundry alliances, a Motorola license agreement, and a Perkin-Elmer research and development letter of intent.

ALLIANCES

Motorola June 1986 Motorola signed ILSI as a source for design.

SERVICES

Gate Array Design
CAD Software
Fast-Turn Prototype Manufacturing (1Q 1987)
Fast-Turn Assembly
Fast-Turn Packaging (1Q 1987)

PROCESS TECHNOLOGY

3.0-, 2.0-, and 1.5-micron CMOS
1.2-micron CMOS (Available January 1987)

PRODUCTS

CMOS Gate Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
CB-3000	Si-Gate	3.0	1.8	808 to 7,260
CA-2000	Si-Gate	2.0	1.0	1,000 to 15,000
CA-1000	Si-Gate	1.5	0.7	1,500 to 18,000

Compiled CMOS Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gate Equivalents
CA-2000	Si-Gate	2.0	1.0	1,000 to 40,000
CA-1000	Si-Gate	1.5	0.7	1,500 to 60,000

FACILITIES

Colorado Springs, CO 10,000 sq. ft. Administration and design
A 15,000 sq. ft. Clean Room is planned for first quarter 1987.

Design Centers;
Colorado Springs, CO MOS Gate Arrays and Compiled Arrays

Integrated Power Semiconductors, Ltd.
Corporate Headquarters
MacIntosh Road
Kirkton Campus
Livingston
Scotland EH54 7BW
Tel: 44 506 416416
FAX: 44 506 413526

ESTABLISHED: April 1984
NO. OF EMPLOYEES: 120

U.S. Headquarters
2727 Walsh Avenue
Suite 201
Santa Clara, CA 95051
408/727-2772

BOARD

Name	Affiliation
Jack Armstrong	Allen Bradley Company
John Wesley	Investors in Industry
David Wood	IPS, Ltd.
Tony Lear	IPS, Ltd.
Alan Henderson	Newmarket Venture
Peter English	Fleming Ventures

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Mng Dir/CEO	David Wood	Silicon General	Dir Engr
Dir R&D	Tony Lear	Texas Instruments	R&D Mktg Dev Mgr
Dir US Sales/Mktg	Herb Scott	Texas Instruments	West Mgr OEM Sales
Controller	Thomas Valentine	Beckman	Finance Director
Applications Mgr	Norman Matzen	Astec Systems	Design Mgr
Engr Manager	Eric Joseph	Motorola	Prod Dsn Mgr

FINANCING

Date	Round	Sources	Amount
1984	Round 1	3i Ventures; ATA Venture Capital Fund Ltd.; Charterhouse Japhet; CIN Industrial Investments Ltd.;	$8.0M
	Grants	British Government	$8.0M
	Bldg/Equip Lease		$13.0M

FINANCING

Date	Round	Sources	Amount
March 1986	Round 2	3i Ventures; Newmarket; Charterhouse Japhet; Scottish Development Agency; Robert Fleming & Associates; and others	$8.0M
1984	Equip Lease		$3.0M
	Bank Line of Credit		$2.0M
July 1986	Round 3	Round 2 investors	$6.0M

BACKGROUND

Integrated Power Semiconductor, Ltd. (IPS), designs, develops, and manufactures monolithic standard, semicustom, and full custom high-current, high-power ICs (smart power ICs or power ICs). IPS products address "high-power" smart power IC applications for power controllers and power drivers in the U.S. and European markets. The Company is dedicated to the solutions of monolithic power control and is prepared to address the issues of mixed technology, varying power levels, and nonstandard packaging.

IPS is designing proprietary products with metal mask configurability to enable customers to configure specific characteristics of the IC to specific needs. IPS has a large CAD design center for custom linear ICs and is developing a functional cell library for semicustom IC design. Initially all products are produced in bipolar technology, but future developments will include DMOS for high-voltage applications and CMOS for logic functions, or a merged technology of CMOS and bipolar processes that will be available in 1986.

IPS was founded by a group of Silicon Valley engineers to produce the "next generation" large-scale ICs for controlling switched-mode power supplies, motors, and actuators used in computer peripherals and industrial products. IPS's efforts are toward integrating bipolar, CMOS, and DMOS on a single chip. The Company's first products were offered in early 1985.

Scotland was chosen as the manufacturing site, because it is inside the 14 percent EEC duty barrier; it possesses a large supportive semiconductor infrastructure; and the choice provided the advantage of $15 million in venture capital and grants. The Company's wafer fab started production in January 1986.

IPS has established four U.S. sales offices, three European sales offices, and a representative and distributor network to handle orders.

ALLIANCES: Not available

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

Bipolar
CMOS (Available late 1986)
DMOS (Available late 1986)
(4-inch wafers)

PRODUCTS

IP7800 Series	Voltage Regulators
IP123	Voltage Regulators
IP7900 Series	Voltage Regulators
IP117/217/317	Positive Voltage Regulators
IP137/237/337	Negative Voltage Regulators
IP50A and IP138 Series	Voltage Regulators
IP293/293D/293E	Push-Pull Drivers
IP1524B/IP2524B/IP3524B	Regulating Pulse Modulators

Applications:
Peripherals: Disk drives, printers, typewriters, plotters
Industrial: Robotics, programmable controllers, power supplies

FACILITIES

Livingston, Scotland	45,000 sq.ft.	Design, fab, and test

Design Center:
Livingston, Scotland

COMPANY HIGHLIGHTS

March 1985	IPS offered the IP7805/140-05, IP7812/140-12, IP7815/140-15, IP123, and IP7900 Series Voltage Regulators, packaged in TO-220 and steel TO-3 cans, in commercial, industrial, and military grades.
March 1985	IPS added the IP117/217/317 Positive Voltage Regulators and the IP137/237/337 Negative Voltage Regulators packaged in steel TO-3, TO-220 metal cans in commercial, industrial, and military grades.
June 1985	IPS introduced the IP50A Series and IP138 Series Voltage Regulators, packaged in TO-3 and TO-220 in commercial, industrial, and military grades.
Aug. 1985	IPS introduced the IP1524B/IP2524B/IP3524B Regulating Pulse Modulators.
Oct. 1985	IPS added the IP293/293D/293E Push-Pull Drivers in 16-pin or 20-pin batwing DIP packages, commercial grade.
Feb. 1986	IPS opened its $18 million plant in Scotland that houses its headquarters, development center, and wafer fab facility. IPS employs 100 Scottish workers and expects shipments to begin during the second quarter.

Intercept Microelectronics
2890 Zanker Road
San Jose, CA 95134
408/434-7070

ESTABLISHED: October 1985
NO. OF EMPLOYEES: 10

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Val Rodriguez	Matra-Design	President
VP Dsn Auto	J-M Gastineau	Matra-Design	VP R&D
CAD S/W Dev Mgr	Eric Archembeau	Matra-Design	CAD Grp Leader
Mgr Engr App	Kelvin Tsang	Matra-Design	Mgr Engr App
Personnel Mgr/Ctlr	Steve Hyndman	Matra-Design	N/A

FINANCING: Not available

BACKGROUND

In April 1986, Intercept Microelectronics offered its first products: a new series of gate arrays and a complete CAD system based on the IBM PC-AT. The two-level metal CMOS digital arrays, called Optimized Gate Arrays use a standard cell procedure to optimize the die size. Rows of cells are automatically completed to transform the base layers of the circuit into a new gate array. Eight arrays are currently available and range from 150- to 1,900-gates in complexity. The entire design cycle, from design entry to test program generation, is performed with an IBM PC-AT based CAE system. CAE software is provided free to Intercept customers.

Intercept was founded by a group from Matra-Design Systems (MDS), a CMOS gate array supplier. MDS is owned by the French Matra Harris group. Founders are Val Rodrigues, Jean-Marie Gastineau, Eric Archembeau, Kevin Tsang, and Steve Hyndman. The founders supplied the initial funds. Intercept is in the process of raising first-round financing.

The Company's products are targeted at OEM system engineers who have limited knowledge of CAD or IC design.

ALLIANCES: None

SERVICES

Design
CAD Tools

PROCESS TECHNOLOGY

3.0- and 2.0-micron CMOS
1.5-micron (Near future)

PRODUCTS

Gate Arrays	150- to 1,900-gates

FACILITIES

San Jose, CA	6,000 sq. ft.	Design

International CMOS Technology, Inc.
2031 Concourse Drive
San Jose, CA 95131
408/434-0678

ESTABLISHED: October 1983
NO. OF EMPLOYEES: 26

BOARD

Name

Paul Reagan
Director
Lee Lunsford
Director

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Drew A. Osterman	NSC	Mktg Mgr NV Mems
VP Technology	Samuel Wang, PhD	NSC	Sr Process Eng Mgr
VP Dsn Eng	Dhaval Brahmbhatt	NSC	Engr Mgr
VP Opns	Donald E. Robinson	NSC	Prod Mgr EPROMs
VP CFO	Lawrence Yaggi	Perkin-Elmer	Controller

FINANCING

Date	Round	Sources	Amount
1984	Round 1	Hyundai Electronics Industries	$5.0M

BACKGROUND

International CMOS Technology, Inc. (ICT), was formed to design and manufacture a broad line of CMOS ICs. ICT intends to replace slower bipolar and NMOS products with its more reliable, higher speed, and lower power consuming CMOS devices.

ICT's initial product offerings are user-programmable CMOS products, including very high-performance erasable programmable logic devices (EPLDs)and nonvolatile memories.

ICT was founded by Drew Osterman, Samuel Wang, Dhaval Brahmbhatt, and Donald Robinson, all of whom were formerly with National Semiconductor Corp., and Lawrence Yaggi who was with Perkin-Elmer.

The Company is currently offering its trademarked Programmable Electrically Erasable Logic (PEEL) family (known generically as erasable programmable logic devices or EPLDs). The PEEL family includes four CMOS devices that offer bipolar-equivalent speeds of 25ns combined with the advantages of CMOS. Additional ICT products include a 120ns 64K CMOS UV EPROM and a 35ns 64K UV EPROM targeted at the bipolar 24-pin market.

ICT has entered into technology development agreements with Gould Semiconductor and Hyundai Electronics to offset major start-up costs. These agreements provide ICT with operating capital and a significant share of production capacity in North America, Europe, and Asia. The agreements also provide ICT with additional technical support in the form of CAD services and prototype wafer fabrication.

ALLIANCES

Hyundai	Oct. 1983	Hyundai and ICT signed a joint development agreement to develop and produce seven or eight parts including 1K CMOS EEPROMs, fast SRAMs, and 64K EPROMs. Hyundai funded ICT's initial product development and allocated 30 percent of its wafer fab capacity for an equity interest in ICT.
IMP	July 1984	IMP and ICT codeveloped a CMOS EEPROM process.
Gould Semiconductor	April 1986	ICT will transfer its CMOS EE process technology and products to Gould in exchange for foundry services and second-sourcing of PEEL and EEPROM devices. Gould will provide foundry services for ICT's new high-speed CMOS EPROM family. Both companies will work on new product and technology development that will include PEEL products.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

1.25- and 2.0-micron CMOS EE Process

PRODUCTS

Telecommunications

Device	Description
3530	300 BPS Modem
35213	1200/300 BPS Modem
35212A	Filter
3506/07/07A	Codec
3525	DTMF Bandsplit Filter
3526B	DTMF Bandsplit Filter
3528	Low Pass Filter
3529	High Pass Filter
6551	UART

Microprocessor

Device	Description
68045	CRT Controller
6845	CRT Controller

Memory

Device	Description
93C46	1K EEPROM
98C64	64K EEPROM (2Q1987)
27C64A	64K EPROM
27Cx641	64K EPROM (Nov. 1986)

PEEL EPLDs

Device	Design Rules (micron)	Speed (ns)
18CV8	2.0	25
22CV10	2.0	25 (Feb. 1987)
22CP210	2.0	25 (Nov. 1986)
18CP210	2.0	25 (Dec. 1986)

FACILITIES

San Jose, CA	8,200 sq. ft.	Headquarters and design

COMPANY HIGHLIGHTS

Oct. 1983	ICT announced an agreement with Hyundai for equity, a share of HEI's production capacity in Korea, technical support for CAD services, prototype wafer fabrication and development, and cross-licensing agreements that allow ICT to bring products to the market quickly.
Sept. 1985	ICT sampled a 1K CMOS EEPROM.
Feb. 1986	ICT began volume production of the 93C46, a low power CMOS 1K EEPROM, 5V in an 8-pin DIP, in commercial, industrial, and military grades.
June 1986	ICT announced a multimillion dollar strategic alliance with Gould Semiconductor that positions ICT for significant growth. The agreement includes the cross licensing of several products, a production support contract, and a joint technology agreement.

International Microelectronic Products
2830 North First Street
San Jose, CA 95134
408/432-9100
TWX: 910 338 2274
Telex: 499-1041

ESTABLISHED: January 1981
NO. OF EMPLOYEES: 242

BOARD

Position	Name	Affiliation
Chairman	George Gray	IMP
Director	Barry Carrington	IMP
Director	Zvi Grinfas	IMP
Director	Gerald Bay	Vista Ventures
Director	Russell Carson	Welsh, Carson, Anderson and Stowe
Director	Richard Smith	Sohio
Director	Dr. Carver Mead	CA Institute of Technology
Director	DuBose Montgomery	Menlo Ventures
Director	Elmer Robinson	

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Pres/CEO	Barry Carrington	AMI	Sr VP Mfg
Sr VP/CFO	Charles Isherwood	AMI	Sr VP Corp Svcs
VP Sales/Mktg	Willian Michaels	Synertek	Natl Sales Mgr
VP Mfg	Larry Anderson	NEC	Mfg Manager
VP Technology	Dr. Moiz Khambaty	AMI	CMOS Tech Dev

FINANCING

Date	Round	Sources	Amount
Aug. 1981	Start-up	Citicorp Venture Capital; Charles River Partnership; Continental Illinois Venture Corp.; Harvest Ventures; INCO Securities; Lambda (Drexel Burnham Lambert, Inc.); Menlo Ventures; Robertson, Colman, & Stephens; Vista Ventures (Sohio); Welsh, Carson, Anderson and Stowe; IMP management and individuals	$8.75M
1981	Lease	Bank of America Equipment Lease; Orchard Properties Property Lease	$13.0M

FINANCING

Date	Round	Sources	Amount
Aug. 1982	Round 2	Initial investors (except IMP management and individuals); Foster Industries; Republic Ventures; Murray Johnstone, U.K.; Prudential Nominees, U.K.; Stewart Enterprises, U.K.; Wilmark R&D (Ivory & Sime), U.K.; H.G. Usher, U.K.; Edinburgh Financial, U.K.; R.W. Allsop; Robinson Investments; Scottish Development Agency; Toronto Dominion Bank	$7.4M
June 1983	Round 3	Same as Round 2 (except Stewart Ent.; Wilmark R&D); IMP management and individuals; General Electric Pension Fund; Citibank (NA for GTE Pension); Mutual Benefit Life; Schulf, Woltman & Co.; IBM Retirement Trust Fund; The Hillman Company; Morgan Stanley & Co.; Alex Brown & Sons; Pacific Technology Venture; Latigo Ventures; Robert Fleming & Co.; Kleinwort Benson; Drayton Montagu; Morgan, Grenfell & Co.; Lombard Odier; Walter Scott & Partners; Aiken Hume	$14.2M
June 1984	Round 4	National Semiconductor	$3.0M
Aug. 1984		Standard Oil of Ohio	$4.0M
June 1985		Northern Telecom, Sohio	$6.2M
June 1986		Citicorp Venture Capital Ltd.; CIN Investor Nominees Ltd.; Pruventure, Syntech, Grosvenor Technology Fund	£3.0

BACKGROUND

International Microelectronic Products (IMP) was formed to design, develop, manufacture, and market VLSI custom MOS ICs. IMP plans to achieve and maintain a technology leadership position among custom VLSI suppliers through its CAD and process technologies.

IMP's CAD design system is a fully automated standard cell design system with an integrated data base, single point of entry, schematic design and capture through pattern generation. IMP's Universal netlist translator can convert any gate array netlist to an IMP standard cell design, enabling customers to upgrade designs from gate arrays to standard cells.

IMP is developing 1.5-micron CMOS and NMOS processes, block or macrocell generation, compilation, and placement and routing tools.

In June 1986, IMP formed IMP Europe Limited as a new company to serve the European market. IMP Europe's initial activities include custom IC design and applications engineering services. The services use the IMP design system transferred from the United States for both developing custom IC designs and for manufacturing support.

ALLIANCES

Zoran	June 1983	With Zoran IMP codeveloped a CMOS PROM technology.
IXYS	Nov. 1983	IMP codeveloped a high voltage CMOS process with IXTS.
NSC	1984	IMP and National Semiconductor signed a 5-year technology exchange and second-source agreement transferring IMP's standard cell designs in exchange for NSC's multiple-layer metal silicon-gate CMOS process, as well as future CMOS processes.
	April 1985	IMP will second-source NSC's 2-micron gate arrays.
Micro Linear	June 1984	IMP and Micro Linear codeveloped a 10 volt CMOS process and IMP provides foundry services for Micro Linear.
ICT	July 1984	IMP and ICT codeveloped a CMOS EEPROM process.
Iskra	April 1985	IMP and Iskra codeveloped a CMOS analog cell library for which IMP provides foundry services.
Lattice Logic	May 1986	Lattice Logic's CHIPSMITH Silicon compiler software is available with IMP's design rules.

ALLIANCES

Silicon Compilers	June 1986	SCI and IMP announced a strategic alliance to develop analog compilation capability for SCI's Genesil Silicon Development System. SCI will incorporate IMP's 3-micron, double-poly, double-metal process into the Genesil System.

SERVICES

Foundry	Silicon-gate CMOS & NMOS
Design	Gate Arrays, Cell Libraries, Full Custom
Manufacturing	
Packaging	
Test	

PROCESS TECHNOLOGY

Silicon Gate NMOS 5.0-, 3.0-, 2.0-micron
Silicon Gate CMOS 5.0-, 3.0-, 2.0-micron
(4-inch wafers)

PRODUCTS

CMOS Gate Arrays

Process	Linewidth (micron)	Delay (ns)	Gates
Si-Gate	2.0	1.0	800 to 6,000

CMOS Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
C3013	Me-Gate	3.0	3.5	>200 logic, 40 analog
C3002	Si-Gate	3.0	3.5	>200 logic
C2002	Si-Gate	2.0	1.0	>200 logic, RAM, ROM, PLA
C2003	Si-Gate	2.0	1.0	>200 logic, RAM, ROM, PLA
C3005	Si-Gate	3.0	3.5	84 logic

FACILITIES

San Jose, CA	120,000 sq. ft.	Headquarters and manufacturing
	18,000 sq. ft.	Class 100 Clean room
	2,000 sq. ft	Class 10 Clean room

Design Centers:
San Jose, CA
Swindon, England

Isocom Limited
Prospect Way
Park View Industrial Est.
Brenda Road
Hartleypool, Cleveland, England
(0429) 221431

Isocom, Inc.
Suite F
274 E. Hamilton Avenue
Campbell, CA 95008
408/370-2212

ESTABLISHED: November 1982
NO. OF EMPLOYEES: 84

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Colin Rees	Litronix	Mgr Europe Sales
U.S. GM	Sam Kauffman	Siemens	Dir Mktg Optocoupler Div
Technical Dir	Andrew Mann	Siemens	Prod Mgr Optocoupler Div

FINANCING: Not available

BACKGROUND

Isocom Limited was formed to design, manufacture, and market optocouplers with plans to become a major player in the $18 million military optocoupler market. Marketing efforts were concentrated in the European commercial and industrial markets for the first two years. In 1986, the Company began offering devices to the military market.

Isocom was founded by several former Litronix managers and is headquartered in Hartleypool, England, with a U.S. sales and marketing office in Campbell, California. Design, manufacturing, and test are done at the 20,000-square-foot Hartleypool facility. Assembly is contracted to companies in the Far East.

Isocom's initial products included a range of photo-Darlingtons and interrupter switches in single, dual, and quad package configurations. In 1984 and 1985, the product line expanded to include Hewlett-Packard-compatible, high-speed gain couplers, AC input optocouplers, photo SCRs, TRIACs, Schmitt Trigger devices, and phototransistor optocouplers. In the second quarter of 1985, the Company became one of the first to offer a range of surface-mount devices.

SERVICES

Design
Manufacturing
Test

PROCESS TECHNOLOGY

Silicon

PRODUCTS

IS800/ISM 800 Series	Minicouplers
6N and HCPL	High-Speed/High-Gain Couplers
H11AV1 Series	High-Isolation Opto Couplers
IL100/IL101	High-Speed Tri-State Opto Couplers
H11D1 Series	High-Voltage Photo Transistor Couplers
ISH 710/ISH 711	Hybrids
H21/ISTS	Switches

FACILITIES

Hartleypool, England	25,000 sq. ft.	Research and development, design, manufacturing, and test
Campbell, CA	1,000 sq. ft.	Marketing, sales, and distribution

IXYS Corporation
142 Charcot Avenue
San Jose, CA 95131
408/435-1900
Telex: 384928 IXYS SNJ UD

ESTABLISHED: April 1983
NO. OF EMPLOYEES: 25

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Alan Hofstein	Anatros Corp.	President/CEO
Exec VP	Nathan Zommer	GE Intersil	Mgr Pwr MOS R&D
VP Engr Opns	Mark Barron	GE Calma	Sr VP R&D
VP Sales/Mktg	Daniel Schwob	GE	Prod Mktg Mgr
VP Finance/Admin	Ron Boemi	Anatros Corp.	VP Finance
Mgr Opns	Ross Yu	GE	Mgr Wfr Fab

FINANCING

Date	Round	Sources	Amount
1983	Round 1	Fred Adler	$0.8M
Oct. 1985	Round 2	Adler & Co.; Burr, Egan, Deleage; Grace Ventures Corporation; Harvest Ventures; Arthur D. Little Enterprises; Oak Investment Partners; Stanford University; U.S. Venture Partners; Zimmerman Family Partnership	$6.7M

BACKGROUND

IXYS was formed to design and manufacture a specialized line of power monolithic ICs, discrete MOSFET insulated gate transistors, and motor control ICs that are available as standard products. IXYS also offers full-custom design services.

The Company is developing logic designs to take advantage of the next microprocessor generation in building industrial-control systems. It developed a proprietary process, IMOS, that combines both CMOS and DMOS power functions on the same chip in order to make the ideal of "smart power" reality.

Initially IXYS is using offshore foundries.

ALLIANCES

IMP	Nov. 1983	IMP and IXYS codeveloped a high-voltage CMOS process.
Ricoh	1984	IXYS and Ricoh signed a technology exchange for Ricoh to provide wafers; IXYS is providing its power MOSFET HDMOS process.
Samsung	Jan. 1986	IXYS made an agreement with Samsung Semiconductor and Telecommunications under which Samsung will receive IXYS's power MOS technology for low- and medium-range power devices; IXYS will manufacture its high-current power MOS devices in Samsung's facility overseas; the two companies will jointly manufacture IXYS's first smart power products that are to be introduced later this year.

SERVICES

Full Custom Design
System Development
Breadboarding

PROCESS TECHNOLOGY

HDMOS (High-performance DMOS)
HDCMOS (Smart power CMOS and HV DMOS)
5 volt Digital CMOS
18 volt Analog CMOS
(5-inch wafers)

PRODUCTS

Standard Products
ASPIC (Application-Specific Power ICs)

IXSE501	Shaft Encoder Peripheral Interface IC (CMOS Motion Control ICs)
IXTM Series	High Voltage Power MOSFETs
IXTH Series	High Voltage Power MOSFETs
ICTP Series	High Voltage Power MOSFETs
MOSIGT	MOS Insulated Gate Transistors

Applications: Automation, robotics, peripherals, and instrumentation markets

FACILITIES

San Jose, CA	10,000 sq. ft.	Research and development, design, and prototyping

Ixys is moving to a 23,000-square-foot facility in Fremont, California, in January 1987.

COMPANY HIGHLIGHTS

Jan. 1986 IXYS offered its first product, the IXSE501, a Shaft Encoder Peripheral Interface IC that provides velocity and position feedback from motors to 8-bit and 16-bit MPUs.

Jan. 1986 IXYS announced an agreement with Samsung Semiconductor and Telecommunications; Samsung will receive IXYS' power MOS technology for low- and medium-range power devices; IXYS will manufacture its high-current power MOS devices in Samsung's facility overseas; the companies will jointly manufacture IXYS's first smart power products that are to be introduced later this year.

Feb. 1986	IXYS offered the IXTM Series, the IXTH Series, and the ICTP Series of high-voltage power MOSFETs.
June 1986	IXYS has offered a line of MOS insulated-gate transistors (MOSIGT) developed by Nathan Zommer, who originally developed IGTs while at GE Intersil. The new devices combine the IGT design with polysilicon gate CMOS technology. It combines the company's HDCMOS technology with CMOS local oxidation and full ion implantation.

Kyoto Semiconductor
Namiginame-machi 418-3
Fukushimi-ku Kyoto-shi
Japan
075 (631) 8823

ESTABLISHED: 1980
NO. OF EMPLOYEES: 17

BOARD: Not available

COMPANY EXECUTIVE

Position	Name	Prior Company
President	Y. Nakata	Mitsubishi

FINANCING

Capitalization: 62 million yen

BACKGROUND

Kyoto is offering GaAs light-emitting diodes (LEDs) with twice the efficiency of available units. The heterostructured diodes feature a 23.6 percent light-emitting efficiency at peak wave lengths of 190 nanometers. Four selections of wave lengths are available: 660, 750, 830 and 890.

Assembly is done in Taiwan.

SERVICES: Not available

PROCESS TECHNOLOGY: Not available

PRODUCTS

- High Bright LED
- Infra LED
- Photo TR
- Photosensors
- LED Display

FACILITIES

Kyoto, Japan	Production

Laserpath Corporation
160 Sobrante Way
Sunnyvale, CA 94086
408/773-8484

ESTABLISHED: June 1983
NO. OF EMPLOYEES: 25

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Michael E. Watts	Dynabyte	President
VP Finance	Timothy P. Carlson	Lightyear	VP
VP R&D	Thomas Toombs	Synertek	VP
VP Mktg	Larry Jordan	Seeq	VP
VP/Ch Scientist	Morgan Johnson	Symmetry	President

FINANCING

Date	Round	Sources	Amount
June 1983	Seed	Crosspoint Venture Partners	$1.0M
July 1985	Round 1	James D. Wolfensohn & Assoc.; GE Venture Capital Corp.; Emerging Growth Partners; Crosspoint Venture Partners	$4.3M
Nov. 1985	Equipment Lease	Pheonix Leasing, ESI	$3.0M

BACKGROUND

Laserpath provides quick-turn laser-programmable gate arrays and uses 3- and 2-micron double-metal CMOS processes. It has also developed a proprietary laser processing technology to fabricate parts in one day in quantities suitable for design verification, breadboarding, beta site testing, and test marketing. Production quantities are produced using traditional photolithographic techniques.

The principal founder of Laserpath is Morgan Johnson, who in 1983 invented a method for quick-turn of multi-layer printed circuit boards and ICs.

VLSI Technology and General Electric provide foundry services; assembly is also subcontracted.

ALLIANCES

General Electric Co.	Feb. 1986	Laserpath and GE entered into a multi-million dollar joint marketing and development agreement to manufacture and sell quick-chip prototype laser-programmable gate arrays. Customers can purchase "instant" prototypes from either Laserpath or GE. GE supports volume production deliveries.

SERVICES

Design
Prototyping
CAD Workstation Support

PROCESS TECHNOLOGY

3.0- and 2.0-micron double-layer metal CMOS

PRODUCTS

QUICK-CHIP Gate Arrays

Family	Linewidth (micron)	Gates	Layers
LP1008L	3.0	880	1-metal
LP1014L	3.0	1,400	1-metal
LP2022L	2.0	2,200	2-metal
LP2032L	2.0	3,200	2-metal
LP2042L	2.0	4,200	2-metal (Dec 1986)
LP2060L	2.0	6,000	2-metal (TBA)
LP2080L	2.0	8,400	2-metal (TBA)
LP20100L	2.0	10,000	2-metal (TBA)

CAD support equipment is available on Daisy, Mentor, and P-CAD workstations.

FACILITIES

Sunnyvale, CA	25,000 sq. ft.	Design and quick-turn prototyping
	1,000 sq. ft.	Clean room for laser processing

Lattice Semiconductor Corp.
15400 NW Greenbrier Pkwy
Beaverton, OR 97006
503/629-2131
Telex: 277338 LSC UR
FAX: 503 645 7921

ESTABLISHED: April 1983
NO. OF EMPLOYEES: 100

BOARD

Name	Affiliation
Rahul Sud	Lattice Semiconductor, President/CEO
C. Norman Winningstad	Floating Point Sytems, Chairman
S. Robert Breitbarth	General Cable International (Retired)
Harry A. Merlo	Louisiana Pacific Corp., Chairman/CEO
Ole Christian Sand	A/S Nevi, Oslo, Norway, Partner
Douglas C. Strain	Electro Scientific Industries, Chairman
Jay C. McBride	Lattice Semiconductor, VP/GM

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Rahul Sud	Intel	Mgr CMOS Mem Opns
VP/Secretary	Raymond Capece	Rosen Research	Vice President
VP Finance	A. Roger Pease	Touche-Ross Intl	Dir Opns
VP/Opns	Jay C. McBride	Intel	Mgr CMOS Engr
Asst VP Sales/Mktg	Paul Kollar	Signetics	Dir Natl Dist Opns
Dir Mktg	Jan Johannessen	Lattice	Dir Corp Finance

FINANCING

Date	Round	Sources	Amount
1983	Round 1	Floating Point Systems, Inc.; Louisiana-Pacific Corp.; C. Norman Winningstad; Harry A. Merlo; Datavekst A/S, Norway; and other corporate stockholders	$2.5M
July 1984	Credit	Oregon Bank; U.S. National Bank	$2.7M

BACKGROUND

Lattice Semiconductor designs, develops, manufactures, and markets high-performance CMOS semiconductor memory and logic components using a proprietary 1.1-micron CMOS and EE CMOS technology. Lattice has pioneered a line of high-speed EE CMOS programmable logic devices called GALs as direct pin-for-pin replacements of bipolar PALs. The Company is offering next-generation GAL devices that include in-system programmability that makes logic configurable "on-the-fly" under software control for robotics and artificial intelligence applications.

Lattice supplies high-speed CMOS SRAMs for commercial and military applications, application-specific 256K SRAMs for highly parallel pipelined supercomputer applications, and high-speed CMOS 64K EEPROMs. The speed is achieved by using a proprietary 1.1-micron EE CMOS process, single-ended sense amplifiers, and substrate biasing. Lattice has achieved first silicon of a 256Kx1 fast SRAM and will follow shortly with a 64Kx4 and 32Kx8 versions. The targeted specification speed is 35ns.

Lattice has established two high-volume wafer fabrication sources in Japan and anticipates initial production from one European source in 1986. All wafer and final testing, including quality and reliability in conformance with MIL-STD-883C, is done at Lattice's facility in the United States.

Lattice publicly commits a 24-hour response to its customers worldwide. It has established 10 direct sales offices in North America, others in London, Paris, and Munich. The Company has also established distribution networks throughout North America, Europe, and the Far East.

Lattice anticipates an initial public offering in April 1987.

ALLIANCES

Floating Point Systems	1983	Lattice and Floating Point Systems agreed to exchange technology for Lattice's UltraMOS technology and FPS's DSP and array processor technology. Floating Point Systems gained major equity participation as well as long-term purchase agreements from Lattice.
Synertek	July 1984	Lattice and Synertek completed a cross-license and second-source agreement under which Synertek will use Lattice's UltraMOS process to manufacture a 35ns 64K SRAM in exchange for a portion of Synertek's production capacity in Santa Cruz, California.

VLSI Technology	Sept. 1984	Lattice provided technology for CMOS EEPROMs and SRAMs to VLSI Technology in exchange for foundry services at VLSI.
Seiko Epson S-MOS	Jan. 1986	Lattice announced a manufacturing and second-source agreement. Seiko Epson acquired the license to Lattice's 16Kx4 SRAM design and process technology; S-MOS acquired the rights to market the part in North America.

SERVICES

Design
Assembly
Test

PROCESS TECHNOLOGY

1.1-micron CMOS
0.7-micron (available late 1986)
(6-inch wafers)

PRODUCTS

MEMORY

SRAM

Organization	Speed (ns)
16Kx4	35
64Kx1	35
8Kx8	35
256Kx1	35
64Kx4	35
32Kx8	35

EEPROM

8Kx8	70, 90, 120

PRODUCTS

ASICS

CMOS EPLD
GAL (Generic Array Logic))

Product Number	Speed (ns)
GAL 16V8	15-25
GAL 20V8	15-25
GAL 39V18	15-25

CMOS Logic

ispGAL 16V8	15-25
ispGAL 20V8	15-25
PR 64K8	45-70

Applications: Computer, communications, military and industrial.

FACILITIES

Beaverton, Oregon	120,000 sq. ft.	Design, assembly, and test.

COMPANY HIGHLIGHTS

1983	Lattice completed first round financing for $2.5 million of equity. Floating Point, one of the investors, will have access to Lattice's UltraMOS technology and 10 percent of wafer fab.
Oct. 1983	Lattice sampled the SR64K4 64K SRAM at 35-55ns in commercial and military grades.
Dec. 1983	Lattice signed a 15-year lease on two buildings in Beaverton, Oregon.
July 1984	Lattice signed an agreement that included cross-licensing and second-sourcing of Synertek's wafer fab and 64K SRAM technology.
	Lattice completed its leaseline from the Oregon Bank for $2.7M to equip an engineering lab.

Sept. 1984	Lattice and VLSI Technology signed an agreement calling for joint development and cross licensing for Lattice to provide EEPROM, SRAM, and EPLD technology and to jointly develop an advanced manufacturing technology at VLSI's wafer fab.
April 1985	Lattice offered the EE64K8 16Kx4 CMOS SRAM.
	Lattice expanded its wafer fab capacity with Japanese companies.
	Lattice introduced the GAL16V8 CMOS PLD with a reprogrammable output macrocell and user array, and featuring EEPROM cells instead of fuses.
May 1985	Lattice moved into its new manufacturing and development facility. In this facility, Lattice will initially design, assemble, and test products with plans to add fabrication in 1987/88.
Dec. 1985	Lattice lowered prices on its GAL 16V8 products due to increased production capability.
Jan. 1986	Lattice announced a second-source agreement for its high-speed SR64K4 64K SRAM. Seiko Epson, of Fujimi, Japan, will receive a license to the chip design and process technology, and S-MOS Systems of San Jose, California will market the chip in North America.
Feb. 1986	Lattice sampled the GAL (Generic Array Logic) 20V8, a CMOS EEPROM-based 24-pin device that operates at 25ns. It replaces 20 of the devices in MMI's 24-pin PAL family of bipolar PLDs.
March 1986	Lattice offered a complete line of fast 64K SRAMs, 64Kx1, 8Kx8, and 16Kx4 at 35ns.

Linear Technology Corp.
1630 McCarthy Blvd.
Milpitas, CA 95035-7487
408/942-0810

ESTABLISHED: September 1981
NO. OF EMPLOYEES: 100

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Robert H. Swanson	NSC	VP/GM Linear Div
VP Engr	Robert C. Dobkin	NSC	Dir Adv Linear Cts
VP Opns	Brian E. Hollins	NSC	Prod Line Mgr
VP Mktg	William A. Ersham	NSC	Grp Dir Mktg Comm
VP Finance	R. Michael O'Malley	Finnigan	Corporate Controller
VP Q&A	Clive B. Davies, PhD	NSC	Technology Dir
VP Sales	Stephen R. Pass	PMI	VP Sales

FINANCING

Date	Round	Sources	Amount
Sept. 1981	Round 1	Hambrecht & Quist; Kleiner, Perkins, Caufield & Byers; Capital Management Services; Mayfield Fund; Sequoia Capital; Sutter Hill Ventures; Technology Venture Investors	$5.0M
May 1982	Round 2	Olivetti; Finance for Industry; and a Hong Kong investor	$5.0M
	Lease	Greyhound Computer Corp.	$9.0M
April 1983	Round 3	Morgan Stanley; Cowen and Company; State Farm; Kemper Financial; Kleinwort Benson; Greivson Grant; Touche Remnant; and others	$7.0M
	Lease	Greyhound Computer Corp.	$9.0M

BACKGROUND

Linear Technology Corp. (LTC) was formed to design, manufacture, and market a broad base of proprietary linear products and enhanced second-sourced products for the military and commercial markets.

LTC's goal is to become the linear market specialist and to lead and direct linear circuit technology and design concepts of the future by addressing difficult application problems in the analog and analog-to-digital interface markets. LTC designers have designed more than 50 percent of today's mainline linear circuits.

Initial LTC product offerings were primarily selected second-sourced products from NSC, PMI, and Analog Devices. The vast majority of new product releases over the last year have been proprietary, which is consistent with the long term strategy of the company.

From its beginning, LTC chose to develop a marketing strategy aimed at penetrating the military market. The achievement of DESC facility qualification in August 1984 allowed the Company to make substantial inroads into the military marketplace.

The Company has incorporated many process enhancement features such as super beta, precision thin-film layers, ion implantation, sub-surface zeners, JFETS, polysilicon, and more to manufacture nearly any kind of linear circuit. LTC is supplying traditional linear products including op amps, voltage regulators, comparators, references, buffers, choppers, filters, interface ICs, and ICs for other special functions as well as temperature sensors. The Company is addressing proprietary linear functions for all of the above as well as for its data-acquisition products, many of which are CMOS.

Linear Technology was founded in 1981 by Robert Swanson, Robert Dobkin, Brian Hollins, Brent Welling, and Robert Widler from National Semiconductor's linear design group. In September 1982, the manufacturing team was in place and the Company had moved into its current facility in Milpitas. By January 1983, the Company had produced its first wafers and production commenced.

In May 1986, LTC established a Japanese unit in Tokyo, Japan to provide technical services to its Japanese customers. The Japanese unit was named Linear Technology K.K. and is wholly owned by the U.S. parent.

In May 1983, LTC began marketing and sales efforts in the United States, Europe, and Japan. LTC has established a network of independent manufacturers' representatives and electronics distributors to provide complete sales coverage.

ALLIANCES

Silicon General	July 1982	LTC and Silicon General completed a technology exchange and second-source agreement; Silicon General provided pulse width modulators and two additional circuits and second-sourced several high-current series pass regulators developed by LTC; no masks were involved.
Teijin Japan Macnics Technology Trading	June 1983	LTC signed an agreement with Teijin Advanced Products, Japan Macnics, and Technology Trading for distribution in Japan.
Signetics	July 1984	LTC completed an alternate-source agreement with Signetics covering LTC's high-end linear circuits and Signetics' small-outline surface mount packages; the agreement included an unspecified royalty payment and other financial considerations.

SERVICES

Design
Manufacturing
Assembly
Test
Military Conformance

PROCESS TECHNOLOGY

Bipolar
Silicon-Gate CMOS (LTCMOS)
(4-inch wafers)
Small Outline Packaging

PRODUCTS

Product Number	Description
LT1001/1002	Single and Dual Precision Bipolar Op Amps
LT1007/1037	Low Noise Op Amp
LT1012/1008 Series	Universal Precision Op Amp
LT1014/1013	Precision Quad and Dual Op Amp
LT1024	Dual-Matched Precision Op Amp
LT1028	Op Amp
LTC1052	CMOS Precision Chopper-Stabilized Op Amp
LF155/156	JFET Op Amp
LT 1044CS8	CMOS Switched Capacitor Voltage Converter
LT1003	Regulator
LT1005	Dual 5V Regulator
LT1033	Precision Regulator,
LT1038	10 Amp Adjustable Voltage Regulator
LT317A/350A/338A/337A	Adjustable Voltage Regulators
LT1070	Switching Regulator
LT1004CS8	Micropower Voltage References
LT1020	Monolithic Micropower Voltage Regulator and Comparator
LT1034	Precision Voltage Reference
LT1004	Micropower Reference Diodes
LT1009	2.5V Reference Diode
LTC1044	Voltage Inverter
LT 1010	Fast Unity Gain Power Buffer
LT1016	High-Speed Comparator
LT1017/1018	Dual Comparators
LTC1040	CMOS Dual Comparator
RS-232	Quad Line Driver
LTC1061/1060/1059	CMOS Universal Switched Capacitor Filters
LTC1062	Low-Pass Filter

FACILITIES

Milpitas, CA	41,000 sq. ft.	Design and manufacturing
	20,000 sq. ft.	Class 10 Clean room
Milpitas, CA	53,000 sq. ft.	Linear headquarters and test

The Company will convert to a 5-inch line as demand expands.

COMPANY HIGHLIGHTS

Sept. 1981	LTC received initial funding--$4.5 million from venture capital and $450,000 from founders.
May 1982	LTC completed Round 2 of financing for a total of $14.0 million.
July 1982	LTC completed a technology exchange and second-source agreement with Silicon General. Silicon General provided pulse width modulators and two additional circuits and second-sourced several high-current series pass regulators developed by LTC; no masks were involved.
Sept. 1982	LTC moved into its new facility.
Jan. 1983	LTC completed its first wafer.
April 1983	LTC completed the designs of second-source and proprietary products.
	LTC completed Round 3 of financing for $16.0 million.
May 1983	LTC offered the 60uV LT1001/1002, single- and dual-precision Bipolar Op Amps as upgrades for standard OP-07, OP-207 devices, commercial and military. Packages include 8- and 14-pin molded DIP, CERDIP, and TO-5 metal can with or without 883B processing.
June 1983	LTC began volume shipments at more than $1M per month.
	LTC signed an agreement with Teijin Advanced Products, Japan Manix, and Technology Trading for distribution in Japan.
July 1983	LTC offered the LT1003 Regulator, 5V, 5A.
Aug. 1983	LTC offered the LT1005 Dual 5V Regulator for digital logic control.
Sept. 1983	LTC offered the LT 1012/1008 Series Universal Precision Op Amp.
Oct. 1983	LTC offered the LT1004M-1.2/1.5 Micropower Reference Diodes in a TO-92 plastic package, commercial, and military grades.

Dec. 1983	LTC introduced the LT1033 Precision Regulator.
	LTC introduced the LT1007/1037 Low Noise Op Amp.
	LTC offered the LT1009 2.5V Reference Diode, a plug-in device for older untrimmed references.
April 1984	LTC introduced the LT317A/350A/338A/337A Adjustable Voltage Regulators.
March 1984	LTC offered the first LTCMOS product using silicon-gate CMOS, a 20 volt process tailored for linear ICs, the LTC 1044 Voltage Inverter pin-compatible with the Intersil 7660.
April 1984	LTC offered the LT 1010, Fast Unity Gain Power Buffer.
July 1984	LTC signed an alternate-source agreement with Signetics covering LTC's high-end linear circuits and Signetics' small-outline surface mount packages; the agreement included an unspecified royalty payment and other financial considerations.
Aug. 1984	LTC offered the industry's first plug-in compatible Precision Quad and Dual Op Amp, the LT 1014/1013.
	LTC is qualified as one of 18 military supplier firms after receiving DESC line certification.
Sept. 1984	LTC offered the LT 1038 10 Amp Adjustable Voltage Regulator.
Jan. 1985	LTC offered the first group of products using small-outline surface mount packages: LT 1001CS8, Op Amp; LT 1004CS8, Micropower Voltage References; LT 1012S8, Op Amp; and LT 1044CS8, CMOS Switched Capacitor Voltage Converter.
Feb. 1985	LTC offered the LT 1024 Dual-Matched Precision Op Amp for low noise, low-offset voltage applications.
Mar. 1985	LTC offered the LF 155/156 JFET Op Amp.
May 1985	LTC offered the LTC 1052, CMOS Precision Chopper-Stabilized Op Amp for commercial and military.

June 1985	LTC offered the LTC 1040, CMOS Dual Comparator.
Aug. 1985	LTC offered the LT1055/1056 JFET Op Amps; 15V, 8-lead plastic DIP or TO-39 metal can; commercial and military.
	LTC offered the RS-232 Quad Line Driver.
Sept. 1985	LTC offered the LTC1061/1060/1059 CMOS Universal Switched Capacitor Filters; single, dual, and triple versions in plastic or ceramic DIP, commercial and military.
Oct. 1985	LTC offered the 10ns LT 1016, High-Speed Comparator.
Nov. 1985	LTC offered the 5V LTC 1062 Low-Pass Filter in an 8-pin miniDIP, commercial and military.
Jan. 1986	LTC offered the 3V to 60V LT 1070 Switching Regulator.
March 1986	LTC broke ground for its new 43,000-square-foot second building.
April 1986	LTC offered the LT1034, a dual, low-power, precision voltage reference on a single chip. It includes 1.2 volt, low-drift reference, and a 7 volt general purpose reference in one package.
	LTC introduced the LT1017/1018, two new low-power dual comparators which include a class B pull-up current on the die. The comparator operates with as low as 1.1 volts and can run on a single-cell battery.
May 1986	LTC offered the LT1028, Op Amp.
June 1986	LTC announced the expansion of its military production lines following a second round of DESC approval.
July 1986	LTC offered the LT1020 Monolithic Micropower Voltage Regulator and Comparator on the same chip for battery powered systems.

Logic Devices Inc.
628 East Evelyn Avenue
Sunnyvale, CA 94086
408/720-8630
Telex: 172387

ESTABLISHED: April 1983
NO. OF EMPLOYEES: 34

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	James McAllister	Raytheon	Dir Mfg
VP Engr	William J. Volz	TI	Sr Technical Staff
VP Mktg/Sales	Jesse O. Huffman	Intel	Mktg/Sales
Dir QA	Scott Crabtree	Interdesign	QA Mgr
Dir Prod Dev	Joel H. Dedrick	TI	Sr Engr
Dir Tactical Mktg	Collyn B. Youngman	Fairchild	Bus Planning
Dir Finance	Todd Ashford	W.R. Grace	Financial Analyst
Dir Sales	Paul E. Meyrowitz	IMP	Sales Manager

FINANCING

Date	Round	Sources	Amount
Aug. 1983	Seed	B. Kanter; Farkas Group	$1.5M
June 1985	Round 2	B. Kanter; Farkas Group	$1.4M

BACKGROUND

Logic Devices Incorporated was formed to design, manufacture, and market high-performance CMOS components for the digital signal processing (DSP) and array processing markets. It is one of the first companies in the DSP market dedicated exclusively to CMOS technology.

The Company's first products were direct replacements for existing TRW and AMD parts that offered substantially increased performance at lower power levels. A line of proprietary parts was later introduced to expand its product family and capitalize on the firm's technological capabilities.

Logic's operations are conducted from its Sunnyvale, California, headquarters where it has administrative, engineering, assembly, and test facilities. The facility includes a semiautomatic assembly and testing line with high-reliability and burn-in production flows.

Logic markets its products through a network of domestic and European distributors and manufacturers' representative firms.

SERVICES

Design
Manufacturing
Assembly
Test

PROCESS TECHNOLOGY

2.0- and 2.5-micron CMOS Silicon-Gate

PRODUCTS

Special Purpose Memory Circuits

Product Number	Description
LRF08	Five-Port Register File
LRF07	Three-Port Register File
LPR520/LPR521	16-bit Multilevel Pipeline Registers
L29C520/L29C521	8-bit Multilevel Pipeline Registers

Multipliers

Product Number	Description
LMU08/LMU8U	8x8 bit Parallel Multipliers
LMU557/LMU558	8x8 bit Parallel Multipliers
LMU12/LMU13	12x12 bit Parallel Multipliers
LMU16/LMU17/LMU18	16x16 bit Parallel Multipliers

Arithmetic & Multiplier/Accumulator Circuits

Product Number	Description
LMA1009	12x12 Multiplier/Accumulator
LMA1010	16x16 Multiplier/Accumulator
LMA1043	16x16 Multiplier/Accumulator
L429C01	16-bit Bit Slice Processor
L10C23	64-bit Digital Correlator
LSH32	32-bit Barrel Shifter/Normalizer
L4C381	16-bit Arithmetic Logic Unit
L4C381-1	CMOS ALU that combines the capabilities of four 54S381 4-bit ALUs

Applications: DSP applications including defense electronics; guidance systems; and avionics; image and graphics processing systems; robotics; telecommunications equipment; speech compression

FACILITIES

Sunnyvale, CA	12,300 sq. ft.	
	2500 sq. ft.	Class 1000 Clean room

COMPANY HIGHLIGHTS

1983 — In August 1983, Logic Devices received its first round of financing and later that year set up its manufacturing, assembly, and production test areas.

Feb. 1984 — Logic Devices introduced the following products: The LMU08/LMU8U, 8x8 bit Parallel Multipliers; the LRF08, a Five-Port Register File; the LMU12/LMU13, 12x12 bit Parallel Multipliers; and the LMU16/LMU17/LMU18, 16x16 bit Parallel Multipliers.

May 1984 — Logic Devices offered the LMU557/LMU558, 8x8 bit Parallel Multipliers.

Oct. 1984 — Logic Devices offered the LPR520 and LPR521, 16-bit Multilevel Pipeline Registers, and the L29C520 and L29C521, 8-bit Multilevel Pipeline Registers.

Aug. 1985	Logic Devices offered the LRF07, a Three-Port Register File.
Dec. 1984	Logic Devices offered the LMA1010, a 16x16 Multiplier/Accumulator.
Jan. 1985	Logic Devices offered the L429C01, a 16-bit Bit Slice Processor.
July 1985	Logic Devices offered the LMA1009, a 12x12 Multiplier/Accumulator.
Nov. 1985	Logic Devices offered the L4C381, a 16-bit Arithmetic Logic Unit.
Dec. 1985	Logic Devices offered the L10C23, a 64-bit Digital Correlator.
March 1986	Logic Devices offered the LMA1043, a 16x16 Multiplier/Accumulator.
May 1986	Logic Devices offered the LSH32, a 32-bit Barrel Shifter/Normalizer.
July 1986	Logic Devices offered the L4C381-1, a CMOS ALU that combines the capabilities of four 54S381 4-bit ALUs.

LSI Logic Corporation
790 Sycamore Drive
Milpitas, CA 95035
408/433-8000

ESTABLISHED: January 1981
NO. OF EMPLOYEES: 1,155

BOARD

Name	Affiliation
Wilfred J. Corrigan	LSI Logic Corporation
James H. Keyes	Johnson Controls, Inc.
Thomas J. Perkins	Kleiner, Perkins, Caufield & Byers
Donald Valentine	Capital Management Services, Inc.
George D. Wells	LSI Logic Corporation

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
CEO	Wilfred Corrigan	Fairchild	Chairman
President	George Wells	Fairchild	VP
Pres/European Opns	Bob Blair	Fairchild	Dir Mktg Europe
Pres/Canadian Opns	Mitchell Bohn	Fairchild	Finance
Pres/Far East Opns	Keiske Yawata	NEC Elec.	President
VP Rel/QA/Mil	Norman Chanoski	Precision Mon	President
VP NA Mktg	Perry Constantine	Eaton	VP Mktg
VP R&D	Conrad Dell'Oca	HP	
VP/Corp Ctr	Raymond Fritz	Xerox	VP Finance
VP Opns & Dev	Cyril F. Hannon	Optimetrics	President
VP Engr	Ven L. Lee	Intersil	
VP Des Auto	James S. Koford	Boeing	
VP Bus Dev	Murray McLachlan	Fairchild	GM Asia Opns
VP/CFO	D. Scott Mercer	Price Waterhouse	VP/Corp Ctr
VP Marketing	Bill O'Meara	Fairchild	VP Sales
VP Corp Commun	Bruce Entin	Atari	VP Corp Commun
VP Std Prod Engr	Robert Walker	Intel	
VP Mtls/Logistics	A. Travis White	Honeywell	Dir Central Ops
VP Indus Relations	Lewis Wallbridge	Amdahl	Dir Indus Rel
VP Milpitas Mfg	Hoseph Zelayeta	Raytheon	Prod Engr Mgr

FINANCING

Date	Round	Sources	Amount
Jan. 1981	Round 1	Kleiner, Perkins, Caufield & Byers; Mayfield Fund; Sutter Hill Ventures; Institution Venture Associates; California Northwest; Bank America Capital	$6.0M
Feb. 1982	Round 2	Original investors; Merrill, Pickard, Anderson & Eyre; Sequoia Fund; Technical Development Capital, London	$9.9M
	Lease	First Interstate Bank	$10.0M
May 1983	Round 3	Initial Public Offering	$160.0M
Feb. 1984	Round 4	Private Offering	$18.8.0M

BACKGROUND

LSI Logic was established to design, develop, manufacture, and market high-performance programmbale logic arrays and has concentrated on four areas: CAD tools, multilayer metal interconnect, high-pin count on ceramic packaging, and high-performance CMOS and ECL processing.

The company was founded by Wilfred J. Corrigan, Rob Walker, William O'Meara, and Mitchell D. Bohn.

LSI Logic believes that to compete internationally, a presence must be established in Japan, Europe, and the United States. As a result, LSI Logic has set up wholly owned subsidiaries in Japan, Europe, and Canada, and has raised equity there. In 1984, LSI Logic Limited was formed in Bracknell, United Kingdom, and in March of the same year, Nihon LSI Logic K.K. was formed to serve the Japanese market. Headed by Keiske Yawata, Nihon LSI Logic K.K. plans to reach $100 million in sales by 1992, or 10 percent of the Japanese ASIC market, and to employ 200 in 1986. A second design center is open in Osaka with plans for a third in Tsukuba for 1986. Initially it will offer 1.5-micron CMOS technology.

LSI Logic also formed the Nihon Semiconductor joint subsidiary with Kawasaki Steel which will be a manufacturing facility for the company in Japan.

LSI Logic recently formed LSI Logic Corporation of Canada, Inc., to serve the Canadian market. The Canadian Company is headed by Mitchell Bohn.

ALLIANCES

CDI	July 1981	LSI and CDI participated in an exchange agreement covering CDI's HC Series of gate arrays in exchange for LSI Logic's CAD system.
Toshiba	Aug. 1981	LSI and Toshiba participated in joint development of 1,000- to 10,000-gate CMOS arrays. Toshiba supplied HCMOS wafers; LSI Logic provided gate array designs. The codevelopement effort produced a 6,000-gate array with SRAM on-chip in December.
	June 1983	LSI participated in joint development of a channel less "Compacted Array".
	June 1985	LSI and Toshiba agreed to a 4-year joint venture for the development of a 50,000-gate "Sea-of-Gates" array for sales in FY 1986 using 1.5-micron design rules, Toshiba's CMOS process, and LSI logic's simulation and software.
AMD	Jan. 1982	LSI granted a 5-year logic array license to AMD for manufacturing the LCA 1200 Series of 600 to 1200-gate ECL macrocell arrays.
	Aug. 1984	LCI and AMD agreed to joint development of CMOS standard cell definitions and a library for designing large-scale ICS. AMD provided 1.6-micron technology, LSI Logic provided software development.
Fujitsu	1982	LSI and Fugitsu signed an agreement covering HCMOS gate arrays.
RCA	April 1983	LSI signed an alternate-source agreement with RCA under which RCA will provide an alternate source for LSI Logic's 5000 Series.
SGS	April 1983	LSI licensed SGS as an LSI 5000 Series and CAD software alternate source.

LSI Logic K.K.	1984	LSI formed a Japanese subsidiary.
LSI Logic Europe, Ltd.	1984	LSI Logic formed a subsidiary in the United Kingdom.
Intersil	Feb. 1984	Intersil and LSI signed a 5-year second-source agreement for LSI Logic's HCMOS process logic arrays and Intersil's CMOS gate array family.
C. Itoh	April 1985	C. Itoh reached an agreement with LSI Logic K.K. to sell LSI products in Japan.
Kawasaki Steel	Aug. 1985	LSI Logic and Kawasaki Steel formed a joint venture gate array company, Nihon Semiconductor, at a capitalization of $47 million. LSI holds a 55 percent interest and Kawasaki Steel 45 percent. The company will be located in Japan, with construction planned for 1986, and production planned in 1987. The gate arrays will be marketed by LSI Logic and Nihon LSI Logic. The first year sales target is $200M.
Raytheon	Jan. 1986	LSI signed a 5-year agreement for Raytheon to second-source LSI Logic's LL7000 Series of Logic Arrays; LSI Logic will provide its LDS software system to design and produce the logic arrays.
Master Images	Mar. 1986	LSI Logic acquired a 20 percent equity in Master Images, a photomask supplier.
Sun Microsystems	April 1986	Sun and LSI Logic signed an agreement allowing LSI Logic to sell Sun's technical workstation and advanced schematic capture system and to use Sun's workstations for internal software development.

STC	May 1986	STC plc agreed in principle to sell a majority stake in its semiconductor division to LSI Logic Europe Ltd. as part of its financial recovery efforts. STC will sell 90 percent to LSI and others with LSI retaining a majority holding. Under the agreement, STC and LSI will form a joint venture to make and market semiconductors at an uncompleted facility in Foots Cray, England.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

2.0- and 1.5-micron dual-layer HCMOS
(4-, 5-, 6-inch wafers)

PRODUCTS

CMOS Logic Arrays

Family	Process	Design Rules (micron)	Delay (ns)	Gates
LL 3000	Si-gate HCMOS	3.5	4.5	272 to 2550
LL 5000	Si-Gate HCMOS	2.5	2.5	504 to 6,000
LL 7000	Si-Gate HCMOS	2.0	1.3	968 to 10,013
LL 8000	Si-Gate HCMOS	2.0	1.4	880 to 3,200
LL 9000	Si-Gate HCMOS	1.5	1.0	880 to 10,000
LCA10,000	Si-Gate HCMOS	1.5	0.7	38,000 to 129,000

CMOS Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
LSA 2000	Si-Gate	2.0	1.4	200-gates, 300 MSI, RAM, ROM, PLA, multiplier
LST 20	Si-Gate	2.0	1.4	400-gates, 300 MSI, multiplier, barrel shifters, 6845, 8251, 2901 family

CMOS Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
LSC 20	Si-Gate	2.0	1.4	400-gates, 300 MSI, RAM, ROM, PLA and LST cells

DSP

L64032 32-bit Fixed Point Multiplier/Accumulator (MAC)

Evaluation Chip

5220Q An evaluation chip for the LSI 5000 Series of logic arrays. Based on 3-micron double-layer metal HCMOS, it contains from 880 to 6,000 gates.

CAD Tools

LDS-1 A development system CAD tool to design arrays using CMOS, ECL, or HCMOS.

MACGEN A megacell compiler that can generate multiplier/accumulators (MACs), multipliers, and adders for cell-based custom designs and structured arrays, or gate arrays with fixed macroblocks.

FACILITIES

Milpitas, CA	339,000 sq. ft.	Class 10 and 100 Clean room
Munich, West Germany	15,000 sq. ft.	Assembly and test facility under construction

Design Centers:

Milpitas, CA
Irvine, CA
Sherman Oaks, CA
Boca Raton, FL
Itasca, IL
Waltham, MA
Minneapolis, MN
Dallas, TX

Design Centers (Continued):

Calgary, Alberta
Kanata, Ontario
Tokyo, Japan
Osaka, Japan
Berkshire, United Kingdom
Dusseldorf, West Germany
Munich, West Germany

COMPANY HIGHLIGHTS

July 1981	LSI signed an agreement to provide LSI's forthcoming Cad system, LDS-1, to California Devices Inc. in exchange for manufacturing rights to CDI's HC Series of CMOS gate arrays, single-layer metal, 300- to 1,700-gates.
Aug. 1981	LSI signed a joint development agreement with Toshiba for CMOS gate arrays (3-micron, 5ns, 1,000 to 10,000 gates).
Jan. 1982	LSI granted a 5-year logic array license for AMD to manufacture the LCA 1200 Series of ECL macrocell arrays (600 to 1,200-gates).
Feb. 1982	LSI completed Round 2 of equity and lease financing for $16.35 million that provided additional working capital for capital equipment purchases and plant expansion.
May 1982	LSI offered the LDS-1, a development system CAD tool to design arrays using CMOS, ECL or HCMOS.
Oct. 1982	5220Q, an Evaluation Chip, for the LSI 5000 Series of logic arrays. Based on 3-micron double-layer metal HCMOS, it contains from 880 to 6,000 gates.
Mar. 1983	LSI introduced the LL7000 Series of HCMOS logic arrays with 968- to 10,000-gates, 1.3ns delay, and mask gate lengths of 2.0-micron and 1.4-micron.
April 1983	LSI signed an alternate-source agreement with RCA for the LSI 5000 Series. SGS is licensed as LSI 5000 Series and CAD software alternate source.

May 1983	LSI offered 7.7 million shares in an initial public offering which raised $152 million to fund manufacturing and design expansion.
June 1983	LSI went into volume production of the LSI 5000 Series.
	LSI and Toshiba jointly developed a 1.3ns, 2-micron CMOS process for gate arrays up to 10,000 gates.
	LSI added a gate array design center in Irvine, California.
Dec. 1983	LSI moved into its new facility in Milpitas, California.
Feb. 1984	LSI signed a 5-year second source agreement with Intersil for gate arrays.
Feb. 1984	Private offering of LSI Logic K.K. stock which raises $18.8 million.
Aug. 1984	AMD and LSI sign a joint agreement for standard cells; AMD will also alternate-source the LL7000 Series of 2-micron gate arrays.
Oct. 1984	LSI introduced the LL8000 Series of HCMOS arrays (2-micron, 2-layer metal, 880- to 3,200-gates). The arrays include 200 macrocells and are packaged 68-pin plastic chip carriers.
	LSI opened its 74,000 sq. ft. test and assembly plant in Fremont, California.
Jan. 1985	Keiske Yawata was hired to run Japanese subsidiary.
April 1985	LSI Logic announced plans to build a $50 million, 70,000 sq. ft. manufacturing facility in Braunschweig, West Germany, which will open in late 1986 or early 1987. It will house LSI Logic Europe, Ltd., and provide HCMOS sub-2-micron design, manufacturing, assembly, and test.
May 1985	LSI introduced the LSA 2000 Family of Structured Arrays with 3,000 to 6,000 gates of logic and 2,304 and 9,216 bits of RAM.

June 1985	Toshiba and LSI Logic plan to develop a series of 1.5-micron CMOS gate arrays using a sea-of-gates approach with more than 20,000 gates.
Aug. 1985	LSI Logic and Kawasaki Steel will jointly build an affiliated manufacturing company, Nihon Semiconductor. It will be funded for a total of $200 million with an initial investment of $100 million. The company will be headed by Keiske Yawata. LSI Logic will provide the technical expertise.
Oct. 1985	Toshiba and LSI Logic announced the LCA 10,000, an HCMOS channel less gate array using 1.5-micron design rules with 50,000 usable gates and having a 1.1ns gate delay.
	LSI announced the LL9000 Series of HCMOS Logic Arrays using 1.5-micron HCMOS, with 1.0ns delays, 880 to 10,000 gates in 200 macrocells.
Nov. 1985	LSI announced the availability of the LSC 20 Structured Cells Library on its LDS design system with 32K of SRAM and 128K of ROM. LSI Logic has combined its LST 20 standard cell family and LL7000 gate arrays family with megacells to create the new library.
Jan. 1986	LSI signed a 5-year agreement for Raytheon to second source LSI Logic LL7000 Series of Logic Arrays; LSI Logic will provide its LDS software system to design and produce the logic arrays.
Mar. 1986	LSI Logic acquired a 20 percent equity share in Master Images, a photomask supplier.
April 1986	LSI Logic introduced MACGEN, the first of a series of Megacell Compilers. MACGEN is a proprietary megacell compiler that operates in conjunction with LSI Logic's LDS design system. It generates multiplier/accumulators (MACs), multipliers, and adders for cell-based custom designs and structured arrays (gate arrays with fixed macroblocks).
	LSI Logic offered its first standard product, a 32-bit fixed point multiplier/accumulator (MAC), the L64032. MAC is manufactured using 1.5-micron HCMOS and operates at 80ns commercial and 100ns military. It was generated with MACGEN.

April 1986 Sun Microsystems and LSI Logic sign an agreement allowing LSI Logic to sell Sun's technical workstation and advanced schematic capture system and to use Sun's workstations for internal software development.

May 1986 STC plc agreed in principle to sell a majority stake in its semiconductor division to LSI Logic Europe Ltd. as part of its financial recovery efforts. STC will sell 90 percent to LSI and others with LSI retaining a majority holding. Under the agreement, STC and LSI will form a joint venture to make and market semiconductors at an uncompleted facility in Foots Cray, England.

LSI Logic offered more than 20 ASIC library elements which can be incorporated into its array-based or cell-based product lines.

LSI Logic began guaranteeing turnaround times on prototype gate arrays for its major customers. The company announced plans to reduce the time from sign off on simulation to prototype delivery from about four weeks to two weeks.

Lytel
61 Chubb Way
Sommerville, NJ 08876
201/685-2000

ESTABLISHED: November 1983
NO. OF EMPLOYEES: 100

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Chairman	Dr. Eugene Gordon
President	Ralph Simon
Executive VP	Ron Nelson
VP Mktg	Tom Lewis
VP Finance/Admin	Sid Landman
VP Mfg	Jim Vaughn

FINANCING

Date	Round	Sources	Amount
1984	Start-up	AMP	$20.0M

BACKGROUND

Lytel was formed to design, develop, and manufacture InGaAsP technology-based electro optic components for the telecommunications and data communications markets.

Lytel's first products, introduced in January 1986, were InGaAsP high-power lasers for fiber optics applications. The Company is focusing on quality, reliability, delivery, and performance--in short, "speaking the customers' language."

Lytel is both a merchant and captive supplier.

ALLIANCES: Not available

SERVICES

Design
Manufacturing
Assembly
Test

PROCESS TECHNOLOGY

InGaAsP
1.3-micron

PRODUCTS

InGaAsP High Power Lasers
LEDs
Optical Data Lengths

Applications: Telecommunications and data communications

FACILITIES

Sommerville, NJ	60,000 sq. ft.	
	5,000 sq. ft.	Class 10,000 Clean room

Matra-Harris Semiconductor
La Chantrerie
Route de Gachet
B.P. 942
44075 Nantes Cedex
France
Phone: (40) 303030
Telex: MATHARI 711930 F

ESTABLISHED: 1979
NO. OF EMPLOYEES: 1,000

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Chairman	Guy Dumas
Strategist	Jean-Claude Rentlet
Commercial Dir	Michael Thouvenan

FINANCING

Date	Round	Sources	Amount
1979		Matra S.A. and Harris Corp	$40.0M

BACKGROUND

Matra-Harris Semiconducteurs (MHS) was formed in 1979 as a joint venture company by Matra of France and Harris Corporation of the United States. Prior to this formal link, Matra and Harris had made agreements for CMOS technology transfers. The agreement was extended in 1980 to include bipolar products.

The Company was supported by the French Government in place at that time to develop high technology in France. A 12,000-square-foot factory was built near Nantes and designated as an area for industrial development, which allowed MHS to gain government financial assistance. Initial wafer fabrication began in December 1980.

In March 1981, MHS signed an agreement with Intel Corporation covering the manufacture of Intel's NMOS circuits in Nantes and the two companies established a joint design facility called Cimatel. The objective of Cimatel was to increase the MHS and Intel product ranges. Cimatel activities have been largely related to modifications and improvement of existing designs.

In 1982, MHS and Harris merged their European marketing operations outside France (Harris-MHS). The new operation was financed equally by the two partners. Under the 1979 agreement, MHS continues to have exclusive sales rights in France for the Harris line of semiconductors. Conversely, Harris represents MHS exclusively for sales in North America.

Today, Matra-Harris remains the only independent French semiconductor operation not absorbed into the Thomson Group.

Matra-Harris has developed CMOS, bipolar, and NMOS technologies. Its main product strategies center around memories, microprocessors, gate arrays, and telecommunications circuits.

ALLIANCES

Intel	March 1981	MHS and Intel sign an agreement covering NMOS circuits and to establish a joint design facility in Nantes.
Cypress and Harris	Oct. 1985	Cypress transferred masks for its 25ns 4K 16K SRAMs and provided its 1.2-micron CMOS technology to Matra-Harris. Cypress will receive 2 percent of Matra-Harris stock for an undisclosed amount of cash. A similar deal for the Cypress 0.8-micron process and 64K SRAM is planned.
Weitek	March 1986	Matra and Weitek signed a wide-ranging technology exchange and foundry agreement. MHS was granted Weitek's high-performance 16-bit integer multiplier product family. Weitek has preferred access to the MHS CMOS process in exchange for manufacturing a variety of Weitek's products. The agreement also included joint development on complex high-speed logic devices intended to solve compute intensive problems in the DSP, telecommunications, and military markets.

Silicon Compilers	June 1986	MHS and Silicon Compilers will integrate SCI's Genesil silicon design system with MHS's advanced 2-micron dual-level-metal CMOS process. MHS will also offer prototyping services, volume production, and design services for Genesil users.

SERVICES

Design
Manufacturing
Assembly
Test

PROCESS TECHNOLOGY

2.0-micron CMOS

PRODUCTS

CMOS SRAMs

	Device	Organization	Speed (ns)
1K	HM-6561	256x4	220 to 750
4K	HM-6504	4,091x4	220 to 370
	HM-6514	1x4,091	220 to 750
16K	HM-65161/6116	2,048x8	70 to 120
	HM-65261	16,384x1	70 to 100
	HM-65681	4,096x4	55 to 85
64K Module	HM5-6564	16,334x4 8,192x8	400 to 500
	65641	8Kx8	70, 120

CMOS Gate Arrays

Family	Gates
MA-0250	250
MA-0400	400
MA-0800	800
MA-1200	1,200

Micro Components

Device	Description
8031/8051	8-Bit MCU
8086	16-Bit MPU
8088	8-Bit HMOS MPU
82C43A	Interface
80C86	16-Bit CMOS MPU
80C88	CMOS 8/16-Bit MPU
82716/VSDD	Video storage and display device

FACILITIES

Nantes, France	72,000 sq. ft.	Design, manufacturing, assembly, and test

Maxim Integrated Products
510 North Pastoria
Sunnyvale, CA 94086
408/737-7600

ESTABLISHED: May 1983
NO. OF EMPLOYEES: 100

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Jack Gifford	Intersil	President
VP R&D	Dave Fullagar	Intersil	VP R&D
VP Opns	Dr. Steven Combs	GE	VLSI Process Dev
VP Sales	Fred Beck	Hamilton Avnet	Founder
Controller	Richard Slater	Atari	Controller

FINANCING

Date	Round	Sources	Amount
1983	Round 1	Bessemer Venture Partners; Brentwood Associates; DSV Partners, Venad; Merrill, Pickard, Anderson & Eyre; Overseas venture capital	$4.9M
Feb. 1985	Round 2	Adler & Co.; Bessemer Venture Partners; Brown Boveri; Brentwood Associates; Data Sciences Ventures; De Monet Industries; Merrill, Pickard, Anderson & Eyre	$5.5M
	Lease	Bank of America; Bank of the West	$5.25M
Sept. 1985	Round 3	Bessemer Venture Partners; BNP Ventures; Brentwood Assoc.; Data Sciences Ventures; Merrill, Pickard, Anderson & Eyre; Rothschild, Inc.	$6.4M
March 1986	R&D	Venture Technology Funding	$1.2M

BACKGROUND

Maxim Integrated Products was formed to offer monolithic CMOS, complex bipolar hybrids, and ASICs.

Maxim was formed by Jack Gifford, Dave Fullagar, and Fred Beck, former employees of Intersil's Analog IC Product Division.

Maxim's 30,000-square-foot facility in Sunnyvale, California, purchased from Si-Fab, houses design and test activities. Packaging is done offshore. Maxim introduced 30 products in 1984, 35 in 1985, and plans to introduce 40 products in 1986. The Company achieved its first profitable month in June 1985.

The Company set up sales bases in 11 European countries in 1984 and 1985 and set up a direct sales office in Japan in August of 1985.

ALLIANCES

Brown Boveri	Feb. 1985	Maxim agreed to design and manufacture devices for Brown Boveri.
Intersil	April 1986	Maxim and Intersil signed a second-source agreement.

SERVICES

Design
Manufacturing
Test

PROCESS TECHNOLOGY

CMOS
Bipolar

PRODUCTS

Product Number	Description
ICL 7663A/7664A	CMOS Voltage Regulators
MAX 4193	CMOS DC-DC Regulator
MAX 634/MAX4391	CMOS DC-DC Inverting Regulators
ICL 7650/7652	CMOS Chopper-Stabilized Op Amps
LH0101	Power Op Amp
MAX 420 Series	CMOS Op Amp Family
ICL 7106/7107/7109	CMOS A/D Converters
ICL 7126/7129/7135/7136	CMOS A/D Converters
ICL 7129A	Low Noise ADC
MAX 600 Family	ADC Converters
MAX 4193	CMOS DC-DC Converter
MAX 699 Family	Low-Cost Converters
AD 578S	12-bit ADC
MAX136	A/D with a data hold function
MF10	CMOS Dual Switched Capacitor
ICM 7218	Single-Chip LED Display Driver
MAX 7231-7234	Triplexed LED Driver
ICM 7217	Up/Down Counters
ICM 7240/50/60	Timers/Counters
MM74C945	Up-Down Counters
AD2700	Positive Reference
AD2701	Negative Reference
MAX670/671	Precision References
REF01/REF02	CMOS Precision Voltage References
IH 5341/5342	CMOS Monolithic Analog Switches
IH 5040/5140 Family	CMOS Analog Switches
DG201A/211	Analog Switches
MAX 232	5V Transceiver
MAX 8211/8212	Micropower Voltage Detectors
MAX 460	JFET Input Voltage Follower
BB3553	Unity Gain Buffer
IH6108/IH6208	Analog Multiplexers

FACIILITIES

Sunnyvale, CA	30,000 sq. ft.	Design and test.

COMPANY HIGHLIGHTS

Over the last two years Maxim has sequentially introduced the following products:

Mar. 1985	ICL 7663A/7664A, CMOS Voltage Regulators; 1 percent output accuracy, 5V; 8-pin plastic DIP/CERDIP/TO-99/SO/die form, industrial;
June 1985	ICL 7650/7652, CMOS Chopper-Stabilized Op Amps;
Aug. 1985	ICL 7106/7107/7109/7126/7129/7135/7136, a line of CMOS A/D converters;
	LH0101 Power Op Amp
Sept. 1985	MF10, CMOS Dual Switched Capacitor; 20-lead plastic or ceramic DIP or die form, commercial, industrial, and military;
	ICM 7218 Single-Chip LED Display Driver;
	ICM 7217 Family of Up/Down Counters, 28-pin plastic or CERDIP;
Oct. 1985	Positive Reference, AD2700; Negative Reference, AD2701; 14-pin sidebrazed DIP; commercial, industrial, and military;
	Low Noise ADC, ICL 7129A; 3mV of noise, 10mV resolution change; 40-pin plastic DIP/CERDIP/44-lead plastic chip carrier, commercial;
	IH 5341/5342 CMOS Monolithic Analog Switches;
Nov. 1985	Triplexed LED Driver, MAX 7231-7234 for MPU interface; 4.5-5.5V, 40-pin plastic DIP;
	Timers/Counters, ICM 7240/50/60, plastic or ceramic DIP, commercial and military;
	CMOS Op Amp Family, MAX 420/421; 8-pin or 14-pin plastic DIP/8-pin TO-99, commercial, industrial, and military;

Nov. 1985	CMOS Analog Switches, IH 5341/5352; plastic or ceramic DIP/TO-100 metal can, commercial, industrial, and military;
	Micropower Voltage Detectors, MAX 8211/8212 DIC; 8-pin CERDIP or plastic DIP, commercial and military;
Dec. 1985	AC-DC, MAX 600 Family; Converts AC voltages to a fixed 5V DC; 8-pin DIP, commercial;
	CMOS DC-DC Regulator, MAX 4193; 2.4-16.5V; 8-pin plastic DIP/8-pin SO/8-pin CERDIP, commercial, industrial, and military;
	MAX 699 Family of low-cost converters;
	AD 578S, 12-bit ADC;
Jan. 1986	MAX 232, 5V Transceiver TTL/CMOS compatible; 16-pin DIP/CERDIP/SO surface mount;
	IH5040/5140 Family of CMOS Analog Switches;
	DG201A/211 Analog Switches;
March 1986	Maxim introduced MAX670 and 671 Precision References Sources.
	Maxim introduced MAX 460, a JFET input voltage follower.
April 1986	Maxim introduced BB3553, a unity gain buffer.
May 1986	Maxim introduced MAX136, an LCD 3-1/2-digit A/D with a data hold function.
	Maxim introduced MM74C945 Up-Down Counters.
July 1986	Maxim introduced IH6108 and IH6208 analog multiplexers.
	Maxim introduced REF01 and REF02 CMOS Precision Voltage References and MAX634 nd MAX4391 CMOS DC-DC inverting regulators.

MCE Semiconductor Inc.
U.S. Headquarters
1111 Fairfield Drive
West Palm Beach, FLA 33407
305/845-2837
Telex: 441 405 (MCE UI)
Telefax: 305 863 8275

ESTABLISHED: 1977
NO. OF EMPLOYEES U.S.: 85

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President/CEO	Otto Hibbe
Dir Mktg	Dirk Schwebe
Dir QA	Richard McCargar
Controller	Jim Fitzgerald
R&D Coordinator	Dr. Fawzi Hamzawi

FINANCING: Not available

BACKGROUND

MCE Semiconductor designs and manufactures custom and semicustom ICs, design tools, and selected standard products for high growth markets. Available technologies include bipolar linear and digital, I2L, power, BiFET, and CMOS. MCE conducts testing, including environmental screening and stress tests.

MCE Semiconductor was founded in 1977 as an engineering facility for custom ICs. Financing came from private individuals. In 1978, a computer system for CAD and simulation was added. Wafer fabrication and full production testing began in 1979. Subsequently the facilities were expanded to include fully computer-controlled, state-of-the-art 4-inch wafer fabrication using positive resist.

MCE distributes its products from its sales offices in Munich and Berlin, West Germany, and through a nationwide organization of manufacturers' representatives.

ALLIANCES

MCE U.K.	Second-source and technology agreement.

SERVICES

Foundry	Bipolar and CMOS
Design	CMOS and Bipolar Gate Arrays, Cell Libraries
CAD	
Manufacturing	

PROCESS TECHNOLOGY

5.0-micron Metal-Gate CMOS
4.0-micron Silicon-Gate CMOS
Bipolar
(4-inch wafers)

PRODUCTS

Standard Cell

MCE Unicell	Bipolar J1	4.0	7	Op Amps, references, comparators

Gate Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates and Functions
MCE MGA	Me-Gate CMOS	5.0	8	220 to 285
MCE MGA	Me-Gate CMOS	5.0	10	21 gates, 38 MSI, bias generator, comparator, Op Amp
MCE SGA	Si-Gate CMOS	9.0	5	15 gates, 13 MSI, comparator, Op Amp, bias generator

Linear ICs

Family	Process	Linewidth (micron)	Delay (ns)	Gates
MCE Uniray	Bipolar J1	5.0	15	38 to 220

Standard ICs

- Data Converters
- Voltage Regulators
- Comparator
- Audio Power Amplifiers
- BiFET Operational Amplifiers

FACILITIES

West Palm Beach, FL	33,000 sq. ft.	Production, test, assembly, wafer fab, research and development, CAD, CAE, sales and marketing, and quality assurance/quality control
Planned facility	15,000 sq. ft.	
Munich, West Germany	12,000 sq. ft.	Design center, sales and marketing
Berlin, West Germany	15,000 sq. ft.	Test, CAD, and quality control Adding 21,000 sq. ft.
Gloucestershire, England	60,000 sq. ft.	Production assembly, test and quality control

Design Centers:
West Palm Beach, FLA
Munich, West Germany

Micro Linear
2092 Concourse Drive
San Jose, CA 95131
408/262-5200

ESTABLISHED: October 1983
NO. OF EMPLOYEES: 110

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman	Dr. Alan Grebene	Exar	Founder/Sr VP
President/CEO	Art Stabenow	NSC	Sr VP/Analog Div
VP Sales/Mktg	Art Fury	Siliconix	VP Marketing
VP WW Sales	Brian Currie	AMD	VP NA Sales
VP Engr	Dr. Jim McCreary	Intel	Program Mgr
VP Finance/Admin	Al Castleman	MCI/Quantel	VP Finance
VP Mfg	Abe Korgav	Seeq	Dir Test/Assembly

FINANCING

Date	Round	Sources	Amount
Oct. 1983	Round 1	Adler & Co.; Oak Investment Partners; Fairfield Ventures; Richard Reardon; and founders	$4.0M
	Leases	California First Bank; Western Technology Investors	$3.5M
Nov. 1985	Round 2	Original investors; Accel Partners; Grace Ventures; Greenwood Funds; Harvest Ventures; International Industrial Interests; Institutional Venture Partners; Investors in Industry; Kyocera International; Montgomery Ventures; Tadiran, Israel; Xerox Venture Capital;	$12.0M
	Leases	Burnham Leasing Corp.; California First Bank	$6.2M

Date	Round	Sources	Amount
Feb. 1986	Round 3	Original investors; General Electric Pension Fund; Northern Telecom, Canada; Aeneas Venture Corp.; Schroeder Ventures; U.S. Venture Partners; First Analysis Corp.; United Technical Services; Kuwait & Middle East Financial Services	$15.3M

BACKGROUND

Micro Linear designs and manufactures linear and mixed linear/digital application-specific large-scale integrated (LSI) circuits. Its customized LSI products are aimed primarily for the telecommunications, industrial controls, computer peripherals, and military applications.

Micro Linear also offers a number of computer-aided design (CAD) tools and a portfolio of linear semicustom design methodologies--including mask programmable analog arrays and standard cells--that greatly simplify the development of ASIC products containing analog functions.

The company was founded by Dr. Alan B. Grebene, Norman J. Miller, James McCreary, and Abe Korgav.

Micro Linear's market thrust and strategy can be summarized as follows:

- Simplify analog LSI design through semicustom techniques such as arrays and standard cells.
- Automate analog design through proprietary CAD tools and design software.
- Make the semicustom techniques and the CAD tools directly accessible to the customer so that he can design his own semicustom analog LSI devices quickly and inexpensively.

ALLIANCES

IMP	June 1984	IMP and Micro Linear codeveloped a 10 volt CMOS process; IMP provides foundry services for Micro Linear.

Rockwell	1985	Rockwell invested $1.2M in Micro Linear and received ASIC linear product technology; Rockwell provides wafers.
Xerox Kyocera Intl Tadiran	1985	These companies participated in Micro Linear's second-round financing.
Nihon Teksel	April 1985	Micro Linear and Nihon Teksel signed an agreement giving the Japanese company the right to sell Micro Linear's semicustom linear ICs; the 1985 sales goal was for ¥2 billion.
Japan Teksel	Sept. 1985	Japan Texel and Micro Linear signed a marketing agreement to sell linear ASICs in Japan.
Toko	Oct. 1985	Toko will make bipolar devices for Micro Linear at its Saitama plant.
Analog Design Tools	July 1986	Micro Linear will integrate both its micro- and macrocell libraries into Analog Design Tools' workbench CAE system.

SERVICES

Design and development Custom/Semicustom Analog LSI
- Bipolar Linear Arrays
- CMOS Cell Libraries

Linear LSI CAD/CAE Tools and Software
Manufacturing
Test
Pilot Assembly

PROCESS TECHNOLOGY

Bipolar
5.0-micron, dual-layer metal (1.0 GHz)
3.0-micron, Silicon-Gate double-poly CMOS

PRODUCTS

Bipolar Analog Arrays

Family	Process	Linewidth (micron)	Interconnect
FB900	Bipolar	8.0	Single-layer metal
FB300	Bipolar	5.0	Dual-layer metal

CMOS Linear Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
SCM2000	Si-Gate	3.0	3.0	100+ digital and 30+ analog cells

CAD Tools

LINEAR-CAD I: A software package for the design and simulation of linear circuits based on the IBM PC-XT or AT.

LINEAR CAD II: A second-generation linear design software program for the IBM-XT or AT.

Standard Linear Products

ML117 Read/Write Pre-Amp Circuit

Application markets: Data acquisition, telecommunications, computer peripherals, industrial controls, and military

FACILITIES

San Jose, CA	48,000 sq. ft.	
	3,000 sq. ft.	Class 10 Clean room

Micro Linear plans to complete a wafer fab that will add approximately 10,000 sq. ft. in early 1987.

Design Centers:
San Jose, CA
Tokyo, Japan
Nordlingen, West Germany
Aylesbury, England
Milano, Italy

COMPANY HIGHLIGHTS

Dec. 1983	Micro Linear completed its first round of financing securing $4.0 million of equity and a $3.5 million credit line.
May 1984	Micro Linear sampled its first product.
June 1984	Micro Linear relocated to a new San Jose, California facility. It is 20,000 sq. ft with a 10,000-sq.-ft. wafer fabrication module.
July 1984	Micro Linear ramped up initial production.
July 1984	Micro Linear introduced the FB900 Series of linear semicustom arrays. It consists of a family of six bipolar array chips which can be customized into ASIC LSI functions by means of metal interconnecting patterns.
Aug. 1984	Micro Linear introduced the Linear CAD-1, a PC-based analog design workstation.
Dec. 1984	Micro Linear introduced the FB300 Series of linear mask programmable tile array products, that provide systems designers with a method of implementing single-chip linear designs. Each chip is composed of arrays of distinct component groupings, called "tiles", that fit together forming a mosaic. Each tile is treated like a mini chip and is designed so that one or more macro cells fit on each one.
Jan. 1985	Micro Linear completed Round 2 for $12 million of equity financing and $6.2 million of additional lease credit. One-third was raised from corporate investors and the remaining divided approximately equally between the original investors and new venture capital.
Aug. 1985	FB 330, a new family of linear/digital tile-array family was introduced for commercial and military applications.
Sept. 1985	Japan Teksel and Micro Linear have signed an agreement for the marketing of linear ASICs in Japan. Teksel will use Micro Linear's CAD system and macrocell library and establish ASIC technology design support.

Feb. 1986	Micro Linear announced its first standard linear circuit, the ML117, which is a Read/Write Pre-Amp circuit.
Feb. 1986	Micro Linear completed Round 3 of financing for $15.3 million which will be used as operating capital for product development and to expand the company's CAD and manufacturing facilities.
March 1986	Micro Linear introduced LINEAR CAD II, its second-generation linear design software program for the IBM PC-XT or AT.
July 1986	Micro Linear will integrate its micro- and macrocell libraries into Analog Design Tools' CAE system.

Micron Technology, Inc.
2805 East Columbia Road
Boise, ID 83706
208/383-4000

ESTABLISHED: October 1978
NO. OF EMPLOYEES: 1,040

BOARD

Position	Name
Chairman	Joseph L. Parkinson
Vice Chairman	Ward D. Parkinson
	Robert A. Lothrop
	Thomas T. Nicholson
	Allen T. Noble
	Douglas R. Pitman
	Don J. Simplot
	John R. Simplot
	Ronald C. Yanke

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
CEO	Joseph L. Parkinson	Private law firm	Partner-Attorney
President/COO	Juan A. Benitez	Mostek	Opns Mgr
Ex VP	Randal W. Chance	Mostek	Engineering
VP Sales/Mktg	James W. Garret	Wescon Marketing	Owner
VP Finance/CFO	Leslie A. Gill	Citizens Ntl Bank	Pres Assist
VP Gen Counsel	Larry L. Grant	Private law firm	Attorney
VP Quality	Edward Heitzeberg	NSC	Prod Engr
VP R&D	Thomas M. Trent	Motorola	Dsn Engr
	James E. O'Toole	Mostek	Designer
VP	Douglas R. Pitman	Mostek	Layout Designer
Prod Dev Mgr	Warren C. Wheeler	Siemens	Tech Consultant

FINANCING

Date	Sources	Amount
June 1984	Public Offering-Common Stock	$25.0M
May 1985	Public Offering-Convertible Subordinated Debentures	25.0M

BACKGROUND

Micron Technology, Inc., designs, manufactures, and markets dynamic random access memory (DRAM) components used primarily for computer applications. The Company also manufactures and markets electronic cameras, image sensors, and burn-in and test systems.

The initial shareholders and employees included semiconductor designers and layout experts. Revenue for funding Micron Technology's original design development and construction of the Company's initial 50,000-square-foot plant were furnished by local investors. The Company's first fabrication, test, and assembly facility was completed in September 1981. Micron became a public company in June 1984. The Company's second facility was completed in December 1984.

Micron is currently shipping 64K and 256K DRAMs. A design for a one-megabit CMOS DRAM is complete with volume production slated for 1987.

ALLIANCES

Standard Telecom	1983	Standard Telecom acquired rights to produce the Micron Technology 64K DRAM.
Samsung	June 1983	Samsung obtained a license to manufacture and market the 64K DRAM design. Samsung provided Micron with cash. The agreement was later extended to include Micron's 256K DRAM.
	July 1986	Samsung purchased 2.7 percent interest in Micron for $5 million as part of an out-of-court settlement. Micron obtained rights to the Samsung SRAM and EEPROM technology for a 1.0 percent royalty.
Commodore	Aug. 1983	Micron licensed Commodore to produce Micron's 64K DRAM.
National Semiconductor	Nov. 1984	NSC purchased a license to manufacture and sell Micron's 64K DRAM for about $5 million. The deal included an option on a 512K DRAM.
Barvon Research	Nov. 1985	Micron acquired a 16 percent equity interest in BRI to diversify its product line and gain access to BRI's ASIC design expertise.

SERVICES

Design Consulting
DRAM Manufacturing
Assembly
Test

PROCESS TECHNOLOGY

NMOS and CMOS
Custom Packaging

PRODUCTS

DRAM

64Kx1
256Kx1
1Mb
1Mbx1, 256Kx4
SIPP/SIMM Modules
128K (2-64K DRAMs)

System Products

AMBYX Burn-In/Test System
MicronEye Electronic Camera
Idetix Digitizing Camera System
Image Sensor Semiconductors

FACILITIES

Boise, ID	250,000 sq. ft.	Total
	10,000 sq. ft.	Class 10 Clean room
	8,000 sq. ft.	Class 100 Clean room

COMPANY HIGHLIGHTS

Sept. 1981 Micron completed its first manufacturing facility.

Jan. 1982 Micron began volume shipments of its MOS 64K DRAM.

June 1984	Micron became a publicly-held company (OTC).
Q3 1984	Micron sampled the MOS 256K DRAM.
Q4 1984	Micron offered production quantity of the MOS 256K DRAM.
May 1985	Micron filed a registration statement with SEC for $25 million of convertible subordinated debentures; sale was completed in August 1985.
March 1985	Micron laid off 625 employees, half its staff.
June 1985	Micron files an antidumping petition with the Commerce Department and the International Trade Commission charging Japanese DRAM makers with dumping 64K DRAMS in the U.S. market at prices below fair market value.
Nov. 1985	Micron entered the ASIC market through an investment in Barvon Research, Inc.
Dec. 1985	Micron reported revenue of $5M and a net loss of $11 million for the quarter ending 11/27/85 due to depressed prices in the component industry and high operating costs.
Jan. 1986	Micron introduced new packages for its MT1257 256K DRAM. In addition to standard DIP, the device is available packaged in zigzag-in-line (ZIP), PLCC, and SIMM (single-in-line memory module).
May 1986	The ITC finds that exports of 64K DRAMs from Japan have injured U.S. manufacturers. Antidumping investigation concludes with the imposition of penalty duties.
May 1986	Micron files a registration statement with the SEC relating to the public offering of 2.3 million shares of common stock in order to pay off part of its current long-term debt to Idaho First National Bank. Micron pledged its assets to Idaho First to keep its major lines of credit open.
June 1986	Micron announced the successful shrink of its 64K DRAM to 14,000 square mils, resulting in a 61 percent increase in possible die per five-inch wafer. Micron plans to shrink the 256K DRAM in July 1986.

July 1986	Samsung has purchased a 2.7 percent interest in Micron for $5 million as part of an out-of-court settlement to a suit brought against Samsung. Micron claimed that Samsung failed to pay for materials and provide certain technology in a 64K DRAM exchange pact. Micron obtained rights to the Samsung SRAM and EEPROM technology for a 1.0 percent royalty if sales exceed one million parts.

Microwave Monolithics
465 Easy Street
Simi Valley, CA 93065
805/584-6642

ESTABLISHED: April 1982
NO. OF EMPLOYEES: 20

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prio Company	Prior Position
President	Daniel Che'en	Rockwell	Mgr M/W Rsch

BACKGROUND

Microwave Monolithics is specializing in GaAs monolithic microwave ICs (MMICs) for Department of Defense microwave specialty circuits as well as custom GaAs circuits.

The company is privately held by five partners and completed first-round financing in 1983 through private sources.

Microwave Monolithics did custom GaAs circuit design research and development work for government agencies and OEMs until financing was secured. The company began producing GaAs MMICs by year end 1984.

ALLIANCES: None

SERVICES

Design

PROCESS TECHNOLOGY

0.5-micron GaAs fine-line capability

PRODUCTS

MMICs

Applications: Radar, electronic warfare, and telecommunications

FACILITIES

Simi Valley, CA	8,000 sq. ft.	Two Class 100 Clean rooms

MicroWave Technology, Inc.
4268 Solar Way
Fremont, CA 94538
415/651-6700

ESTABLISHED: May 1982
NO. OF EMPLOYEES: 140

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	T.R. Baruch	Exxon	Pres/Mtls Div
VP Finance	J. Geyton	Avantek	Div Controller
VP Materials	A. Herbig	Avantek	Tech Staff
R&D Manager	E. Stoneham	Hewlett-Packard	Eng Mgr
VP R&D	Dr. Masa Omori	Avantek	Eng Mgr
VP Marketing	James Cochrane	Avantek	Product Mgr
VP Sales	David Gray	EM Systems	Sales Mgr
VP Opns	Norm Gri	Hewlett-Packard	Mfg Mgr

FINANCING

Date	Round	Sources	Amount
Aug. 1983	Initial	Location Venture Capital	$4.8M
	Round 2	Venture capital and equipment lease	$4.3M
June 1985		RLOC	$1.0M

BACKGROUND

MicroWave Technology, Inc., is a merchant supplier with advanced GaAs design and fabrication capability. Its products include microwave components and GaAs ICs in advanced packages.

In May 1985, the Company offered PICO-PAK, an ultraminiature GaAs FET microwave amplifier.

ALLIANCES: None

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

GaAs FET
GaAs MMIC
GaAs MIC
Thin-Film Hybrid

PRODUCTS

GaAs FETs
GaAs FET Amplifiers

FACILITIES

Fremont, CA	31,000 sq. ft.	
	900 sq. ft.	Class 100 Clean room

Mietec
Headquarters
Westering, 15
B-9700 Oudenaarde
Belgium
Tel: 32-55-33 2211
Telex: 85 739

ESTABLISHED: March 1983
NO. OF EMPLOYEES: 300

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
GM/CEO	Jean-Pierre Liebaut	Matra-Harris
Dir Mktg/Sales	Eric Schutz	Motorola

FINANCING: Not available

BACKGROUND

Mietec currently offers a range of gate arrays and standard cell products as well as full custom and foundry capabilities. Its gate arrays can be upgraded to standard cells without redesign. Given the Company's extensive system design experience it is expected to offer a series of application-specific standard products in the near future.

The Company is focusing on the automotive, industrial, telecommunications, and certain consumer and military applications. Mietec will be a major supplier of the ASIC products for the ITT-designed System 1240 digital telephone exchange.

Mietec is a joint venture, 49.5 percent of which is owned by Bell Telephone Manufacturing Co. (BTM), the ITT-owned Belgium telephone system company; 49 percent is owned by Gewestelijke Investerings Maatschappij voor Vlaanderen (GIMV), a Flanders regional investment company; and 1.5 percent is owned by a private investment bank.

The company's formation represents an integral portion of a microelectronics plan developed in Flanders and also includes the following:

- Inventive systems: Training support for small and medium-size companies to encourage the use of microprocessors for existing electromechanical applications.
- Interuniversity MicroElectronics Centre (IMEC): Aimed at developing software for the design of VLSI ICs, developing advanced process technologies at the 1.25-micron level and beyond; and developing software and technology tools for industry.
- Invomec: A training program covering all the technical engineering schools in Flanders.
- Mietec: The production branch of the plan.

Mietec, founded in March 1983, started operations in May 1983 and achieved its first revenue in 1984. The facility built at Oudenaarde was constructed during 1983 and 1984. In July 1985 the facility reached full production status. All manufacturing is done in Belgium.

The initial marketing thrust is aimed at Europe. Sales offices are established in Bracknell, United Kingdom, and Munich, West Germany, as well as in Belgium. Future sales centers are expected in Frankfurt, Germany and Paris, France.

ALLIANCES

Lattice Logic	Feb. 1985	Mietec's standard cell is being ported to Lattice Logic's software.
Sprague	1983	Mietec entered a cross-licensing agreement with Sprague for a BiMOS process.

SERVICES

Design	
Foundry	CMOS, NMOS, and BiMOS
Manufacturing	
Assembly	
Test	

PROCESS TECHNOLOGY

3.0- to 2.4-micron CMOS, NMOS, BiMOS, HVMOS
Single or double-layer metal

PRODUCTS

Gate Arrays	500 to 3,000 gates
Standard Cell	
Full Custom	
Linear Products	

FACILITIES: Facilities in Oudenaarde include a Class 120 Clean room.

Design Centers:
Leuven, Belgium
Oudenaarde, Belgium

Modular Semiconductor
2334 Walsh Avenue
Santa Clara, CA 95051
408/748-1501

ESTABLISHED: September 1983
NO. OF EMPLOYEES: 16

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Singh Yalamachili	Signetics	Mgr Dsn Components
VP Mktg/Sales	Farooq Quadri	AMD	Strat Mktg Mgr
Dir Mfg	Dr. Lenin Anne		

FINANCING: Not available

BACKGROUND

Modular Semiconductor was founded by individuals from Synertek, Signetics, and Hewlett-Packard to design, develop, manufacture, and market VLSI ICs using a 1.0-micron CMOS process technology.

The Company is focusing on data communication chips, memories, semi-custom and custom designs, VME bus chip sets, and telecommunication products. Modular Semiconductor began manufacturing with a 2-micron CMOS process and is now offering 1.6-micron technology with plans to use 1.0-micron in three years.

ALLIANCES

Ricoh Panatech	Nov. 1984	Modular Semiconductor made a 5-year, three-way agreement with Panatech and Ricoh of Japan. Modular provides Ricoh with its high-performance CMOS designs and process technology for 16K SRAM and 256K DRAM. Ricoh will manufacture these devices in Japan and has the rights to market them in Japan. Panatech has the rights to market 16K memories only in North America.

SERVICES

Design
Gate Array, standard cell, and full custom

PROCESS TECHNOLOGY

1.6-micron CMOS

PRODUCTS

Memory

CMOS SRAM

MS6168	16K	35ns
MS6167	16K	35ns

Microperipherals

MS88C681	CMOS DUART
MS88C691	UART
16C450/82C50	PC UART

VME Support Circuits
IBM 3270 Protocol Interface Circuit

FACILITIES

Santa Clara, CA	6,000 sq. ft.	Design

Molecular Electronics Corp.
4030 Spencer Street
Torrance, CA 90503-2417
213/214-1485
Fax: 213/542-1270

DATE ESTABLISHED: 1983
NO. OF EMPLOYEES: 17

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman/CEO	George N. Reynolds	Stress Transformation Center	Founder
Pres/COO	Dr. Vladimir Rodov	TRW	Sr. Scientist
VP Engr	Dr. Meir Bartur	SSDI	Dir Research
VP/Dir Mktg	Thomas Y. Bowman	Applied Materials	Manager
CFO	Dr. Eitan Gurel	VSC	Professor

FINANCING: Molecular Electronics has raised $4 million in two rounds of financing.

BACKGROUND

Molecular Electronics Corporation (MEC) was formed to develop proprietary technology and exploit commercial opportunities in molecular electronics and molecular film technology (MFT). By mid-1985 the Company succeeded in demonstrating a unique method for producing molecular (Langmuir-Blodgett) films in a continuous process on large substrates. Recently, MEC completed a full-size preproduction machine tradenamed MonoFab and has begun customer sampling (Alpha site).

MEC's proprietary process enables the formation of highly ordered, perfectly uniform organic films with thickness control down to 10A. MEC's know-how includes the molecular engineering and synthesis of molecular film materials with desirable electronic and optical properties.

MEC has developed two commercial applications of MonoFab, the first is an ultra-thin, uniform high-resolution e-beam resist (MonoResist) for lithography on masks and wafers (direct-write). The second is a thin corrosion protective lubricant for rigid disk magnetic media.

MEC is also working on research and development relationships with several corporations including one for a gallium arsenide device that incorporates a performance enhancing molecular film dielectric. Corporate partnerships and development contracts are part of a long term plan to develop unique molecular film device applications (passivation, surface modification, quantum spacers, gate dielectrics, and active sensing elements).

MEC is now seeking additional financing to develop new market applications of MFT.

ALLIANCES: Not available

SERVICES

Research and development

PROCESS TECHNOLOGY

Molecular Film Technology (MFT)

PRODUCTS

E-beam resist system based on MFT

FACILITIES

Torrance, CA	7,500 sq. ft.	Headquarters, research and development
	1,200 sq. ft.	Class 10 Clean room

MOSel
491 Macara Avenue
Sunnyvale, CA 95086
408/733-4556

ESTABLISHED: September 1983
NO. OF EMPLOYEES: 30

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Peter Chen	Fairchild	Semi Tech Mgr
VP Technology	Nasa Tsai	Fairchild	Sr MTF
Dir Eng Design	Yun Hwang	Synertek	Design Mgr
Dir Sales/Mktg	Bruce Campbell	Intel	Mktg Mgr
Dir Finance	George Sun	Delta 7.9	VP Finance

FINANCING

Date	Round	Sources	Amount
1983	Seed	Founders	$1.0M
1984	Round 1	Pacific Electric Wire & Cable (Taiwan)	$2.0M

BACKGROUND

MOSel was formed to design and develop CMOS SRAMs and is also designing a family of special-feature and application-specific memories for the dual-port cache control and telecommunication markets. The Company plans to later develop products that will integrate analog and EPLD functions in one chip.

MOSel does front-end research and development and marketing at its headquarters in Sunnyvale, California. UMC, Fuji, Hyundai, and Sharp provide foundry services. Through its agreements MOSel is guaranteed fabrication capacity until 1990. Assembly and test are subcontracted.

ALLIANCES

MOSel-Taiwan	April 1985	MOSel orginally planned to build a 1.5-micron VLSI production facility in Taiwan at a cost of $40 million. These plans were canceled because of the worldwide excess of semiconductor capacity creating the opportunity to use foundry services for several years.
UMC	Oct. 1985	MOSel transferred rights to a high-speed 2Kx8 SRAM and EEPROM to UMC in Taiwan, additionally providing 1.5- and 2.0-micron processes which were used to bring up the 2-micron CMOS process at UMC.
	Dec. 1985	MOSel announced a 64K SRAM.
Fuji Electric	Sept. 1985	Under an agreement with Fuji Electric MOSel provided its 1.5- to 2.0-micron CMOS process. Fuji Electric will manufacture 64K SRAMS using MOSel's technology.
Lien Hua Electronics	Sept. 1985	Lien Hua Electronics Corp. and MOSel signed a $5 million joint venture to develop a 64K SRAM in the Hsinchu-based Industrial Park in Taiwan.
Hyundai	Feb. 1986	MOSel provided 8Kx8 SRAM technology to Hyundai in exchange for foundry capacity under a discounted OEM contract.
Sharp	May 1986	MOSel provided a 256K SRAM design and 1.2-micron CMOS process to Sharp in exchange for foundry capacity. Sharp will provide 256K SRAMs under a favorable OEM contract.

SERVICES

Design
Test

PROCESS TECHNOLOGY

BiCMOS Three high-performance bipolar CMOS (H-BiCMOS) processes with minimum dimensions as follows:

Device	Drawn (micron)	Effective (micron)
	2.0	1.5
	1.5	1.1
	1.2	0.8

PRODUCTS

Device	Access Time (ns)
2Kx8 CMOS SRAM	55
4Kx4 CMOS SRAM	35
	25 (Dec 1986)
16Kx1 CMOS SRAM	35
	25 (Dec 1986)
8Kx8 CMOS SRAM	45
32Kx8 SRAM	55 (Dec 1986)
64Kx1 SRAM	30 (Dec 1986)
Dual Port RAM	
1Kx8	55
2Kx8	55

FACILITIES

Sunnyvale, CA	6,000 sq. ft.	Design and test

Nihon Information Center Co., Ltd.
Headquarters
6-11-3 Nishi Shinjuku
Shinjuku-ku, Tokyo 160
Japan
03-348-1631
FAX: 03-346-2846
TLX: 232-4821

ESTABLISHED: 1977
NO. OF EMPLOYEES: 93

U.S. Office
3945 Freedom Circle
Suite 660
Santa Clara, CA 95054
415/965-3722

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President/CEO	Yoshihisa Ogawa
Dir/Chief Engr	Kuniyuki Takyu
Exec Dir Mktg/Sales	Masao Nawa
U.S. Managing Director	Osamu Kano

BACKGROUND

Nihon Information Center Co., Ltd. (NIC), designs, manufactures, and markets computer-aided electronic publishing systems based on its own LSI raster image processor technology. In June 1986, NIC expanded its operations to include a family of LSI chips, interface boards, and subsystems that enhance the performance of today's computer-aided publishing system.

Introduced in 1986 were eight graphics ICs that create a wide variety of images with any type of computer. The NIC HYPER-KIT is a general-purpose module designed to capitalize on the company's image processing capabilities. It is offered in combinations of five image data-oriented processors.

NIC's headquarters in Tokyo house administration, design, and product development. Of NIC's 93 employees, 40 are IC designers. Its Santa Clara, California, marketing office is seeking potential partnership arrangements. Hitachi Hokkai is doing NIC's packaging, and wafer fabrication is done by three second-tier semiconductor manufacturers in Japan. Sumitronics, a subsidiary of Sumitomo, has been signed to sell products in the United States.

The Company is currently marketing its NIC Publications System directly to a variety of end users primarily in Japan. The LSI chip and board sets--VR-FIP, Hyper-Kit, and Special Hyperboard subsystems--are marketed as OEM products to manufacturers of personal computers, laser printers, word processors, bit-map CRT display monitors, facsimile machines, and communications equipment.

ALLIANCES: None

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

2.0-micron CMOS

PRODUCTS

HYPER-KIT 1
VR-FIP: Vector/Raster Fill-In Processor
RVP: Raster Vector Processor

HYPER-KIT 2
ICP: Image Compression Processor
IEP: Image Expansion Processor

HYPER-KIT 3
RGP: Raster Graphics Processor
OR-VOP: Outlines Raster Processor

HYPER-KIT 4
BSP: Bit Set Processor

PRODUCTS (Continued)

HYPER-KIT 5	
PCP: Page Compiler Processor	
SPECIAL HYPERBOARD	A subsystem using the VR-FIP; includes an MC68020 CPU, buffers, and VERSA bus for a host computer interface
NIC PUBLICATIONS SYSTEMNIC LSI	An electronic publishing system based on the chip, boards, and subsystems

FACILITIES: Not available

NMBS Co., Ltd.
Ochanomizu Center Bldg.
2-12 Hongo 3-chome,
Bunkyo-ku, Tokyo 113
Japan
011-81-3-818-3761

ESTABLISHED: April 1984
NO. OF EMPLOYEES: 240

NMB Semiconductor Corp.
4677 Old Ironsides Drive
Santa Clara, CA 90554
408/727-2630

BOARD

Name	Affiliation
Takumi Tamura	NMB Semiconductor
Toshio Egawa	NMB Semiconductor
Masatomo Yuki	Minebea
Takami Takahashi	Minebea
Iwao Ishizuka	Minebea
Goro Ogino	Minebea
Mitsuo Ichikawa	Minebea
Sadahiko Oki	Minebea

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Takumi Tamura	Tokyo Sanyo	Managing Director
Sr Mng Dir	Toshio Egawa	Minebea	Sr Mng Dir
Dir Mfg & R&D	Shosuke Shinoda	Matsushita	Dir MOS Process
Corp Mktg Mgr/Jpn	Jiro Miyamoto	Minebea	Mktg Mgr
VP General Mgr	Gary Ater	NMB	Sales Manager

FINANCING

Date	Round	Sources	Amount
1984	Start-up	Bank of Tokyo, Ltd.; Fuji Bank; Japan Associated Finance Co., Ltd.; K.K. Keiaisha; Kyowa Bank; Long Term Credit Bank of Japan; Minebea Co; Nippon Enterprises Development Corp.; Nippon Investment & Finance Co., Ltd.; Sumitomo Trust & Banking; Takami Takahashi; Takumi Tamura; Tokai Bank	$11.11M

BACKGROUND

NMBS Co., Ltd., was formed to run as a one-product/one-technology company and produces 256K and 1-megabit CMOS DRAMs. It is Japan's first specialty manufacturer of VLSI circuits and plans to be the lowest-cost producer in the world. NMBS is Japan's first start-up to build a VLSI facility capable of fabricating products with submicron geometries. Present capacity is 2-million memory devices a month, increasing to 4 million by the end of 1986. The company acquired designs and technology through a license agreement and technology exchange with INMOS and licenses with other U.S. companies to bring existing process on-line quickly.

NMB Semiconductor Corp. is a wholly owned subsidiary of NMB (USA) Inc., located in Chatsworth, California, a company that is in turn a subsidiary of the multinational Minebea Co., Ltd., of Tokyo Japan. NMB Semiconductor Corp. is responsible for all U.S. semiconductor operations and the marketing of the high-speed VLSI semiconductor memory devices manufactured in the $25 million, fully automated facility by NMBS Co., Ltd., in Tateyama, Japan.

ALLIANCES

Minebea Co.	1984	NMB is the subsidiary of and is financed by Minebea.
INMOS	June 1984	NMB obtained a 5-year license to produce INMOS' 256K CMOS DRAM. NMB paid an initial sum and continuing royalties. NMB also cooperated on the technology for INMOS' 64K DRAM and a 1Mb DRAM.
	March 1985	Minebea agreed to ship 50 percent of its 256K DRAM output to INMOS.

U.S. Maker	1985	Fast 64K SRAMS
Vitelic	Nov. 1985	Vitelic granted a license to NMBS for its 1Mb CMOS DRAM in exchange for one-third of NMBS' plant capacity.
National Semiconductor	Sept. 1986	CMOS SRAMs (four types)
Unannounced	1986	CMOS SRAMS and DRAMS

SERVICES

Manufacturing

PROCESS TECHNOLOGY

1.0- to 2.0-micron CMOS
(5-inch wafers)

PRODUCTS

MEMORY

DRAM

256Kx1	60 to 100ns
1MBx1	100ns
64Kx4, 32Kx8 Planned	

SRAM

64Kx1	35 to 55ns
16x4, 256Kx1 Planned	

EEPROMs

Planned

Video RAMs

Planned

FACILITIES

Tateyama, Japan	200,000 sq. ft.	
	43,000 sq. ft.	Class 1 Clean Room

In 1986, NMBS plans to add an additional facility for a 6-inch wafer line and a 7,500 sq. ft. research and development center complete with main-frame, a computer, a Calma CAD system, and a pilot fabrication line.

COMPANY HIGHLIGHTS

Aug. 1984	Groundbreaking at Tateyama occurred for NMBS facility.
Feb. 1985	All NMBS' structures were completed.
May 1985	First wafers were started through NMBS' fabrication line.
Aug. 1985	NMBS offered its first working samples.
Dec. 1985	NMBS announced that it was producing 2 million 64K SRAMs and 256K DRAMs a month. NMBS expects to produce 4 million units by the end of 1986.
Nov. 1985	Vitelic licensed its 1Mb CMOS DRAM to NMBS.
Feb. 1986	NMBS began the manufacture of 1Mb CMOS DRAMs with a feature size of 1.2-micron. The NMBS DRAMs were licensed from Vitelic Corp.

Novix, Inc.
19925 Stevens Creek Blvd.
Cupertino, CA 95014
408/255-2750

ESTABLISHED: March 1984
NO. OF EMPLOYEES: 20

BOARD

Name	Affiliation
John Peers	Novix, Inc.
Ed Mack	Consultant
Wayne Kirk	Thelen, Marrin, Johnson & Bridges, Attorneys

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	John Peers	Technology Industries	President
VP Finance	Ronald Murphy	Halicrafters	VP Finance

FINANCING

Date	Round	Sources	Amount
March 1984	Round 1	Sysorex International	$1.0M

BACKGROUND

Novix, Inc., was formed to develop a high level language direct execution microprocessor. Novix founders included Charles Moore, John Peters, John Golden, and Robert Murphy. The Company, originally named Technology Industries, was formed when Sysorex Information System, Inc., offered about $1 million to develop devices based on the FORTH "language slice" computing. The combined Sysorex-Technology Industries partnership was renamed Novix, Inc.

The Company's initial strategy was to form a research and development partnership to develop its technology and market it to the FORTH community. Its long-term strategy is to convert its marketing approach to produce general-purpose microprocessors capable of running any language at speeds faster than anything yet being offered in 16-bit microprocessor CMOS. Future plans also include implementing gallium arsenide into its product lines. All manufacturing and assembly is subcontracted at this time.

Novix is targeting the artificial intelligence, imbedded controller, cryptographics, robotics, and machine vision markets. Its first product, the NC4000, a 16-bit high-speed MPU utilizing FORTH-in-silicon architecture, was introduced in June 1986.

ALLIANCES

Sysorex	March 1984	Sysorex International participated in first-round financing.
Harris Semiconductor	July 1986	Harris will add the Novix FORTH language MPU into its ASIC library as part of a multimillion dollar pact covering MPU and MCU products based on the FORTH engine.

SERVICES

Research and development
Design

PROCESS TECHNOLOGY

3-micron CMOS
2-micron (available Jan. 1987)
1.2-micron (available 2Q 1987)

PRODUCTS

NC4000 16-bit MPU
NC6000 16-bit MPU (available Jan. 1987)
Beta Board to do prototype design
Development system tools

FACILITIES

Cupertino, CA	6000 sq. ft.	Design and some test

Opto Tech Corp.
32 Industrial East 4th Road
Science-Based Industrial Park
Hsinchu, Taiwan
ROC
(035) 777-481/3
Telex: 31592 OPTO TECH

ESTABLISHED: December 1983
NO. OF EMPLOYEES: 100

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	James Chiu	Petrochemical Industry	President
Business Liaison	S. Shyu	N/A	N/A

FINANCING: Not available

Sources	Amount
Opto Tech Corp.; Bank of Communications, Fortune Plastic Manufacturing Co.	$2.5M

BACKGROUND

Opto Tech is offering GaAs based products, silicon wafers, and photo-resistor and photodiode semiconductors. The Company plans to offer small-signal and transmitting transistors, junction FETs, microwave transistors, and fast-recovery and Schottky-barrier diodes. Production began in July 1984.

The Company spun out from Fine Microelectronics and is owned by local investors and the Bank of Communications.

ALLIANCES: None

SERVICES

- Design
- Manufacturing

PROCESS TECHNOLOGY

GaAs
Silicon

PRODUCTS

LED
Transistors
Photodiodes
Phototransistors
Infrared Devices

FACILITIES

Hsinchu, Taiwan 9,175 sq. ft.

Orbit Semiconductor
1230 Bordeaux Drive
Sunnyvale, CA 94086
408/744-1800

ESTABLISHED: 1985
NO. OF EMPLOYEES: 75

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Gary Kennedy	Comdial Semiconductor	President
VP Technology	Steve Kam	Comdial Semiconductor	Dir Technology
VP Finance	Joseph Wai	Comdial Semiconductor	Corp Controller

FINANCING: Not Available

BACKGROUND

Orbit specializes in offering design layout, fabrication, test, and packaging for customers having limited or indeterminate unit-volume production requirements.

In late 1979, Comdial Corporation, an Oregon firm that made subsystems for telephone dialing, started the firm as its engineering subsidiary. Comdial acquired an existing facility in 1979 and developed industry compatible silicon-gate NMOS and CMOS processes. The Company, operating under the name Comdial Semiconductor, offered foundry services in January 1980 and became the only guaranteed quick-turn fab in the business. Half the resources of the Company were dedicated to quick-turn services and guaranteed parts within as few as five days for NMOS and ten days for CMOS.

In November 1985, 80 percent of Comdial Semiconductor was acquired by Orbit Instruments, Inc., a supplier to Hughes and other military contractor companies. The management of Comdial Semiconductor retained 20 percent of the Company. In addition to continuing the previous services, Orbit is positioning itself to be a stronger supplier to the high-reliability commercial and military-oriented users.

Orbit guarantees single-poly and single-metal CMOS or HMOS in 10 working days or fewer and double-poly or double-metal CMOS in 15 working days or fewer.

ALLIANCES: Not available

SERVICES

Foundry: PMOS, HMOS, CMOS,CCD Processes
Prototype Manufacturing
Volume Manufacturing
Assembly
Packaging

PROCESS TECHNOLOGY

2.0-micron Silicon-Gate NMOS
2.0-micron Silicon-Gate PMOS
2.0-micron Silicon-Gate CMOS
HMOS
Double-poly Silicon-Gate: 2.0-micron
Second-poly or metal: 5.0-micron pitch
Second Metal: 7.0-micron pitch
(4-inch wafers)

FACILITIES

Sunnyvale, CA 28,000 sq. ft.

Pacific Monolithics, Inc.
245 Santa Ana Court
Sunnyvale, CA 94086
408/732-8000
FAX: 408 732 3413

ESTABLISHED: March 1984
NO. OF EMPLOYEES: 40

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Donald A. Bond	Sanders	VP/GM Microwave
Pres/Dir R&D	Allen Podell	A.F. Podell Assoc.	President
VP Opns	Larry Templeton	Western Telephone	VP/Dir Eng
VP Mktg/Sales	Doug Lockie	Strategic Tech	President
VP Bus Dev	Frank Russell	Avantek	Sales Mgr
VP Engr	Pang Ho	Geotech	President
Mfg Manager	Raymond Waugh	Iridian	Founder/Engr Dir

FINANCING

Date	Round	Sources	Amount
Aug. 1985	Round 1	Vanguard Associates; IAI; Shaw Ventures; Hytek Corp.; Sand Hill Financial Corp.; Canadian Enterprises Development Corp.	$5.0M

BACKGROUND

Pacific Monolithics designs and manufactures monolithic microwave integrated circuits (MMICs) based on gallium arsenide (GaAs). The Company offers microwave "macrocells" for semicustom IC designs for consumer, communications, and defense applications.

Pacific Monolithics was founded by Allen Podell and Doug Lockie. Mr. Podell is regarded as an expert in the field of GaAs ICs. Company strengths include yield-tolerant design techniques that Podell developed, and advanced packaging technology.

By May 1985, Pacific Monolithics had produced several custom designs. The first was a monolithic GaAs receiver for C band satellite receivers, the first of its kind in volume production. The receiver can be used as a universal intermediate-frequency converter.

Since then, the Company has developed a set of monolithic GaAs subsystem building blocks for microwave signal processing. Pacific Monolithics' ASIC cell library includes ampliphiers, mixers, oscillators, couplers, combiners, switches, attenuators, phase shifters, modulators, and demodulators.

In April 1986, Pacific Monolithics introduced three MMIC devices that are offered in 5V, commercial grade, 8-lead surface mount packages. They are:

PM-CV0301-A a 0.8 to 3 GHz Converter
PM-CO0601-A a 3 to 6 GHz Converter
PM-CV0801-A 5 to 6 GHz Converter

In March 1986, the Company relocated from its 10,000-square-foot facility to a 22,000-square-foot facility that can be expanded by an additional 13,000 square feet. Presently, Pacific Monolithics uses the foundry services of Triquint and others.

ALLIANCES: Not available

SERVICES

Design
Packaging

PROCESS TECHNOLOGY

GaAs

PRODUCTS

- Converters
- Amplifiers
- Oscillators
- Attenuators
- Active Isolators
- Phase Shifters
- Switches

Application: Aerospace and communications markets

FACILITIES

Sunnyvale, CA	22,000 sq. ft.	
	6000 sq. ft.	Class 100 Clean room

Panatech Semiconductor
3375 Scott Boulevard
Suite 314
Santa Clara, CA 95054
408/727-7700
FAX: 408-727-8144
TELEX: 910 380 3973 PANATECH SEMI

ESTABLISHED: 1981
NO. OF EMPLOYEES: 11

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	William Bradford	NEC	Dir Microsystems
Chief Engr	Chet Braun	McDonnell Douglas	Dir Biocybernetics

FINANCING: Not available

BACKGROUND

Panatech Semiconductor develops and markets advanced semiconductor devices and other products. The Company was funded by and is a division of Panatech Research and Development, a venture capital company. Panatech is also the North American technology and marketing partner of the electronic device division of Ricoh Company, Limited, Osaka, Japan. Panatech has exclusive rights to sell any semiconductor products manufactured by Ricoh. This partnership is in effect until 1989. Marketing and sales activities are conducted by the Company from its Santa Clara, California, office. Licensing agreements and technology acquisitions are managed by the corporate staff of Panatech Research and Development.

Initially Panatech Semiconductor is using third-party gate array designs for Ricoh. One design center was in place in mid-1986 and two more are planned for mid-1987.

ALLIANCES

Ricoh	Sept. 1984	Panatech and Ricoh agreed to joint development, a technology exchange, and a mutual sales agreement for 256K DRAMs. The 256K DRAM project was cancelled due to the unstable supply and demand DRAM scenario. The R&D emphasis was placed on PLDs.

ALLIANCES

	April 1985	Ricoh acquired 15 percent of Panatech Research and Development for $500,000. The two companies will share technologies, and Panatech Semiconductor has exclusive rights to market Ricoh products in the United States. Panatech Semiconductor marketing CMOS field-programmable logic array developed by Panatech Research and Development and fabricated by Ricoh in Japan.
Modular Semiconductor Ricoh	Nov. 1984	Modular Semiconductor made a 5-year, three-way agreement with Ricoh of Japan and and Panatech. Modular provided Ricoh with high-performance CMOS designs and process technology for its 16K SRAM and 256K DRAM. Ricoh will manufacture these devices and has the rights to market them in Japan. Panatech has the rights to market the 16K SRAMs only in North America.
Burns Research	1985	Burns was contracted as a design and prototype center.

SERVICES

Design

PROCESS TECHNOLOGY

2.0-micron double-metal CMOS
Metal-Gate BiCMOS

PRODUCTS

Micro Devices
32K, 64K, 128K and 256K CMOS and NMOS ROMs
512K and 1024K NMOS ROMs
16K CMOS SRAM
32K, 64K, and 256K EPROM
EPLA

FACILITIES

Santa Clara, CA	1,750 sq. ft.	Marketing and sales

Panatech will be adding 2,000 sq. ft. in 1987 for marketing and sales.

COMPANY HIGHLIGHTS

1985	Ricoh and Panatech Research and Development agree to jointly develop ICs. The ICs include CMOS PLA designs that use EPROM technology for allowing later conversion to both gate array and standard cell devices. Panatech will supply logic interface software and EPL programmers. Ricoh will fab the EPL devices.
April 1985	Panatech sampled a color-graphics CRT controller.
April 1985	Panatech offered a Real-Time Clock Calendar, the RP5C01/15.
Sept. 1985	Panatech Semiconductor reported its first profitable quarter.
Jan. 1986	Panatech offered the second series of its line of CMOS electrically programmable logic devices (EPLDs). The new higher performance B series consists of eight 35ns ICs that are available in one-time programmable and reprogrammable (UV-erasable) 20-pin packages. A 25ns device will be available during the second quarter. The ICs are produced by Ricoh Company, Ltd., of Japan.
Feb. 1986	Panatech introduced the industry's first 20-inch thermal print head (TPH) produced by Ricoh. The TPH includes 64 (BiCMOS) 64-bit shift registers, latches, switching transistors, and gate circuits.
March 1986	Panatech Semiconductor expanded its floor space by 100 percent.
April 1986	Panatech's 1Mb ROM that is produced by Ricoh was in full production.

Performance Semiconductor
610 Wedell Drive
Sunnyvale, CA 94089
408/734-8200

ESTABLISHED: 1984
NO. OF EMPLOYEES: 50

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President	Dr. Thomas Longo	Schlumberger
VP Opns	Dave Maxwell	Fairchild
VP Mktg/Sales	Jerry Herzog	RCA
VP Finance	George Wikle	Memorex
VP Human Resources	William Strickland	Fairchild
Mktg Mgr Mem/Logic	Sam Young	Micromos

FINANCING

Date	Round	Sources	Amount
Oct. 1984	Start-up	Advanced Technology Ventures; Albion Ventures; Arbeit & Co,; Asset Management Company; Brentwood Associates; DSV Partners; IAI Venture Partners; North Star Ventures; Norwest Venture Capital Management; Rotan MOSel Technology Partners; Taylor & Turner; U.S. Venture Partners; Venwest Partners (Westinghouse Electric Corp.)	$11.3M
	Lease	Westinghouse Electric Corp.	$6.6M

BACKGROUND

Performance Semiconductor designs, develops, manufactures, and markets high-speed CMOS MPUs, logic devices, and SRAMs for military and commercial computing applications.

In March 1985, Performance leased a 26,000-square-foot facility where it conducts research and development and all manufacturing.

Performance Semiconductor's first products are a 20ns 64K SRAM that is a CMOS equivalent of Fairchild's bipolar 9450, and a 10ns 1K SRAM.

ALLIANCES

Westinghouse	Aug. 1986	Performance will fabricate a VHSIC Phase I 11,000-gate gate array designed by the Westinghouse Defense and Electronics Center for the Air Force's Wright Aeronautical Laboratories.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

1.25-micron CMOS (0.8-micron effective channel lengths)
(6-inch wafers)

PRODUCTS

CMOS SRAMs

P4C188	64K	20, 35, 45ns commercial/military
P4C422	256x4	10-25ns commercial/15-35ns military

Pace Logic CMOS Family

74PCT273/374 250 MHz toggle rates
74PCT373/533 Gated Latches
74PCT241/244 Bus Drivers
74PCT245/545/640/643/645 Transceivers

FACILITIES

Sunnyvale, CA	26,000 sq. ft.	Manufacturing
	5,000 sq. ft.	Class 2 Clean room

COMPANY HIGHLIGHTS

Oct. 1984	Performance completed first-round financing for $11.3 million.
March 1985	The Company leased a 26,000-square-foot facility for research and development and office use.
Sept. 1985	Performance achieved first silicon.
May 1986	Performance sampled the P4C188, a 64K SRAM offered in commercial speed grades of 20, 35, and 45ns and military grades clocked at 25, 35, and 45ns.
June 1986	Performance introduced the first of its Pace Logic CMOS family: • 74PCT273/374 250 MHz Toggle Rates • 74PCT373/533 Gated Latches • 74PCT241/244 Bus Drivers • 74PCT245/545/640/643/645 Transceivers
July 1986	Performance introduced the P4C422 1K CMOS SRAM with access times of 10-25ns commercial and 15-35ns military. It is configured as 256 x 4.

Quasel, Inc.
4701 Patrick Henry Drive,#301
Santa Clara, CA 95054
408/732-1483

ESTABLISHED: 1984
NO. OF EMPLOYEES:

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Dick Koo	Xerox	Sr. Research
VP Engr	Ronald Chwang, Ph.D.	Intel	Engr Mgr DRAMs

FINANCING

Date	Round	Sources	Amount
Sept. 1984	Round 1	Taiwan Banks, U.S. pension funds, venture capital	$4.0M
Oct. 1984	Round 2	Development Fund of the Executive Yuan; Bank of Communications; and others	$16.0M
	Lease		$18.5M

BACKGROUND

Quasel, Inc., was founded to be a commodity supplier of HRAMs (high-performance RAM), hybrids of DRAMs and SRAMs. Quasel formed a manufacturing subsidiary in Taiwan, Quasel Taiwan Company, Ltd., to take advantage of the lower cost, highly skilled engineering talent available there, thus establishing a highly competitive manufacturing facility.

The Company plans to establish a prototype fabrication line in the United States.

ALLIANCES

Taiwan Investors	Oct. 1984	Quasel established a joint manufacturing subsidiary with Taiwan investors at a capitalized $16 million, $8M of which was derived from Taiwan investors.
ERSO	May 1985	Technology license

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

CMOS III

PRODUCTS

CMOS 64K and 256K HRAM

FACILITIES: Not available

Samsung Semiconductor, Inc.
5150 Great America Parkway
Santa Clara, CA
408/980-1630

ESTABLISHED: 1983
NO. OF EMPLOYEES: 250

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	S. Joon Lee	Honeywell	Manager
VP R&D	Ilbok Lee	NSC	Div Mgr
VP Mktg/Sales	C.H. Oh	SST	Sr VP
VP Finance	Won Yang	SST	GM
Dir Mktg	Orlando Gallegos	Zytrex	VP Mktg/Sales
Dir Sales	Mike Barthmen	Hitachi	Ntl Sales Mgr

FINANCING

Date	Round	Sources	Amount
1983	Start-up	Samsung Semiconductor and Telecommunications Ltd. (SST)	$6.0M
	Lease	SST	$7.0M

BACKGROUND

Samsung Semiconductor, Inc. (formerly Tristar Semiconductor), is the U.S. subsidiary of Samsung Semiconductor and Telecommunications, Ltd. (SST), of the Samsung Group, a Korean conglomerate. SST's 1983 to 1987 investment in the subsidiary will total $550 million.

Samsung supplies NMOS and CMOS memories, logic devices, microprocessors and peripherals, and power MOSFETs.

ALLIANCES

SST	1983	Samsung Semiconductor is set up as a U.S. subsidiary.
Exel	1983	Samsung entered into a joint development project to act as a second-source for Exel's 16K EEPROMs.

	May 1985	The agreement was extended to include 64K EEPROMs.
Micron Technology	June 1983	Samsung obtained a license to manufacture and market Micron's 64K DRAM design. Samsung provided Micron with cash. The agreement was later extended to include Micron's 256K DRAM.
	July 1986	Samsung bought a 2.7 percent interest in Micron for $5 million as part of an out-of-court settlement to a suit brought against Samsung. Micron claimed that Samsung failed to pay for materials and provide certain technology in a 64K DRAM exchange pact. Micron obtained rights to the Samsung SRAM and EEPROM technology for a 1 percent royalty if sales exceed one million parts. The prior agreement was terminated.
Intel	Jan. 1985	Samsung reached an agreement with Intel to second-source Intel MPUs, MCUs, and MPRs.
Zytrex	June 1985	Zytrex and Samsung agree to a three-year technology/fab agreement. Samsung is providing financial and manufacturing support. Samsung will provide alternate-sourcing for Zytrex's LSI logic devices; Zytrex will provide use of its proprietary ICE-MOS process. Zytrex will provide alternate-sourcing for Samsung's products.
Mostek	1986	Mostek and Samsung signed an agreement covering Mostek's 256K DRAM technology.
IXYS	Jan. 1986	IXYS reached an agreement with Samsung Semiconductor and Telecommunications. Samsung will receive IXYS's power MOS technology for low and medium-range power devices; IXYS will manufacture its high-current power MOS devices in Samsung's facility overseas; the companies will jointly manufacture IXYS' first smart power products to be introduced later this year

SERVICES

Design
Prototyping
Manufacturing

PROCESS TECHNOLOGY

1.5-micron CMOS, NMOS, Bipolar
(4.-, 5- and 6-inch wafers)

PRODUCTS

Linear	Model	Description
Op Amps	LM324	Quad Op Amp
	LM358/1458/4558	Dual Op Amp
	LM741	Single Op Amp
	LM386	Low Voltage Power Amp
Timers	NE555	Single Timer
	NE556	Dual Timer
Voltage Regulators	KA33	Precision V-Regulator
	LM723	Adjustable Precision
	MC78	Positive V-Regulator
	MC79	Negative V-Regulator
Comparators	LM311	Single Comparator
	LM339	Quad Comparator
	LM393	Dual Comparator
Data Converters	KS25C02/03	8-bit Successive Aprox Register
	KS25C04	12-bit Successive Aprox Register
	KSV3100	8-bit and 10-bit Flash Converter
Interface	MC1488/489	Quad Line RS232 Receiver
Other	KA2181/82/83	Remote Control Preamp
	KA2580/2588	8CH Source Driver
	KA2803	Ground Default Detector
	KA2804	Zero Voltage Switch
Telecommunications	LM567	Tone Decoder
	KA2410/11	Tone Ringer
	KA2412	Subset Amplifier
	KA2413/5808	DTMF
	MC3361	FM IF Amplifier
	KS5804/05	Pulse Dialer

Discrete Transistors	Power MOSFET General-Purpose Transistors Low-Noise Amplifier Transistors High-Voltage Transistors Darlington Transistors
Logic	KS54/74AHCT Family-Advanced High-Speed CMOS KS54/74HCTLS Family-High-Speed CMOS
Memory	DRAM 64K, 128K, 256K SRAM 16K, 64K EEPROM 16K, 64K

FACILITIES

Santa Clara	38,000 sq. ft.	Research and development

An additional 32,000 sq. ft. to include a Class 10 clean room will be added in February 1987.

Design Center:
Santa Clara, CA

COMPANY HIGHLIGHTS

In its short history, Samsung has accomplished the following:

2Q84	Sampled an MOS 64K DRAM.
Oct. 1984	Began production quantities of MOS 64K DRAM (6 million units/month).
1984	Built a plant for manufacturing 256K DRAMs.
3Q84	Sampled an NMOS 16K EEPROM, 300ns.
Jan. 1985	Sampled a 256K DRAM.
July 1985	Reduced 64K DRAM production; ramped up production for 16K SRAMs and 16K EEPROMs.

Sept. 1985	Began volume production of KM6264 CMOS 64K SRAMs; 8Kx8; 100/120/150ns.
Jan. 1986	Signed IXYS technology agreement for SST to manufacture and sell IXYS power devices for low and medium-range applications; IXYS will use SST's fab to manufacture its high-voltage, high-current power devices
Feb. 1986	Sampled CMOS Logic Families, 54/74HCT and 54/74HCTLS. Each family includes a total of 63 devices fabricated with a 2-micron process.
April 1986	CMOS logic products in production.

Saratoga Semiconductor
10500 Ridgeview Court
Cupertino, CA 95014
408/973-0945
FAX: 408 255 0328

ESTABLISHED: September 1985
NO. OF EMPLOYEES: 52

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Edward Browder	Falco Data Products	President/CEO
Chief Tech Off	Andrew Wang	Amdahl	GM Comp Tech
VP Fabrication	Y.T. Loh	Amdahl	Mgr Process Eng
VP Design	Walford Ho	Amdahl	Mgr Design Engr
VP Mktg/Sales	Ray Hawkins	Inova	VP Mktg/Sales
VP Military Prod	F.L. Rosebrooks	EE Technology	Pres/CEO

FINANCING

Date	Round	Sources	Amount
Nov. 1985	Round 1	Berry Cash Southwest Partnership; Dougery, Jones & Wilder; Interwest Partners; Matrix Partners; Sierra Ventures/Wood River Capital; Sigma Partners; Weiss, Peck & Greer Venture Partners	$3.2M
May 1986	Round 2	Initial investors; Merril, Pickard, Anderson & Eyre; MBW Venture Partners	$8.3M

BACKGROUND

Saratoga Semiconductor designs, manufactures, and markets standard and custom semiconductors that combine CMOS and bipolar technologies on the same circuit. Applications for the circuits include electronic data processing, aerospace and defense, industrial and instrumentation electronics, and telecommunications.

Saratoga Semiconductor is using a proprietary wafer fabrication technology it calls "Self-Aligned Bipolar CMOS" (SABiC II) that combines bipolar and CMOS processes on the same circuit. Saratoga Semiconductor believes the resulting BiCMOS, that offers the high-speed and drive of bipolar and the low-power demands and high-density of CMOS, represents the next breakthrough in silicon wafer processing.

Founders Andrew Wang, Y.T. Loh, and Walford Ho were given a unique opportunity to develop their SABiC II process while still working at Amdahl. In August 1984, Amdahl announced that it would shut down its semiconductor operations by mid-1985. However, Amdahl considered it critical, that the team of engineers in place remained to complete the development of the ICs needed for its new Amdahl 5890 computer. As a result the engineers were given generous incentives to complete the project. The project was successfully completed during that last year. Simultaneously Mr. Wang and his teammates developed, designed, and produced their first BiCMOS ECL chip. On August 30, 1985, the founders terminated their employment and formed Saratoga Semiconductor.

In September 1985, Saratoga Semiconductor acquired a Class 10 wafer fab facility in Cupertino from Trilogy. Within a year the founders completed development of the SABiC II process. In August 1986, it announced its first products, a family of four 4096-bit ECL SRAMs that operate at 15ns. Fabrication and wafer test is done at the Cupertino, California, facility. Commercial assembly, test, and burn-in is subcontracted to offshore vendors.

In the short term, Saratoga plans to offer high-density ECL SRAMs (16K and 64K) and high-density TTL SRAMs (64K and 256K) that utilize a 1.5-micron SABiC II process. The Company plans later to enter other markets including standard cell, programmable logic, and silicon compilation.

ALLIANCES: None

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

2.0-micron BiCMOS
1.5-micron BiCMOS planned for 1986
(4-inch wafers)

PRODUCTS

ECL SRAMS

Device	Organization	Speed
SSM10470-15	4096x1	15ns
SSM-10474-15	1024x4	15ns
SSM100470-15	4096x1	15ns
SSM100474-15	1024x4	15ns

FACILITIES

Cupertino, CA	12,000 sq. ft.	Office, manufacturing
	10,000 sq. ft.	Class 10 Clean room

COMPANY HIGHLIGHTS

Sept. 1985 — Saratoga signed a letter of intent to lease Trilogy's Cupertino wafer fabrication facilities for five years with a five-year renewal option. Included in the agreement was a $1.7 million equipment loan guaranteed by Trilogy in exchange for warrants to buy stock in the future.

Nov. 1985 — Saratoga Semiconductor closed first-round financing for $3.2 million. Funding was secured on the merits of the company's new technology, rather than a detailed business plan.

March 1986 — Saratoga Semiconductor produced working ECL RAMs at its new facility.

May 1986 — Saratoga completed second-round financing for $8.3 million to be used for bringing Saratoga's first BiCMOS products into volume production.

July 1986 — Saratoga introduced the following numbers of a family of 15ns ECL-compatible 4K BiCMOS SRAMs:

SSM-10474-10 4096x1
SSM-10474-15 1024x4
SSM100470-15 4096x1
SSM100474-15 1024x4

SEEQ Technology, Inc.
1849 Fortune Drive
San Jose, CA 95131
408/262-5041

ESTABLISHED: January 1981
NO. OF EMPLOYEES: 300

BOARD

Position	Name	Affiliation
Chairman	E. Floyd Kvamme	Kleiner, Perkins, Caufield & Byers

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	J. Daniel McCranie	Harris	VP Sales/Mktg
VP Opns	Gerald A. Robinson	Zilog	VP W/W Opns
VP Engr	Phil Salsbury, PhD.	Intel	Dir Engineering
VP Finance/CFO	Patrick B. Brennan	NSC	VP/Treasurer
Dir Mktg	Mike Villot	Motorola	Dir Customer Mkt
Dir WW Sales	Phil Ortiz	CDI	Dir Int'l Sales
Dir R&QA	Tom Endicott	Signetics	Mgr R&QA
Dir HR	Steve Gonia	California M/W	Mgr HR

FINANCING

Date	Round	Sources	Amount
March 1981	Initial	Kleiner, Perkins, Caufield & Byers; Hillman Co.	$15.0M
Sept. 1983	Initial	Public Offering	$20.0M
March 1985		Private placement	$14.0M
Oct. 1986		Private placement	$6.0M

BACKGROUND

SEEQ Technology, Incorporated, was formed to design, manufacture, and market nonvolatile semiconductor memory devices used in microprocessor systems. In August 1982, SEEQ shipped the first 16K EEPROM. SEEQ began operations in its own fabrication facility in October 1982.

SEEQ Technology was founded by Gordon Campbell, Philip J. Salsbury, Larry T. Jordan, Maria Ligeti, and George Perlegos, all formerly employed by Intel Corporation, and Dan Barbato who was previously employed by Synertek.

SEEQ products are strategically grouped into three classifications: EPROM and EEPROM products that support nonvolatile memory needs; EEPROM microprocessors, and an Ethernet controller chip set.

In 1986, SEEQ refocused its development activities, resulting in several new products including a 256K EEPROM with internal linewidths of 1.25-microns and a 128K "flash" erase EEPROM to replace its UVEPROM line. The Company's plans include expanding its EEPROMs in the ASIC market by offering silicon development systems and EEPROM technology for designing user-reconfigurable and self-adaptive ASICs. Through an agreement with Silicon Compilers, SEEQ will integrate its proprietary Q-Cell EEPROM array library into SCI's Genesil Silicon Development software.

Since January 1986, SEEQ has offered foundry services. In July 1986, SEEQ announced that it would de-emphasize its EPROM memory business and terminated 125 of its 425 employees, 100 of whom were production workers in the EPROM lines. The company indicated the move was taken because the commodity UV EPROM products contributed less than one-third to revenues with only a slight contribution to gross margin. SEEQ's net loss for the first nine months ending June 30, 1986 totaled $13.5 million or $1.13 a share. SEEQ is going ahead with plans to market the "flash" EEPROM device as a replacement for EPROMs and the full-featured EEPROM as a niche product.

SEEQ markets its products in the United States and Europe through a network of sales representatives and distributors.

ALLIANCES

Amkor	1981	SEEQ signed Amkor to assemble its IC products.
Rockwell	July 1982	SEEQ signed an exclusive license agreement to provide its 16K EEPROM and 16K UV EPROM technology to Rockwell. In exchange, Rockwell paid SEEQ $5M, leased $5.5M of SEEQ's equipment, and agreed to pay a 3 percent royalty on sales of these products.
Texas Instruments	Aug. 1982	SEEQ licensed its EEPROM technology to TI for its TMS7000 8-bit MCU.

Silicon Compilers Inc.	1983	SEEQ announced that it would manufacture SCI's Ethernet data link controller.
	July 1985	SEEQ provided all of its EEPROM designs for integration into SCI's Genesil System. SEEQ will manufacture the EEPROM logic circuits using its 2-micron CMOS process.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

2.0-micron double-poly floating-gate CMOS
1.25-micron double-poly floating-gate CMOS

PRODUCTS

MEMORY

EPROMs

Device	Organization	Access Time (ns)
2764	8Kx8	200
27128	16Kx8	200
27256	32Kx8	200
27C256	32Kx8	200

EEPROMs

Part Number	Organization	Accesstime
DM5213	2Kx8	200
M52B33	8Kx8	200
5517A, 2817A	2Kx8	200
2864	8Kx8	200
28C256	256K	200
48128	128K	170
2804A	4K	250

OTHER PRODUCTS

8001	CMOS 2-chip Ethernet Data Link Controller
8003	EDLC Ethernet Data Link Controller
8023A	MCC Manchester Code Converter
72720	Self Adaptive EEPROM Single-Chip Microcomputer

Application markets: Automotive, consumer, industrial, telecommunications, and military

FACILITIES

San Jose, CA	120,000 sq. ft.	
	15,000 sq. ft.	Class 1000 Clean room

COMPANY HIGHLIGHTS

In its five-year history SEEQ's accomplishments include the following:

April 1981	Leased 57,000 sq. ft. for its headquarters, manufacturing, and research.
2Q82	Sampled its MOS 64K EPROM.
3Q82	Began quantity production of the MOS 64K EPROM.
3Q82	Began quantity production of the MOS 16K EEPROM; 2Kx8 Military, DM5213, 350ns, 5V, 24-pin DIP.
July 1982	Agreed with Rockwell to allow the use of SEEQ's EEPROM and EPROM process and to second-source SEEQ's 16K EEPROM and 64K UV EPROM products. SEEQ gets cash, royalties, and leases on equipment. This agreement occurred as SEEQ was bringing up its first wafer fab production line.
Aug. 1982	Agreed with Texas Instruments to develop the TMS 7000 single-chip MPU family using SEEQ's 16K EEPROM.
Oct. 1982	Offered monolithic Ethernet Data-Link Controllers, the CMOS 8001 two chip-set encoder/decoder.
2Q83	Sampled the MOS 128K EPROM.

July 1983	SEEQ reduced prices on its 8001 Ethernet Data-Link Controller by 58 percent.
Sept. 1983	Filed an initial public offering (IPO) of 1.8 million shares to raise funds for working capital, capital expenditures, and product development.
Oct. 1983	Sampled the MOS 64K EEPROM.
3Q83	Began quantity production of the 128K EPROM.
July 1983	Offered the Ethernet Controller, 8002MCC single-chip CMOS Manchester Code Converter.
4Q83	Sampled the MOS 32K EEPROM.
Q483	Began quantity production of the 8Kx8 Military MOS 64K EEPROM; M52B33; 250ns, 5V, 28-pin DIP. It was the first EEPROM with 1Megacycle endurance.
June 1984	Accomplished its first profitable quarter.
2Q84	Sampled the CMOS 27C256 256K EPROM; 32Kx8, 250ns.
4Q84	Began quantity production of the CMOS 256K EPROM.
July 1984	Offered 16K 5517A and 2817A EEPROMS; 2Kx8, 5V.
July 1984	SEEQ moved to a new 63,000-square-foot facility.
Jan. 1985	SEEQ laid off 5.3 percent of its work force due to order cancellations and returned EPROMs.
Feb. 1985	Sales topped $1M net in first quarter because of the higher percent of EEPROM products.
	Established a northern Europe sales office in Swindon, England. John Cowrie, previously employed by Intel as sales manager for Scotland, was named regional manager. The office will offer sales and applications support for EPROMs in the United Kingdom, Scandinavia, and Finland.
March 1985	Completed a private placement of stock that raised $14 million which will be used to repay loans, finance capital equipment, and continue research and development efforts.

March 1985	SEEQ cut work force by 15 percent to 523 from 606.
May 1985	Planned to sample 256K EEPROM in December 1985, with volume production scheduled for 1987.
	Reduced work force by an additional 10 percent; 450 employees remain.
June 1985	Announced that 75 percent of its wafer starts were EEPROMs.
July 1985	Sampled the 2864, a military 8Kx8 NMOS EEPROM with on-chip timer that automatically times the write cycle; 250ns, 5V, 28-pin DIP, commercial.
July 1985	Agreed to a technology exchange with Silicon Compilers to integrate SEEQ's Q-Cell EEPROM array library into SCI's Genesil Silicon Development software for designing user-configurable and self-adaptive ASICs. SEEQ will be the exclusive developer of EEPROM compilers for SCI's system and will manufacture custom logic circuits in its 2-micron facilities.
July 1985	President Malcolm R. MacPherson is replaced by Floyd Kvamme.
Oct. 1985	SEEQ laid off 75 employees after a $6.3 million fourth-quarter loss; 395 employees remain.
Jan. 1986	Offered foundry services.
March 1986	SEEQ offered the 28C256, the first 5V 256K EEPROM using a 1.25-micron CMOS process. The device features SEEQ's proprietary oxynitride process and Q-cell design.
July 1986	SEEQ withdrew from the EPROM memory business and terminated 125 of its 425 employees. Production workers in the EPROM lines were more than 100 of those laid off.

Sensym, Inc.
1255 Reamwood Avenue
Sunnyvale, CA 94089
408/744-1500
Telex: 176376

ESTABLISHED: October 1982
NO. OF EMPLOYEES: 103

BOARD

Name	Affiliation
Dennis Dauenhauer	Sensym
Brent Welling	Sensym
Roger J. Barry	Crosspoint Venture Partners
Robert L. Cummings	Robertson, Colman & Stephens

COMPANY EXECUTIVES

Position	Name
President	Dennis Dauenhauer
VP Mktg/Sales	Brent Welling
Director	Fred Adamic
VP Hybrid Opns	Saeed Nasiri

FINANCING

Date	Round	Sources	Amount
Oct. 1982	Round 1	Robertson, Colman & Stephens; Crosspoint Venture Partners	$1.0M
	Round 2	Robertson, Colman & Stephens; Crosspoint Venture Partners; Med-Tec Ventures; National Semiconductor	$1.5M

BACKGROUND

Sensym is a leading manufacturer of high-quality IC pressure sensors (transducers), handheld precision manometers, and foundry services for 4-inch wafer processing. The Company provides low-cost, high-performance products for a variety of industries including energy management, avionics, medical diagnostics, agrionics, and industrial controls.

Sensym was founded when the principal management of National Semiconductor's transducer group initiated a leveraged buyout from the parent company with the assistance of venture capital funding. The Company set up its operation in Sunnyvale, California, to provide only U.S.-built products. Round two of financing, completed in 1984, assisted in the expansion of Sensym's manufacturing capacity.

Sensym is a market-driven, sales-oriented corporation that relies on contact from customers for product ideas and/or enhancements.

Sensym offers the National Semiconductor Transducer product line as well as numerous product additions.

ALLIANCES

NSC	Sensym second-sourced the NSC transducer product line.
Metravib	Sensym has a technology agreement with Metravib, France.

SERVICES

Manufacturing
Assembly

PRODUCTS

Transducers

Applications: Semiconductor processing equipment, medical equipment, computer tape drives, energy management systems, and machine pneumatics

FACILITIES

Sunnyvale, CA	40,000 sq. ft.	Manufacturing and offices
	1500 sq. ft.	Class 100 Clean room

SID Microelectronics S. A.
Head Office
Av. Brig. Faria Lima
1476 - 7. andar
01452 - Sao Paulo
Brazil
(011) 210-4033

ESTABLISHED: April 1984
NO. OF EMPLOYEES: 850

BOARD

Name	Affiliation
Matias Machline	SHARP S/A Equipamentos Eletronicos
Jose B. Amorim	SID S/A Servicos Tecnicos
Yuichi Tsukamoto	SHARP S/A Equipamentos Eletronicos
Jose Papa, Jr.	FIESP

COMPANY EXECUTIVES

Position	Name	Prior Company
President	Matias Machline	N/A
VP R&D	Adalberto Machado	Ford-Brazil
VP Finance	Luis Paulo Rosenberg	N/A
Mng Director	Victor Blatt	CPQD-Telebras
Indus Director	Wilson L.M. Leal	Siemens
Planning Mgr	Luiz Mauge	Sharp
Mktg Mgr	Inacio Hatanaka	RCA

FINANCING

Date	Round	Sources	Amount
1984	Initial	Private	$14.2M

BACKGROUND

SID was formed to provide merchant market and captive semiconductor devices and to be the major Brazilian semiconductor manufacturer by the end of 1986.

The Company's long-term strategy includes plans to introduce hybrid circuits, surface mounted device technology, professional metallic-can transistors, ceramic and metal (cermet) ICs, and digital IC assembly. Additional product plans include MOS logic, custom/semicustom ICs, memories, microprocessors, TTL, LIC, and LSI devices. The Company plans to continue support of its design and research and development activities in CMOS, and to begin a 2-micron CMOS process by the end of 1988.

SID succeeds the RCA-Ford semiconductor manufacturing joint venture in Brazil that closed in 1983. In 1984 SID purchased the IC fab from RCA to produce ICs for the merchant market. SID is the only South American semiconductor manufacturing company with all the manufacturing steps, including wafer production.

SERVICES

- Design
- Foundry
- Manufacturing
- Assembly
- Test

PROCESS TECHNOLOGY

- 3.0-micron bipolar

PRODUCTS

- Small Signal Transistors
- Linear ICs
- Medium Power Transistors

FACILITIES

Contagem, Brazil

Sierra Semiconductor Corporation
2075 North Capitol Avenue
San Jose, CA 95132
408/263-9300
Telex: 384467
FAX: 408 263 3337

ESTABLISHED: November 1983
NO. OF EMPLOYEES: 165

BOARD:

Name	Affiliation
James V. Diller	Sierra Semiconductor Corporation
Donald T. Valentine	Capital Management Services
Charlie C. Bass	Ungermann-Bass
Joseph Caligiuri	Litton Industries
Robert J. Schreiner	Borg-Warner Electronics
Kheng-Nam Lee	Singapore Technology Corporation, Inc.

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	James W. Diller	NSC	VP MOS Opns
VP Design	Andrew G. Varadi	NSC	VP Technology
VP Process Tech	Ying K. Shum, PhD.	NSC	Prod Line Mgr
VP Opns	Edward Boleky	Intel	Mgr Mem Prod
VP Mktg/Sales	John T. Reynolds	NSC	Group Mktg Dir
VP N.A. Sales	Alden Chauvin	TI	Area Sales Mgr
VP Analog Dsn	Roubik Gregorian	Gould AMI	Mgr Telecom Engr
VP Technology	Tom Klein		VP Opns

FINANCING

Date	Round	Sources	Amount
Jan. 1984	Initial	Arscott, Norton & Assoc.; Asset Management Co.; Associated Venture Investors; Bay Partners; Borg-Warner Electronics; Capital Management Services; Investors in Industry; Mohr, Davidow Ventures; Sutter Hill Ventures; Technology Venture Investors; Venrock Associates	$7.7M
	Lease		$15.0M

Date	Round	Sources	Amount
April 1985	Round 2	Initial investors; Bryan and Edwards; Burr, Egan, Deleage & Co.; Litton Industries; IndoSuez Technology Fund; Tellabs, Inc.	$15.0M
	Lease		$2.0M
Oct. 1986	Round 3	Asset Management; Associated Venture Investors; Bay Partners; Borg-Warner; Chuchill International; Hambrecht & Quist; Litton Fund; MIP Equity Fund; Mohr, Davidow; Sequoia Capital; Suez Technology Fund; Sutter Hill Ventures; Technology Venture Investors; Venrock Assoc.; Singapore Technology Corp.	$18.4M
June 1986	Grants	Netherlands Ministry of Economic Affairs	$9.0M

BACKGROUND

Sierra Semiconductor is a service-oriented supplier of CMOS application-specific cell-based ICs with a complementary portfolio of standard products. Sierra utilizes a proprietary Triple Technology for combining analog, digital, and EE nonvolatile memory on a single IC. The Company's market segments include telecommunications, data communications, and industrial. Sierra's initial products are fabricated on five-inch wafers using two-micron and three-micron CMOS process technology.

Sierra Semiconductor was founded by a group of executives from National Semiconductor Corporation, James V. Diller, Andrew G. Varadi, Thomas Klein, Dr. Ying K. Shum, and John T. Reynolds.

In June 1986 Sierra announced a new corporation in the Netherlands--Sierra Semiconductor B.V.--that will serve the IC needs of the Pan-European marketplace. The new corporation is being formed as a result of $8 million in funding from Netherlands-based MIP Equity Fund. The European headquarters, scheduled to open in October 1986, will provide a design center, technical support and services, and marketing and sales for Sierra's standard and cell-based ICs.

Sierra's wafer manufacturing is done in Sunnyvale in a leased National Semiconductor building using Sierra products and technology.

ALLIANCES

National Semiconductor	July 1984	Sierra and NSC have a technology exchange agreement covering selected advanced CMOS products and processes. Sierra leased a facility from National to develop its process and manufacture products using its own equipment and employees.
VLSI Technology	Jan. 1985	Sierra and VLSI have an agreement which provides for the exchange of technical information and the mutual sharing of developments in ASIC software, design expertise, and products.

SERVICES

Design
Foundry Silicon-Gate CMOS
Prototype Manufacturing

PROCESS TECHNOLOGY

2.0-Micron Double-Poly, Double-Metal CMOS
3.0-Micron Double-Poly, Single-Metal CMOS
(5-Inch wafers)

PRODUCTS

Standard Memory

EEPROM

Product Number	Description
SC22001	CMOS 256-bit Serial
SC22011	CMOS 1024-bit Serial
SC22101	CMOS 128x8 Multiplexed
SC22102	CMOS 256x8 Multiplexed
SC22104	CMOS 512x8 Multiplexed

Standard Data Communications

Product Number	Description
SC11000/SC11001/SC11005	CMOS Modem Filters
SC11002/SC22003	CMOS Modem 300bps
SC11004/SC11014	CMOS Modem 1200bps
SC11007/SC11008	CMOS Modem Controller

Standard Telecommunications

Product Number	Description
SC11202/SC11203/SC11204/SC11270	CMOS DTMF Receiver
SC11280/SC11289/SC11290	CMOS DTMF Transceiver

Standard Computer/Peripheral

Product Number	Description
SC11401/SC11402/SC11403/SC11404	CMOS Video DAC

CMOS Cell Library

Process	Linewidth	Cells
Si-Gate CMOS	2.0-micron	280 digital cells 33 analog cells 15 EEPROM cells RAM, ROM, PLA, 2901, Multiply

Applications: Data communications, telecommunications, computers/peripherals, and industrial

FACILITIES

San Jose, CA	71,000 sq. ft.	Design and test

Sierra Semiconductor is planning a 6-inch wafer fab with Class 10 clean room for 1987.

Design Centers:

San Jose	CMOS	Custom and Cell-based

Additional U.S. and international design centers are planned for 1987.

COMPANY HIGHLIGHTS

In Sierra's three-year history, the Company has accomplished the following:

Jan. 1984	Completed initial financing for $22.7 million.
July 1984	Exchanged technologies with National Semiconductor.
Jan. 1985	Agreed with VLSI Technology to exchange design tools, designs, and products.
March 1985	Completed second round of financing for $17 million to support new product and technology developments and provide a new facility for a design center.
April 1985	Introduced the CMOS Modem Filters.
June 1985	Introduced the 300 bps CMOS Modem.
July 1985	Introduced the CMOS serial and multiplexed EEPROM memory.
Aug. 1985	Introduced the CMOS DTMF Receiver.
Jan. 1986	Sampled the CMOS 1200 bps single modem and companion controller.
March 1986	Sierra, which offers both analog and digital standard cells in its CMOS library, offered CMOS EEPROM cells as well as completing a three-pronged product strategy.
June 1986	Announced that MIP Equity Fund, a Dutch venture capital firm, has invested $8 million in Sierra to launch Sierra's European operations. Sierra Semiconductor B.V. will be located in the Netherlands to serve as European headquarters, for design, support, and marketing and as the distribution center for Europe.

Si-Fab
27 Janis Way
Scotts Valley, CA 95066
408/438-6800

ESTABLISHED: 1981
NO. OF EMPLOYEES: 12

BOARD: Not available

COMPANY EXECUTIVE

Position	Name
President	Leon Pearce

FINANCING: Not Available

BACKGROUND

Si-Fab is in Chapter 11 and is operating at a low level. The Company went through a reorganization in 1985, and the employee count went from 70 to 12. Si-Fab is experiencing higher yields and expects 1986 to be a year of growth with a new management team and state-of-the-art equipment.

ALLIANCES: Not available

SERVICES

- Design

PROCESS TECHNOLOGY

3.0-micron PMOS
(3-inch wafers)

PRODUCTS: Proprietary

FACILITIES

Scotts Valley, CA	12,000 sq. ft.	
	2,500 sq. ft.	Clean room

Silicon Macrosystems, Inc.
2960 No. First Street
San Jose, CA 95134-2021
408/434-1100

ESTABLISHED: April 1984
NO. OF EMPLOYEES: 11

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Philip Siu	VLSI Technology	Dir Std Prod Memory
VP R&D	Mark Ebel	VLSI Technology	Mgr Memory Div
VP Opns	Paul Lui	VLSI Technology	Prod Mgr
Dir Wfr Tech	Miin Wu	VLSI Technology	TD Mgr
Dir Sales	Joe Queen	Logic Devices	Sales Mgr

FINANCING

Date	Round	Sources	Amount
Jan. 1985	Round 1	Corporate, Private	$1.1M

BACKGROUND

Silicon Macrosystems, Incorporated (SMI), designs and manufactures high-performance CMOS-based memory and analog standard products for the computer and telecommunications markets.

Within six months of operation, SMI developed a one-megabit ROM while simultaneously providing design services.

Silicon Macrosystems develops products internally and subcontracts its manufacturing activities.

In September 1986, Austek Microsystems purchased Silicon Microsystems, Inc. who will operate as a value-added design operation concentrating on memory products.

ALLIANCES

Goldstar	Undisclosed

SERVICES

Design

PROCESS TECHNOLOGY

1.5-micron CMOS (double-metal/double-poly)
2.0-micron CMOS (double-metal/single-poly)
3.0-micron Bipolar

PRODUCTS

Memory	Access Time (ns)
512K Static ROM SM23512 64Kx8	150
16K CMOS SRAM SM27HC16 2Kx8	25
1Mb SRAM SM231024 128Kx8	200
32K CMOS EPROM SM27HC32 4Kx8	35
64K CMOS EPROM SM27HC64 8Kx8	35

FACILITIES

San Jose, CA	5,000 sq. ft.	Design

COMPANY HIGHLIGHTS

March 1985	SMI introduced the SM 231024, a 1Mb Static ROM (128Kx8, 150ns 28-pin ceramic or plastic DIP).
May 1985	SMI moved research and development and administrative offices to a new 5,000-square-foot facility.
May 1985	SMI introduced the SM 23512, a 64Kx8 512K Static ROM (150ns 28-pin ceramic or plastic DIP, commercial).

Silicon Systems Inc.
14351 Myford Road
Tustin, CA 92680
714/731-7110

ESTABLISHED: 1981
NO. OF EMPLOYEES: 1,000

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Chairman/CEO	Carmelo J. Santoro, PhD.
President	Steven E. Cooper
Chief Technical Officer	Gary Kelson
Executive VP Mfg Opns	William Healey
Executive VP Sales/Mktg	Rick Goerner
Executive VP/CFO	Richard Holder

BACKGROUND

Silicon Systems Inc. (SSI) designs, manufactures, and markets standard and custom application-specific ICs for the microperipheral, industrial, and telecommunications markets.

Silicon Systems has set itself apart from the commodity manufacturers with proprietary design techniques and innovative products for the telecommunications and disk drive markets. The Company specializes in the production of combined analog and digital circuits on single ICs. SSI's capabilities cover all phases of custom circuit production, from product definition through manufacturing and final test. SSI also functions as a foundry for its customers' proprietary designs.

Silicon Systems was founded in 1972 as a custom design house by a group of Scientific Data Systems (Xerox) engineers on the premise that ICs of the future would be complete single-chip systems. In 1981, SSI went public and constructed its wafer fab to become a manufacturing company. Carmelo Santoro changed the focus from strictly custom IC development to include standard product manufacturing and sales. SSI developed expertise in CMOS switched-capacitor filter design and went on to develop the first single-chip DTMF device.

In January 1986 the Company announced the formation of an industrial strategic business unit to focus resources on broadening the Company's impact in the industrial arena. Industrial and military customers accounted for about 5 percent of SSI's business in 1985, and the Company's objective is to increase this to 15 or 20 percent. This new unit complements the Company's other division for microperipheral and telecommunications products. To broaden its product line SSI initially has entered into an agreement with Ferranti to expand into the analog/digital industrial market.

SSI's headquarters, design engineering, and testing are located in its Tustin, California, facility. Additional design engineering facilities are located in Grass Valley, California. In March 1986 SSI had a grand opening for its new $5 million assembly and test plant in Singapore. The Company expected it to be supplying 80 percent of the plastic DIP and quad surface mount package assembly requirements by second quarter.

ALLIANCES

Rogers	Nov. 1985	SSI and Rogers formed a joint venture to design, manufacture, and market value-added intelligent flexible subsystems, or SMARTFLEX Systems. While initially focused on rotating memory applications, the joint venture charter calls for a broadened scope to serve other industrial and military markets.
RCA	Feb. 1986	SSI and RCA signed a product and technology exchange agreement that provides for RCA to second-source SSI's monolithic modem ICs. An exchange of CMOS process technology gave RCA the rights to SSI's analog CMOS process and SSI the rights to RCA's digital 2-micron CMOS process. RCA also agreed to supply SSI with CMOS wafers over a three year period. This agreement resulted in the following three advantages: SSI secured a well-known second-source for its single-chip modems and can accelerate design wins; SSI gained immediate access to a production wafer supply of 2-micron digital CMOS necessary for several new products in digital telecommunications and peripheral controller applications; and SSI gained a long-term foundry commitment from RCA that allows SSI to defer a major investment in wafer fab capacity until justified by volume economics.

Ferranti	March 1986	SSI and Ferranti signed an agreement under which SSI will second-source Ferranti's data conversion ICs in the United States. SSI will develop, produce, and market the devices. The agreement includes future cooperation on product planning and development. The agreement increases Ferranti's penetration in North America, while giving SSI access to the analog data conversion market for which the majority of applications are in industrial and military accounts.
Oki Electric	Sept. 1986	Single-chip modem LSIs (1200 bps)

SERVICES

Design
Foundry Silicon-Gate CMOS and Bipolar
Manufacturing

PRODUCTS

Microperipherals

Read/Write Amplifiers
Pulse Detectors
Data Recovery
Servo
Controller
Motor Speed Control
Data Separators
SSI 67C401 CMOS FIFO asynchronous register
SSI 214 Analog Processor IC

Telecommunication

K 212A/222 Single-Chip Modem IC 1200/300 BPS
T1 Transmission, Transceiver and Interface
Crosspoint Switches
Local Area Network Transceivers
DSP SCF and Time Signaling

Data Conversion

Video DACs
Flash ADC
SSI 6030 8-bit Monolithic Data Converter IC
SSI 6070 10-bit A/D Converter IC

FACILITIES

Tustin, CA	Building 1	57,000 sq. ft.	Headquarters and test
	Building 2	83,000 sq. ft.	Manufacturing

Design Centers:
Grass Valley, CA
Singapore

COMPANY HIGHLIGHTS

Sept. 1985 — SSI introduced the 67C401, a high-speed expandable CMOS FIFO asynchronous register.

Nov. 1985 — SSI sampling the K 212A/222 Modems.

SSI and Rogers formed a joint venture to design, manufacture, and market value-added intelligent flex subsystems, SMARTFLEX Systems. While initially focused on rotating memory applications, the J-V's charter is to broaden its scope to serve other industrial and military markets.

Feb. 1986 — SSI and RCA signed a product and technology exchange agreement which calls for RCA to second source SSI's monolithic modem ICs and an exchange of CMOS processing technologies. The exchange gave RCA rights to SSI's analog CMOS process and SSI rights to RCA's digital 2-micron CMOS process. RCA also agreed to supply SSI with CMOS wafers over a three-year period.

March 1986 — SSI will second-source Ferranti's data conversion ICs in the United States. SSI will develop, produce, and market the devices and will cooperate on future product planning and development. The agreement serves to increase Ferranti's penetration in North America, while giving SSI access to the analog data conversion products for applications in the industrial and military markets.

March 1986	SSI announced a new multifunction 8-bit data converter IC, the SSI 6030. It provides A/D, D/A, and voltage-to-frequency conversion. The monolithic bipolar chip is suited for robotics, avionics, test instrumentation, process, and industrial control applications.
March 1986	SSI announced the SSI 6070, a 10-bit analog-to-digital converter IC available in commercial and military temperature ranges. Versions are packaged in either a 28-lead CERDIP or plastic DIP.
July 1986	Silicon Systems introduced the SSI K222, a single-chip modem IC with 1200/300 bps.
July 1986	Silicon Systems introduced the SSI 214 Analog Processor IC, a complete front-end for DSP-based V.22-bit and Bell 212A compatible modems. It is designed to work with two additional ICs, a single-chip MCU and a DSP.

S-MOS Systems, Inc.
2460 North First Street
San Jose, CA 95131
408/993-1212

ESTABLISHED: November 1983
NO. OF EMPLOYEES: 38

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Daniel S. Hauer	Micro Power	VP/Custom Prod
Dir Sales	Joel Silverman	IMI	Dir Mktg
Sr Dir Sales/Mktg	R. G. Engelbrecht	Samsung	VP Sales/Mktg
Dir Mktg	Dave O. Perry	Elmo Semicon	Dir Mktg
Dir Engineering	John Conover	Siliconix	Engr Mgr
VP Finance/Admin	F. Kanazawa	Epson	Accounting Mgr

BACKGROUND

S-MOS Systems, Inc., was formed to provide computer and telecommunication manufacturers with advanced LSI and VLSI CMOS products. S-MOS offers a unique "super-silicide, silicon-gate" process and a VLSI "building-block" approach to producing semicustom gate arrays and standard cell devices.

S-MOS is a marketing and engineering affiliate of Seiko Epson, a division of the Seiko Group. In 1983 Seiko Epson set up S-MOS as a design center in San Jose. Designs are sent from the San Jose, Boston, and Midwest design centers via satellite for production at Seiko Epson's Fujimi plant in Japan. The Fujimi plant produces 35,000 4-inch wafers per month and 15,000 2-micron, 5-inch wafers per month. Seiko Epson is ramping a new 6-inch, 1.2-micron line to produce 20,000 wafers a month. S-MOS is allotted one-third of the capacity at this new plant.

During its first 12 months of operation, S-MOS rose to rank fifth among suppliers of 16K CMOS SRAMs to the North American market. S-MOS is presently supplying the 32Kx8 SRAM as well as other fast static RAMs and EPROMs.

ALLIANCES

Seiko Epson	1983	S-MOS was established as an affiliate of Seiko Epson which holds 30 percent of S-MOS. S-MOS uses Seiko Epson's CMOS process and develops CMOS gate array designs for production in Japan.
IMI	April 1984	International Microcircuits, Inc., and S-MOS signed a 2-year exchange agreement to second-source respective 2-micron CMOS gate arrays and to share standard cell libraries.
AMCC	May 1985	S-MOS was signed to second-source AMCC's Q6000 Series of 1.9-micron CMOS logic arrays. The arrays have 1,400 to 6,600 gates, and a 1.3ns delay. Seiko Epson licensed its SLA 6000 Series of high-performance gate arrays and its 2.0-micron silicon-gate, dual-layer process to AMCC. Production initially will be in Japan and is planned for the United States in 1986.
Siliconix	Nov. 1985	S-MOS and Siliconix made a technology exchange agreement that allows Siliconix to produce 1.5- and 2.0-micron gate arrays designed by Seiko Epson and S-MOS.
Lattice Semiconductor	Jan. 1986	Lattice announced a second-source agreement for its high-speed SR64K5 64K SRAM. Seiko Epson of Fujimi, Japan, will receive a license to the chip design and process technology and S-MOS will market the chip in North America.
Xilinx	1986	Xilinx entered into a joint development agreement with Seiko Epson to design, manufacture, and market logic cell arrays and development systems using Seiko Epson's CMOS manufacturing technology and Xilinx's proprietary logic cell array technology. The companies will jointly develop Seiko Epson's CMOS process. Seiko Epson gained nonexclusive marketing rights to the product in Japan.

SERVICES

Design	CMOS Gate Arrays, Cell Library
Foundry	
Manufacturing	
Test	

PROCESS TECHNOLOGY

1.5-, 2.0-, 3.0-micron Silicon-Gate CMOS
Dual-layer metal oxide-isolation process
(4-, 5-, 6-inch wafers)

PRODUCTS

Memory

SRAM

Product Number	Organization	Access Time (ns)
SRM 2114C	1024x4	250
SRM 2016/2017/2018	2Kx8	70, 90, 120, 150
SRM 2064	8Kx8	150
SRM 2261	64Kx1	55, 70
SRM 2264	8Kx8	90, 100, 120
SRM 2268C	4Kx4	45, 55, 70
SRM 2367C	16Kx1	35, 45
SRM 20256	32Kx8	100, 120

EPROM

	64K	150-300
	128K	250-300
	256k	200-300

EEPROM

	64K	150-300
	128K	250-300
	256K	200-300

Product Number	Organization	Access Time (ns)
ROM		
	64K	350-450
	128K	250
SMM6325/6326	256K CMOS	250
SMM63100C	128Kx8	250
MPU Family		
SMC 84C00	Z80 MPU	
SMC 82C37	DMA Controller	
SMC 82C51	Communications Interface	
SMC 82C54	Interval Timer	
SMC 82C55	Peripheral Interface	
SMC 82C59	Interrupt Controller	
Telecommunications		
Modem		
STC 9471	300 bps FSK Modem CCITT C21	
STC9472C	300 bps FSK Modem BELL 103	
STC 9120	1200 bps MSK single-chip Modem	
CMOS Pulse Dialer		
STC 2560C/2565C	CMOS Pulse Dialers	
STC 2580C	Tone/Pulse Dialer	
Other		
SCI 7661	DC-DC Converter	
SED 9420	Data Separator	
Optoelectronics		
SED 1200/1500/1100	CMOS LCD Drivers and Controllers	
SED 2020	CMOS VFD Driver	
SEA 700/3000	Solid State Image Sensors	

ASIC

CMOS Gate Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
SLA 5000	Si-Gate	3.0	3.0	413 to 3082
SLA 6000	Si-Gate	2.0	1.5	820 to 6,204
SLA 7000	Si-Gate	1.5	1.2	(Available 2Q86)

CMOS Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
SSC 1000	Si-Gate	2.0	1.5	131 MSI, RAM, ROM, PLA

FACILITIES

San Jose, CA	14,000 sq. ft.	Marketing, sales, engineering and administration.

Design Centers:

San Jose, CA	MOS	Gate Arrays, Standard Cell
Boston, MA	MOS	Gate Arrays, Standard Cell

S-MOS plans to announce a design center in the midwest in the near future.

COMPANY HIGHLIGHTS

Jan. 1984 — S-MOS introduced the SMM6325/6326 256K CMOS Mask ROM, with an access time of 250ns.

Feb. 1984 — S-MOS introduced the STC9472C/9482C 300-bps CMOS Modem and Filter Set.

Feb. 1984 — S-MOS sold $2.2 million of memory and microcomputer products during its first four months and revised first fiscal year sales goal from $10.8 to $15 million. SRAMs accounted for 70 percent of the sales.

April 1984	S-MOS and International Microcircuits agreed to exchange second-sourcing for each company's CMOS gate arrays.
Nov. 1984	S-MOS offered the SRM2064 64K SRAM, 8Kx8, 150ns, 5V, 24-pin plastic DIP, in a commercial grade.
Jan. 1985	S-MOS introduced the SRM2016M 16K SRAM (2Kx8, 150ns, in a surface mount package or 24-pin plastic DIP in commercial grade).
	S-MOS introduced the STC 2560C/2565C CMOS Pulse Dialers at 1.3 to 3.5V, in 18-pin plastic DIP, commercial grade.
May 1985	S-MOS agreed to second-source AMCC's Q6000 Series of sub-2-micron CMOS logic arrays of 1,400- to 56,600-gates with 1.3ns delays. Seiko Epson licensed its SLA 6000 Series of high-performance gate arrays and 2-micron silicon-gate, dual-level process to AMCC.
Oct. 1985	S-MOS introduced the SRM 2264C90 8Kx8 CMOS SRAM (100 & 120ns, 5V, 28-pin plastic DIP).
Nov. 1985	S-MOS introduced 64K and 256K CMOS UV EPROMs with 150 and 200ns access times.
	Siliconix signed a three-way pact with Seiko Epson and S-MOS to produce 1.5- and 2.0-micron gate arrays designed by Seiko and S-MOS. The arrays have 500- to 6,200-gates, with a 2ns delay.
Dec. 1985	S-MOS offered two 16K SRAMs: the SRM 2367C, 16Kx1, 35 and 45ns, amd the SRM 2268C, 4Kx4, 45, 55, 70ns. Both are TTL-compatible, 5V, packaged in 20-pin DIP, in commercial grade.
Dec. 1985	S-MOS offered its CMOS MPU Family based on Zilog's NMOS Z80 CPU. The family includes: the SMC 84C00AC-L, with a sleep-mode feature; the SMC 8400AC-S, with an on-chip oscillator in addition to the sleep-mode feature; and the SMC 8400AC with no sleep-mode. All are 5V in a commercial grade.
	S-MOS returned to a full five-day work week due to the increased demand for gate arrays and SRAMs. The Company had been on a four-day week since August of 1985.

Jan. 1986	S-MOS introduced the SRM 2261C 64K SRAM (55 and 70ns, 22-pin DIP) and the SMM63100C 128Kx8 CMOS Masked ROM at 250ns in a 28-pin DIP.
Jan. 1986	Lattice Semiconductor licensed the manufacturing and marketing rights to its fast SR64K4, 64K SRAM CMOS design to S-MOS and Seiko Epson in exchange for a second-source and five-year foundry commitment. S-MOS will second source Lattice Semiconductor's fast SRAMs, Seiko Epson will manufacture them in Japan. The three companies also discussed extending the agreement to include 256K SRAMs.
Feb. 1986	AMCC and S-MOS jointly introduce a new line of mutually second-sourced high-performance 1.8-micron CMOS logic arrays with propagation delays of 1.5ns. AMCC's Q6000A Series and S-MOS' SLA 6000A family includes ten CMOS arrays with densities ranging from 500- to 6,200-gates. Cell utilization is greater than 85 percent. The arrays are supported on Daisy workstations and will be supported on Mentor workstations in the second quarter by both companies. The family is supported on the IBM-PC/XT or AT by S-MOS.
April 1986	S-MOS introduced the SRM20256 32Kx8 CMOS SRAM in 100 and 120ns versions.
May 1986	S-MOS introduced the SED1341F CMOS Interface Device.
June 1986	Seiko Epson launched a new set of modem chips through S-MOS. The new chips include the STC9420C 300 Baud Modem, the STC9490C 1200 Baud Modem, the STC2580C Tone/Pulse Dialer, the SEK9400B Evaluation Board, and SEK9401B Modem Board.

III-V Semiconductor, Inc.
4545 S. Wendler Dr.
Tempe, AZ 85282
602/431-0431
TWX: 510 601 1436

ESTABLISHED: April 1985
NO. OF EMPLOYEES: 80

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Frank Shroff	NSC	Dir Optoelectronics
VP Finance/COO	Brent R. Fox	Senitron	President/CEO
VP Mktg/Sales	Dennis Riccio	Eaton	VP Sales/Semi Equip
VP Opns	Joseph Riccio	Motorola	Area Sales Mgr
VP R&D	John Gragg, PhD.	Sensym	VP Operations
Dir Europe Opns	Martin Woolfenden	NSC	Marketing Mgr
Troy Plant Mgr	Carl Derrington, PhD.	Motorola	Prod Mgr Sensors

BACKGROUND

III-V Semiconductor, Inc., produces and markets custom and semicustom products that combine silicon and GaAs technologies for the consumer, industrial, telecommunications, and computer markets.

III-V Semiconductor was formed via a leveraged buy-out of National Semiconductor's Optoelectronics business unit. The founders of the new company are Frank Shroff, John Gragg, Dennis Riccio, Joe Riccio, and Brent Fox. The Company's acquisition funding, completed in December 1985, was from Continental Illinois Venture Corporation (Chicago) and Opto-Ven of Phoenix, an investment company formed specifically to invest in III-V.

III-V Semiconductor is headquartered in Tempe, Arizona, and plans to establish a corporate research and development center near Arizona State University under the direction of Dr. Derrington. U.S. manufacturing operations are located in a 37,000-square-foot facility acquired from National in Troy, Michigan. The facility is capable of producing single-crystal GaAs and GaAlAs materials, vapor-phase and liquid-phase epitaxial deposition, and complete wafer processing. Final assembly and test are performed offshore.

Currently 400 products that were developed by the Company while a division of NSC are being offered by III-V. The devices include smart displays, specialty lamps, infrared devices, and custom devices. New products include a full line of six-pin optocouplers. In the long-term, the Company will focus on GaAs-based products, including materials (crystals and EPI), optoelectronics (standard and custom), and analog ICs (MMICs, high-temperature, and integrated optoelectronic ICs).

The Company plans substantial investments in materials and equipment such as reactors, crystal pullers, metallization equipment, and automated assembly equipment.

New product emphasis will initially be on high-performance coupler products and analog monolithic microwave ICs (MMICs).

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

GaAs

PRODUCTS:

FACILITIES

Troy, New York	Manufacturing
Tempe, Arizona	

Tachonics Corporation
107 Morgan Lane
Plainsboro, NJ 08536
609/275-2501

ESTABLISHED: June 1985
NO. OF EMPLOYEES: 40

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman	Robert A. Nafis	Grumman	Pres Elec Sys Div (Current)
President	Chuni L. Ghosh, PhD.	ITT	Mgr GaAs Products
VP Admin	William J. Sirico	Grumman	Mgr Elec Sys Div (Current)
Treasurer	Gary L. Symansky	Grumman	Controller (Current)
Secretary	Raymond Nightengale	Grumman	VP (Current)

FINANCING

Date	Round	Sources	Amount
1985	Initial	Grumman Corporation	$15-20M

BACKGROUND

Tachonics, a division of Grumman Corp., designs, develops, and manufactures custom GaAs linear and digital ICs. Grumman invested $15 to $20 million in the Tachonics plant and equipment. Initially Tachonics will produce GaAs devices for Grumman only on a captive basis. Its first commercial products are expected by the middle of 1986.

ALLIANCES

Grumman	July 1985	Tachonics was formed as a subsidiary of the Grumman Corporation. Grumman invested $15 to $20 million in the Tachonics plant and equipment.

SERVICES

GaAs Foundry
Design
Manufacturing
Assembly
Test

PROCESS TECHNOLOGY

GaAs
(1.0-micron)

PRODUCTS: Proprietary

FACILITIES

Plainsboro, NJ	38,500 sq. ft.	
	6,000 sq. ft.	Class 10 Clean room

Teledyne Monolithic Microwave
1274 Terra Bella Avenue
Mountain View, CA 94043
415/962-6879
RAX: 415/968-6533

ESTABLISHED: 1984
NO. OF EMPLOYEES: 15

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Exec Dir	James Ewar, Ph.D.
Dir Tech	Steven Ludvik, Ph.D.
Dir Applications	Robert Mandel, Ph.D.

FINANCING: Financing was provided by Teledyne MEC for an undisclosed amount.

BACKGROUND

Teledyne Monolithic Microwave (TMMIC) was formed by Teledyne MEC. Teledyne MEC is providing support while TMMIC sets up its technical and business base in preparation for spinning-off as an independent company some time in the next two to three years.

TMMIC developed its products in 1985 and introduced its first product in the first-half 1986, TTM 85001 an amplifier chip. It is a wide-band MMIC that operates between 2 and 18.6 GHz. It also features very flat gain across the entire band with 6dB gain and 16dBm power output.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

GaAs

PRODUCTS

TMM 85001	Amplifier

FACILITIES

Mountain View, CA	4,000 sq. ft.	Design

Telmos Inc.
740 Kifer Road
Sunnyvale, CA 94086
408/732-4882

ESTABLISHED: January 1981
NO. OF EMPLOYEES: 88

BOARD: Not Available

COMPANY EXECUTIVES: Telmos is in a reorganization

FINANCING

Date	Round	Sources	Amount
1981	Initial	Founders and Arthur Rock	$0.6M
Aug. 1982	Round 1	Analogic Corporation	$2.5M
Dec. 1982	Round 2	Venture Capitalists and Swiss Bank	$6.6M
Dec. 1983	Round 3	Institutions in United Kingdom	$12.0M
Sept. 1985	Round 4	Venture Capitalists and Merlin Gerin	$6.0M

BACKGROUND

Telmos Inc.'s products include high voltage ICs, analog/digital arrays, data conversion products and DMOS FETS for the electronic data processing, military, and industrial products.

Telmos is a manufacturing company founded by Dr. Jean Hoerni and Dr. Luc Bauer to exploit markets that can be serviced by unique technologies. In addition to the founders, funding for the Company has come from Arthur Rock, New Enterprises Associates, Montgomery Securities, Robertson, Colman & Stephens, Eugene Kleiner, Jay Last, Ventech Partners, Analogic Corporation, Merlin Gerlin, several European investors, and investors from Singapore.

ALLIANCES

CDI	1982	Telmos licensed CDI's linear CMOS products.
Analogic Corp.	Aug. 1982	Analogic Corporation acquired 38 percent of Telmos for $2.5 million. The transaction also included possible technology exchanges
Dainichi Seigyo	1983	Dainichi Seigyo is named the Company's exclusive sales agent in Japan
Merlin Gerin	Sept. 1985	Joint-venture design center in France and design and development of an ADC array product line

SERVICES

Design	CMOS Gate Arrays, Cell Library
Foundry	2.5-micron Silicon-Gate CMOS
Manufacturing	
Assembly	
Packaging	
Test	

PROCESS TECHNOLOGY

2.5-micron Silicon-Gate CMOS
(4-inch wafers)

PRODUCTS

CMOS Analog/Digital Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
TM 4030	Si-Gate		5-15	300-gates Check
TMG 6000	Si-Gate	4	4.0	80 to 660

CMOS Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
TMH 5000	Si-Gate	1 to 50	4	10 MSI, 500V FETs, SCRs, thyristor IGTs, diodes

Linear

TM 1070	7-bit Flash A/D Converter
TM 1073	7-bit Flash A/D Converter
TML 1072	7-bit Flash A/D Converter Series (20ns)
TML 1842	CMOS 8-bit Video DAC
TMH5008	An enhanced high voltage 8-channel analog switch
TMH5155/TMH5156	A pair of prototyping parts kits that will create high-voltage circuit designs on a breadboard and shorten the time between prototyping and developing a production-version high-voltage IC (HIVIC)

Discrete

SD 210-215	DMOS FETs

Applications: Motor control, line operated ICs, ATE, Ultra Sonic Imaging, ballast for fluorescent lighting, display drivers, telephone switching and interface

FACILITIES

Sunnyvale, CA	45,000 sq. ft.	Manufacturing
	10,000 sq. ft.	Class 100 Clean room

COMPANY HIGHLIGHTS

Aug. 1982 — Analogic Corporation acquired 38 percent of Telmos for $2.5 million. The transaction also included possible technology exchanges.

Oct. 1982 — TM 6000 ULA Family of linear/logic arrays was introduced.

Dec. 1982 — Round 2 financing was completed for $3.6 million of equity and $3.0 million of lease financing. Seven venture capitalists and two private investors participated in the capitalization.

Dec. 1983 — Round 3 financing was completed for $12.0 million of equity and $6 million of lease financing. Bank of America provided the lease credit. The funding was used to expand manufacturing operations and to buy design equipment. At that time the Analogic Corporation ownership was reduced to 16 percent from 30 percent.

Sept. 1985 — Telmos received $6.0 million for working capital, increasing inventory, and building expansion.

Feb. 1986 — President Earl Rogers left the presidency over a dispute with the board of directors. The Company will be managed by a three-person group until a new president is named.

Topaz Semiconductor Inc.
1971 North Capitol Avenue
San Jose, CA 95132-3799
408/748-1953

ESTABLISHED: March 1985
NO. OF EMPLOYEES: 40

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Thomas Cauge	SPI	VP Opns
VP Engr	Bruce Watson	SPI	Prod Mktg Mgr
Dir Mktg	Paul Denham, PhD.	SPI	VP Engr
Dir Opns	Bruce Woodward	Acrian	VP Opns
Controller	Colin Levy	Grey Stanforth	Partner

FINANCING

Date	Round	Sources	Amount
1985	Seed	Private	$0.6M

BACKGROUND

Topaz Semiconductor designs and manufactures advanced field-effect transistors (FETs). Topaz, a company representing a partial buy-out of Semi-Processes, Inc. (SPI), was formed by Thomas Cauge and Bruce Watson. The purchase included DMOS transistor and certain IC designs, and wafer fabrication, test and finishing equipment. Topaz later acquired the SPI facilities as the result of an agreement to be acquired by Hytek Microsystems, Inc., of Los Gatos, California.

Topaz Semiconductors operates as a wholly owned subsidiary of Hytek Microsystems. Hytek designs and manufactures thick-film hybrid microcircuits. In July 1985, Hytek purchased all the DMOS-related assets of SPI. Hytek's integration of the SPI assets with Topaz Semiconductor insures a continued source of supply of SPI products, as well as contributing to the faster expansion of Topaz Semiconductor.

With the financial backing of Hytek, a significant number of new Topaz products have been added. These products include medium-power lateral DMOS discretes (high-voltage and ultra low-leakage N- and P-channel); vertical DMOS discrete products with 20-micron Hex-to-Hex spacing; and new CMOS/DMOS IC analog switch products for video switching applications. Topaz will focus on high-speed digital and precision analog switching applications for its lateral DMOS devices, and on low- to medium-current relay-replacement applications for its vertical DMOS line. Topaz has initially integrated DMOS and CMOS on a single chip. Plans include integrating logic with both lateral and vertical DMOS to allow more user flexibility. Topaz also supplies standard and special high reliability products that are tested to military requirements.

Topaz subcontracts manufacturing and assembly operations to companies in Thailand, Singapore, and Taiwan.

ALLIANCES

Hytek Microsystems	July 1985	Topaz was acquired by Hytek Microsystems and operates as a wholly owned subsidiary. Hytek and Topaz cooperate on product development.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

3.0-micron and 20.0-micron Hex-to-Hex Spacing Silicon-Gate Vertical DMOS
(5-inch wafers)
Lateral DMOS (3-inch wafers)
3.0-micron CMOS

PRODUCTS

Lateral DMOS FETs
DMOS Power FET
DMOS FET Ultra-Low-Leakage
High-Voltage DMOS Power FETs
Vertical DMOS FET
Dual Gate DMOS FET

DMOS FET Switches
Ultra High-Speed, Low-Cost Switch
Quad Monolithic SPST CMOS/DMOS Analog Switches
Dual Monolithic SPST CMOS/DMOS T-Configuration Analog Switch

DMOS FETs 8-Channel Arrays
Quad DMOS Power FET Array
Quad DMOS FET Driver Array
Quad DMOS FET Analog Switch Arrays

FET Ultra High-Speed Dual Driver

Applications: Automated test equipment, telephone and video switching equipment, analog/digital converters, backplane testers, telecommunications switching, solid-state relays, and display drivers

FACILITIES

San Jose, CA	30,000 sq. ft.	Topaz utilizes 20,000 sq. ft. for design, wafer fab, and test
	8,000 sq. ft.	Class 100 Clean room

Triad Semiconductors International
P.O. Box 25111
Colorado Springs, Colorado 80936
303/599-8099
FAX: 303/599-5893

ESTABLISHED: October 1985
NO. OF EMPLOYEES: 20

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Managing Director	Michael Burton	INMOS	Mgr Commercial Opns
VP Products	O. Fred Jones	INMOS	Strat Mktg Mgr
VP Dsn & Tech	William Slemmer	INMOS	App Dsn Mgr
VP Operations	Bob Welch	INMOS	Business Opns Mgr
Corp Development	Hoon Yang	Hyundai America	President
Principle Dsn Engr	Kim Hardee		Consultant
CFO	Jop van der Wiel	AMRO Bank	Mgr Int'l Credit

FINANCING

Date	Round	Sources	Amount
1985	Initial	Founders; The Limburg Investment Bank; AMRO Bank; Private Placement; Grants and subsidies from the Dutch government	$20M

BACKGROUND

Triad Semiconductors International (TRIAD) designs, develops, and markets application-optimized VLSI ICs for use in high-performance data and algorithmic processors, digital telecommunications and video applications, image voice synthesis and recognition, and advanced industrial instrumentation and control systems.

The parent company and corporate offices of TRIAD are registered in the Netherlands, which provides favorable support and financial incentives for research and development activities. The U.S. subsidiary company is headquartered in Colorado Springs, Colorado, with a branch design center in Naples, Florida.

TRIAD does not plan significant investments in manufacturing assets, but rather, has adopted a strategy of developing a worldwide network of corporate alliances with industrial partners to support this plan. TRIAD recently announced the first of these alliances with Fairchild Semiconductor Corporation and plans additional alliances to position it in Europe and Asia.

Initial product development includes a series of specialty devices based on CMOS SRAM technology and includes a 16Kx4 pipelined device, 64K Write Control Store (WCS) high-speed SRAM, and 256K pipelined standard SRAM. A Monolithic Color Palette (MCP) IC combines the color lookup table function and the digital-to-analog conversion on a single chip. Additionally, TRIAD is developing products targeted for DSP applications and other specialty markets. These products will be announced as a family in 1987.

ALLIANCES

Fairchild	1985	TRIAD and Fairchild have signed a joint-venture agreement. Fairchild is providing a 64K SRAM and 1.5-micron process. TRIAD will design products using Fairchild's technology and both will act as second sources for the products.

SERVICES

Design
Packaging
Test

PROCESS TECHNOLOGY

1.5-micron CMOS

PRODUCTS: Available in 1987

FACILITIES

Colorado Springs, CO	5,000 sq. ft.	U.S. headquarters, design
Holland	25,000 sq. ft.	European headquarters

TRIAD is presently occupying 10,000 sq. ft. in its Holland facility.

Design Centers:
Naples, Florida
A design center is planned in Linberg in early 1987.

TriQuint Semiconductor, Inc.
Group 700
P.O. Box 4935
Beaverton, OR 97075
503/645-8067

ESTABLISHED: January 1984
NO. OF EMPLOYEES: 89

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Alan D. Patz	Tektronix	GM GaAs ICs
VP Mktg/Sales	Thomas Reeder, PhD.	Tektronix	Chief Scientist
VP Mfg	John Roper, PhD.	Tektronix	Principal Engr
VP Foundry Prods	Ajit Rode, PhD.	Tektronix	IC Process Engr
VP R&D	Richard Koyama, PhD.	Tektronix	Technical Manager
VP Engr	Binoy Rosario, PhD.	Tektronix	Design Manager
QA/Mtls Mgr	Richard Allen	Tektronix	Div Mfg Mgr
Dir Finance/Admin	Richard Sasaki	Tektronix	Financial Mgr

BACKGROUND

TriQuint was formed to manufacture and market ultra-high-speed GaAs ICs. The Company intends to be a full-line supplier of standard commodity parts based on its QLOGIC gallium-arsenide foundry process. TriQuint is emphasizing its foundry services and multiproject chips that enable several customers to participate simultaneously in individual wafer runs, therefore reducing prototyping costs.

TriQuint is a subsidiary of Tektronix. Tektronix provided 80 percent of TriQuint's initial funding, and leases a 25,000-square-foot facility to the subsidiary company. Al Patz, TriQuint's president and other key management personnel were formerly with Tektronix.

TriQuint's first products, introduced in March 1986, included the Q-Chip array, an MSI GaAs cell array, and the Q-Chip macrolibrary that can be used for designing logic circuits of up to 140 gates and runs on Daisy workstations.

TriQuint's long-term projects include large-scale ICs and RAMs. The Company expects to introduce standard GaAs ICs for use in digital and microwave system integration as well as to provide the capability for customer-specified ASICs.

Sixty percent of TriQuint's capacity is used for aerospace/military production and 40 percent is used for commercial. The company reportedly had more than 25 customers as of October 1985, including RCA for a GaAs 8-bit, 100-Mips RISC microprocessor.

ALLIANCES

Tektronix	Jan. 1984	Tektronix spun out TriQuint, remaining the parent company and completing a sales agreement with the new subsidiary.
EEsof	May 1986	EEsof and TriQuint teamed to incorporate TriQuint's GaAs custom MMIC foundry models into Touchstone, EEsof's minicomputer and workstation-based MMIC CAD program. Jointly they developed a GaAs MMIC Element Library that allows users to simulate microwave ICs using MMIC components that model components available from TriQuint's custom MMIC foundry facility.

SERVICES

Design	GaAs D-MESFET Gate Array
Foundry	GaAs D-MESFET
Manufacturing	
Assembly	

PROCESS TECHNOLOGY

GaAs D-MESFET, 1.0-micron
(3-inch wafers)
GaAs Ehancement/Depletion Mode (E/D)

PRODUCTS

GaAs Gate Arrays

Family	Process	Linewidth	Delay	Gates
Q-Chip	GaAs MESFET	1.0-micron	0.15ns	140

GaAs Cell Library

Family	Process	Linewidth	Delay	Gates
Q-Logic	GaAs E/D	N/A	80-160ps	500

Q-LOGIC Family

TQ1111	4-bit Ripple Counter	2-3 GHz
TQ1112	4-bit Synchronous Up/Down Counter	1 GHz
ETF-FP10	Engineering Test Fixture	
EK-TQ1111	Evaluation Kit for TQ1111 Counter	
TQ9111	Amplifier	1-8 GHz
TQ9141	Power Divider	1-10 GHz
TQ9151	SPDT Switch	1-10 GHz
TQ9161	Variable Attenuator	1-10 GHz

Applications: TVRO, microwave, electronic warfare, fiber optics, high-speed EDP, workstation interface, high-speed communications, cache memory

FACILITIES

Beaverton, Oregon	25,000 sq. ft.	Office and assembly
	12,000 sq. ft.	Class 100 Clean room

COMPANY HIGHLIGHTS

Jan. 1984 TriQuint offered GaAs IC foundry services.

1985 TriQuint offered its Q-Chip gate arrays.

Dec. 1985 TriQuint's GaAs IC design kit was made available on Daisy Systems workstations. IC designers can use Daisy's schematic capture, logic simulation, and verification software in conjunction with the TriQuint Q-Chip logic macrolibrary to design GaAs ICs with up to 140 logic gates.

March 1986 Tek's CAE Systems division offered TriQuint's Q-Chip GaAs cell array library for use on its workstation design system that runs on DEC VAX and Apollo Domain workstations.

March 1986	TriQuint offered a line of digital GaAs components based on the firm's Q-Logic depletion-mode standard cell library. The first component available was the TQ1111, a 4-bit ripple counter offered in frequency ranges up to 3 GHz. The series will be extended to include interface and instrumentation components, such as multiplexers, and de-multiplexers, as well as a workstation-based standard cell design package.
April 1986	TriQuint extended its GaAs IC foundry service to 0.5-micron FET gate length.
May 1986	EEsof and TriQuint teamed to incorporate TriQuint's GaAs custom MMIC foundry models into Touchstone, EEsof's minicomputer and workstation-based MMIC CAD program. Jointly they developed a GaAs MMIC Element Library that allows users to simulate microwave ICs using MMIC components that model components available from TriQuint's custom MMIC foundry facility.
July 1986	TriQuint offered the Q-Logic standard cell kit for designing GaAs MSI circuits with 100 to 200ps gate delays and equivalent gates up to 500.
July 1986	TriQuint announced its GaAs LSI foundry service, capable of manufacturing LSI circuits in volume. The LSI capability is based on TriQuint's Q-ED process, a high-yield process that integrates both enhancement and depletion mode FETs. The process includes applications such as MPUs, multipliers, ALUs, and RAMs with complexities to 6,000 gates.

United Microelectronics Corp.
#3 Industrial Road
Hsin-Chu City
Taipei, Taiwan
Tel: (035) 773131
Telex: 31476 UMCHSC
FAX: 035 774 767

ESTABLISHED: September 1979
NO. OF EMPLOYEES: 800

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Robert H.C. Tsao	ERSO	VP Operations
VP Operations	Alex I.D. Liu	ERSO	Production Manager
VP Marketing	John Hsuan	ERSO	Marketing Manager
Dsn Grp Dir	M.K. Tsai	ERSO	Design Manager

FINANCING

Date	Round	Sources	Amount
1979	Initial	Bank of Communications; Kuang Hua Investment Co.; Ministry of Economic Affairs; Yao Hua Glass Co.; China Development Corp.; Teco; Sampo; Walsin-Lihwa Electric Wire & Cable; Orient Semiconductor	$12.5M
July 1985	Round 2	Initial Public Offering	$7.5M

BACKGROUND

United Microelectronics Corp. (UMC) offers gate array and standard cell design services in addition to consumer, telecommunications, memory, and microprocessor ICs. The Company was formed to commercialize ERSO's IC technology and is Taiwan's largest wafer foundry.

In 1983, UMC funded Unicorn Microelectronics, a design center, in San Jose. National Microelectronic Corp. is the U.S. sales and distribution arm for UMC's foundry services and products.

The Company is providing foundry services for major U.S. and domestic IC design companies.

ALLIANCES

ERSO	1979	ERSO granted UMC a license for design and process technology for 4-inch silicon wafers.
AMI	April 1983	Dialer ICs were produced in cooperation with AMI. UMC is also a second source for AMI's products and 5-micron silicon-gate CMOS in Asia.
Unicorn	Jan. 1985	UMC funded Unicorn for $2.5 million.
	June 1985	UMC and Unicorn agreed to jointly develop a standard cell library and to design cells for data path, memory, I/O, random logic, and complex logic.
MOSel	Oct. 1985	MOSel transferred rights to a high-speed 2Kx8 SRAM and EEPROM to UMC, additionally providing 1.5- and 2-micron processes that were used to bring up the 2-micron CMOS process at UMC.
Honeywell Synertek	July 1985	UMC gained nonexclusive product licenses for 18 types of ICs formerly produced by Synertek and purchased some Synertek production equipment and inventory from Honeywell. Products covered in this agreement included 4K and 16K SRAMs and 8K, 16K, and 32K ROMs. Honeywell received $3 million plus royalties of 3 to 5 percent over the next three years.

SERVICES

Design	Gate Arrays, Standard Cell, Full Custom
Foundry	CMOS, NMOS, PMOS
Prototype Manufacturing	
Production Manufacturing	

PROCESS TECHNOLOGY

Silicon-Gate NMOS
5.0- to 1.25-micron Single and Double-Metal CMOS
(4-inch wafers)

PRODUCTS

Memory

CMOS and NMOS SRAMs

Part Numbers	Organization	Process	Access Time (ns)
UM6104	1Kx4	CMOS	120-250
UM2114AL/2158/2159	1Kx4	NMOS	100-200
UM2147	4Kx1	NMOS	45-70
UM2148/2149	1Kx4	NMOS	45-70
UM6116	2Kx8	CMOS	70-120
UM2128/2129	2Kx8	NMOS	100-200
UM6168	4Kx4	CMOS	45-55
UM2168/2169	4Kx4	NMOS	45-70
UM2167	16Kx1	NMOS	45-70
UM6167	16Kx1	CMOS	45-55

NMOS ROM

UM2332/2333	4Kx8	NMOS	250-450
UM2364/2366	8Kx8	NMOS	200-450
UM23128	16Kx8	NMOS	200-450
UM23256	32Kx8	NMOS	200-450

Consumer ICs

Part Number	Description
UM3181	Melody Generator
UM3381/3164/3165/3166	Simple Melody Generator
UM3481	Multi-Instrument Melody Generator
UM3163/3168	Melody Generator with LCD
UM3511	Melody Organ Generator
UM3521/22	Paper Organ

(Continued)

PRODUCTS (Continued)

Consumer ICs

Part Number	Description
UM3561	Three-Siren Sound Generator
UM3203A/3219	LCD Watch
UM3205	LCD Count-Down Timer
UM3262	Analog Clock
UM3128/3135	8-digit Solar Cell CMOS Calculator
UM3032	8-digit Battery CMOS Calculator
UM3711/3712	Sensor Touch-Controlled Dimmer
UM3621/3763/3641	Voice Control IC

Microcontroller

UM8048/35/49/39	8-bit Single-Chip NMOS IC
UM8051/31	8-bit Single-Chip NMOS IC

Microprocessor

UM6502/6507/6512	8-bit MPU

Microperipherals

UM6845/9007	CRT Controller
UM8321	Video Attributes Controller
UM8312	Double Row Buffer
UM8272/8372	Floppy Disk Controller
UM9228/8326/8329	Floppy Data Separator
UM82C55	CMOS Programmable Peripheral Interface
UM82C84A	Clock Generator & Driver
UM82C88	Bus Controller
UM82C01	Capacitance Keyboard Encoder
UM82288	Bus Controller for iAPX286 Processors
UM82284	Clock Generator and Ready Interface for iAPX286 Processors
UM8253/8254	Programmable Interval Timer
UM8259A	Programmable Interrupt Controller
UM2661	EPCI IC
UM2681	DUART
UM6520/6521	PIA
UM6522	VIA

(Continued)

PRODUCTS (Continued)

Microperipherals

UM6532	RAM I/O Timer Array
UM6551	ACIA
UM146818	Real Time Clock Plus RAM (RTC)

Linear
Data Converter ICs

UM7106	Digit A/D Converter
UM7126	Digit A/D Converter

Telecommunications

UM9151/40992/40993	Simple Pulse Dialer
UM91603C/91610/91611	Repertory Pulse Dialer
UM9169	Simple Tone Dialer
UM91230	T/P Redial
UM91250	Repertory T/P Dialer
UM9160/91531	Slave T/P Dialer
UM9161	Direct Access Adapter
UM92100	Crosspoint

ASICs

CMOS Gate Arrays

Product	Linewidth (micron)	Gates
UM1200 Series	3.0	300 to 920
UM1300 Series	2.0	1,200 to 3,000

Applications: Consumer, computers, and telecommunications

FACILITIES

Taiwan	92,000 sq. ft.	
	17,000 sq. ft.	Wafer fab Cost: $40 million

Design Centers:

San Jose, CA	MOS	Gate Arrays, Standard Modular Library
Los Angeles, CA	MOS	Gate Arrays, Standard Modular Library
Ottawa, Ontario	MOS	Gate Arrays, Standard Modular Library
Fort Lauderdale, FLA	MOS	Gate Arrays, Standard Modular Library
Dallas, TX	MOS	Gate Arrays, Standard Modular Library
Taiwan	MOS	Gate Arrays, Standard Modular Library
Europe (2)	MOS	Gate Arrays, Standard Modular Library

COMPANY HIGHLIGHTS

In chronological sequence, UMC has accomplished the following:

March 1982	UMC fab began production.
March 1982	Made first export sales.
Sept. 1982	Offered ROMs.
Nov. 1982	Achieved profitability.
April 1983	Dialer ICS produced in cooperation with AMI.
Dec. 1983	Offered 8-bit microproccessor.
Aug. 1984	VLSI development began in cooperation with MOSel.
Jan. 1985	UMC funded Unicorn Microelectronics in California for $2.5 million to do research and development, design, and marketing.
April 1985	Announced agreement with Honeywell to license Synertek's 4K and 16K SRAMs, MPRs, and MPU products.
July 1985	UMC was the first to offer stock in the Taiwan marketplace.
1985	Produced CMOS 64K DRAM, 50ns.

Universal Semiconductor Inc.
1925 Zanker Road
San Jose, CA 95112
408/436-1906

ESTABLISHED: April 1978
NO. OF EMPLOYEES: 95

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President	George A. Stephan	Interdesign
COO	Bill Smithson	Consultant
VP Design	Gideon Amir	AMI
VP Process	Jack Yuan	Hewlett-Packard
VP Opns	Bob Bowie	Trilogy
VP Finance	Scott Thomas	Fortune

FINANCING

Date	Round	Sources	Amount
1979	Round 1	Allstate Insurance; U.S. Venture Partners; Michigan Capital; Aetna; Montgomery Securities	$3.0M
Aug. 1985	Round 2	U.S. Venture Partners; Chartered Electronics Industries; Aetna; Michigan Capital	$2.0M

BACKGROUND

Universal Semiconductor was formed to develop and produce high-speed CMOS gate arrays, standard ICs, and customer tooling services using advanced silicon gate CMOS processes.

Universal was incorporated in California by cofounders, W. Sandy Chau, who was a director of a management consultant firm and Dr. Paul Ou-Yang, the device physics manager at AMI. The initial plan called for operation of Universal as a research and development lab and as a small-volume manufacturer. Additional financing in early 1979 enabled the firm to redefine its business to include custom IC fabrication, the manufacturing of standard memory products, and technology and engineering services.

Universal has recently announced a new ISORAD technology, a silicon-gate CMOS process that will withstand one million RADs total dosage of gamma ray radiation. Universal will be offering not only radiation-hardened, high-performance CMOS semicustom arrays supported by fully automated design methodology implemented on Daisy and Mentor workstations, but also will offer a family of radiation-hardened standard products. Product offerings will include digital gate arrays with complexities to 13,000 gates, the 5400 Series of 200 standard logic components, and other standard products including 68000 MPRs, encoders, decoders, and parity checkers.

ALLIANCES

Siliconix	Dec. 1982	Universal entered a second-source agreement with Siliconix for Universal's 5-micron ISO-5 and 3-micron ISO-3 CMOS gate arrays of from 360 to 1,800 gates.
	June 1983	Siliconix announced that it will set up a design center for Universal's silicon gate arrays in Swansea, Wales.
Western Digital	Aug. 1983	Universal granted Western Digital a license for second-sourcing Universal's CMOS gate arrays to fabricate WD's board-level products.
Edsun Laboratories	Sept. 1985	Universal entered a joint development agreement with Edsun Laboratories for computer-related CMOS products.
ICS	1985	Universal and ICS signed a cooperative gate array agreement to personalize wafers and designs supplied by Integrated CMOS Systems. Universal also is to provide foundry services.

SERVICES

Design	CMOS Gate Arrays, Cell Library
Foundry	Silicon-Gate PMOS, NMOS, CMOS
Manufacturing	
Assembly	
Test	

PROCESS TECHNOLOGY

1.5 to 5.0-micron
Silicon-Gate CMOS (p-well)
Silicon-Gate CMOS (n-well)
(4-inch wafers)

PRODUCTS

CMOS Gate Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
ISO 5	Si-Gate	5.0	2.8	100 to 2,400
ISO 3	Si-Gate	3.0	1.3	100 to 2,400
ISO 2	Si-Gate	2.0	0.7	100 to 2,400

Linear Array

UCLA-1 Universal CMOS Linear Array

CMOS Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
ISO 3	Si-Gate	3.0	1.3	43 MSI, RAM, PLA

Standard

SL 300	Manchester Encoder/Decoder
USLC 374	Quad CMOS Voltage Comparator
USLC 556	CMOS Dual Timer
SL 2002	NR21 Encoder/Decoder
USLC 5534X	CMOS Dual Op Amp

CAD Tools

UNICAD-1 A hardware and software package to design and simulate gate array designs remotely using IBM PC-XTs

Applications: Computers, medical, military, telecommunications

FACILITIES

San Jose, CA	25,800 sq. ft.	
	3000 sq. ft.	Class 100 Clean room
	480 sq. ft.	Portable Fab

Design Centers:	
San Jose, CA	Gate Arrays
Tel Aviv, Israel	Gate Arrays

COMPANY HIGHLIGHTS

Dec. 1981	Universal completed a round of financing for $3 million.
Dec. 1982	Siliconix licensed Universal's 5-micron ISO-5 and 3-micron ISO-3 silicon CMOS gate arrays.
March 1983	USI announced the ISO-3/ISO-5 CMOS gate arrays of from 360 to 1,800 gates, 1 or 3ns.
April 1983	USI offered the ISO-3G/5G Fast CMOS Gate Arrays (3- and 5-micron, 1800 gates, 92 bonding pads). USI offered the ISO-3H/5H Fast CMOS Gate Arrays (2400 gates, 96 bonding pads, TTL or CMOS buffers).
June 1983	Siliconix set up a design center for USI's silicon gate arrays in Swansea, Wales.
Aug. 1983	Western Digital fabricated board-level products using Universal's gate arrays.
Oct. 1983	USI offered full-custom silicon-gate IC design and production capability as well as conversion for gate arrays to full-custom and super macrocell for standard ICs.
Feb. 1984	USI offered UNICAD-1, a software and hardware package for designing and simulating gate array designs remotely using IBM PC-XTs.
1985	International CMOS Systems and USI signed a cooperative gate array agreement to personalize wafers and designs supplied by International CMOS Systems.
July 1985	USI opened a new gate array design center in Tel Aviv, Israel.

July 1985	USI introduced the SL 300 Manchester Encoder/Decoder that connects LAN controllers and transceivers.
July 1985	USI introduced the USLC 374 Quad CMOS Voltage Comparator (2-18V, 16-pin or 14-pin DIP, commercial).
July 1985	USI introduced the USLC 556 CMOS Dual Timer (2-18V, 14-pin DIP, industrial).
Aug. 1985	USI completed a round of financing for $12 million.
Aug. 1985	USI introduced the SL 2002, NR21 Encoder/Decoder in a 22-pin plastic DIP, commercial grade.
Aug. 1985	USI introduced the USLC 5534X CMOS Dual Op Amp in a 14-pin CERDIP or plastic DIP, commercial grade.
Aug. 1985	USI introduced the UCLA-1 Universal CMOS Linear Array.
Sept. 1985	Edsun Laboratories Inc., Massachusetts and USI have signed a joint development agreement for two computer-related CMOS products.
Jan. 1986	Universal announced the new ISORAD CMOS process that withstands one million RADs of total voltage of gamma ray radiation.

Visic, Inc.
1120 Ringwood Court
San Jose, CA 95131
408/945-9991

ESTABLISHED: November 1983
NO. OF EMPLOYEES: 75

BOARD

Name	Affiliation
Peter Bagnall	Visic
Bob Kunze	Hambrecht & Quist
Chad Waite	Hambrecht & Quist
Irwin Federman	MMI

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Ken Yagura		Consultant
Sr VP Mktg	Peter Bagnall	Motorola	Dir Mktg
Sr VP Engr	John Reed		
VP Finance	Bill Wall	MMI	VP Finance
Dir R&D (SJ)	Bruce Barbara	NSC	Dir R&D
Dir R&D (OR)	Bob Scott	Intel	Engr Mgr
Dir Rel/QA	Steve Farnow	Intel	Dir Rel/QA
Dir Process Dev	Arnie London	NSC	Dir Process Dev

FINANCING

Date	Round	Sources	Amount
Dec. 1983	Round 1	Hambrecht & Quist; Greylock Management Corporation	$4.5M
March 1985	Round 2	Advanced Technology Ventures; Bryan & Edwards; Greylock Management Corporation; Hambrecht & Quist: Morgan Holland Management; Rainier Venture Partners; Merrill Lynch; L.F. Rothschild, Unterberg & Towbin; SunVen Partners; Venture Growth Associates	$7.5M

BACKGROUND

Visic is a focused company dedicated to offering novel architectures and designs to maximize system performance of random access memories (RAMs).

Visic introduced the first Hierarchical RAM (HRAM), winning the Electronics Products product of the year award.

ALLIANCES

VLSI Technology	Feb. 1984	VLSI and Visic formed a joint development venture to design and market CMOS RAM technology and products, including 64Kx1 and 16Kx4 CMOS DRAMs. VLSI provided wafers and second sourced the first products.
MMI	Nov. 1984	Visic and MMI announced a technology exchange and cross-licensing agreement for joint development of a 1.5-micron double-level metal CMOS process and the exchange of proprietary products. MMI second-sourcing is assured at initial market introduction with MMI providing wafers.

SERVICES

Design
Wafer and Device Testing Lab

PROCESS TECHNOLOGY

1.2-micron CMOS (Twin-well, double-poly, double-metal)

PRODUCTS

Device	Description
64K HRAM	35/25/10ns
256K DRAM	70ns
256K HRAM	35/25/10ns (1987 availability)
1Mb DRAM	70ns (1988 availability)

Applications: Mainframe, mini, and supercomputers, high-performance test systems, digital signal processing, LAN controllers, high-resolution graphics, electronic instrumentation

FACILITIES

San Jose, CA	32,500 sq. ft.	Design, process development, and test

Visic has plans for a 60,000-square-foot wafer fab facility in 1988.

Design Center:
Beaverton, OR

Vitelic Corp.
3910 North First Street
San Jose, CA 95134
408/433-6000

ESTABLISHED: 1983
NO. OF EMPLOYEES: 80

BOARD

Name	Affiliation
Alex Au	Vitelic
Jim Riley	Dataquest
Kazuo Inamori	Kyocera Corporation
Neill Brownstein	Bessemer Venture Partners, L.P.
Harry Marshall	J.H. Whitney & Company
Fumio Kohno	Sony

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Alex Au	Fairchild	Dir Research
VP Mktg/Sales	Jack Ordway	Hitachi America	VP Marketing
VP R&D	James T. Koo	Synertek	Dir Memory Prod
VP Opns	John Seto	Hyundai	Dir Opns
VP Finance/Admin	Art Wang	Raychem	GM Malaysia and Thailand
Strat Prog Mgr	Sam McCarthy	IDT	SRAM Div Mgr

FINANCING

Date	Round	Sources	Amount
March 1984	Round 1	Bessemer Venture Partners; J.H. Whitney & Co.; INCO Securities Corp.; Kyocera International; Oak Investment Partners; Oxford Venture Fund; Waverly Vencap	$7.0M
Aug. 1985	Round 2	Original investors; Pathfinders Chappell; Sony Corp.	$7.2M

BACKGROUND

Vitelic was formed to design, develop, manufacture, and market high-performance reliable VLSI CMOS memory products for markets that demand low power and high speed. The Company's emphasis will be on DRAMs and SRAMs. Initially, the Company is focusing on high-performance, low-power 64K, 256K, and one megabit CMOS DRAMs and 16K, 64K, and 256K SRAMs. It is using 1.5-micron manufacturing technology and plans to become a major supplier of 256K DRAMs by 1986/1987. Vitelic is also expanding into application-specific memory products such as display memories and multiport devices.

Vitelic was founded by Alex Au, former director of VLSI research at Fairchild Camera and Instrument Corporation.

Vitelic established a subsidiary in Taiwan--Vitelic Taiwan--in September 1984 to conduct product and test engineering. Vitelic is also establishing subsidiaries in Korea and Japan to provide engineering support and to conduct sales and marketing. The subsidiaries in Korea and Japan will be operational in 1987.

ALLIANCES

Kyocera	March 1984	Kyocera participated in first-round financing of Vitelic.
ERSO	May 1984	ERSO signed a cooperative agreement to jointly develop VLSI ICs. Development of EPROMs and 64K and 256K CMOS DRAMs was to be completed in a year.
Sony	June 1985	Vitelic completed a joint venture agreement that gave Sony access to Vitelic's 256K CMOS DRAM technology and 64K SRAM in exchange for fab capacity. The agreement left open the option for Sony to second-source some Vitelic products in exchange for licensing fees and royalty payments.
NMBS	July 1985	Vitelic granted a license for its 1Mb DRAM to NMBS in exchange for one-third of NMBS' plant capacity.

Hyundai	July 1985	Hyundai obtained a license to Vitelic memory products in exchange for manufacturing capacity. Vitelic memory products included 16K CMOS SRAMs, and 64K, 256K, and 1Mb CMOS DRAMs.
Philips, NV	March 1986	Philips and Vitelic signed a joint venture agreement which covers technology transfer, joint development, and cooperative manufacturing. The agreement gives Vitelic access to Philips' proprietary process technology. Vitelic will design a family of high-performance CMOS SRAMs for manufacture, use, license, and sale by both companies.
Tokyo Sanyo	Oct. 1986	Tokyo Sanyo and Vitelic will jointly develop a high-speed 64K SRAM family. Tokyo Sanyo will manufacture the SRAMs using 1-micron process technology. The agreement includes manufacture of the products Vitelic designs for Philips using Philips process by Tokyo Sanyo.

SERVICES

Design
Engineering Services
Manufacturing
Test

PROCESS TECHNOLOGY

2.0- to 1.0-micron CMOS (n-well)
VICMOS III

PRODUCTS

CMOS DRAM

Device	Organization	Description
V51C64	64Kx1	Ripple mode
V51C256	256Kx1	Ripple mode
V51C259	64Kx4	Static Column
V51C100	1Mx1	Ripple mode

CMOS SRAM

Device	Organization	Description
V61C16	2Kx8	35,45,55ns
V61C67	16Kx1	35,45,55ns
V61C68	4Kx4	35,45,55ns
V61C69	4Kx4	35,45,55
V61C62	16Kx4	45,55,70ns
V61C64	8Kx8	45,55,70ns
V62C64	8Kx8	120,150ns

Dual-Port RAM

V61C32	2Kx8
V61C33	2Kx8
V61C34	2Kx8

Video RAM

V51C264	64Kx4

Applications: Portable computers, graphics display systems, image processing, office automation, telecommunications, CAD/CAM, automotive, military/aerospace, home information/entertainment equipment

FACILITIES

San Jose, CA	33,000 sq. ft.	Headquarters and design
Taiwan		Engineering and test

Design Center:
San Jose, CA

COMPANY HIGHLIGHTS

March 1984 — Vitelic received $7 million to begin CMOS DRAM manufacturing in Taiwan. Vitelic established a subsidiary in Hsinchu Industrial Park.

4Q84 — Vitelic sampled its first product, the 51C64, a 64Kx1 CMOS DRAM. It is compatible with the Intel 51C64; 80ns, ripple mode, 5V, 16-pin plastic DIP, commercial.

Jan. 1985 — Vitelic sampled a 2Kx8 SRAM, V61C16, 45 or 70ns.

April 1985	Vitelic announced plans to expand into 256K CMOS DRAMs, to be available by the end of 1985.
June 1985	Vitelic moved into its corporate headquarters in San Jose, California.
July 1985	Vitelic became the third producer of 256K DRAMs after Intel and Hitachi.
July 1985	Vitelic formed a partnership with NMBS to license Vitelic's 1Mb DRAM to NMBS in exchange for manufacturing 64K DRAMs in NMBS' facility.
July 1985	Vitelic announced that Hyundai Electronics Industries Co. will manufacture CMOS SRAMs and DRAMs for Vitelic Corp. in Korea under a manufacturing and licensing pact. The agreement covers Vitelic's 16K SRAM, 64K DRAM, a group of 256K DRAMs, and a 1Mb DRAM to be undertaken shortly. Hyundai's 5-inch and 6-inch lines in Ichon will handle all manufacturing. Hyundai benefits from a worldwide license to the Vitelic memories.
Aug. 1985	Vitelic closed its second round of financing for $7.2 million. Sony invested $2 million and is providing 1-micron wafer fab in exchange for 256K CMOS DRAM technology and a seat on the board of directors.
Sept. 1985	Vitelic began production quantity of the 2Kx8 CMOS SRAM, V61C16; 55 or 70ns, 5V, 24-pin DIP, commercial.
Dec. 1985	Vitelic offered the V62C64 8Kx8 CMOS SRAM; 150ns, 5V, commercial, 24-pin DIP, 24-pin gull-wing flat package.
March 1986	Vitelic and N.V. Philips signed a joint development pact to use Philips' CMOS design rules to develop 64Kx1 and 16Kx4 SRAMs that will be manufactured by both Vitelic and Philips. Vitelic will produce and tweak prototypes of the SRAMs in Asia while Philips offers fabrication in Europe.
June 1986	Vitelic introduced a fast 35ns 16K CMOS SRAM family, the V61C16 2Kx8, V61C68 4Kx4, and the V61C67 16Kx1. Applications include buffers, cache, and main memory for computers, instruments, CAD/CAM systems, industrial control, and telecommunications devices. The SRAM uses Vitelic's VICMOS III technology and a six-transistor memory cell.

Vitesse Electronics Corp.
741 Calle Plano
Camarillo, CA 93010
805/388-3700

ESTABLISHED: July 1984
NO. OF EMPLOYEES: 100

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	A.S. Joseph, PhD.	Rockwell	Dir Solid State
Dir Finance/Admin	Michael Russell	Avicom, Int'l	CFO
President IC Div	Lou Tomasetta, PhD.	Rockwell	Dir R&D Center
VP Engr IC Div	Ira Deyhimy	Rockwell	Mgr IC Engr
VP Mktg IC Div	James Brye	Fairchild	Div Mktg Mgr
VP Opns IC Div	James Mikkelson	Hewlett-Packard	Mgr Process Dev
President DP Div	Allan I. Edwin	GE Medical Sys	General Manager
VP Opns DP Div	L.E. Hughes, PhD.	Encore Cptr	Div President
Prin Sci DP Div	Creve Maples, PhD.	Lawrence-Berkeley Labs	Dir Adv Comp Arch
VP Sales DP Div	Harvey Raider	IBIS Systems	VP Sales

FINANCING

Date	Round	Sources	Amount
Aug. 1984	Initial	Norton Company	$30.0M

BACKGROUND

Vitesse is focusing on GaAs ICs, GaAs microwave and optoelectronics, board-level products, and minisupercomputers. It has developed large-scale-integration ICs employing very fast GaAs technology and is including them in the design of high-performance digital processors. The Company is vertically integrated to speed the incorporation of GaAs LSI ICs into systems-level products, to lead to the development of greatly superior digital processor systems, and to assure the financial success of the company beyond what could be expected for two separate enterprises.

Vitesse was funded for $30 million by the Norton Company, a $1.3 billion Fortune 500 company of Worcester, Massachusetts.

The Company is organized into two divisions:

Integrated Circuits Division

The primary objective of the IC division is to accelerate the development of LSI circuits in GaAs in order to produce them in commercial volume and to offer standard and custom ICs that are superior to competitive products.

The IC Division has developed a proprietary fabrication technology based on the production of enhancement/depletion mode MESFETs using one-micron feature capability and self-aligned gates. The process has already been proven in Vitesse's facility and work is progressing toward the introduction of the Company's first commercial products later this year.

The division has opened its fabrication facility to foundry service business and has begun establishing a nationwide network of manufacturers' representatives to sell those services and coming products.

Digital Products Division

The primary objective of the DP Division is to develop a family of digital processor products for computation-intensive scientific and engineering applications. The processor products will be designed to migrate to high-speed GaAs components when the level of integration of those components is sufficiently high.

The Company's first minisupercomputer product, the Vitesse Numerical Processor, has been designed and simulated and is scheduled for introduction in the second half of 1987.

Vitesse is headquartered in a 70,000-square-foot facility in Camarillo, California, in what is known as "Gallium Gulch." The building is designed specifically for the production of LSI-level digital ICs in gallium arsenide. Approximately 12,000 square feet has been designated as "clean room" area, and half of that area is a Class 10 clean room.

ALLIANCES

Norton Company	July 1984	Vitesse was funded by an original investment by the Norton Company, a $1.3 billion company of Worcester, Massachussetts, in the amount of $30 million.

AMD	Nov. 1985	Vitesse and AMD reached a technology exchange agreement for the development and fabrication of AM2900-family microprocessor devices in gallium arsenide.

SERVICES

GaAs Foundry Services	1.25 GaAs E/D MESFET
GaAs IC Design	
Packaging	
Test	

PROCESS TECHNOLOGY

GaAs E/D MESFET
1.0-micron
(3-inch wafers)

PRODUCTS

GaAs Bit Slice Processors	VE29G00
GaAs Static Memories	VE12G00 1Kx4

Applications: Computer products, ATE, digital signal processors, image processors, military systems

FACILITIES

Camarillo, CA	70,000 sq. ft.	
	33,000 sq. ft.	Computerized labs and manufacturing
	6,000 sq. ft.	Class 10 Clean room

COMPANY HIGHLIGHTS

Since its formation, Vitesse has done the following:

July 1985	Founded with an investment from the Norton Company.
April 1985	Moved into a headquarters facility in Camarillo, California.
Nov. 1985	Signed a technology-exchange agreement with AMD.
Dec. 1985	Offered foundry services.

VLSI Technology, Inc.
1109 McKay Drive
San Jose, CA 95131
408/434-3000
TELEX: 278807

ESTABLISHED: December 1980
NO. OF EMPLOYEES: 920

BOARD

Name	Affiliation
Pierre S. Bonelli	Mema-Metra
Stewart Carrell	Hambrecht & Quist Incorporated
David C. Evans	Evans & Sutherland Computer Corporation
Henri A. Jarrat	VLSI Technology, Inc.
James J. Kim	AMKOR Electronics, Inc.
Johannes Spanjaard	Wang Laboratories, Inc.
Alfred J. Stein	VLSI Technology, Inc.
E.E. (Ed) Ferrey	American Electronics Association

COMPANY EXECUTIVES

Position	Name
Chairman/CEO	Alfred J. Stein
President/COO	Henri Jarrat
VP Dsn Tech	Douglas G. Fairbairn
VP Finance	Kenneth A. Goldman
VP Sales/Mktg	James N. Miller
VP Sales	Ronald C. Kasper
VP Wfr Fab	David N. Ledvina

FINANCING

Date	Round	Sources	Amount
Dec. 1980	Initial	Advanced Technology Ventures; Evans & Sutherland; Hambrecht & Quist; Kleiner, Perkins, Caulfield & Byers; Rothschild, Inc.; Venrock Associates	$10M
Feb. 1981	Round 1	Evans & Sutherland Computer Corp.;	$3M
		Bendix Corp.	$17M

Feb. 1983	Round 2	Initial Public Offering	$53M
Jan. 1984	Round 3	Wang	$34M
April 1986	Round 4	Secondary Public Offering	$33M

BACKGROUND

VLSI Technology, Inc., offers complete application-specific IC solutions, including IC design software, a wide range of ASIC products, design assistance at its network of design centers, and state-of-the-art wafer fabrication facilities. The Company has expanded its technology base to include programmable logic, gate arrays, standard cells, megacells, and silicon compilers. It has also added new memory and logic products targeted for the telecommunications and data processing markets.

The Company continues to design and introduce advanced memory products not just to generate revenue, but to keep its service standards and manufacturing technology in the vanguard of the industry. VLSI provides memory technology to ASIC customers who want to integrate entire systems or subsystems containing memory blocks on a single chip. As part of that strategy, the Company introduced a 512K EPROM and 64K HRAMs in 1986.

The Company entered the logic product market in late 1984, and by the end of 1985 had increased its offerings to 21 logic products. The products range in type from communications, storage, and video controllers to specialized interfaces and analog/digital signal processing circuits. At least eight additional logic products have been scheduled for sampling in the first or second quarter of 1986. The logic products are synergistic with the Company's ASIC thrust, since they can be used as megacells or large functional building blocks in more complex, highly-integrated chips.

VLSI's manufacturing expertise not only supports its ASIC, memory, and logic products, but also enables VLSI to accept fabrication (foundry) business from customers whose ASIC designs were developed on other available IC design software. VLSI accepts foundry business from other semiconductor companies, many of which have not developed fabrication facilities. Most of the ASIC products designed with VLSI's design tools and services are manufactured by the company at its wafer fabrication facilities located in San Jose, California.

The Company subcontracts virtually all of its assembly and much of its final product testing to third parties, principally Amkor Electronics, Inc., Rockwell International, and Technology Engineering and Manufacturing.

VLSI uses a direct sales force, commissioned representatives, and distributors for sales to OEMs and electronics companies. The Company significantly expanded its direct sales and sales representatives organizations in 1985 and currently has sales offices or representatives in 35 U.S. and 7 foreign locations. VLSI began selling products through several authorized distributors in 1985, including Arrow Electronics in the United States, five distributors in Europe, and three distributors in Japan.

The Company was formed by three individuals who had been involved in the formation of Synertek: Jack Baletto, Synertek's director of marketing; Dan Floyd, Synertek's vice president of manufacturing; and Gunnar Wetlessen, Synertek manager of memory products and process technology.

VLSI Technology initially pursued three product activities: custom design, using traditional techniques, and fabrication, including customer-tooled fabrication; ROMs and other standard products with some custom content; and VLSI engineering using the design techniques developed by Carver Mead and others, training, and support.

ALLIANCES

Amkor	1980	Amkor provided assembly for VLSI's IC products.
Bendix Corp.	Aug. 1981	Bendix Corp. received a warrant guarantee for 14 percent of VLSI preferred stock; $2 million R&D funding, $15 million equipment lease line.
Ricoh	1982	Ricoh provided all wafers.
	1983	VLSI and Ricoh completed a technology exchange and second-source agreement for NMOS and CMOS mask ROMS. VLSI will supply 64K, 128K, and 256K mask NMOS ROMs to Ricoh in exchange for Ricoh's mask CMOS ROMs of similar density.
KIET	1983	VLSI and KIET, a research and development center established by the Korean government, signed a technology and production agreement. VLSI gave its 32K ROM technology in exchange for silicon foundry services. VLSI trained members of KIET in implementing the process. VLSI also trained members of KIET to use VLSI's design tools.

Texas Instruments	July 1983	VLSI second-sourced TI's TMS4500A DRAM controller and developed its 256K DRAM controller.
Wang Evans & Sutherland	Nov. 1983	Wang purchased 15 percent of VLSI's stock for $34 million. In addition, VLSI will develop custom products for Wang's office automation products. Evans & Sutherland purchased 10 percent.
Visic	Feb. 1984	VLSI and Visic formed a joint development venture to design and market VMOS RAM technology and products. Products included were 64Kx1 and 16Kx4 CMOS DRAMs. VLSI provided wafers, process development, and second-sourced first products.
Fairchild	May 1984	VLSI and Fairchild jointly developed and second-sourced Fairchild's 2-micron CMOS gate arrays, ranging from 600 to 8,000 gates, and a gate array development system.
Lattice Semiconductor	Sept. 1984	Lattice provided technology for CMOS EEPROMs and SRAMs to VLSI Technology in exchange for foundry services at VLSI.
Silicon Compilers	Oct. 1984	VLSI Technology was licensed to manufacture and market Silicon Compilers' RasterOp advanced graphics processor chip. VLSI is providing foundry services for customers who design circuits using SCI's design system.
Western Digital	1984	Western Digital and VLSI entered a three-year joint agreement in which VLSI will develop CMOS versions of proprietary WD products and second source several of WD's products. VLSI provides foundry support for three years.
ICS	1985	VLSI Technology agreed to provide foundry services for Integrated CMOS Sytems.
Rockwell	1985	VLSI and Rockwell agreed to jointly develop erasable programmable logic arrays.
Sierra Semiconductor	Jan. 1985	Sierra was licensed to use VLSI's IC software design tools in exchange for Sierra's standard cell analog designs; Sierra will develop analog standard cells for VLSI's library.

Honeywell	April 1985	VLSI acquired the manufacturing and marketing rights to devices previously produced by Synertek, a CRT controller, interface circuits, 4K SRAM, and a 16K ROM.
NSC	April 1985	VLSI and National Semiconductor exchanged manufacturing and marketing rights to a jointly developed CMOS EPROM family ranging from 64K to 512K. NSC is to provide product designs and VLSI is to develop process technology.
Nihon Teksel	June 1985	VLSI signed a sales contract with Nihon Teksel to sell mainly standard product LSIs into the Japanese market; first year sales are expected to be $4 million.
Daisy Systems	June 1985	VLSI's design tools and silicon compilers were made available to users of Daisy's concurrent CHIPMASTER and SILICONMASTER workstations.
Zilog	June 1985	VLSI and Zilog reached a five-year agreement in which Zilog is licensed to use VLSI's design software. Both companies will cooperate to develop megacell versions of Zilog products and to develop innovative new products.
Hewlett-Packard	Oct. 1985	VLSI made an agreement with Hewlett-Packard that allows HP to use selected VLSI design tools on HP workstations.
MEM		VLSI transferred its process technology to Microelectronics-Marin for new manufacturing capacity to be installed by MEM that will be used by VLSI.
Olivetti		VLSI and Olivetti established a joint design center in Italy.
Bull Group		Bull was licensed to use VLSI's design technology for development of computer products.
University of Louvain		The University of Louvain and VLSI signed an agreement to install VLSI's IC design methodology for the teaching of advanced IC design to students.

Mosaic	1986	Mosaic is considering a license with VLSI to solve ASIC design limits. The alliance allows the two companies to build die and plug them all together on the Mosaic process after applying high-density packaging techniques.
Acorn Computers	May 1986	VLSI and Acorn Computers of Cambridge, Great Britain, introduce a high-performance, single-chip 32-bit reduced instruction set computer (RISC) and associated controller chips. Acorn will develop systems with the new ICs; VLSI will market them worldwide.

SERVICES

Design	CMOS Gate Arrays, CMOS and NMOS Cell Library
Foundry	CMOS, HMOS, and HCMOS
Manufacturing	

PROCESS TECHNOLOGY

3.0-, 2.0-, 1.5-, 1.25-micron Silicon-Gate HMOS and HCMOS
(4- and 5-inch wafers)

PRODUCTS

APPLICATION-SPECIFIC MEMORY PRODUCTS

ROMs	16K
	256K
VT 231024	1Mb ROM (150ns)
EPROMs	64K
	128K
VT27C256	CMOS 256K UV-EPROM (200ns)
	512K
SRAMs	
VT64KS4/65KS	16Kx4 HCMOS SRAM (35ns)
DRAMs	
VT16H4	64K HRAMs (35ns)
VL4502	CMOS 256K DRAM (150ns)
Dual-Port RAM	1Kx8 (100ns)

USER-SPECIFIC ICS

CMOS Gate Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
VGC Series	CMOS	2.0	1.2	540 to 8,000
VGT10	CMOS	2.0	1.2	600 to 8,000
VGT100	CMOS	1.5	0.7	9,000 to 50,000

NMOS and CMOS Cell Libraries

Family	Process	Linewidth (micron)	Delay (ns)	Cells
Cell Compiler	CMOS	2.0	16	10 gates, 16 MSI, RAM, ROM, PLA, all are user-customized
Cell Compiler	CMOS	2.0	3.5	8 gates, 38 MSI, RAM, ROM, PLA, multiplier, customized
VSC Series	CMOS	2.0	2.0	250 library cells, 155 MSI, RAM, ROM, PLA, multiplier, shifter, 2901 compiler, user-customized

CMOS PLDs

MPL (Mask Programmable Logic)

Family	Organization	Delay
VP16RP8M	64Kx32	25, 35ns
VP20RP8M	72Kx40	25, 35ns

GAL (Generic Array Logic)

VP16V8E	64Kx32	25, 35ns
VP20V8E	64Kx40	25, 35ns

APPLICATION-SPECIFIC LOGIC PRODUCTS

Data Storage

Floppy Disk Controller
CMOS Interface

Data/Telecommunications

SDLC Interface
USART
Dual UART
CMOS UART
ACIA

Specialized Interface

VL4500A DRAM controller (150ns)
CMOS DMA Controller
CMOS PIAT
PIA/Timer

Video/Graphics

HMOS CRT Controller
CMOS CRT Controller
Raster Op

MPU

CMOS Microprocessor
CMOS Interface Controller
CMOS Clock Generator
CMOS Bus Controller

Analog/Digital Processors

Modems
Filters
VL2010 16x16 Parallel Multiplier/Accumulator (50ns)

CAD/CAE Design Tools

Data Path Compiler
VLSI Tools featuring 2-micron CMOS silicon compiler technology
Logic Compiler, a cell compiler that translates AM2901 designs to standard cell layouts
Multiplier Compiler, 2-micron for military, digital signal processing, and high-performance computer applications.

Applications: EDP, telecommunications, automotive, and industrial

FACILITIES

San Jose, CA	220,000 sq. ft.	Five buildings for corporate headquarters, manufacturing, design, and sales and marketing
Phoenix, AZ		Application-specific logic and government products
Munich, West Germany		European Headquarters

Design Centers:

San Jose, CA	CMOS	Gate Arrays, Std Cell, Full Custom
Santa Ana, CA	CMOS	Gate Arrays, Std Cell, Full Custom
Schaumberg, IL	CMOS	Gate Arrays, Std Cell, Full Custom
Wilmington, MA	CMOS	Gate Arrays, Std Cell, Full Custom
Richardson, TX	MOS	Gate Arrays, Std Cell, Full Custom
Munich, West Germany	CMOS	Gate Arrays, Std Cell, Full Custom

VLSI Technology will open design centers in England; Paris, France; Princeton, New Jersey; and Boca Raton, Florida, during the second and third quarters of 1986.

COMPANY HIGHLIGHTS

1980	VLSI completed financing for $10 million to establish a custom circuit silicon foundry.
Aug. 1981	Bendix Corp. received a warrant for 14 percent of preferred stock; $2 million research and development funding, $15 million equipment funding.
Nov. 1982	VLSI offered the first of its Cell Compiler family for quick design, a CAD system on VAX and Apollo systems utilizing 2.5- to 4.0-micron HCMOS.
Feb. 1983	Ricoh and VLSI jointly developed 64K, 128K, and 256K ROMs, Ricoh in CMOS and VLSI in NMOS.
July 1983	VLSI second-sourced TI's TMS4500A DRAM controller and developed the 256K DRAM controller.
Nov. 1983	VLSI offered 3 million shares of common stock. Wang purchased 15 percent of VLSI's stock for $34 million. VLSI will develop custom products for Wang's office automation products.

Dec. 1983	VLSI added its first dual-layer metal HCMOS cell library utilizing a 3-micron process.
Jan. 1984	VLSI posted its first profitable quarter of $91,000 for Q4 1983.
Feb. 1984	VLSI and Visic signed a joint development agreement to develop CMOS RAM products.
May 1984	VLSI and Fairchild jointly develop and second-source Fairchild's 2-micron CMOS gate arrays and gate array development system.
July 1984	VLSI offered the VL4500A DRAM controller at 150ns. It is a version of TI's TMS 4500A
Sept. 1984	VLSI offered 256K ROMs with delivery in five weeks.
	VLSI and Lattice cross-license for EEPROMS and SRAMs; Lattice provides technology and VLSI manufactures.
Jan. 1985	VLSI and Sierra Semiconductor will exchange software, designs, and products.
April 1985	VLSI offered the VT 231024 1Mb ROM; 5V, 150ns, commercial, 28-pin plastic DIP.
	VLSI added megacells to its cell-based design and fab capabilities. New products of this family include the VGC6845, CMOS CRT controller, and 16K, 32K, 64K, and 128K HMOS ROMs. Future additions will include high-speed SRAMs and fast EEPROMs from a technology exchange with Lattice Semiconductor and fast pseudo-DRAMs from a trade with VTC. All future designs will be in 2-micron CMOS, twin-well.
May 1985	VLSI agreed with Honeywell to manufacture and market Synertek's CRT controller, interface circuits, 4K SRAM, and 16K ROM.
	A family of EPL arrays based on advanced CMOS EPROM process technology was announced by Ricoh and VLSI.
	NSC and VLSI jointly introduced a series of new CMOS 256K 200ns UV-EPROMs, the NMC27C256 and VT27C256.

June 1985	VLSI introduced its new HCMOS 256K EPROM, a 200ns to 450ns 1Kx8 Dual-Port RAM with on-chip logic.
	VLSI introduced the VT231024 1Mb ROM; 150ns, 5V, 28-pin plastic DIP, commercial.
	VLSI signed a five-year cross-licensing agreement with Zilog to develop and manufacture VLSI ICs combining processor and peripheral functions. Zilog will provide product technology, VLSI will provide design technology; for ASIC and user-specific ICs.
	VLSI added two new silicon compilers, a logic compiler to convert schematics to silicon, and the Data Path Compiler which builds on the 2901 4-bit MPU slice architecture and translates 2901 board-level designs to semicustom chips.
	VLSI signed an agreement with Daisy that allowed users of Daisy's concurrent CHIPMASTER and SILICONMASTER workstations to acquire VLSI's design tools and silicon compilers.
July 1985	A 1Kx8 Dual-Port RAM marks VLSI's entry into the application-specific memory market. It is available with on-board arbitration, 100ns, 5V, 48-pin DIP, commercial.
Sept. 1985	VLSI offered the fastest 64K SRAM at 35ns; the VT64KS4/65KS4 is a 16Kx4 HCMOS SRAM, commercial grade.
Oct. 1985	VLSI made its IC design system for schematic capture and logic simulation available on Hewlett-Packard's HP 9000 Series 300 engineering workstations.
	VLSI introduced a standard cell library with more than 260 cells.
Nov. 1985	VLSI entered the DSP market with the VL2010, a 16x16 Parallel Multiplier/Accumulator; 50ns, 5V, 64-pin CERDIP, plastic DIP, PLCC.
	VLSI offered prototype manufacturing.
	VLSI introduced the VL4502, a CMOS 256K DRAM with maximum access time of 150ns.

Jan. 1986	VLSI offered a full-custom CMOS EPROM Family with a 64K, 128K, and 512K EPROM; 12V, 150ns to 200ns.
March 1986	VLSI offered the VGC8000, an 8,000-gate high-performance gate array implemented in double-metal CMOS with an effective channel length of 1.3-microns and an internal gate propagation delay of 1.1ns. It was developed in a cooperative effort with Fairchild, a company that will serve as a second source.
April 1986	VLSI announced a public offering of 2.5 million shares of common stock to raise funds for the expansion of manufacturing facilities and general working capital purposes.
May 1986	VLSI and Acorn Computers of Cambridge, Great Britain, introduced a high-performance, single-chip 32-bit reduced instruction set computer (RISC) and associated controller chips. Acorn will develop systems with the new ICs; VLSI will market them worldwide.
	VLSI announced its new Generic Array Logic (GAL) family composed of the 20-pin VP16V8E and the 24-pin VP20V8E devices.
June 1986	VLSI introduced 64K HRAMs that combine the attributes of SRAMs and DRAMs in one chip. The VT16H4 allows read, write, and cycle times of 35ns in total random mode and 25ns times in static column mode.
	VLSI introduced a 2-micron multiplier compiler for military, digital signal processing, and high-performance computer applications.
	VLSI offered its IC design software product line on Sun Microsystem's Sun-3 family of technical workstations.
	VLSI sampled the VM27C256, a 256K CMOS EPROM for military markets. It is the first product from the government products business unit.

VTC, Incorporated
2401 East 86th Street
Bloomington, MN 55420
612/851-5000

ESTABLISHED: May 1984
NO. OF EMPLOYEES: 42

BOARD

Name	Affiliation
D.B. Griffith	Control Data
W.L. Workman	ITT
D.A. Orton	Fairchild

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	T.E. Hendrickson, PhD.	Fairchild	Engr Mgr
Exec VP	J.R. Hodgson	Fairchild	Mktg Mgr
General Counsel	B.G. Roberts	Control Data	Counsel
VP/CFO	Howard C. Hensen	Control Data	VP/Venture Investments

FINANCING

Round	Sources	Amount
Round 1	Loan	$1.0M
Round 2	Asset purchase for stock	$22.7M
Round 3	Equity investment by Control Data Corp.	$1.5M
Round 4	Equipment lease line	$60.0M
Round 5	Building lease	$16.3M
Round 6	Equipment lease line	$10.0M

BACKGROUND

VTC, Incorporated, designs, manufactures, and markets high-performance linear bipolar and digital CMOS devices for the aerospace, telecommunications, and computer markets. VTC also provides a complete set of CAD tools for linear, digital bipolar, and CMOS designs.

The Company's VHSIC technology division produces high-speed CMOS interface logic and VHSIC-level radiation-hardened devices. Its microcircuits division specializes in high-performance bipolar ICs.

In the first quarter of 1986, VTC occupied an additional 165,000-square-foot facility. The facility includes a 30,000-square-foot Class 10 clean room. The Company makes it own masks in a shop equipped with E-Beam technology. Its factories are designed for high-volume production with advanced manufacturing, in-house packaging, and test equipment.

In May 1986, VTC announced a 1-micron CMOS radiation-hardened standard cell library, a 1.6-micron CMOS library using silicon compiler technology, and a family of analog master chips using a 6-GHz bipolar linear 2-micron process.

ALLIANCES

Control Data	Oct. 1984	CDC participated in round three of financing. The arrangement includes a fabrication technology license.
Silicon Compilers	May 1986	VTC signed an agreement to provide its 1.6-micron and 1.0-micron double-level metal CMOS technologies to users of Genesil, the silicon development system offered by Silicon Compilers Inc. The radiation-hardened system needs of the military and aerospace community will be supported under the agreement with a hardened cell to be developed by VTC and made available on the Genesil system. VTC's 1-micron CMOS process will offer total dose tolerance in excess of one megaRad. Under the terms of the agreement, VTC will develop additional macrocells for SCI's silicon compiler system.

SERVICES

Design	CMOS and Bipolar Gate Arrays Bipolar Cell Libraries
Foundry Manufacturing	CMOS, Bipolar Linear/Digital, and Bipolar ECL

PROCESS TECHNOLOGY

3.0- and 2.0-micron Bipolar Linear
2.0-micron Bipolar Digital
1.6 and 1.0-micron CMOS
All two-layer metal

PRODUCTS

Gate Arrays

Family	Process	Linewidth (micron)	Delay (ns)	Gates
VG6000	CMOS	1.6	0.7	6,000
VJ800	Bipolar	3.0	1.5	50
VJ900	Bipolar	2.0		Up to 1448 active

Cell Library

Family	Process	Linewidth (micron)	Delay (ns)	Cells
VL1000	Bipolar	3.0	1.5	120 cells, 9 gates, 1 MSI, RAM,ROM, data converters, amplifiers
VL2000	Bipolar	2.0	0.42	22 gates, 38 MSI, RAM, full adder
VL5000	CMOS	1.0	0.57	25 gates, 19 MSI, 8 I/O

Silicon Compiler

VL7000	CMOS	1.6		RAM, ROM, FIFO, PLA
VL8000	CMOS	1.0		RAM, ROM, FIFO, PLA

V54/74 ACT Interface Logic family

Octal Buffers and Line Drivers
Octal Bus Transceivers
Octal D-Type Transparent Latches
Octal D-Type Edge Triggered Flip-Flops

LSP and Bipolar Semicustom

High-Speed Precision Op Amp
Dual High-Speed Precision Op Amp
Quad High-Speed Precision Op Amp
High-Speed Fast-Settling Op Amp
Dual High-Speed Fast-Settling Op Amp
Quad High-Speed Fast-Settling Op Amp
Wideband High-Slew Rate Op Amp
Wideband Dual-High-Slew Rate Op Amp
Wideband Quad-High-Slew Rate Op Amp

Applications: Military and high-volume commercial

FACILITIES

Facility 1	Bloomington, MN	200,000 sq.ft.	Headquarters
Facility 2	Bloomington, MN	30,000 sq. ft.	Class 10 Clean room

COMPANY HIGHLIGHTS

May 1986 — VTC signed an agreement to provide its 1.6-micron and 1.0-micron double-level metal CMOS technologies to users of Genesil, the silicon development system offered by Silicon Compilers Inc. The radiation-hardened system needs of the military and aerospace community will be supported under the agreement with a hardened cell to be developed by VTC and made available on the Genesil system. VTC's 1-micron CMOS process will offer total dose tolerance in excess of one megaRad. Under the terms of the agreement, VTC will develop additional macrocells for the silicon compiler system.

June 1986 — VTC made its VL2000 digital bipolar standard cell library available to users of Computervision's Personal Engineer PC-AT design automation software. Cells in the VL2000 library range from simple gates to LSI functional elements including a 2901 4-bit ALU.

June 1986 — Jim Schmook was named manager of a new wholly owned VTC regional design center that opened in San Jose, California, the company's first such facility outside Minnesota. Linear and digital ASIC products are available now at the new center; VTC's library of CMOS standard cells will be added later this year.

WaferScale Integration, Inc.
47280 Kato Road
Fremont, CA 94538
415/656-5400

ESTABLISHED: August 1983
NO. OF EMPLOYEES: 70

BOARD

Name	Affiliation
Ralph Ungermann	Ungermann-Bass
Alex Milner	Tadiran
Harry Marshall	J.H. Whitney
Jim Swartz	Accel Partners
Dr. Eli Harari	WaferScale Integration
Donald K. Grierson	WaferScale Integration
Richard Santilli	RCA Corporation

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman	Eli Harari	Synertek	VP Opns
President	Sheldon Taylor	Intel	GM Prog Mem Opns
VP Technology	Stephen C. Su	Synertek	Dir Adv Tech
VP Sales	Bob Casel	Oki	VP Sales/Mktg
Dir Finance	Robert J. Barker	MMI	

FINANCING

Date	Round	Sources	Amount
Feb. 1984	Round 1	Accel Partners; Adler & Co.; Bessemer Venture Partners II; Genevest (Switzerland); Intergraph; Oak Investment Partners; Robertson, Colman & Stephens; Smith Barney Venture Corp.; Tadiran (U.S.) Inc.; Warburg-Pincus; J.H. Whitney;	$16.1M
	Lease	Bank of America; Equitec; Bateman Eichler Leasing Corp.	

Nov. 1984	Round 2	Original investors; Continental Illinois Venture Corp.; Baillie Gifford & Co. (Scotland)	$8.5M
April 1986	Round 3	Original investors; RCA Corporation; Sharp Corporation; Intergraph Corp.	$13.0M

BACKGROUND

WaferScale Integration (WSI) designs and manufactures high-performance CMOS semicustom ICs that incorporate advanced CMOS EPROM capabilities. The ICs are developed for high-performance systems applications such as in minicomputers, graphics processing, digital signal processing, telecommunications, and reduced instruction set computers (RISC).

WSI Products include: High-performance CMOS application-specific ICs; high-speed 4-bit, 16-bit, and 32-bit CMOS bit-slice processors and support chips; and high-density, high-speed CMOS EPROMs. In the first year of operation WSI completed a semicustom cell library based on 2-micron CMOS design rules with sub-1ns gate delays. The cell library incorporated bit-slice LSI MPU cells and CMOS EPROM LSI cells.

Sharp and RCA are providing foundry services for WSI.

ALLIANCES

Sharp	Dec. 1984	Sharp signed a technical cooperation contract to use WSI's technology and produce the 64K CMOS EPROM. WSI received manufacturing capacity and royalties from Sharp. Development and production of 256K CMOS EPROMS are planned.
	Oct. 1985	WSI and Sharp expanded a 1984 agreement to include WSI's 1.6-micron CMOS technology in exchange for royalties and foundry capacity.
RCA Corp.	March 1986	RCA and Sharp entered into a five-year strategic alliance with WSI to cooperate on manufacturing and technology for high-performance CMOS ICs. WSI's library of LSI macrocells will be combined with cell libraries from RCA and Sharp to provide a

RCA Corp. (Continued)

three-company-sourced advanced cell library. WSI also licensed RCA and Sharp to manufacture WSI's high-speed EPROMs and MPUs. In addition, the companies will cooperate on developing next-generation 1.0-micron cell libraries, advanced tools, packaging techniques, high-speed EPROMS, and other high-performance standard products. The alliance gives WSI alternative sources of chips and a springboard into the market in Japan.

SERVICES

Design	CMOS Cell Library
Foundry	Silicon-Gate CMOS

PROCESS TECHNOLOGY

SCMOS I: 2.0-micron, double-metal CMOS
SCMOS II: 1.5-micron, double-metal CMOS (available 1987)
(6-inch wafers)

PRODUCTS

Memory

Device	Organization	Delay (ns)
WS57C49	8Kx8 EPROM	70
WS27C64	8Kx8 EPROM	200
WS57C64F	64K EPROM	70

Microprocessor

WS5901C/5901D	4-bit MPU Slice	
	16-bit CMOS Bit-Slice Processor Cell	70
WS59032	32-bit CMOS Bit-Slice Processor	80

Modular Cell Library

Process	Linewidth (micron)	Delay (ns)	Description
Si-Gate	1.2	0.85	75-gates, 26 MSI, RAM, ROM, PLA, EPROM, 2901 family

Applications: CAD/CAE workstations, graphics, superminicomputers, digital signal processing, modems, array processors

FACILITIES

Fremont, CA	66,000 sq. ft.	Design and test

Design Centers:

Fremont, CA	MOS	Standard Cell

COMPANY HIGHLIGHTS

In its brief history, WaferScale Integration has accomplished the following:

Feb. 1984 — Completed the first round of equity and equipment lease-line financing for $16.1 million and began construction of headquarters.

Sept. 1984 — Moved into its new 66,000-sq.-ft. headquarters in Fremont, California, that were designed to handle multi-design, high-performance CMOS products with emphasis on high yields and very fast cycle time.

Nov. 1984 — Completed second round of financing for $8.45 million to be used for operating expenses as the company moves from development to production stage.

Completed first test chip.

Sampled the WS27C64 64K CMOS EPROM; 8Kx8 UV EPROM, 200ns, 5V 28-pin CERDIP, in a commercial grade.

WSI offered the Modular Cell Library of high-density, high-performance LSI building blocks available on Daisy, VAX, and the IBM PC/AT. It achieves sub-nanosecond gate delays and is a 1.2-micron EPI CMOS cell library.

Dec. 1984	Signed agreement to provide Sharp with WSI's proprietary 2.0- and 1.2-micron CMOS EPROM technology in exchange for royalties and product manufacturing capacity for the EPROM.
March 1985	Added a 16-Bit CMOS Bit-Slice Processor Cell to its Modular Cell Library that contains five functional blocks, 70ns, 15 MHz.
April 1985	Offered a 64K EPROM as a cell in its Modular Cell Library.
May 1985	Offered the WS 59032 CMOS 32-Bit Microprocessor Cell, available on Modular Cell.
Aug. 1985	Introduced the WS 5901C/5901D, CMOS 4-Bit MPU Slice that is 100 percent compatible with the AMD AM2901C, 40-pin CERDIP and plastic DIP.
Sept. 1985	Offered the WS 57C49, an 8Kx8 RPROM (Re-Programmable Read-Only Memory) at 70ns, ESD protection exceeding 2,000V, 24-pin CERDIP.
Oct. 1985	Expanded the Sharp agreement to include foundry services from Sharp for WSI's large-volume ASICs and standard products; all products use 1.6-micron CMOS.
Nov. 1985	Sampled the WS 57C64F, 64K CMOS EPROM, 70ns, 28-pin EPROM configuration. It was the second erasable memory in the WaferScale family based on an EPROM cell. Volume production was scheduled for early 1986.
March 1986	WSI laid off 14 people or 16 percent of its staff. The layoff resulted from WSI's decision to shift all manufacturing to Japan.
	RCA and Sharp entered into a five-year strategic alliance with WSI to cooperate on manufacturing and technology for high-performance CMOS ICs. WSI's library of LSI macrocells will be combined with cell libraries from RCA and Sharp to provide a three-company-sourced advanced cell library. WSI also licensed RCA and Sharp to manufacture WSI's high-speed EPROMs and MPUs. In addition, the companies will cooperate on developing next-generation 1.0-micron cell libraries, advanced tools, packaging techniques, high-speed EPROMS, and other high-performance standard products. The alliance gives WSI an alternative source of chips as well as a springboard into Japan.

April 1986 WSI raised $13 million in third-round financing, bringing, its total capitalization to $29.6 million. All of WSI's previous investors participated in the third round. New investors are RCA Corporation, Sharp Corporation, and Intergraph Corporation. RCA and Sharp purchased about seven percent of WSI's stock through RCA/Sharp Microelectronics (RSM), an RCA/Sharp joint venture. The investment is part of a recently announced strategic alliance to jointly develop high-performance CMOS ICs.

July 1986 WSI announced the WS59032E, a 20 MHz 32-bit CMOS bit-slice processor.

Weitek Corp.
1060 East Arques Avenue
Sunnyvale, CA 94086
408/738-8400

ESTABLISHED: 1980
NO. OF EMPLOYEES: 100

BOARD

Name	Affiliation
G. Leonard Baker	Sutter Hill Ventures
Arthur J. Collmeyer	Weitek Corporation
David House	Intel Corp.
Gerald Lodge	InnoVen Partners
Arthur Reidel	Alex Brown
James Patterson	Quantum Corporation

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Arthur J. Collmeyer	Calma	GM Microelec Div
VP Engr	Steven Farrow	Intel	Opns Mgr
VP IC Mfg	Godfrey Fong	Hewlett-Packard	Mfg Mgr
VP Sales	James F. Girand	Calma	VP Sales
VP Sys R&D	Saul Goldstone	Calma	VP Engr
VP Mktg	John F. Rizzo	Apple	Mktg Mgr
VP Finance/Prod	A. Brooke Seawell	Southwall	CFO
VP Corp Dev	Ed Sun	Hewlett-Packard	Engr Mgr
VP IC R&D	Chi Shin Wang	Hewlett-Packard	Engr Mgr

FINANCING

Date	Round	Sources	Amount
Jan. 1981	Round 1	InnoVen Capital; Sutter Hill Ventures	$2.3M
March 1983	Round 2	InnoVen; Sutter Hill Ventures; Merrill, Pickard, Anderson & Eyre; Institutional Venture Partners	$2.2M
Jan. 1986	Round 3	All of the above; Alex Brown; Glynn Capital	$3.0M

BACKGROUND

Weitek began as a custom design house specializing in gate arrays, standard cell, and full custom circuits. However, the Company now is producing specialty advanced circuit design semiconductors that use advanced concepts in numeric processing.

Weitek was founded by Godfrey Fong, Dr. Edmund Sun, and Dr. Chi-Shin Wang.

Weitek plans to become a leading company in the market for VLSI building blocks that solve compute-intensive problems.

In 1984, Weitek opened its European Headquarters in Geneva, Switzerland. Yves CODA-Forno is the managing director.

ALLIANCES

Toshiba	1980	Weitek and Toshiba reached an agreement for graphics chips; Toshiba provided the wafers.
AMI	March 1982	AMI signed to manufacture and market Weitek-designed, high-speed NMOS 16K, 32K, and 64K ROMs.
Cypress	Oct. 1985	Weitek and Cypress made an agreement to jointly develop a series of high-performance VLSI logic circuits designed by Weitek and manufactured using Cypress' 1.2-micron CMOS process. The circuits are designed for telecommunications, graphics, instrumentation, military, and CAD/CAM applications.
Intel	Oct. 1985	Weitek agreed to develop an interface IC, that Intel will second-source and for which Intel will provide foundry services on 6-inch NMOS and CMOS wafer processing equipment.
NSC	Oct. 1985	National Semiconductor announced that it will design, manufacture, and market an interface chip to work with Weitek's floating-point chip set.
Step Engineering	March 1986	Step Engineering signed to produce development tools for debugging and microcoding of Weitek's floating-point integer processor designs.

Matra-Harris	March 1986	Matra and Weitek sign a wide ranging technology exchange and foundry agreement. Matra-Harris was granted rights to Weitek's high-performance 16-bit integer multiplier product family, and has granted Weitek preferred access to its CMOS process in exchange for manufacturing a variety of Weitek's products. The agreement also included joint development of complex high-speed logic devices aimed at solving compute-intensive problems in the DSP, telecommunications, and military markets.
Quadtree	April 1986	Weitek announced that Quadtree Software will develop behavioral simulators for the WTL 2264/2265 chip set.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

2.0-micron CMOS, 1-level metal
2.0-micron CMOS, 2-level metal
1.5-micron CMOS, 1-level metal
1.5-micron CMOS, 2-level metal
1.2-micron CMOS, 2-level metal
2.0-micron NMOS
1.5-micron NMOS

PRODUCTS

Product and Number	Description	Speed (ns)
WTL 1016	NMOS Multiplier Processor	140, 100
WTL 1010	16x16 Multiplier/Accumulator	65
WTL 1043	16x16 Multiplier/Accumulator	
WTL 2010	16x16 Multiplier/Accumulator	45
WTL 2044/2045	16x16 Multiplier/Accumulator	50

PRODUCTS (Continued)

Product and Number	Description	Speed (ns)
WTL 2516C	16x16 Parallel Array Multiplier	35
WTL 2517	16x16 Parallel Array Multiplier	50
WTL 2245	16x16 Multiplier	
WTL 1066	32x32 Six Port Register File	
WTL 1064/1032/1164	64-Bit Floating-Point Multipliers	
WTL 1065/1033/1165	64-Bit Floating-Point ALU	
WTL 7137	32-bit Integer Processor/Controller	
WTL 7136	32-bit Sequencer	
WTV 008	Single-chip Speech Recognizer	
WTE 6400	SPICE Accelerator	

Board-Level Products

WTE 7100	PC/AT Solid Modeling Engine
WTE 7110	PC SME Graphics Design Kit
WTE 7130	PC KL Scientific Processor Design Kit
WTE 5300	Transformation Processor
WTE 5310	Floating-Point Design Kit

Applications: CAE/CAD, imaging, animation, simulation, machine vision, molecular modeling, medical diagnostics, signal processing

FACILITIES

Sunnyvale, CA 50,000 sq. ft.

COMPANY HIGHLIGHTS

July 1981 Weitek offered its first product, the WTL 1016 NMOS 16x16 parallel multiplier, 100ns.

Oct. 1981 Weitek offered the WTV 008 Single-chip Speech Recognizer with internal ROM.

March 1982	Weitek completed Round 1 of financing for $2.3 million, which will be used to support Weitek through the first quarter of 1983 in its development efforts.
	Weitek introduced a design for a 64K NMOS ROM with access time as low as 300ns using 5-micron design rules.
	AMI agreed to manufacture and market a Weitek-designed high-speed NMOS 16K, 32K, and 64K ROMs.
Aug. 1982	Weitek announced that UMC will produce and market Weitek's 64K NMOS ROM.
May 1983	Weitek introduced the WTL 1032/1033 NMOS 32-Bit Floating-Point Chip Set.
3Q83	Weitek has been profitable on a quarterly basis since third quarter 1983.
Feb. 1985	Weitek offered the WTL 1164/1165 Floating-Point Chip Set; 5V, 64-pin DIP and 68-pin LCC, commercial and military.
Sept. 1985	Weitek closed its U.K. office because the market was not as large as statistics suggested.
Oct. 1985	Cypress and Weitek agreed to share design and marketing rights to five logic circuits that Weitek will design and Cypress will manufacture. Weitek will supply architectural design and engineering; Cypress will furnish design support, processing, and 1.2-micron CMOS fabrication.
Jan. 1986	Weitek reduced prices on its 64-Bit Floating-Point Chip Set.
March 1986	Weitek announced two new very high-speed 16-bit integer multiplier products: the WTL 2516C, a 16x16 integer multiplier that operates at 35ns; and the 2010B, a multiplier/accumulator that operates at 45ns. The new devices are fabricated with a 1.2-micron double-metal CMOS process that yields nearly a 50 percent performance increase over previous devices.
April 1986	Weitek announced two new products: the 2264/2265, a new 64-bit floating-point chip set that operates at 40 MFLOPs in single precision and 24 MFLOPs in double precision.

April 1986	Weitek announced the WTL 7000 Series for design automation, graphics, and simulation applications. The series consists of the WTL 7137, a 32-bit Integer Processor/Controller, and the WTL 7136 32-bit Sequencer.
May 1986	Weitek announced a CMOS 64-bit Floating-Point Data Path unit. The single chip provides a 32-bit register file, a 32-bit multiplier, a 32-bit ALU, and 20 MFLOPs performance.
	Weitek introduced the WTL 3132 and WTL 3332, two 32-bit floating-point devices that integrate entire data path functions on one chip.

Wolfson Microelectronics Ltd.
The Kings Buildings
Mayfield Road
Edinburgh EH9 3JL
Scotland
United Kingdom
031/667-9386
Telex: 727442 UNIVED G

ESTABLISHED: January 1985
NO. OF EMPLOYEES: Not available

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Managing Dir	David Milne

FINANCING: Not Available

BACKGROUND

Wolfson Microelectronics Ltd. designs and manufacturers application-specific ICs and complete development systems. Products offered include gate arrays, standard cell, and full-custom implementations.

Wolfson Microelectronics Ltd. evolved out of the Wolfson Microlectronics Institute at Edinburgh University. The Company, although completely autonomous, retains its technological links with the academic research activities of the University.

The Company has adapted to a 2-micron double-layer metallization CMOS process developed by Plessey. Its first product will be a 128-point, finite-impulse-pulse-response filter.

ALLIANCES: None

SERVICES

- Design
- Manufacturing
- Test

PROCESS TECHNOLOGY

5.0-micron Metal-Gate NMOS
3.0-micron Silicon-Gate NMOS
3.0-micron CMOS
2.0-micron double-layer metal CMOS

PRODUCTS

Standard Cell

2.5-micron	Multipliers, accumulators, memories

Applications: Image processing, sonar communications, digital signal processing, telephones, and custom circuits

FACILITIES: Not available

Design Centers:

One European location	Standard cell, Gate arrays

Xicor, Inc.
851 Buckeye Court
Milpitas, CA 95035
408/946-6920

ESTABLISHED: 1978
NO. OF EMPLOYEES: 512

BOARD

Name

Raphael Klein
S. Allen Klein
Julius Blank
Andrew W. Elder
Hans G. Dill

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Raphael Klein	Intel	R&D Prog Mgr
Executive Vice President	Ari Schifirin	Data General	MOS Opns Mgr
VP R&D	William Owen, III	Intel	Sr Dsn Engr
VP/Controller	Klaus Hendig	NBK	Dir Finance
VP Reliability/Quality	John Caywood	Intel	Mgr Rel
VP Manufacturing	Manuel Mere	IBM	Mrg Mem Opns
VP Strategic Planning	Wallace Tchon	Intel	Sr Staff Engr

BACKGROUND

Xicor is engaged in the design, development, production, and marketing of nonvolatile, random-access memory (NOVRAM) devices and EEPROMs.

Xicor, Inc., was founded by Raphael Klein, Richard T. Simko, Wallace Tchon, and William H. Owen III, all of whom were formerly employed at Intel Corporation. Other founders included Julius Blank, formerly with Nortec, and S. Allen Kline and Paul I. Myers Jr., both formerly with Intersil.

Xicor markets its products in the United States and internationally through a direct sales team and a network of independent sales representatives and nonexclusive distributors.

ALLIANCES

Intel	Aug. 1985	Xicor and Intel announced the joint development of advanced EEPROMs and second sourcing on other undisclosed products. Intel provided $6.5 million in cash, leases, and other considerations to cover the costs of the joint research and development program.

SERVICE

Design
Manufacturing
Assembly
Test

PROCESS TECHNOLOGY

2.0-micron CMOS and NMOS
(4-inch wafers)

PRODUCTS

NOVRAM	Device	Speed (ns)
256-Bit	X2210	250-300
1K	X2201	300
1K	X2212	250-300
4K	X2004	250-300
Serial NVRAM	X2444	
EEPROM		
4K	X2804	250-450
16K	X2816	45-450
64K	X2864	45-450
256K	X28256	150

Serial EEPROM

Device	Organization
X2404	512 x 8
X24C16	2,048 x 8

PRODUCTS (Continued)

EE Potentiometers (E2POT)

X9103
X9104
X9105
X9203
X9503
X9504

FACILITIES

Milpitas, CA	Building 1	40,000 sq. ft	Manufacturing
		1,400 sq. ft.	Class 10 Clean room
		12,600 sq. ft.	Class 100 Clean room
	Building 2	30,000 sq. ft.	
	Building 3	76,000 sq. ft	

COMPANY HIGHLIGHTS

Aug. 1980	Xicor announced construction had started on its production facility.
April 1981	Xicor introduced two new 5-volt programmable NOVRAMs.
July 1981	Xicor announced military and industrial temperature range NOVRAMs.
March 1982	Xicor began shipping NOVRAM memories from its Silicon Valley plant.
April 1982	Xicor announced Mil-Std-883 NOVRAM memories.
June 1982	Xicor introduced a 5-volt programmable 16K EEPROM.
March 1983	Xicor expanded its EEPROM line with a 64K Byte-wide device, the X2864A.
April 1983	Xicor announced the X2444, a 256-bit Serial NOVRAM.
Sept. 1983	Xicor broke ground for a second manufacturing plant.
Feb. 1984	Xicor offered products packaged in plastic.

April 1984	Xicor reported its first profitable quarter.
May 1984	Xicor inaugurated a new test facility.
Aug. 1984	Xicor received the Hughes Aircraft 1984 Supplier Superior Performance Award.
March 1985	Xicor implemented cost-saving measures and laid off 70 employees.
April 1984	Xicor completed MIL SPEC qualification of its 64K EEPROM.
June 1984	Xicor's 64K EEPROM was qualified to MIL-STD-883, Class B.
Aug. 1985	Intel and Xicor announced a joint-development agreement.
Nov. 1985	Xicor introduced the EEPOT, a digitally-controlled potentiometer.
Jan. 1985	Xicor introduced the 256K EEPROM, the X28256, that is fully compatible with the industry standard 2864A and includes advanced capabilities for DATA polling, instead of a Ready/BUSY pin to indicate the chip's condition, and a unique software data-protection mechanism.

Xilinx
2069 E. Hamilton Avenue
San Jose, CA 95125
408/559-7778

ESTABLISHED: February 1984
NO. OF EMPLOYEES: 60

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Bernie Vonderschmitt	Zilog	VP/GM IC Div
VP Admin/Strat Plan	James Barnett	Zilog	Prod Line Dir
VP Eng	Ross Freeman	Zilog	Dir Eng
VP Sales	R. Scott Brown	Menlo Corp.	VP Sales
VP Opns	Frank Myers	Exel	VP Opns
VP Mktg	Wes Patterson	VLSI	Dir Opns

FINANCING

Date	Round	Sources	Amount
March 1984	Round 1	Hambrecht & Quist; Kleiner, Perkins, Caufield & Byers; J.H. Whitney & Co.	$4.3M
Dec. 1985	Round 2	Berry Cash Southwest Partnership; Hambrecht & Quist; InterFirst Venture Company; Interwest Partners; Matrix Partners; Morgan Stanley; Rainier Venture Partners; Kleiner, Perkins Caufield & Byers; J.H. Whitney	$8.3M

BACKGROUND

Xilinx was formed to become the first and leading supplier of logic cell arrays (LCAs) for the ASIC market. The LCA is a specially designed SRAM that can be programmed to perform logic functions with Xilinx design software.

Xilinx was founded by James Barnett, Ross Freeman, and Bernard Vonderschmitt, all formerly with Zilog. First-round financing for $4.25 million was completed in March 1984 and first silicon was produced in July 1985.

Xilinx's charter is to develop a RAM-based logic cell array and an enhanced development system to shorten design time to less than eight hours and ease total system debugging. The Company introduced its logic cell array in November 1985. The XC 2064 is manufactured in 1.5-micron double-metal CMOS and operates at 33-MHz toggle rate. The product consists of 1,000 to 1,500 equivalent two-input NAND gates. Complexities are expected to reach 3,000- to 4,000-gates in late 1986 or early 1987, and up to 10,000 gates a year later. The logic design is performed on an IBM XT or AT.

The Company has a partnership agreement with Seiko Epson. The devices are being built in the Suwa plant, in Japan.

MMI is second sourcing Xilinx's logic cell arrays and development system.

ALLIANCES

Seiko Epson/ SMOS	Dec. 1985	Xilinx and Seiko Epson reached a joint-development agreement to design, manufacture, and market logic cell arrays and development systems. The LCAs will use Seiko Epson's CMOS manufacturing capability and Xilinx's proprietary logic cell array technology. The companies also agreed to joint development of Seiko Epson's CMOS process. Seiko gained nonexclusive marketing rights to the LCA product in Japan.
MMI	June 1986	Xilinx and MMI signed a three-year technology exchange agreement calling for MMI to manufacture and market Xilinx's Logic Cell Arrays and associated development system. The first product transferred is the XC-2064, a 1,200-gate device. Xilinx will supply future extensions of the LCA family to MMI as they become available. Xilinx has also given rights to market the XACT development system and the Xactor in-circuit emulator. The two companies will cooperate in extending software support for LCA products.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

1.5 Double-Metal Silicon-Gate CMOS

PRODUCTS

XC 2064	CMOS Logic Cell Array, 1,000 to 1,500 gates
XACT Design Development System	
In-Circuit Emulation	
LCA Development System	Combines hardware and software and allows a design engineer to observe, control, and modify the operation of ASIC logic.

FACILITIES

San Jose, CA	31,000 sq. ft.	Research and development, design, test, marketing, and sales

COMPANY HIGHLIGHTS

July 1985	Xilinx offered the XACT development system.
Dec. 1985	Xilinx completed its second round of financing for $8.3 million.
Jan. 1986	Xilinx offered its first IC product, the XC 2064 CMOS Logic Cell Array with SRAM technology; 1,000 to 1,500-gates.
Feb. 1986	Xilinx had sold over 40 development systems and expected to sell another 40 over the following two months.
March 1986	Xilinx offered an increased-speed XC2064 CMOS Logic Cell Array, with 1,000 to 1,500 gates, at 33 MHz.
April 1986	Xilinx added in-circuit emulation capability to the LCA development system. The emulator combines hardware and software, allowing a design engineer to observe, control, and modify the operation of ASIC logic.

June 1986	MMI has signed a three-year technology license pact to second-source Xilinx's proprietary logic cell array and related development system. MMI will begin sampling the XC 2064, 1,200-gate LCA with production planned for early 1987. The agreement also covers joint development and marketing of development tools, including Xilinx's new in-circuit emulator and software tools, and new products developed by both firms.

Xtar Electronics, Inc.
9951 Business Park Ave.
Suite A
San Diego, CA 92131
619/271-4440

ESTABLISHED: September 1982
NO. OF EMPLOYEES: 5

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
CEO	Emmett J. Powers	Universal Rsch Labs	Project Mgr
President	Anthony J. Miller	Universal Rsch Labs	Dir Engr
VP Eng	Terrence Coleman	Universal Rsch Labs	Chief Engr

BACKGROUND

Xtar was formed to design, develop, and manufacture graphics microprocessors, video shift registers, board-level products, and graphics systems with software support.

Xtar funded the formation of the Company and development costs through its sales. It has developed a graphics microprocessor (GMP), a video shift register (VSR), and board-level products. Its GMP, a full-custom device, is designed to replace 400 devices with 2 chips. The VSR utilizes a standard cell CMOS process technology. All of Xtar's products were sampled in September 1984, and production quantities were available in the fourth quarter of 1984.

XTAR contracts wafer fabrication.

The Company is planning to relocate in San Diego, California, in the fall of 1986.

ALLIANCES

XTAR Design Services, Inc. (Consulting affiliate)

SERVICES

Design

PROCESS TECHNOLOGY

3.0-micron CMOS and NMOS
(4-inch wafers)

PRODUCTS

XTAR Graphics Board (PC Compatible)
GMP (Two-chip set Graphics Microprocessor)
VSR (Video Shift Register)
3-D Modeler System
3-D View System

Applications: CAD/CAM, process control systems, graphics workstations and terminals, flight simulation, mechanical simulation

FACILITIES

San Diego, CA	Design

Zoran Corporation
3450 Central Expressway
Santa Clara, CA 94051
408/720-0444
FAX: 408 749 8057

ESTABLISHED: 1983
NO. OF EMPLOYEES: 100

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	John Ekiss	Intel Corporation	VP/GM
Ex VP/Chief Tech Officer	Levy Gerzberg, PhD.	Stanford U.	Assoc Dir/Sr Rsch Assoc
Sr VP	Yuval Almog	Raychem	Manager
VP Opns	Terry Martin	Intersil	VP Opns
VP Mktg/Sales	Alan H. Portnoy	Silicon Systems	Sr VP

FINANCING

Date	Round	Sources	Amount
Aug. 1983	Initial	Adler & Company; Elron Electronics Industries, Ltd., Israel	$3.5M
1984	Round 2		$1.5M
Oct. 1985	Round 3	Initial investors; Concord Partners; Grace Ventures Corp.; Investment Advisors, Inc.; Kleiner, Perkins, Caufield & Byers; Mitsui & Co. Inc. (USA),; Montgomery Securities; Vista Ventures; Welsh, Carson, Anderson & Stowe	$22.0M

BACKGROUND

Zoran Corporation is dedicated solely to developing, manufacturing, and marketing ICs for the high-end digital signal processing (DSP) market. The Company is focusing on a unique systems design approach and combines VLSI and digital signal processing to integrate DSP functions on single chips.

Zoran, a privately held company, was cofounded by Dr. Levy Gerzberg and Yuval Almog. Prior to founding Zoran, Dr. Gerzberg was Associate Director and Senior Research Associate at the Stanford University Electronics Laboratory. Mr. Almog served in management positions at Raychem Corporation where he was responsible for military electronics marketing and resource planning. Zoran's systems approach to products is based on the research conducted by the cofounders.

Presently, the Company is offering three products from two families--two Digital Filter Processors and one Vector Signal Processor. Each product is fully supported with a comprehensive portfolio of development tools that were designed for systems engineers and software and hardware developers. The support tools help designers develop high-level functions, including DSP algorithms and real-time simulations, thereby significantly reducing the development cycle time.

Zoran purchased a fully equipped fabrication plant from Storage Technology in Santa Clara, California, for $5 million. It also operates a second design center in Haifa, Israel. All manufacturing is done by Zoran.

To accelerate the implementation of its processors into end-user products, the Company has embedded algorithms and high-level instructions into the hardware. Zoran's integration of software algorithms and optimized hardware in its systems processors provides ease of design, high reliability, high performance, and optimized architectures.

Zoran's products are targeted for the telecommunications, medical electronics, digital audio/video, instrumentation, military electronics, industrial automation, and computer markets.

Zoran has a direct sales force with offices in Santa Clara, Los Angeles, Boston, and Haifa, and Dallas and London sales representatives. Other offices are scheduled for the Northeast, the Midwest, and the Southeast.

ALLIANCES

IMP	June 1983	IMP and Zoran codeveloped a CMOS PROM technology.

SERVICES

Design
Manufacturing

PROCESS TECHNOLOGY

2.0-micron (Double-Metal) CMOS
(4-inch wafers)

PRODUCTS

Digital Filter Processors

- Embedded finite impulse response filter

Vector Signal Processors

- Embedded fast fourier transform (FFT) algorithm
- Monolithic vector processor
- High-level instruction set
- 16-bit block floating processor

Support Tools

- Software or Simulator Module
- Assembler Module
- Hardware Module
- Logic Analyzer

FACILITIES

Santa Clara, CA	45,000 sq. ft.	Research and development and manufacturing
	4,600 sq. ft.	Class 100 Clean room

Design centers:

Santa Clara, CA
Haifa, Israel

ZyMOS Corporation
477 North Mathilda Avenue
Sunnyvale, CA 94086
408/730-8800

ESTABLISHED: 1978
NO. OF EMPLOYEES: 200

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman	W.C. Kim	Daewoo	Present Chairman
Interim COO	Haller M. Moyers	TI	Dept Mgr
Exec VP	Alex W. Young	Intel	Mgr Telecom/Auto Engr
VP Admin	B.J. Chang	Daewoo	Dir/GM

FINANCING

Date	Round	Sources	Amount
1979	Round 1	Intermedics, Inc.	$10.0M
	Lease		$5.0M
1981	Round 2	Intermedics, Inc.	$4.0M
July 1983	Initial Public Offering		$46.9M

BACKGROUND

ZyMOS is a full-service custom house with design, prototype fabrication, CAD tool, and foundry capabilities.

The Company was originally founded as Custom MOS Inc. in 1978 and operated as a custom IC design house. Its charter was to offer a standard cell library supported by a design automation system for custom IC development. The founders were Bert Braddock who had been director of custom product development at Synertek; Dave Isert, fab manager at Synertek; and Alan Louwerse, president of a layout design firm.

In 1979, 40 percent ownership of the Company was acquired by one of its customers, Intermedics, Inc., a manufacturer of heart pacemakers, in Freeport, Texas. The acquisition enabled the firm to construct a fabrication facility that became operational in November 1980. Intermedics provided funding of $15 million to build the facility in 1979. The present name, ZyMOS, was adopted in late 1980.

ZyMOS Corporation developed and designed ZyP, a design system for cell-based ICs.

In April 1986, Daewoo Corp., a $7.7 billion Korean conglomerate, completed plans to buy a controlling interest in ZyMOS. Daewoo will buy an undisclosed number of shares from Intermedics, a company owning 47 percent of ZyMOS, and will purchase new shares from ZyMOS to give the Company a direct cash infusion. Daewoo is the first Korean company to take control of an American chip maker.

ALLIANCES

Intermedics	1979	ZyMOS received financing from Intermedics, Inc., a medical electronics supplier, for $10 million and lease guarantees for $5 million. ZyMOS supplied Intermedics with custom ICs for its medical electronic products.
	Nov. 1981	ZyMOS received additional financing from Intermedics for $4 million to upgrade its 5-inch fab to 3-micron.
Intel	Jan. 1983	ZyMOS and Intel signed a technology exchange agreement to expand and standardize ZyMOS' custom VLSI circuits, utilizing Intel's CHMOS technology. ZyMOS provided its ZyP CAD system for Intel's CHMOS process and the two companies jointly developed a standard cell library.
	July 1984	Intel and ZyMOS extended the joint-development agreement for custom VLSI circuits; ZyMOS provided its ZyP design automation system for Intel's CHMOS II process. The agreement also included mutual second-sourcing of each company's products.
General Instrument	Aug. 1983	ZyMOS signed an agreement with General Instrument for GI to use ZyP software and Zy40000 to design custom and standard circuits and to develop the Zy40000 standard cell library. GI provided foundry services.
	April 1985	General Instrument extended its agreement with ZyMOS for an additional three years.

Source III	Sept. 1985	ZyMOS agreed to provide foundry services for Source III.
Daewoo Corp.	April 1986	Daewoo Corp., a $7.7 billion Korean conglomerate, completed plans to buy a controlling interest in ZyMOS. Daewoo will buy an undisclosed number of shares from Intermedics, a company owning 47 percent of ZyMOS, and will purchase new shares from ZyMOS to give the Company a direct cash infusion. Daewoo is the first Korean company to take control of an American chip maker.

SERVICES

Design	CMOS Cell Libraries
Foundry	Silicon-Gate CMOS, NMOS
Manufacturing	
Test	

PROCESS TECHNOLOGY

5.0-, 4.0-, 3.0-micron Silicon-Gate NMOS
5.0-, 4.0-, 3.0-, 2.0-micron Silicon-Gate CMOS
(4-inch wafers)

PRODUCTS

CMOS Cell Libraries

Family	Process	Linewidth (micron)	Delay (ns)	Cells
Zy-DP3/6000	Si-Gate	2.0	4	RAM, ROM, PLA, 2900 family, 82XX peripherals
Zy40000	Si-Gate	5.0	6	RAM, ROM, PLA, 80C49
ZyDP-11/50000	Si-Gate	3.0	12	RAM, ROM, PLA, 80C49 core microcontroller

PRODUCTS (Continued)

CAD TOOLS

ZyP CAD System

ZyPAWS I	A CAD system for 3- and 5-micron standard cells with 350 cells, including MPUs, RAMs, and ROMS on the Prime 2250 system.
ZySPICE	A circuit simulator
ZyPSIM	A logic simulator
ZyPART	An artwork generation software package
Poach-1 and Poach-2	MPR Functions for the IBM PC AT motherboard.
Poach-3	MPR functions for the IBM PC or PC XT motherboards that replace seven LSI components.

Linear Products

Single-Supply Comparator
Single- and Dual-Supply DAC
Single-Supply Op Amp

FACILITIES

Sunnyvale, CA	93,000 sq. ft	
	13,000 sq. ft.	Class 10 Clean room

Design Centers:

Sunnyvale, CA	MOS	Standard Cell, Full Custom
Huntington Beach, CA	MOS	Standard Cell
Wakefield, MA	MOS	Standard Cell
European locations (3)		Standard Cell

COMPANY HIGHLIGHTS

1979 ZyMOS received financing from Intermedics, Inc., a medical electronics supplier for $10 million and lease guarantees for $5 million. ZyMOS supplies Intermedics with custom ICs for its medical electronic products.

1980 ZyMOS moved into its first building and changed its name to ZyMOS.

Dec. 1980	ZyMOS fabricated its first ICs.
April 1980	ZyMOS introduced the ZyP CAD system.
Aug. 1981	ZyMOS offered ZyP, a 500-cell library of devices that use silicon-gate and metal-gate CMOS.
Nov. 1981	ZyMOS received additional financing from Intermedics for $4 million to upgrade its 5-inch fab to 3-micron.
Feb. 1982	ZyMOS opened an independent design center in Stockholm, Sweden, and equipped it with ZyP CAD systems.
May 1982	ZyMOS offered a 4-bit MPU with RAM module in its ZyP design system.
Jan. 1983	ZyMOS and Intel signed a technology exchange agreement to expand and standardize ZyMOS' custom VLSI on Intel's CMOS process. ZyMOS will provide its ZyP CAD system for Intel's CHMOS process and jointly develop a standard cell library.
Feb. 1983	ZyMOS offered ZyPAWS I, a CAD system for 3- and 5-micron standard cells with a 350-cell library, including MPUs, RAMs, and ROMS on the Prime 2250 system.
April 1983	The Zy40000 Analog Cell Library was offered for IC design. Utilizing 5-micron silicon-gate CMOS, it had 70 cells including op amps, comparators, switches, drivers, and oscillators. ZyMOS also offered ZySPICE, a circuit simulator; ZyPSIM, a logic simulator; and ZyPART, an artwork generation software package.
May 1983	ZyMOS offered the Zy50000, a 3-micron standard cell with 100 cells that use Intel's CHMOS II process.
Feb. 1984	ZyMOS offered the 80C49 Core MPU as part of the ZyP standard cell library for designing Intel-like microcontrollers.
June 1983	ZyMOS filed an IPO of 3.75 million shares and raised $46.9 million. The funds were used to reduced indebtedness and to equip a 30,000-square-foot wafer fab for 2-micron CMOS.

Aug. 1983	ZyMOS signed an agreement with General Instrument for GI to use ZyP software and Zy40000 to design custom and standard circuits and to develop the Zy40000 standard cell library.
Sept. 1983	ZyMOS opened a design center in Irvine, California.
March 1985	ZyMOS completed its 1.5-micron Class 10 wafer fabrication facility.
April 1984	ZyP software was made available on the Digital Equipment VAX, Daisy, and Mentor Graphics workstations.
July 1984	ZyMOS and Intel extended an agreement to exchange design and software technologies.
April 1985	ZyMOS laid off 119 employees, or 38 percent of its work force.
	General Instrument extended its agreement with ZyMOS for three years.
Aug. 1985	ZyMOS offered the ZY-DP3 library of cells that utilize 2-micron CMOS.
	A transfer of a controlling interest in ZyMOS was offered to Hambrecht & Quist and Penn Central Corp. for $10 million. The transfer was not completed.
Sept. 1985	ZyMOS agreed to provide foundry services for Source III.
Nov. 1985	ZyMOS added a third device to it Linear Cell Kit. The Zy40117 offers five additional linear cells that can be used for system breadboarding and/or the evaluation of cell performance.
Dec. 1985	ZyMOS introduced a three-chip set that provides MPR functions for the IBM PC AT and PC XT motherboards. Poach-1 and Poach-2 work together to provide MPR functions for the PC AT motherboard. The third chip, Poach-3, provides MPR functions for the IBM PC or PC/XT motherboards, replacing 7 LSI components.

April 1986 Daewoo Corp., a $7.7 billion Korean conglomerate, completed plans to buy a controlling interest in ZyMOS. Daewoo bought an undisclosed number of shares from Intermedics, who owned 47 percent of ZyMOS, and will purchase new shares from ZyMOS to give the company a direct cash infusion. Daewoo is the first Korean company to take control of an American chip maker. The equity investment gave Daewoo more than four seats on the ZyMOS seven-person board and prompted ZyMOS to begin aggressive equipment purchases to support a move to reduce feature size to 1.5-microns.

Dataquest

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