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Dataquest

A Decade of Semiconductor Companies

1988 Edition

Components Division

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I. INTRODUCTION

Dataquest has noted 157 semiconductor companies formed between 1977 and 1987. These companies are developing new niche markets and technologies that did not exist only a few years ago. Several companies have already become $100 million companies. Although several start-ups have failed, these have been replaced quickly by newcomers.

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

For our clients' convenience, Dataquest has prepared A Decade of Semiconductor Companies—1988 Edition to keep clients informed of these new and emerging companies. The information contained in the report was gathered through surveys, telephone interviews, and publicly available material. Some of the text was integrated verbatim from background information provided by the companies. This information may or may not reflect Dataquest's view of these companies. This report provides the following information:

- Recent company formations
- Financing raised by companies
- Strategic alliances
- Product participation in the ASIC, digital signal-processing, gallium arsenide, linear, memory, microprocessor, and other markets.
- Up-to-date profiles of 139 companies

Definition of Start-Ups

Dataquest defines IC start-ups as semiconductor manufacturers that design and ship finished products under their own labels; they need not have in-house wafer fabrication facilities. We observed that, due to the high cost of state-of-the-art plants and equipment, most start-ups use silicon foundries to reduce up-front costs. These companies complete circuit designs and subcontract manufacturing to other companies. Unlike custom design houses, these companies offer product lines.

Dataquest has made the following observations:

- The 157 companies reported in this edition represent a 19 percent increase over the 127 companies reported in IC Start-Ups 1987.
- Fifteen companies were established in 1987.
- Of the 157 companies formed between 1977-1987 (see Figure 1), 84 were in Silicon Valley; of the 15 companies formed in 1987, 7 are in Silicon Valley.

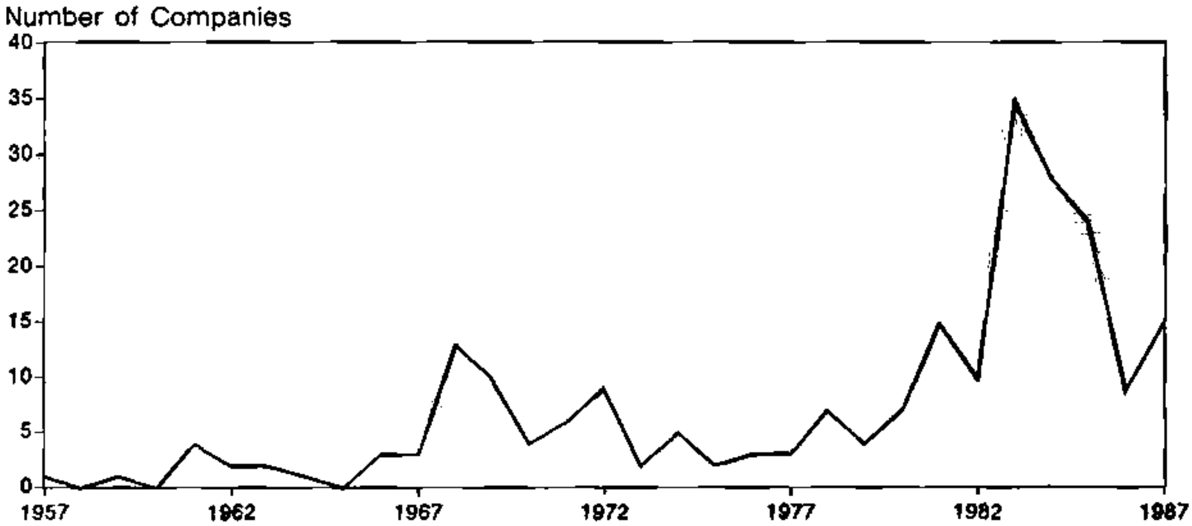
- The 11 companies that have closed represent 7 percent of the 157 companies formed. Seven companies were acquired.

- The companies have made numerous strategic alliances (more than 82 in 1987) in recent years.

- The companies raised about $685 million in financing in 1987 and raised a total of about $2.9 billion in the last 10 years.

Figure 1

Start-Up Activity by Year (1957-1987)



Source: Dataquest June 1988

Start-Up Activity, 1986 and 1987

In 1987, a remarkable number of new companies were formed after the dramatic drop in company formations in 1986. After the rapid emergence of companies between 1983 and 1985, venture capital firms shifted their interest from semiconductors to other areas, and only 9 companies received seed or first-round financing in 1986. However, 15 companies received seed or first-round financing in 1987, and based on past experience, we expect to see more companies as they raise initial financing and complete development efforts.

One of the reasons for the increase in company formations in 1987 is the development of unique technologies. These new companies are using and/or commercializing a variety of technologies that include neural networks, superconductivity, ferroelectric memory, silicon carbide, and optical ICs.

Another factor that has affected the number of companies being formed is the investment by companies that are relatively young themselves. Rather than risk the high costs to develop new processes and products, companies such as Cypress Semiconductor and LSI Logic have established wholly owned companies. Aspen Semiconductor, Cypress' subsidiary, is developing ECL memory, and G-2 Incorporated, LSI Logic's subsidiary, develops chip sets for microcomputers.

Also, in 1987, Sierra Semiconductor Corporation, in cooperation with National Semiconductor Corporation and the Singapore Technology Corporation, a company owned by the Singapore government, established a foundry facility named Chartered Semiconductor Manufacturing Company Limited. The venture takes advantage of financial incentives to develop an industrial base in Singapore.

Start-up activity by year is shown in Tables 1a to 1k. Tables 2a and 2b list companies that have been acquired or are closed.

Table 1a

Start-Up Activity by Year—1987 (15)

Company	Location	Products
Aspen Semiconductor	San Jose, CA	ECL memory, ASICs
Chartered Semiconductor	Singapore	Foundry
Conductus	Palo Alto, CA	Superconductors
Cree Research	Durham, NC	Silicon carbide discretes
G-2 Incorporated	Milpitas, CA	Micros
Genesis Microchip	Canada	ASICs
GL Micro Devices	Santa Clara, CA	CMOS products
Graphics Communications	Japan	Micros
Hualon Micro-Electronics	Taiwan	Linear, micros, ASICs
Linear Integ. Systems	Fremont, CA	Linear
LOGICSTAR	Fremont, CA	Micros
Photonic Integration	Columbus, OH	Optical ICs
Ramax	Australia	Ferroelectric memory
SIMTEK	Colorado Springs, CO	Memory
Synergy Semiconductor	Santa Clara, CA	ECL memory, logic

Table 1b

Start-Up Activity by Year—1986 (9)

Company	Location	Products
AMPi	Taiwan	Power MOSFETs
Gazelle Microcircuits	Santa Clara, CA	GaAs
IST	Phoenix, AZ	ASICs
MemTech Technology	Folsom, CA	Bubble memory
PLX Technology	Sunnyvale, CA	ASICs
Powerex	Youngwood, PA	Discretes
Synaptics	San Jose, CA	Neural network
TSMC	Taiwan	Foundry
Telcom Devices	Newbury Park, CA	GaAs photodiodes, LEDs

Table 1c

Start-Up Activity by Year—1985 (24)

Company	Location	Products
ABM Semiconductor (Inactive)	San Jose, CA	GaAs opto
ACTEL	Sunnyvale, CA	ASICs
Acumos	San Jose, CA	ASICs
Advanced Linear	Sunnyvale, CA	Linear
Alliance Semiconductor	San Jose, CA	Memory
ANADIGICS	New Jersey	GaAs analog and digital
Catalyst Semiconductor	Santa Clara, CA	Memory
Chips and Technologies	San Jose, CA	Micros
Dolphin Integration	France	ASICs
ES2	West Germany	ASICs
GAIN Electronics	New Jersey	GaAs ASICs
Hittite Microwave	Massachusetts	GaAs MMICs
Intercept	Sunnyvale, CA	ASICs
Krysalis	New Mexico	Ferroelectric memory
Level One Communications	Folsom, CA	Linear
NovaSensor	Fremont, CA	IC sensors
Orbit Semiconductor	Sunnyvale, CA	Foundry
Sahni (Closed)	Sunnyvale, CA	ASICs
Saratoga Semiconductor	Cupertino, CA	BICMOS memory
Tachonics	New Jersey	GaAs microwave, digital
Three-Five Systems	Phoenix, AZ	GaAs opto
Topaz Semiconductor	San Jose, CA	Discrete, linear
Triad Semiconductors	Colorado	Memory
Wolfson Microelectronics	Scotland	ASICs, DSP

Table 1d

Start-Up Activity by Year—1984 (28)

Company	Location	Products
Advanced Power	Bend, OR	Power MOSFETs
ATMEL	San Jose, CA	ASICs, memory, linear
Austek Microsystems	Australia	Micros
Celeritek	San Jose, CA	GaAs FETs, MMICs
Cirrus Logic	Milpitas, CA	Micros
Crystal Semiconductor	Austin, TX	Linear
Custom Arrays	Sunnyvale, CA	ASICs
Dallas Semiconductor	Dallas, TX	Memory, linear, micros
Epitaxx	New Jersey	GaAs opto
Integrated CMOS Systems	Sunnyvale, CA	ASICs
Integ. Power Semi (Acquired)	Scotland	Linear
Lytel	New Jersey	GaAs opto
Molecular Electronics	Torrance, CA	Bioelectronics
NMB Semiconductor	Chatsworth, CA	Memory, foundry
Novix	Cupertino, CA	Micros
Pacific Monolithics	Sunnyvale, CA	GaAs MMICs
Performance	Sunnyvale, CA	Memory, micros, logic
PromTech	San Jose, CA	Memory
Quasel Taiwan	Taiwan	Memory
Ramtron	Colorado	Ferroelectric memory
SID Microelectronics	Brazil	Discretes, linear
Silicon Macrosystems (Acquired)	San Jose, CA	CMOS memory
TMMIC	Mt. View, CA	GaAs MMIC
TriQuint Semiconductor	Oregon	GaAs analog/digital
Vitesse Semiconductor	Camarillo, CA	GaAs digital, foundry
VTC	Minnesota	Linear, ASICs, logic
Wafer Technology (Closed)	California	Logic
Xilinx	San Jose, CA	ASICs

Table 1e

Start-Up Activity by Year—1983 (35)

Company	Location	Products
Altera	Santa Clara, CA	ASICs
Asahi Kasei Microsystems	Japan	ASICs, linear, micros, memory
BIT	Beaverton, OR	DSP
Brooktree	San Diego, CA	Linear
Calmos Systems	Canada	ASICs, DSP, memory, linear
Calogic	Fremont, CA	Linear, ASICs
Custom Silicon	Massachusetts	ASICs
Cypress Semiconductor	San Jose, CA	Memory, ASICs, DSP
Elantec	Milpitas, CA	Linear
Electronic Technology	Ames, IA	ASICs
Exel Microelectronics	San Jose, CA	Memory, micros, ASICs
HYPRES	New York	Superconductors
Hyundai America (Closed)	Santa Clara, CA	Memory
iLSi	Colorado	ASICs
ICT	San Jose, CA	Memory, ASICs
Iridian (Closed)	Chatsworth, CA	GaAs FETs
IXYS	San Jose, CA	Power FETs, ICs
Laserpath (Closed)	Sunnyvale, CA	ASICs
Lattice Semiconductor	Oregon	ASICs
Logic Devices	Sunnyvale, CA	Memory, DSP, micros
Maxim Integ. Products	Sunnyvale, CA	Linear
Micro Linear	San Jose, CA	ASICs, linear
Mietec N.V.	Belgium	ASICs
Modular Semiconductor	Santa Clara, CA	Memory, micros
MOS Electronics	Sunnyvale, CA	Memory
Opto Tech	Taiwan	GaAs opto
Samsung Semiconductor	San Jose, CA	Linear, discretes, logic, memory
Sierra Semiconductor	San Jose, CA	ASICs, memory, micros, linear
S-MOS Systems	San Jose, CA	Memory, micros, linear, ASICs
Texet (Closed)	Allen, TX	Discretes
Vatic (Merged)	Mesa, AZ	ASICs
Visic (Acquired)	San Jose, CA	Memory
Vitelic	San Jose, CA	Memory
WaferScale Integration	Fremont, CA	Memory, ASICs, micros
Zoran	Santa Clara, CA	DSP

Table 1f

Start-Up Activity by Year—1982 (10)

Company	Location	Products
Array Devices	San Diego, CA	ASICs
Custom MOS Arrays (Merged)	Milpitas, CA	ASICs
IC Sensors	Milpitas, CA	Pressure sensors
ICI Array Technology	San Jose, CA	ASICs
Isocom	England	Opto
Microwave Monolithics	Simi Valley, CA	GaAs MMICs
Microwave Technology	Fremont, CA	GaAs FETs, MMICs
Sensym	Sunnyvale, CA	IC sensors
Solid State Optronics	San Jose, CA	Opto
XTAR	San Diego, CA	Micros

Table 1g

Start-Up Activity by Year—1981 (15)

Company	Location	Products
Adaptec	Milpitas, CA	Micros
Barvon Research	Milpitas, CA	ASICs
GigaBit Logic	Newbury Park, CA	GaAs ASICs, logic, memory
IMP	San Jose, CA	ASICs
LTC	Milpitas, CA	Linear
LSI Logic	Milpitas, CA	ASICs, DSP, micros
Opto Diode	Newbury Park, CA	GaAs LEDs
Panatech Semi (Acquired)	Santa Clara, CA	ASICs
SEEQ Technology	San Jose, CA	Memory, micros
Si-Fab	Scotts Valley, CA	Foundry
Signal Processor (Acquired)	Utah	DSP
Silicon Systems	Tustin, CA	Linear, micros
Telmos (Chapter 11)	Sunnyvale, CA	ASICs, linear, opto
Weitek	Sunnyvale, CA	DSP
Zytrex (Closed)	Sunnyvale, CA	CMOS memory, logic

Table 1h

Start-Up Activity by Year—1980 (7)

Company	Location	Products
California Micro Devices	Milpitas, CA	ASICs, linear
Harris Microwave Semi	Milpitas, CA	GaAs FETs, MMICs
IDT	Santa Clara, CA	Memory, logic, DSP, micros
Kyoto Semiconductor	Japan	Optoelectronics
Spectrum Microdevices	Maryland	ASICs
Trilogy (Sold Semi Ops)	Cupertino, CA	Waferscale integration
VLSI Design Associates	Campbell, CA	Micros

Table 1i

Start-Up Activity by Year—1979 (4)

Company	Location	Products
Applied Micro Circuits	San Diego, CA	ASICs
Matra-Harris	France	ASICs, memory, micros
United Microelectronics	Taiwan	Linear, micros, memory, foundry
VLSI Technology	San Jose, CA	ASICs, memory, micros

Table 1j

Start-Up Activity by Year—1978 (7)

Company	Location	Products
Acrian Inc.	San Jose, CA	Discretes
California Devices	Milpitas, CA	ASICs
Inmos Limited	United Kingdom	Memory, DSP, micros
Micron Technology	Idaho	Memory
Universal Semiconductor	San Jose, CA	ASICs, discretes, linear
Xicor	Milpitas, CA	Memory
ZyMOS	Sunnyvale, CA	ASICs, micros, linear

Table 1k

Start-Up Activity by Year—1977 (3)

Company	Location	Products
A&D Co., Ltd.	Japan	Linear
MCE Semiconductor	Florida	ASICs, linear
Nihon Information Center	Japan	Micros

Source: Dataquest
June 1988

Table 2a

Companies No Longer Operating (11)

Company	Year Formed	Location	Products
ABM (Inactive)	1985	San Jose, CA	GaAs opto
Array Devices (Closed)	1982	San Diego, CA	ASICs
Hyundai (Closed)	1983	Santa Clara, CA	Memory
Iridian (Closed)	1983	Chatsworth, CA	GaAs FETs
Laserpath (Closed)	1983	Sunnyvale, CA	ASICs
Sahni (Closed)	1985	Sunnyvale, CA	ASICs
Telmos (Chapter 11)	1981	Sunnyvale, CA	ASICs, linear
Texet (Closed)	1983	Allen, TX	Discretes
Trilogy (Closed)	1980	Cupertino, CA	Waferscale
Wafer Tech (Closed)	1984	California	Logic
Zytrex (Closed)	1981	Sunnyvale, CA	CMOS logic

Table 2b

Companies That Have Been Acquired or Merged

Company/Year Formed	Acquired by	Location	Products
Custom MOS Arrays (1982)	CMD	Milpitas, CA	ASICs
Integ. Power Semi (1984)	Seagate	Scotland	Linear
Panatech (1981)	Ricoh	Santa Clara, CA	ASICs
Signal Processor (1981)	Analog Devices	Utah	DSP
Silicon Macrosystems (1984)	Austek	San Jose, CA	CMOS Memory
Vatic (1983)	Thomson-Mostek	Mesa, AZ	ASICs
Visic (1983)	VLSI Technology	San Jose, CA	Memory

Source: Dataquest
June 1988

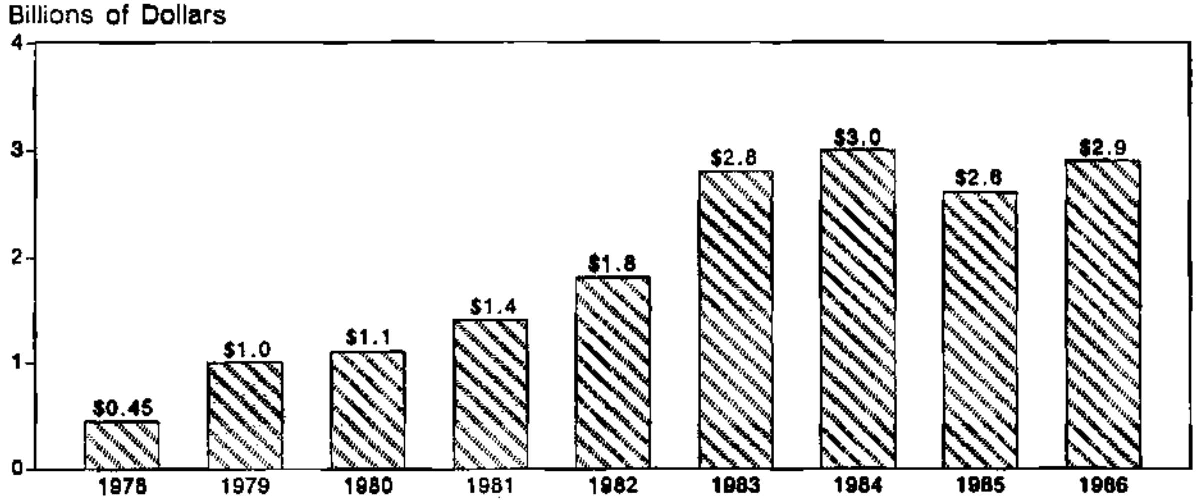
II. VENTURE CAPITAL

The flow of venture capital disbursements increased from $450 million in 1978 to $2.9 billion in 1986, as shown in Figure 2. In 1987, the semiconductor companies included in this report raised about $685 million in financing, as shown in Table 3. However, it should be noted that the financing was provided by corporations and governments in addition to venture capital sources.

The companies formed in the last 10 years have raised a total of approximately $2.9 billion in financing. Figure 3 shows this financing raised by year. The 1988 data cover only the first quarter of the year. Table 3 is a list of companies and the total financing that they have raised, including investments by corporations, governments, and/or venture capital sources.

Figure 2

Venture Capital Disbursements



Source: Venture Capital Journal
Dataquest
June 1988

Table 3

Capitalization by Company
(Millions of Dollars)

Company	Amount	Sources
ABM (Not Operating)	$ 1.0	Corporate
Acrian	$ 15.5	Not available
ACTEL	$ 10.4	Venture capital, private, corporate
Adaptec	$ 10.0	Initial public offering
Advanced Power	$ 13.8	Venture capital
Altera	$ 27.9	Venture capital, lease
ANADIGICS	$ 34.0	Venture capital, lease
AMCC	$ 22.0	Venture capital, corporate
Aspen	$ 7.4	Corporate
ATMEL	$ 3.3	Venture capital
Austek	$ 6.7	Venture capital
Barvon	$ 1.7	Private, venture capital, corporate
BIT	$ 39.5	Corporate, venture capital, lease
Brooktree	$ 35.0	Venture capital, private, corporate
CDI	$ 20.4	Venture capital
CMD	$ 5.2	Initial public offering
Calmos	$ 5.5	Private, grants
Calogic	$ .02	Private
Catalyst	$ 4.5	Venture capital
Celeritek	$ 8.4	Venture capital
Chartered	$ 40.0	Corporate, government
Chips	$ 30.0	Private, corporate, public offerings
Cirrus	$ 27.6	Venture capital
Conductus	$ 6.1	Venture capital
Cree	$ 3.0	Not available
Crystal	$ 26.2	Venture capital, private, corporate
Custom Arrays	$ 1.3	Corporate, venture capital, private, blind pool
Custom Silicon	$ 4.0	Venture capital, private
Cypress	$152.6	Venture capital, Stanford University, public offerings
Dallas	$ 74.1	Venture capital, bond, IPO
Dolphin	$ 0.6	Corporate, private
Elantec	$ 16.1	Venture capital, corporate, private
ETC	$ 2.0	State, venture capital
Epitaxx	$ 1.5	Venture capital
ES2	$ 44.0	Venture capital, corporate
Exel	$ 25.0	Private, venture capital
GAIN	$ 23.0	Corporate, venture capital
Gazelle	$ 7.9	Venture capital, lease line

(Continued)

Table 3 (Continued)

Capitalization by Company (Millions of Dollars)

Company	Amount	Sources
GBL	$ 45.0	Venture capital, corporate, leases, R&D partnership
GL Micro	$ 2.4	Venture capital
Hualon Micro	$ 30.0	Corporate
HYPRES	$ 8.6	Venture capital
Inmos	$100.0	Government
ICS	$ 8.0	Venture capital, private
IDT	$ 25.1	Venture capital, lease, IPO
iLSi	$ 5.0	Over-the-counter offering
ICT	$ 9.9	Corporate, venture capital
IMP	$ 81.9	Venture capital, lease, government, corporate, IPO
IPS (Acquired)	$ 48.0	Venture capital, government
IXYS	$ 10.5	Private, venture capital, Stanford University
Krysalis	$ 4.2	Venture capital
Laserpath (Closed)	$ 8.3	Venture capital
Lattice	$ 15.2	Corporate, credit, venture capital
Level One	$ 7.8	Venture capital
LTC	$ 59.0	Venture capital, corporate, lease, IPO
LSI Logic	$399.7	Venture capital, lease, IPO, Eurobond, private
Lytel	$ 20.0	Corporate
Matra-Harris	$ 40.0	Corporate
Maxim	$ 23.3	Venture capital, lease (not including IPO)
Mietec N.V.	$ 48.2	Not available
Molecular Elec.	$ 5.0	Not available
Micro Linear	$ 41.0	Private, venture capital, leases, corporate
Micron	$ 76.9	Public offerings, private placements
Microwave Technology	$ 10.1	Venture capital
MOSel	$ 3.0	Private
NMB	$ 11.1	Venture capital
Novix	$ 1.0	Corporate
Pacific Monolithics	$ 8.5	Venture capital
Performance	$ 27.9	Venture capital, corporate
Photonic Integration	$ 10.0	Corporate
PromTech	$ 0.5	Private

(Continued)

Table 3 (Continued)

Capitalization by Company
(Millions of Dollars)

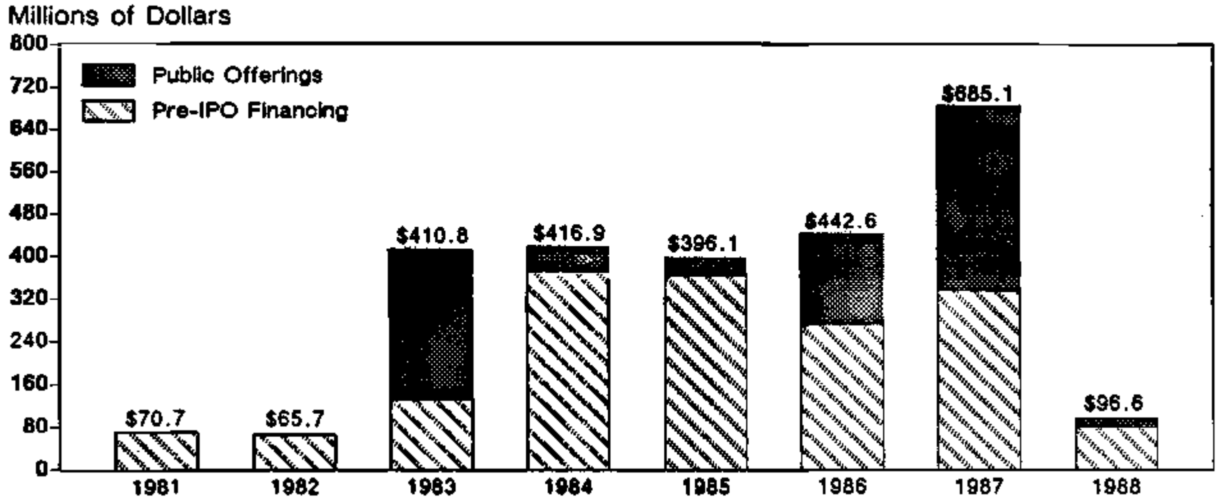
Company	Amount	Sources
Quasel Taiwan	$ 38.5	Venture capital, government, lease
Ramax	$ 0.9	Government
Ramtron	$ 5.0	Venture capital
Samsung	$ 13.0	Corporate
Saratoga	$ 30.7	Venture capital
SEEQ	$ 55.0	Venture capital, IPO, private
Sensym	$ 4.0	Venture capital, corporate
SID Microelectronics	$ 14.2	Private
Sierra	$ 51.1	Venture capital, government
Silicon Macro (Acquired)	$ 1.1	Corporate, private
Synaptics	$ 2.1	Venture capital
Synergy	$ 12.9	Venture capital
Tachonics	$ 15.0	Corporate
TSMC	$ 77.0	Corporate, venture capital
Telmos (Chapter 11)	$ 27.7	Venture capital, corporate
Three-Five	$ 5.5	Venture capital, corporate
Topaz	$ 1.5	Private
Triad	$ 8.0	Venture capital, government
UMC	$ 20.0	Corporate, government, IPO
Universal	$ 10.0	Venture capital, corporate
Visic (Acquired)	$ 12.0	Venture capital
Vitelic	$ 16.2	Venture capital, corporate
Vitesse	$ 48.1	Corporate, venture capital, government
VLSI Technology	$204.5	Corporate, venture capital, public offerings, bonds
VTC	$ 75.0	Operating leases, corporate
WaferScale	$ 45.6	Venture capital, corporate
Weitek	$ 7.5	Venture capital
Xicor	$ 39.8	Public offerings
Xilinx	$ 16.0	Venture capital
Zoran	$ 33.8	Venture capital, corporate
ZyMOS	$ 65.9	Corporate, lease, IPO

IPO = Initial public offering

Source: Dataquest
June 1988

Figure 3

Financing Raised by Year



Source: Dataquest
June 1988

III. STRATEGIC ALLIANCES

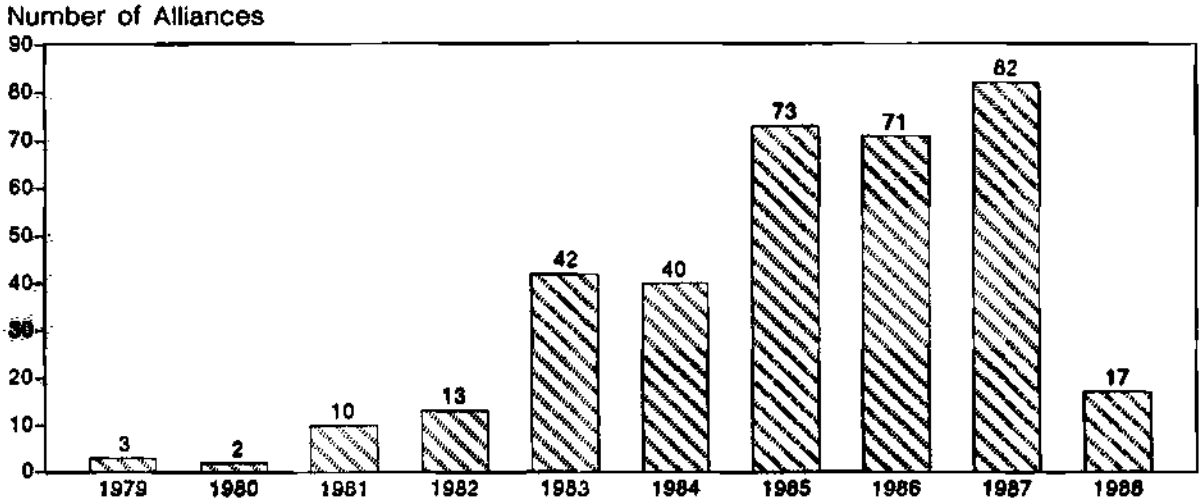
The companies have established numerous licensing and joint-development agreements. At a time when venture capital has become increasingly scarce, smaller companies are often under pressure for near-term funding. In addition to seeking funds, start-ups are entering strategic alliances for a variety of other reasons, as follows:

- To avoid the prohibitive costs of advanced fab facilities
- To increase production capacity
- To defray increasing product development costs
- To strengthen product portfolios
- To increase a worldwide presence
- To provide alternative sources and establish standards

Figure 4 shows the number of alliances by year.

Figure 4

Alliances by Year



Source: Dataquest
June 1988

A total of 353 alliances were established by these companies since 1979. Table 4 shows the number of alliances by year and the product areas involved. The total number shown is greater than the actual number of alliances since, in many cases, the alliances involve more than one area.

Table 4

Alliances Matrix by Year/Product Area

Product Area	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
ASIC	1	1	5	7	13	12	23	30	19	5
Discrete					1	1		1	1	
DSP					1		1	4	1	3
Ferroelectric							1		2	
GaAs							1	1	8	2
Linear				2	1	3	5	5	2	2
Memory			1	2	12	11	14	13	12	1
Micro				1	1	3	9	5	15	3
Other										
Contract								1	6	1
Equity/Debt	1		2		7	6	7	6	8	
Fab			2	2	4	14	25	10	7	3
Mergers and Acquisitions				1	1	1			7	1
Process	1				1	5	9	3	1	
Sales/Mktg.					1	2	5		2	

Source: Dataquest
June 1988

Tables 5a to 5g list alliances by year and by company.

Table 5a

1988 Alliances

Company	Date	Description
Adaptec Chips	Oct. 1988	Joint introduction of a series of products for IBM PS/2 Models 50-/60-/80-compatibles
AMCC Plessey	Jan. 1988	Jointly develop high-performance ECL gate arrays with up to 14,000 gates
Brooktree Analog Devices	Jan. 1988	Analog Devices to second-source Brooktree's video DACs
Calmos Siltronics	Feb. 1988	Calmos' acquisition of Siltronics' bipolar component business for $500,000
GAIN Interface Tech	March 1988	GAIN to supply personalized versions of its GFL gate array product family
GBL Cray Research	Jan. 1988	Cray placed $6.5 million foundry order
ICI Array National	March 1988	ICI Array Technology to use National Semiconductor's design systems and process specifications to develop proprietary ASICs
iLSi Oki	April 1988	Oki to manufacture and sell gate arrays based on iLSi technology and provide foundry services
LSI Logic Sun	March 1988	LSI Logic to manufacture, market, modify, and enhance MPUs, related components, and software and systems using Sun's SPARC
LSI Logic ITI	March 1988	Imaging Technology Inc. (ITI) to design a new generation of imaging products using LSI Logic's L64200 series of real-time image processing chips
Micron Intel	March 1988	Intel to market Micron DRAMs under Intel's label, beginning with 256Ks
Micron SMC	April 1988	Micron's purchase of 1.6 million shares of Standard Microsystems Corp. (SMC) common stock at $6.03 per share

(Continued)

Table 5a (Continued)

1988 Alliances

Company	Date	Description
TriQuint MSC	March 1988	Microwave Semiconductor Corporation (MSC) and TriQuint to provide interchangeable GDS-II tape with equivalent performance for GaAs analog and digital ICs and MMICs
VLSI Technology Harris	April 1988	Codevelop a rad-hard gate array and future commercial and non-rad-hard military gate arrays
VLSI Technology Sanyo	April 1988	Sanyo to manufacture and market VLSI Technology's 32-bit ACORN RISC Machine IC family worldwide
Zoran Toshiba	Jan. 1988	Technology and manufacturing alliance
Zoran SGS-Thomson	March 1988	Technology and manufacturing alliance

Table 5b

1987 Alliances

Company	Date	Description
Adaptec SCO	Oct. 1987	Adaptec and the Santa Cruz Operation (SCO) to jointly develop SCSI support for SCO's XENIX system V operating system
Adaptec Connor Peripherals	Oct. 1987	Adaptec to supply disk controller ICs to Connor Peripherals
Alliance NMB	Dec. 1987	Five-year agreement covering 256K and 1Mb DRAMs; NMB to manufacture and sell the devices worldwide
Altera WSI Sharp	Jan. 1987	Codevelop a family of standalone micro-sequencer products with wafers manufactured by Sharp of Japan
Altera Cypress	June 1987	Codevelop a family of CMOS EPLDs
ANADIGICS Bendix	June 1987	Contract from Bendix Aerospace to develop CAD tools for the DOD's MMIC program
Asahi Kasei Crystal Semi	Jan. 1987	Asahi Chemical's acquisition of an 8 percent share in Crystal for about $4 million; Asahi Kasei to manufacture and market Crystal's devices for the Far Eastern market
Asahi Kasei ICT	Jan. 1987	Asahi Kasei's receipt of a license to ICT's technology; Asahi Kasei to market ICT's EEPROMs
Aspen Cypress	Dec. 1987	Cypress' guarantee of $7.4 million to Aspen, a wholly owned subsidiary of Cypress, which will fabricate and sell ECL devices
Austek ZyMOS	Oct. 1987	ZyMOS licensed to make and sell the Austek Microcache as part of the POACH chip set

(Continued)

Table 5b (Continued)

1987 Alliances

Company	Date	Description
BIT Sun	July 1987	Sun's license of a bipolar 32-bit RISC MPU to BIT
Calmos Samsung	Jan. 1987	Calmos' license of its 8200 series of devices to Samsung in exchange for a foundry commitment
Catalyst Oki Electric	March 1987	Previous agreement extended to include a wide range of CMOS EEPROMs
CDI IST	April 1987	Joint product development and second-source agreement covering two families of ASICs using Channelless architectures
Chartered Sierra National STC	Oct. 1987	National Semiconductor, Sierra Semiconductor, and the Singapore Technology Corporation established joint-venture company named Chartered Semiconductor Corporation
Cirrus Logic WDC	Jan. 1987	Cirrus Logic's license of a custom Winchester disk drive controller IC to Western Digital Corporation
Cirrus Logic DIA-Semicon	Oct. 1987	DIA-Semicon Systems to distribute new and existing products in Japan
Cirrus Logic Award Software	Nov. 1987	Award Software to develop a VGA graphics BIOS and demonstration board for Cirrus Logic's GD510/520 VGA chip set
CMD Tachonics	March 1987	Tachonics to manufacture commercial and military GaAs ICs using CMD cell design and tools in the 1.0- to 0.5-micron range
CMD Telefonica	Nov. 1987	Joint venture agreement to form a company named California Micro Devices SA in Spain

(Continued)

Table 5b (Continued)

1987 Alliances

Company	Date	Description
Cypress Sun	July 1987	Joint development of a CMOS RISC MPU product line based on Sun's SPARC
Cypress Matra-Harris	Dec. 1987	Prior agreement extended to include manufacture and marketing of five Cypress 64K SRAMs
Dallas Xecom	May 1987	Three-year second-source agreement covering Xecom's modem products and development kits and Dallas' SmartSocket and SmartWatch families
Dallas Amp	Aug. 1987	Dallas and Amp R&D partnership to develop interconnect techniques
Elantec Micro Power	Nov. 1987	Micro Power to market Elantec's FET power buffers
ES2 Lattice Logic	1987	ES2's acquisition of Lattice Logic
ES2 Philips TI	Feb. 1987	ES2, Philips, and TI joint agreement for the manufacture of the SystemCell; TI and Philips to supply volume parts, ES2 to provide prototypes and low-volume quantities
ES2 Mitsui & Co.	Oct. 1987	ES2 and Mitsui & Co. joint purchase of a Japanese software and design company called Best, which will market ES2's products in Japan
G-2 LSI Logic	July 1987	LSI Logic's establishment of G-2 as a wholly owned subsidiary, LSI Logic to provide macrocells, megacells, and gate arrays
Genesis National	Oct. 1987	Design center and manufacturing agreement
GigaBit Logic Cray Research	Jan. 1987	Cray Research's $3.2 million foundry order

(Continued)

Table 5b (Continued)

1987 Alliances

Company	Date	Description
GigaBit Logic Cray Research	May 1987	Cray Research's January order increased from $3.2 million to $5.5 million
GigaBit Logic Seattle Silicon WTC	April 1987	GBL, Seattle Silicon, and the Washington Technology Center (WTC) to form a joint design project and fabricate a functional, compiler-based GaAs IC design
GigaBit Logic Tachonics	Oct. 1987	Mutual second-sourcing of GaAs standard and ASIC ICs developed by each other
IDT VTC	Jan. 1987	IDT to second-source VTC's FCT product line
IDT MIPS Computer	Nov. 1987	IDT to manufacture MIPS Computer's complete line of 32-bit RISC MPUs
iLSi Yamaha	Dec. 1987	Yamaha's purchase of a license for iLSi's gate arrays in exchange for royalties and foundry services
IMP Electrolux	Nov. 1987	Five-year agreement with Electrolux to develop ASIC devices for home appliances
IST SDA Systems	May 1987	SDA Systems to develop CAD systems for use by Innovative Silicon Technology's (IST's) customers
Krysalis National	Dec. 1987	Seven-year agreement with National Semiconductor to pursue UniRAM technology jointly
Lattice SGS	Feb. 1987	LSC's licensing of its GAL products to SGS Semiconductor; both companies to cooperate on future PLD products
Lattice National	April 1987	National Semiconductor's minority investment in LSC and licensing of its GAL technology

(Continued)

Table 5b (Continued)

1987 Alliances

Company	Date	Description
Lattice MMI	Nov. 1987	LSC's licensing of MMI's patent; exchange of rights to worldwide patents in PLDs
LSI Logic Stellar Computer	Jan. 1987	LSI Logic to supply custom ASICs to Stellar Computer for use in a graphics supercomputer
LSI Logic Aida Corp.	Jan. 1987	Aida Corp. to incorporate LSI Logic's gate array libraries into its design automation tools
LSI Logic ZyCAD Corp.	Feb. 1987	LSI Logic's acquisition of the marketing rights to a customized version of ZyCAD Logic Evaluator circuit design accelerators
LSI Logic Case Technology	March 1987	Joint development to allow LSI Logic's schematic libraries to be designed on Case Technology's workstations
LSI Logic Sun	April 1987	LSI Logic and Sun's joint establishment of an ASIC laboratory project at San Jose State University
LSI Logic Logic Automation	May 1987	Joint development to incorporate LSI Logic's channelled gate arrays on Logic Automation's Mentor Graphics workstations
LSI Logic Asix Systems	June 1987	LSI Logic's licensing of its ASIC design verification software to Asix Systems Corp
LSI Logic Video Seven	July 1987	LSI Logic's acquisition of 20 percent of Video Seven for $7 million in cash
LSI Logic ACT	Aug. 1987	Joint venture company named Inter-Act Corporation, which will develop and market software/hardware development system for the MIL-STD-1750 embedded system market

(Continued)

Table 5b (Continued)

1987 Alliances

Company	Date	Description
LSI Logic MIPS Computer	Nov. 1987	LSI Logic to manufacture and market MIPS Computer Systems' entire family of circuits, including its 32-bit RISC MPU and floating-point coprocessor
LTC TI	March 1987	Five-year agreement allowing TI to select six LTC circuits every six months; TI to pay royalties
Matra-Harris Intel	June 1987	CIMATEL dissolved by Intel
Alcatel Mietec SGS-Thomson	1987	Alcatel, Mietec, SGS-Thomson--transfer of a 1.2-micron CMOS process
NMB TI	Nov. 1987	NMB to manufacture and supply TI with TI-designed 1Mb field RAMs
Performance MIPS Computer	Nov. 1987	Performance to manufacture and market MIPS Computer Systems' 32-bit RISC MPU, floating-point coprocessor, and other peripherals
Batelle Institute Photonic MEC NTT	July 1987	The Batelle Institute, Mitsubishi Electric Corporation (MEC), and NTT--formation of Photonic Integration
PromTech Yamaha	1987	PromTech's licensing of its EPROM technology to Yamaha Corp., which will combine it with voice- and image-processing capabilities
Ramax Ramtron	June 1987	Ramax's licensing of ferroelectric process technology from Ramtron
Samsung Intel	June 1987	Samsung to supply Intel with 64K and 256K DRAMs, which Intel will sell under its own label

(Continued)

Table 5b (Continued)

1987 Alliances

Company	Date	Description
SEEQ National	Oct. 1987	Four-year agreement to develop and market a new family of CMOS flash EEPROMs
SEEQ Hamilton-Standard	Oct. 1987	SEEQ to supply 256K EEPROMs to Hamilton-Standard
Sierra Mentor Graphics	Sept. 1987	Sierra's MIXsim behavioral modeling tools available on Mentor Graphics' Idea workstation
TriQuint TRW	June 1987	Jointly develop and supply Class-S level GaAs devices for space applications
Vitesse Ford	Oct. 1987	Vitesse and Ford Microelectronics to mutually second-source IC foundry services
Vitesse E-Systems	Aug. 1987	E-Systems to use Vitesse's GaAs technology in its current and future programs
Vitesse VLSI Technology	Sept. 1987	Vitesse to develop a GaAs cell library for VLSI's design tools
VLSI Technology Visic	1987	VLSI's acquisition of Visic for about $525,000
VLSI Technology TCMC	March 1987	Agreement covering second-sourcing and product development for memory designs including FIFOs, dual-port RAMs, cache-tag RAMs, and SRAMs
VLSI Technology Zilog	May 1987	VLSI to second-source Zilog's Super8 MCU and FIFOs
VLSI Technology GE Solid State	July 1987	GE to produce and market VLSI's VGT10 and VGT100 families of CMOS gate arrays.

(Continued)

Table 5b (Continued)

1987 Alliances

Company	Date	Description
VLSI Technology Daisy Systems	Nov. 1987	Gate array design kit offered for Daisy's CAE workstation
VLSI Technology Oak Technology	Nov. 1987	Codevelop IBM PS/2 logic chips, using VLSI Technology's software tools
VTC Control Data	1987	VTC became a wholly owned subsidiary of Control Data (CDC); VTC's award of a $7.5 million contract from CDC's Government Systems Division to supply ASIC chips
VTC TRW	March 1987	TRW Components International and VTC to cross-sample space-quality, Class-S devices including rad-hard CMOS SRAMs, comparators, amps, and transceivers
VTC VME Technology	Sept. 1987	VTC's contract to design, develop, and manufacture a VMEbus interface IC (VMIC) for the VME Technology Consortium
WSI GE/RCA	July 1987	Prior agreement expanded to include EPROM manufacturing
Weitek HP	May 1987	Hewlett-Packard to manufacture and incorporate the Weitek model 2264/65 chip set in current and future HP Precision Architecture computers
Xicor Intel	June 1987	R&D agreement terminated; cross-licensing and royalty obligations remain in force
ZyMOS Intel	Nov. 1987	Intel to market ZyMOS' POACH AT system logic set bundled with its 80286 MPU, which will be sold as 82X3X multifunctional peripherals

Table 5c

1986 Alliances

Company	Date	Description
ACTEL Data General	June 1986	Joint development agreement covering gate arrays and a fab arrangement
BIT Raytheon	July 1986	Joint development of ASICs
Brooktree Fairchild	April 1986	Broad-ranging partnership combining Brooktree's D/A conversion technology with Fairchild's manufacturing capability
Catalyst Thomson CSF	1986	Catalyst and Thomson to conduct R&D in France
Catalyst Oki Electric	July 1986	Long-term R&D of NVRAMs for ASICs, using CMOS EPROMs and EEPROMs
Chips National	Nov. 1986	National Semiconductor to manufacture CMOS ICs for Chips and Technologies under a fabrication agreement
Cirrus Logic Silicon Systems	Oct. 1986	Cirrus Logic's and Silicon Systems' exchange of controller and buffer manager functions
CMD CMA	Sept. 1986	Merge of CMD and Custom MOS Arrays (CMA)
CMD Fuji Photo	Nov. 1986	CMD's licensing of HCMOS gate array and cell-based design technology to Fuji Photo Film for $1 million
Custom Arrays Teledyne	1986	Joint development agreement for a new family of BICMOS semicustom and cell-based libraries
CSi Motorola	Aug. 1986	CSi to act as the northwestern independent design center for Motorola.
CSi NCR	Sept. 1986	NCR's licensing of CSi's cell-based library

(Continued)

Table 5c (Continued)

1986 Alliances

Company	Date	Description
Dallas Thomson-Mostek	Jan. 1986	Thomson-Mostek's receipt of Dallas' multiport memory in exchange for laser production equipment and TCMC's MK4501 FIFO
ES2 British Aerospace	Jan. 1986	British Aerospace investment of $5 million
ES2 SDA Systems	Jan. 1986	ES2 to market SDA Systems' design systems throughout Europe and to use them in design centers
ES2 Philips TI	May 1986	ES2, Philips-Elcoma, and Texas Instruments--cooperation on the SystemCell cell-based library
Exel Exar	Feb. 1986	Exar's completion of the $5.5 million acquisition of Exel
GAIN NTT	Sept. 1986	Technology transfer giving GAIN access to NTT's self-aligned implantation for N+layer transistor (SAINT) technology
ICI Array ICI	Jan. 1986	Imperial Chemical Industries PLC--acquisition of Array Technology
ICT Gould Semiconductor	April 1986	ICT's transfer of its CMOS EEPROM technology and products in exchange for foundry services and second-sourcing of PEEL and EEPROM devices
iLSi Motorola	June 1986	iLSi's licensing of its line of gate arrays to Motorola
iLSi Sumitomo	Dec. 1986	Sumitomo's licensing of ASIC design technology from iLSi in exchange for royalty payments and foundry services
IMP Lattice Logic	May 1986	Lattice Logic's CHIPSMITH Silicon compiler software available with IMP's design rules

(Continued)

Table 5c (Continued)

1986 Alliances

Company	Date	Description
IMP Silicon Compilers	June 1986	SCI and IMP to develop analog compilation capability for SCI's Genesil Silicon Development System
IMP Micro Linear MBB	Aug. 1986	IMP and Micro Linear--agreement to transfer ASIC design know-how to Messerschmitt Bolkow Blohm (MBB) over a three-year period
IMP Lasarray	Aug. 1986	IMP and Lasarray to cooperate on a family of base wafers for personalization on Lasarray's turnkey design and manufacturing system module
IXYS Samsung	Jan. 1986	Samsung's receipt of IXYS' power MOS technology for low- and medium-range power devices; IXYS will manufacture its high-current power MOS devices in Samsung's facility
Lattice Seiko Epson	Jan. 1986	Seiko Epson licensed to Lattice's high-speed 64K SRAM
LSI Logic Raytheon	Jan. 1986	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
LSI Logic Master Images	March 1986	LSI Logic's acquisition of a 20 percent equity interest in Master Images, a photomask supplier
LSI Logic Sun	April 1986	LSI Logic to sell and use internally Sun Microsystems' workstation and advanced schematic capture system
LSI Logic STC	May 1986	LSI Logic's acquisition of a majority stake in STC's semiconductor division

(Continued)

Table 5c (Continued)

1986 Alliances

Company	Date	Description
LTC National	July 1986	Patent licensing agreement granting Linear Technology Corp. (LTC) rights to products under two National BIFET patents; National was granted rights to LTC's BIFET-related patents
Matra-Harris Weitek	March 1986	Matra-Harris Semiconductor's (MHS) receipt of Weitek's 16-bit integer multiplier product family; Weitek has preferred access to the MHS CMOS process in exchange for foundry services
Matra-Harris Silicon Compilers	June 1986	MHS to integrate its 2-micron, double-metal CMOS process with Silicon Compilers' Genesil silicon design system
Maxim Intersil	April 1986	Second-source agreement
Micro Linear Analog Design	July 1986	Micro Linear to integrate its micro- and macrocell libraries into Analog Design Tools' workbench CAE system
Micro Linear Daisy Systems	Aug. 1986	Daisy Systems to port Micro Linear's cell libraries to its workstations
Micron Samsung	July 1986	Samsung's purchase of a 2.7 percent interest in Micron for $5 million as part of an out-of-court settlement; Micron received Samsung SRAM and EEPROM technologies for a 1.0 percent royalty
MOSel Hyundai	Feb. 1986	MOSel--8Kx8 and 1Mb SRAMs and 1.2- and 1.5-micron CMOS processes provided to Hyundai in exchange for a foundry commitment

(Continued)

Table 5c (Continued)

1986 Alliances

Company	Date	Description
MOSel Sharp	June 1986	MOSel--a 256K SRAM design based on a 1.2-micron CMOS process provided to Sharp, which provided 256K SRAMs
NMB National	Sept. 1986	NMB to manufacture fast SRAMs; this agreement is no longer in effect
Novix Harris	July 1986	The Novix FORTH language MPU included in Harris' ASIC library
Performance Westinghouse	Aug. 1986	Performance to fabricate a VHSIC Phase-I, 11,000-gate gate array designed by the Westinghouse Defense and Electronics Center
Powerex Westinghouse Mitsubishi GE	1986	Powerex formed by Westinghouse, GE, and Mitsubishi Electric Electric; Powerex received licenses and technology from the companies.
Samsung Mostek	1986	Agreement covering Mostek's 256K DRAM technology
Samsung Goldstar Hyundai	1986	Samsung, Goldstar, and Hyundai to cooperate on a 1Mb DRAM
SEEQ AMD/MMI	Nov. 1986	Monolithic Memories acquisition of 16 percent of SEEQ for $4 million; jointly develop CMOS EEPROM-based PLDs
SEEQ Motorola	Dec. 1986	Engineering development agreement to develop an EEPROM microcomputer
Sierra Mentor Graphics	Dec. 1986	Sierra's cell library supported on Mentor Graphics workstations

(Continued)

Table 5c (Continued)

1986 Alliances

Company	Date	Description
Silicon Systems RCA	Feb. 1986	RCA to second-source SSi's monolithic modem ICs; RCA gained rights to SSi's analog CMOS process; SSi gained rights to RCA's digital 2-micron CMOS process; RCA also agreed to supply SSi with CMOS wafers over three years
Silicon Systems Ferranti	March 1986	SSi to second-source Ferranti's data conversion ICs in the United States
Silicon Systems Telmos Universal	Aug. 1986	Universal's second-source agreement between Telmos and Silicon Systems acquired for the fabrication of analog/digital arrays
Silicon Systems Oki Electric	Sept. 1986	Oki to second-source SSi's K-series modems; Oki will pay royalties, furnish DSP chips, and provide foundry services
S-MOS Xilinx Seiko Epson	1986	Development agreement with Xilinx, S-MOS, and Seiko Epson for logic cell arrays and development systems, using Seiko Epson's CMOS process
TSMC Philips	1986	N.V. Philips' 27.5 percent interest in Taiwan Semiconductor Manufacturing Corp. and option to purchase controlling interest in the Company
TriQuint EEsof	May 1986	EEsof to incorporate TriQuint's custom GaAs MMIC foundry models into Touchstone, a minicomputer and work-station-based MMIC CAD program
UMC TRW	April 1986	Joint development of 1.25-micron VLSI products
UMC SMC	June 1986	Contract to cooperate on computer ICs

(Continued)

Table 5c (Continued)

1986 Alliances

Company	Date	Description
Vitelic Philips	March 1986	Vitelic's access to Philips' process technology; Vitelic to design a family of high-performance CMOS SRAMs
Vitelic Sanyo	Oct. 1986	Jointly develop a high-speed 64K SRAM family; Sanyo will manufacture the SRAMs
Vitesse TRW	Dec. 1986	Vitesse to supply TRW with high-performance wafers, die, and packaged devices, which TRW will assemble, test, qualify, and sell to the space-quality, Class-S level market
VLSI Technology Mosaic Systems	1986	Joint agreement to build die and plug them together on the Mosaic process
VLSI Technology Intel	1986	Codeveloped a single-chip interface for the Intel-based Multibus II system bus architecture
VLSI Technology Acorn Computer	May 1986	Codevelopment of a single-chip, 32-bit RISC MPU and associated controller chips
VTC Silicon Compilers	May 1986	VTC to provide its 1.6- and 1.0-micron 2-layer metal CMOS processes to users of Genesil; VTC to develop a rad-hard cell for Genesil
WSI GE/RCA Sharp	March 1986	GE/RCA and Sharp--a five-year agreement with WSI to jointly develop an advanced cell library
Weitek Step Engineering	March 1986	Step Engineering to produce development tools for debugging and microcoding of Weitek's floating-point integer processor designs

(Continued)

Table 5c (Continued)

1986 Alliances

Company	Date	Description
Weitek Quadtree	April 1986	Quadtree Software to develop behavioral simulators for the WTL2264/2265 chip set
Xilinx MMI/AMD	June 1986	MMI/AMD to manufacture and market Xilinx's Logic Cell Arrays and development system
ZyMOS Daewoo Corp.	April 1986	Controlling interest in ZyMOS acquired by Daewoo Corp.

Table 5d

1985 Alliances

Company	Date	Description
Altera Intel	June 1985	Extension of 1984 agreement with Intel for two years; includes additional products using Intel's CHMOS process and its evolutions
Altera P-CAD Systems	Feb. 1985	Marketing agreement with P-CAD Systems
Altera Data I/O- FutureNet	May 1985	OEM marketing agreement with Data I/O's FutureNet for the DASH schematic capture packages
AMCC Sanders	Feb. 1985	Sanders to develop prototype ECL gate arrays by customizing AMCC base wafers for in-house use only
AMCC Seiko Epson	May 1985	BICMOS joint development effort using Seiko Epson's 1.5-micron CMOS process and AMCC's bipolar process
ATMEL GI	March 1985	ATMEL technology provided to General Instrument for fab capacity; this agreement is no longer in effect
Barvon Research Micron Technology	Nov. 1985	Micron's acquisition a 16 percent equity interest in Barvon Research; Barvon to design ASICs for Micron
Brooktree Toshiba	1985	Brooktree's technology licensed by Toshiba for consumer digital audio applications
CMD TRW	July 1985	TRW to manufacture HCMOS gate arrays in its JAN-qualified fab, using CMD/CMA's 1.2-micron design rules
Catalyst Zilog	Dec. 1985	Joint development and second-sourcing agreement; initial product will be a version of Zilog's Z8 MCU

(Continued)

Table 5d (Continued)

1985 Alliances

Company	Date	Description
Chips Toshiba Yamaha Fujitsu	Nov. 1985	Foundry services from these companies subcontracted by Chips and Technologies
Cirrus Logic AMD	Sept. 1985	Cirrus Logic's development of an MCU for AMD in exchange for foundry services
CSi Viewlogic	Oct. 1985	Custom Silicon's (CSi's) cell-based library offered on Viewlogic's Workview workstation
Cypress Matra-Harris	Oct. 1985	Cypress masks for its SRAMs and 1.2-micron CMOS process transferred to MHS; which received 2 percent of Cypress' stock for $25 million
Cypress Weitek	Oct. 1985	Joint development of a series of VLSI logic circuits designed by Weitek and manufactured by Cypress
ETC NCR	Oct. 1985	Electronic Technology Corp. (ETC) to establish design centers and design cell-based ICs for NCR
ES2 Lattice Logic	1985	ES2 to market Lattice's logic compiler in Europe
Exel Samsung	May 1985	Prior agreement extended to include second-sourcing of 64K EEPROMs
Exel Oki Electric	March 1985	Oki to second-source Exel's 2Kx8 NMOS EEPROM
GAIN Mitsui	1985	Mitsui's acquisition of 30 percent interest in GAIN
Inmos NMB/Minebea	March 1985	NMB/Minebea to ship 50 percent of its 256K DRAM output to Inmos

(Continued)

Table 5d (Continued)

1985 Alliances

Company	Date	Description
ICS VLSI Technology Toshiba	1985	VLSI Technology and Toshiba to provide foundry services for Integrated CMOS Systems (ICS)
ICS Universal	1985	Cooperative gate array agreement to personalize wafers and designs supplied by ICS
IDT Internix	April 1985	Sales contract for Internix to sell IDT's products in Japan
IMP National	April 1985	IMP to second-source National's 2-micron gate arrays
IMP Iskra	April 1985	IMP's and Iskra's codevelopment of a CMOS analog cell library for which IMP provides foundry services
LSI Logic Toshiba	June 1985	Four-year joint venture to develop a 50,000-gate sea-of-gates array
LSI Logic C. Itoh	April 1985	C. Itoh to sell LSI Logic's products in Japan
LSI Logic Kawasaki Steel	Aug. 1985	Formed joint-venture gate array company in Japan, named Nihon Semiconductor
LTC Motorola	Jan. 1985	Agreement granting each company rights to a number of patents
Maxim Brown Boveri	Feb. 1985	Maxim to design and manufacture devices for Brown Boveri
Micro Linear Rockwell	1985	Rockwell's $1.2 million investment in Micro Linear and receipt of ASIC linear product technology; Rockwell provides wafers
Micro Linear Toko	Oct. 1985	Toko to make bipolar devices for Micro Linear at its Saitama, Japan, plant

(Continued)

Table 5d (Continued)

1985 Alliances

Company	Date	Description
MOSel UMC	Oct. 1985	MOSel's EEPROM, a 2Kx8 SRAM, and a 2-micron process transferred to UMC in exchange for fab capacity
MOSel Fuji Electric	Sept. 1985	Fuji Electric--supplied 4- and 6-inch wafers, using MOSel 1.5- and 2.0-micron processes; jointly develop CMOS 16K and 64K SRAMs for MOSel
NMB Vitelic	Nov. 1985	A 1Mb CMOS DRAM license granted to NMB in exchange for one-third of NMB's plant capacity
Quasel Taiwan ERSO	May 1985	Technology license
Ramtron General Motors	1985	Contract with General Motors to demonstrate ferroelectric feasibility in special applications such as space and automotive
Samsung Intel	Jan. 1985	Samsung licensed to second-source certain Intel micros
Samsung Exel	May 1985	Prior agreement extended to include 64K EEPROMs
Samsung Zytrex	June 1985	LSI logic devices and proprietary ICE-MOS process provided to Zytrex; Zytrex is no longer in business
SEEQ Silicon Compilers	July 1985	All EEPROM designs provided by SEEQ for integration into SCI's Genesil System
Sierra VLSI Technology	Jan. 1985	Sierra Semiconductor licensed by VLSI for IC software design tools in exchange for Sierra's cell-based designs

(Continued)

Table 5d (Continued)

1985 Alliances

Company	Date	Description
Silicon Systems Rogers	Nov. 1985	Joint venture to design, manufacture, and market value-added intelligent flexible subsystems, called SMARTFLEX Systems
S-MOS Siliconix	Nov. 1985	Agreement allowing Siliconix to produce 1.5- and 2.0-micron gate arrays designed by Seiko Epson and S-MOS
Tachonics Grumman	July 1985	Tachonics--a subsidiary of the Grumman Corporation
Topaz Hytek	July 1985	Topaz acquired by Hytek Microsystems; Hytek and Topaz cooperated on developing precision, standard hybrid circuits
UMC Unicorn	Jan. 1985	Unicorn, a design center based in Silicon Valley, funded by UMC for $2.5 million; joint development of a cell library
UMC Honeywell/ Synertek	July 1985	Nonexclusive product licenses gained by UMC for 18 ICs formerly produced by Synertek
Universal Edsun Laboratories	Sept. 1985	Joint development with Edsun Laboratories for computer-related CMOS products
Vitelic Sony	June 1985	Sony's access to Vitelic's 256K CMOS DRAM and 64K SRAM technologies in exchange for fab capacity
Vitelic Hyundai	July 1985	Hyundai's license to Vitelic memory products in exchange for manufacturing capacity
Vitesse AMD	Nov. 1985	Jointly develop and manufacture AMD's AM2900 family of MPUs in GaAs

(Continued)

Table 5d (Continued)

1985 Alliances

Company	Date	Description
VLSI Technology Rockwell	1985	Jointly develop erasable programmable logic arrays
VLSI Technology Honeywell/ Synertek	April 1985	Rights to a CRT controller, interface circuits, 4K SRAM, and a 16K ROM acquired by VLSI
VLSI Technology National	April 1985	National Semiconductor CMOS EPROM technology supplied to VLSI; VLSI manufactured the part and supplied wafers
VLSI Technology Nihon Teksel	June 1985	Sales contract to sell mainly standard product LSIs into the Japanese market
VLSI Technology Daisy Systems	June 1985	VLSI's design tools and silicon compilers available on CHIPMASTER and SILICONMASTER workstations
VLSI Technology Zilog	June 1985	Zilog licensed to use VLSI's design software; cooperate to develop megacell versions of Zilog products
VLSI Technology Hewlett-Packard	Oct. 1985	Hewlett-Packard to use selected design tools on HP workstations
VLSI Technology MEM	1985	VLSI's process technology, which will be used by VLSI installed by Microelectronics-Marin (MEM)
VLSI Technology Olivetti	1985	Joint design center in Italy
VLSI Technology Bull Group	1985	VLSI's design technology licensed by Bull to develop computer products
VLSI Technology University of Louvain	1985	Agreement to install VLSI's IC design methodology to teach advanced IC design to students

(Continued)

Table 5d (Continued)

1985 Alliances

Company	Date	Description
WSI Sharp	Oct. 1985	Prior agreement extended to include WSI's 1.6-micron CMOS technology
Weitek Intel	Oct. 1985	Weitek to develop an interface IC that Intel will second-source; Intel to provide foundry services
Weitek National	Oct. 1985	National to design, manufacture, and market an interface chip
Xilinx Seiko Epson	Dec. 1985	Codevelop logic cell arrays and development systems; Seiko Epson to manufacture; jointly develop Seiko Epson's CMOS process
Xicor Intel	Aug. 1985	R&D technology exchange agreement to develop EEPROMs; both companies cross-licensed their EEPROM technology
ZyMOS GI	April 1985	Extended agreement for an additional three years; covers cell library and foundry services
ZyMOS Source III	Sept. 1985	ZyMOS to provide foundry services for Source III

Table 5e

1984 Alliances

Company	Date	Description
Altera Intel	Aug. 1984	CHMOS EPROM fabrication technology and foundry services provided by Intel; Altera provided its EPLD design, test, and development support
AMCC Honeywell	Aug. 1984	Honeywell to second-source AMCC's Q700 gate arrays and to alternative-source bipolar gate arrays
Calogic Koki Company	Dec. 1984	Koki to sell Calogic's CMOS data bus driver ICs in Japan
Custom Arrays ATAC-Diffusion	1984	ATAC to operate a design center and conduct marketing for Custom Arrays in Europe
Custom Arrays Interdesign	1984	Jointly developed the MM family of linear arrays
Custom Silicon FutureNet	March 1984	CSi's cell-based design available on the FutureNet DASH design system
ETC Gould-AMI	1984	Agreement for 3.0- and 5.0-micron, single-layer metal CMOS gate arrays; AMI provides foundry services
Inmos NMB	June 1984	NMB to produce the Inmos 256K CMOS DRAM for an initial sum and royalties; NMB will also cooperate on the Inmos 64K and 1Mb DRAMs
Inmos Thorn-EMI	1984	Thorn-EMI's acquisition of 76 percent of Inmos
Inmos Hyundai	Dec. 1984	Hyundai--$6 million payment for the Inmos 256K DRAM technology.
ICT IMP	July 1984	Codevelopment of a CMOS EEPROM process

(Continued)

Table 5e (Continued)

1984 Alliances

Company	Date	Description
IMP National	1984	Five-year technology exchange and second-sourcing agreement covering IMP's cell-based designs and National's CMOS process
IMP Micro Linear	June 1984	Codevelopment of a 10V CMOS process; IMP provides foundry services
IXYS Ricoh	1984	Wafers provided by Ricoh; IXYS provided its power MOSFET HDMOS process
Lattice Synertek	July 1984	Cross-licensing and second-sourcing agreement covering Lattice's UltraMOS process in exchange for Synertek's production capacity
Lattice VLSI Technology	Sept. 1984	Lattice CMOS EEPROM and SRAM technology provided to VLSI in exchange for foundry services
LSI Logic AMD	Aug. 1984	Jointly develop CMOS standard cell definitions and a library for design of large-scale ICs
LSI Logic Intersil	Feb. 1984	Agreement covering LSI Logic's HCMOS process logic arrays and Intersil's CMOS gate array family
LTC Signetics	June 1984	Signetics to purchase die in wafer form and receive manufacturing rights for three precision op amps and other products; Signetics provided LTC with certain small-outline packaging services
LTC Interdesign	July 1984	The right to design IC arrays, using up to three of LTC's processes, and dedicated foundry capacity to manufacture the Interdesign designs granted by LTC

(Continued)

Table 5e (Continued)

1984 Alliances

Company	Date	Description
Maxim Intersil	1984	Agreement to exchange products as part of a legal settlement
Micron National	Nov. 1984	A license to manufacture and sell Micron's 64K DRAM purchased by National for about $5 million
Modular Ricoh	Nov. 1984	Modular Semiconductor CMOS designs and processes for a 16K SRAM and 256K DRAM provided to Ricoh
NMB Minebea	1984	NMB--the subsidiary of and financed by Minebea
NMB Inmos	June 1984	NMB to produce Inmos' 256K CMOS DRAM in exchange for cash, royalties, and 50 percent of the output
Novix Sysorex	March 1984	Sysorex International participant in first-round financing
PromTech Japanese Company	1984	PromTech licensed technology
Sierra National	July 1984	Technology exchange covering selected CMOS products and processes; Sierra leased a facility from National
S-MOS IMI	April 1984	Two-year agreement with International Microcircuits Inc. (IMI) to second-source 2-micron CMOS gate arrays and share cell-based libraries
TriQuint Tektronix	Jan. 1984	TriQuint--a subsidiary of Tektronix
Vitelic Kyocera	March 1984	Kyocera--participant in first-round financing
Vitelic ERSO	May 1984	ERSO and Vitelic to codevelop EPROMs and 64K and 256K CMOS DRAMs

(Continued)

Table 5e (Continued)

1984 Alliances

Company	Date	Description
Vitesse Norton Company	July 1984	The initial investment of $30 million provided by the Norton Company
VLSI Technology Visic	Feb. 1984	VLSI Technology and Visic to design and market CMOS 64Kx1 and 16Kx4 CMOS DRAMs
VLSI Technology Fairchild	May 1984	Joint development and second-source of Fairchild's 2-micron CMOS gate arrays
VLSI Technology Silicon Compilers	Oct. 1984	VLSI licensing of Silicon Compilers' RasterOp graphics processor chip in exchange for foundry services for customers who design circuits using SCI's design system
VLSI Technology Western Digital	1984	Joint agreement to develop CMOS versions of proprietary WD products and second-source several of WD's products; VLSI provides foundry support for three years
VTC CDC	Oct. 1984	Control Data Corp. (CDC) investment of $56 million in VTC; the arrangement includes a fabrication technology license
WSI Sharp	Dec. 1984	Sharp to produce a 64K CMOS EPROM for manufacturing capacity and royalties licensed by WSI
ZyMOS Intel	July 1984	ZyMOS ZyP design automation system provided for Intel's CHMOS II process; ZyMOS to manufacture Intel's 80C49 8-bit MCU

Table 5f

1983 Alliances

Company	Date	Description
Acrian Bharat	1983	Acrian technology transferred to Bharat Electronics Limited
AMCC Signetics	Sept. 1983	AMCC and Signetics to exchange future families of gate arrays and processes
AMCC Daisy Systems	Feb. 1983	The Q-700 gate array family on Gatemaster supported by Daisy
Asahi Kasei Hitachi Limited	1983	Hitachi Limited's advanced CMOS process technology licensed by Asahi Kasei
BIT Analog Devices	1983	Equity investment
CDI Olympus Optical	Jan. 1983	CDI gate array technology transferred to Olympus Optical Co.
CDI Western Microtechnology	1983	CDI's gate arrays sold through Western Microtechnology's design center
CMD/CMA Ricoh	1983	Joint technology agreement with Ricoh covering CMOS silicon-gate and BIMOS gate arrays and cell-based ICs
CMD/CMA Micro Innovators	Jan. 1983	Merge of CMD/CMA with Micro Innovators, a team of custom MOS/LSI designers
Custom Silicon NCR	Nov. 1983	CSi to design and resell NCR's cell-based and gate array products in New England
Cypress MMI/AMD	June 1983	Cypress' 1.2-micron, CMOS process and warrants received by MMI/AMD in exchange for loan guarantees
ETC Exar	Dec. 1983	Foundry services provided by Exar

(Continued)

Table 5f (Continued)

1983 Alliances

Company	Date	Description
Exel Samsung	1983	Samsung Semiconductor license to second-source its 16K EEPROMs granted by Exel
GBL Kidder, Peabody	Dec. 1983	R&D partnership to develop four ultrahigh-speed GaAs SRAMs.
ICT Hyundai	Oct. 1983	International CMOS Technology (ICT) and Hyundai to jointly develop devices including 1K CMOS EEPROMs, fast SRAMs, and 64K EPROMs; Hyundai allocated 30 percent of its wafer fab capacity for an equity interest in ICT
IMP Zoran	June 1983	Codevelopment of a CMOS PROM technology
IMP IXYS	Nov. 1983	Codevelopment of a high-voltage CMOS process
Inmos GI	Oct. 1983	Inmos' 8Kx8 EEPROM licensed by General Instrument
Inmos Intel	Dec. 1983	Intel and Inmos to develop consistent specifications on 64K and 256K CHMOS DRAMs
Lattice FSP	1983	Lattice UltraMOS technology provided in exchange for Floating Point Systems' (FSP) DSP and array processor technologies; FSP also made an equity investment
LSI Logic RCA	April 1983	RCA to second-source LSI Logic's 5000 Series
LSI Logic SGS	April 1983	SGS licensed by LSI as an LSI 5000 Series and CAD software alternative source

(Continued)

Table 5f (Continued)

1983 Alliances

Company	Date	Description
LSI Logic Toshiba	June 1983	Jointly developed a channelless Compacted Array
LTC Teijin Japan Macnics Technology Trading	June 1983	Agreements for distribution in Japan
Micron ITT/STC	Jan. 1983	ITT/STC granted a worldwide license by Micron to manufacture and sell 64K DRAMs
Micron Samsung	June 1983	Samsung granted a license by Micron to manufacture and market Micron's 64K and 256K DRAM in exchange for cash
Micron Commodore	Aug. 1983	Commodore licensed by Micron to produce a 64K DRAM; this agreement is no longer in effect
Mietec Sprague	1983	Cross-licensing agreement with Sprague for a BIMOS process
Samsung SST	1983	Samsung Semiconductor--the U.S. subsidiary of Samsung Semiconductor and Telecommunications (SST)
SEEQ Silicon Compilers	1983	SEEQ to manufacture SCI's Ethernet data link controller
S-MOS Systems Seiko Epson	1983	S-MOS affiliated with Seiko Epson, which holds 30 percent of S-MOS
UMC AMI	April 1983	Dialer ICs produced in cooperation with AMI
Universal Siliconix	June 1983	Siliconix to set up a design center for Universal's gate arrays in Swansea, Wales

(Continued)

Table 5f (Continued)

1983 Alliances

Company	Date	Description
Universal Western Digital	Aug. 1983	Western Digital to second-source Universal's CMOS gate arrays
VLSI Technology Ricoh	1983	Technology exchange for NMOS and CMOS mask ROMs
VLSI Technology KIET	1983	VLSI's 32K ROM technology licensed by KIET in exchange for foundry services
VLSI Technology Texas Instruments	July 1983	VLSI second-source of TI's TMS4500A DRAM controller and developer of its 256K DRAM controller
VLSI Technology Wang Labs	Nov. 1983	Wang purchase of 15 percent of VLSI's stock for $34.0 million
ZyMOS Intel	Jan. 1983	ZyMOS ZyP CAD system provided for Intel's CHMOS I process; codevelop a cell library
ZyMOS GI	Aug. 1983	General Instrument to use ZyP software and Zy40000 to design circuits and to develop the Zy40000 cell library for foundry services

Table 5g

1982 Alliances

Company	Date	Description
Acrian Communications Transistor	1982	Acrian acquisition of Communications Transistor Corp
AMCC Sorep	Jan. 1982	AMCC and Sorep to design, assemble, test, and market gate arrays in France
AMCC Thomson CSF	July 1982	Thomson-CSF to alternative source and develop AMCC's bipolar Q-700 series of gate arrays
CDI Telmos	1982	CDI's linear CMOS products licensed by Telmos
CDI Corintech	Oct. 1982	Corintech, a thick-film manufacturer, to make and sell CDI gate arrays in Britain
CMD/CMA Ricoh	1982	Ricoh wafers provided to CMD/CMA
CMD/CMA Racal	Jan. 1982	CMD/CMA to manufacture and sell Racal's CMOS gate arrays in the United States
LSI Logic AMD	Jan. 1982	A five-year license to manufacture the LCA 1200 Series of ECL macrocell arrays received by AMD
LSI Logic Fujitsu	1982	Agreement covering HCMOS gate arrays
LTC Silicon General	July 1982	Technology exchange and second-sourcing agreement; Silicon General provided PWMs and two additional circuits and second-sources several high-current series pass regulators developed by LTC

(Continued)

Table 5g (Continued)

1982 Alliances

Company	Date	Description
SEEQ Rockwell	July 1982	SEEQ 16K EEPROM and 16K UV EPROM technology provided to Rockwell for cash, a lease, and a royalty
SEEQ TI	Aug. 1982	SEEQ EEPROM licensed to TI in exchange for its TMS7000 8-bit MCU
Universal Siliconix	Dec. 1982	Second-source for Universal's 5-micron ISO-5 and 3-micron ISO CMOS gate arrays
VLSI Technology Ricoh	1982	All wafers provided by Ricoh

Table 5h

1981 Alliances

Company	Date	Description
Barvon Research Ricoh	1981	Foundry services provided by Ricoh
Barvon Research Goldstar	1981	Foundry services provided by Goldstar; joint development of an analog/digital CAD
CDI LSI Logic	July 1981	CDI's HC Series of gate arrays exchanged for LSI Logic's LDS1 CAD system
CDI Giltspur	Nov. 1981	A U.K. design center for CDI gate arrays established by Giltspur, a supplier of MPUs
Inmos TI	Oct. 1981	Agreement for 64K DRAMs
LSI Logic Toshiba	Aug. 1981	Joint development of a family of 1,000- to 10,000-gate CMOS arrays
Matra-Harris Intel	March 1981	Agreement covering NMOS circuits and a joint design facility, named Cimatel, in Nantes, France
SEEQ Amkor	1981	IC products assembled by Amkor
VLSI Technology Bendix	Aug. 1981	Warrant guarantee for 14 percent of VLSI Technology preferred stock; $2 million R&D funding, $15 million equipment lease line
ZyMOS Intermedics	Nov. 1981	Additional financing from Intermedics for $4 million

Table 5i

1980 Alliances

Company	Date	Description
CDI AMI	1980	CDI HC Series licensed to AMI
VLSI Technology Amkor	1980	Assembly for VLSI Technology's IC products provided by Amkor

Table 5j

1979 Alliances

Company	Date	Description
AMCC Signetics	April 1979	Signetics to alternative-source the Q700 Quick-Chip series
UMC ERSO	1979	ERSO granted UMC a license for design and process technology for 4-inch silicon wafers
ZyMOS Intermedics	1979	Financing from Intermedics, Inc., for $10 million and lease guarantees for $5 million; ZyMOS supplied custom ICs

Table 5k

Other Alliances

Sensym	Abbot Labs	Technology agreement
	Becton-Dickenson	Technology agreement
	Metravib	Technology agreement
	Michelin	Technology agreement
	National	National's transducer product line second-sourced by Sensym
Triad	Japanese Company	Agreement that gives Triad access to advanced process technologies, capacity, a second source, and also includes joint R&D
	AT&T	Foundry alliances
	Seiko	Foundry alliance for the monolithic color palette
	Rood Testhouse	Guaranteed engineering and test capacity in exchange for business committed by Triad
Wolfson	SGS-Thomson AMS Mietec Fujitsu	Manufacturing arrangements

Source: Dataquest
June 1988

Emerging Technology Companies

Start-up companies in the United States have historically been at the leading edge of new trends in product and process technology. The latest companies follow the same pattern. Table 6 lists some of the emerging technology companies and areas in which they are developing.

Table 6

Emerging Technology Companies

Company	Technology/Product
Conductus	Superconductivity
Cree Research	Silicon carbide discretes
HYPRES	Superconductivity
Krysalis	Ferroelectric memory
Molecular Electronics	Biomembranes (bioelectronics)
Photonic Integration	Optoelectronic ICs
Ramax	Ferroelectric memory
Ramtron	Ferroelectric memory
Synaptics	Neural network ICs

Source: Dataquest
June 1988

Analog ICs

Companies offering analog products are concentrating on high growth products, particularly amplifiers, data conversion, and interface circuits. A very specialized niche is the IC sensor segment. Three companies offering sensor products are IC Sensors, NovaSensor, and Sensym.

Application-specific analog ICs, another analog approach, are expected to be a key area. Companies that can design cost-effective and reliable analog and digital circuits on a single chip will be able to provide a valuable service to the market. Companies presently offering analog array design services are listed in the subsection entitled "ASICs."

Product segments in the analog marketplace include the following:

- Operational amplifiers
- Comparator products
- Consumer circuits

- Data conversion products
- Interface products
- Voltage regulators/voltage references
- Sensor products

Table 7 indicates the companies offering analog products.

Table 7

Companies Offering Analog ICs

	Op Amps	Comparators	Consumer	Data Conv.	Interface	Regulators/ References	Sensors
A&D				X			
ALD	X	X					
Asahi Kasei				X			
ATMEL				X	X		
Brooktree	X		X	X			
Calmos	X			X			
Calogic	X					X	
Crystal	X			X			
Dallas					X		
Elantec	X	X			X		
Hualon			X				
IC Sensors							X
IDT				X			
LIS				X			
LTC	X	X		X	X	X	
Maxim	X			X	X	X	
MCE	X	X		X		X	
Micro Linear				X	X		
NovaSensor							X
Samsung	X	X		X	X	X	
Sensym							X
Sierra				X			
SSi	X						
S-MOS				X			
Topaz				X	X		
UMC			X	X			
Universal				X	X		
VLSI Design				X			
VTC	X	X		X	X		
ZyMOS	X	X		X			

Source: Dataquest
June 1988

ASICs

Application-specific ICs (ASICs) are transforming the electronics industry. The ASIC market was a $5 billion market in 1986 and is projected to be a $14 billion market by 1992. Of all ICs consumed in 1986, more than 20 percent were ASICs. In addition, many of the newer companies were formed with the sole objective of penetrating the ASIC market. Table 8 lists the companies participating in the ASIC market and the products that they offer.

Table 8

Companies Participating in the ASIC Market

	Gate Array	Analog Array	Cell Library	PLD	Silicon Compilation
ACTEL	X				
Acumos	X				
Altera				X	
AMCC	X				
Asahi Kasei	X		X		
ATMEL				X	
Barvon	X		X		
Calmos	X		X		
Calogic	X				
CDI	X				
CMD	X		X		
Custom Arrays		X			
Custom Silicon	X		X		
Cypress				X	
Dolphin			X		
ETC		X			
ES2					X
Exel				X	
Genesis	X		X		
ICI Array	X	X			
IST	X		X		
ICS	X				
iLSi	X				
Intercept	X				
ICT				X	
IMP	X		X		
Lattice				X	
LSI Logic	X		X		
Matra-Harris		X			
MCE			X		
Micro Linear		X			
Mietec			X		
PLX				X	
Sierra			X		
S-MOS	X		X		
Spectrum Micro	X				
UMC	X		X	X	X
Universal	X	X			
VLSI Design			X		
VLSI Technology	X		X		
VTC	X		X		X
WaferScale			X		
Xilinx				X	
ZyMOS			X		

Note: Aspen plans to offer PLDs with subnanosecond access times.

Source: Dataquest
June 1988

Digital Signal Processing

The digital signal-processing (DSP) market is a fast-growing area that allows innovative start-up companies to establish a dominant market position. DSP applications have emerged as consumers of substantial numbers of ICs, particularly in the communications and military market segments, which currently represent about 75 percent of all DSP applications. However, the technology and products are migrating quickly into mainstream commercial and consumer areas. In 1986, the market consumed 25 million DSP ICs for a total of $311 million. The worldwide consumption for 1987 was $408 million, and Dataquest estimates that it will grow to $769 million in 1990.

DSP products, as defined by Dataquest, include four categories: single-chip DSP microprocessors, microprogrammable devices, special-function circuits, and ASIC DSP products. DSP microprocessors are analogous to MPUs used in the PC environment, with the main difference being that their architectures are optimized to solve digital signal-processing problems. Microprogrammable products are used to build customized architectures to solve high-performance problems and include multipliers, multipliers/accumulators, sequencers, and other traditional bit-slice products. Special-function devices include modems, codecs, filters, and speech- and image-processing circuits. ASIC DSP products utilize a cell-based approach and are designed specifically for DSP applications.

Table 9 shows the companies participating in the DSP market and the types of products that they offer.

Table 9

Companies Offering DSP Products

	DSP MPU	Microprogrammable	Special Function	ASIC DSP
BIT		X		
Calmos			X	
Chips		X		
Cypress		X		
Dallas	X			
Inmos			X	
IDT		X		
Logic Devices		X		
LSI Logic	X	X	X	X
Matra-Harris		X		
NIC			X	
VLSI Technology		X	X	X
WaferScale		X		
Weitek		X		
Wolfson		X	X	
Zoran	X		X	

Source: Dataquest
June 1988

Discrete Semiconductors

The discrete market was $6.5 billion in 1987. We believe that the discrete market will grow about 6.4 percent from 1987 through 1992. Dataquest segments the discrete market into seven categories: small signal and power transistors, diodes, thyristors, and other discretes. Power field-effect transistors (FETs) are included as a separate category because many of the newer companies are concentrating in this area. FETs differ from most bipolar transistors in that they are voltage-controlled rather than current-controlled devices. FETs are available in two types: junction types, or JFETs, and metal oxide types, or MOSFETs.

Table 10 shows the companies participating in the discrete semiconductor market and the products that are available.

Table 10

Companies Offering Discrete Products

	Diodes	Transistors	Power FETs	Thyristors	Other
Acrian			X		
ALD			X		
AMPi			X		
APT			X		
Calmos	X				
Calogic			X		
IXYS			X		X
Powerex	X			X	
Samsung		X	X		
SID		X			
Topaz			X		

Source: Dataquest
June 1988

Gallium Arsenide

Gallium arsenide (GaAs) potentially has wide-range applications in the military, communications, and data processing market segments. Dataquest estimates that the market for GaAs semiconductors crossed the $2 billion mark in 1987, up from 1986 shipments of an estimated $1.9 billion. The predominant devices were discrete semiconductors.

GaAs products are segmented into the following classifications:

- Analog ICs: MMIC amps, MIC converters, frequency multipliers
- Digital ICs: Logic, memory, ASICs, dividers

- Discretes: Small-signal transistors, power FETs
- Optoelectronics: LEDs, lasers, detectors, photovoltaic cells, isolators, couplers, integrated opto devices

Table 11 shows the companies that offer GaAs products.

Table 11

Companies Offering GaAs Products

	Analog		Digital				
	MMICs	Linear	RAMs	ASICs	Std Logic	Discretes	Opto
Acrian		X					
ANADIGICS	X	X					
Celeritek	X	X				X	
Epitaxx							X
GAIN				X			
GigaBit		X	X	X	X		
HMS	X	X			X	X	
Hittite	X						
Isocom		X					X
Kyoto							X
Lytel							X
M/W Monolithics	X						
M/W Technology	X	X					
Opto Diode							X
Opto Tech						X	X
Pacific	X	X		X			
Tachonics	X	X		X			
TMMIC		X					
Three-Five							X
TriQuint	X	X		X	X		
Vitesse		X	X	X	X		

Note: Gazelle plans to announce products.

Source: Dataquest
June 1988

Memory

Most of the newly formed memory companies offer fast SRAM products. Competition is very fierce in the fast SRAM area; however, there are many benefits. The fast SRAM market is relatively stable, and products command higher average selling prices (ASPs). SRAM technology is being used as an avenue to specialty memory products and as a process driver for ASIC and MPU products, in addition to specialty memory products. Inmos, for example, uses SRAM technology for its transputer product, and VLSI Technology for its ASIC products.

An important advantage for smaller companies is that the use of SRAM technology does not require a large production facility. Performance Semiconductor, for example, is manufacturing fast SRAMs, without a very high capital investment.

Many of the companies are also offering specialty memories such as FIFOs, dual-port RAMs, content-addressable memories (CAMs), cache tags, and writable control store memories. These products command higher ASPs than standard memories, because they offer system manufacturers better integration and faster speeds, allowing the manufacturers to differentiate their products. These product areas are expected to remain limited in size; however, the number of product types is expected to increase.

Table 12 lists companies in the memory market and the products offered.

Table 12

Companies Offering Memory Products

	DRAM	SRAM	ROM	EPROM	EEPROM	FIFO	Other
Alliance	X	X					
Asahi Kasei		X	X				
ATMEL				X	X		X
Austek							X
Brooktree	X						X
Calmos		X					
Catalyst		X		X	X		
Cypress		X				X	X
Dallas		X				X	X
Exel							X
Hualon		X	X				
Inmos	X	X					
IDT*		X			X	X	X
ICT				X	X		
Logic Devices		X				X	X
Matra-Harris		X					X
Micron	X	X					X
Modular		X					
MOSel		X				X	X
NMB	X						
Performance		X					
PromTech				X			
Quasel Taiwan	X	X					
Samsung	X	X			X		
Saratoga		X				X	X
SEEQ				X	X		
Sierra					X		
S-MOS		X	X	X			
Triad		X					X
UMC		X	X			X	
Vitelic	X	X				X	X
VLSI Tech		X	X				X
WaferScale				X			
Xicor					X		X

*In May 1988, IDT announced that it will not be offering EEPROMs.

Note: Aspen plans to offer ECL-compatible memory with subnanosecond access times; SIMTEK plans to offer memory products; and Synergy plans to offer ECL memory products.

Source: Dataquest
June 1988

Microcomponents

Microcomponent products generally demand higher ASPs, 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. These are the fastest-growing segments in the microperipherals area. Companies are also offering what previously have been board-level solutions to several peripherals applications with ICs. These products are classified under system support.

Table 13 indicates the companies offering microcomponent products.

Table 13

Companies Offering Microcomponent Products

	MPU	MCU	MPR Commun.	Mass Storage	Sys. Support	Key/Display
Adaptec				X	X	
Asahi Kasei		X				
Calmos	X			X	X	
Catalyst		X				
Chips			X	X	X	X
Cirrus Logic			X	X		X
Cypress		X				
Dallas		X			X	X
Graphics Communications						X
Hualon			X		X	X
Inmos	X					X
IDT	X				X	
Logic Devices			X		X	
LOGICSTAR			X		X	
LSI Logic	X				X	
Matra-Harris	X	X			X	X
Modular					X	
NIC						X
Novix Inc.	X					
Performance	X				X	
SEEQ		X			X	
Sierra		X				
SSi				X	X	
S-MOS	X		X		X	
UMC	X	X		X	X	X
VLSI Design					X	
VLSI Technology	X			X	X	X
XTAR						X
ZyMOS					X	X

Source: Dataquest
June 1988

Optoelectronics

The optoelectronics market was about $1.8 billion in 1987, and Dataquest expects it to grow to $2.9 billion by 1992. Growth is fastest in the optocoupler and "other" categories. Optoelectronics growth is being fueled by the communications and computer industries, which use light as a medium for communication. Optoelectronics are also heavily used in the consumer market.

Table 14 lists the companies offering optoelectronic products.

Table 14

Companies Offering Optoelectronic Products

	Light Emitting	Light Sensing	Image Sensors	Other
Acrian				Solar cells
Isocom				Optocouplers
S-MOS			X	Drivers
Solid State	X	X		
Telcom Devices	X			Photodiodes

Note: Photonic is developing optical IC technology.

Source: Dataquest
June 1988

Telecommunication ICs

The telecommunication IC market is growing faster than the analog market, of which it is a segment. One of the factors driving the growth of telecommunication ICs is the need to automate the office by linking personal computers. Another factor is the need to communicate faster, farther, and in a variety of ways including through satellites and facsimile machines.

The demand for better and faster communication is also spurring the development of new devices such as line interfaces and switch arrays.

Table 15 lists the companies offering telecommunications ICs.

Table 15

Companies Offering Telecommunications ICs

	Dialer	Modem	UART/ DUART	Line Interface	Codec/ Filter	Switch Array	Other
Asahi Kasei					X		
ATMEL					X		
CMD	X				X		
Calmos					X		X
Calogic						X	
Crystal	X	X		X			X
Dallas				X			X
Exel			X				
Hualon	X						X
Level One				X			
Matra-Harris		X		X	X		
Modular			X				
Samsung	X				X		X
Sierra	X	X			X		
SSi	X	X					X
S-MOS	X	X					
Topaz						X	
UMC	X		X				
Universal			X				
VLSI Technology		X	X	X	X		

Source: Dataquest
June 1988

Other Products

Foundry

The companies listed in Table 16 were formed to serve as semiconductor foundries. The most recent company to be formed is Chartered Semiconductor Corporation, which was formed as a joint venture among National Semiconductor, Sierra Semiconductor, and the Singapore Technology Corporation to establish a technology base in Singapore.

Table 16

Companies Operating as Foundries

Company	Location
Chartered Semiconductor	Singapore
Orbit Semiconductor	United States
NMB Semiconductor	Japan
Si-Fab	United States
Taiwan Semiconductor Manufacturing	Taiwan

Source: Dataquest
June 1988

Bubble Memory

MemTech Technology Corporation is dedicated to the manufacture of bubble memory devices and related products. The Company was formed to acquire the business and principal assets of Intel Corporation's Magnetics Operations.

A&D Co., Ltd.
Shintaiso-Bldg., No. 5-1052
10-7 Dogenzaka, 2-chome
Shibuya-ku, Tokyo 150
Japan
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 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

MANUFACTURING

Technology: Not available

Facilities

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

PRODUCTS

Electronic Balances
Weighing Indicators/Controllers
FFT Analyzers
Data Converters

Acrian Inc.
490 Race Street
San Jose, CA 95126
408/294-4200

ESTABLISHED: May 1978
NO. OF EMPLOYEES: 250

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President/Chief Operating Officer	Gary Irvine
Executive Vice President	Jim Huiskens
Vice President, Administration	Elain Skloot
Vice President, Sales & Marketing	Don Smith
Chief Financial Officer	John Root
VP, GM/Silicon Semiconductors	Roger Thornton
GM/Amplifier Division	Robert Kaswen
GM/GaAs	Matias Pardo
GM/Solar Division	Dale Matteson

FINANCING: Acrian has raised a total of $15.5 million in seven rounds of funding. The last round of $2.65 million was completed in 1987.

BACKGROUND

Acrian Inc. designs, develops, manufactures, and markets application-specific power amplifier components, modules, and subassemblies, as well as discrete semiconductor devices that provide high-performance characteristics for manufacturers of power amplifiers. Devices include bipolar transistors, MOSFETs, capacitors, resistors, attenuators, and terminations.

Acrian offers both standard components, developed to satisfy basic power amplification needs, and custom components, designed for specific applications. Today the Company is the second-largest domestic producer (second only to Motorola) of radio-frequency (RF) and microwave power amplifiers, and the only privately held company competing in the market.

The Company is beginning to develop devices and power amplifiers using gallium arsenide (GaAs) technology for frequencies above 4 GHz.

The major markets for Acrian's products are telecommunications, avionics, and defense, with the military making up about 60 percent of sales.

Since 1981, the Company has been vertically integrating its product lines by assembling its devices and associated circuitry into power modules. In 1982, Acrian acquired the product lines of Communication Transistor Corp. from Varian. The lines included primarily bipolar devices in the frequency range from 1 MHz to 1 GHz, and also included passive components such as microwave and radio frequency resistors, attenuators, and terminations that are used in power modules.

In late 1985, Acrian entered into a major contract to complete development of a solar cell for use by major utilities in generating electrical power. The program allowed the Company to construct a prototype manufacturing capability within the Acrian facility. Following its success on early parts of the program, Acrian now has been contracted to develop techniques for mounting and assembling the cells.

Acrian markets its products worldwide through independent sales representative organizations. The Company currently has about 230 customers including E-Systems, General Electric, ITT, M/A-Com, Motorola, Rockwell International/Collins Radio Division, and TRW.

Recent Highlights

Aug. 1987 Acrian raised an additional $2.65 million in financing.

ALLIANCES

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

SERVICES

Microwave Power Design
Bipolar Manufacturing

MANUFACTURING

Technology

1.0-micron MOS and bipolar on silicon

Facilities

San Jose, CA	65,000 sq. ft.	Administration and manufacturing
	25,000 sq. ft.	Clean room
U.K.		Assembly, test, engineering

PRODUCTS

Power FETs
Radio Frequency Transistors
Microwave Power Transistors
Subassemblies

ACTEL Corporation
320 Soquel Avenue
Sunnyvale, CA 94086
408/732-2835
Fax: 408/732-1152
Telex: 62957251

ESTABLISHED: October 1985
NO. OF EMPLOYEES: 50

BOARD

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

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Amr Mohsen	Intel	Sr. Engr Mgr, Tech Development Division
VP Operations	Paul Franklin	MMI	GM-Memory, Digital & Logic Divisions
Sr. VP Sales/Mktg	M. Douglas Rankin	Signetics	VP WW Sales

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	$9.9M

BACKGROUND

ACTEL Corporation designs, manufactures, and markets user-configurable integrated solutions for the design and implementation of ICs in electronic systems.

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

ACTEL has developed a CMOS gate array based on proprietary architecture and customer-configurable interconnect technologies. Customers can map applications instantly with ACTEL's design automation systems, which includes development software and system hardware.

In 1986, ACTEL signed a three-year joint development agreement with Data General that allows Data General to design and develop semiconductor products based on ACTEL's technology. The partnership includes shared resources for product development, and in return, Data General supplies ACTEL with use of test equipment, wafer fabrication, and engineering facilities at its Sunnyvale facility.

In 1987, ACTEL received $750,000 in follow-on funding, bringing first-round financing to $9.9 million. In March 1988, William Davidow, an Intel veteran and well-known venture capitalist, was elected chairman of ACTEL. Mr. Davidow assumes the position from Amr Mohsen who remains president and CEO.

ALLIANCES

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

SERVICES

Design
Test

MANUFACTURING

Technology

CMOS

Facilities

Sunnyvale, CA	10,000 sq. ft.	R&D, development, marketing, administration

PRODUCTS: A family of customer-configurable Gate Arrays supported by a design automation system.

Gate Arrays

Acumos, Inc.
1531 Industrial Road
San Jose, CA 94070
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., specializes in analog-to-digital arrays, small-to-medium high-drive and high-voltage arrays, and analog switching arrays that incorporate both CMOS and DMOS switches.

In 1987, Acumos offered the A300 gate array that incorporates analog and digital functions. The device, which is a PLD replacement part, is designed for voice filtering, robotics, magnetic disk drive applications, and communications markets. The Company plans later introductions of specialty high-voltage products.

In 1985, the Company acquired 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 subcontracts manufacturing and assembly with U.S. and offshore companies. The Company plans to sell into the Japanese and U.S. markets.

ALLIANCES: None

SERVICES

- Design
- Test

MANUFACTURING

Technology

3.0-, 4.0-, 5.0-micron silicon-gate CMOS

Facilities

San Jose, CA	1,000 sq. ft.	Design and test

PRODUCTS

Gate Arrays

Device	Linewidth	Gates	Description
7001/7004/7005	4-micron	100 to 700	High 15V Output Drive Digital Gate Arrays, Typical 3ns Delay
D315-D3120 Series	3-micron	150 to 1,200	Typical 2ns Delay
A300	4-micron	300	Analog/Digital Array with Op Amps, Resistors, Capacitors, Comparators, 5ns-Internal Gate Aelay
CD01/CD02		30-100	CMOS/DMOS Monolithic Gate Array

Adaptec, Inc.
691 S. Milpitas Boulevard
Milpitas, CA 95035
408/945-8600
Fax: 408/262-1845
Telex: 910-338-0060

ESTABLISHED: May 1981
NO. OF EMPLOYEES: 230

BOARD

Name	Affiliation
Lawrence B. Boucher	Adaptec, Inc., chairman
Robert J. Loarie	Lawrence, WPG Partners, general partner
David F. Marquardt	Technology Venture Investors, general partner
B.J. Moore	Outlook Technology Inc., president
W. Ferrell Sanders	Consultant

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	John G. Adler	Amdahl	VP Prod Dev
VP Engr	Larry Scasser	Amdahl	Mgr Channel Dev
VP Mktg	Jeffrey A. Miller	Intel	Mktg Mgr/MPU Opns
VP Fin/CFO	Paul Hansen	Raychem	Asst Controller
VP Systems	Bernard G. Nieman	Shugart	Project Mgr
VP Sales	Roger McLean	Imagen Corp.	VP OEM Sales
VP Mfg	Gary J. Weitz	Finnigan	General Manager

FINANCING

Date	Round	Sources	Amount
June 1986	Initial Public Offering		$10.0M

BACKGROUND

Adaptec, Inc., develops and supplies I/O components used to control the flow of data between MPU-based computers and high-speed Winchester disk and tape storage systems. The Company's products include proprietary VLSI circuits, a broad line of PC- and SCSI-based controller and host adapter boards, and a family of SCSI test and development systems.

Adaptec designs full custom, semicustom, and gate array circuits in NMOS, CMOS, and bipolar technologies in geometries ranging from 4.0- to 2.0-micron. Products are targeted to customers in three segments of the microcomputer market: the personal computer market; the multiuser systems, network file server, and engineering workstation market; and the supercomputer market for scientific and business applications.

In January 1988, Adaptec, Chips and Technologies, Phoenix Technologies, and The Santa Cruz Operation (SCO) jointly announced a new set of Micro Channel-compatible products. These products are designed for IBM PS/2 Models 50, 60, and 80-compatible computer manufacturers. Adaptec's products are a series of high-performance I/O controllers. Chips and Technologies introduced two new chip sets for 80286 and 80386 PS/2-compatible machines. This combination of products, plus software support from Phoenix and SCO, allows OEMs to produce PS/2-compatible computers with high-performance features. Adaptec's most impressive new high-performance product is the ACB-26M20 ESDI controller that allows concurrent operations for multitasking support. Another product is the AHA-1020 low-cost PC XT SCSI host bus adaptor that was also announced for the PS/2 Models 25 and 30.

The Company subcontracts all IC production, however, Adaptec performs final test on all products to maintain the quality and reliability of its devices. High-volume board products are assembled in Singapore by Adaptec Manufacturing Singapore.

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 has 15 manufacturers' representative organizations, 5 industrial distributors, 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.

Recent Highlights

Jan. 1987	Adaptec established a subsidiary in Singapore. The new company, called Adaptec Manufacturing (Singapore) Private Ltd., will manufacture surface-mount controllers.
Jan. 1987	Adaptec offered the AIC-610 mass storage controller chip. The chip is designed to be embedded in 3-1/2-inch and 5-1/2-inch drives.
June 1987	Adaptec offered the AIC-6225 data separator that operates at data rates of up to 33 Mbits per second.
Aug. 1987	Adaptec offered the AIC-6250 single-chip SCSI protocol chip with 20-Mbyte per second host transfer rate.

Oct. 1987	Adaptec signed a $5 million contract to supply Conner Peripherals with disk controller ICs during 1988.
Oct. 1987	Adaptec offered the AHA-1540 AT to SCSI host adapter. The adapter features host data transfer rates up to 10 Mbytes per second.
Oct. 1987	Adaptec signed an agreement with The Santa Cruz Operation (SCO) to jointly develop SCSI support for SCO's XENIX System V operating system.
Nov. 1987	Adaptec offered an SCSI-to-ESDI disk controller board, the ACB-4525Z, with zero latency.
Jan. 1988	Adaptec and Chips and Technologies jointly announced hardware products for IBM PS/2 system solutions. Also at the briefing, The Santa Cruz Operation and Phoenix Technologies announced software support for the Adaptec and Chips products.

ALLIANCES

SCO	Oct. 1987	Adaptec signed an agreement with The Santa Cruz Operation (SCO) to jointly develop SCSI support for SCO's XENIX system V operating system.
Connor Peripherals	Oct. 1987	Adaptec signed a $5 million contract to supply Conner Peripherals with disk controller ICs in 1988.

SERVICES

Design
Manufacturing
Assembly
Test

MANUFACTURING

Technology

4.0- to 2.0-micron NMOS, CMOS, bipolar

Facilities

Milpitas, CA	100,000 sq. ft.	Administration, development
Singapore		Manufacturing

PRODUCTS

Integrated Circuit Products

AIC-010	10-Mbit/second Programmable Storage Controller
AIC-011	15- and 24-Mbit/second Programmable Storage Controller
AIC-250	MFM Encoder/Decoder
AIC-270	2,7 RLL Encoder/Decoder
AIC-300	Dual-Port Buffer Controller
AIC-301	Enhanced Dual-Port Buffer Controller
AIC-500	SCSI Interface Circuit
AIC-610	10-Mbit/second Integrated Programmable Storage Controller
AIC-6225	33-Mbit/second (1,7 RLL) Data Separator
AIC-6250	20-Mbyte Host Transfer with SCSI Protocol Circuit

Board Products

SCSI Winchester Controllers

ACB-4000	SCSI-to-ST412/506 Single-User
ACB-4070	SCSI-to-ST412/506, 2,7 RLL, Single-User
ACB-4525	SCSI-to-ESDI
ACB-5500	SCSI-to-ST412/506 Multitasking
ACB-558	SCSI-to-SMD, 10 Mbits/sec, Multitasking, Differential
ACB-5580	SCSI-to-SMD, 10 Mbits/sec, Multitasking, Single-Ended
ACB-5585D	SCSI-to-ESMD, 15 Mbits/sec, Multitasking, Differential
ACB-5585	SCSI-to-ESMD, 15 Mbits/sec, Multitasking, Single-Ended

SCSI Host Adaptors

AHA-1020	PS/2 Models 25 and 30, PC XT, AT-to-SCSI Adaptor
AHA-1540	PC AT-to-SCSI Host Adaptor
AHA-1640	Micro Channel-to-SCSI Host Adaptor

Micro Channel Hard Disk Controllers

ACB-2610	Micro Channel-to-ST412/506 MFM Hard Disk Controller
ACB-2670	Micro Channel-to-ST412/506 RLL Hard Disk Controller
ACB26M20	Micro Channel-to-ESDI Hard Disk Controller

PC/AT/XT and PS/2 Model 30 Hard and Hard/Floppy Disk Controllers

ACB-2072	PC XT, PS/2 Model 30 Hard Disk Controller
ACB-2320	PC AT-to-ESDI Hard Disk Controller
ACB-2322	PC AT-to-ESDI Hard Disk and Floppy Disk Controller
ACB-2370	PC AT-to-ST412/506 2,7 RLL Hard Disk Controller
ACB-2372	PC AT-to-ST412/506 2,7 RLL Hard/Floppy Disk Controller

SCSI Test and Development Systems

SDS-2	SCSI Development System with Target and Initiator Emulation
SDS-100	Field and Manufacturing SCSI Test System
SDS-210	Add-On Logic Analyzer for SDS Development and Test Systems

Advanced Linear Devices, Inc.
1030 W. Maude Avenue
Suite 501
Sunnyvale, CA 94086
408/720-8737
Fax: 408/720-8297

ESTABLISHED: January 1985
NO. OF EMPLOYEES: 10

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), designs, develops, manufactures, and markets linear ICs for low-power, low-voltage precision applications. Products are manufactured using a proprietary silicon-gate CMOS technology optimized for 5V operation. They are used for industrial control and electronic instrumentation, computer and peripheral equipment, medical instrumentation, telecommunications, aerospace, and military systems.

The Company offers two product lines. A series of about 25 standard products that include timers/oscillators, op amps, comparators, and n-channel and p-channel MOSFETs.

The second product line, which was offered in March 1988, is a Function-Specific Standard Cell Linear Program for the design of custom and semicustom ICs. The library includes timers/oscillators, op amps, comparators, and MOSFETs, as well as diodes, resistors, and capacitors. The program consists of a kit of 86 standard ICs of 20 different types and a design manual. Customers use the parts to breadboard the desired circuit, then return the working design to ALD, who then designs the circuit.

ALD subcontracts wafer fabrication to two foundries in the United States and assembly to contractors in the Far East. ALD conducts all wafer probe, sort, and final test at its facility in Sunnyvale, California. In 1987, ALD put in place its U.S. and Canadian network of sales representatives and established a U.S. distributor network.

Recent Highlights

April 1986	ALD offered its first product, the ALD55 monolithic CMOS timer. It features 500ns monostable mode and 2-MHz astable mode operation.
Aug. 1986	ALD offered the ALD2301 silicon-gate CMOS dual comparator with typical response time of 650ns.
Nov. 1986	ALD offered the ALD1502/2502/4501 family of quad CMOS timers that operate on 2V to 12V supplies. The series is available in commercial and military grades.
March 1987	ALD offered the ALD2701 CMOS dual rail-to-rail op amp. The device operates from single or dual supplies and input and output signal levels both extended to the supply voltage rails.
March 1988	ALD offered the function-specific standard cell ASIC approach for linear ICs.

ALLIANCES: Not available

SERVICES

Design
Test

MANUFACTURING

Technology

3.0-, 5.0-micron silicon-gate CMOS

Facilities

Sunnyvale, CA	2,000 sq. ft.	Design, test

PRODUCTS

ALD1701	CMOS, Rail-to-Rail, Micropower Amplifier
ALD1702	CMOS, Rail-to-Rail, Oscillation Resistant Amplifier
ALD1703	CMOS, Low-Cost Amplifier
ALD1704	CMOS, Low-Cost, JFET-Replacement Amplifier
ALD1706	CMOS, Rail-to-Rail, Very Low Power Amplifier
ALD2701	Dual, CMOS, Rail-to-Rail, Micropower Amplifier
ALD4701	Quad, CMOS, Rail-to-Rail, Micropower Amplifier
ALD2301	Dual, CMOS, Open Collector Output Comparator w/Drivers
ALD4302	Quad, CMOS, Push-Pull Outputs Comparator w/Drivers
ALD555/1502/1504	Single Precision Timer/Oscillator
ALD2502/2504	Dual Precision Timer/Oscillator
ALD4501/4503	Quad Precision Timer/Oscillator
ALD1101	Dual N MOSFET Transistors
ALD1102	Dual P MOSFET Transistors

Advanced Microelectronic Products, Inc.
1/F #17 Industriale E. 2nd Road
Hsinchu, Taiwan

ESTABLISHED: June 1986
NO. OF EMPLOYEES: N/A

North American Headquarters
1887 O'Toole Avenue, Ste. C-111
San Jose, CA 95131
408/727-8880
Fax: 408/727-6320

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President	James Yen

FINANCING: Not available

BACKGROUND

Advanced Microelectronic Products, Inc. (AMPi), was formed to design, manufacture, and market power MOSFETs. The Company is implementing a three-pronged strategy. Initially, the Company entered the market with standard, functional equivalents to International Rectifier's line of leading power MOSFETs. Concurrently, it designed value-added products from its standard product line. Future plans involve using proprietary technology to offer smart power devices.

In August 1986, the Company produced its first prototype product, the IRF450 power amplifier. By April 1987, the Company readied its line of International Rectifier-compatible products and opened its North American headquarters in Santa Clara.

AMPi has established relationships with ERSO (Taiwan), which will conduct manufacturing, and Lingsen (Taiwan) and New Era (Hong Kong), which will perform assembly for AMPi.

Sales representatives have been signed in the United States, Canada, and the Far East.

ALLIANCES: Not available

SERVICES

Design
Foundry
Assembly and Test

MANUFACTURING

Technology

3-micron MOS

Facilities

Santa Clara, CA	Design, marketing
Hsinchu, Taiwan	Headquarters, engineering, manufacturing, assembly, test

PRODUCTS

Device	Voltage	Drain Source (Amps)	Current Package
AM0610LL/AM2222LM	60	15, 19	TO-92
AM10KLM/AM2222LM	60	.25, .3	TO-237
AM4000 Family	100 to 500	18.0 to 56.0	AMPAK-04
IRF100-400	60 to 500	12.0 to 33.0	TO-3
IRF500-800/BUZ	50 to 500	1.3 to 30.0	TO-220AB

Advanced Power Technology, Inc.
405 S.W. Columbia Street
Bend, Oregon 97702
503/382-8028
Fax: 503/388-0364

ESTABLISHED: June 1984
NO. OF EMPLOYEES: 69

BOARD

Name	Affiliation	Position
Morris Chang	Taiwan Industrial Technology Research Institute	president
Charles Cole	Julian, Cole & Stein	general partner
Ted Hollinger	Advanced Power Technology, Inc.	founder
Leib Orlanski	Freshman, Marantz, Orlanski Cooper & Klein	attorney, partner
Patrick Sireta	Advanced Power Technology, Inc.	president/CEO
Ed Snape	The Vista Group	general partner
Dave Stein	Julian, Cole & Stein	general partner

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Patrick Sireta	TI	VP CMOS Div
VP Adv Applications and Systems	Ted Hollinger	AMD	Chief Technical Officer
VP Marketing	Thomas G. Daly	GE	Prod Mktg Mgr
VP Operations	John Hess	Seeq	Dir Operations
CFO	Robert M. Holburn	TI	Ctr WW MOS Mem
VP Engr	Dah Wen Tsang	Theta-J	Dir Research
Sales Manager	Terry Bowman	Micron	VP Sales/Mktg

FINANCING

Date	Round	Amount
1985	Seed	$0.4M
1985	Round 1	$2.5M
1986/1987	Round 2	$8.1M
1988	Round 3	$2.8M

Major investors include Julian, Cole & Stein; The Vista Group; Orien Ventures; 1st Chicago Investment Advisors; Sunwestern Ventures Company; J.F. Shea Company; and Mitsui & Company (U.S.A.), Inc.

BACKGROUND

Advanced Power Technology (APT) designs, manufactures, and markets low-cost, high-power MOSFETs for advanced electric power switching applications, such as data processing and telecommunications equipment, defense systems, and variable speed electric motors.

APT has developed a family of large-die MOSFETs, that match the power and price advantages of low-speed thyristors and bipolar transistors with equivalent switching speeds. The MOSFETs feature lower on resistance and lower input capacitance, achieved with a metal-gate and 6-micron feature sizes. APT has also reduced manufacturing costs by developing a simpler MOSFET design that reduces the number of masks required.

The Company's future plans include developing a line of hybrids and insulated gate bipolar transistors (IGBTs).

Recent Highlights

Oct. 1986	First prototype MOSFETs produced.
March 1987	Internal wafer fabrication facility fully operational.
June 1987	Shipped first sample MOSFETs for evaluation
Dec. 1987	First production MOSFETs shipped to customers.

ALLIANCES: Not available

SERVICES

Design
Manufacturing
Final Test

MANUFACTURING

Technology

5-micron metal-gate MOS
4-inch wafers

Facilities

The Company conducts all manufacturing in its Bend, Oregon, facility. Assembly for military products is done in the United States, other assembly is conducted by companies overseas.

Bend, Oregon	31,750 sq. ft.	Total area
	18,250 sq. ft.	Administration, assembly, test
	13,500 sq. ft.	R&D, engineering, wafer fabrication (including class 10 areas underhood)

PRODUCTS

Device	Vds Volts	Id cont. Amps	Idm Amps	Available
APT4020/4025	400	20.3 to 22.6	81.0 to 90.6	Now
APT4525/4530	450	18.5 to 20.3	74.0 to 81.0	Now
APT5025/5030	500	18.5 to 20.3	74.0 to 81.0	Now
APT40XX	400	8.9 to 28.2	35.8 to 112.7	2Q 1988
APT45XX	450	7.6 to 25.2	34.7 to 100.8	2Q 1988
APT50XX	500	7.7 to 25.2	30.5 to 100.8	2Q 1988
APT55XX	550	7.3 to 23.0	29.2 to 92.0	2Q 1988
APT60XX	600	7.3 to 21.3	29.2 to 85.2	2Q 1988
APT4008/09/30/40/85	400	7.0 to 51.4	28.0 to 205.7	3Q 1988
APT451/09/10/40/50/85	450	6.0 to 48.5	24.0 to 193.9	3Q 1988
APT501/10/12/40/50/85	500	6.0 to 46.0	24.0 to 184.0	3Q 1988
APT551/11/13/50/60	550	5.5 to 43.8	22.0 to 175.4	3Q 1988
APT601/13/15/60/70	600	4.7 to 40.3	18.8 to 161.3	3Q 1988
APT8032/40/75/90	800	10.7 to 25.7	46.8 to 92.0	3Q 1988
APT901/45/50/90	900	10.1 to 21.7	42.7 to 82.3	3Q 1988
APT1001/50/60	1000	10.1 to 20.6	40.5 to 82.3	3Q 1988
APT801/802	800	3.8 to 10.2	15.2 to 40.7	4Q 1988
APT901/902/903	900	3.4 to 9.0	13.6 to 36.0	4Q 1988
APT1001/2/3/4	1000	3.4 to 8.5	13.6 to 34.0	4Q 1988

Alliance Semiconductor
1930 Zanker Road
San Jose, CA 95112
408/436-1860

ESTABLISHED: 1985
NO. OF EMPLOYEES: 10

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	N.D. Reddy	Modular Semiconductor	President
VP Sales/Mktg	Robert Reid	Oki Semiconductor	SR VP
VP Engineering	C.N. Reddy	Cypress Texas Instruments	SRAM Dsn Mgr

FINANCING

The Company has financed its developmental activity with private investment and seed funding from its offshore corporate partners.

BACKGROUND

Alliance Semiconductor was formed to design, manufacture, and market SRAMs and DRAMs. The Company is using a 1.2-micron CMOS planar process which, when combined with architectural innovations, produces value-added high-speed devices.

In December 1987, Alliance offered the AS4C188 16Kx4 SRAM that features access times of 25ns, 30ns, and 35ns. By the end of the first quarter of 1988, the Company plans to offer a 1Mb DRAM with RAS access times of 60ns, 70ns, and 80ns. Products are designed for superminis, workstations, and other computing applications using 32-bit MPUs running at 20-MHz or better.

The Company's future plans are to offer FIFOs and other specialty memories, and to encourage designers to consider the high-speed DRAMs as complete replacements for cache memories.

Alliance has signed agreements to have its DRAMs manufactured by NMB Semiconductor in Japan, while the SRAMs are being manufactured by Goldstar in Korea.

ALLIANCES

NMB	Dec. 1987	Alliance Semiconductor signed a 5-year agreement with NMB Semiconductor covering 1Mb DRAMs. NMB will manufacture the devices and sell them in Japan

SERVICES

Design
Development

MANUFACTURING

Technology

1.2- and 1.0-micron CMOS

Facilities: Not available

PRODUCTS

Device	Description	Speed
AS4C188	16Kx4 SRAM	25, 30, 35ns
AS4C1000	1Mbx1 DRAM	60, 70, 80ns
AS44C256	256Kx4 DRAM	60, 70, 80ns

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

ESTABLISHED: June 1983
NO. OF EMPLOYEES: 200

BOARD

Rodney Smith
Michael Ellison
Paul Newhagen
T. Peter Thomas

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Rodney Smith	Fairchild	GM/Linear Div
VP Marketing	David A. Laws	AMD	VP Bus Dev
VP Sales	John Duffy	Fairchild	VP Sales/Mktg
VP/IC Engr	Robert F. Hartmann	Source III	President
VP Technology	Dr. James Sansbury	Hewlett-Packard	Production Mgr
VP Finance	Paul Newhagen	Source III	Controller/CFO
VP Operations	Bipin Shah	Fairchild	Operations Mgr
VP Software Engr	Clive McCarthy	Fairchild	Marketing Mgr

FINANCING

Date	Round	Sources	Amount
June 1983	Round 1	Alpha Partners	$1.3M
April 1984	Round 2	Allstate Investments; 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; Institutional Venture Partners; Parker Drilling Company	$9.9M
	Lease	Bank of America	$2.0M
May 1986	Round 4	European investors	$5.0M
	Lease	Bank of America	$1.7M

BACKGROUND

Altera Corporation designs, manufactures, and markets user-configurable EPROM-based ICs and associated CAE development systems, and is focused entirely on developing this market. Altera invented and was the first company to ship electrically programmable logic devices (EPLDs).

The Company's products are specified for operation over commercial, industrial, and military operating ranges. The predominant users are manufacturers that supply equipment for the industrial, office automation, and telecommunications markets as well as military and aerospace contractors. Altera is qualified to supply devices to the requirements of MIL-STD-883 Revision C.

Altera's CAE tools and user-configurable devices allow design engineers to create custom logic functions on the IBM PC. Wafers using 1.0- and 0.8-micron CMOS technology are obtained through technology agreements. This strategy allows Altera to concentrate on architecture, circuit design, software, and service, which has earned the Company a reputation for providing excellent service and easy-to-use CAD software. 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.

In March 1988, Altera amended its registration statement for an initial public offering of 4 million shares of common stock at $5.50 per share. Of the shares being offered, 1 million were sold by certain shareholders. The statement was originally filed in October 1987. Net proceeds will be used principally for working capital and for repayment of long-term debt.

In 1987, Altera began offering function-specific EPLDs. The SAM (Stand-Alone Microsequencer) family integrates 448 words of EPROM memory with a microcoded sequencer and pipelined register (SAM) for microcoded state machines and sequencer applications. The Buster family of configurable bus interface peripheral devices combines a programmable bus interface, PLD, and storage elements in a single device.

In January 1988, Altera introduced three new products for the IBM PS/2 add-in board market. The EPB2001 is a single-chip user-configurable interface chip that replaces 14+ TTL PLDs needed to build the Micro Channel interface, the EPB2002 direct memory access (DMA) arbitration chip integrates the additional logic needed for DMA capability, and the MCMap provides software design support. The interface chip can be programmed to fit the requirements of any add-in board function including disk controller, laser printer controllers, graphics controllers, and modems. Add-in boards are licensed and encouraged by IBM and serve to add functions not included in the basic computers such as expanded memory, communications interfaces, peripheral equipment, and other functions as Fax and voice mail.

The Company markets its products in North America, Europe, Australia, the Far East, and the Pacific Rim through direct sales offices and a network of distributors and sales representatives. Altera's distributors include Hall-Mark, Lionex, Pioneer, Quality Components, Schweber Electronics, and Wyle in the United States, and Future Electronics and Semad in Canada.

Recent Highlights

Nov. 1986	Altera achieved full compliance to the Class B requirements of MIL-STD-883, Revision C for the EP310 and EP1210 devices. All other Altera devices in most package styles are available screened and environmentally tested to the MIL-STD specifications while compliancy requirements are being satisfied.
Jan. 1987	Altera and WaferScale Integration (WSI) announced a 5-year technology relationship to develop a new family of standalone microsequencer products with wafers manufactured by Sharp of Japan.
Feb. 1987	Altera and Monolithic Memories, Inc. (MMI), settled the patent infringement suit brought against Altera by MMI. Altera agreed to the entry of a consent of judgment and the parties agreed to license each other under certain patents in the programmable logic field.
March 1987	Altera offered the standalone microsequencer (SAM) family of EPLDs. The devices are user-configurable ICs designed for complex state machines and high-performance controller applications operating up to 30 MHz. The first two members integrate 448 words of EPROM memory with a microcoded sequencer and pipelined register. These are the first products resulting from the Company's agreement with WaferScale Integration.
March 1987	Altera's LogiCaps now supports IBM's EGA and the Hercules graphics controllers. Altera also reduced the price of LogiCaps from $950 to $695.
June 1987	Cypress Semiconductor and Altera signed a 5-year agreement to develop a family of CMOS EPLDs. The 5,000-gate family is named MAX for Multiple Array Matrix. Altera is providing architecture, circuit design, and software support. Cypress is providing 0.8-micron CMOS EPROM process, manufacturing, and marketing support.

Oct. 1987	Altera introduced two families of function-specific EPLDs. SAM for complex state machines and high-performance controllers, and Buster for user-configurable MPU peripherals.
Dec. 1987	Altera offered the EP610 and EP910 with 30ns delay
Jan. 1988	Altera announced three new products for IBM PS/2 add-in boards. The EPB2001 is a single-chip user-configurable interface chip that replaces 14+ TTL PLDs needed to build the Micro Channel interface. The EPB2002 is a direct memory access (DMA) arbitration chip that integrates the additional logic needed for DMA capability. The MCMap provides software design support. The EPB2001 interface chip can be programmed to fit the requirements of any add-in board function including disk controller, laser printer controllers, graphics controllers, and modems.
March 1988	Altera amended its registration statement for an IPO of 4 million shares of common stock at $5.50 per share, originally filed in October 1987. Of the shares being offered, 1 million were being sold by certain shareholders. The net proceeds will be used principally for working capital and for repayment of long-term debt.

ALLIANCES

Intel	Aug. 1984	Altera signed a 5-year technology exchange agreement with Intel. Intel provided CHMOS EPROM fabrication technology and foundry services; Altera provided its EPLD design and test technology, and software and hardware development support. Intel will be an alternate source for the CHMOS EPLDS. Both companies cooperate on developing support tools for EPLD development systems.
	June 1985	The agreement with Intel was extended for two additional years and includes additional products using Intel's CHMOS process and its evolutions.
P-CAD Systems	Feb. 1985	Altera entered a marketing agreement with Personal CAD Systems, Inc., 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.
Cypress	June 1987	Cypress Semiconductor and Altera signed a 5-year agreement to develop a family of CMOS EPLDs. The 5,000-gate family is named MAX for Multiple Array Matrix. Altera is providing architecture, circuit design, and software support. Cypress is providing 0.8-micron CMOS EPROM process, manufacturing, and marketing support.

SERVICES

Design
Manufacturing

MANUFACTURING

Untested wafers are provided through technology exchange agreements with Intel, WaferScale/Sharp, Cypress Semiconductor, and other foundry relationships. Assembly operations are subcontracted to two vendors. Volume production assembly is conducted in the Far East; quickturn and prototype assembly is performed locally. Assembled components are final tested, burned-in, marked, packed, and shipped at Altera.

Technology

1.2-micron CHMOS
0.8- and 1.0-micron CMOS EPROM

Facilities

Santa Clara, CA	52,000 sq. ft.	Administration, engineering, manufacturing, marketing

PRODUCTS

User-Configurable ICs

EP3XX	300-gate EPLD	35, 40 MHz
EP6XX	600-gate EPLD	26, 45 MHz
EP9XX	900-gate EPLD	26, 45 MHz
EP12XX	1,200-gate EPLD	28 MHz
EP18XX	2,100-gate EPLD	20 MHz
EPS444/448	Stand-Alone Microsequencer (SAM)	30 MHz
EPB1400	Configurable Peripheral (Buster)	25 MHz
EPB2001	Micro Channel Interface Chip	
EPB2002	DMA Arbitration Chip	

Most of the above are available in commercial, military, and industrial temperature ranges in a variety of speed grades. The components are offered in both ceramic and plastic dip packages and J-lead surface-mount packages. Pin-grid array packages are also available.

Design Tools

PLDS2, PLCAD4	Development Systems for Programmable Logic
A+Plus	Software Logic Compilers for Programmable Logic
LogicMap II	Software Program to Verify and Examine Devices
LogiCaps	Schematic Capture
DASH I/F	Schematic Capture Interface
PLSME	State Machine Software
PLFSIM	Simulation Software
PLSLIB	TTL Macrofunction Library
MCMap	IBM PS/2 Micro Channel Interface Software Support
PLDS-SAM	Development System for SAM Devices
SAM+PLUS	SAM Design Processor
Hardware	Hardware Programming Units and Package Adaptors

Altera's development systems run on Daisy Systems Corporation's Personal LOGICIAN workstation, and on more than 18 personal computers including AT&T, COMPAQ Plus, COMPAQ Deskpro, Columbia, Columbia Portable, Corona, IBM PC/XT/AT, IBM Portable, ITT XTRA, Leading Edge, MAD 86186, Panasonic SR. Partner, Televideo, Sperry, ISI Model 5160, Zenith 100 and 151 PC, and Intersil System PC.

ANADIGICS, Inc.
35 Technology Drive
Box 4915
Warren, NJ 07060
201/668-5000
TLX: 510-600-5741
Fax: 201/668-5068

ESTABLISHED: January 1985
NO. OF EMPLOYEES: 70

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Ronald Rosenzweig	Microwave Semicon	President
Exec VP/COO	George Gilbert	Microwave Semicon	Exec VP Opns
VP Engr	Dr. Charles Huang	Avantek	Dir GaAs R&D
Dir Mktg/Sales	Michael P. Gagnon	TRW LSI Products	Mgr Strat Plan
Dir Finance	John Lyons	General Electric	Dir Finance

FINANCING

Date	Round	Sources	Amount
April 1985	Round 1	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
Nov. 1986	Round 2	First round investors; Arthur D. Little Co.; Century IV Fund; Englehard Corp.; Memorial Drive Fund; Metropolitan Life Insurance Co.	$10.0M

BACKGROUND

ANADIGICS, Inc., designs, manufactures, and markets gallium arsenide (GaAs) analog and digital ICs for the telecommunications, military, and instrumentation markets. The Company is currently offering RF microwave and signal conditioning amplifiers, A/D converters, dividers, and multiplexers/demultiplexers. In addition, ANADIGICS offers GaAs services and designs both catalog and custom GaAs ICs, as well as custom hybrid assemblies, including fiber-optic data links.

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.

Recent Highlights

Jan. 1987	ANADIGICS offered the AOP3510 350-MHz unity gain stable GaAs op amp in commercial and military grades. The device has a bandwidth of 70 MHz and a settling time of 20ns.
March 1987	ANADIGICS offered the AWA20601 and ADA25001 wideband MMIC gain amplifiers. The Company also offered the ADV3040 4-to-1 divider.
June 1987	ANADIGICS was awarded a contract by Bendix Aerospace to develop CAD tools for the DOD's MMIC program. Bendix will adapt the software tools for layout and simulation in the design of GaAs high-frequency broadband amplifiers and mixers.
July 1987	ANADIGICS offered the ACP10010 comparator for ATE and high-speed fiber-optic receivers.
Sept. 1987	ANADIGICS offered the ATA30010, a 3-GHz transimpedance amplifier.
Jan. 1988	ANADIGICS introduced the ALD30010, a 3-GHz laser driver.
Feb. 1988	ANADIGICS was awarded a $500,000 contract from the Navy to develop a chip set for X-band radars.
March 1988	ANADIGICS completed the first stage of a $4 million equity financing. Investors were ABS Ventures; Alan Patricof Associates Inc.; Alex Brown Emerging Growth; Canaan Venture Limited Partnership; Century IV Partners; Fairfield Ventures; First Century Partnership III; Investments Orange Nassau; Memorial Drive Trust; Metropolitan Life; Rothschild Inc.

ALLIANCES:

Bendix	June 1987	ANADIGICS was awarded a contract by Bendix Aerospace to develop CAD tools for the DOD's MMIC program. Bendix will adapt the software tools for layout and simulation in the design of GaAs high-frequency broadband amplifiers and mixers.

SERVICES

Foundry
Design
Manufacturing
Assembly
Test

MANUFACTURING

Technology

GaAs MESFET (3-inch wafers)

Both low-power D-MESFET and E/D MESFET process technologies are in development for use in 1988.

Facilities

Warren, NJ	50,000 sq. ft.	Design, test, manufacturing, and administration
	8,000 sq. ft.	Clean room

ANADIGICS is planning an additional $10 million investment within the next two-year period.

PRODUCTS

Device	Description
AOP1510	Op Amp, 150 MHz
AOP3510	Monolithic Op Amp, 350 MHz
AWA20601	10dB Gain Amplifier, 2 to 6 GHz
ACP10010	Comparator, 1.0ns Typical Delay
ADA25001/25002	25dB Gain Amplifier, 3 GHz
ADV3040	4-to-1 Divider
ALD30010	Laser Driver, 3 GHz
ATA30010	Transimpedance Amplifier, 3 GHz
APS30010	Phase Splitter, 3 GHz

Applied Micro Circuits Corporation
6195 Lusk Boulevard
San Diego, CA 92121
619/450-9333
Fax: 619/450-9885

ESTABLISHED: April 1979
NO. OF EMPLOYEES: 225

BOARD

Name	Affiliation
Roger A. Smullen, Chairman	Applied Micro Circuits Corp.
William K. Bowes, Jr.	U.S. Venture Partners
F.K. Fluegel	Matrix Partners, L.P.
Ms. Gari Grimm	Adler & Company
Franklin P. Johnson	Asset Management Corporation
Albert Martinez	Applied Micro Circuits Corp.
Gregorio Reyes	ASET
Jeffrey D. West	Miramar Ventures

COMPANY EXECUTIVES

Position	Name
President/CEO	Al Martinez
VP Finance/Admin	Joel O. Holliday
VP Mktg/Sales	A. C. D'Augustine
VP Operations	Don Schrock
VP Engineering	Ray Yuen

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; Adler & Co.; Asset Mgmt. Co.; 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	$5.0M

FINANCING

Date	Round	Sources	Amount
Sept. 1987	Round 3	Accel Capital; Adler & Co.; Asset Mgmt. Co.; Eberstadt Fleming Venture Capital; Harrison Capital; International Industrial Investments (France); Jamieson & Co.; Kemper; Kimball Manufacturing; Matrix Partners; Oak Investment Partners; Olivetti; PaineWeber Ventures; PM Investment; Prime Capital; Robertson, Colman & Stephens; Time, Inc.; US Venture Partners; Venture Growth Associates;	$12.0M

BACKGROUND

Applied Micro Circuits Corporation (AMCC) specializes in the design and manufacture of high-speed ECL gate arrays. In 1987, the Company began offering BICMOS gate arrays. AMCC targets its products at OEMs that make industrial instruments, high-performance computers, electronic warfare systems, test equipment, graphics hardware, and telecommunications equipment.

AMCC is a privately held company that was formed by Howard Bobb and Joe Mingione, who had previously been American Microsystems Inc.'s chairman of the board and marketing manager, respectively. 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. Under the leadership of Roger Smullen, AMCC refocused its efforts in 1983 to the high-performance array marketplace. Mr. Smullen replaced the founders as president and CEO.

There are 29 sales representative organizations with more than 90 sales people that handle AMCC's gate arrays in North America, Europe, Israel, and the Far East.

RECENT HIGHLIGHTS

May 1987 AMCC offered the Q5000 Series of bipolar products and entered the BICMOS logic array market with its Q14000 series. The Q14000 is the result of a two-year joint development agreement with Seiko Epson.

July 1987	AMCC named Al Martinez president and chief executive officer, filling a vacancy that had existed since March 1987 when former president Jonathon K. Yu left the Company. Mr. Martinez was most recently vice president and general manager of TRW's LSI Product Division in La Jolla, California.
Sept. 1987	AMCC completed a private sale of $12 million in convertible preferred stock. The funds are being used to reduce short-term borrowing and provide working capital for anticipated growth, including expansion into its recently completed facility in San Diego, California.
Sept. 1987	AMCC moved into its new corporate facility in San Diego. The 100,000-square-foot building, on a 6.5-acre site, houses engineering, marketing, and administrative staff. The additional facility brings AMCC's total space to 121,000-square-feet, which includes a class 10 fab and production facility.
Jan. 1988	AMCC and Plessey signed an agreement to jointly develop a family of high-performance ECL gate arrays. The arrays, which range up to 18,000-gates, will be fabricated using Plessey's 1-micron triple-layer metal, HE1 bipolar process.

ALLIANCES

Signetics	April 1979	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 that covers a technology transfer of future gate array families 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 provided 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.
Honeywell	Aug. 1984	Honeywell signed an agreement to second source AMCC's Q700 series gate arrays and to alternate source AMCC's bipolar gate arrays.
Sanders	Feb. 1985	Sanders agreed to develop prototype ECL gate arrays by customizing AMCC base wafers for in-house use only.
Seiko Epson	May 1985	Seiko and AMCC entered into a BICMOS joint development effort. Seiko's 1.5-micron CMOS process is merged with AMCC's bipolar process to produce a 1.5-micron BICMOS process.
Plessey	Jan. 1988	AMCC and Plessey agreed to jointly develop a family of high-performance ECL gate arrays up to 14,000-gates. It will be fabricated using Plessey's 1-micron triple-layer metal, HE1 bipolar process.

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

2.0-, 3.0-, and 5.0-micron double-level-metal bipolar
1.5-micron BICMOS
Three-level fine pitch metal
4-inch wafers

Facilities

San Diego, CA	48,000 sq. ft.	Administration, marketing, development, manufacturing
	5,000 sq. ft.	Class 10 clean room

PRODUCTS

ECL Gate Arrays

Family	Process	Linewidth (Microns)	Delay (ns)	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
Q5000	Bipolar			1,300 to 5,000

BICMOS Gate Arrays

Q14000	BICMOS	1.5	0.7	2,160 to 13,440

Foundry

Process	Minimum Geometries	Number of Base Layers	Number of Metal Layers/Pitch	Wafer Size
Bipolar Junction Isolated	5-micron	7	2/10, 16	4"
Bipolar Oxide Isolated	3-micron	10	2/7, 10	4"
Bipolar Oxide Isolated	2-micron	10	3/5.5, 8.0, 15	4"

Asahi Kasei Microsystems Co., Ltd.
Imperial Tower 1-1
Uchisaiwai-cho 1-chome
Chiyoda-ku, Tokyo, Japan
(03) 507-2371
Fax: (03) 591-2567

ESTABLISHED: June 1983
NO. OF EMPLOYEES: N/A

BOARD: Not available

COMPANY EXECUTIVES: Not available

FINANCING: Not available

BACKGROUND

Asahi Kasei Microsystems Co., Ltd., manufactures and markets memory, application-specific ICs, linear, and microcontroller products. The Company was originally founded as Asahi Microsystems, Inc., by Asahi Chemical of Japan and American Microsystems Inc. (AMI) in June 1983. The Company focused on the design and marketing of custom and ASICs based on AMI technology.

In 1986, the Company became a wholly owned subsidiary of Asahi Chemical and changed its name to Asahi Kasei Microsystems. Asahi Kasei Microsystems has established an Electronics Research Laboratory in Atsugi, Japan, to develop new bipolar and CMOS process technologies and new applications, and plans to set up a manufacturing facility in two years.

The Company has established technical ties with Hitachi Ltd. for the acquisition of its advanced CMOS process technology. Crystal Semiconductor will manufacture and market Crystal's devices for the Far Eastern market, and International CMOS Technology (ICT) will market its EEPROMs.

AMI manufactures all the custom and standard products it develops and Hitachi manufactures its digital ICs. The Company manufactures new products developed through its tie-up with ICT on a small scale at an Atsugi plant.

ALLIANCES

Hitachi	Asahi Kasei has licensed Hitachi Limited's advanced CMOS process technology
Crystal Semiconductor	Asahi Kasei will manufacture and market Crystal's devices for the Far East market
ICT	Asahi Kasei will market International CMOS Technology's (ICT) EEPROMs.

SERVICES

Design
CAD
Manufacturing
Test

MANUFACTURING

Technology

2- and 3-micron CMOS

Facilities: Not Available

PRODUCTS

SRAMs

Device	Description	Speed (ns)
AKM6264	64K 8Kx8	100, 120, 150
AKM6287	64K 64Kx1	45, 55, 70
AKM6288	64K 16Kx4 (In Development)	25, 35, 45
AKM62256	256K 32Kx8	85, 100, 120, 150
AKM6207	256K 256Kx1 (In Development)	35, 45
AKM6208	256K 64Kx4 (In Development)	35, 45
AKM66203	1Mb Module 128Kx8	100, 120, 150

ROMs

AKN623257/8	256K 32Kx8	150, 200
AKN62321	1Mb 128Kx8	150, 200
AKN62312	2Mb 256Kx8	200
AKN62412	2Mb 256Kx8/128Kx16	200
AKN62304	512Kx8	200
AKN62404	512Kx8/256Kx16	200

Gate Arrays

Family	Gates	Typical Internal Delay (ns)
AK61H	448 to 2,560	2.0
AK62B	4,032 to 7,136	1.8
AK62H	4,309 to 24,020	0.7

Cell-Based Library

Device	Description
Digital Cells	CPU/Peripheral Cells--Clock Generator, Bus Controller, DMA Controller, Programmable Counter/Timer, Multiplier
	Memory Cells--ROM, RAM
Analog Cells	Op Amps, A/D Converter, SCF Filters

Microcontrollers

AKMC4608	4-Bit Telephone Chip with DTMF Generator, LCD Driver, Real-Time Clock, 8Kx10 ROM, 1Kx4 RAM
AKMC4678	4-Bit Answering Machine Chip with DTMF Receiver, 8Kx10 ROM, 512x4 RAM
AKMC4919	4-Bit General-Purpose MCU with 1 microsecond of Instruction Time, 16Kx10 ROM, 992x4 RAM

Linear ICs

CS31412	A/D Converter
CS7008	Programmable Universal Filter

Aspen Semiconductor Corporation
195 Champion Court
San Jose, CA 95134
408/943-2105
Fax: 408/943-2741

ESTABLISHED: December 1987
NO. OF EMPLOYEES: 25

BOARD

Name	Affiliation
Dr. T.J. Rodgers, Chairman	Cypress Semiconductor Corp., president/CEO
L.J. Sevin	Sevin-Rosen Management Company, president
Larry Sonsini	Wilson, Sonsini, Goodrich and Rosati, partner

COMPANY EXECUTIVES

Position	Name
Acting President	T.J. Rodgers

FINANCING

Date	Round	Source	Amount
Dec. 1987	Round 1	Cypress Semiconductor	$7.4M

BACKGROUND

Aspen Semiconductor was formed to design, develop, and market ultrahigh-speed ECL-compatible memory and PLD products with subthree nanosecond access times.

Initial financing was provided by Cypress Semiconductor Corporation in the amount of $7.4 million. Aspen operates as a wholly owned subsidiary of Cypress and gains access to Cypress' 0.8-micron wafer fabrication facilities. All Aspen-developed devices will be fabricated by Cypress and sold through Cypress' sales organization.

The Company is developing an ECL process utilizing a fourth generation scalable bipolar design technology named STAR for Scalable Transistors and Resistors. Aspen will use 1.2- and 1.0-micron design geometries to produce ICs with performance characteristics beyond current ECL circuits.

ALLIANCES

Cypress	Dec. 1987	Cypress provided initial funding in the amount of $7.4 million. Aspen operates as a wholly owned subsidiary of Cypress and gains access to Cypress' 0.8-micron wafer fabrication facilities. All Aspen-developed devices will be fabricated by Cypress and sold through Cypress' sales organization.

SERVICES

Design

MANUFACTURING

Technology

1.2-, 1.0-micron bipolar

Facilities

San Jose, CA	7,000 sq. ft.	Administrative, design, development, marketing

PRODUCTS: To be announced

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

ESTABLISHED: December 1984
NO. OF EMPLOYEES: 90

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	George Perlegos	Seeq	VP Engineering
VP Technology	Dr. T.C. Wu	Seeq	Process Dev Mgr
VP/General Manager	Dr. Gust Perlegos	Seeq	Engr Manager
VP Finance	Raymond Ostby	Intel	Ctlr Europe Ops
VP Sales	Jack Peckham	Semi Processes	Dir Sales/Mktg
VP Plan & Info Sys	Mikes Sisois	Qronos	VP Prod Dev

FINANCING

Date	Round	Sources	Amount
Dec. 1987	Round 2	Institutional Venture Partners	$3.3M

BACKGROUND

ATMEL (Advanced Technology-Memory & Logic) specializes in the design, manufacture, and marketing of high-speed EPROM, EEPROM, EPLD, and analog products. The Company's products are manufactured using a CMOS technology with geometries as low as one-micron combined with two-layer metal and silicide processes.

ATMEL was founded by George Perlegos, Gust Perlegos, and T.C. Wu with private funds.

ATMEL's first products were a CMOS 64K EEPROM at 120-450ns and a CMOS 256K EPROM operating at 120-250ns. They were followed by a CMOS 512K EPROM operating at 120-250ns. Currently, ATMEL offers additional EPROM, EEPROM, EPLD, and analog devices in a variety of organizations and densities.

In 1987, ATMEL introduced a line of linear products, including the AT76C10 programmable amplifier/delay equalizer, which is designed for use in modem and data communication equipment.

ALLIANCES

General Instrument	March 1985	ATMEL provided technology for its OTP EPROM, UV EPROM, and EEPROM in exchange for fab capacity at GI's plant in Chandler, Arizona. This agreement is no longer in effect.

SERVICES

Engineering
Design
Test

MANUFACTURING

Technology

1.25-micron two-level-metal CMOS

Facilities

San Jose, CA	30,000 sq. ft.	Administration, engineering, design, test, sales and marketing

PRODUCTS

High-Speed EPROM

Device	Density	Organization	Speed (ns)
27H64	64K	8Kx8	45-120
27HC256	256K	32Kx8	55-120
27HC1024	1Mb	64Kx16	70-120

EPROM

Device	Density	Organization	Speed (ns)
27C256	256K	32KX8	120-250
27C512	512K	64KX8	120-250
27C1024	1Mb	64Kx16	120-250
27C010	1Mb	128Kx8	120-250

CMOS PROM

Device	Density	Organization	Speed (ns)
28HC191/291	16K	2Kx8	35-90
27HC641/642	64K	8Kx8	35-90

High-Speed EEPROM

28HC16	16K	2Kx8	45-120
28HC64	64K	8Kx8	55-120
28HC256	256K	32Kx8	70-120

EEPROM

28C04	4K	512x8	120-450
28C16/17	16K	2Kx8	120-450
28C64	64K	8Kx8	120-450
28PC64	64K	8Kx8 Paged	120-450
28C256	256K	32Kx8	120-450

EPLD

Device	Gates	Speed (ns)
22V10	500	25-55
V750	750	30-55
V2500	2,500	45-55
V5000	5,000	35-55

Linear

76C09	Programmable Low Pass Filter
76C10	Programmable Telephone Line Delay Equalizer/Amplifier
76C11	8-Bit Video D/A Converter; 40 MHz
76C12	High-Accuracy A/D Converter; 14 to 16 Bits

Austek Microsystems Pty. Ltd.
Technology Park, Adelaide
South Australia 5095, Australia
8-260-0155
Fax: 8-260-8261

Austek Microsystems Proprietary, Inc.
444 Castro Street, Suite 1020
Mountain View, CA 94041
415/960-1315
Fax: 415/960-0799

ESTABLISHED: July 1984
NO. OF EMPLOYEES: 50

BOARD

Name	Affiliation
A.G. Summers	Bennett and Fisher Ltd., chairman of the board
Denis L. Redfern	Austek Microsystems, managing director
Roger Buckeridge	CP Ventures, director
Barry Hilson	Australian Industry development corporation
Dr. J. Craig Mudge	Austek Microsystems, director advanced development
Dr. Ivan Sutherland	Evans & Sutherland, cofounder

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Mng Director	Denis Redfern	Wormald Data Sys	Div Manager
Dir Adv Dev	Dr. J. Craig Mudge	CSIRO	Chief Scientist
VP Mktg/Sales	Roger Fisher	TI	Strat Mktg Mgr
GM/Australian Ops	Dr. Robert Potter	Control Data	Designer
Mgr Mfr	John Gloekler	TI	Mgr Prod Engr

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.; Bennett & Fisher (Australia); and other individuals	$6.7M

BACKGROUND

Austek Microsystems designs, manufactures, and markets high-performance VLSI solutions for designers of computer systems. The Company's initial business focus was custom VLSI design primarily for Australian customers, including the Australian government. Products the Company developed include an autocorrelator for processing data from radio telescopes, a speech processing chip used in hearing aids, a floating-point controller, a content addressable memory, and a surveillance preprocessor.

In 1986, Austek moved into the next phase of its business plan and began developing proprietary products. It is focusing on the areas of integrated cache memory and digital signal processing. In June 1987, the Company introduced the A38152 Microcache, a cache memory controller chip. The device implements a 32-Kbyte, four-way set-associative, coherent cache by integrating storage control and interface logic on-chip, with four 8Kx8 SRAMs.

The Company was founded in Adelaide, South Australia, by a team of scientists and engineers from Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO). CSIRO had established a VLSI design group in 1981 to develop VLSI capability in Australia. Design and engineering is conducted in Adelaide. Marketing and sales operations are directed from its United States subsidiary, Austek Microsystems Proprietary, Inc., in Mountain View, California. Products are sold through a network of sales representatives.

Austek subcontracts wafer fabrication to VLSI Technology, Inc., in the United States and Ricoh in Osaka, Japan. The Company conducts low-volume assembly and test in Adelaide. High-volume ceramic and plastic assembly is subcontracted.

Recent Highlights

Dec. 1986	Austek offered a 25ns 64K EPROM
June 1987	Austek offered the A38152 Microcache, a 32-bit controller for systems based on Intel's i80386 MPU. The device features 16-, 20-, and 25-MHz operation, direct interface to the i80386, direct interface to four 8Kx8 SRAMs, 32-bit addressability for 4 Gbytes of memory, and on-chip 16ns tag RAM.

ALLIANCES

ZyMOS	Oct. 1987	Austek and ZyMOS signed a letter of intent that would give ZyMOS a license to manufacture and sell Austek's A38152 Microcache as part of ZyMOS' POACH chip set for Intel 80386-based systems.

SERVICES

Design
Test

MANUFACTURING

Technology

2.5-micron HMOS
3.0-, 1.5-micron CMOS

Facilities

Mountain View, CA	5,000 sq. ft.
Australia	20,000 sq. ft.

PRODUCTS

A38152	Microcache 32-bit Controller; 16-, 20-, and 25-MHz Direct Interface to the i80386, Direct Interface to Four 8Kx8 SRAMs, 32-bit addressability for 4-Gbytes of Memory, On-Chip 16ns Tag RAM.

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 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 multifunctional 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.

In November 1985, Micron Technology purchased 16 percent of BRI to gain entry into the ASIC market.

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

MANUFACTURING

Technology

2.0- to 1.5-micron double-metal CMOS

Facilities

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

PRODUCTS

CMOS Gate Arrays

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

PRODUCTS

Cell Library

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

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 Designs.

Analog and Digital CAD: Automatic Place and Route and Mixed-Mode Simulation.

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

ESTABLISHED: July 1983
NO. OF EMPLOYEES: 115

BOARD

Name	Affiliation
George Wilson, Chairman	Bipolar Integrated Technology, CTO
Stephen E. Cooper	Bipolar Integrated Technology, President & CEO
Larry Sullivan	Analog Devices Enterprises
Wayne Kingsley	InterVen Partners
Jeff Watts	Union Venture Corp.
George Rutland	Ultratech Stepper

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman/CTO	George Wilson	Tektronix	Sr Engr/Bip Div
President/CEO	Stephen E. Cooper	Silicon Systems	President/COO
VP R&D	Dr. Ken Schlotzhauer	Tektronix	Sr Engr
VP Mktg	Les Soltesz	Intel	Prod Mktg Mgr
VP Finance	Ken Giles	Columbian Co.	VP Finance
VP Engr	John Deignan	Intel	Design Mgr

FINANCING

Date	Round	Sources	Amount
1983	Seed	Analog Devices, Inc.	$ 0.3M
May 1984	Round 1	Analog Devices, Inc. First Interstate Venture Capital BancBoston Ventures	$ 3.7M
	Lease	Bank of Boston	$ 3.4M
		Oregon State Revenue Bond	$ 4.1M
May 1986	Round 2	Round 1 investors; Harvard Mgmt. Co.; Raytheon Company; Republic Ventures; Union Venture Corp.	$ 7.7M
July 1986	Round 3	Fairfield Venture Partners; InterVen	$ 2.5M

July 1987	Round 4	Round 2 & 3 investors; Cowen & Co.; DFC Ventures; Manufacturers Hanover; Pell Rudman & Co.	$10.0M
April 1988	Round 5	Round 4 investors; Bancorp Hawaii; Sun Microsystems; Weeden Capital Mgmt.	$11.2M

BACKGROUND

Bipolar Integrated Technology, Inc. (BIT), designs, manufactures, and markets high-performance bipolar VLSI computational building blocks for the high-end digital signal processing (DSP) and data processing markets.

The Company's founders include George Wilson, Kenneth Schlotzhauer, James/Pickett, Kenneth Giles, and Les Soltesz. Steve Cooper recently joined BIT as president and chief executive officer. Mr. Cooper was most recently president and COO at Silicon Systems.

BIT has developed a VLSI bipolar process named BIT1. The process is based on 2-micron lithography and polysilicon self-aligning techniques. BIT1 density is said to be comparable to 1.5-micron CMOS and is five times denser than existing bipolar ECL.

The Company's ECL and TTL products include 16x16 integer multipliers, 16x16 multiplier-accumulators, five-port register files, and a floating-point multiplier/ALU 2-chip set. BIT has also developed ECL gate arrays with Raytheon and will produce a bipolar 32-bit RISC MPU as a result of an agreement with Sun Microsystems.

BIT has established a nationwide network of sales representatives and has opened sales offices in Norcross, Georgia, and in Saratoga and Costa Mesa, California.

Recent Highlights

Nov. 1986 BIT offered two 16x16 fixed-point multiplier/accumulators, the B3011 and B2011. The B3011 is an ECL version and the B2011 is a TTL version.

Nov. 1986 BIT sampled the B3210 1K register file with typical read-cycle time of 6ns.

Feb. 1987 BIT offered a chip set that consists of a floating-point multiplier and a floating-point ALU, and offers 60-mflop performance for nonpipelined 64-bit operations. The B3110 multiplier and B3210 ALU are ECL 10KH compatible. The B2110 multiplier and B2120 ALU are TTL versions.

July 1987	BIT signed an agreement with Sun Microsystems to produce a bipolar 32-bit RISC MPU.
Oct. 1987	Stephen E. Cooper was elected chairman of the board and CEO of BIT. Mr. Cooper was most recently president and COO at Silicon Systems.
Jan. 1988	BIT was selected by Electronic Business magazine as one of the 38 "hot" electronics industry start-ups. The results were based on a poll of 125 leading venture capitalists.

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.
Sun Microsystems	July 1987	Sun Microsystems licensed BIT to produce a 32-bit bipolar RISC MPU using its BIT1 process. The part uses Sun's scalable processor architecture (SPARC) developed for workstation applications. BIT has full marketing rights including software support. BIT plans to offer a higher performance RISC SPARC chip in 1989 using its BIT2 process.

SERVICES

Design
Manufacturing

Technology

1.5-micron bipolar

Facilities

Beaverton, OR	46,000 sq. ft	Design and manufacturing
	6,000 sq. ft.	Class 10 clean room

PRODUCTS

Device	Description	Clocked Multiply Time
B3018	ECL 16x16 Integer Multiplier	13ns
B2018	TTL 16x16 Integer Multiplier	19ns
B3011	ECL 16x16 Multiplier-Accumulator	15ns
B2011	TTL 16x16 Multiplier-Accumulator	16ns
B3210	ECL 64x18-bit Five-Port Register File	7ns
B2210	TTL 64x18-bit Five-Port Register File	16ns
B3110/2110	2-Chip Set Floating-Point Multiplier	50ns
B3120/2120	Floating-Point ALU	25ns

Brooktree Corporation
9950 Barnes Canyon Road
San Diego, CA 92121
619/452-7580
Fax: 619/452-1249
Telex: 383596

ESTABLISHED: 1983
NO. OF EMPLOYEES: 215

BOARD

Name	Affiliation
Myron Eichen, Chairman	Brooktree Corporation
James Bixby	Brooktree Corporation
Ellsworth Roston	Roston and Schwartz
Sid Webb	Titan Corporation
Jack Savidge	Venture Strategies
F. Duwaine Townsend	Ventana Corporation
Bill Mobratten	Independent

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	James Bixby	Spin Physics	Dir Engr
VP/Chief Scientist	Henry Katzenstein	Quantrad	VP/Ch Scientist
VP/CFO	William Peavey	Monitor Labs	VP Finance/CFO
VP	Steve Ou	Rockwell	Dir Dev Engr
VP Distribution	Joseph Santen	Burr-Brown	GM Data Conv
VP/GM Subsystems	Richard Lee	Mostek	VP Sales
VP/GM Components	Charles Long	GE	VP/GM
VP Strat Plan	Stewart Kelly	Intel	Strat Bus Chrmn
VP Human Resources	Bob Zabaronick	Cipher Data Prod	VP Human Rescs

FINANCING

Date	Round	Sources	Amount
Nov. 1983	Round 1	Oak Industries, individual investors	$ 5.0M
Early 1985	Round 2	Institutional investor	$ 5.0M
Summer 1985	Round 3	Institutional investor	$ 5.0M
Early 1986	Round 4	Institutional investor, individual and foreign investors; Fairchild Semiconductor	$10.0M

Early 1987	Round 5	Institutional investor	$ 5.0M
Late 1987	Round 6	Shintech (a division of Shin-Etsu) individual and foreign investors	$ 5.0M

BACKGROUND

Brooktree Corporation designs, develops, and markets high-performance data conversion devices. The Company currently offers a complete line of VIDEODACs, which are D/A converters designed for use in video applications; RAMDACs, which are a combination of VIDEODACs and a color look-up table on one chip; and other related products. Brooktree's products are based on the Brooktree Matrix,a proprietary design technology that allows the combination of analog and digital processes on a single chip. The Company uses standard CMOS or bipolar manufacturing processes.

One of the founders of Brooktree was Dr. Henry Katzenstein, who developed the Brooktree Matrix. The Matrix is a fundamental advance in data conversion architecture and was the initial impetus for the formation of the Company. James Bixby, president of the Company, was previously director of engineering at Spin Physics, a division of Eastman Kodak. While at Spin Physics, Mr. Bixby developed a high-speed motion analysis system.

In November 1987, Brooktree acquired Manx Engineering Corp., a small company that has developed specialized hardware for document compression/ decompression. The acquisition gives Brooktree an opportunity to move into systems, specialized chips, and boards for document management.

Brooktree also intends to broaden its customer base with the addition of a product line aimed at ATE and instrumentation applications. The Company is currently offering a series of timing vernier ICs for ATE use.

Recent Highlights

July 1987 — Brooktree offered radio-frequency identification (RD ID) chips that are being used to automate tool changing. The chips are a mix of on-chip logic, PROMs, and communication components that identify the right tool so the host computer can direct its attachment.

Nov. 1987 — Brooktree acquired Manx Engineering Corp., a small company that developed specialized hardware for document compression/decompression. The acquisition gave Brooktree an opportunity to move into systems, specialized chips, and boards for document management.

Jan. 1988	Brooktree signed Analog Devices as a second source of the Bt471 and Bt478 video DACs, which are aimed at PS/2 and VGA add-in boards.

ALLIANCES

Toshiba	1985	Toshiba signed a royalty-bearing licensing agreement to utilize Brooktree technology for consumer digital audio applications.
Fairchild	April 1986	Brooktree and Fairchild signed a broad-ranging partnership coupling Brooktree's D/A conversion technology with Fairchild's manufacturing capability. Fairchild made an equity investment and provides foundry services.
Analog Devices	Jan. 1988	Brooktree signed Analog Devices as a second source of the Bt471 and Bt478 video DACs, which are aimed at PS/2 and VGA add-in boards.

SERVICES

Design
Development
Test

MANUFACTURING

Technology

3.0-, 2.0-, 1.5-micron Silicon-Gate Double-Metal CMOS
2.0-, 1.5-micron ECL bipolar

Facilities

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

PRODUCTS

VIDEODACS

Device	Description	Clock Rate (MHz)
Bt101	Triple 8-Bit, Pipelined Operation	50, 30
Bt102	Single 8-Bit, 0,7.5 or 10 IRE Pedestal	75
Bt103	Triple 4-Bit, Pipelined Operation	75, 30
Bt106	Single 8-Bit, Pipelined Operation	50, 30
Bt107	Single 8-Bit, 2:1 Multiplexed Pixel Inputs	400
Bt108	Single 8-Bit, Pipelined Operation	400, 300, 200
Bt109	Triple 8-Bit, Pin Compatible to TDC1318	250

RAMDACS

Bt450	Triple 4-Bit, 16x12 Dual Port Color Palette RAM	70, 50, 30
Bt451	Triple 4-Bit, 256 Word Dual Port Color Palette RAM	25, 110, 80
Bt453	Triple 4-Bit, 256 Word Color Palette RAM	66, 40
Bt454	Triple 4-Bit 16x12 Color Palette RAM	170, 110
Bt457	Single 8-Bit, 256x8 Dual Port Color Palette RAM	125, 100, 80
Bt461	Single 8-Bit, Multiplexed TTL Pixel Ports	170, 110, 80
Bt471	Triple 6-Bit, 256x18 Color Palette RAM	80, 50, 35

Graphics Peripheral Devices

Bt401-404	256x8 Pipelined SRAM, Optional 3x8 Overlay Registers, 10KH and 100K ECL Compatible	250
Bt424	40-Bit Multi-Tap Shift Register, 10KH ECL/TTL Compatible	250
Bt431	64x64 User Definable Cursor	35 MHz per 5 pixels
Bt438	Clock Generator Chip for 125 MHz CMOS RAMDACS	250
Bt439	Clock Generator/Synchronizer Chip for Single Channel 125 MHz CMOS RAMDACS	150
Bt501/502	Octal ECL/TTL Bidirectional Transceiver/Translator, 10KH and 100K ECL Compatible	N/A

D/A Converters

Device	Description	Settling Time
Bt104	Monolithic Single 12-bit, Unlatched Data Inputs	40ns
Bt105	Monolithic Single 12-bit, Latched Version of Bt104	40ns
Bt110	Monolithic Octal 8-bit, Standard MPU Bus Interface	100ns

ATE Devices

Device	Description
Bt601	Dynamically Programmed Timing Edge Vernier, 10KH ECL Compatible
Bt602	Programmable Timing Edge Vernier, 20ps Resolution, 10KH ECL Compatible
Bt603	Programmable Timing Edge Delay, 20ns to 200ns span, 10KH ECL Compatible
Bt687	Ultrafast ECL Dual Comparator

Military Devices

Bt101/883	MIL-STD-883C Version of Bt101 VIDEODAC, 30-MHz Clock Rate
Bt102/883	MIL-STD-883C Version of Bt102 VIDEODAC, 66-MHz Clock Rate
Bt453	MIL-STD-883C Version of Bt453 RAMDAC, 40-MHz Clock Rate, 40-Pin Ceramic Sidebrazed DIP Package
Bt458/883	MIL-STD-883C Version of Bt458 RAMDAC, 100-MHz Clock Rate, 84-Pin Ceramic PGA Package

California Devices, Inc.
535 Los Coches Street
Milpitas, CA 95035-5423
408/262-4440

ESTABLISHED: 1978
NO. OF EMPLOYEES: 140

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Jerry Robinson	Censtor	VP Operations
VP Mktg/Sales	Stephen Pass	Linear Technology	VP Sales
VP Finance/Admin	Bill Stopperan	Adv Energy Tech	Controller
VP Operations	Richard Veldhouse	Dynatech	VP Admin
VP Engineering	Tim Carmichael	National	Engr Mgr
Mgr Process Engr	Richard Morley	Sprague	Process Engr Mgr
Dir QA/Rel	Nicholas Ortenzi	UTC	QA Engr

FINANCING

Date	Round	Sources	Amount
Aug. 1985	Round 1	Bay Partners; Brentwood Associates; Dougery, Jones, & Wilder; InnoVen Group; Merrill Lynch Venture Capital; Oxford Partners; Alan Patricof Assoc.; Xerox Venture Capital	$13.5M
Sept. 1986	Round 2	Bay Partners; Brentwood Associates; Dougery, Jones & Wilder; Drexel Burnham Lambert; John Hancock Ventures; InnoVen Group; Merrill Lynch Venture Capital; Alan Patricof Assoc.	$ 3.0M
Oct. 1986	Round 3	Bay Partners; Brentwood Associates; Dougery, Jones & Wilder; Edelson Technology Partners; Hook Partners; InnoVen Group; John Hancock Ventures; Lambda Fund; Merrill Lynch Venture Capital; Oxford Partners; Alan Patricof Assoc.; J.F. Shea & Co.; Xerox	$ 3.9M

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 that are manufactured using a CHANNELLESS (TM), which CDI pioneered. The process is a silicon-gate CMOS, which utilizes two-layer metal interconnection technology. The architecture achieves twice the circuit density of comparable existing gate array products and is, therefore, much less expensive to manufacture.

In August 1987, California Devices filed for Chapter-11 protection and reorganized the Company. As part of the reorganization, Edelson Technology Partners became a majority shareholder of CDI and played an important role in keeping the Company independent. The move was made to keep Storage Technology Corporation (STC) from selling the Louisville, Colorado, plant. CDI acquired the plant from STC and still owes about $3 million.

Recent Highlights

April 1987	CDI and Innovative Silicon Technology (IST) agreed to a joint product development and second-source agreement covering two families of ASICs using CHANNELLESS architecture. The first family is a 2-micron, double-metal CMOS with up to 24,000 gates. The second family is based on a 1.5-micron technology and will include more than 100,000 gates.
Dec. 1987	CDI offered a PC-based design kit for its 2-micron gate arrays. The kit was developed in cooperation with Asic Engineering Inc. The design kit is ported to the Viewlogic Workstation platform, and handles CDI's line of CHA CHANNELLESS gate arrays ranging from 200 to 12,000 gates. CDI also authorized Asic Engineering as a design center for the CDI arrays.

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	CDI announced the first portion of a three-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.
IST	April 1987	CDI and Innovative Silicon Technology (IST) agreed to a joint product development and second-source agreement covering two families of ASICs using CHANNELLESS architecture. The first family is a 2-micron, double-metal CMOS with up to 24,000 gates. The second family is based on a 1.5-micron technology and will include more than 100,000 gates.
Asic Engineering	Dec. 1987	CDI offered a PC-based design kit for its 2-micron gate arrays. The kit was developed in cooperation with Asic Engineering Inc. The design kit runs on Viewlogic's Workstation platform and handles CDI's line of CHA CHANNELLESS gate arrays ranging from 200 to 12,000 gates. CDI also authorized Asic Engineering as a design center for the CDI arrays.

SERVICES

Design
Manufacturing
Assembly
Test

MANUFACTURING

Technology

1.5-, 2.0-, and 3.0-micron CMOS
Two-layer metal

Facilities

Milpitas, CA	12,000 sq. ft.	Headquarters, design, marketing, sales
Louisville, CO	65,000 sq. ft.	Wafer fab
	12,000 sq. ft.	Class-10 and Class-100 clean rooms

PRODUCTS

CMOS Gate Arrays

Family	Process	Linewidth (Microns)	Delay (ns)	Gates
DLM	Si-Gate	3.0	2.0	210 to 10,000
CHA	Si-Gate	2.0	1.1	210 to 13,230
CSB	Si-Gate	1.5	1.0	3,500 to 21,000

California Micro Devices Corporation
215 Topaz Street
Milpitas, CA 95035
408/263-3214

ESTABLISHED: 1980
NO. OF EMPLOYEES: 370

BOARD

Name	Affiliation
Chan M. Desaigoudar, Chairman	California Micro Devices Corporation, CEO
James P. Burgess	Cambur Company, president
C. Lester Hogan	Varian Associates, director
Dr. Handel H. Jones	California Micro Devices Corporation, president
Angel G. Jordan	Carnegie-Mellon University, provost
Stuart Schube	Acorn Ventures, Inc., president

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
CEO	Chan M. Desaigoudar		
President/COO	Handel H. Jones	Custom MOS Arrays	President
VP Sales	Frank Richardson	Unitrode	Regional Mgr

FINANCING

Date	Sources	Amount
Oct. 1986	Initial public offering	$5.2M

BACKGROUND

California Micro Devices Corporation (CMD) designs, manufactures, and markets a wide range of high-performance electronic components through its Thin Film, ASIC, and Microcircuits Divisions. The components are marketed to military, aerospace, medical, computer, and communications customers.

CMD was formed originally in 1980 to acquire the assets of Capsco Sales, Inc., a thin-film company founded in 1976. In 1982, CMD established Custom MOS Arrays (CMA), which designed, manufactured, and marketed HCMOS cell-based ICs and gate arrays in the 200- to 2,000-gate range. In September 1986, CMD and CMA merged into one company. Dr. Handel H. Jones, formerly president of CMA, became president and COO of the new company.

CMA operates as the ASIC division of CMD and produces primarily gate array and cell-based ICs based on 2.5-, 2.0-, and 1.25-micron HCMOS technologies, with complexities of from 100 to 20,000 gates. The Company has adapted its cell-based designs to analog and digital products and has increased the level of integration by depositing precision thin film on to the ICs.

The thin-film division designs and manufactures precision resistive products including networks, capacitors, and metallized substrates for both hybrid and microwave applications. The division also produces nonimpact, high-density, color ink-jet printheads. In November 1985, the Company introduced its proprietary SX resistor chip materials for high-performance applications that require precision resistance and stability characteristics.

In August 1987, CMD acquired the assets of GTE Communication Systems' Microcircuits Division for $14.5 million. The acquisition covered all of Microcircuits assets including inventory, receivables, trade payables, intellectual properties, five acres of land, silicon wafer foundry and test facilities, and personnel. In the transaction, GTE Communication Systems also granted a preferred vendor status to CMD and a license to proprietary technology in custom chips.

The division, which operates as the Microcircuits Division of CMD, offers custom telecommunications circuits, MPU and peripherals ICs, and gate arrays used in telecommunications systems. R&D efforts focus on products in the telecommunications arena. About 60 percent of sales is into the telecommunications market, 20 percent in the personal computer market, with the remainder from foundry business. The division provides about 50 percent of its production to support the internal requirements of GTE Communications Systems.

Recent Highlights

Sept. 1986	CMD and Custom MOS Arrays merged. The charter of the combined companies is to advance state-of-the-art thin-film technology and apply it to products in high-growth markets.
Oct. 1986	CMD made an initial public offering of 1.0 million shares of common stock at $6.00 per share. The offering raised $5.2 million.
Nov. 1986	CMD signed an agreement with Fuji Photo Film Co., Ltd., under which CMD will license its HCMOS gate array and cell-based design technologies for $1 million. Fuji Photo Film will use the technology internally in image- and information-processing equipment.

March 1987	CMD signed an agreement with Tachonics Corporation to produce GaAs ICs. Tachonics will manufacture the commercial and military products at its foundry in New Jersey. CMD will provide cell design and tools in the 1.0- to 0.5-micron range. Initial products will be GaAs gate arrays in the 500- to 2,500-gate range and with radiation-hardened capability.
June 1987	CMD reported fiscal 1987 revenue of $10.2 million for the period ending June 30, 1987. Net income was $433,000.
Aug. 1987	CMD acquired the assets of GTE Microcircuits Division.
Nov. 1987	CMD and Telefonica, a $4 billion national telephone company in Spain, signed a joint venture agreement to form a company named California Micro Devices SA in Spain. CMD plans to invest about $2 million and will own about one-third of the firm. CMD SA will offer thin-film passive components for hybrid assemblies, gate arrays, cell-based ICs, and nonimpact printhead substrates. CMD and Telefonica will also jointly develop ASICs. CMD will provide technology and training. Products marketed in Spain will serve Spain's defense needs.
Nov. 1987	CMD offered the G8870, a CMOS DTMF receiver that is a combination decoder and filter. The device is said to detect all 16 DTMF tone pairs and convert them into code.
Dec. 1987	CMD reported second-quarter revenue of $7.3 million for the period ending December 31, 1987. Second-quarter revenue for the same quarter a year ago was $2.3 million. Net income was $437,000, an increase of 113 percent from the $205,000 for the same period a year before.
Dec. 1987	CMD and Western Design Center Inc. (WDC) filed suits against each other, covering products that CMD acquired when it purchased the GTE Microcircuits Division. CMD claims that the licensing agreements signed by GTE and WDC were included in the sale of GTE Microcircuits Division to CMD. WDC claims that CMD has no legal right to manufacture and sell products incorporating WDC designs.

ALLIANCES

Ricoh	1982	Ricoh provided wafers to CMA.
	1983	CMD signed a joint technology agreement with Ricoh covering CMOS silicon-gate and BIMOS gate arrays and standard cells.

Racal	Jan. 1982	Racal agreed to allow CMA to design, manufacture, and sell Racal's new 5.0-micron silicon-gate CMOS gate arrays in the United States.
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 1.2-micron design rules. TRW will use the rules internally for its DSP products.
CMA	Sept. 1986	CMD and CMA merged. The charter of the combined companies is to advance state-of-the-art thin-film technology and apply it to products in high-growth markets.
Fuji Photo Film	Nov. 1986	CMD signed an agreement with Fuji Photo Film Co., Ltd., under which CMD will license its HCMOS gate array and cell-based design technology for $1 million. Fuji Photo Film will use the technology internally in image- and information-processing equipment.
Tachonics	March 1987	CMD signed an agreement with Tachonics Corporation that calls for Tachonics to manufacture commercial and military GaAs ICs at its foundry in New Jersey. CMD will provide cell design and tools in the 1.0- to 0.5-micron range. Initial products will be GaAs gate arrays in the 500- to 2,500-gate range and with radiation-hardened capability.
Telefonica	Nov. 1987	CMD and Telefonica signed a joint venture agreement to form a company named California Micro Devices SA in Spain. CMD plans to invest about $2 million and will own about one-third of the firm. CMD SA will offer thin-film passive components for hybrid assemblies, gate arrays, cell-based ICs, and nonimpact printhead substrates. CMD and Telefonica will also jointly develop ASICs. CMD will provide technology and training.

SERVICES

Design
Packaging
Test

MANUFACTURING

Technology

1.25-, 1.5-, 2.0-, and 2.5-micron HCMOS
Silicon-gate, single- and dual-layer metal
4-inch and 6-inch wafers

Facilities

Milpitas, CA	40,000 sq. ft.	Total space
	15,000 sq. ft.	Class-1000 clean room
Tempe, AZ	46,000 sq. ft.	Manufacturing, test
	20,000 sq. ft.	Clean room

PRODUCTS

CMOS Gate Arrays

Family	Process	Linewidth (Microns)	Delay (ns)	Gates
C1000	Si-Gate	1.5	0.8	5,000 to 18,000
C2000	Si-Gate	2.0	2.0, 1.25	200 to 3,100
C3000	Si-Gate	2.5	2.5	1,500 to 10,500
C5000	Si-Gate	1.25	0.4	500 to 25,000

CMOS Cell Library

Process	Linewidth (Microns)	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

Linear

G8870	CMOS DTMF Receiver That Combines Decoder and Filter
G8912	PCM Filter

Calmos Systems, Inc.
20 Edgewater Street
Kanata, Ontario, Canada K2L 1V8
613/836-1014
Fax: 613/831-1742
Telex: 053-4501

ESTABLISHED: April 1983
NO. OF EMPLOYEES: 50

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
VP Technology	Gyles Panther	Siltronics	VP Technology
VP Engineering	Andrew Herrington	Amiga	Dir Engineering

FINANCING

Date	Round	Sources	Amount
Not available	Round 1	Private	$1.0M
Not available	Round 2	Private	$0.4M
Not available	Round 3	Private and grants	$3.6M
Nov. 1987	Round 4	Private	$0.5M

BACKGROUND

Calmos Systems designs, develops, and markets a variety of devices, including VHSIC-level products that use CMOS and bipolar processes. The Company's CMOS products consist of the CA80C85B MPU and a line of peripherals, including SCSI and SCC devices. The Company also offers fast-turn prototyping and low-volume production runs that use e-beam technology.

In February 1988, Calmos acquired Siltronics' bipolar IC line. The acquisition adds about $2.5 million to Calmos' sales, which were $2 million in 1987. Calmos has purchased Siltronics' assets, especially the equipment for testing and assembly of the circuits.

Calmos hired about 24 of Siltronics' key employees, including founder and Vice President Gyles Panther, doubling the size of Calmos' work force.

The Siltronics' product line consists of FM receiver chips for data and cellular radio applications, a delta codec chip based on an exponentially variable step-size algorithm, DC-DC converter chips, a power supply monitor, and an MPU supervisory chip.

The Company participates in a EUREKA, a European consortium R&D project and is working with European Silicon Structures (ES2) to exploit the technology in ASIC design. Calmos, together with ES2, offers quick-turn prototyping using direct-write e-beam technology, which can implement several design projects on the same wafer.

Recent Highlights

Jan. 1987	Calmos licensed its 8200 series of devices to Samsung in exchange for a foundry commitment.
Feb. 1987	Calmos formed an alliance with ES2 to offer quick-turn prototyping. The companies will use direct-write e-beam technology, which can implement several design projects on the same wafer.
Sept. 1987	Calmos announced that it has developed a prototype of a public-key data-encryption system implemented on a chip. The chip uses an algorithm developed at the University of Waterloo in Ontario that allows encryption by exponentiation at speeds of several hundred bits per second.
Feb. 1988	Calmos acquired Siltronics' bipolar component business for $500,000. Siltronic's product line consists of FM receiver chips, a codec chip, DC-DC converter chips, a power supply monitor, and an MPU supervisory chip.
Nov. 1987	Calmos received a federal contribution of more than $3 million from the Canadian DRIE to join the EUREKA program. The project involves the expansion of the Company's headquarters located in Kanata, Ontario, to include packaging and test facilities for semiconductor products and the expansion of its CAE system.

ALLIANCES

Samsung	Jan. 1987	Calmos licensed its 8200 series of devices to Samsung in exchange for a foundry commitment.
Siltronics	Feb. 1988	Calmos acquired Siltronics' bipolar component business for $500,000. The product line consists of FM receiver chips, a codec chip, DC-DC converter chips, a power supply monitor, and an MPU supervisory chip.

SERVICES

Design
Assembly
Test

MANUFACTURING

Technology

2.0- and 3.0-micron CMOS
0.9- to 1.5-micron CMOS VHSIC
3.0- and 5.0-micron bipolar

Facilities

Kanata, Ontario, Canada	13,000 sq. ft.

PRODUCTS

ASICs

Device	Description
CMOS Gate Arrays	228 to 1,000 Gates, 2ns Typical Delay
Structured Cell Library	80 Cells Including 4-Bit Adders Shift Registers
Macro Cell Library	RAM, ROM, Dual-Port RAM, 29C01, 80C85, and 8200 Series of Peripherals

Microcomponents

Device	Description	Speed
CA80C85B	8-Bit MPU with Extended Instruction Set	3 to 5 MHz
CA80C85S	CA80C85B with Static Operation (2Q88)	6 to 10 MHz

8000 Series Peripherals

CA82C12	8-Bit MPU	8 to 10 MHz
CA82C37A	Static DMA Controller	5 to 10 MHz
CA82C54	Static Interval Timer	8 to 10 MHz
CA82C55A	Static Peripheral Interface	5 to 10 MHz
CA82C59A	Static Interrupt Controller	5 to 10 MHz
CA82C84A	Static Clock Generator/Driver	8 to 10 MHz
CA82C88	Static Bus Controller	5 to 10 MHz
CA53C80	Static SCSI Interface Controller	1.5 to 3.0 Mbps
CA34C168	Real-Time Data Encryption Processor	300 Kbps

DSP

CA29C128	Digital FIR Filter Controller	25 MHz
DFS001-P	PC Board with Programmable FIR Filter and with Software Interface	
FIRCALC-PC	FIR Filter CAD Program	

Memory

CA16C08	2KX8 SRAM	25ns
CA16C09	2Kx9 SRAM	25ns
CA64C08	8KX8 SRAM	35ns
CA64C09	8Kx9 SRAM	35ns

Bipolar IC Product Line

Communications Circuits

S422	FM Receiver
S412	Cellular Radio Receiver
S404/406	FM Receiver Two-Chip Set
S408/410	FM Receiver for Data
S2842	Delta Codec

Power Supply Circuits

S420/424	Low-Voltage DC-DC Converters
S2862	Power Supply Monitor

Specialty Circuits

S416	Programmable Monolithic Diode Matrix
S2854	MPU Control Circuit
S144	Triple Op Amp

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

ESTABLISHED: July 1983
NO. OF EMPLOYEES: 40

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Manny Del Arroz	Intel	Process Manager

FINANCING

Date	Round	Sources	Amount
1983	Initial	Private	$0.025M

BACKGROUND

Calogic Corporation designs, develops, and manufactures DMOS analog products, CMOS and bipolar linear products, and gate arrays. The Company also builds fabrication facilities and markets semiconductor equipment.

The Company was founded without venture capital and from 1985 to 1987, initially concentrated on foundry contracts and building mini fabrication facilities, using its own facility as a model. Calogic has set up fabrication facilities for Data Linear, Microwave Device Modules, and other foreign companies.

In the first quarter of 1988, Calogic began ramping up its proprietary line of linear products, which includes op amps, reference, and regulators. The Company plans to introduce 20 additional products in 1988 and to double its wafer fabrication capacity to a total of 30,000 square feet.

Calogic achieved a positive cash flow within its first year of operation. The Company is profitable, with sales of about $5 million, and continues to grow at a rate of about 50 to 100 percent per year.

ALLIANCES

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

SERVICES

Consulting
Design
Foundry

MANUFACTURING

Technology

3-micron DMOS
5.0- to 3.0-micron metal-gate CMOS
3.0-micron bipolar linear with thin film

Facilities

Fremont, CA	30,000 sq. ft.	Design, manufacturing, and test
	7,000 sq. ft.	Class-100 clean room

PRODUCTS

Op Amps
Regulators
References
DMOS FET
CMOS MPR
DMOS Switching Arrays

Catalyst Semiconductor, Inc.
2231 Calle De Luna
Santa Clara, CA 95054
408/748-7700
Fax: 408/980-8209
Telex: 5106017631

ESTABLISHED: October 1985
NO. OF EMPLOYEES: 52

BOARD

Name	Affiliation
B.K. Marya	Catalyst Semiconductor, president
George Pottorff	Pottorff, MacFarlane & Associates, Inc.

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	B.K. Marya	Exel	President
Exec VP	Stephen Michael	GE Solid State	VP Custom ICs
VP Corp Dev	Hide Tanigami	Exel	Bus Dev/Japan
Mgr European Sales	Barry Stanley		

FINANCING

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

BACKGROUND

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

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

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, California, within the next two years.

Recent Highlights

Jan. 1987	Catalyst offered the CAT93C46 and CAT59C11, two CMOS 1K serial EEPROMs. The devices offer selectable serial memory organization and automatic write instruction.
March 1987	Catalyst and Oki Electric extended a previous agreement to include a wide range of CMOS EEPROMs. The agreement includes 1K serial EEPROMs; 256-bit and 512-bit serial EEPROMs; and 16K, 64K, and 256K EEPROMs.
April 1987	Stephen Michael, formerly vice president of GE Semiconductor's Custom Integrated Circuit Department, joined Catalyst as executive vice president and COO. He has responsibility for all day-to-day operations.
June 1987	Catalyst offered the CAT62C580, a CMOS 8-bit MCU with 16K of EEPROM on-chip. The device also includes 3 Kbytes of mask-programmable ROM and 128 bytes of data RAM.
June 1987	Catalyst offered the EASE 62580 program development and evaluation system for the CAT62C580 single-chip, 8-bit MCU. The system runs on the IBM PC AT or compatible MS-DOS machines.
July 1987	Catalyst offered its first CMOS SRAMs. The CAT71C256 and CAT71C256L are low-power 32Kx8 devices with an access/cycle time of 85ns. The CAT71C88 is a 16Kx4 SRAM with an access time of 45ns.
Sept. 1987	Catalyst sampled a 1Mb EPROM with an access time of 150ns.
Oct. 1987	Catalyst introduced the CAT28C16A and CAT28C17A, its first 16K EEPROMs. Both are organized as 2Kx8 and offer a 150ns access time.

ALLIANCES

Zilog	Dec. 1985	Catalyst and Zilog entered into a joint development and second-source agreement for user-programmable standard products. The Companies' initial effort 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	July 1986	Catalyst and Oki entered into an agreement calling for long-term research and development of NVRAMs for ASICs using CMOS EPROMs and EEPROMs. Terms include a nonexclusive marketing agreement.
	March 1987	Catalyst and Oki Electric extended the previous agreement to include a wide range of CMOS EEPROMs. The two companies planned a joint introduction of a 1K serial EEPROM; 256-bit and 512-bit serial EEPROMs; and 16K, 64K, and 256K EEPROMs by the end of 1987.

SERVICES

Design
Test

MANUFACTURING

Technology

1.2-micron design rules
Double-metal, double-poly CMOS

Facilities

Santa Clara, CA	20,000 sq. ft.	Offices

PRODUCTS

CMOS SRAM

Device	Description
CAT22C10	64x4
CAT22C12	256x4
CAT71C256/71C256L	32Kx8
CAT71C88	16Kx4
CAT24C44	16x16 Serial RAM

CMOS EPROM

1Mb EPROM

CMOS EEPROMs

CAT93C46/59C11	1K Serial
CAT28C16A/28C17A	2Kx8

Microcontrollers (SmartCard Chips)

CAT62C580	8-Bit MCU, 16K of EEPROM On-Chip, 3 Kbytes of Mask-Programmable ROM, 128 Bytes of Data RAM

Development Tools

EASE 62580	A Program Development and Evaluation System for the CAT62C580 Single-Chip, 8-Bit MCU

Celeritek, Inc.
617 River Oaks Parkway
San Jose, CA 95134
408/433-0335
Fax: 408/433-0991

ESTABLISHED: 1984
NO. OF EMPLOYEES: 60

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Tamer Husseini	Granger Assoc.	VP Operations
VP Amp Ops	Gary Policky	Avantek	Mgr Adv Dev M/W
VP SC Ops	Ross Anderson	Avantek	Mgr GaAs Dev
VP Finance	John Beman	ROLM	Controller
VP Mktg/Sales	Robert Jones	Avantek	Dir Marketing

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, Inc., designs, manufactures, and markets GaAs FETs, MMICs, and custom subsystems such as up/down converters for military and commercial applications.

The Company has developed a thin-film microwave amplifier technology and manufactures many of its low-noise and medium-power GaAs FETs in-house. All microwave amplifier thin-film circuits use a high-energy sputtering process for reliable and repeatable metal adhesion. The Company can also manufacture silicon MOS capacitors. Celeritek uses a family of standard amplifier modules that can be combined and aligned to achieve customer-specific specifications.

Recent Highlights

July 1987	Celeritek leased 23,860 square feet of R&D space in San Jose, California.
Dec. 1987	Avantek filed a suit against Celeritek and two of its founders, Tamer Husseini and Ross Anderson, charging theft of trade secrets.

ALLIANCES: None

SERVICES

Design
Manufacturing
Assembly

MANUFACTURING

Technology

GaAs

Facilities

San Jose, CA	23,860 sq. ft.	Research and development and manufacturing
	1,000 sq. ft.	Class-100 clean room

PRODUCTS

Low-Noise Amplifiers

Family	Frequency	Power Output
CMA Series	0.5 to 18 GHz	+18 dBm
CMT Series	2 to 18 GHz	+18 dBm

Medium-Power Amplifiers

Family	Frequency	Power Output
CPA Series	6 to 18 GHz	+27 dBm
CPT Series	6 to 18 GHz	+23 dBm

Microsize Connectorless Amplifiers

Family	Frequency	Power Output
240/400 Series	2 to 18 GHz	
520 Series	0.5 to 4 GHz	

MMIC Chips

CMM-2 Amp	2 to 6 GHz	
CMM-4 Amp	2 to 18 GHz	
CMS-12 Switch	DC to 18 GHz	

GaAs FETs

CF004-02	2 to 40 GHz	+13 dBm
CF003-01	2 to 20 GHz	+22 dBm
CF010-01	2 to 18 GHz	+28 dBm

Chartered Semiconductor Pte Ltd.
3-Lim Teck Kim Road
STC Building 10-02
Singapore 0208
Phone: 65-320-7271

ESTABLISHED: October 1987
NO. OF EMPLOYEES: N/A

BOARD

Ming Seong Lim, chairman

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Managing Director	B. John Hambridge	Fairchild	VP Logic Division

FINANCING

Date	Round	Sources	Amount
Oct. 1987	Round 1	National Semiconductor Corporation (9%); Sierra Semiconductor Corporation (17%); Singapore Technology Corporation (74%)	$40.0M

BACKGROUND

Chartered Semiconductor Pte Ltd. is a result of a joint venture among National Semiconductor Corporation, Singapore Technology Corporation, and Sierra Semiconductor Corporation. Singapore Technology holds 74 percent of the Company; Sierra holds 17 percent, and National the remaining 9 percent. Total investment in the facility and equipment will be about $40 million.

The Company, which is located at a 170,000-square-foot site in the Singapore Science Park, will initially fabricate and test CMOS wafers and ASIC devices primarily for Sierra Semiconductor and National Semiconductor. Chartered Semiconductor began construction in October 1987 and plans its first wafer starts in January 1989. The facility will fabricate submicron devices in a Class-1 clean room with an initial capacity of 5,000 6-inch wafers per month. The facility will be capable of generating about $50 million in revenue per year.

Sierra is contributing its proprietary Triple Technology CMOS process, technical management, and training. National is providing CMOS process technology, technical training, and technical support in the construction and start-up of the clean-room facility. Singapore engineers have been training at Sierra's San Jose, California, facility for more than a year. Additional training is scheduled at National and Sierra facilities in 1988. Tom Klein, vice president and founder of Sierra, will supervise the facility construction and start-up of the manufacturing process. Sierra's Triple Technology is capable of integrating analog, digital, and EE memory on one chip.

ALLIANCES

National, Sierra, Singapore	Oct. 1987	National Semiconductor, Sierra Semiconductor, and the Singapore Technology Corporations cooperated in a joint venture to form Chartered Semiconductor.

SERVICES

- Foundry
- Manufacturing
- Test

MANUFACTURING

Technology

- Submicron CMOS
- 6-inch wafers

Facilities

Singapore	170,000 sq. ft.	Manufacturing

The Company plans its first wafer starts in January 1989. The facility will include a Class-1 clean room and have initial capacity of 5,000 wafers per month.

PRODUCTS (Planned)

- CMOS Wafers
- ASIC Devices

Chips and Technologies, Inc.
3050 Zanker Road
San Jose, CA 95134
408/434-0600
Fax: 408/434-9315

ESTABLISHED: January 1985
NO. OF EMPLOYEES: 150

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Gordon Campbell	SEEQ	Founder/President
VP/GM Sys Logic	Dado Banato	SEEQ	Dir Engr
VP Sales	David Bowman	Apple	Natl Sales Dir
VP Technology	Morris E. Jones	Amdahl	
VP/GM Dsn Svcs Op	Stephen Kahng	Up to Date Tech	Founder
VP Mktg/Sales	Keith Lobo	LSI Logic	VP/GM MPU Prod Grp
VP Finance/CFO	Gary P. Martin	Apple	VP Finance
VP Graphics Op	Judy Owen	Silicon Graphics	GM MCAE Div
VP Manufacturing	James Stafford	SEEQ	Dir Materials
VP Business Dev	Ronald T. Yara	Intel	Mktg Mgr

FINANCING

Date	Round	Sources	Amount
1984	Round 1	Bill Marocco, other individuals	$ 1.7M
1984	Round 2	Ascii; Kyocera; Mitsui; Yamaha	$ 1.5M
Oct. 1986	Round 3	Initial public offering	$11.3M
July 1987	Round 4	Second public offering	$15.5M

BACKGROUND

Chips and Technologies, Inc., designs, manufactures, and markets VLSI circuits for IBM-compatible microcomputer systems. The Company offers products in four areas--system logic, graphics, communications, and mass storage. The Company also offers a computer-aided environment (CAE) that enables the mapping of existing technology into vendors' products.

In January 1988, Chips and Technologies announced a line of chip sets designed to be compatible with IBM's PS/2 line of personal computers. The chip sets are the result of a codevelopment effort undertaken with Adaptec, Phoenix Technologies, and The Santa Cruz Operation. The companies introduced a series of integrated hardware products that provide complete systems solutions for producing desktop computers fully compatible with IBM PS/2 Models 50, 60, and 80. The Chips and Technologies and Adaptec products are fully compatible with Microsoft's MS-DOS and OS/2. Phoenix Technologies and The Santa Cruz Operation are providing critical software support. The new CHIPS250 is a micro channel-compatible system logic chip set for IBM PS/2 Models 50 and 60, and the CHIP280 is a chip set compatible with the Model 80. The chip sets are manufactured using 1.5-micron CMOS technology and consist of the following devices.

Chipset	Description
CHIPS/250 for Models 50/60 16-Bit Products	
82C221	CPU and Micro Channel Controller
82C222	Advanced Memory Controller
82C223	Advanced DMA Controller
82C225	Data Address Buffers
82C226	System Peripherals Controller
82C607	Multifunction Controller
82C451/452	VGA
82C61X/82C62X	Standard or Custom MicroCHIPS
CHIPS/280 for Model 80 32-Bit Products	
82C321	CPU and Micro Channel Controller
82C322	Advanced Memory Controller
82C223	Advanced DMA Controller
82C325	Data Buffer/Controller
82C226	System Peripherals Controller
82C607	Multifunction Controller
82C451/452	VGA
82C61X/82C62X	Standard or Custom MicroCHIPS

Recent Highlights

Sept. 1986 Chips and Technologies offered the 82C206 Integrated Peripheral Controller (IPC) chip, which is IBM PC AT-compatible. The chip combines the functions of seven VLSI chips in an AT system board.

Oct. 1986 Chips and Technologies offered the 82C435 Enhanced Graphics Controller (EGC) and the 82A436 Bus Interface, which, when combined, will configure a complete EGA-compatible board with 15 chips, including 256K of display memory.

Oct. 1986 Chips and Technologies introduced the CS8230 AT/386 CHIPSet, a seven-chip set for Intel 80386-based 32-bit microcomputers. The CS8230, combined with the 82C206 IPC chip, lets users configure an IBM PC AT-compatible system board with a total of 40 chips, plus memory. The 8230 includes the following chips:

- 82C301 bus controller
- 82C302 page/interleave memory controller
- 82C303/304 address buffer
- 82C305 data buffer
- 82C306 control logic

June 1987 Chips and Technologies sampled the 82C437 SharpScan, an EGA-compatible graphics chip set with drivers and 1,128x560 line resolution.

July 1987 Chips and Technologies introduced its first chip set for designing IBM PS/2 Model 30-compatible microcomputer systems. The 82C100 supports the 8088, 8086, C20, and V30 MPUs at speeds of up to 10 MHz and targets the Model 30, PC XT computers. The 82C101 chip supports 8088 and V20 MPUs and targets XT-compatible computers. Three companion chips are the 82C606 CHIPSpak and the CHIPSport, which are both multifunctional peripherals controllers, and the 82C764A, which is an analog floppy disk data separator.

Aug. 1987 Chips and Technologies introduced the CS8221 NEAT CHIPSet, a four-chip, 16-MHz 286 chip set for high-performance PC AT-compatibles. The chip set uses a new 16 MHz 80286-16 MPU introduced by AMD and consists of three new VLSI circuits from Chips. The new circuits are the 82C211 Bus/Clock Controller, the 82C212 Interleaved Page Mode Memory Controller, the 82C215 Address/Data Buffer, and a high-speed version of the IPC.

Oct. 1987 Chips sampled MicroChips, a 2-chip Micro Channel interface for add-in boards on PS/2-compatible systems. MicroChips consists of the 82C611 and the 82C612. The 82C611 is said to replace up to 10 to 15 TTL devices and is designed for memory, I/O, and multifunctional adapters. The 82C612 replaces 25 to 30 TTL devices and is made for peripherals control adapters.

Oct. 1987 Chips and Technologies introduced the 82C570 CHIPSLink, a single-chip controller that implements the IBM 3270 protocol.

Dec. 1987	Chips reported second-quarter revenue of $32.4 million for the period ending December 31, 1987. Revenue for the same quarter a year ago was $16.5 million. Net income for the period was $5.6 million, an 82 percent increase over the net income of $3.1 million for the same quarter a year before. The increase was attributed to higher-volume shipments of PC AT-compatible systems logic products that increased manufacturing efficiency and raised the gross margin to 52 percent for the quarter.
Jan. 1988	Chips and Technologies and Adaptec introduced a series of integrated hardware products that provide a complete PS/2 systems solution. Phoenix Technologies and The Santa Cruz Operation are providing critical software support. The Chips and Technologies and Adaptec products are fully compatible with Microsoft's MS-DOS and OS/2. Chips and Technologies new CHIPS/2 family of CHIPSets is for IBM PS/2 Models 50, 60, and 80. The CHIPS/250 is a solution for 12- and 16-MHz, 80286-based PS/2 Models 50-/60-compatible systems and is also 100 percent-compatible with IBM's Micro Channel Architecture.
Jan. 1988	Chips and Technologies introduced the CHIPS/280, a seven-chip, 32-bit chip set for building systems 100 percent-compatible with the IBM PS/2 Model 80.
Jan. 1988	Chips and Technologies introduced the CHIPS/450 series, a line of single-chip VGA graphics products that feature a high-performance interface to the CHIPS/250 and CHIPS/280 CHIPSets. Introduced were the 82C451 VGA Controller and 82C452 Super VGA Controller, both optimized for PS/2 environments.

ALLIANCES

Fujitsu, Toshiba, and Yamaha	Nov. 1985	Chips subcontracts foundry services from from Fujitsu, Toshiba, and Yamaha for CMOS and bipolar arrays.
National	Nov. 1986	National Semiconductor will manufacture CMOS ICs for Chips and Technologies under a fabrication services agreement. National is Chips' first U.S. source.
Adaptec	Oct. 1988	Chips and Adaptec introduced a series of integrated hardware products that provide complete solutions for producing desktop computers fully compatible with IBM PS/2 Models 50, 60, and 80.

SERVICES

VLSI Design
Microcomputer Systems Design

MANUFACTURING

Technology

1.25- to 1.5-micron CMOS, bipolar
BICMOS

Facilities

Milpitas, CA	27,000 sq. ft	Design

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

PRODUCTS

Systems Logic

Part Number	Description	Process	Speed (MHz)
82C100	Model-30-Compatible Chip	CMOS	10
82C101	Low-Cost XT Chip	CMOS	10
CS8220	PC AT-Compatible CHIPSet		8,10,12
82C201	System Controller	CMOS	8,10,12
82C202	Memory Decoder and I/O Controller	CMOS	8,10,12
82A203	High-Address Buffer and Port B	Bipolar	8,10,12
82A204	Low-Address Buffer and Refresh Control	Bipolar	8,10,12
82A205	Data Bus Buffer and Parity Control	Bipolar	8,10,12
CS8221	New Enhanced PC AT/CHIPSet (NEAT)		12,16
82C211	Bus Controller	CMOS	12,16
82C212	Memory Interleave Controller	CMOS	12,16
82C215	Data Bus Buffer and Transceiver	CMOS	12,16
82C206	Integrated Peripherals Controller (IPC)	CMOS	12,16
CS8226	CS8220 with an IPC		10,12

Part No.	Description	Process	Speed (MHz)
CS8230/1/2	AT/386 CHIPSet		16,20
82C301	Bus Controller	CMOS	16,20
82C302	Memory Controller	CMOS	16,20
82A303	High-Address Buffer	Bipolar	16,20
82C303	High-Address Buffer	CMOS	16
82A304	Low-Address Buffer	Bipolar	16,20
82C304	Low-Address Buffer	CMOS	16
82A305	Data Buffer	Bipolar	16
82B305	Data Buffer	BICMOS	16,20
82C305	Data Buffer	CMOS	16
82A306	Control Signal Buffer	Bipolar	16,20
82C306	Control Signal Buffer	CMOS	16
82C312	Cache Controller	CMOS	16,20
DK8210	Model-30-Compatible Development Kit		
DK8220	PC AT-Compatible Development Kit		
DK8221	PC/NEAT Development Kit		
DK8230	AT/386 Development Kit		
Graphics			
CS8240	Four-Chip (EGA) CHIPSet	CMOS	24
82C431	Graphics Controller	CMOS	24
82C432	Sequencer	CMOS	24
82C433	Attributes Controller	CMOS	24
82C434	CRT Controller	CMOS	24
82C435	Enhanced Graphics Controller	CMOS	30,38
82A436	Bus Interface	Bipolar	38
82C437	SharpScan	CMOS	60
CM82C437	SharpScan Chips Module		
CS8241	SEGA CHIPSet with BIOS		30
CS8245	VGA CHIPSet		30,38
82C441	VGA Controller	CMOS	30,38
82C442	VGA Bus Interface	Bipolar	38
DK82C435	SEGA BEGA Development Kit		
DK8245	VGA Development Kit		

Part No.	Description	Process	Speed (MHz)
Communications Family			
82C550	StarLAN Serial Interface	CMOS	
82C551	StarLAN Hub controller	CMOS	
82C605	CHIPSport: Multifunctional Controller	CMOS	
82C606	CHIPSpak: Multifunctional Controller	CMOS	
DK 82C605/606	CHIPSport/CHIPSpak Development Kit		
Mass Storage			
82C64A	Floppy Disk Data Separator	CMOS	
82C570	CHIPSLink	CMOS	
DK82C764A	Data Separator Development Kit		

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

ESTABLISHED: 1984
NO. OF EMPLOYEES: 120

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Michael Hackworth	Signetics	Sr VP
Exec VP/Strat Ops	Kamran Elahian	CAE Systems	Founder/President
VP R&D	Dr. Suhas Patil	Patil Systems	Founder
VP Engineering	Kenyon Mei	Intel	GM OEM Comm
VP Manufacturing	Michael L. Canning	Teledyne	President/GM
VP Marketing	George Alexy	Intel	Mktg Mgr MPUs
VP Sales	Eugene Parrott	Intel	Mgr Strat Accts
VP Finance	Marilyn Guerrieri	Zitel	Dir Finance

FINANCING

Date	Round	Sources	Amount
March 1984	Seed	Nazem & Company	$ 1.6M
May 1985	Round 1	Brentwood Associates; Nazem & Company; New Enterprise Associates; Robertson, Colman & Stephens; Technology Venture Investors	$ 7.5M
May 1986	Round 2	Previous investors; Institutional Venture Partners	$ 3.0M
Nov. 1986	Round 3	Previous investors; Kuwait & Middle East Financial; New York Life Insurance	$ 4.5M
June 1987	Round 4	Previous investors; Berkeley Development Capital; Evergreen; Management Partners; New Venture Partners; T.R. Technology Investment; UNC Ventures	$11.0M

BACKGROUND

Cirrus Logic, Inc., designs, manufactures, and markets optimized mass storage controllers, communications controllers, and graphics controller chips for data communications, mass storage control, and display/graphics control applications. The Company's VLSI circuits use a proprietary silicon compilation technique and can be designed as standard products, as well as market- and customer-specific derivatives.

Cirrus Logic is the commercial follow-on to Patil Systems, a research laboratory founded in 1981. In 1984, financing was received from Nazem & Company of New York, and Cirrus Logic acquired Patil Systems.

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 with the density and performance of full-custom devices. Suhas Patil invented the S/LA concept, a type of silicon compilation technology with supporting CAD tools for logic design, simulation, and automatic layout.

Recent Highlights

Jan. 1987	Cirrus Logic licensed a custom Winchester disk drive controller IC to Western Digital Corp. (WDC). WDC gained indirect access to the product when it acquired Adaptive Data Systems, Inc., a board manufacturer.
June 1987	Cirrus Logic raised $11 million in funding. The funds were used to expand manufacturing and test capabilities, with the intent of doubling test capacity. Cirrus Logic also purchased $1.5 million worth of Sun Microsystems work-stations for its design centers.
Oct. 1987	Cirrus Logic signed an agreement with DIA-Semicon Systems in Japan to distribute new and existing products in Japan. Cirrus Logic began sale of its Winchester disk controller chip set in Japan. DIA-Semicon Systems was founded in 1986 and is 80-percent owned by Mitsubishi Electric Corporation.
Oct. 1987	Cirrus Logic offered the CL-GD510/520, a video graphics array device for the IBM PS/2-compatible market. A custom version of the device was developed in part with Video Seven.
Nov. 1987	Cirrus Logic offered the CL-SH135 CMOS enhanced Winchester hard-disk formatter chip.
	Cirrus Logic offered the CL-SH250, a CMOS single-chip SCSI disk controller that consists of a formatter, buffer manager, and SCSI bus interface.

Nov. 1987	Award Software, Inc., of Los Gatos, California, agreed to develop a VGA graphics BIOS and demonstration board for Cirrus Logic's GD510/520 VGA chip set. The agreement includes a complete hardware and software solution for PS/2-compatible graphics.
Dec. 1987	Cirrus Logic announced that it had begun volume production of the CL-GD510/520 chip set.
April 1988	Cirrus Logic offered the CL-SH260, a CMOS single-chip PC XT-/AT-compatible disk controller that consists of a formatter, buffer manager, and PC XT/AT bus interface.

ALLIANCES

AMD	Sept. 1985	Cirrus Logic and AMD agreed to a technology exchange wherein Cirrus Logic will use silicon-compiled, 1.6-micron, double-metal CMOS-processed wafers to develop an MCU for AMD. AMD provides foundry services.
Silicon Systems	Oct. 1986	Cirrus Logic and Silicon Systems agreed to exchange controller and buffer manager functions and mutually second-source the devices. Both chips will be processed with a 2-micron CMOS technology.
WDC	Jan. 1987	Cirrus Logic licensed a custom Winchester disk drive controller IC to DC, which gained indirect access to the product when it acquired Adaptive Data Systems, Inc., a board manufacturer.
DIA-Semicon Systems	Oct. 1987	Cirrus Logic signed an agreement with DIA-Semicon Systems in Japan to distribute new and existing products in Japan. Cirrus Logic began sale of its Winchester disk controller chip set in Japan. DIA-Semicon Systems was founded in 1986 and is 80 percent-owned by Mitsubishi Electric Corporation.
Award Software	Nov. 1987	Award Software, Inc., of Los Gatos, California, agreed to develop a VGA graphics BIOS and demonstration board for Cirrus Logic's GD510/520 VGA chip set. The agreement includes a complete hardware and software solution for PS/2-compatible graphics.

SERVICES

Design
Test

MANUFACTURING

Technology

3.0-micron NMOS and CMOS
1.5- and 2.0-micron, double-metal CMOS

Facilities

Milpitas, CA	50,000 sq. ft.	Administration, engineering, design, and marketing
	10,000 sq. ft.	Class-1000 clean room (test facility)

PRODUCTS

Mass Storage Controllers

Device	Description
CL-SH120	CMOS Buffer Storage Manager
CL-SH130	CMOS Winchester Hard Disk Formatter
CL-SH135	CMOS Enhanced Winchester Hard-Disk Formatter
CL-SH250	SCSI Disk Controller with Formatter, Buffer Manager
CL-SH260	Disk Controller with Formatter, Buffer Manager, XT/AT Bus Interface

Display Controller

CL-GD510/520	Video Graphics Array--IBM PS/2-Compatible

Conductus Inc.
2275 East Bayshore Road
Palo Alto, CA 94303
415/494-7836

ESTABLISHED: September 1987
NO. OF EMPLOYEES: N/A

BOARD

Name	Affiliation
John Shoch	Asset Management Company
Tony Sun	Venrock Associates
Regis McKenna	Kleiner, Perkins, Caufield & Byers

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	John Shoch	Asset Management Co.	General Partner
CFO	Tony Sun	Venrock Associates	General Partner

FINANCING

Date	Round	Sources	Amount
Oct. 1987	Round 1	Asset Management; Banner Partners; Bryan & Edwards; Burr, Egan, Deleage & Co.; Glenwood Mgmt.; Institutional Venture Partners; Kleiner, Perkins, Caufield & Byers; Stanford University; Technology Venture Investors; Venrock Associates	$6.1M

BACKGROUND

Conductus Inc. was formed to explore and commercialize high-temperature superconductor technology for use in the production of superconducting electronic devices. The Company plans to explore very high-speed digital devices, magnetic field detectors, other types of detectors and sensors, and high-speed interconnection between ICs and between printed circuit boards.

The Company does not expect immediate commercialization of these applications; however, Conductus plans to undertake R&D projects with established computer and electronics companies, and it will pursue available government contracts to advance the new technology.

Cree Research Inc.
2810 Meridian Parkway
Durham, NC 27713
919/361-5709

ESTABLISHED: 1987
NO. OF EMPLOYEES: 11

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Eric Hunter	MKS Instruments	District Sales Mgr
Dir Technology	Calvin H. Carter	NCSU	Assoc Professor

FINANCING

Date	Round	Sources	Amount
Nov. 1986	Seed	Not available	$0.5M
March 1988	Round 1	Not available	$2.5M

BACKGROUND

Cree Research Inc. was formed to develop, design, manufacture, and market discrete devices using silicon carbide (SiC) technology developed at North Carolina State University (NCSU). Founders of the Company are Eric Hunter, Calvin H. Carter, Jr., Neal Hunter, John A. Edmond, and John Palmour--all former research team members at the university. Cree Research has obtained exclusive worldwide rights on the university's 10 U.S. SiC patents and on any future filings.

Initially, the Company is focusing on simple devices--diodes and blue LEDs that have immediate benefit to customers in aircraft engine applications, deep well drilling, and digital color imaging. Prototypes were introduced in April 1988.

Cree Research plans to have an SiC-based MOSFET prototype in the third quarter of 1988. The transistor was developed by John W. Palmour, a doctoral candidate in materials science and engineering at NCSU. Presently, the wafer size is 1 inch; however, the Company expects to be able to grow 2-inch wafers by year end.

In November 1987, the Company raised $500,000 in financing to fund itself through the prototype stage. In March 1988, $2.5 million was raised in first-round financing. The funds are being used to establish an 8,200-square-foot manufacturing facility, which will be completed in July 1988.

The Company has won contracts with the Department of Defense, set up arrangements for assembly and test services, and is also discussing arrangements with major semiconductor manufacturers.

ALLIANCES: Not available

SERVICES

- Development
- Design
- Manufacturing

MANUFACTURING

Technology

MESFETs and MOSFETs on silicon carbide

Facilities

Durham, NC	8,200 sq. ft.	Development, design, manufacturing

PRODUCTS

Blue LEDs
Diodes--High-Temperature pn, 350° Centigrade with Reverse-Bias Leakage Current of less than 1 nanoamp at +125V

Crystal Semiconductor Corp.
4210 South Industrial Road
P.O. Box 17847
Austin, TX 78760
512/445-7222
TWX: 910-874-1352

ESTABLISHED: October 1984
NO. OF EMPLOYEES: 110

BOARD

Name	Affiliation
H. Berry Cash, chairman	Berry Cash Southwest Partnership
L.J. Sevin	Sevin, Rosen Management Company
James H. Clardy	Crystal Semiconductor
Michael J. Callahan	Crystal Semiconductor
Dietrich R. Erdmann	Sevin, Rosen Management Company

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	James H. Clardy	Harris	VP WW Ops
VP Engineering	Michael J. Callahan	Texas Micro-Circuit	Founder/Pres
VP Marketing	Craig H. Ensley	Rockwell	Director Mktg
VP Technology	Eric J. Swanson	AT&T	Telecom Engr Mgr
VP Sales	Alan R. Schuele	Cypress Semiconductor	Regional Sales Mgr

FINANCING

Date	Round	Sources	Amount
Oct. 1984	Round 1	Berry Cash Southwest Partnership; Dietrich Erdmann; Hambrecht & Quist; The Hill Partnership; InterWest Partners; Republic Investment Co.; Sevin, Rosen Management Company	$ 4.5M
Feb. 1986	Round 2	Original investors; Coronado Venture Fund; Crown Associates; Kleiner, Perkins, Caufield & Byers; Rho Management Company; Rust Ventures	$ 6.7M
Jan. 1987	Equity	Asahi Chemical	$15.0M

BACKGROUND

Crystal Semiconductor Corp. develops, manufactures, and markets advanced Smart Analog ICs that combine analog and digital functions on a single CMOS device for the telecommunications/data communications, 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 that 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 communications 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).

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

Recent Highlights

Jan. 1987	Asahi Chemical acquired an 8 percent share in Crystal for about $4 million. Asahi Kasei Microsystems, a subsidiary of Asahi Chemical, will manufacture and market Crystal's devices for the Far Eastern market. The agreement gives Crystal an aggregate financial package of $15 million.
April 1987	Crystal offered the CS61534 analog line interface which combines the analog transmit and receive line interface functions for T1/CEPT applications. The device features a programmable line driver and on-chip data-and-timing recovery circuit.
April 1987	Crystal offered the CS5016 16-bit, self-calibrating D/A converter featuring conversion time of 16 microseconds, MPU interface, three-state output buffers, and digitally selectable unipolar or bipolar output ranges.

May 1987 — Crystal offered the CSZ511X Series of 12-, 14-, and 16-bit successive approximation A/D converters for DSP systems.

Sept. 1987 — Crystal offered the CS7820 8-bit A/D self-contained converter with a 1.36-microsecond conversion time.

Oct. 1987 — Crystal offered the CS3112 self-calibrating, 12-bit, 1-microsecond track-and-hold amplifier.

Dec. 1987 — Crystal offered the CS5012-7 self-calibrating, 12-bit, 100-KHz sampling A/D converter with on-chip sample-and-hold amplifier.

Jan. 1988 — Crystal offered the CSZ5412 monolithic 12-bit, 1-MHz, self-calibrating A/D converter with on-chip track-and-hold amplifier, MPU interface, three-state output, and overrange output.

ALLIANCES

Asahi Chemical	Jan. 1987	Asahi Chemical acquired an 8 percent share in Crystal for about $4 million. Asahi Kasei Microsystems, a subsidiary of Asahi Chemical, will manufacture and market Crystal's devices for the Far Eastern market. The agreement gives Crystal an aggregate financial package of $15 million.

SERVICES

Research and Development
Design

MANUFACTURING

Technology

3.0-micron CMOS silicon-gate
2-layer poly structure, single layer of metal

Facilities

Austin, TX	25,000 sq. ft.	Design and test

Crystal is planning a production facility in 1990. Currently, Orbit Semiconductor and International Microelectronic Products in the United States, Mitel Semiconductor of Canada, and Asahi Chemical of Japan provide foundry services.

PRODUCTS

T1/CCITT PCM Line Interfaces

Device	Description
CS61544/61534/61574/6158	Analog Line Interface; 1 MHz, CCITT 2 MHz

Jitter Attenuators

CS61600	T1 1.5-MHz and CCITT 2.0-MHz Jitter Attenuators
CS80600	4.5- to 8.5-MHz Token Ring Jitter Attenuators

DTMF Receivers

CS202/203/204/8870	DTMF Receivers

Fiber-Optic Transmitters/Receivers

CS8123/8124	OptiModem
CS8125/8126	Fiber-Optic T1 Transmitter/Receiver

Analog Data Converters

CS5012	12-Bit, 7-Microsecond A/D Converter
CS5014	14-Bit, 14-Microsecond A/D Converter
CS5016	16-Bit, 16-Microsecond A/D Converter
CS7820	Flash 8-Bit, 1.4-Microsecond A/D Converter
CSZ112	12-Bit, 100-kHz A/D Converter
CSZ114	14-Bit, 55-kHz A/D Converter
CSZ116	16-Bit, 50-kHz A/D Converter
CSZ5316	16-Bit, 20-kHz Delta Sigma A/D Converter
CSZ5317	16-Bit, 20-kHz Delta Sigma A/D Converter with PLL Clock Generator
CSZ5412	12-Bit, 1-MHz, Two-Step Flash A/D Converter

Amplifiers

CS31412	Quad, 1-Microsecond Acquisition Time, Track and Hold
CS3112	Single, 1-Microsecond Acquisition Time, Track and Hold

Filters

C7008	Universal Digitally Programmable Switched-Capacitor Filter
C7004	Two-Biquad Digitally Programmable Switched-Capacitor Filter
CDS7000	ICE Development System

Evaluation Boards

CDB31412	Quad Track and Hold
CDB501X/511X	Successive Approximation A/D Converters
CDB5316	Delta Sigma A/D Converters
CDB5412	Two-Step Flash A/D Converters
CDB61534/61544	PCM Line Filter
CDB7008	Universal Filter

Custom Arrays Corporation
525 Del Rey Avenue
Sunnyvale, CA 94086
408/749-1166
Fax: 408/749-1718
Telex: 510-600-5119

ESTABLISHED: October 1984
NO. OF EMPLOYEES: 11

BOARD

Name	Affiliation
B. Bornette	ELF Aquitaine, France
Pierre R. Irissou	Custom Arrays Corporation
George Krautner	Custom Arrays Corporation

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Pierre R. Irissou	ATAC Diffusion SA	Managing Director
Exec VP	George Krautner	Ferranti-Interdesign	VP Mktg/Sales
VP Finance	B. Hass	Ferranti-Interdesign	VP Finance

FINANCING

Date	Round	Sources	Amount
April 1985	Round 1	ATAC Diffusion SA (division of ELF Aquitaine)	$300,000
Oct. 1986	Round 2	SOFIPA (investment division of ELF Aquitaine)	$500,000
July 1987	Round 3	FINAXIA; private investors	$400,000
Oct. 1987	Round 4	Merger with public company (blind pool)	$145,000
May 1988	Round 5	Societe Financiere Internationale de Participations	$500,000
		Gaz et Eaux	$500,000

BACKGROUND

Custom Arrays Corporation was formed to design and manufacture analog bipolar linear arrays that are supported by a CAE design software environment and run on MS-DOS on a PC AT hardware platform. The Company also offers quick-turn prototyping services.

The Company's founder is Pierre R. Irissou, who also serves as the Company president and the vice president of research and development. Mr. Irissou remains a board member of ATAC which has exclusive marketing rights for Custom Arrays' products in France. In October 1987, the Company merged with a blind-pool public corporation and is listed on the pink sheets and traded OTC. The Company is incorporated in Nevada; however, all operations are conducted in Sunnyvale, California.

The Company's short-term strategy is to offer quick turnaround on prototypes based on its MM and MV families of bipolar arrays. The MM family consists of nine arrays with 2 to 28 macrocells. The MV family consists of five arrays with 4 to 20 macrocells. Both families are a result of a joint development venture with Ferranti-Interdesign, located in Scotts Valley, California.

The Company's long-term strategy is to expand its bipolar array offerings to include thin-film technology options including laser-trim capability. Custom Arrays is developing new arrays based on a high-voltage BICMOS process compatible with thin-film technology.

Custom Arrays has expanded its facilities to support in-house reticle and mask manufacture, direct-step-on-wafer (DSW) photolithography, wafer processing for metal patterning and top-glass passivation, dice-package assembly, and full-production testing at both the wafer and package level.

ALLIANCES

ATAC-Diffusion	ATAC operates a design center and conducts marketing for Custom Arrays in Europe.
Ferranti-Interdesign	The MM family is the result of a joint development venture with Ferranti-Interdesign, Inc. Ferranti-Interdesign acts as a second source.
Teledyne	Custom Arrays entered into a joint development agreement with Teledyne Semiconductor for a new family of BICMOS semicustom and cell-based libraries. The technology will feature operating voltage levels of 18V.

SERVICES

Design
Prototype Manufacturing
Production Manufacture
Assembly
Test

MANUFACTURING

Technology

Bipolar
BICMOS

Facilities

Sunnyvale, CA	12,000 sq. ft.	Manufacture, assembly, test

PRODUCTS

Linear Arrays

MM Family of 20V Bipolar Analog Arrays with 2 to 28 Macrocells
MV Family of 40V Bipolar Analog Arrays with 4 to 20 Macrocells

Development Tools

MMSPICE/MMSCOPE	Circuit (SPICE) Simulator
LIBERTY	MM and MV Layout and Verification Software
PC-PG	Mask File Translator for Pattern Generation
LIKE	Cell-Based IC Design Software

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 R. Shean	Custom Silicon Inc.

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Albert P. Belle Isle	Wang	Vice President
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	Bank of New England; First Chicago; Turner Revis Associates;	$1.1M
June 1985	Round 2	Original investors; Massachusetts Capital Resource Company; Paine Webber Ventures	$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'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 currently produces devices with up to 14,000 gates and planned to add a family of CMOS and bipolar linear arrays in the first quarter of 1987.

CSi is the ASIC distribution channel for NCR Corporation for both New England and the Pacific Northwest; it is also the northeastern independent design center for Motorola. In September 1986, WSI NCR licensed CSi's standard cell library that includes 342 TTL macrocells and microcomputer building blocks of up to 5,863 gates. CSi's library was built from NCR's existing library.

CSi's sales strategy is to build a network of regional operations to act as distribution channels for major manufacturers that serve 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 resell 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	NCR licensed CSi's standard cell library that includes 342 TTL macrocells and microcomputer building blocks of up to 5,863-gates. CSi's library was built from NCR's existing library.
FutureNet	March 1984	CSi offered its standard cell library on the FutureNet DASH design system.
VIEWlogic	Oct. 1985	CSi offered its standard cell library on VIEWlogic's Workview PC-based workstation. The library includes 165 digital primitives and 7,400/TTL macrocells.

Motorola	Aug. 1986	CSi agreed to act as the northeastern independent design center for Motorola.

SERVICES

Design

MANUFACTURING

Technology

3.0-, 2.0-, and 1.5-micron CMOS and bipolar

Facilities

Lowell, MA	12,000 sq.ft.	Design

CSi has a long-term licensing and sourcing agreement with NCR, which provides preferred access to multiple manufacturing facilities.

PRODUCTS

CMOS Standard Cells

Device	Description
Micro Blocks Family	200 Cells Including Adders, ALUs, Multiplexers; Dual-Port RAMs; Multiplexers, Shift Registers; and Three-State Bus Drivers
TTL Macro Cells	Encoders, Decoders, Adders, Shift Registers, Multiplexers, Counters
Supercells	ROM, RAM, EEPROM, PLA, MPU, Timer, SCSI Controller
Analog Cells	General-Purpose Op Amp and Comparator, 8-Bit A/D and D/A Converter, Current-Bias Generator, Analog Switch, Oscillators

CMOS Gate Arrays

Family	Linewidth (Microns)	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

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

ESTABLISHED: April 1983
NO. OF EMPLOYEES: 650

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 Ops	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	Kleiner, Perkins, Caufield & Byers; Mayfield Fund; Merrill, 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 Mgmt.; Robert Fleming Investment Management; Glynn Capital; Robertson, Colman & Stephens	$11.7M

March 1985	Round 3	First- and second-round investors; T.R. Berkeley; Harvard Management; Manufacturers Hanover Trust; Newtek; Security Pacific; Stanford University; Yamaichi	$10.5M
Aug. 1985	Round 4	Capital Management; Glynn Capital; Harvard Management; Kleiner, Perkins, Caufield & Byers; Manufacturers Hanover Trust; Mayfield Fund; Merrill, Pickard, Anderson & Eyre; Robert Fleming Investment Management; Robertson, Colman & Stephens; Security Pacific; J.H. Whitney	$10.5M
June 1986		Initial public offering (IPO)	$72.8M
June 1987		Post-IPO offering	$39.8M

BACKGROUND

Cypress Semiconductor Corp. designs, develops, manufactures, and markets high-performance, high-speed digital ICs, using CMOS process technologies. The Company uses proprietary 1.2-micron or smaller technology to produce a broad line of standard products for numerous performance-driven niche markets.

Products include fast SRAMs, EPROMs, FIFOs, PLDs, a bit-slice family, and DSP devices that feature high speed, low power consumption, and packaging to any specifications. The Company's products are used in military and aerospace, telecommunications, instrumentation, and computation applications.

In January 1987, Cypress established a subsidiary, Cypress Semiconductor Texas, which conducts manufacturing in the new Round Rock, Texas, facility.

In December 1987, Cypress formed a wholly owned subsidiary, Aspen Semiconductor, and provided first-round financing of $7.4 million. Aspen will design and develop ultrahigh-speed bipolar ECL ICs including memories and PLDs with a sub-3ns access time. The devices that Aspen develops will be manufactured and marketed by Cypress.

Recent Highlights

June 1986	Cypress completed an initial public offering that raised $72.8 million. The funds were used to build a new manufacturing facility in Texas. The facility became operational in February 1987. The San Jose, California, location was 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.
Feb. 1987	Cypress reincorporated in Delaware.
March 1987	Cypress offered the CY7C251 a 16Kx8 reprogrammable power-switched PROM featuring a 45ns access time. It is manufactured with a 1.2-micron CMOS process.
June 1987	Cypress offered an additional 5.1 million shares of common stock and raised $39.8 million, increasing the Company's cash balance to $108.0 million. The net proceeds were used for working capital and to increase its capital base.
Oct. 1987	T.J. Rodgers joined the board of Vitesse Semiconductor.
Nov. 1987	Cypress established Cypress Semiconductor GmbH in Munich, West Germany. The new Company is headed by Gerhard Kittel.
Dec. 1987	Cypress formed a wholly owned subsidiary, Aspen Semiconductor, and provided first-round financing for $7.4 million. Aspen will design and develop ultrahigh-speed bipolar ECL ICs including memories and PLDs with a sub-3ns access time. The devices that Aspen develops will be manufactured and marketed by Cypress.
Dec. 1987	Cypress reported fourth-quarter revenue of $24.3 million and net income of $4.0 million for the period ending December 31, 1987. Revenue for fiscal 1987 was $77.3 million and net income was $13.4 million.
Dec. 1987	Cypress announced that its Round Rock facility generated more than $8 million in revenue. Cypress also offered two new products--the 7C162, a 16Kx4 SRAM, and the 7C254, a 16Kx8 PROM. In addition, Cypress offered a 12ns version of the 7C150 1Kx4 SRAM.

Dec. 1987	Cypress and Matra-Harris Semiconducteurs (MHS) extended a prior agreement to include the manufacture and marketing of five Cypress 64K SRAMs. The new agreement provided $600,000 in licensing revenue to Cypress in the fourth quarter of 1987. In addition, Cypress contracted $1.5 million in technology revenue through agreements with MHS in 1988.

ALLIANCES

MMI	June 1983	Monolithic Memories, Inc. (MMI) 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 (7C187 16Kx1) SRAMs and provided its 1.2-micron CMOS process to MHS. MHS received 2 percent of Cypress' stock for $25 million. A joint development agreement for Cypress' future 0.8-micron process and an ultrahigh-speed 64K SRAM were also included.
	Dec. 1987	Cypress and MHS extended their prior agreement to include the manufacture and marketing of five Cypress 64K SRAMs. The new agreement provided $600,000 in licensing revenue to Cypress in the fourth quarter 1987. Cypress has also contracted with MHS for $1.5 million in technology revenue in 1988.
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.
Altera	June 1987	Cypress and Altera signed a five-year agreement to develop a family of EPLDs. Altera is providing architecture, circuit design, and software support. Cypress is providing its 0.8-micron CMOS EPROM process, manufacturing capability, and marketing support.

Sun Microsystems	July 1987	Cypress and Sun Microsystems agreed on the joint development of a CMOS RISC MPU product line based on Sun's scaleable processor architecture (SPARC). This second-generation SPARC MPU will include an integer processor, floating-point processor, MMU, and cache memory.
Aspen	Dec. 1987	Cypress formed a wholly owned subsidiary, Aspen Semiconductor, and provided first-round financing for $7.4 million. Aspen will design and develop ultrahigh-speed bipolar ECL ICs including memories and PLDs with a sub-3ns access time. The devices that Aspen develops will be manufactured and marketed by Cypress.

SERVICES

Design
Manufacturing
Assembly
Test

MANUFACTURING

Technology

0.8- and 1.2-micron n-well CMOS
5- and 6-inch wafers

Facilities

San Jose, CA	61,500 sq. ft.	Fab-I manufacturing, assembly, test
	8,000 sq. ft.	Subclass-10 clean room
	60,000 sq. ft.	Headquarters, engineering, marketing and sales
Round Rock, TX	65,000 sq. ft.	Fab-II manufacturing including Class-1 clean room

PRODUCTS

Memory

CMOS Fast SRAMs

Part Number	Organization	Delay (ns)
CY7C123	256x1	7
CY7C147	4Kx1	25-35
CY7C150	1Kx4	12
CY7C167	16Kx1	25-35
CY7C168/169	4Kx4	25-35
CY7C171/172	4Kx4	25
CY7C162/189/190	16Kx4	25
CY7C187	64Kx1	25

CMOS PROMs

Device	Organization	Speed (ns)
CY7C225	512x8	15
CY7C235	1Kx8	30
CY7C251/254	16Kx8	45
CY7C261	8Kx8	40
CY7C267/268	8Kx8	40, 50, 60
CY7C281/282	1Kx8	30
CY7C291/245	2Kx8	35, 50

Specialty Memories

FIFOs

Device Type	Organization	Speed (MHz)
Dual-Port CMOS FIFO	64x4, 64x5	15
CY7C408	64Kx8	35
CY7C409	64Kx9	35

Microprocessors

Part Number	Description	Speed (ns)
CY7C901	4-Bit Slice MPU	23
	16-Bit Slice MPU	24
CY7C909/11	Microprogram Sequencer	30
	12-Bit Controller	50

DSP

Part Number	Description	Delay (ns)
CY7C516/517	16x16 Multipliers	38-45

Programmable Logic Devices

Part Number	Linewidth (Microns)	Delay (ns)
PALC16	1.2	20
PLDC20G10	1.2	25-35
PAL22V10	1.2	25-35

Development Tools

QuickPro	Programs PLD and PROM Devices

Dallas Semiconductor Corporation
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 Corporation

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	Abingworth Ltd.; New Enterprises Associates; Southwest Enterprises Associates; Ventech Partners	$2.0M
June 1984	Round 1	Initial investors; Arscott, Norton & Assoc.; Crossroads Capital; First Source Capital Corp.; John Hancock Venture Capital Fund LP; Merrill, Pickard, Anderson & Eyre; New Venture Partners; Oak Investment Partners; Republic Venture Group; J.F. Shea & Company; Venture Growth Associates	$9.6M
	Industrial Bond	Republic Bank, Dallas	$6.5M
March 1986	Round 2	Previous investors; British Petroleum Ventures; Alex Brown & Sons; Emerging Growth Stocks; HLM Partners; Merifin N.V.	$15.0M

April 1987	Round 3	Abingworth; Alex Brown & Sons; British Petroleum Ventures; Emerging Growth Stocks; HLM Partners; Merifin N.V.; New Enterprise Assoc.; Southwest Enterprises Assoc.; T. Rowe Price; Threshold Fund; Ventech Partners	$ 5.0M
Sept. 1987		Initial public offering	$36.0M

BACKGROUND

Dallas Semiconductor Corporation designs, manufactures, and markets low-power CMOS memory, linear, and microcontroller circuits and subsystem products. The Company is an applications-oriented supplier that uses proprietary late-definition techniques to customize wafers after test and characterization. This flexibility, called soft silicon, is achieved through the use of lithium power sources, direct laser writing, high-energy ion implantation, and subsystem integration.

The resulting products offer OEMs the advantage of adding functionality without the redesign of existing systems. Some of the more innovative products are the Company's intelligent sockets, which add features such as nonvolatility and timekeeping ability; timekeeping circuits, which replace up to 20 discrete components in the IBM PC AT and PS/2-compatible computers; silicon timed circuits, which replace crystal and discrete components and feature-precise, system-signal timing; and security products, which protect software from unauthorized use.

In August 1984, Dallas purchased Commodore's Texas plant for $3.5 million. Until early 1987, the Company purchased all wafers and completed its late-definition technique at its plant in Texas. In 1987, Dallas completed construction of a $10 million wafer fabrication facility adjacent to its headquarters. The facility includes a 10,000-square-foot, Class-1 clean room and has the capacity to produce 6-inch CMOS wafers with geometries down to 0.6-micron. Currently, Dallas processes about 90 percent of its wafer needs.

Dallas ships its wafers to assembly contractors in the Philippines and Korea for separation and packaging. Dallas conducts burn-in and final testing on its devices and conducts its own subsystem assembly.

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

Recent Highlights

Q1 1987	Dallas began producing wafers in a newly constructed, $10 million wafer fabrication facility adjacent to its headquarters.
Feb. 1987	Dallas offered the DS2167 digital signal processor (DSP) said to double the link of full-duplex telephone transmission lines. The DS2167 combines a DSP with the adaptive differential pulse code modulation (ADPCM) standard.
March 1987	Dallas offered the DS5000 8-bit CMOS soft MCU, which features nonvolatile technology designed to preserve all information in the absence of power.
Oct. 1987	Dallas offered 3.75 million shares of common stock at $9 per share in an initial offering and raised $36.0 million. The proceeds will be used for capital equipment and general corporate purposes.
Oct. 1987	Dallas offered the DS1207 CMOS Timekey circuit designed to control access to PC software packages for specified periods of time.
May 1987	Dallas and Xecom signed a second-source agreement covering Xecom's modem products and development kits and Dallas' SmartSocket and SmartWatch families. The companies will also cooperate on developing and manufacturing future modem-related products, the area of Xecom's expertise.
Aug. 1987	Dallas and Amp, Inc., formed an R&D partnership to solve applications problems with semiconductor technology.
Dec. 1987	Dallas filed a suit against Maxim Integrated Products. The suit is in response to warnings by Maxim that Dallas is violating certain receiver/transmitter patents held by Maxim.
Dec. 1987	Dallas reported fourth-quarter revenue of $9.8 million and a net income of $1.5 million for the period ending December 31, 1987. Fiscal 1987 revenue was $30.7 million and net income was $2.6 million, which included an extraordinary benefit of $954,000.

ALLIANCES

Thomson-Mostek	Jan. 1986	Thomson-Mostek (TCMC) was given royalty-free rights to second-source Dallas' multiport memory. In exchange for these rights, Dallas received an option to purchase a percentage of the products from Thomson. Dallas also received laser production equipment from Thomson and received technical information on TCMC's MK4501 FIFO.
Xecom	May 1987	Dallas and Xecom signed a three-year second-source agreement covering Xecom's modem products and development kits and Dallas' SmartSocket and SmartWatch families. The companies also agreed on the joint development of and manufacture of future modem-related products, the area of Xecom's expertise.
Amp	Aug. 1987	Dallas and Amp, Inc., formed an R&D partnership that will develop innovative interconnect techniques.

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

3.0- to 0.6-micron CMOS
6-inch wafers

Facilities

Dallas, TX	65,000 sq. ft.	Manufacturing area and a 10,000-square-foot Class-1 clean room
	60,000 sq. ft.	Warehouse, offices

PRODUCTS

SRAMs

Device	Description	Application
DS1220	16K 2Kx8 Module, 150ns	Gasoline Pump
DS1225	64K 8Kx8 Module; 150, 200 ns	Blood Analyzer, Printer
DS1230	256K 32Kx8 Module, 150ns	T1 Multiplier

FIFOs

DS2009	512x9 FIFO	Laser Printer
DS2010	1Kx9 FIFO, 120, 150ns	Avionics
DS2001	2KX9 FIFO, 150, 200ns	Telephone Tester

Microcontrollers

DS5000	8-Bit Soft MCU	Hospital Bed
DS5000T	8-Bit Time MCU	Personal Diabetes Monitor
DS2167	Digital Signal Processor	Telephone Transmission Lines

Linear Telecommunications Circuits

DS2168	Adaptive Differential PCM Processor	Speech Compression
DS2175	T1/CEPT Elastic Store Memory	Data and Voice Transmission
DS2176	T1 Receiver Buffer	Data and Voice Transmission
DS2180	Serial T1 Transceiver	Data and Voice Transmission
DS2186	T1 Transmit Line Interface	Data and Voice Transmission
DS2190	T1 Network Interface	Data and Voice Transmission

Timekeeping

DS1215	Time Chip	Industrial Controller
DS2187	Clock/Calendar	IBM PC AT, PS/2

Intelligent Sockets

DS1213	SmartSocket with Lithium Power	Traffic Light
DS1216	SmartWatch	Pay Telephone, Computer Workstations

Silicon Timed Circuits

DS1000	5-Tap Silicon Delay Line	Multibus Computer Systems
	10-Tap Silicon Delay line	Personal Computer
	3-in-1 Silicon Delay Line	Graphics Workstation

Security Products

DS1204	Electronic Key	Scientific Software Protection
DS1207	Time Key	Software Leasing
DS1250	Internal KeyRing	Medical Insurance Software Protection
DS1253	Rear Access KeyRing	Business Software Protection
DS1255	Electronic Lock	CAD Software Protection

User-Insertable Memory

DS1217	Electronic Memory Cartridge	Film Developer
	High-Density Memory Cartridge	Automated Teller Machine
DS1201	Electronic Tag	Flow Meter

Integrated Lithium Battery Backup

DS1211	Single NVRAM Controller	Airline Reservation System
DS1221	4 NVRAM Controller	Cellular Phone Base Station
	8 NVRAM Controller	Point-of-Sale Terminal
DS1212	16 NVRAM Controller	Hand-Held Inventory Control
DS1231	Power Monitor	Modem
DS1232	Micromonitor	
DS1259	Battery Manager	Lithium Power Pack
DS1260	SmartBattery	Lottery Totalizer
DS1215	TimeKeeper	

Systems Extension

DS1223	Electronic Configurator	Instrumentation
DS1206	Phantom Interface Serial Port	Chemical Analyzer
DS1290	Eliminator	IBM PS/2 Add-In Card
DS232	RS-232 Transceiver	Terminal Interconnect

Dolphin Integration SA
8, Chemin des Clos-ZIRST
38240 MEYLAN, France
33 (76) 41-10-96

ESTABLISHED: January 1985
NO. OF EMPLOYEES: 20

BOARD

Name	Affiliation
Michel Depeyrot, chairman	Dolphin Integration SA, president
Jean Gouliardon	SAGEM International
Michael Capart	EPICEA
Bernard Michelon	SOGINNOVE
Pierre Faurre	SAGEM, chairman

COMPANY EXECUTIVES

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

FINANCING

Date	Round	Sources	Amount
1985	Initial	EPICEA, SAGEM, SOGINNOVE, and founders	$600,000

BACKGROUND

Dolphin Integration SA provides design, 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- to 1-micron CMOS technology. Dolphin's design rules adapt to any silicon foundry's process. Dolphin has enlarged its catalog of design rules to include analog technologies using double-poly from 3 to 1.5 microns. The Company has also developed signal-processing and protocol ICs.

ALLIANCES: Dolphin has entered an agreement with a CAD/CAM group in California.

SERVICES

Design

MANUFACTURING

Technology

DIGIT--2.0- to 1.0-micron double-metal CMOS
DIANA--3.0- to 1.5-micron analog CMOS
DIXIE--Mixed high-power (BIMOS) and low-voltage CMOS

Facilities: Not available

PRODUCTS

Developmental Tools

VAX Network with Three Families
Tektronix X115, MicroVAX II, and COMPAQ 396
ECAD Software (ICAP and MASKAP)
LoF Cell Generator

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

ESTABLISHED: July 1983
NO. OF EMPLOYEES: 120

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	David O'Brien	PMI	President/CEO
VP Marketing	Dean Coleman	National	Analog Mktg Mgr
VP Operations	Richard Corbin	PMI	VP Technology
VP Sales	Ralph Granchelli	Teledyne Semi	Ntl Sales Mgr
VP Engineering Design	Barry Siegel	National	Std Hybrid

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 Corporation; Burr, Egan, Deleage & Co.; International Industrial Interests; Murray Electronics; Pacific Technology Ventures; Paribaven; Thorn EMI Venture Fund; Walden Capital Corporation	$3.1M
Aug. 1985	Round 3	Original investors; Jean Claude Asscher; Paribas Technology; Hytec Investment	$2.5M
Dec. 1986	Round 4	Capital Riksa Trust; CEI; Cypress Fund; Harvard Management; Morgan-Holland;Sequoia Capital; St. James Venture Capital Fund; U.S. Venture Partners; and others	$7.8M

BACKGROUND

Elantec, Inc., designs, manufactures, and markets high-performance analog circuits, using dielectric-isolation (DI) monolithic and hybrid technologies. The circuits are designed to be used in military and high-performance commercial applications. The Company supplies products to more than 25 military OEMs.

Elantec concentrates on high-performance analog IC and hybrid solutions and has identified a niche for very-high-speed operational amplifiers and buffers in video, page scanner, and fast radar systems. Advanced technologies are employed, including dielectric isolation, which allows very-high-speed npn and pnp transistors in the same chip.

Initially, Elantec offered alternatively sourced products 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 alternatively sourced versions of Harris Semiconductor's components that use a complementary bipolar dielectric-isolation process. Harris-sourced devices include op amps and buffers. Elantec is also developing proprietary devices such as a servo loop controller. In the long term the Company is considering data acquisition circuits.

One of the key strengths of the Company has been its military program. Elantec's facilities have been qualified by more than 25 major military OEMs including General Dynamics, Hughes, IBM, and Lockheed. The Company's facilities comply with MIL-STD-M38510, MIL-STD-1772A, and MIL-STD-883, Revision C. Elantec was the fourth among approximately 20 companies in the world to be certified to produce hybrid devices to MIL-STD-1772A. Elantec has also placed a great deal of emphasis on reliability and has adopted a two-for-one guarantee under which a part that fails is replaced with two good devices.

In December 1987, Elantec announced that its wafer fabrication facility in Milpitas, California, is operational. The facility uses its proprietary dielectric-isolation process and is capable of producing 2,000 4-inch wafers per month. Initially, the facility will produce 3-inch wafers. Elantec manufactures all military products on-shore, with some commercial assembly done in Southeast Asia.

European operations are managed from London, and Japanese sales are handled by Internix, a Japanese distributor. Marshall, Wyle, and Zeus are signed as North American distributors. Elantec also has regional sales offices in Dallas, Texas, and in Boston, Massachusetts.

Recent Highlights

March 1987	Elantec offered the EL2017J/883B monolithic closed-loop servo controller that features both precision linear and high-current switching modes of operation.
May 1987	Elantec offered the EL2020, a 50-MHz, current-feedback amplifier that is optimized for video and other applications, with gains between -10 and +10.
Sept. 1987	David O'Brien joined Elantec as president and chief executive officer, and Richard Corbin joined as vice president of operations. Mr. O'Brien replaced Al Vindasius who left the Company to pursue other interests.
Nov. 1987	Elantec signed an agreement allowing Micro Power to market Elantec's FET power buffers.
Dec. 1987	Elantec announced that its wafer fabrication facility is operational.

ALLIANCES

Micro Power	Nov. 1987	Elantec reached a joint agreement under which Micro Power will market Elantec's FET power buffers.

SERVICES

Design
Manufacturing
Test

MANUFACTURING

Technology

5-micron bipolar
4-inch wafers

Facilities

Milpitas, CA	21,000 sq. ft.	Corporate offices and manufacturing
	8,500 sq. ft.	Class-1000 clean room

PRODUCTS

Device	Description
EL2003/2033	Video Line Driver
EL2004	350-MHz FET Buffer
EL2005	High-Accuracy Buffer
EL2006	Precision High-Speed FET Amplifier
EL2007	Precision Servo Driver
EL2015	350-MHz Quad PNP
EL2016	300-MHz Quad NPN
EL2017	Servo Controller
EL2018	Fast, High-Voltage Comparator with Latch
EL2019	Fast, High-Voltage Comparator with Master/Slave Flip/Flop
EL2020	50-MHz Current-Mode Feedback Amplifier
EL2022	165-MHz Current-Mode Feedback Amplifier
EL2039	Very High-Rate, Wideband Op Amp
EL2040/2190	Wideband, Fast-Settling Op Amp
ELH0002	100mA Current Buffer
ELH0021	1A Power Op Amp
ELH0032	High-Speed FET Op Amp
ELH0033	High-Speed FET Buffer
ELH0041	200 mA Power Amp
ELH101	2A Power Op Amp
EDH0006	Current Driver
EDH0008	High-Voltage, High-Current Driver
EHA2500	Precision, High-Slew-Rate Op Amps
EHA2520	Uncompensated, High-Slew-Rate Op Amps
EHA2539	Very-High-Slew, Wideband Op Amp
EHA2600	Wide-Bandwidth, High-Impedance Op Amp
EHA2620	Wide-Bandwidth, Uncompensated Op Amps

Electronic Technology Corp.
525 East 2nd Street
Ames, IA 50010
515/233-6360
Fax: 515/233-6367

ESTABLISHED: December 1983
NO. OF EMPLOYEES: 22

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	E. Locke Walsh		
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 and venture capital	$2.0M

BACKGROUND

Electronic Technology Corp. (ETC) provides linear and digital design with an emphasis on linear products. The Company also provides complete fabrication, packaging, and test services and guarantees production units 100 percent-compatible with prototypes.

ETC was funded initially by a midwestern consortium of venture organizations. ETC's primary customer base is in the midwestern corridor (extending from the eastern slopes of the Rockies to the Ohio Valley). The Company plans to become the midwest's major supplier. The Company has a close working relationship with the Micro Electronics Research Center at Iowa State University in Ames.

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 cell-based 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
Manufacturing
Packaging
Test

MANUFACTURING

Technology

2.0- and 5.0-micron CMOS
Bipolar

Facilities

Cedar Rapids, IA	12,000 sq. ft.	Total space
	2,000 sq. ft.	Class-100 clean room

PRODUCTS

Industry Standard (20V) Array with 11 Arrays
High-Voltage (75V) Array with 1 Array
Bi-FET (36V) Arrays with 3 Arrays
Cellular (20V) Array with 1 Array

Epitaxx Inc.
3490 U.S. Route One
Princeton, NJ 08540
609/452-1188
Fax: 609/452-0824

ESTABLISHED: 1984
NO. OF EMPLOYEES: 30

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Dr. Gregory Olsen	RCA	Scientist
Exec VP	Dr. Vladimir Ban	RCA	Scientist

FINANCING

Round	Sources	Amount
Round 1	DSV Partners; Warburg Pincus	$1.5M

BACKGROUND

Epitaxx Inc. produces indium gallium arsenide phosphide (InGaAsP) light emitting diodes, lasers, and photodetectors for fiber-optic and infrared instrumentation applications. The Company also supplies InGaAsP, using a proprietary crystal growth technique called vapor phase epitaxy (VPE), which allows the elements to be deposited from gases. Custom services include 2,000 and 2,500nm photodiodes, detector arrays, and pulsed laser diodes. Epitaxx sells its components to telecommunications vendors, such as GTE and ITT, and to fiber-optic companies as Fibercom and Plantronics Wilcom.

In order to expand its products, Epitaxx conducts R&D sponsored by industry and the government. The following are some of the Company's development activities:

- InGaAs linear arrays for use in spectroscopy and imaging and airborne communication.
- Extended-range sources and detectors for optical sensors and transoceanic communications applications.

- InGaAs avalanche photodiodes for optical communications and sensors, rangefinding, and instrumentation applications.

- 5mm InGaAs visible response (500 to 1,700nm) detectors for optical test and calibration and temperature sensors.

The Company was founded by Dr. Gregory Olsen and Dr. Vladimir Ban, former research scientists at the RCA David Sarnoff Research Laboratories in Princeton, New Jersey. The founders developed the VPE applications while employed there.

Recent Highlights

Feb. 1988 Epitaxx announced that the Company was selected by the NASA Goddard Space Flight Center for a Phase-II Small Business Innovative Research (SBIR) contract to develop large-area InGaAs photodetectors for the 500 to 1,700nm spectral range.

March 1988 Epitaxx announced that the Company was awarded a $50,000, Phase-I SBIR contract by NASA's Goddard Space Flight Center to develop a linear array of InGaAs detectors. The array will have a minimum of 32 elements (30 X 30 microns each) and will be installed in a commercial multiplexer readout. Epitaxx plans to apply for a Phase-II program based on linear arrays of InGaAs detectors that are sensitive over the 0.8 through 2.2 micron spectral range.

April 1988 Epitaxx exhibited the following infrared components at CLEO '88.

Edge-emitting LEDs (1,300nm and 1,550nm) in a low-cost pigtailed package for local communication and optical instrumentation.

Large-area (0.5 to 3.0 mm) InGaAs detectors for gyroscopes, gas sensors, space photography, SWIR detection, and fiber-optic test instrumentation.

High-speed, small-area, planar InGaAs PIN photodiodes for lightwave and rangefinding receivers.

ALLIANCES: Not available

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

InGaAs

PRODUCTS

Epitaxx 1300	High-Power LEDs, 1,550 and 1,300nm
ETX60B	PIN InGaAs Photodetector, Low Capacitance and High Speed, 1,300 and 1,550nm
ETX75/100/300	InGaAs PIN Photodetectors, 900 to 1,700nm, with High Responsivity
ETX75F/100F	InGaAs Fibered Photodetectors with Low Dark Current and Capacitance, 1,300 and 1,550nm
ETX500/1000/2000	InGaAs Photodetectors, for Low Noise Measurements of Long Wavelengths (900 to 1,700nm)
ETX3000	Large-Area (3mm) InGaAs Photodetector for Low Noise Detection in the 0.8- to 1.7-Micron Spectral Range

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: 150

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, cochairman	Wilmot Enterprises
Robert Heikes, cochairman	Entrepreneur
Jean-Luc Grand-Clement	European Silicon Structures, CEO
Pierre Lesieur	European Silicon Structures, VP Finance
Viscount Etienne Davignon	Societe Generale de Belgique, director
Albert Kloezen	EuroVenture, Benelux, managing director
Elserino Piol	Ing. C. Olivetti & Co., executive vice president
Klaus Volkholz	Philips International BV, director corporate planning

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
CEO/Mng Dir	J.l. Grand-Clement	Motorola	VP Europe Group
VP Fin/Admin	Pierre Lesieur	Motorola	Dir Finance
VP/Dir Ops	Rod Attwooll	TI	Mng Dir Bedford
VP/Mfg	Bernard Pruniaux	Thomson CSF	Dir Opns
VP/Dir S/W Tech	John Gray	Lattice Logic	Founder/Mng Dir
VP/Dir S. Europe	J.P. Demange	National	Dir Strat Mktg
VP/Dir Central Europe	H.P. Friedrich	N/A	Mng Dir
Wfr Fab Mgr	Francis Courreges	Sierra Semi	Prod Eng Mgr
Dir Technology	Eric Demoulin	Thomson CSF	Dir MOS Tech

FINANCING

Date	Sources	Amount
1985	Advent, London; Techno-Venture Mgmt. Corp.	$ 5.0M
Dec. 1985	Brown Boveri and CIE of Switzerland; Ing. C. Olivetti & Co. (Italy); N.V. Philips (the Netherlands); Saab-Scandia AB (Sweden)	$25.0M
Jan. 1986	British Aerospace	$ 5.0M
Nov. 1986	Banque International a Luxembourg; European Investment Bank	$ 9.0M

BACKGROUND

European Silicon Structures (ES2) was formed to design, develop, and offer quick-turn silicon prototyping and low-volume production (less than 50,000 units) of application-specific ICs for the European marketplace. The Company's objectives are to make available ASIC design and production capability available to European systems manufacturers, generate a CAD product line, and offer fast turnaround with the use of e-beam technology.

The Company's Solo 1000 is based on Lattice Logic's Chipsmith system, and the Solo 2000 is based on the SDA Systems family of integrated CAD tools. Solo 1000 enables designers to produce full-custom and optimized designs and is available on PC AT-based hardware and UNIX-based work-stations. Solo 2000 incorporates compiled macro blocks, which include RAM, ROM, PLA, ALU, and others. The Company's capability includes PLDs, optimized arrays, cell-based ICs, and handcrafted custom devices and circuits that will meet MIL-STD-38510 Class-B compliance.

In January 1987, ES2 introduced the ECDM20 CMOS, a process demonstrating subnanosecond gate delay performance. The n-well process features 5V digital CMOS; an epitaxial substrate for high latch-up immunity; and single-poly, two-layer metal using 10 masking steps. All processing is conducted using Perkin-Elmer Aeble 150 e-beam lithography equipment that is now operational.

ES2 is incorporated in Luxembourg and headquartered in Munich, West Germany. ES2's design automation technology is being developed by its software technology division located in Bracknell, United Kingdom. The Company's manufacturing technology division is responsible for silicon manufacturing, which is conducted in Rousset, France, near Aix-en-Provence.

In November 1987, ES2 was granted a loan of $9 million by the Bank Banque International and the European Investment. The funds are being used to build ES2's production plant, called the Rousset Technology Center, at Rousset in southern France. The four-year loan is part of a larger financing package that could total $18 million. The manufacturing division also operates the Aeble 150 machine at the Exel Microelectronics plant in San Jose, California.

In 1987, ES2 acquired Lattice Logic and turned the Silicon Valley design arm of Lattice Logic into an ES2 design center named United Silicon Structures that serves the United States. Also in late 1987, ES2 formed a partnership with Mitsui & Co., Ltd., and purchased a software and design company in Japan called Best. The company will be responsible for marketing ES2's products in Japan.

Through its own R&D and in conjunction with industrial partners and universities, ES2 is developing proprietary silicon compilation tools and is working to establish a set of standards for the European market.

ALLIANCES

Lattice Logic	1985	ES2 signed an agreement with Lattice Logic to market Lattice's logic compiler in Europe.
	1987	ES2 acquired Lattice Logic. ES2 had been marketing Lattice Logic's compilers in Europe since 1985.
British Aerospace	Jan. 1986	British Aerospace invested $5 million in ES2.
SDA Systems	Jan. 1986	ES2 signed an agreement to market SDA Systems' design systems throughout Europe and to use them in a number of planned design centers.
Philips-Elcoma TI	May 1986	ES2, Philips-Elcoma, and Texas Instruments agreed to cooperate on the SystemCell standard cell library.
	Feb. 1987	ES2, Philips, and TI signed an agreement covering manufacturing of the SystemCell. TI and Philips will supply volume parts; ES2 will provide prototypes and low-volume quantities.

Mitsui & Co.	Oct. 1987	ES2 formed a partnership with Mitsui & Co., Ltd., and purchased a software and design company in Japan called Best. The company will be responsible for marketing ES2's products in Japan.

SERVICES

Foundry
Manufacturing
Assembly
Test

MANUFACTURING

Technology

2.0-micron, double-metal CMOS
1.25-micron, double-metal (1988)
E-beam on 5-inch wafers

Facilities

Munich, West Germany		Headquarters
Bracknell, United Kingdom	11,800 sq. ft.	Software products
Rousset, France	16,147 sq. ft.	Manufacturing, assembly, test
	8,600 sq. ft.	Fab area

PRODUCTS

Development Tools

Solo 1000	A Low-Cost Development System with up to 5,000 Gates: Schematic Capture, Simulation, Layout, Back Annotation
Solo 2000	Advanced Software, Full-Custom Modules for ASICs with up to 150,000 Transistors: Structure Compiler, 250 Cells, Module Generators, Test Analyzer, Simulation, Automatic Place and Route.

Exel Microelectronics Inc.
2150 Commerce Drive
San Jose, CA 95131
408/432-0500

ESTABLISHED: February 1983
NO. OF EMPLOYEES: 200

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President	Takashi Kobayashi
VP Mktg/Sales	Edwin M.W. Chow

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 & Assoc.; Hutton Venture; IBM Retirement Fund; Montgomery Securities; Orange Nassau; Paribas Technology; Prudential-Bache; Riordan Venture Mgmt; Rothschild, Unterberg & Towbin Ventures; J.F. Shea & Co.; TA Assoc.; 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 nonvolatile memory and microcomponent devices for the EDP, industrial controls, automotive, telecommunications, military, and robotics markets.

The Company has leveraged its proprietary EEPROM expertise into a broad base of EE technology-based, high-performance, low-power products including bipolar PROM replacements, UV-EPROM replacements, and PLDs. 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 the long term, Exel plans to develop microcomponent products with on-chip EEPROM memory.

In February 1986, Exel Microelectronics was acquired by Exar Integrated Circuits for $5.5 million. Exel operates as a wholly owned subsidiary of Exar and maintains an independent fabrication facility and R&D staff.

Exar is a publicly owned company headquartered in Sunnyvale, California. It 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.

Recent Highlights

Feb. 1986	Exar completed its $5 million acquisition of Exel.
Oct. 1987	Exel's Class-10 CMOS fabrication facility met MIL-STD-883C specifications. The first devices to be compliant with this specification are the XL2864B 8Kx8 EEPROM and the XL78C800 EPLD.
Nov. 1987	Exel offered the XL46HC64, a CMOS 64K EEPROM with a 35ns access time. The device can be erased in 10 milliseconds and reprogrammed and retested at least 10,000 times.

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	The prior Samsung agreement was extended to include second-sourcing for 64K EEPROMs.
Paribas Technology	Sept. 1984	Paribas 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 the $5.5 million acquisition of Exel.

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

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

Facilities

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

PRODUCTS

EEPROM

Device	Organization	Process	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
XL28C64	8Kx8	CMOS	120
XL28C65	8Kx8	CMOS	120
XL29C512	64Kx8	CMOS	150

CMOS PROM

XL46C15	2KX8	CMOS	55
XL46C16	2KX8	CMOS	55

DUART

XL68C681/88C681 CMOS Dual-Channel UART

Programmable Logic Device

78C800 CMOS ERASIC Family, 600 to 800 Gates

G-2 Incorporated
1655 McCarthy Boulevard
Milpitas, CA 95035
408/943-0224
Fax: 408/943-1659

ESTABLISHED: July 1987
NO. OF EMPLOYEES: N/A

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	William O'Meara	LSI Logic	Founder/VP Sales/Mktg
Dir Ops	Bill Sams	LSI Logic	Dir Intl Mktg
Dir Mktg	Chris J. Tubis	Siliconix	Dir MOS, Power IC, and Gate Array Bus Units
Dir Systems Engr	Steve Yueng	Siliconix	Engr Mgr ASIC Dev
Dir Circuit Engr	Patrick Yin	Fairchild	Supervising Engr

FINANCING: Not available

BACKGROUND

G-2 Incorporated was formed to design and market application-specific chips and chip sets for the EDP market. In the short term, the Company is focusing on logic and graphics chips and chip sets used in the IBM PC-compatible market.

The Company was established as an independent affiliate of LSI Logic Corporation and is headed by William O'Meara, founder of and former vice president of marketing at LSI Logic. G-2 is applying the technology and design tools of LSI Logic to design and quickly bring to market large-volume, high-end consumer standard parts. LSI Logic is providing the use of its silicon macrocells, megacells, gate arrays, and cell-based library. G-2 conducts its own marketing and engineering activities.

In September 1987, G-2 introduced its first product, the GC101/102, a 16-MHz PC AT three-chip set that, when used with 10 peripheral circuits, is said to reduce the number of ICs in an AT from 110 to 13. The GC101 is a peripheral controller; the GC102 is an address/data buffer.

In October 1987, G-2 introduced the GC201, a single-chip graphics controller that the Company claims reduces the chip count of an enhanced graphics adapter (EGA) board by half. The GC201 supports all video modes on an EGA monitor with a built-in automode switch logic. The device is fabricated using LSI Logic's 1.5-micron HCMOS channel-free technology.

In December 1987, G-2 named AvanTek Corporation its exclusive representative in the People's Republic of China and Hong Kong. AvanTek will market and distribute the G-2 product line through its Hong Kong subsidiary, ATSys International Co., Ltd.

ALLIANCES

July 1987 — G-2 is a wholly owned subsidiary of LSI Logic Corporation. G-2 is applying the technology and design tools of LSI Logic to design and quickly bring to market large-volume, high-end consumer standard parts. LSI Logic is providing the use of its silicon macrocells, megacells, gate arrays, and cell-based library.

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

1.5- to 0.9-micron channel-free HCMOS

PRODUCTS

PC AT-Compatible Chip Set

16 MHz, Three-Chip Set

EGA Multimode Graphics Controller

Single-Chip EGA That Offers 800 X 600 Resolution

PS/2 Model 30 XT Compatible Chip

Single Chip That Supports Clock Speeds of up to 10 MHz, with Programmable Wait State Generator

Advanced VGA

Single Chip

386 AT Chip Set

Three-Chip Set with Processing Speed of up to 20 MHz, Supports 80287 and 80387 Numeric Coprocessors

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

ESTABLISHED: October 1985
NO. OF EMPLOYEES: 65

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President/CEO	Warren Wheeler	
VP Business Development	Dr. Russ Buckley	Bell Labs
VP Engineering	Dr. Charles Lee	Bell Labs
VP Process Development	Dr. Rudi Hendel	Bell Labs
Dir Corporate Services	Tim Ramsey	RCA/Sharp Microelectronics
Director Manufacturing	John E. Davenport	Ford Microelectronics
Director Marketing	Michael D. Logan	AT&T

FINANCING

Date	Round	Sources	Amount
1985	Seed	Edelson Technology Partners; Mitsui & Company; United Capital Ventures	$23.0M

BACKGROUND

GAIN Electronics Corporation designs, develops, manufactures, and markets advanced GaAs ICs for commercial applications. GAIN also offers semi-custom and full-custom design services, foundry services, direct-write e-beam services, and GaAs wafers grown by molecular beam epitaxy. GAIN plans to introduce standard cells in late 1988.

The Company has licensed the self-aligned implantation for N+ layer transistor (SAINT) technology from NTT and is bringing it into production. In early 1988, GAIN plans to introduce its proprietary process called Selectively-Doped Heterostructure Transistor (SDHT) (also called HEMT, MODFET, and TEGFET) device structure, which its founder, Dr. Raymond Dingle, invented. GAIN licensed the SDHT technology from AT&T to commercialize it.

GAIN was founded by Dr. Dingle, who pioneered GaAs technology at AT&T's Bell Laboratories. Dr. Dingle invented the multiquantum-well laser in addition to the SDHT device. The initial $23 million invested in the Company was made by a consortium of investors. The capital was used to set up a 55,000-square-foot fabrication facility in Branchburg, New Jersey. The facility comprises Class-10 clean rooms, electron-beam lithography, molecular beam epitaxy, and other process and control equipment. The facility has the capacity to produce 15,000 wafers per year. In September 1986, GAIN began offering high-performance epitaxial wafers grown by molecular beam epitaxy.

Recent Highlights

Nov. 1986	The DOD awarded GAIN two GaAs development programs for the army and air force. The army program involves development of ultrasubmicron device structures to improve IC performance. The air force program involves basic design-level work in characterizing and modeling the selectively doped heterostructure transistor (SDHT).
Feb. 1987	GAIN offered the GFL4000 gate array, a commercial gate array with 4,000 equivalent gates and 132 I/O ports. The device features a proprietary GaAs FET Logic (GFL), that provides a nominal noise margin of 700mV, without sacrificing speed or power.
Nov. 1987	GAIN offered the GFL7000, a family of gate arrays with 7,000 gates and 184 I/O buffers.
March 1988	GAIN signed a $15 million, multiyear agreement with Interface Technology, a test subsystem producer. GAIN will supply personalized versions of its 4,000-gate and 7,000-gate GFL gate array product family.

ALLIANCES

Mitsui	1985	Mitsui acquired a 30 percent interest in GAIN.
NTT	Sept. 1986	NTT and GAIN agreed to a technology transfer agreement that gives GAIN access to NTT's SAINT technology.
Interface Technology	March 1988	GAIN signed a $15 million, multiyear agreement with Interface Technology, a test subsystem producer. GAIN will supply personalized versions of its 4,000-gate and 7,000-gate GFL gate array product family.

SERVICES

Design
Foundry
Direct-Write E-Beam Services

MANUFACTURING

Technology

GaAs

Facilities

Sommerville, NJ	55,000 sq. ft.	Design and manufacturing
	25,000 sq. ft.	Class-10 clean rooms

PRODUCTS

Gate Arrays

GFL2000	2,000 Equivalent Gates, 80 I/O Buffers
GFL4000	4,000 Equivalent Gates, 132 I/O Buffers
GFL7000	7,000 Equivalent Gates, 184 I/O Buffers

Gazelle Microcircuits, Inc.
2300 Owen Street
Santa Clara, CA 95054
408/982-0900
Fax: 408/982-0222

ESTABLISHED: June 1986
NO. OF EMPLOYEES: 40

BOARD

Name	Affiliation
Jerry Crowley, chairman	Gazelle Microcircuits, Inc., president/CEO
David MacMillan	Gazelle Microcircuits, Inc., vice president
Floyd Kvamme	Kleiner, Perkins, Caufield & Byers, general partner
Stewart Carrell	Hambrecht & Quist, partner
Philip Young	Dillon Read-Concord Partners, managing director
David Hathaway	Venrock Associates, general partner
Steve Sharp	Hambrecht & Quist

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Jerry Crowley	Oki Semiconductor	Vice Chairman
VP Marketing	David MacMillan	GigaBit Logic	
VP Engineering	Andrew Graham	Mostek	
VP Technology	Thomas Andrade	Pacific Monolithics	Mgr Semi Dev

FINANCING

Date	Round	Sources	Amount
Aug. 1986	Seed	Hambrecht & Quist; Kleiner, Perkins, Caufield & Byers	$0.9M
April 1987	Round 1	Dillon Read-Concord Partners; Hambrecht & Quist; Kleiner, Perkins, Caufield & Byers; Merrill, Pickard, Anderson & Eyre; Venrock Associates	$5.5M
	Lease Line	Comdisco, Ventures	$1.5M
April 1988	Lease Line	Comdisco Ventures	$2.5M

BACKGROUND

Gazelle Microcircuits, Inc., was founded to design and market high-performance, digital LSI and VLSI GaAs ICs for high-volume commercial applications such as computation, communication, and military/aerospace. The Company is concentrating on product design and marketing development and does not plan to invest in a wafer fabrication facility.

Gazelle's product strategy is to offer high-yielding, low-cost circuits of large-scale complexity, using existing GaAs fabrication processes. The Company will concentrate on developing unique circuit design approaches to differentiate its performance-oriented devices.

The Company was formed by ex-GigaBit Logic executives Andrew Graham and David MacMillan. In January 1987, Jerry Crowley left Oki Semiconductor, where he was vice chairman and founder, to head Gazelle. In March 1988, Thomas Andrade joined Gazelle as vice president of technology from Pacific Monolithics where he was manager of semiconductor development. Mr. Andrade will be responsible for identifying and qualifying the foundries and processes used to fabricate Gazelle's circuits. Before joining Pacific Monolithics, he developed the first of Avantek's microwave IC process and transferred it into volume manufacturing. He was also a member of the research staff at IBM where he did basic research on GaAs fabrication processes and materials. He also did work on NMOS processes, much of which was funneled into the VHSIC project.

In February 1988, Gazelle moved into its new 22,000-square-foot headquarters in Santa Clara, California. The facility will be used for engineering development, circuit design, product evaluation, and marketing operations. Gazelle also has an option on an adjoining 24,000-square-foot space.

Gazelle has signed pacts with several U.S. manufacturers to supply GaAs wafers to the firms and plans to offer TTL-replacement devices in 1988.

ALLIANCES: Not available

SERVICES

Design

MANUFACTURING

Technology

GaAs

Facilities

Santa Clara, CA	22,000 sq. ft.	Headquarters, engineering, design

The Company also has an option on an adjoining 24,000-square-feet of space.

PRODUCTS: Not available

Genesis Microchip Inc.
2900 John Street
Markham, Ontario, Canada
L3R 5G3
416/470-2742
Fax: 416/470-2447

ESTABLISHED: January 1987
NO. OF EMPLOYEES: 14

BOARD

Name	Affiliation
W.L. Stapleton, chairman	Corporate Systems Strategies Ltd.
Paul M. Russo	Genesis Microchip Inc, president/CEO
William H. White	Genesis Microchip Inc, vice president
Jean-Claude Bonhomme	Investor
Marvin J. Singer	Armstrong, Schiralli & Dunne

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Paul M. Russo	GE	General Manager-MEC
VP Semi Ops	William H. White	Harris Semi	Dir Engr Dig Prod
Comptroller	Peter W. Hawley		Consultant

FINANCING

Date	Round	Sources	Amount
Aug. 1987	Round 1	Private Investors	Undisclosed
Nov. 1987	Round 2	Private Investors	Undisclosed
April 1988	Round 3	Private Investors	Undisclosed

BACKGROUND

Genesis Microchip Inc. was formed to be a supplier of design services, prototyping, and low-volume quantities of ASICs to the central North American market. Genesis is offering gate array, cell-based ICs, as well as full-custom design services. Products target the telecommunications, military, and industrial applications markets.

Initially, the Company operates as a Canadian design center for National Semiconductor's CMOS ASIC products under an agreement signed in October 1987. The agreement includes National's gate arrays and cell-based libraries, as well as the full range of design tools. National provides prototyping and volume manufacturing, and assembly and test of all CMOS ASIC devices designed by Genesis, using National's 2.0- and 1.5-micron technologies. National also provides manufacturing for Genesis customers that design custom cells not included in the National libraries.

ALLIANCES

National	Oct. 1987	National Semiconductor and Genesis signed a design center agreement covering National's gate array and cell-based libraries and design tools. National provides prototyping and production for CMOS ASICs designed by Genesis using National's 2.0- and 1.5-micron technologies. Genesis operates as National's Canadian design center.

SERVICES

Design

MANUFACTURING

Technology

2.0- and 1.5-micron CMOS

Facilities

Genesis plans to build a 100,000-square-foot Canadian fabrication facility that features a Class-10 clean room. The facility will have the capacity for processing 1.5- and 1.0-micron CMOS double-level metal ASICs on 6-inch wafers. The facility will be optimized for quick-turn, low-volume manufacturing and will support MIL-STD-883 conformance.

PRODUCTS

Genesis Offers the Full Range of National's CMOS Gate Array (2.0- and 1.5-Micron) and Cell-Based (2.0-Micron) Families including Analog, RAM/ROM, EEPROM, and MCU Cells. In addition, Genesis can design Special Cells and Full-Custom ICs as Customer-Owned Tooling Designs for manufacture by National Semiconductor.

GigaBit Logic, Inc.
1908 Oak Terrace Lane
Newbury Park, CA 91320
805/499-0610
Fax: 805/499-2751
Telex: 6711358

ESTABLISHED: August 1981
NO. OF EMPLOYEES: 102

BOARD

Name	Affiliation
John D. Heightley	GigaBit Logic, Inc., chairman, president, CEO
Heinrich F. Krabbe	Analog Devices, Inc.
Richard C. Eden	GigaBit Logic, Inc.
David B. Jones	InterVen Partners, Inc.
Lawrence T. Sullivan	Analog Devices, Inc.
Mark C. Masur	Interfirst Venture
Chris C. Ellison	DFC of New Zealand

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	John Heightley	Inmos	President
VP R&D	Richard C. Eden	Rockwell	Principal Scientist
VP Prod Dev	Frank S. Lee	Rockwell	Dsn Engr Mktg
VP Sales/Mktg	James Brye	Vitesse	VP Mktg/Sales
VP Finance	Spencer Brown	CR Technology	VP Finance/CFO
VP Mfg	Bryant M. Welch	Rockwell	Not Available

FINANCING

Date	Round	Sources	Amount
Mar. 1982	Seed	First Interstate Capital; Riordan Venture Group; Wood River Capital	$ 1.0M
Nov. 1982	Round 1	Analog Devices Ent.; First Interstate Capital Corp.; and others	$ 8.1M
	Leases		$ 3.5M
Dec. 1983	R&D Partnership	Kidder, Peabody & Co.	$ 6.1M

Feb. 1985	Round 2	Analog Devices Ent.; First Interstate Capital; GE Venture Corp.; Interfirst Venture Corp.; Standard Oil Company; Union Venture Corp.	$11.4M
April 1987	Round 3	Analog Devices; Cray Research; Digital Equipment Corporation; DFC New Zealand; FAIC Capital; Fairfield Equity; First Interstate Capital; GE Venture Corp.; Hanover Capital; Interfirst Venture; InterVen Partners; New Enterprises Assoc.; Riordan Capital	$14.9M

BACKGROUND

GigaBit Logic (GBL) designs, develops, manufactures, and markets GaAs standard and application-specific digital ICs capable of 1-GHz to 5-GHz operation. GBL's goal is to be the leader in the commercial digital GaAs IC market and 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 worldwide. Currently, GBL has sales representatives nationwide and franchised distributors in Japan, Germany, Italy, France, the United Kingdom, Israel, Canada, Sweden, Denmark, Taiwan, Australia/New Zealand, and Korea.

Recent Highlights

Jan. 1987 GBL named its president and CEO, John Heightly, chairman of the board. Mr. Heightly takes over the chairman's post from Heinrich Krabbe, who remains a director. Mr. Krabbe is vice president of new business development for Analog Devices, an investor in GBL.

April 1987 GBL completed a private placement of convertible preferred stock and raised $14.9 million. The funds were used to recapitalize the Company.

April 1987 GBL, Seattle Silicon, and the Washington Technology Center (WTC) announced that a joint design project has resulted in the fabrication of a functional GaAs IC design that is compiler based. It is based on GBL's cell library, Seattle Silicon's compiler, and WTC's design, engineering support, packaging, and test.

May 1987	GBL announced that Cray Research had increased its January 1987 foundry order from $3.2 million to $5.5 million. Cray will use the logic and memory devices procured under this order to enter the next phase of development of a GaAs-based parallel processor supercomputer.
July 1987	Prisma Corp., a manufacturer of high-speed computers, is planning to build a GaAs-based, 32-bit, real-time computer using GigaBit's logic devices and other ECL-based memory. The machine will incorporate RISC, will implement Ada language, and will offer performance in the 100 to 200-mips range. The first machine is expected to be shipped by the end of 1989. Future systems are expected to use FORTRAN, C, and Lisp. Prisma is a spin-off from Cray Research and is capitalizing on Cray's research into implementing computers with GaAs.
Oct. 1987	Tachonics and GBL agreed mutually to second-source GaAs standard and ASIC ICs. GBL will also transfer data bases, schematics, and test specs of the PicoLogic cell-based families to Tachonics. The companies will codevelop cell libraries to support future GaAs technologies.
Oct. 1987	GBL achieved profitability.
Jan. 1988	Cray placed a $6.8 million foundry order.

<u>ALLIANCES</u>

Kidder, Peabody & Co.	Dec. 1983	GBL and Kidder, Peabody & Co. formed a research and development partnership to develop four ultrahigh-speed GaAs SRAMs.
Cray Research	Jan. 1987	Cray Research placed a $3.2 million foundry order.
	May 1987	Cray Research increased its January order from $3.2 million to $5.5 million. Cray is using the devices procured under this order to enter the next phase of development of a GaAs-based parallel processor supercomputer.
	Jan. 1988	Cray placed a $6.5 million foundry order.

Seattle Silicon WTC	April 1987	GBL, Seattle Silicon, and the Washington Technology Center (WTC) announced that a joint design project has resulted in the fabrication of a functional GaAs IC design that is compiler based. It is based on GBL's cell library, Seattle Silicon's compiler, and WTC's design, engineering support, packaging, and test.
Tachonics	Oct. 1987	Tachonics and GBL agreed mutually to second-source GaAs standard and ASIC ICs. GBL will also transfer data bases, schematics, and test specs of the PicoLogic cell-based families to Tachonics. The companies will codevelop cell libraries to support future GaAs technologies.

SERVICES

Foundry
Manufacturing
Assembly
Test

MANUFACTURING

Technology

0.8- and 1.0-micron GaAs MESFETs
3-inch wafers

Facilities

Newbury Park, CA	60,000 sq. ft.	R&D, design, manufacturing, assembly, test
	5,000 sq. ft.	Class-10 clean room

GBL has full assembly and test capability on-site.

PRODUCTS

Standard Logic

Device	Description	Speed
PicoLogic (Analog and Digital ICS)		
10G000	Quad 3 Input NOR	320ps
10G001	Quad 2 Input NOR	320ps
10G002	Quad Differential XOR/XNOR, Line Receiver	1.8 GHz
10G003	5, 4, 2/3, 2 input AO/AOI	800ps
10G004	Quad 2:1 MUX	1.8 GHz
10G010	Differential MUXed Fanout Buffer	1.6 GHz
10G011	Dual 1:4 Fanout Buffer	1.6 GHz
10G012/ 10G013	Dual Complementary Driver/Comparator	1.75 GHz
10G021	Dual Precision D Flip Flop	2.7 GHz
10G022	Octal Register/Shift Register and PIN Code Generator	1.5 GHz
10G023	Quad MUXed Input Flip Flop	1.9 GHz
10G024	Quad XOR Input Flip Flop	1.9 GHz
10G044	3:8 or Dual 2:4 Decoder/DEMUX	1.4 GHz
10G040	8:1 Time Division MUX	1.45Gb/s
10G041	1:8 Time Division DEMUX	1.45Gb/s
10G046	Quad 4:1 or 8:1 MUX	1.5 GHz
10G045	Dual 9-Bit Parity Generator/Checker and 8-Bit Equivalence Checker	1.5 GHz
10G060	+2, +4 Prescaler/Ripple Counter	3.0 GHz
10G061	4-bit Synchronous Programmable Counter	1.3 GHz
10G065	7-stage Counter/Divider	3.0 GHz
10G070	Variable Modulus Divider	2.0 GHz
10G100	Expandable Adder	1,200ps
10G101	Ultrahigh-Speed Carry Look-Ahead	675ps
16G010	15mA Diode Array	--
16G011	100mA Diode Array	--
16G020	Single-Gate FET Array	15 GHz
16G021	Dual-Gate FET Array	15 GHz
16G040	Clock and Data Recovery Circuit	1.0Gb/s
16G044	Phase Frequency Comparator	1.0 GHz

NanoRAM Memory

Device	Description	Speed
12G014	256x4 Pipelined SRAM	2.5ns (Cycle Time)

ATE and Instrumentation Products

16G060	Time Delay Generator	1.0ps resolution
16G061	Dual High-Speed Pin Driver	1.5 GHz

ASIC Products

80GSC1	Standard Cell Library (to 5,000 gates)	1.2 GHz

Prototyping and Development Support

90GCOR	16G040 Demonstration Board/OEM Board	800 Mb/s
90GKIT-40	Universal Prototype Kit	
90GUPB	Universal Prototype Board	
90GSKT	High-Speed Socket (40L Package)	
90GHS40A	Heatsinks (40 I/O L and C)	
90GHS36A	Heatsinks (36 I/O F and Z)	

Foundry Services

Wafer Fabrication
  Depletion--Low Power, High Margin, Enhancement/Depletion
Wafer Saw, Plate, Visual Inspection
Assembly and Test

GL Micro Devices
3375 Scott Boulevard
Suite 340
Santa Clara, CA 95054
408/496-1201

ESTABLISHED: February 1987
NO. OF EMPLOYEES: 11

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
VP Technology	Norman Godinho	IDT	VP/GM DSP Div
VP Prod Dev	Frank Lee	IDT	Codirector Corp R&D

FINANCING

Date	Round	Sources	Amount
Feb. 1987	Round 1	El Dorado Ventures, Glenwood Management	$2.4M

BACKGROUND

GL Micro Devices was formed to develop high-performance advanced CMOS products and is in an R&D mode. Norman Godinho and Frank Lee, founders of GL Micro Devices, are also founders of Integrated Device Technology (IDT). Mr. Godinho served as vice president and general manager of IDT's digital signal-processing (DSP) division, and Mr. Lee was codirector of IDT's corporate research and development group.

AGREEMENTS: Not available

SERVICES

Design

MANUFACTURING

Technology

CMOS

Facilities

Santa Clara, CA	6,500 sq. ft.	R&D

PRODUCTS: To Be Announced Later This Year

Graphics Communication Technology ESTABLISHED: 1987

BOARD: Not available

FINANCING: Not available

BACKGROUND

Graphics Communication Technology was formed by Ascii Inc., a Japanese software house. Graphics Communication was 70 percent financed by the joint MITI and Ministry of Posts and Telecommunications (MPT) Key Technology Research Promotion Center and 30 percent by 11 companies, including Mitsui Corporation, Iwasaki Communications, Ascii, and Okura Electric. Ascii holds a 5 percent share in the venture, which is headed by Kazuhiko Nishi, an Ascii vice president.

Harris Microwave Semiconductor, Inc.
1530 McCarthy Blvd.
Milpitas, CA 95035
408/433-2222

ESTABLISHED: June 1980
NO. OF EMPLOYEES: 72

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President/Chief Executive Officer	John T. Hartley
Vice President/General Manager	Dr. Joseph Barrera
Marketing and Sales Director	Vic Kovacevic

FINANCING: Not available

BACKGROUND

Harris Microwave Semiconductor (HMS), Inc., was formed to develop and manufacture GaAs-based FETs, MMICs, and digital ICs. In addition to offering standard products, the Company offers full and semicustom capabilities and provides foundry services. HMS is a vertically integrated, wholly owned subsidiary of Harris Corporation, which has provided 100 percent of the Company's funding.

In February 1984, HMS introduced the world's first commercially available digital ICs based on gallium arsenide. HMS has begun 0.5-micron MMIC FET foundry services. The Company has capabilities for manufacturing GaAs crystals and wafers as well as ICs, packaged products, and subsystems. HMS is said to have the world's largest high-purity GaAs ingot-growing capacity, which produces single-crystal GaAs ingots of up to 7 inches in diameter.

Recent Highlights

Jan. 1987	Harris transferred its CAE tools developed for CMOS digital ASICs in Melbourne, Florida, to its GaAs operation in Milpitas, California, and set up a commercial GaAs standard cell operation.

Jan. 1987	HMS also offered a GaAs cell-based library and front-to-back CAE support that makes design steps transparent to the user. The cell-based library consists of 35 cells and is an open-ended collection of basic logic functions. The library features 1.0-micron MESFET two-level metal technology and typical gate delays of 180ps.
July 1987	HMS offered the HMM-10610, a dual-stage, 2 to 6-GHz, 0.5-micron, medium-power monolithic amplifier in die form.
	HMS offered the HMD-11685, an ECL-compatible comparator with a 500 ps propagation time.
Feb. 1988	HMS introduced the HMM-10620, a 2 to 6-GHz low-current, cascadable, broadband MMIC amplifier designed to meet the electronic warfare systems' low-current requirements.

ALLIANCES: Not available

SERVICES

- Design
  - Full-custom design based on computer specifications
  - Cell-based design
  - Integrated CAE/CAD tools
- Foundry
- Manufacturing
  - Hi-rel qualification
- Packaging
- Test
  - Parametric and RF wafer testing
  - Device testing characterization
  - DC and RF packaged testing

MANUFACTURING

Technology

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

Facilities

Milpitas, CA	37,000 sq. ft.	15,000 square feet are manufacturing space.

PRODUCTS

FETs (Available in chip or packaged form)

Device	Description
HMF-0300	2-18 GHz, 125 mW Power
HMF-03100-100	2-20 GHz, Low Noise, Gain
HMF-03100-200	2-20 GHz, Gain/Drive
HMF-03100-300	2-20 GHz, Drive
HMF-0330	2-20 GHz, Low Noise Low Current
HMF-0600	2-20 GHz, 250 mW Power
HMF-0610	2-20 GHz, Gain
HMF-0620	2-14 GHz, High Transconductance
HMF-12000-100	2-16 GHz, 500 mW Power
HMF-12000-200	2-16 GHz, 650 mW Power
HMF-1210	2-20 GHz, Gain
HMF-24000-100	2-14 GHz, 800 mW, Power
HMF-24000-200	2-14 GHz, 1.2W, Power

MMICs

HMR-10502	Analog Amplifier, 0.5-5.0 GHz Commercial
HMR-10503	Analog Amplifier, 1-5 GHz Commercial
HMM-10610	Broadband Amplifier, 2-6 GHz
HMM-10620	Broadband Amplifier, 2-6 GHz, Low Current
HMM-11810	Broadband Amplifier, 6-18 GHz
HMM-11820	Broadband Amplifier, 6-18 GHz, Low Current

Digital ICs

HMD-11011	Divide by 10/11 Variable Modulus Divider
HMD-11016	Divide by 2/4/8 Binary Counter
HMD-11101	5-Input NOR/OR Gate
HMD-11104	5-Input NAND/AND Gate
HMD-11113	Dual 2-Input Exclusive OR Gate
HMD-11131	Master/Slave D Flip-Flop (Positive Edge)
HMD-11131-203	Master/Slave D Flip-Flop (Negative Edge)
HMD-11188	Dual Clock Drive/Fanout Buffer
HMD-11301	Divide by 2 Prescaler
HMD-11502	Programmable Pulse Driver/Formatter
HMD-11685	Ultrahigh-Speed Comparator
HMD-12141	Four-Bit Universal Shift Register

Digital IC Evaluation Kits

HMK-11SSI-2	Allows Individual Evaluation of an SSI Standard Product
HMK-11MSI-2	Allows Individual Evaluation of an MSI Standard Product
HMK-ICKIT	Allows Evaluation of Six GaAs Standard Products in Concert with Si ECL Product in a High-Speed Test Application

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

ESTABLISHED: January 1985
NO. OF EMPLOYEES: N/A

BOARD: Not available

COMPANY EXECUTIVES

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

FINANCING: Private

BACKGROUND

Hittite Microwave was formed to market custom and proprietary GaAs MMICs for military and commercial applications. The Hittite team has been involved in all aspects of design, development, and production of monolithic GaAs components, including participation in several Department of Defense GaAs technology development programs.

Hittite's expertise ranges from designing small, single-chip systems to 500-watt, continuous-wave, multichip components and subsystems. Hittite's facility is equipped to conduct design, layout, verification, packaging, and test of GaAs-based components. Wafer fabrication is conducted by foundries.

Hittite is part of the General Dynamics, Honeywell, TRW consortium that is addressing the critical technology, fabrication, and cost issues of inserting microwave/millimeter wave monolithic IC (MIMIC) technology into advanced tactical weapons systems. The team has targeted three main mission areas for MIMIC insertions--smart weapons, electronic warfare, and communications.

ALLIANCES: Hittite is part of the General Dynamics, Honeywell, TRW consortium as part of the Department of Defense MIMIC program.

SERVICES

Custom design of MMICs
Assembly
Test

MANUFACTURING

Technology

0.5- and 1.0-micron GaAs MESFETs

Facilities

Woburn, MA Offices, R&D, assembly, test

PRODUCTS

Signal Control Components
Microwave Radar Ranging Systems
Other proprietary products

Hualon Micro-Electronics Corporation
9th Floor, No. 61, Chung Shan N.
Road Sec. 2, Taipei, Taiwan R.O.C.
(02) 562-8813 Ext. 768
Fax: (02) 531-3241

ESTABLISHED: April 1987
NO. OF EMPLOYEES: 400

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Vice President	Andrew Oung

FINANCING

Date	Round	Sources	Amount
1987	Round 1	Hualon Textile	US$30.0M

BACKGROUND

Hualon Micro-Electronics Corporation (HMC) was formed to offer telecommunications ICs, consumer ICs, microcomponents, and ASICs. Initially, the Company will use 2-micron CMOS technology to manufacture its products but has plans to develop CMOS technology to the 1-micron level in 1989.

Recently, HMC opened a new 269,097-square-foot fabrication facility in the Hsinchu Science-Based Park. The facility is capable of manufacturing 30,000 5-inch wafers per month. The Company plans to reach a capacity of 60,000 5-inch wafers per month by 1991.

HMC was financed by the Hualon Group for about US$30 million. The Hualon Group's first venture into the IC business was an assembly plant set up in 1984. As its requirements for high-quality ICs that use advanced process technologies increased, the Hualon Group decided to invest in an IC fab.

ALLIANCES: Not available

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

5-micron metal-gate CMOS
2.0- and 3.5-micron silicon-gate CMOS
3.5-micron NMOS

Facilities

Hsinchu City, Taiwan	269,097 sq. ft.	Total space includes design and manufacturing
	39,900 sq. ft.	Class-1 and Class-10 clean rooms

PRODUCTS

Consumer IC Family

	Device	Description
Clock	HM 3200	Analog Clock
	HM 3203	3-1/2-Digit Alarm Clock
	HM 3204	World Time Clock
Watch	HM 3201	3-1/2-Digit LCD Watch
	HM 3202	4-Digit LCD Watch
Home Electronics IC	HM 3701	Touch Dimmer
Calculator	HM 3401	Solar Calculator
Melody	HM 5801	64-Note Simple Melody
	HM 5802	128-Note Simple Melody
	HM 4801	512-Note Simple Melody
	H 66T	64-Note Simple Melody (3-Pin Package)
	H 67T	64-Note Simple Melody (4-Pin Package)
	H 68T	128-Note Doorbell

	Device	Description
Voice IC	HM 2005	3-Second PCM
	HM 2005-1	1.5-Second PCM (Piezo)
	HM 2005-2	1.5-Second PCM
	HM 2006	LPC Processor
	HM 2007	Speech Recognition
Organ	HM 5601	Simple Mini-Organ

Microcomponent & Memory IC Family

	Device	Description
System	HM 6667/8	PC AT 16-MHz Zero-Wait Chip Set
Peripheral	HM 666A/B	RS 232x2, Printer Portx2
	HM 82C11	Printer Port
	HM 16450	PC AT Asynchronous Communications Element
	HM 8250	PC XT Asynchronous Communications Element
	HM 6818	PC AT Real-Time Clock
	HM 58167	PC XT Real-Time Clock
	HM 6845/A/B	CRT Controller
Memory	HM 2300/2301	Character Generator
	HM 2333	4Kx8 ROM
	HM 2366	8Kx8 ROM
	HM 23C256	32Kx8 ROM
	HM 6116	2Kx8 SRAM
	HM 6164	8Kx8 SRAM

Telecommunication IC Family

	Device	Description
Telephone Dialers	HM 9100	Pulse Dialer
	HM 9101/9102	Tone/Pulse Dialer
	HM 9105	5-Memory Tone/Pulse Dialer
	HM 9110	10-Memory Tone/Pulse Dialer
	HM 9113	14-Memory Tone/Pulse Dialer
	HM 9114	15-Memory Tone/Pulse Dialer
	HM 9115	Advanced 15-Memory Tone/Pulse Dialer+ARD
	HM 9120	Advanced 20-Memory Tone/Pulse Dialer+ARD
	HM 9187	Tone Dialer
Peripheral	HM 2004	Voice Processor
	HM 9200	Call-Progress Tone Decoder
	HM 9202/ 9203/9204	DTMF Receiver Series

HYPRES, Inc.
500 Executive Boulevard
Elmsford, NY 10523
914/592-1190
Fax: 914/592-1732

ESTABLISHED: October 1983
NO. OF EMPLOYEES: 56

BOARD

Name	Affiliation
Sadeg Faris, chairman	HYPRES, Inc.
Charles C. Francisco	HYPRES, Inc.
Michael Maguire	HYPRES, Inc.

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Charles Francisco	EG&G	Sr Vice President
VP/CFO	Gerald M. Haines	Harris Graphics	Asst Corp Ctr
VP System Dev	Eric Hanson	Nicolet Scientific	Mgr FFT Analyzers
VP Operations	Mert Kenniston	Encore Computer	VP Mfr Ops
Dir Human Rscs	Robert Perez	Englehard	Mgr HR
Dir Defense Prog	Michael Maguire	Harris Corp.	Senior VP

FINANCING

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

BACKGROUND

HYPRES, Inc. (HYper Performance RESearch) was formed to commercialize the superconducting technology initially developed at IBM combined with related Company-developed technologies. In the short term, the Company has identified market opportunities in the area of very-high-speed test and instrumentation products. In the long term, HYPRES is working to manufacture and market superconductive devices for the digital data processing system products.

Superconductivity involves the total elimination of electrical resistance of certain materials, which occurs when they are cooled to temperatures approaching absolute zero (0° K to -273.15° C, or 460° F).

Dr. Sadeg Faris was a member of the IBM team at Yorktown Heights, New York, where IBM's Josephson junction research took place. Josephson junctions are two-terminal electronic devices with an ultrathin insulating layer that permits the passage of supercurrents from two outer superconducting layers, while maintaining zero voltage. These devices switch very rapidly (less than 2ps) to a high-resistance state when current levels exceed threshold values of supercurrents.

While at IBM, Dr. Faris invented memory cells, laser-programmable logic arrays, a sampling system that measures electrical and optical picosecond signals, and other superconducting devices. In 1983, he invented and developed both a superconducting oscilloscope and the Quiteron, a nonequilibrium superconductive device.

In May 1983, Dr. Faris left IBM to form HYPRES with IBM's blessings, and received a license for IBM's Josephson junction research and patents.

Since its formation, HYPRES has overcome many obstacles to producing superconductive chips. The following are some of the breakthroughs that it has achieved:

- Advances in materials, such as nobium and niobium nitride, to solve the cycling problem confronted in the change from room temperature to the chips' critical temperature
- Development of novel architectures to improve chip uniformity
- Development of an innovative cryogenic process to cool the chip
- Development of superconductive IC design tools
- Development of manufacturing processes
- Development of packaging techniques

These advances have been integrated into the Company's first product, which was introduced in February 1987. The PSP-1000 and PSP-750 families constitute a series of picosecond signal processing workstations used for sampling oscilloscopes and time domain reflectometry (TDR) measurements. They combine two superconducting devices and Josephson junction technology.

HYPRES houses a superconducting fabrication facility that is self-sufficient in thin-film processing; photolithography; and all support functions including CAD, wafer processing, and cryogenic testing of software and hardware support development. HYPRES also offers complete IC fabrication and R&D services.

HYPRES has won Department of Defense contracts for funded development programs addressing the following areas:

- Development of niobium nitride technology, which allows the operation of superconducting devices to 10° Kelvin
- Development of novel infrared sensors for imaging applications for SDI and other markets
- Development of low-noise temperature mixers at millimeter and submillimeter wavelengths for space communications and high-resolution radar
- Development of analog and digital ultrasensitive SQUID sensors for magnetometer and gradiometer applications
- SIS mixers and phase shifters for SDI's Terahertz project
- Research in high critical-temperature superconducting materials

ALLIANCES: Not available

SERVICES

R&D
Design
IC Fabrication
Manufacturing
Assembly
Cryogenic Test

MANUFACTURING

Technology

2.5-micron linewidths integrating up to 30 Josephson junctions

Facilities

Elmsford, NY	32,000 sq. ft.	Headquarters, manufacturing

PRODUCTS

PSP-1000 and PSP-750 Families

A series of Picosecond Signal Processing Workstations for Sampling Oscilloscopes and Time Domain Reflectometry (TDR) Measurements

IC Sensors, Inc.
1701 McCarthy Blvd.
Milpitas, CA 95035
408/432-1800
Fax: 408/434-6687

ESTABLISHED: 1982
NO. OF EMPLOYEES: 145

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Chief Executive Officer	Donald G. Lyman
President	Dr. James W. Knutti
Vice President, Marketing and Sales	Frank A. Perrino
Vice President, Engineering	Henry V. Allen
Chief Engineer	Edward J. Russell
Vice President, Operations	Manuel G. Rossell

FINANCING: Not available

BACKGROUND

IC Sensors, Inc., designs, develops, and manufactures both standard and custom pressure sensors. The Company developed its silicon sensor technology and applied it to design and manufacture a variety of pressure sensors, accelerometers, pressure switches, load sensors, valves and actuators, and other microstructures. The Company's products are used in medical, industrial, automotive, aerospace, and consumer applications.

IC Sensors was formed with funds provided by the founders. The Company received additional funds when it formed a strategic partnership with Borg-Warner. In December 1986, IC Sensors, Inc., and Transensory Devices, Inc. (TDI), completed a merger. TDI was founded in 1982, and developed a micromachining technology that is used to fabricate both custom and standard devices.

In September 1987, IC Sensors introduced a new technology, called Silicon Micromachining, which applies semiconductor production techniques to mechanical devices. Micromachined sensors are produced by etching precise micromechanical structures in silicon. As a result, the structure that serves as a mechanical sensing device is also a semiconductor.

The basic elements of the microstructure technology include the photo-lithographic processes, oxidations, diffusions, thin-film processes, and metallizations common in the IC industry. A number of other processes are used as well, such as wet chemical and dry etch processes, etch stops, double-sided patterning, and multilayer structures.

Recent Highlights

June 1987	IC Sensors offered the 1210 and 1220--two piezoresistive sensors
July 1987	IC Sensors offered the 2501, a miniature silicon pressure switch that eliminates the need for comparators, external voltage references, and potentiometers
July 1987	IC Sensors offered the 410, a general-purpose piezoresistive sensor that is mountable on PC boards
Sept. 1987	IC Sensors introduced a new technology, silicon micromachining, that applies semiconductor production techniques to mechanical devices
Sept. 1987	IC Sensors introduced a silicon piezoresistive accelerometer, the Model 3021

ALLIANCES

Borg-Warner Corp.

SERVICES

Design
Manufacturing

MANUFACTURING

Technology: Not available

Facilities

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

PRODUCTS

Pressure Sensors
Accelerometers
Pressure Switches
Load Sensors
Valves and Actuators

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

ESTABLISHED: 1982
NO. OF EMPLOYEES: 130

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President	Bernie Aronson
Vice President Marketing & Sales	Jack Hullman
Vice President Product Assurance	Terry Rutlin
Director Finance	Mike Cleland
Director Engineering	Dennis Morris
Director of Operations	Rich Frieberger

FINANCING: Not available

BACKGROUND

ICI Array Technology offers a variety of technologies to support development and manufacturing of small-footprint subsystem products. The Company emphasizes designing for manufacturability. Subsystem design is supported with ASIC capability in CMOS gate arrays and cell-based-designed ICs. One of the Company's major strengths is surface-mount technology (SMT) and COB technology offered as part of a totally integrated system.

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

ALLIANCES

ICI	Jan. 1986	Imperial Chemical Industries PLC (ICI), a large U.K. chemical company, acquired Array Technology.

National	March 1988	National Semiconductor and ICI Array Technology signed an agreement under which ICI Array will use National's design systems and process specifications to develop proprietary ASICs.

SERVICES

Design--ASIC and Subsystem
Manufacturing
Surface Mount
Chip-on-Board
Assembly

MANUFACTURING

Multiple offshore and U.S. sources provide CMOS silicon wafers.

Technology

1.0-, 1.5-, 2.0-, and 3.0-micron, double-layer metal, silicon-gate CMOS designs on Mentor tools

Facilities

San Jose, CA	50,000 sq. ft.	Administration, design, production

PRODUCTS

CMOS Gate Arrays

Process	Linewidth (micron)	Delay (ns)	Cells
Si-Gate	1.5,2.0,3.0	0.5-2.0	RAM, ROM

Digital Gate Arrays

150 to 20,000 gates

Linear Arrays

Semicustom Subsystems

Inmos International, plc
Worldwide Headquarters
1000 Aztec West, Almondsbury
Bristol BS12 4SQ, United Kingdom
011 44 454 616616
TWX: 444723

ESTABLISHED: July 1978
NO. OF EMPLOYEES: 1,850

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Managing Director	Iann Barron
Chief Executive	Douglas Stevenson
Director Microcomponents	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 develops, designs, manufactures, and markets a broad range of products. Inmos is a subsidiary of Thorn EMI plc and operates as its technology division, which also includes Thorn Ericsson, Systron Donner, and other software activities.

Since its inception, Inmos has been engaged in microprocessor development. The first results were OCCAM, a new programming language and associated programming tools. In 1986, Inmos offered the 20-MHz IMS T800 32-bit floating-point transputer. The transputer combines a 32-bit processor, a full-standard IEEE 64-bit floating-point processor, 4K of fast RAM, and four standard communications links used to connect transputers into networks. A 30-MHz version, planned for 1988, will operate at 2.25 mflops. Inmos has expanded its product line to include DRAMs, SRAMs, graphics chips, and digital signal-processing chips.

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. In 1984, Thorn EMI plc of London acquired the British Government's majority shareholding in Inmos for $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.

In 1986, Thorn EMI began restructuring the company due to continuing losses. CMOS manufacturing at the Cheyenne Mountain facility in Colorado Springs, Colorado, was discontinued and employment was reduced from 800 to 350. In December 1987, Inmos transferred all manufacturing to South Wales and in April 1988, Inmos announced that Cray Research Inc. will purchase the Cheyenne Mountain facility, subject to final agreement. Inmos will maintain a U.S. staff for sales and customer support, as well as continue test and operations for military products in Harrison Park in Colorado Springs.

Recent Highlights

Nov. 1987	Inmos began volume production of the 32-bit transputer at its Newport, South Wales, facility.
Dec. 1987	Inmos closed its Colorado Springs facility and laid off 300 employees. All memory, MPU, DSP, and graphics chip manufacturing was transferred to Newport. Inmos will continue sales and customer support in the United States in addition to test operations.

ALLIANCES

Texas Instruments	Oct. 1981	Inmos and TI reached an agreement for 64K DRAMs.
General Instrument	Oct. 1983	Inmos licensed GI to second-source an 8Kx8 EEPROM. The pact included a complete technology transfer including masks and processing information.

Intel	Dec. 1983	Intel and Inmos agreed to develop consistent specifications for 64K and 256K CHMOS DRAMs. Each company will independently develop, introduce, and market products.
NMB	June 1984	NMB obtained a five-year license to produce the Inmos 256K CMOS DRAM. NMB paid an initial sum and will pay continuing royalties. NMB will also cooperate on the technology for the Inmos 64K DRAM and a 1Mb DRAM.
	March 1985	Minebea/NMB 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 production in late 1986.

SERVICES

Design
Manufacturing
Assembly
Test

MANUFACTURING

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 1601	64Kx1	CMOS	55, 70
IMS 1620	64Kx4	CMOS	45, 55, 70
IMS 1624	16Kx4	CMOS	45, 55, 70

DSP

IMS A100	Digital Transversal Filter	320 mips
D704	DSP Development System	

MPU

T800	Combines a 32-Bit Transputer and 64-Bit On-Chip Floating-Point Processor
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
IMS G170	Video Look-Up Table

Innovative Silicon Technology
1000 East Bell Road
Phoenix, AZ 85022
602/867-6100

ESTABLISHED: May 1986
NO. OF EMPLOYEES: N/A

BOARD: Not available

COMPANY EXECUTIVES: Not available

FINANCING: Not available

BACKGROUND

Innovative Silicon Technology (IST) was formed to concentrate on quick-turn R&D for the ASIC market. IST, formed by Piero Martinotti and others from Motorola, is a wholly owned subsidiary of SGS. SGS, which transferred the assets of its ASIC activities to IST, provides high-volume foundry services, allows access to its design centers by IST engineers and IST customers, and provides sales and marketing support.

IST conducts R&D, design, prototyping, low-volume production, assembly, and test, and uses a 1.5-micron double-layer metal and direct-write on e-beam. The Company, which is located in an SGS facility, is planning a new R&D facility, fab, and operations separate from SGS, which will be located northeast of Milan.

The Company's capability includes gate arrays with up to 10,000 gates and a cell-based library with 140 logic cells.

ALLIANCES

CDI	April 1987	IST and California Devices Inc. (CDI) agreed to a joint product development and second-source agreement covering two families of ASICs using channelless architectures. The first family is a 2-micron, double metal CMOS with up to 24,000 gates. The second family is based on a 1.5-micron technology and will include more than 100,000 gates.
SDA Systems	May 1987	IST signed an agreement with SDA Systems to develop CAD systems based on SDA technology for use by IST customers.

SERVICES

- R&D
- Design
- Prototyping
- Low-Volume Production
- Assembly
- Test

MANUFACTURING

Technology

1.5-micron, double-layer metal CMOS

Facilities

The Company is planning a new R&D, design, and fabrication facility northeast of Milan.

PRODUCTS

Gate Arrays

10,000 Gates; 2-Micron Double-Layer Metal
6,000 Gates; 3-Micron Double-Layer Metal
2,500 Gates; 3.5-Micron Single-Layer Metal

Cell-Based Library

140 Cells; 3- and 1.5-Micron, Double-Layer Metal; Fully Compatible with Gate Array Libraries

Integrated CMOS Systems Inc.
440 Oakmead Parkway
Sunnyvale, CA 94086
408/735-1550
Fax: 408/735-9808

ESTABLISHED: October 1984
NO. OF EMPLOYEES: 70

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Lin Wu	STC Computer Rsch Corp.	Sr VP Opns/COO
VP Engineering	Larry Cooke	STC Computer Rsch Corp.	Dir Dsn Automation
VP Development	Jin Shyr	STC Computer Rsch Corp.	
VP Strat Plan	Symon Chang	STC Computer Rsch Corp.	Sr Eng Mgr
VP Sales/Mktg	Tom Miller	Fairchild	Mgr MPUs

FINANCING

Date	Round	Sources	Amount
1985	Round 1	Hambrecht & Quist; private individuals	$2.5M
May 1987	Round 2	DSV Partners; Hambro International Venture Fund; Montgomery Securities; Venrock Associates	$5.5M

BACKGROUND

Integrated CMOS Systems (ICS) designs, manufactures, and markets system-level VLSI semiconductors for cost-effective design and production of customer-specific subsystems. ICS provides complete turnkey solutions from design definition to working multichip subsystems.

ICS has developed a family of gate array masterslices; advanced, high-pin-count surface-mount packaging; and board-level technology for high-performance, midrange computer systems. The Company's design technology is integrated with a design automation system that can take a description of a system and transform it into an optimized and testable subsystem-level solution.

The Company's future plans include submicron processes, expanded gate array families, and advanced behavioral design implementation.

In March 1988, ICS and Apollo Computer Inc. introduced the series 10000, a new RISC-based workstation based on ICS' subsystem technology. The series 10000 achieves an execution rate of more than one instruction per cycle. The performance is achieved by parallelism among processors using 64-bit data paths and an efficiently coupled set of VLSI devices. ICS contributed system-level design and gate arrays that incorporate level-sensitive scan design (LSSD) test methodology to assure a testable product the first time.

The system uses 10 different 1.5-micron, double-level metal CMOS gate arrays with densities of 30,000+ gates from the ICS10000 Series Family. The implemented chips include a RISC-based integer processor, a floating-point register file, a memory manager, an I/O manager, and a high-speed system bus processor. The ICS10000 has up to 360 configurable I/O pads and comes in packages with up to 340 pins.

The Company's heritage is high-performance, large computer system design and development. ICS' founders came from Amdahl, IBM, and the STC Computer Research Corp., which was set up by Storage Technology.

ALLIANCES

VLSI Technology Toshiba	1985	Toshiba and VLSI began providing foundry services for ICS.

SERVICES

Design
Test

MANUFACTURING

ICS subcontracts wafer fabrication to Toshiba of Japan and VLSI Technology and uses other subcontractors for assembly and other manufacturing operations.

Technology

1.5-micron, double-level metal CMOS

Facilities

Sunnyvale, CA	12,500 sq. ft.	Headquarters and design

PRODUCTS

Gate Arrays

10,000 to 30,000+ Gates

Boards

Proprietary Designs Based on ICS' Gate Array Families and Integrated Design Automation Tools

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

ESTABLISHED: May 1980
NO. OF EMPLOYEES: 1,200

BOARD

Position	Name	Affiliation
Chairman	D. John Carey	Integrated Device Technology
Director	Leonard C. Perham	Integrated Device Technology
Director	Carl E. Berg	Berg & Berg Industrial Developers
Director	Louis B. Sullivan	Investor

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman/CEO	D. John Carey	AMD	VP Opns
President/COO	Leonard C. Perham	Western Digital	Process Mgr
VP Technology	Fu-Chieh Hsu	Hewlett-Packard	Dir Tech Dev
VP Div Mgr	Luc O. Bauer	Telmos	Founder/Pres
VP GM Subsystems	Joseph Santandrea	Monosil	President
VP GM DSP Div	Al Huggins		
VP/GM SRAM Div	David C. Turcotte	Sperry	VP
VP Finance	Jay R. Zerfoss	Maruman	Finance Dir
VP Applications	John R. Mick	AMD	App Dir
VP Marketing	Larry T. Jordon	Laserpath	VP Marketing
VP Sales	Joe Zabkar	Metromatics	President
VP HR	Tom Wroblewski	Zilog	Dir HR
VP Prod Assurance	Chuck Crane	Hewlett-Packard	Dir Prod Assurance

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

Date	Round	Sources	Amount
Feb. 1986		Second public offering	$37.2M
1987	Equip. Lease		$15.0M

BACKGROUND

Integrated Device Technology (IDT) designs, manufactures, and markets a broad range of CMOS product families, using CMOS and BICMOS processes. Products include fast SRAMs, EEPROMs, specialty memories, high-density memory modules, fast MSI logic, DSP devices, MPU products, ECL interface products, and data conversion devices that target high-performance, high-reliability, military and commercial markets.

The Company focuses on standard products with high speeds and low power enhancements; CMOS building blocks that target the high-performance computing systems; proprietary products such as its specialty memories; and products differentiated by speed, packaging, I/O, and control pins. The Company has implemented a very effective strategy to target niche markets and avoid competition from Japanese companies.

Early in its development, IDT targeted the military market and is virtually unchallenged in the areas that it serves. In 1987, IDT increased its commercial sales to equal its military sales. It is working to increase its commercial sales to 80 percent of revenue. One of the factors contributing to the shift is the addition of new plastic packaging capability.

IDT is organized into the following groups:

- Fast SRAM Group
- Specialty Memory Products Group
- EE Memory Group
- Data Conversion Group
- Microprocessor Group
- DSP Group
- FCT Logic Group
- ECL I/O Products Group
- Subsystems Group

In 1988, IDT introduced its first BICMOS product, a 64Kx1 SRAM with ECL I/Os and a 15ns access time. The Company plans to introduce one new BICMOS product each quarter, featuring speed upgrades at or below the 10ns access time level. The Company's CEMOS process, which took 18 months to develop, is based on IDT's 1.2-micron CEMOS III process, which is transportable to the Company's CEMOS V process in development.

In 1987, the Company signed a long-term agreement with MIPS Computer Systems to manufacture and market MIPS' complete line of 32-bit RISC MPUs. The agreement includes a 32-bit RISC CPU, a floating-point coprocessor, and a RISC-optimized software environment. IDT and MIPS will also codevelop future RISC chips. The agreement allows IDT to leverage software work already completed by MIPS.

SRAM manufacturing is performed in Salinas, California, and subsystems and DSP products are manufactured at the Santa Clara facility. Processes use an advanced CEMOS dual-well, oxide-isolated, ion-implanted technology with feature sizes down to the submicron level. In January 1988, IDT-Malaysia executed an agreement to purchase Thomson-Mostek's 100,000-square-foot assembly and test facility in Penang, Malaysia.

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

Recent Highlights

Oct. 1986	Leonard C. Perham, former vice president and general manager of IDT's SRAM Division, assumed the duties of president and chief operating officer. D. John Carey remains as chief executive officer and chairman of the board.
Jan. 1987	IDT agreed to allow VTC to second-source its FCT product line of TTL-compatible CMOS logic devices.
April 1987	IDT established Integrated Device Technology K.K. in Japan. The Company is capitalized at $142,857. The new firm began contracting chip assembly in Japan by Japanese firms in 1987.
July 1987	IDT offered three 256K SRAMs with access times of 35ns or better and a battery back-up data retention feature. The IDT71256 is organized as 32Kx8; the IDT71257 is organized as 256Kx1; and the IDT71258 is organized as 64Kx4.
Nov. 1987	IDT signed a long-term agreement with MIPS Computer Systems to manufacture and market MIPS' complete line of 32-bit RISC MPUs. Products include a floating-point coprocessor and a RISC-optimized software environment. IDT and MIPS will also codevelop future RISC chips.
Nov. 1987	IDT offered the IDT7216L20 and IDT7117L20, two 16Kx16 parallel CMOS multipliers with 20ns clocked multiply times.

Nov. 1987 IDT offered the IDT49C460B 32-bit CMOS error detection and correction (EDC) device. It features a maximum error detection time of 25ns, and 30ns for error correction.

Nov. 1987 IDT offered the IDT78C16 and IDT78C18, two CMOS 16K EEPROMs with 55ns read access time and serial protocol channel (SPC).

Dec. 1987 IDT offered the IDT721264/65, a floating-point, two-chip set consisting of a multiplier and an ALU. The chip set performs 32-bit operations at 33.4 megaflops and 64-bit operations at 25 megaflops.

Dec. 1987 IDT offered two 1Mb SRAM modules that feature a 45ns access time. The IDT8M824S45 is organized as 128Kx8, and the IDT8M624S45 is organized as 64Kx16. The modules are made up of four 32x8 SRAMs and one FCTA decoder.

Dec. 1987 IDT offered the IDTMP6025, a 512K CMOS asynchronous RAM module organized as 64Kx8. Cycle times are 45ns, 55ns, and 70ns.

Jan. 1988 IDT offered the IDT7201, a 512x9 CMOS FIFO featuring a 25ns access time.

Jan. 1988 IDT received DESC approval for the Standardized Military Drawing (SMD) program. Currently, 35 products are approved or pending approval for the SMD program.

Jan. 1988 IDT-Malaysia executed an agreement to purchase Thomson-Mostek's 100,000-square-foot assembly and test facility in Penang.

Jan. 1988 IDT offered four CMOS logic functions to its FCT family. They are three registered transceivers and an octal transceiver with parity.

Feb. 1988 IDT announced plans to sample the IDT100490, the first in a series of BICEMOS products. The IDT100490 is a 64Kx1 ECL I/O SRAM featuring a 15ns access time and 70 percent lower power consumption. IDT's goal is to offer one new BICEMOS product per quarter and to offer speed upgrades at or below the 10ns access time level. The BICEMOS process derives from IDT's submicron CEMOS platform with the addition of high-performance vertical bipolar transistors.

March 1988 IDT ordered several 1:1 lithography systems with submicron capability valued at about $8 million.

ALLIANCES

Internix	April 1985	IDT signed a sales contract with Internix to sell high-speed 16K and 64K SRAMs and 8K and 16K dual-port SRAMs in Japan. The agreement covers all of IDT's products.
VTC	Jan. 1987	IDT agreed to allow VTC to second-source its FCT product line of TTL-compatible CMOS logic devices.
MIPS Computer	Nov. 1987	IDT signed a long-term agreement with MIPS Computer Systems to manufacture and market MIPS' complete line of 32-bit RISC MPUs. Products include a 32-bit RISC CPU, a floating-point coprocessor, and a RISC-optimized software environment. IDT and MIPS will also codevelop future RISC chips.

SERVICES

Design
Manufacturing
Assembly
Test

MANUFACTURING

Technology

1.2-micron CEMOS
1.0-micron CEMOS in development
1.2-micron BICEMOS
6-inch wafers

Facilities

Santa Clara, CA	200,000 sq. ft.	R&D, design, development, assembly, test, marketing
	8,000 sq. ft.	R&D lab
Salinas, CA	97,000 sq. ft.	Manufacturing, design, test
	25,000 sq. ft.	Class-1 clean room
Penang, Malaysia	100,000 sq. ft.	Assembly and test

PRODUCTS

CMOS SRAM

Device	Description	Access Time
IDT6167	16Kx1	12, 15ns
IDT6168A	4Kx4	15ns
IDT71681/71682	4Kx4, Separate Data I/O	20, 25ns
IDT6116	2Kx8	20, 25ns
IDT7187	64Kx1	15, 25ns
IDT100490	64Kx1, ECL 100K I/O	15ns
IDT7188/6198	16Kx4, Output Enable (OE)	20ns
IDT7198	16Kx4, OE, Memory Control	20ns
IDT71981/71982	16Kx4, Separate Data I/O	20ns
IDT7164/7165	8Kx8, Chip Select	30, 35ns
IDT71C65	8Kx8, CMOS I/O	30, 35ns
IDT7186	4Kx16	45, 55ns
IDT71257	256Kx1	25, 35ns
IDT71258	64Kx4	25, 35ns
IDT61298/71281/ 71282	64Kx4, OE or Separate Data I/O	25, 35ns
IDT71256	32Kx8	35, 45ns
IDT71027	1Mb (1024x1)	45, 55ns
IDT71028	1Mb (256Kx4)	45, 55ns
IDT71024	1Mb (128Kx8)	45, 55ns

EEPROMs

IDT78C16/18	2Kx8, Serial Protocol Channel	70, 90ns
IDT78C64	8Kx8	55, 70ns
IDT78M64	8Kx8 Module	70, 85ns
IDT78C46	8Kx8 Registered	55, 70ns
IDT78C56	8Kx8 Registered, Serial Protocol Channel	55, 70ns
IDT78C256	32Kx8	55, 70ns
IDT78C4256	32Kx8 Registered	55, 70ns
IDT78C5256	8Kx8 Registered, Serial Protocol Channel	55, 70ns

Dual-Port RAMs

IDT7130/7140	1Kx8 Master/Slave	35, 45ns
IDT7132/7142	2Kx8 Master/Slave	35, 45ns
IDT71321/71421	2Kx8 Master/Slave, Interrupt Output	45-55ns
IDT71322	2Kx8, Semaphore	45ns
IDT7133/7143	2Kx16 Master/Slave, 32-Bit Words	55, 70ns
IDT7134	4Kx8	45ns
IDT71342	4Kx8, Semaphore	45ns
IDTM134/144	8Kx8 Dual-Port RAM Module, Master/Slave	45, 60ns
IDT7M135/145	16Kx8 Dual-Port RAM Module, Master/Slave	45, 60ns
IDT7M137	32Kx8 Dual-Port RAM	55, 60ns

FIFO

Device	Description	Speed
IDT72401 Family	64x4, 64x5, Output Enable, Half-Full, Almost-Full/Empty Flags	35-, 45-MHz
IDT7200 Family	256x9, 512x9, 1Kx9, 4Kx9, 2Kx9, Output Enable, Half-Full, Almost/Full Empty Flags	25-50ns
IDT7200 FIFO Module Family	2Kx9, 4Kx9, 8Kx9, 16Kx9	40, 50, 60ns
IDT72100 Serial FIFO Family	2Kx9, 4Kx9 Parallel-Serial I/O, 40 MHz	50ns

Other

IDT6178	4Kx4 Cache Tag, Address Comparator	12, 15ns
IDT7174	8Kx8 SRAM, Address Comparator, Chip Select	35, 45ns
IDT71501	64Kx1 Synchronous RAM	35, 45ns
IDT71052	4Kx16 Writable Control Store	35, 45ns

Modules

IDT7MP564	16Kx5 SRAM Module	15ns
IDT8M628/MP628	8Kx16, SIP or Monolithic Pinout	40, 50ns
IDT7MP156/MC156	256Kx1 Plastic or Ceramic SIP	25ns
IDT7MP456	64Kx4, Plastic SIP	
IDT7M856/8M856	32Kx8, Monolithic Pinout	
IDT8M656/MP656	16Kx16, Plastic SIP or Monolithic Pinout	40, 60ns
IDT7M656	16Kx16, 32Kx8, 64Kx4 User-Configurable	15, 25ns
IDT7M812/7M912	64Kx8, 64Kx9	40ns
IDT8M612/8MP612	32Kx16, Plastic SIP or Monolithic Pinout	40, 60ns
IDT7MC4032	16Kx32, Separate I/O	30ns
IDT7MC4001	1,024Kx1	TBD
IDT8MP824/M824	128Kx8, Plastic SIP or Monolithic Pinout	40, 60ns
IDT8MP624/M624	64Kx16, Plastic SIP or Monolithic Pinout	40, 60ns
IDT7MB624/M624	64Kx16, 128Kx8, 256Kx4 User-Configurable	15, 25ns
IDT7M4017	64Kx32	40, 60ns
IDTMP4008	512Kx8, Plastic	40ns
IDTM4016	256Kx16	45ns
IDTMP6025	64Kx8 Registered	25 MHz
IDT7M824	128Kx8, Registered Addresses, I/Os	45, 60ns
IDT7M6001	32Kx20, Double Buffered, Registered Multiplexed Address	20, 25 MHz
IDTM6032	16Kx32 Writable Control Store	TBD
IDT7MB6042	8Kx112 Writable Control Store	TBD

TBD = To Be Determined

DSP Building Blocks

Device	Description	Speed
IDT7320	16-Bit Pipelined Register	10, 15ns
IDT7381	16-Bit Cascadable ALU	30, 35ns
IDT7383	16-Bit Cascadable ALU	20, 25ns
IDT7209	12x12 Multiplier/Accumulator	45, 55ns
IDT7210	16x16 Multiplier/Accumulator, 35-Bit Output	35, 40ns
IDT7243	16x16 Multiplier/Accumulator, 19-Bit Output	45, 55ns
IDT7212	12x12 Parallel Multiplier	35, 40ns
IDT7213	12x12 Multiplier, Single Clock Architecture	35, 40ns
IDT7216	16x16 Parallel Multiplier	20, 25ns
IDT7217	16x16 Multiplier, Single Clock Architecture	25, 30ns
IDT7317	16x16, Single Clock, 32-Bit Output	20, 25ns
IDT721264	32-/64-Bit Floating-Point Multiplier	16.7 mflops
IDT721265	32-/64-Bit Floating-Point ALU	16.7 mflops

Data Converters

IDT75C18	8-Bit Video DAC with ECL Input	125 MHz
IDT75C19	9-Bit Video DAC, TTL input	125 MHz
IDT75MB38	Triple 8-Bit Video DAC Module, ECL Input	125 MHz
IDT75C458	Triple 8-Bit DAC, ECL Input	125 MHz
IDT75C48	8-Bit Flash ADC With ECL Input	20 MHz
IDT75C58	8-Bit Flash ADC, Overflow Output	20 MHz
IDT75M48	Complete 8-Bit Flash Module	20 MHz
IDT75M49	9-Bit Flash Module	20 MHz

Microprocessor Products

Device	Description
Microprocessors	
IDT39C01/03/203	4-Bit Micro Slice
IDT49C401	16-Bit Micro Slice
IDT49C402	16-Bit Micro Slice, 64x16 Dual-Port Memory
IDT49C403	16-Bit Micro Slice, 64x16 Register File, Funnel Shifter, Encoder, Logic, Mask Generator
IDT49C404	32-Bit Slice, 32-Bit ALU, 64x32 Register File, Funnel Shifter, Encoder, Logic, Mask Generator
Sequencer	
IDT39C09/11	4-Bit Sequencer
IDT39C10	12-Bit Sequencer
IDT49C410	16-Bit Sequencer

Register Files

IDT39C705/707	16x4 Register File Extension

Error Detection/Correction (EDC) Unit

IDT39C60	16-Bit Cascadable EDC
IDT49C460	32-Bit Cascadable EDC

Other

IDT39C02	Carry Look-Ahead Generator
IDT49C25	Microcycle Length Controller

RISC Microprocessors

IDT79R3000	32-Bit RISC CPU, 20 mips
IDT79R3010	RISC Floating-Point Accelerator
IDT79R3020	Write Buffer

CMOS Logic Products

Device	Description
IDT29FCT52/53/	Octal Registered Transceiver
IDT29FCT520/521	Multilevel Pipeline Register
IDT49FCT601	16-bit Bidirectional Latch
IDT49FCT618	16-bit Register, Serial Protocol Channel
IDT49FCT661	16-bit Synchronous Binary Counter
IDT49FCT818	Octal Register, Serial Protocol Channel
IDT54/74FCT138	1-of-8 Decoder
IDT54/74FCT139	Dual 1-of-4 Decoder
IDT54/74FCT161/163	Synchronous Binary Counter
IDT54/74FCT182	Carry Look-Ahead Generator
IDT54/74FCT191/193	Up/Down Binary Counter
IDT54/74FCT240/241/244	Octal Buffer
IDT54/74FCT245/640/645	Octal Bidirectional Transceiver
IDT54/74FCT646/FCT52/FCT53	Registered Transceivers
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
IDT39C821/822	10-Bit Noninverting/Inverting Register
IDT39C823/824	9-Bit Noninverting/Inverting Register
IDT39C825/826	8-Bit Noninverting/Inverting Register
IDT39C841/842	10-Bit Noninverting/Inverting Latch
IDT39C843/844	9-Bit Noninverting/Inverting Latch
IDT39C845/846	8-Bit Noninverting/Inverting Latch
IDT39C861/862	10-Bit Noninverting/Inverting Transceiver
IDT39C863/864	9-Bit Noninverting/Inverting Transceiver

Integrated Logic Systems, Inc.
4445 Northpark Drive, Suite 102
Colorado Springs, CO 80907
719/590-1588
Fax: 719/590-1373

ESTABLISHED: August 1983
NO. OF EMPLOYEES: 15

BOARD

Name	Affiliation
Frank Gasparik	Integrated Logic Systems, Inc.
Ted Orf	Integrated Logic Systems, Inc.
David Taylor	Consultant
James Shook	Consultant

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Frank Gasparik	Insouth	VP Engineering
Exec VP/CFO	Ted Orf		Attorney

FINANCING

Date	Round	Sources	Amount
Jan. 1984	Round 1	OTC offering	$5.0M

BACKGROUND

Integrated Logic Systems, Inc. (iLSi), was formed to design and develop a family of silicon-gate CMOS and software-based design aids.

iLSi has introduced new gate array architectures that offer customers state-of-the-art capabilities. iLSi's product line is capable of implementing 45,000-gate designs that can include large complex functions such as ROM, RAM, PLA, PAL, and the 2900 family in a variety of package options.

The Company has licensing and foundry agreements with four major world-wide corporations.

ALLIANCES

Motorola	June 1986	iLSi licensed its line of gate arrays to Motorola.
Sumitomo	Dec. 1986	iLSi signed an agreement with Sumitomo Corporation and SC Hightech Center, a design center formed to carry out the agreement. Sumitomo licensed ASIC design technology from iLSi. In addition to gaining royalty payments, iLSi gained rights to use any foundries that Sumitomo uses.
Yamaha	Dec. 1987	Yamaha Corporation purchased a license to manufacture and sell gate arrays based on iLSi technology for an undisclosed amount. Yamaha will pay royalties and provide foundry services.
Oki	April 1988	iLSi signed a technology purchase and licensing agreement with Oki Electric Industry Company, Ltd., for an undisclosed amount. Oki will manufacture and sell gate arrays based on iLSi technology and will provide foundry services.

SERVICES

Gate Array Design
Full-Custom Design
CAD Software

MANUFACTURING

Technology

1.5-micron silicon-gate CMOS, double-level metal
1.2-micron silicon-gate CMOS, double-level metal under development

Facilities

Colorado Springs, CO	10,000 sq. ft.	Administration and design

PRODUCTS

CMOS Gate Arrays

Family	Process	Linewidth (Microns)	Delay (ns)	Gates
CA-1500	Si-Gate	1.5	1.0	2,000 to 42,000
15GH	Si-Gate	1.5	1.0	2,500 to 110,000

Intercept Microelectronics
1250 Oakmead Parkway, Suite 210
Sunnyvale, CA 94086
408/245-7117

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	Kevin Tsang	Matra-Design	Mgr Engr App
Personnel Mgr/Ctlr	Steve Hyndman	Matra-Design	Not available

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 completed automatically 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 Rodriguez, 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

MANUFACTURING

Technology

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

Facilities

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

PRODUCTS

Gate Arrays

150 to 1,900 Gates

International CMOS Technology, Inc.
2125 Lundy Avenue
San Jose, CA 95131
408/434-0678
Fax: 408/434-0688

ESTABLISHED: October 1983
NO. OF EMPLOYEES: 40

BOARD

Name

Drew Allen Osterman, Chairman of the Board, CEO and President
Paul Reagan, Director
Lee Lunsford, Director
Bruce Bailey, Director
Grover T. Wickersham, Director
Ali Dad Farmanfarma, Director
Dr. Samuel T. Wang, Director and Vice President of Technology
Donald Robinson, Director and Vice President of Operations
C.S. Park, Director

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Drew A. Osterman	National	Mktg Mgr NV Mems
VP Technology	Dr. Samuel Wang	National	Sr Process Eng Mgr
VP Sales/Mktg	Paul K. Forster	Signetics	Dir Dist Sales
VP Dsn Engr	Dhaval J. Brahmbhatt	National	Engr Mgr
VP Operations	Donald E. Robinson	National	Prod Mgr EPROMs
VP CFO	Lawrence A. Yaggi, Jr.	Perkin-Elmer	Controller

FINANCING

Date	Round	Sources	Amount
1984	Rounds 1 & 2	Hyundai Electronics Industries	$5.0M
June 1987	Round 3	Undisclosed institutional investors	$2.0M
Feb. 1988	Round 4	Undisclosed institutional investors	$2.9M

BACKGROUND

International CMOS Technology, Inc. (ICT), designs, manufactures, and markets CMOS EEPROMs, EPROMs, and EEPLDs. ICT stated that in 1984, the Company successfully combined the first 5V-only CMOS EEPROM (the 93C46) in volume production.

The Company's current product offerings include the programmable electrically erasable logic (PEEL) family of CMOS PLDs. The PEEL products use the Company's CMOS 1.25- and 2.0-micron EEPROM technology and feature a propagation delay as fast as 15ns. Additional ICT products include serial EEPROMs; a 40ns, 64K CMOS UV-erasable PROM; and a 35ns, 32K UV-erasable PROM that targets the bipolar 24-pin PROM market.

ICT also offers design and development tools. The Company enlisted John Birkner, the inventor of the PAL (a trademark of Monolithic Memories), to create a low-cost, easy-to-use developmental package consisting of design software and a PC-based, software-controlled programmer. ICT gives the software, free of charge, to any party interested in using PEEL devices.

ICT is developing a family of products that will address the high-density PLD and programmable gate array markets. The introduction of these devices will complete a PLD family ranging from 20-pin, 300-gate equivalent PLDs to 40-/68-/84-pin, 10,000-gate programmable gate arrays.

The Company is planning advances in its memory lines as well, and is working on process and design shrinks to minimize the access times further and allow for the fabrication of 256K and larger devices.

The Company was founded by Drew Allen Osterman, Dr. Samuel T. Wang, Dhaval J. Brahmbhatt, and Donald E. Robinson, all of whom were formerly with National Semiconductor Corporation, and Lawrence A. Yaggi, Jr., formerly with Perkin-Elmer. In January 1988, Paul K. Forster joined ICT as its first vice president of sales and marketing.

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. The agreements also provide ICT with additional technical support in the form of CAD services and prototype wafer fabrication.

Recent Highlights

Jan. 1987 Asahi Chemical Industry received a license to ICT's technology and will market ICT's EEPROMs.

June 1987	ICT raised $2.0 million in third-round financing. The funds were used for additional capital equipment and personnel and for general working capital. ICT also announced a move to a new 31,000-square-foot facility adjacent to its current site in San Jose, California.
July 1987	ICT offered four new CMOS UV EPROMs with access times of 35ns, 45ns, and 55ns. The 27CX641 and 27CX642 are organized as 8Kx8, and the 27CX321 and 27CX322 are organized as 4Kx8. The products differ in packaging.
Sept. 1987	ICT offered the PDS-1 development system for designing and programming PEEL devices. Designers can use either ICT's APEEL compiler or third-party development software. The system includes an editor, a logic assembler, a PLD-to-PEEL translator, a programmer, and a device tester.
Dec. 1987	ICT offered four new CMOS PLD devices. The 20-pin PEEL153 and 24-pin PEEL173 are plug-in replacements for bipolar FPLA devices. The 20-pin PEEL253 and 24-pin PEEL273 offer architectural enhancements to the PEEL153 and PEEL253, respectively.
Jan. 1988	ICT signed a nationwide distribution franchise agreement with Marshall Industries.
Feb. 1988	ICT raised $2.9 million in fourth-round financing from undisclosed institutional investors.

ALLIANCES

Hyundai	Oct. 1983	Hyundai and ICT signed a joint development agreement to develop and produce seven or eight devices 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 EEPROM 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 EEPROM family. Both companies will work on new product and technology development including work on PEEL products.
Asahi Chemical	Jan. 1987	Asahi Chemical Industry received a license to ICT's technology and will market ICT's EEPROMs.

SERVICES

IC Design

MANUFACTURING

Technology

1.25- and 2.0-micron CMOS EE process
1.0- and 0.8-micron CMOS EE process (1989)

Facilities

San Jose, CA	31,000 sq. ft.	Headquarters, design, test, marketing, and sales

PRODUCTS

Memory

Device	Description
93C46	1K Serial 5V Read/Write EEPROM
93C66	4K Serial 2.5V to 7.0V Read/Write EEPROM
27CX321/322	4Kx8 UV-Erasable PROM, 35ns, 40ns, 45ns
27CX641/642	8Kx8 UV-Erasable PROM, 40ns, 45ns, 55ns

PEEL Devices

Device	Delay (ns)	Pins	Programmable Array(s)
PEEL18CV8	15	20	AND
PEEL22CV10	25	24	AND
PEEL20CG10	25	24	AND
PEEL153	30	20	AND/OR
PEEL173	30	24	AND/OR
PEEL253	30	20	AND/OR
PEEL273	30	24	AND/OR
PGS1500	25	24	Undisclosed
PGS2000	25	40	Undisclosed

PDS-1 development system that allows design with either ICT's PEEL logic compiler or third-party software. The system includes editor, logic assembler, logic simulator, PLD-to-PEEL translator, programmer, and device tester.

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: 380

BOARD

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

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Barry Carrington	AMI	Sr VP Mfg
Exec VP/CFO	Charles Isherwood	AMI	Sr VP Corp Svcs
Sr VP Ops	Larry Anderson	NEC	Mfg Manager
Sr VP Sales	Martin Landin	Gould AMI	VP Sales
VP Technology	Dr. Moiz Khambaty	AMI	CMOS Tech Dev
VP Materials	Paul Bolinger	Synertek	Project Manager
VP Sales	Bob Kromer	National	Regional Sales Mgr

FINANCING

Date	Round	Sources	Amount
Aug. 1981	Round 1	IMP management and individuals; Charles River Partnership; Citicorp Venture Capital; Continental Illinois Venture; Harvest Ventures; INCO Securities; Lambda; Menlo Ventures; Robertson, Colman, & Stephens; Vista Ventures; Welsh, Carson, Anderson and Stowe	$ 8.8M
1981	Lease	Bank of America; Orchard Properties	$13.0M

FINANCING

Date	Round	Sources	Amount
Aug. 1982	Round 2	Initial investors (except IMP management and individuals); R.W. Allsop; Edinburgh Financial, U.K.; Foster Industries; Murray Johnstone, U.K.; Prudential Nominees, U.K.; Republic Ventures; Robinson Investments; Scottish Development Agency; Stewart Enterprises, U.K.; Toronto Dominion Bank; H.G. Usher, U.K.; Wilmark R&D (Ivory & Sime), U.K.	$ 7.4M
June 1983	Round 3	Same as round 2 (except Stewart Enterprises and Wilmark R&D); IMP management and individuals; Aiken Hume; Alex Brown & Sons; Citibank; Drayton Montagu; GE Pension Fund; Hillman Company; IBM Retirement Trust Fund; Kleinwort Benson; Latigo Ventures; Lombard Odier; Morgan, Grenfell & Co.; Morgan Stanley & Co.; Mutual Benefit Life; Pacific Technology Venture; Robert Fleming & Co.; Schulf, Woltman & Co.; Walter Scott & Partners	$14.2M
June 1984	Round 4	National Semiconductor	$ 3.0M
Aug. 1984		Standard Oil of Ohio	$ 4.0M
June 1985		Northern Telecom, Standard Oil of Ohio	$ 6.2M
June 1986		CIN Investor Nominees Ltd.; Citicorp Venture Capital Ltd.; Pruventure, Syntech, Grosvenor Technology Fund	£3.0M
June 1987		Initial public offering	$22.3M

BACKGROUND

International Microelectronic Products (IMP) designs and manufactures mixed analog/digital and complex digital chips for single-user applications. The Company is a full-service vendor with in-house capability that includes cell-based design methods, advanced CAD tools, and high-performance CMOS processes. Products designed by IMP are used primarily in the microcomputer, computer peripherals, and communications markets. IMP's goal is to achieve sales of $150 million by the early 1990s.

The Company is composed of three business groups. The IMP-Designed IC (IDIC) group performs complete IC design for customers. The Customer-Designed IC (CDIC) group links customers with their own designs and IMP's prototyping and production manufacturing. The Customer Technology Assistance Program (CTAP) supports customers in their long-term ASIC technology development efforts by coordinating technology licensing and joint development efforts for IC development and/or manufacturing capabilities in partnership with IMP.

In May 1986, IMP formed an affiliate company, IMP Europe Limited, headquartered in Swindon, England. IMP Europe's initial activities include custom IC design and applications engineering services for the European market.

In June 1987, IMP completed an initial public offering of 4.5 million shares of common stock that raised $22.3 million. The Company is using proceeds to upgrade its internal fab lines and design capability to redeem Series-A preferred stock, and for general corporate purposes.

One of IMP's goals is to maintain a process technology leadership position among ASIC suppliers. The Company's 2- and 3-micron CMOS processes have the capability to implement various combinations of polysilicon and metal interconnect in p-well or n-well technology. In May 1988, a new 1.2-micron CMOS process was announced. It is tailored for mixed analog and digital functions on the same chip. The Company's facility uses all-stepper photolithography, gas plasma dry etchers, ion implantation, computer-controlled diffusion, and a computer parameter test process.

The Company's R&D programs are currently focused on developing complex analog and digital cells for use in the IMP Design System; semiconductor manufacturing processes and device structures; advanced design software; and advanced networking, communications, and information systems for use in engineering and manufacturing. IMP is working with Silicon Compiler Systems Inc. to develop analog compilation techniques, with a leading university to develop advanced analog cells, and with the Company's IMP Europe affiliate for advances in CAD.

Recent Highlights

Sept. 1986	Barry Carrington, president, was promoted to CEO from COO. He succeeds George W. Gray who remains as IMP's chairman of the board.
June 1987	IMP completed an initial public offering of 4.5 million shares of common stock, raising $22.3 million. The Company is using proceeds to upgrade its internal fab lines and design capability, to redeem Series-A preferred stock, and for general corporate purposes.

Dec. 1987	IMP reported third-quarter revenue of $13.1 million for the period ending December 31, 1987. Net income for the period was $1.8 million, which was a 200 percent increase compared with the comparable quarter a year before.
May 1988	IMP announced a family of analog and digital 1.2-micron cell libraries and supporting CMOS processes. The ACL-1.2 and DCL-1.2 families can implement analog and digital functions on the same chip and can offer system speeds of 40 MHz. The digital CMOS process, called C1201, and the DCL-1.2 digital cell library became available in May 1988 in the United States and in Europe through IMP Europe. The analog CMOS process, C1202, and the ACL-1.2 analog cell library will be available in the fourth quarter of 1988.

ALLIANCES

Zoran	June 1983	IMP and Zoran codeveloped a CMOS PROM technology.
IXYS	Nov. 1983	IMP codeveloped a high-voltage CMOS process with IXYS.
National	1984	IMP and National Semiconductor signed a five-year technology exchange and second-source agreement transferring IMP's standard cell designs in exchange for National's multiple-layer metal silicon-gate CMOS process, as well as future CMOS processes.
	April 1985	IMP will second-source National's 2-micron gate arrays.
Micro Linear	June 1984	IMP and Micro Linear codeveloped a 10V CMOS process. IMP provides foundry services for Micro Linear.
Micro Linear MBB	Aug. 1986	IMP and Micro Linear agreed to transfer ASIC design know-how to Messerschmitt Bolkow Blohm (MBB) over a three-year period.
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 became available with IMP's design rules.
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.
Lasarray	Aug. 1986	IMP and Lasarray agreed to cooperate on developing a family of base wafers for personalization on Lasarray's turnkey design and manufacturing system module. Initial wafers will contain a 2-micron, 2-layer metal CMOS 2,400-gate array with 1.5ns delay.
Electrolux	Nov. 1987	IMP signed a five-year agreement with Electrolux of Sweden to develop ASIC devices that will be used in home appliances. IMP will also develop CAD tools for Electrolux and its component subsidiary, Electrolux Mecatronik. IMP will manufacture the devices in San Jose, California.

SERVICES

Foundry
Design
CAD Software
Prototyping
Manufacturing
Packaging: DIP, PLCC, SOIC, QFP, PGA
Test

MANUFACTURING

Technology

3.0-, 2.0-, and 1.2-micron CMOS
P-well, double-metal, double-poly
4-inch wafers

Facilities

San Jose, CA	110,000 sq. ft.	Headquarters and manufacturing
	16,000 sq. ft.	Class-10 clean room

PRODUCTS

CMOS Gate Array

Process	Linewidth	Delay	Gates
Si-Gate	2.0-Microns	1.0ns	800 to 6,000

CMOS Cell Library

Family	Process	Gate Length	Delay (ns)	Cells
ACL-3	Si-Gate	3.0 Microns	N/A	>40 Analog
DCL-3	Si-Gate	3.0 Microns	3.5	>0 Logic
DCL-2	Si-Gate	2.0 Microns	1.0	>0 Logic, RAM, ROM, PLA
ACL-2	Si-Gate	2.0 Microns	N/A	8 Analog
DCL-1.2	Si-Gate	1.2 micron	0.3	70 Logic

N/A = Not Applicable

Development Tools

IDS-II	Distributed Processing, Sun-Based Design System for Cell-Based and Full-Custom Products
UNT	Universal Netlist Translator (UNT) that Converts any Gate Array Netlist or Cell-Based Design to an IMP Cell-Based Design
SCF Compiler	Switched Capacitor Filter Compiler Software
SCIL	Standard Cell IC Layout System Software
BIL	Block IC Layout Software

Isocom Limited
Prospect Way
Park View Industrial Est.
Brenda Road
Hartlepool, Cleveland, England
(0429) 221431

ESTABLISHED: November 1982
NO. OF EMPLOYEES: 84

Isocom, Inc.
256 E. Hamilton Avenue, Suite H
Campbell, CA 95008
408/370-2212

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Colin Rees	Litronix	Mgr Europe Sales
Technical Dir	Andrew Mann	Siemens	Prod Mgr Optocoupler Div

FINANCING: Not available

BACKGROUND

Isocom Limited was formed to design, manufacture, and market optocouplers with the goal of becoming a major participant in the $80 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.

The Company's initial products included a range of optocouplers 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, high-gain optocouplers. Isocom's products, which presently include transistor-output, Darlington-output, AC-input, photo SCRs, TRIACs, and Schmitt Trigger optocouplers, are used in power supplies, telecommunications, instrumentation, and modems. In the second quarter of 1985, the Company became one of the first to offer a range of surface-mount devices.

Isocom was founded by several former Litronix managers and is headquartered in Hartlepool, England, with a U.S. sales and marketing office in Campbell, California. Design, manufacturing, and test are done at the 25,000-square-foot Hartlepool facility. Some assembly is contracted to companies in the Far East.

SERVICES

- Full-Custom Optocoupler Design
- Manufacturing
- Test

MANUFACTURING

Technology

- Silicon
- GaAs
- GaAlAs

Facilities

Hartlepool, England	25,000 sq. ft.	R&D, design, manufacturing, test
Campbell, CA	2,000 sq. ft.	Marketing and sales

PRODUCTS

- Minicouplers
- High-Speed/High-Gain Couplers
- High-Isolation Optocouplers
- High-Speed Tristate Optocouplers
- High-Voltage Photo Transistor Couplers
- Switches
- Hybrids

IXYS Corporation
2355 Zanker Road
San Jose, CA 95131
408/435-1900

ESTABLISHED: April 1983
NO. OF EMPLOYEES: 50

BOARD

Name	Affiliation
David Cooper, chairman	IXYS Corporation, president/CEO

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	David Cooper	SGS-Thomson	WW Dir Power MOS
Exec VP	Nathan Zommer	GE Intersil	Mgr Pwr MOS R&D
Sr VP Power ICs	Dick Blanchard	Siliconix	VP Dsn & Tech
VP Engr Opns	Mark Barron	GE Calma	Sr VP R&D
VP Sales	Daniel Schwob	GE	Prod Mktg Mgr
VP Finance/Admin	Jim Wu	Siliconix	Controller
VP Marketing	Edward Day	Sprague Electric	Regional Sales Mgr
Dir Ops	Tony DeCarlo	Intersil	Dir Custom Svc

FINANCING

Date	Round	Sources	Amount
1983	Round 1	Fred Adler	$0.8M
Oct. 1985	Round 2	Adler & Co.; Burr, Egan, Deleage; Grace Ventures; Harvest Ventures; Arthur D. Little; Oak Investment Partners; Stanford University; U.S. Venture Partners; Zimmerman Family Partnership	$6.7M
Aug. 1987	Round 3	Adler & Co.; Burr, Egan, Deleage; Grace Ventures; Harvest Ventures; Oak Investment Partners; U.S. Venture Partners	$3.0M

BACKGROUND

IXYS designs, manufactures, and markets a specialized line of discrete power MOS devices, VLSI CMOS digital ICs, and CMOS analog ICs. The Company's products are designed for motion control applications in machinery, such as robots and home appliances, and in power conversion equipment, such as precision dc motors and high-voltage switches.

IXYS' smart power products include monolithic current sensing to simplify the design of current-mode switching power supplies. The Company plans to integrate a function that will monitor device junction temperature on the power chip.

Recent Highlights

Jan. 1986	IXYS offered its first product, the IXSE501, a Shaft Encoder Peripheral Interface IC. The device is a CMOS monolithic two-channel PWM control processor for micro-stepping two-phase stepper motors and other applications.
June 1986	IXYS has offered a line of MOS insulated-gate transistors (MOSIGTs) developed by Nathan Zommer, who originally developed IGTs while at GE Intersil. The new devices combine the IGT design with polysilicon gate CMOS technology.
March 1987	IXYS relocated into a new 53,000-square-foot facility in San Jose, California. The facility, which is six times larger than the Company's former facility, includes an automated line and has capability for custom packaging. IXYS plans to invest between $2 million and $3 million in the line over the next two years.
March 1987	IXYS offered the IXMS150, a CMOS two-channel PWM control processor.
Aug. 1987	IXYS named David Cooper president and chief executive officer. Mr. Cooper takes over the position from Alan Hofstein. Mr. Cooper will focus on expanding the Company's development efforts in power chips, high-voltage ICs, and power modules, with various new product introductions. Before joining IXYS, Mr. Cooper was worldwide director of power and smart power operations for SGS-Thomson a Milan, Italy-based chip maker with annual sales of more than $1 billion.
Aug. 1987	IXYS raised $3.0 million in third-round financing.

Oct. 1987	Dick Blanchard joined IXYS as senior vice president and will head the Company's smart power IC design team. Mr. Blanchard was previously with Siliconix, most recently as vice president of design and advanced technology development. He reports to Mr. Cooper.
Nov. 1987	IXYS began offering its power MOSFETs and MOSIGTs in military packages.
Dec. 1987	IXYS introduced the MOSBLOC IGBT family of modules, which range from 25A to 200A in both 600V and 1000V versions. The devices are packaged in bipolar Darlington modules, as used by Japanese vendors. The product family is aimed at motor control and other industrial applications that are served by Japanese suppliers. IXYS expects this product family to become its major commercial product line and expects it to account for as much as $30 million per year in revenue.

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 signed an agreement with Samsung Semiconductor and Telecommunications under which 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 two companies will jointly manufacture IXYS' first smart power products.

SERVICES

Design
Packaging
Manufacturing
Assembly and Test

MANUFACTURING

Technology

2.0- to 4-micron HDMOS (high-performance DMOS)
5-inch wafers

Facilities

San Jose, CA	53,000 sq. ft.	Design, manufacturing, hi-rel assembly, test

PRODUCTS

PowerFETs

Device	Description
MegaMOS FETs	Large-Scale Monolithic Power MOSFETs
Power MOSFETs	High-Voltage n-Channel and p-Channel MOSFETs
MirrorFETs	Power MOSFET with Monolithic Current Sensing
LIMOFETs	MegaMOS FET with IC Drive Technology
HiPerFETs	Power MOSFET with High DV/DT Ruggedness
MISIGBTs	Monolithic Power MOSFETs with Bipolar Devices
MOSBLOC Modules	Power MOSFETs or MOSIGBTs

Integrated Circuits

IXLD426-9	CMOS MOSFET Drivers
IXED0900/1500	CMOS Address Encoder/Decoder
IXMS150	CMOS Monolithic Two-Channel PWM Controller
IXPD610	Digital Pulse-Width Modulator (DPWM)
IXSE501	Shaft Encoder Peripheral Interface (SEPI)

Krysalis Corporation
4200 Balloon Park Road
Albuquerque, New Mexico 87109
505/345-1953
Fax: 505/345-1380

ESTABLISHED: 1985
NO. OF EMPLOYEES: 25

BOARD: Not available

COMPANY EXECUTIVE

Position	Name	Prior Company	Prior Position
President/CEO	William D. Miller	Signetics	Process Dev
VP Rsch & Engr	Joseph T. Evans	U.S. Air Force	VP Sales/Mktg
VP/CFO	Neil Hennessey	Gould NavCom	VP Finance

FINANCING

Date	Round	Sources	Amount
May 1986	Seed	Columbine Venture Fund; Crosspoint Venture Partners; Meadows Ventures; OSCCO Ventures; Weeden Capital Partners	$1.0M
Dec. 1986	Round 1	Initial investors	$3.2M

BACKGROUND

Krysalis was formed to develop and manufacture nonvolatile semiconductor memories, using a CMOS ferroelectric technology. Founders of the Company are Joseph T. Evans, formerly of the U.S. Air Force Weapons Laboratory, and William D. Miller, formerly of Signetics.

The Company plans to market 16K and derivative products as initial process vehicles. The products will feature an access time of 120ns and emphasize radiation-hardened and industrial applications.

Krysalis demonstrated the feasibility of manufacturing the devices with a 512-bit UniRAM memory part using a 3-micron process at Orbit Semiconductor. A 16K UniRAM is currently under development. The part, which is equal in function to a nonvolatile SRAM, will be introduced in 1988.

The Company believes that its process can be applied to wide ranges of logic including ASICs, MPUs, and TTL-compatible logic. The ferroelectric technology is also said to be compatible with bipolar, CMOS, and GaAs processes. Krysalis plans to use a deposition technique to add the ferroelectric layers on existing processes.

Recent Highlights

1987	Krysalis set up a small $3.0 million materials research laboratory in New Mexico.
Dec. 1987	Krysalis signed a seven-year agreement with National Semiconductor for the joint pursuit of UniRAM technology. (See "Alliances" for more details.)

ALLIANCES

National	Dec. 1987	Krysalis signed a seven-year agreement with National Semiconductor for the joint pursuit of UniRAM technology. National will provide product engineering, manufacturing, and marketing support. Initially, National will supply base wafers based on a 2-micron process. Krysalis will complete fabrication of the wafers through packaging, test, and burn-in. Krysalis will conduct its own marketing and sales.

SERVICES

R&D
Design
Prototype Manufacturing
Assembly
Test

MANUFACTURING

Technology

2- and 3-micron

Facilities

Albuquerque, NM	13,000 sq. ft.	Headquarters, R&D, design, prototype manufacturing, assembly, test
	2,000 sq. ft.	R&D lab, Class-10 clean room

PRODUCTS

16K UniRAM (1988)
Nonvolatile Logic Product Line (in 1988)

Kyoto Semiconductor Corporation
418-3, Yodosaime-cho
Fushimi-ku Kyoto 613, Japan
075-631-8823
Fax: 075-631-8291

ESTABLISHED: April 1980
NO. OF EMPLOYEES: 20

BOARD: Not available

COMPANY EXECUTIVE

Position	Name	Prior Company
President	Jousuke Nakata	Mitsubishi

FINANCING

Capitalization: ¥62 million

BACKGROUND

Kyoto Semiconductor offers GaAs light-emitting diodes (LEDs), phototransistors, photosensors, and LED displays. The diodes offer twice the efficiency of available units. The heterostructured diodes feature a 23.6 percent light-emitting efficiency at peak wavelengths of 190nm. Four selections of wavelengths are available: 660, 750, 830 and 890.

Kyoto Semiconductor's major customers are Mitsubishi Electric and General Instrument. The Company contracts assembly to companies in Taiwan.

SERVICES: Not available

MANUFACTURING: Not available

Facilities

Kyoto, Japan — Production

PRODUCTS

- High Bright LEDs
- Infra LEDs
- Photo TRs
- Photosensors
- LED Displays

Lattice Semiconductor Corporation
555 N.E. Moore Court
Hillsboro, OR 97124
503/681-0118
Fax: 503/681-3037

ESTABLISHED: April 1983
NO. OF EMPLOYEES: 75

BOARD

Name	Affiliation
C. Norman Winningstad	Floating Point Systems, chairman
Dan Hauer	S-MOS (Seiko Epson), president
Harry A. Merlo	Louisiana Pacific Corp., chairman/CEO
Roy Pollack	RCA (retired)
Ole Christian Sand	A/S Nevi; Oslo, Norway; partner
Douglas C. Strain	Electro Scientific Industries, chairman

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman/CEO	C. Norman Winningstad	Floating Point	Founder
Exec VP/COO	Raymond Capece	Rosen Research	VP
VP Finance/Admin	Jan Johannessen		
VP Sales	Paul Kollar	Signetics	Dir Natl Ops
Dir Marketing	Bill Wiley Smith	Silicon Systems	Dir Apps

FINANCING

Date	Round	Sources	Amount
1983	Round 1	Datavekst A/S, Norway; Floating Point Systems, Inc.; Louisiana-Pacific Corp.; Harry A. Merlo, C. Norman Winningstad, and other corporate stockholders	$1.9M
July 1984	Credit	Oregon Bank, U.S. National Bank	$2.7M
Sept. 1987	Round 2	Previous investors	$1.6M
Jan. 1988	Credit	First Interstate Bank	$1.5M
Feb. 1988	Round 3	Institutional investors	$2.5M
April 1988	Round 4	Institutional investors	$5.0M

BACKGROUND

Lattice Semiconductor Corporation (LSC) designs, develops, manufactures, and markets high-performance PLDs, using a proprietary EE CMOS technology. LSC has pioneered a line of high-speed PLDs called Generic Array Logic (GAL) as direct pin-for-pin replacements of bipolar PAL devices. The next generation, ispGAL devices, includes in-system programmability that makes logic configurable "on the fly" under software control for robotics and artificial intelligence applications.

LSC has established agreements with National Semiconductor and SGS in Milan, Italy. In exchange for the right to use certain GAL designs, the companies are providing wafers and assembly services. The Company conducts all final testing, including quality and reliability testing, at the LSC facility in the United States.

In September 1986, Monolithic Memories, Inc. (MMI), filed a class action suit against LSC and Altera, charging patent infringement of the PAL architecture. LSC filed a $300 million countersuit charging MMI with abusing the Sherman Act, i.e., trying to destroy the competition. The MMI suit brought negotiations for additional financing, which were in progress, to a standstill. In December 1986, Rahul Sud, president; Jay McBride, general manager; S. Robert Brutbarth, and Kishan C. Sud resigned from LSC. As a result of these events, during 1987, LSC took aggressive actions to restructure the Company and filed a voluntary petition for protection under the Chapter 11 federal bankruptcy law.

On September 28, 1987, LSC's reorganization plan under federal bankruptcy law became effective, marking the Company's exit from Chapter 11. As a result of the restructuring, the Company raised $1.6 million in cash, giving the Company a positive net worth. The plan received unanimous approval and strong support from the creditors' committee, which includes representatives of S-MOS and its parent company Seiko Epson. In November 1987, LSC relocated at a new headquarters in Hillsboro, Oregon, tripling its manufacturing space. Also in November, LSC and MMI settled the lawsuits filed against each other. LSC licensed MMI's patent, and both companies exchanged rights to their worldwide patents in PLDs.

In 1987, LSC signed Arrow Electronics as its authorized U.S. distributor and also signed Almex, in France; Alcom, in the Netherlands; Bacher GmbH, in the Federal Republic of Germany; and Henaco, in Norway. In addition, Lattice signed sales representatives in the United States and the United Kingdom.

Recent Highlights

Sept. 1986	LSC adds Bell Industries of Los Angeles, California, as a distributor.
Sept. 1986	Monolithic Memories filed a class action suit against LSC and Altera, charging patent infringement of the PAL architecture. LSC filed a $300 million countersuit charging MMI with abusing the Sherman Act--trying to destroy the competition.
Oct. 1986	LSC offers GAL16V8-25P and GAL20V8-25P "quarter-power" devices that are 25ns PLDs and operate with only 45 milliamperes. The GALs can be configured into any one of 21 PAL architectures.
Oct. 1986	LSC offered Q11987, an 8Kx8, 64K CMOS SRAM with an access time of 25ns.
Dec. 1986	Rahul Sud, founder, president, and CEO, and Jay McBride, vice president of operations and general manager, submitted their resignations. C. Norman Winningstad, chairman of the board, is acting CEO. Rahul Sud, Jay McBride, S. Robert Breitbarth, and Kishan C. Sud also resigned from LSC's board of directors.
Feb. 1987	LSC and SGS Semiconductor Corporation signed an agreement covering LSC's GAL products. SGS acquired a worldwide license to the design and technology developed by LSC for the GAL (PLD). SGS will manufacture GAL products for LSC, and the two companies will cooperate in the design of future PLD products.
April 1987	LSC offered the GAL39V18, a programmable logic device using EE CMOS technology. Maximum delays are 30ns from input to output and 15ns from clock to output.
April 1987	National Semiconductor made a minority capital investment in LSC and licensed its GAL technology. The five-year agreement includes codevelopment of denser architectures of both standard and in-system programmable GALs, as well as a new line of FPLAs and sequencer devices. National has the rights to produce and market LSC's GAL and to purchase initial wafers from Seiko Epson, which operates as a foundry for LSC.
June 1987	LSC recalled its fast 64K EEPROM product line, which it began sampling late last year, due to engineering flaws.

July 1987	LSC filed a voluntary petition for protection under Chapter-11 federal bankruptcy law. The Company cut back on its SRAM development and laid off about 15 employees.
Sept. 1987	LSC's reorganization plan under federal bankruptcy law became effective on September 28, 1987, and marked the Company's exit from Chapter 11. As result of the restructuring, the Company raised an undisclosed amount of cash giving the Company a positive net worth. The plan received unanimous approval and strong support from the creditors' committee, which includes representatives of S-MOS and its parent company Seiko Epson.
Nov 1987	LSC relocated at a new headquarters in Hillsboro, tripling its manufacturing space.
Nov. 1987	LSC and Monolithic Memories, Inc., settled the lawsuits filed against each other. LSC licensed MMI's patent, and both companies exchanged rights to their worldwide patents on PLDs.
Dec. 1987	LSC announced a 33 percent reduction on the average selling price of its GAL devices.
Jan. 1988	LSC, although a privately held company, reported product sales of $3.4 million for the third quarter ending January 3, 1988. The $3.4 million was a 93 percent increase over the third-quarter sales the year before. Second-quarter sales, for the period ending September 26, 1987, were $2.9 million. LSC also reported annual revenue exceeding $13.5 million.

ALLIANCES

Floating Point Systems	1983	LSC and Floating Point Systems agreed to exchange technology for LSC's UltraMOS technology and FPS' DSP and array processor technology. Floating Point Systems gained major equity participation as well as long-term purchasing agreements from LSC.
Synertek	July 1984	LSC and Synertek signed a cross-licensing and second-sourcing agreement allowing Synertek to use LSC'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	LSC provided technology for CMOS EEPROMs and SRAMs to VLSI Technology in exchange for foundry services at VLSI.
Seiko Epson/ S-MOS	Jan. 1986	LSC announced a manufacturing and second-sourcing agreement. Seiko Epson acquired the license to LSC's 16Kx4 SRAM design and process technology; S-MOS acquired the rights to market the part in North America.
SGS	Feb 1987	LSC signed a technology agreement with SGS Semiconductor, giving SGS a license to second-source LSC's GAL products. SGS will manufacture the GAL products for LSC, and both companies will cooperate on the design of future PLD products.
National Semiconductor	April 1987	National Semiconductor made a minority capital investment in LSC and licensed its GAL technology. The five-year agreement includes codevelopment of denser architectures of both standard and in-system programmable GALs, as well as a new line of FPLAs and sequencer devices.
MMI	Nov. 1987	LSC licensed MMI's patent, and both companies exchanged rights to their worldwide patents on PLDs.

SERVICES

Design
Test

MANUFACTURING

Technology

1.1-micron CMOS
0.7-micron (available late 1986)
6-inch wafers

Facilities

Hillsboro, OR	45,000 sq. ft.	Design and test

PRODUCTS

GAL Products

Device	Speed
GAL16V8	10 to 25ns
GAL20V8	10 to 25ns
GAL39V18	15 to 30ns
ispGAL 16Z8	15 to 25ns
ispGAL 20Z8	15 to 25ns

Development Tools

GAL39V18	PLD Development Kit that Includes Programmer, Software, Samples on IBM PC AT
All Devices	Third-Party Development Support from Leading PLD Systems, Both Hardware and Software

Level One Communications Inc.
105 Lake Forest Way
Folsom, CA 95630
916/985-3670
Fax: 916/985-3512

ESTABLISHED: November 1985
NO. OF EMPLOYEES: 36

BOARD:

Name

Charles R. Cole
James M. Julian
Dr. Henry Kressel
Dr. Robert S. Pepper

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Dr. Robert Pepper	RCA	VP/GM Solid State Div
VP Mktg/Sales	J. Francois Crepin	LSI Logic	Dir WW Strat Plan
VP Finance/Admin	Terry S. McCoy	American Continental	Dir Finance
VP Engineering	Cecil Aswell	Siemens	Dir Engr

FINANCING

Date	Round	Sources	Amount
Dec. 1985	Seed	Julian, Cole, & Stein	$0.8M
Dec. 1986	Round 1	Julian, Cole, & Stein	$2.0M
Sept. 1987	Round 2	Julian, Cole and Stein; Warburg, Pincus Ventures Inc.	$5.0M

BACKGROUND

Level One Communications Inc. designs, manufactures, and markets system-specific transceivers (transmitters/receivers) and associated peripheral circuits for the twisted-pair, high-speed digital communications market. Products are designed for integrated voice, data, and video communications systems and networks at speeds from 19.2 Kbps to 16.0 Mbps.

Transceivers combine digital and analog circuitry to convert digital impulses into line code, a language that travels more efficiently on twisted-pair wire than nonencoded digital signals. The sending transceiver converts data according to a given line code and transmits it through twisted-pair wires. The transceiver at the receiving end of the line decodes the encoded signals to data.

Level One offers integrated analog and digital ASIC transceiver ICs that can be tailored to specific systems, using a modular cell-based approach. To significantly accelerate design time, Level One has developed the LxLIB, a library of predefined mixed analog and digital ICs and functional blocks that can be assembled quickly. Level One has also developed dedicated CAD simulation tools for transceiver development. The CAD simulation and techniques model the physical-level communications systems and associated transmission lines. The line simulator is also used for automated component testing by providing analog input waveforms to the tester.

Level One's transceiver products are composed of front and back ends. The front end is the transceiver core and contains blocks of cells that perform the analog functions such as pulse shaping, encoding, and timing and data recovery. The back end is the system interface, which handles the digital functions and the interface to each customer's system.

In January 1988, Level One produced two new cores, the LxC5100 for 80-Kbps TCM applications and the LxC5120 for dual-simplex applications at 256 Kbps. The cores are designed to minimize radio frequency and intersymbol interference, and the XSI serial system interface can be designed easily to meet a specific system's requirements.

The Level One design team has extensive experience in PBX transceivers and ISDN devices at companies such as AMD, AT&T Bell Labs, Hitachi, Intel, Mitel, National Semiconductor, and Rockwell.

In December 1985, Level One completed its seed financing when Julian, Cole, & Stein purchased 38 percent of the Company for $800,000. Since then, the Company completed an additional two rounds of financing for $7 million. In its latest round of financing, which was completed in September 1987, Level One raised $5 million. The funds will be used to expand R&D activities and to establish the Company's sales and marketing organization. The Company has already filed for patents covering key advances in data encoding, timing, recovery/system synchronization, baseband receiver design, differential linedriving, bus isolation, and current-control oscillators.

The Company leased a 21,000-square-foot facility in Folsom, California, where it conducts R&D and design. Level One has contracted International Microelectronic Products (IMP) and Mitel to manufacture its products. IMP will work closely with Level One to adapt its CMOS process to meet the specific analog and digital requirements of integrated transceivers.

ALLIANCES

1986	Level One was selected to codevelop and field test new ISDN platforms with LTX.
Aug. 1987	First major customer design and development contract.
May 1988	Level One and Mitel signed a joint development and second-source agreement.

SERVICES

Design
Development
Test

MANUFACTURING

Technology

3-micron double-poly, double-metal, 5V CMOS
2-micron double-poly, double-metal, 5V CMOS
1.5- and 1.25-micron planned

Facilities

Folsom, CA	21,000 sq. ft.	Administration, design, R&D, and test

PRODUCTS

Transceivers

Device	Description
LxC200	ISDN S-T Interface Transceiver
LxC5100	Core Transceiver, 80 Kbps, TCM
LxC5120	Core Transceiver, 256 Kbps, 4-Wire
LxC5130	Core Transceiver, 144 Kbps, TCM, 3,000 Feet
LxC5131	Core Transceiver, 144 Kbps, TCM, 6,000 Feet
LxT8976	T1 ESF Framer
LxT8979	CEPT CRC4 Framer

Transceivers Under Development

LxT100	80 Kbps, TCM
LxT104	80 Kbps, TCM, Quad
LxT130	144 Kbps, TCM, 3,000 Feet
LxT134	144 Kbps, TCM, Quad, 3,000 Feet
LxT131	144 Kbps, TCM, 6,000 Feet
LxT135	144 Kbps, TCM, Quad, 6,000 Feet
LxT303	T1/CEPT 1.544 Mbps
LxT600	Clock Adapter Device

Development Tools

LxWAVE:	LxSYS (System Simulation) LxNET (Transmission Network Simulation)
LxCAD	CAD System for Schematic Entry, Logic Simulation, Layout
LxTEST	Analog and Digital Transceiver Test System

Linear Integrated Systems Inc.
47853 Warm Springs Boulevard
Fremont, CA 94539
415/659-1015
Fax: 415/659-1365

ESTABLISHED: July 1987
NO. OF EMPLOYEES: 15

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President	John Hall	Micro Power
General Manager	Bob Sabo	Micro Power
Director Sales	Tom Gammon	US Telecenters
Dir Strat Mktg	Richard Hall	Micro Power

FINANCING: Not available

BACKGROUND

Linear Integrated Systems Inc. (LIS) designs, manufactures, and markets standard and custom low-noise, precision, linear ICs and high-resolution A/D and D/A converter ICs. The Company's products are designed to serve data acquisition applications in the military, industrial, and medical market sectors. LIS provides ASIC design services, using a cell-based design approach. The Company's cell-based library uses an advanced set of automated layout tools that combine cells, process, and software.

LIS began offering products in January 1988 and currently offers 18 products. Future plans involve expanding the Company's high-resolution, high-speed, high-accuracy data conversion products; low-noise, high-precision linear ICs products; and additional cell-based designs in both the linear and digital areas. Developments will emphasize military applications with higher levels of radiation hardness.

The Company was founded by John Hall, who founded and served as president of Micro Power Systems. The Company conducts manufacturing and engineering in Fremont, California. Recently, a second facility was completed; it houses design and corporate offices.

ALLIANCES: Not available

SERVICES

Design
Manufacturing
Test

MANUFACTURING

Technology

Bipolar linear
1.5- to 5.0-micron high-density CMOS
Both processes are offered with dielectric isolation and the capability to withstand high levels of nuclear radiation.

Facilities

Fremont, CA	10,000 sq. ft.	Administration, design, manufacturing, test

The Company has an additional 5,000 sq. ft. of dedicated capacity.

PRODUCTS

Precision Low-Noise Linear ICS
High-Resolution A/D and D/A Converter ICs
Cell-Based Library of Linear/Digital Cells

Linear Technology Corporation
1630 McCarthy Blvd.
Milpitas, CA 95035-7487
408/942-0810

ESTABLISHED: September 1981
NO. OF EMPLOYEES: 320

BOARD

Name	Affiliation
Robert H. Swanson, Jr.	Linear Technology Corporation, president, CEO
Regis McKenna	Regis McKenna, Inc., chairman
Glenn M. Mueller	Mayfield Fund, general partner
Thomas S. Volpe	Volpe & Company, managing partner
Arthur F. Schneiderman	Wilson, Sonsini, Goodrich & Rosati, attorney

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Robert H. Swanson	NSC	VP/GM Linear IC Ops
VP Q & A	Dr. Clive B. Davies	NSC	Grp Dir Adv Tech
VP Engineering	Robert C. Dobkin	NSC	Dir Adv Circuit Dev
VP Marketing	William A. Ehrsam	NSC	Grp Dir Mktg Commun
VP Operations	Brian E. Hollins	NSC	Bus Mgr Adv LIC Ops
VP Finance/CFO	Paul Coghlan	GenRad	VP/GM Test Prod Div

FINANCING

Date	Round	Sources	Amount
Sept. 1981	Round 1	Capital Management Services; Hambrecht & Quist; Kleiner, Perkins, Caufield & Byers; 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	Cowen and Company, Greivson Grant, Kemper Financial, Kleinwort Benson, Morgan Stanley, State Farm, Touche Remnant, and others	$ 7.0M
	Lease	Greyhound Computer Corp.	$ 9.0M
May 1986		Initial public offering	$24.0M

BACKGROUND

Linear Technology Corporation (LTC) designs, manufactures, and markets a broad line of standard high-performance linear ICs, using silicon gate CMOS and bipolar technologies. The Company markets about 180 linear ICs, with temperature and packaging variations resulting in more than 1,800 device types, half of which are proprietary. Products focus on the instrumentation, process control, industrial, and military markets.

The Company specializes in precision products in the analog and analog-to-digital interface markets and also provides proprietary linear functions for its products including data-acquisition products. LTC supplies op amps, voltage regulators, references, data conversion devices, interface devices, monolithic filters, and special-function devices such as temperature sensors. In the future, LTC plans to increase its presence in the converter and interface markets. LTC benefits from the increasing prominence of its proprietary chips and from the absence of Japanese competition.

The Company has a strong presence in the military market, accounting for about 10 percent of worldwide sales and about 35 to 40 percent of North American sales. From its beginning, LTC followed a marketing strategy aimed at penetrating the military market. In August 1984, LTC received DESC JAN Class-B qualification and, in 1987, also achieved certification to begin fabrication of JAN Class S-level linear devices for space applications. The first Class-S product will be the LM108AH, an operational amplifier that will be shipped in May 1988.

Linear Technology was founded in 1981 by Robert H. Swanson, Jr., Robert C. Dobkin, Brian E. 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, California. By January 1983, the Company had produced its first wafers.

In September 1986, LTC moved its headquarters and some of its operations to a new 43,000-square-foot building next to its current headquarters in Milpitas. The Company's previous headquarters will be taken over by LTC's expanded design, engineering, and domestic high-reliability assembly and wafer fabrication operations already located in the building.

In May 1986, LTC established a company in Tokyo, Japan, to provide technical services to its Japanese customers. The company, named Linear Technology K.K., is wholly owned by the U.S. parent.

In 1987, LTC signed an agreement with Texas Instruments, providing the Company with TI's BICMOS manufacturing, assembly, test, and CAD tools, and a credible second source.

LTC markets its products through a network of independent sales representatives and electronics distributors. The Company also has about 1,000 OEM customers including Compaq, Fujitsu, Honeywell, HP, Hughes, Philips, Raytheon, Rockwell, and Siemens.

Recent Highlights

May 1986 LTC registered 2.65 million shares of common stock for an initial public offering. The proceeds were used for capital expenditure and working capital.

May 1986 LTC established a Japanese unit to strengthen its technical services to Japanese customers. The unit is Linear Technology K.K. and is wholly owned by LTC in the United States. Robert Swanson was appointed president and Atsushi Nakata, general manager.

Sept. 1986 LTC moved its headquarters and some of its operations to a new 43,000-square-foot building next to its current headquarters in Milpitas. The Company's previous headquarters will be taken over by LTC's expanded design, engineering, and domestic high-reliability assembly and wafer fabrication operations already located in the building.

Oct. 1986 National Semiconductor dropped its complaint that principals of LTC had "misappropriated" trade secrets when they left National.

Dec. 1986 LTC announced voltage references and other devices in surface-mount packages.

Feb. 1987 Linear introduced its XH series that includes five linear ICs guaranteed to operate over the temperature range from -125° to +200° centigrade.

March 1987 LTC and Texas Instruments signed a five-year agreement allowing TI to select six of LTC's circuits every six months for the duration of the agreement. TI will pay LTC $500,000 every six months and pay royalties for a 10-year period on any LTC circuit that TI produces. LTC gains access to TI's BICMOS manufacturing, assembly, test, CAD tools, and a second source.

March 1987 LTC offered the LT1088, a wideband RMS-to-DC converter.

March 1987 LTC offered the LT1039, a triple RS-232 combination line driver/receiver operable from 7mA of current. All three receivers can drive either TTL or CMOS logic and have hysteresis for noise-free switching.

April 1987	LTC offered the LT1030, a bipolar line driver. The quad, low-power, line driver is part of LTC's family of RS-232 driver/receiver circuits. It can be used as an interface, an RS-232 driver, or as a logic level translator.
June 1987	LTC offered the LTZ1000, a high precision voltage reference with a temperature drift of 0.1 ppm degrees centigrade (typical), a noise figure of 1 microvolt p-p, and less than 2 ppm/month long-term drift.
June 1987	LTC offered the LTC1090, a 10-bit CMOS data acquisition system. It includes a software-controlled 8-bit analog multiplexer with sample-and-hold and a 10-bit ADC. The device operates in a full-duplex mode, and a selection feature allows data to be transmitted either most-significant-bit (MSB) first or least-significant-bit (LSB) first.
July 1987	LTC received QPL Part-1 approvals from DESC for 10 of the company's BIFET and low-noise operational amplifiers and negative adjustable regulators. This brings the number of JAN QPL parts available to 30.
Jan. 1988	LTC introduced the LTC1092 monolithic 10-bit A/D converter, which includes a pin that permits the device to use a reference voltage as low as 200 millivolts as fill scale for an input signal.
March 1988	LTC introduced the LTK001 cold-junction compensator kit for thermocouples. The kit consists of the LT1025 cold-junction compensator and a matched op amp required to perform first-order conditioning of a thermocouple.

<u>ALLIANCES</u>

Silicon General	July 1982	LTC and Silicon General signed a technology exchange and second-source agreement, under which Silicon General provides pulse width modulators and two additional circuits and second-sources several high-current series pass regulators developed by LTC; no masks are 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	June 1984	LTC and Signetics signed a three-year agreement granting Signetics the right to purchase die in wafer form and manufacturing rights for three precision op amps and other unnamed products. Signetics provided LTC with certain small-outline packaging services.
Interdesign	July 1984	LTC and Interdesign entered into a three-year agreement granting Interdesign the right to design IC arrays, using up to three of LTC's processes. LTC also agreed to dedicate foundry capacity to manufacture the Interdesign arrays.
Motorola	Jan. 1985	Motorola and LTC signed a seven-year agreement granting each other rights to several patents. LTC gained rights to several Motorola patents; Motorola gained rights to patents obtained and filed during the term of the agreement, which expires in 1991. LTC also will make specific lump-sum payments through 1991.
National	July 1986	National and LTC entered into a patent-licensing agreement granting LTC rights to products under two National BIFET patents. National was granted rights to LTC's BIFET-related patents, including those filed through 1992. LTC pays royalties.
TI	March 1987	LTC and Texas Instruments signed a five-year agreement allowing TI to select six of LTC's circuits every six months for the duration of the agreement. TI will pay LTC $500,000 every six months and pay royalties for a 10-year period on any LTC circuit that TI produces.

SERVICES

Design
Manufacturing
Assembly
Final Test

MANUFACTURING

Technology

Single-layer polysilicon bipolar
Single- and double-layer silicon-gate CMOS (LTCMOS)
4-inch wafers
5-inch wafers planned

Facilities

Milpitas, CA	40,600 sq. ft.	Administration and manufacturing
	20,000 sq. ft.	Class-10 clean room
	42,000 sq. ft.	Linear headquarters and test

Most commercial product assembly is subcontracted to companies in Korea, Malaysia, Thailand, and Taiwan.

PRODUCTS

Regulators

Device	Description
LT1038	10A, Positive Adjustable Voltage Regulator
LT1083/084/085	7.5A, 5A, and 3A Low-Dropout, Positive Adjustable Regulators
LT1003	5A Positive Fixed Regulator
LT338/1084	5A Positive Adjustable Regulator
LT1070/1071	5A and 2.5A High-Efficiency Switching Regulators
LT323	3A Positive Fixed Regulator
LT350	3A Positive Adjustable Regulator
LT1033	3A Negative Adjustable Regulator
LT1035	3A Dual-Positive Fixed Regulator
LT1036	3A Positive Regulator
LT1070	2.5A Switching Regulator
LT317	0.5 to 1.5A Positive Adjustable Voltage Regulators
LT337	0.5 to 1.5A Negative Adjustable Voltage Regulators
LT1072	1.25A Self-Contained PWM and 1.25 Switch
LT1005	1.0A Dual-Positive Fixed 5V Regulator
LT1020	125mA Positive Regulator

Reference

Device	Description
LT1004	Micropower 1.2V Reference
LT1034	Low-TC Micropower Precision Reference
LT1009	2.5V Precision Reference
LT1019	2.5, 5.0, and 10.0V Precision Bandgap Reference
LM136	2.5V General-Purpose Reference
LM185	2.5V Micropower Reference
AD580	2.5V Three-Terminal Low Drift
LT1021	5.0, 7.0, and 10.0V Very Low Drift
LT1029	5.0V Precision Bandgap
LM129	6.9V Low-Drift Reference
LM199	6.95V Ultralow Drift
LT1031	10V Low-Cost, High-Performance Reference
AD581	10V Three-Terminal Low Drift

Op Amps

LT1001/1002	Op Amps with Low Offset Voltage, Low Noise, Low Drift
LT1006/1007	Single Supply Op Amp, Low Noise, Low Drift
LT1008/1012	Universal Precision Op Amp, Low-Bias Current, Low Power
LT1022	Very-High-Speed JFET Input
LT1028/1037	Ultralow-Noise, High-Speed, Low-Drift Op Amp
LTC1052	CMOS Precision Chopper-Stabilized Op Amp
LT1055/1056	Low-Offset, JFET Input, High-Speed, Precision Op Amp
LT1057/1058	Dual and Quad, JFET Input, Precision High-Speed Op Amp
LF155/156	JFET, Low-Bias, No Phase Reversal Op Amp
LM10	Op Amp with On-Chip Reference
LM101	General-Purpose Uncompensated Op Amp
LM107	Compensated General-Purpose Op Amp
LM108	Low-Bias, Low-Supply Current
LM115	High Speed (15 MHz)
OP-05	Low-Noise, Low-Offset Drift with Time
OP-07	Low Initial Offset, Low Noise, Low Drift
OP-15	Precision JFET Input, Low Bias, No Phase Reversal
OP-16	Precision JFET, High Speed, No Phase Reversal
OP-27	Very Low Noise, Unity Gain Stable
LT1002	Dual Matched, High CMMR, PSRR Matching
LT1013	Precision Dual Op Amp in 8-Pin Package
LT1057	Low-Offset, JFET Input, Multiple Op Amps
LF412/OP-215	High-Performance, Dual-JFET, High-Input Op Amp
LH2108	Dual, Low-Bias Current, Side-Brazed Package
OP-227	Dual Matched OP-27
OP-237	Dual Matched OP-37
LT1014	Precision Quad and Dual Op Amp in 14-Pin Package

Comparators

Device	Description
LT1011	Comparator, 250ns
LT1016	High-Speed Comparator, 12ns
LT1017/1018	Dual Comparators
LT1020	Monolithic Micropower Voltage Regulator and Comparator
LTC1040	CMOS Dual Comparator
LTC1042	Window Comparator

Filters

LTC1059	Single Filter
LTC1060	Dual Filter
LTC1061	Triple Filter
LTC1062	Five-Pole, Maximally Flat, Low-Pass Filter

Regulating Pulse-Width Modulators

LLT1524/3524	Oscillator Accuracy
LT1525/3525	Switching Regulator with Undervoltage Lockout
LT1526/3526	Switching Regulator Control with Soft Start, Current Logic, Metering Logic, Undervoltage Lockout
SG1524/3524	Industry-Standard, Switching Power Supply Control Circuit

Interface Products

LT1030/1032	Quad Micropower RS-232 Line Driver
LT1039	Triple RS-232 Driver/Receiver with Shutdown
LT1080/1081	+5V Powered RS-232 Driver/Receiver with Shutdown
LTC1045	Programmable Power Hex Translator/Receiver/Driver

Data Acquisition Products

LTC1090	10-Bit Data Acquisition System; Built-In Eight-Channel Analog MUX and Sample and Hold
LTC1091	10-Bit Data Acquisition System; Built-In Two-Channel Analog MUX and Sample and Hold

Other Products

Device	Description
LF198/398	Sample-and-Hold Amplifier
LM134/334	Adjustable Current Source
LT1054	Switched Capacitor Voltage Converter
LT1088	Wideband RMS to DC Converter Building Block
LTC1043	Precision-Switched Capacitor Building Block
LT1044/7660	CMOS-Switched Capacitor Voltage Converter
LT1010	Fast Unity Gain Power Buffer
LT1004	Micropower Reference Diode
LT1009	2.5V Reference Diode
LTC1044	Voltage Inverter
LTK001	Cold-Junction Compensator Kit for Thermocouples

Logic Devices Inc.
628 E. Evelyn Avenue
Sunnyvale, CA 94086
408/720-8630
Fax: 733/7690
Telex: 172387

ESTABLISHED: 1983
NO. OF EMPLOYEES: 45

BOARD

Name	Affiliation
William J. Volz	Logic Devices Inc., president
James McAllister	Logic Devices Inc., VP operations

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	William J. Volz	TI	Technical Staff
VP Operations	James McAllister	Indy Electronics	Executive VP
Dir Finance/Admin	Todd Ashford	W.R. Grace	Financial Analyst
VP Marketing	Jesse Huffman	Intel	Marketing Manager
Sales Manager	Del Valek	ITT	Sales Manager
Dir QA/Rel	Don Taylor	Exar	QA Manager

FINANCING: Logic Devices is a privately held company. The Company is completing its third consecutive year of profitability.

BACKGROUND

Logic Devices Inc. designs, manufactures, and markets very-high-performance semiconductors, using 1.2-micron CMOS process technology. The Company's products address applications that require very high operating speeds and/or low-power operation.

Currently 35 distinct device types are in production, with an additional 25 devices scheduled for introduction during 1988. The Company offers a line of high-performance 16K, 64K, and 256K SRAMs; a line of high-performance building block components for DSP applications; and a line of computer interface circuits that implement the SCSI standard. The products are used in military signal-processing systems (radar, sonar, and seeker systems), video and medical imaging systems, array processors and superminicomputers, engineering workstations, telephony systems, and personal computers.

About 30 percent of the Company's sales are products produced in full compliance with MIL-STD-883 Rev. C. In addition, the Company produces a portfolio of custom circuits that address high-end military DSP applications (adaptive FIR filtering) and telecommunications problems such as echo canceling, ADPCM compression, and cross-point switching.

Company operations in Sunnyvale, California, include administration, sales and marketing, engineering, assembly, and high-reliability testing and screening. Commercial products are offered in plastic dual-in-line, leaded chip carriers, and SOIC packaging. Military products are available in leaded and leadless chip carriers, flat packs, and pin grid array packages. Manufacturing operation follows the requirements of MIL-STD-9858, -45662, and -883C. These operations have been audited and approved by many major military systems contractors.

Products are marketed through a network of domestic and international stocking distributors and manufacturers' representatives, with 103 locations worldwide. U.S. distributors include Cypress Electronics, Falcon, Future, and Milgray. The Company operates direct regional sales offices in Los Angeles, California and New York City, New York.

SERVICES

Engineering
Assembly
Test

MANUFACTURING

Technology

1.2- and 1.5-micron CMOS

Facilities

Sunnyvale, CA	12,500 sq. ft.	Administration, sales and marketing, engineering, assembly, high-reliability testing and screening
	2,500 sq. ft.	Clean room

PRODUCTS

SRAMs

Device	Description	Speed
L6116	2Kx8	70ns
L7C128	2Kx8	18ns
L7C161/162/164/166	4Kx4	20ns
L7C167	16Kx1	12ns
L7C168 through 172	4Kx4	15ns
L185/186	8Kx8	25ns
L7C187	64Kx1	15ns
L7C191/192/194/196	64Kx4 (Available Q4)	30ns
L197	256Kx1 (Available Q4)	25ns
L7C198/199	32Kx8 (Available Q4)	35ns

Specialty Memory Circuits

L10C05/06	256-Bit Shift Registers
L10C11	18-Stage Pipeline Register
LRF07	Three-Port Register File
LRF08	Five-Port Register File
L29C520/521	8-Bit Multilevel Pipeline Registers
LPR520/521	16-Bit Multilevel Pipeline Registers
L29C524/525	16-Stage Pipeline Registers
L29C818	Shadow Register
L94C03	16X4 FIFO

Multipliers

LMU08	8x8 Signed Parallel Multiplier	30ns
LMU8U	8x8 Unsigned Parallel Multiplier	30ns
LMU557/558	8x8 Mixed Parallel Multipliers	45ns
LMU12/112	12x12 Parallel Multipliers	35ns
LMU13	12x12 Microprogrammable Parallel Multiplier	35ns
LMU16/216	16x16 Parallel Multipliers	35ns
LMU17/217	16x16 Microprogrammable Multipliers	35ns
LMU18	16x16 Parallel Multiplier with Dedicated 32-Bit Output Port	35ns
LMS12	12x12 Video Multiplier with 26-Bit Adder	20 MHz

Multiplier/Accumulator Circuits

LMA1008	8x8 Multiplier/Accumulator	30ns
LMA1009	12x12 Multiplier/Accumulator	30ns
LMA1010/2010	16x16 Multiplier/Accumulators	35ns
LMA1043/2043	16x16 Multiplier/Accumulators	35ns

Arithmetic Logic Units

Device	Description	Speed
L29C101	16-Bit Slice (4x2901 & 2902)	
L429C01	16-Bit Slice ALU	
L4C381	16-Bit Cascadable Adder/Subtractor (4x54S381)	22ns
LSH32	32-Bit Cascadable Barrel Shifter/Normalizer	30ns
L10C32	64x1 Digital Correlator	50 MHz

Communications Controllers

L5380	Asynchronous SCSI Controller Chip
L53C80	Data Transfers of Up to 4.0 Mbps

Development Tools

Designer Chips Tool Kit to Develop DSP Prototype Designs; Includes 11 Sample Devices, Plus Application Literature

LOGICSTAR Inc.
4160 B Technology Drive
Fremont, CA 94538
415/651-2796
Fax: 415/659-9057

ESTABLISHED: 1987
NO. OF EMPLOYEES: 14

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Mark Kaleem	OSM Computer	President
CFO	Ben Morain	Coopers & Lybrand	CFO

FINANCING: Not available

BACKGROUND

LOGICSTAR Inc. was formed to design, manufacture, and market high-performance VLSI graphics and local area network (LAN) chips. The Company is addressing the PC AT market and is using a VLSI design methodology to bring products to market quickly.

The Company's initial products are a five-chip PC AT chip set that is pin-for-pin compatible with Chips and Technologies' chip set, a monographics controller, a memory mapper, a dual-channel NRZI encoder/decoder, and a Starlan interface chip. In April 1988, LOGICSTAR began volume shipments of its chip sets. Future products will include a VGA chip, 386 chip sets, additional disk communications chips, and disk controllers.

The Company has set up joint ventures for design with companies in Japan, Korea, and Taiwan. These agreements may be extended to include manufacturing and marketing at a future time. Foundry services are being provided by companies in the United States, Europe, and Japan.

SERVICES

Design

MANUFACTURING

Technology

1.3-micron, double-metal CMOS

Facilities

Fremont, CA	3,000 sq. ft.	Administration, design

PRODUCTS

Device	Description
SL6001	AT System Controller
SL6002	AT Memory Controller
SL6003/6004/6005	AT System Buffers
SL6012	AT Memory Mapper
SL5001	Parallel Post Chip with Oscillator
SL7001	Monographic Controller
SL2000	NRZI Encoder/Decoder
SL4000	Manchester Encoder/Decoder for Starlan
SL3122	Field-Programmable Counter

LSI Logic Corporation
790 Sycamore Drive
Milpitas, CA 95035
408/433-8000

ESTABLISHED: January 1981
NO. OF EMPLOYEES: 2,400

BOARD

Name	Affiliation
Wilfred J. Corrigan	LSI Logic Corporation
James H. Keyes	Johnson Controls, Inc.
Thomas J. Perkins	Kleiner, Perkins, Caufield & Byers
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	Dr. Gerry Thomas	Schlumberger	President
Pres/Canadian Opns	Mitchell D. 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 Comp & Tech	Cyril F. Hannon	Optimetrics	President
VP Engr Svcs	Ven L. Lee	Intersil	
VP Dsn Automation	James S. Koford	Boeing	
VP Bus Development	Murray McLachlan	Fairchild	GM Asian Opns
VP/CFO	D. Scott Mercer	Price Waterhouse	VP/Corp Ctr
VP Mktg/Sales	Robert N. Blair	LSI Logic Europe	President
VP NA Sales	Robert Skinner		
VP Corp Commun	Bruce Entin	Atari	VP Corp Commun
VP Std Prod Engr	Robert Walker	Intel	
VP Assy, Test, Pkg Ops	Travis White	Honeywell	Dir Central
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	Bank America Capital; California Northwest; Institution Venture Assoc.; Kleiner, Perkins, Caufield & Byers; Mayfield Fund; Sutter Hill Ventures	$ 6.0M
Feb. 1982	Round 2	Original investors; Merrill, Pickard, Anderson & Eyre; Sequoia Fund; Technical Development Capital	$ 9.9M
	Lease	First Interstate Bank	$ 10.0M
May 1983	Round 3	Initial public offering	$160.0M
Feb. 1984	Round 4	Private offering	$ 18.8M
April 1987		Eurobond	$125.0M
April 1987		Canadian offering (Canadian dollars)	$ 30.0M
April 1987		Japanese private investors	$ 40.0M

BACKGROUND

LSI Logic Corporation designs, develops, manufactures, and markets a full line of gate arrays and cell-based ICs in addition to offering design services. The Company 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, Robert Walker, William O'Meara, and Mitchell D. Bohn. In 1987, Dataquest ranked LSI Logic as the largest MOS gate array supplier, with revenue of $260 million. Dataquest believes that LSI Logic has achieved this position as a result of strengths in CAD tools, management, and supplier credibility.

In February 1987, LSI Logic reorganized into the following four strategic business units; each of the four vice presidents reports to George Wells:

- Components and technology — Cyril F. Hannon, vice president of components and technology
- Engineering services — Ven Lee, vice president of assembly, test, packaging
- Software and computer services — James S. Koford, vice president of design automation
- Military/aerospace operations — Norman Chanoski, vice president of reliability, quality, military

The Company will emphasize military programs in the coming year. Al Frederick, currently bringing up a fabrication facility in Tsukuba, Japan, will join Mr. Chanoski's organization when the fab is completed and will be in charge of special programs such as VHSIC, radiation-hardened devices, and 38510 qualification.

In June 1987, LSI Logic expanded its initial DSP line of multipliers/ accumulators and introduced a line of filters and variable-length shift registers intended for graphics applications. The image-processing circuits are available as standard parts or as library elements for larger semicustom circuits. The four-chip set includes variable-length shift registers, a rank-value filter, a binary filter/template matcher, and a multibit filter. The Company claims that speeds of subsystems incorporating all four processors can reach 60 billion binary plus 1 billion 8 x 8 multiplications per second. All devices are fabricated in 1.5 micron CMOS and are available in commercial and military versions.

The Company has established five subsidiaries, as described in the following paragraphs:

LSI Logic (Europe) Limited--In 1984, LSI Logic established LSI Logic (Europe) Limited in the United Kingdom. In May 1986, LSI Logic Limited acquired a majority holding in STC's semiconductor division. STC plc retains an 18 percent stake in the Company. LSI Logic and STC operate a wafer fabrication plant in Foots Cray, England, near London, on a joint venture basis. The facility manufactures BICMOS circuits that were developed originally by STC, for all LSI Logic customers throughout the world. In December 1987, the subsidiary began offering prototypes of its first product, LAD300, a BICMOS analog/digital array. The device is based on LSI Logic's channel-free compacted array CMOS technology and is the first in a family of BICMOS analog/digital devices.

More than 80 percent of LSI Logic Europe is owned by the parent company, with the remainder held by local private investors, insurance companies, and other financial interests. The most visible industrial investor in LSI Logic Europe is Sulzer Brothers AG, a Swiss engineering firm.

LSI Logic introduced a new proprietary software tool at Bracknell, England, named BSIM, a behavioral simulator that forms part of the Company's plan to enter the mixed A/D arena. In addition, LSI Logic has upgraded the Bracknell facility by adding the Logic Evaluator made by ZyCAD Corporation and by introducing new proprietary software.

LSI Logic Europe is building a mass production assembly and test facility in Braunschweig, West Germany. The new facility will form part of the corporation's worldwide capacity. It will begin operating later this year and will act as a subcontractor to the U.S. parent company.

Nihon LSI Logic K.K.--In 1984, LSI Logic formed Nihon LSI Logic K.K. in Japan. The subsidiary is headed by Keiske Yawata. LSI Logic K.K. opened a technical center and plant for ASICs in Tsukuba, Japan, in the Hokubo Industrial Park in early 1987. The Company now employs 74 employees, 28 of whom are engineers. The firm reports that it has received several orders as a result of joint projects with Japanese national research institutions and electronics companies.

Nihon Semiconductor--In August 1985, LSI Logic formed a joint venture company with Kawasaki Steel in Japan. The new firm, named Nihon Semiconductor, will manufacture gate arrays. LSI Logic holds a 55 percent interest, and Kawasaki Steel 45 percent. In 1987, the firm began producing gate arrays, which are marketed by LSI Logic and Nihon LSI Logic.

LSI Logic Corporation of Canada, Inc.--This subsidiary was formed to serve the Canadian market and is headed by Mitchell Bohn. In April 1987, LSI Logic offered 4 million newly issued shares of the Canadian affiliate in Canada. The Company raised $30 million (Canadian) as result of the offering.

G-2 Incorporated--In September 1987, LSI Logic established G-2 Incorporated to develop and market chip sets for the EDP market. Mr. O'Meara, a founder of LSI Logic and former vice president of marketing, was named president of G-2. In September, G-2 offered its first product, a 16-MHz, PC AT, three-chip set that, when used with 10 peripheral circuits, can reduce the number of ICs in an AT from 110 to 13.

LSI Logic has two major wafer fabs in California, as well as a wafer fab in Japan, operated by Nihon Semiconductor. The Company also has metal-lization and assembly facilities in California and West Germany.

Recent Highlights

Jan. 1987 — Aida Corp. will receive a license for LSI Logic's 5,000-, 7,000-, 8,000-, and 9,000-gate channeled gate array libraries and will incorporate the libraries into its design automation tools. LSI Logic will include the Aida design tools in its design centers.

Jan. 1987 — LSI Logic agreed to supply the custom ASICs used in the Stellar Computer graphics supercomputer. The contract is for multiple designs of the 1.5-micron CMOS Compacted Array.

Recent Highlights

Feb. 1987	LSI Logic acquired the marketing rights to a customised version of ZyCAD Corporation's Logic Evaluator circuit design accelerators, valued at $2 million. LSI began sale of the accelerators in the second quarter of 1987 and also uses them in some of its design centers with LDI, LSI Logic's HCMOS ASIC design software.
Feb. 1987	LSI Logic opened a $150,000 ASIC design center in Livingston, Scotland. It hopes that the center will attract $4.5 million worth of business in the first year.
March 1987	Case Technology Inc. and LSI Logic completed a joint development effort that allows LSI Logic's LL5000, LL8000, and LL9000 schematic libraries to be designed on Case Technology's PC-based workstations.
April 1987	LSI Logic offered convertible subordinated debentures on London's Unlisted Securities Market and raised $125.0 million.
April 1987	LSI Logic and Sun established an ASIC laboratory project at San Jose State University in San Jose, California. LSI Logic provided instructional versions of the LDS-III logic design and verification software and of the macrocell library to develop ASICs. Sun donated a SUN-3/160C color workstation, three SUN-3/50 monochrome workstations, the SunOs operating system and networking software.
May 1987	LSI Logic Corporation and Logic Automation Inc. signed a joint development agreement to make available LSI Logic's LL5000, LL7000, LL8000, and LL9000 channeled gate arrays on Logic Automation's Mentor Graphics workstations.
June 1987	LSI Logic Corporation will license design verification software to ASIX Systems Corporation of Fremont, California.
July 1987	LSI Logic acquired about 10 percent of Video Seven from Intelligent Systems Master L.P. for $7 million in cash. Video Seven is a privately held manufacturer of enhancement graphics boards. The transaction also includes a technology agreement between LSI Logic and Video Seven for the development of ICs for use in enhanced graphics applications.

Recent Highlights

Aug. 1987 LSI Logic offered the LMA9000 Micro Array series and the LMB 6000 Micro BASIC series, which are based on the LCA 10000 Compacted Array Series. The products are manufactured using a 1.5-micron gate length, two-layer metal HCMOS process.

Oct. 1987 LSI Logic offered the LCA100K Compacted Array Plus, a 100,000-gate array family that includes a 0.7-micron channel length and uses a 1.0-micron HCMOS process. The LCA100K uses a sea-of-gates architecture in a three-layer metal device. The family has up to 236,000 total gates.

Nov. 1987 LSI Logic offered the AcceLSI family of hardware accelerators developed and manufactured by ZyCAD Corp. The units are marketed and sold exclusively by LSI Logic.

Nov. 1987 Cognex has contracted LSI Logic to manufacture the VC-1 CMOS coprocessor, which it developed. The coprocessor interprets images and is used in the Cognex machine vision system. LSI Logic will use its 1.5-micron CMOS process to fabricate the device.

Jan. 1988 LSI Logic reported fourth-quarter revenue of $78.3 million for the period ending December 31, 1987. Net income was $5.8 million, which included an extraordinary gain of $594,000 relating to the retirement of debt. Fiscal 1987 revenue was $262.1 million and net income was $11.3 million.

Jan. 1988 LSI Logic introduced the LDD10000 Direct Drive Array, a new BICMOS family of arrays with 8,000 to 45,000 usable gates on a single chip. The device also features high-current, high-drive bipolar output for interfacing the arrays. The devices are manufactured in Europe, using a 0.9-micron channel length BICMOS process. Product shipments will begin in the second half of 1988.

March 1988 LSI Logic and Imaging Technology Inc. (ITI) agreed to form a marketing and technology agreement. ITI will design a new generation of imaging products using LSI Logic's L64200 series of real-time image-processing chips. LSI Logic will use ITI's Series 151 image-processing subsystems for training and demonstration purposes. In addition, both companies will cooperate on future products. The chips that ITI is using are the L642220 rank value filter, L64230 binary filter and template matcher, and L64240 multibit filter. Chips that achieve data rates of 20 MHz were introduced at the Electronic Imaging '88 West Conference.

March 1988	Sun Microsystems gave LSI Logic worldwide licensing rights to manufacture, market, modify, and enhance MPUs, related components, software, and systems, using the SPARC architecture. LSI Logic will offer the SPARC architecture both as a standard product and as a building block cell.

ALLIANCES

CDI	July 1981	LSI Logic and CDI signed an agreement to exchange CDI's HC Series of gate arrays for LSI Logic's CAD system.
Toshiba	Aug. 1981	LSI Logic and Toshiba jointly developed a family if 1,000- to 10,000-gate CMOS arrays. Toshiba supplied HCMOS wafers; LSI Logic provided gate array designs. The effort resulted in a 6,000-gate array with SRAM on-chip in December.
	June 1983	Toshiba and LSI Logic jointly developed a channelless compacted array.
	June 1985	LSI Logic and Toshiba agreed to a four-year joint venture to develop a 50,000-gate sea-of-gates array, using 1.5-micron design rules, Toshiba's CMOS process, and LSI Logic's simulation and software.
AMD	Jan. 1982	LSI Logic granted a five-year logic array license to AMD to manufacture the LCA 1200 Series of 600- to 1,200-gate ECL macrocell arrays.
	Aug. 1984	LSI Logic and AMD agreed on the joint development of CMOS standard cell definitions and a library for the design of large-scale ICs. AMD provided 1.6-micron technology; LSI Logic provided software development.
Fujitsu	1982	LSI Logic and Fujitsu signed an agreement covering HCMOS gate arrays.
RCA	April 1983	LSI Logic agreed to allow RCA to second-source LSI Logic's 5000 Series.
SGS	April 1983	LSI Logic licensed SGS as an LSI 5000 Series and CAD software alternative source.

Intersil	Feb. 1984	Intersil and LSI Logic signed a five-year, second-sourcing 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 Steel venture gate array company, Nihon Semiconductor, in Japan. LSI holds a 55 percent interest, and Kawasaki Steel 45 percent. The gate arrays will be marketed by LSI Logic and Nihon LSI Logic.
Raytheon	Jan. 1986	LSI signed a five-year agreement allowing 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.
	April 1987	LSI Logic and Sun established an ASIC laboratory project at San Jose State University. LSI Logic provided instructional versions of the LDS-III logic design and verification software and macrocell library to develop ASICs. Sun donated a SUN-3/160C color workstation, three SUN-3/50 monochrome workstations, and the SunOs operating system and networking software.
	March 1988	Sun Microsystems gave LSI Logic worldwide licensing rights to manufacture, market, modify, and enhance MPUs, related components, software, and systems, using the SPARC architecture. LSI Logic will offer the SPARC architecture both as a standard product and as a building block cell.

STC	May 1986	STC plc sold a majority stake in its semiconductor division to LSI Logic Europe Ltd. as part of its financial recovery effort. STC sold 90 percent to LSI Logic and others, with LSI Logic retaining a majority holding. STC and LSI Logic will also cooperate to develop and market semiconductors at a facility in Foots Cray, England.
Stellar Computer	Jan. 1987	LSI Logic agreed to supply the custom ASICs used in the Stellar Computer graphics supercomputer. The contract is for multiple designs of the 1.5-micron CMOS compacted array.
Aida Corp.	Jan. 1987	Aida Corp. received a license for LSI Logic's 5,000-, 7,000-, 8,000-, and 9,000-gate channelled gate array libraries. It will incorporate the libraries into its design automation tools. LSI Logic will include the Aida design tools in its design centers.
ZyCAD	Feb. 1987	LSI Logic acquired the marketing rights to a customized version of ZyCAD Corp.'s Logic Evaluator circuit design accelerators valued at $2 million. LSI Logic sells the accelerators and uses them in some of its design centers with LDI, LSI Logic's HCMOS ASIC design software.
Case Technology	March 1987	Case Technology Inc. and LSI Logic completed a joint development effort that allows LSI Logic's LL5000, LL8000, and LL9000 schematic libraries to be designed on Case Technology's PC-based workstations.
Logic Automation	May 1987	LSI Logic Corporation and Logic Automation Inc. signed a joint development agreement to make available LSI Logic's LL5000, LL7000, LL8000, and LL9000 channeled gate arrays on Logic Automation's Mentor Graphics workstations.
Asix Systems	June 1987	LSI Logic licensed its ASIC design verification software to Asix Systems Corp., an automated test equipment producer. The software was codeveloped by the two firms for generating test programs in the Asix-1, an IBM PC-based, 256-pin test system.

Video Seven	July 1987	LSI Logic acquired 20 percent of Video Seven from Intelligent Systems Master L.P. for $7 million in cash. The companies also agreed to codevelop ICs for use in enhanced graphics applications.
ACT	Aug. 1987	LSI Logic and Advanced Computer Techniques (ACT) formed a joint venture company named Inter-Act Corporation, which will develop and market an integrated software and hardware development system for the MIL-STD-1750 embedded system marketplace. LSI Logic owns two-thirds of the company and ACT holds the remainder. Oscar Schacter, vice chairman of ACT, was named CEO of Inter-Act.
G-2	Sept. 1987	LSI Logic established G-2 Incorporated to develop and market chip sets for the PC market. William O'Meara, a founder of LSI Logic and former vice president of marketing, was named president of G-2.
MIPS	Nov. 1987	MIPS Computer Systems licensed LSI Logic to manufacture and market MIPS' entire family of circuits, including its 32-bit RISC MPU and floating-point coprocessor. In addition, LSI Logic will make available MIPS' advanced RISC software environment to its customers.
ITI	March 1988	LSI Logic and ITI formed a marketing and technology agreement. ITI will design a new generation of imaging products, using LSI Logic's L64200 series of real-time image-processing chips. LSI Logic will use ITI's Series 151 image-processing subsystems for training and demonstration purposes. Both companies will cooperate on future products.

SERVICES

Design
Manufacturing
Assembly

MANUFACTURING

Process Technology

1.5-micron HCMOS
0.9-micron BICMOS
2- and 3-layer metal

Facilities

Milpitas, CA	339,000 sq. ft.	Includes Class-10 and Class-100 clean rooms
Tsukuba, Japan		Includes Class-1 and Class-10 clean rooms
Braunschweig, West Germany		Fab facility
Sidcup, United Kingdom		Includes Class-10 clean room

PRODUCTS

Gate Arrays

Family	Process	Linewidth (Microns)	Delay (ns)	Gates
LL3000	HCMOS	3.5	4.5	272 to 2,550
LL5000	HCMOS	2.5	2.5	504 to 6,000
LL7000	HCMOS	2.0	1.3	968 to 10,013
LL8000	HCMOS	2.0	1.4	880 to 3,200
LL9000	HCMOS	1.5	1.0	880 to 10,000
LCA10K	HCMOS	1.5	1.0	38,000 to 129,000
LCA100K	HCMOS	1.0		to 236,000
LDD100K	BICMOS	0.9		8,000 to 45,000
LMA9000	HCMOS	1.5		
LMB6000	HCMOS	1.5		

Cell Library

Family	Process	Linewidth (Microns)	Delay (ns)	Cells
LSA2000	CMOS	2.0	1.4	200 Gates, 300 MSI, RAM, ROM, PLA, Multiplier
LST20	CMOS	2.0	1.4	400 Gates, 300 MSI, Multiplier, Barrel Shifters, 6845, 8251, 2901 Family
LCB20	CMOS	2.0	1.4	400 Gates, 300 MSI, RAM, ROM, PLA and LST Cells

DSP

Device	Description
L64032	32-Bit, Fixed-Point Multiplier/Accumulator (MAC)
L64010/11/12	16-Bit Multipliers/Accumulators
L64016/17	16-Bit Multipliers
L64132	32-Bit, Floating-Point Processor
L64220	Rank Value Filter
L64230	Binary Filter and Template Matcher
L64240	Multi-Bit Filter

MPU

L64500	16-Bit MPU with 128K ROM, 32-Bit Core ALU, Registers, Control Logic.
L64550	MMU and Bus Arbitrator

Evaluation Chip

5220Q	An Evaluation Chip for the LSI Logic 5000 Series of Logic Arrays; Based on 3-Micron, Double-Layer Metal HCMOS, It Contains from 880 to 6,000 Gates.

CAD Tools

MDE	Modular Design Environment Software for Multiple-Chip Projects
LDS-1	A Development System CAD Tool for Designing Arrays Using CMOS, ECL, or HCMOS
MACGEN	A Megacell Compiler that Can Generate MACs, Multipliers, and Adders for Cell-Based Custom Designs and Structured Arrays, or Gate Arrays with Fixed Macroblocks
BSIM	Behavioral Simulator for Mixed A/D Products
AcceLSI	A Family of Hardware Accelerators

Lytel
61 Chubb Way
P.O. Box 1300
Somerville, NJ 08876
201/685-2000
Fax: 201/685-1282

ESTABLISHED: October 1984
NO. OF EMPLOYEES: 130

BOARD

Dr. Eugene Gordon, chairman

COMPANY EXECUTIVES

Position	Name
President	Bill Stape
VP Engineering & Development	Ron Nelson
VP Business Manager	Tom Lewis
VP Manufacturing	Jim Vaughn
Controller	Tim Brock

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, data communications, and military markets. Products include semiconductor lasers, LEDs, and photodetectors using an indium phosphide materials technology.

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.

Lytel occupies a 57,000-square-foot facility including a Class-1000 clean room.

ALLIANCES: Not available

SERVICES

Design
Manufacturing
Assembly
Test

MANUFACTURING

Technology

InGaAsP
1.3-micron opto components

Facilities

Somerville, NJ	57,000 sq. ft.	Manufacturing, assembly, test
	5,000 sq. ft.	Class-1000 clean room

PRODUCTS

InGaAsP High-Power Lasers
LEDs
Optical Data Links

Matra-Harris Semiconducteur
La Chantrerie/Route Gachet
B.P. 942
44075 Nantes cedex/France
(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 Semiconducteur (MHS) designs, manufactures, and markets a broad range of ICs, using bipolar, CMOS, and NMOS process technologies. Its main product strategies center on ASICs, fast SRAMs, microprocessors, and telecommunications circuits.

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, France, and designated as an area for industrial development, which allowed MHS to gain government financial assistance. Initial wafer fabrication began in December 1980.

In 1982, Harris and MHS 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.

The Company's ASIC capability includes a range of matrices with from 250 to 7,500-gates, using CMOS technology and integrated design tools based on the VAX or IBM PCs. Libraries are available on Daisy, Mentor, and Valid systems.

Recent Highlights

Dec. 1986	MHS unveiled eight new products at Wescon/86, including the HM65787, a 64Kx1 SRAM that is the first application of the 0.8-micron process licensed from Cypress Semiconductor.
June 1987	Intel and Matra-Harris dissolved their joint venture design facility, CIMATEL G.I.E. CIMATEL was formed in 1982 as an equal partnership to design standard VLSI devices for the telecommunications and computer graphics markets. It was jointly owned by Intel and MHS S.A. The dissolution of CIMATEL is due to a reassessment by Intel of its long-range marketing plans. CIMATEL had been responsible for the design of the 82716 video controller, as well as the announced ISDN chip set, the 29C48 combo, and the 29C53 S-transceiver. CIMATEL was located in Paris, France, and employed 26 persons. MHS has made employment offers to many CIMATEL employees.

ALLIANCES

Intel	March 1981	MHS and Intel signed an agreement covering NMOS circuits and establishing a joint design facility in Nantes called CIMATEL.
	June 1987	Intel and MHS dissolved CIMATEL due to a change in Intel's long-range plans. CIMATEL employed 26 persons, many of whom were offered employment at MHS.
Cypress	Oct. 1985	Cypress transferred masks for its 25ns 4K and 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	MHS and Weitek signed a technology exchange and foundry agreement. MHS was granted Weitek's 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 companies will also codevelop complex, high-speed logic devices for DSP, telecommunications, and military markets.
Silicon Compilers	June 1986	MHS and Silicon Compilers Inc. (SCI) will integrate SCI's Genesil silicon design system with MHS' 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

MANUFACTURING

Technology

2.5-, 2.0-, 1.2-, and 0.8-micron CMOS
1- and 2-layer metal
5-inch wafers

Facilities

Nantes, France	72,000 sq. ft.	Design, manufacturing in Class-10 clean room, assembly, and test

PRODUCTS

CMOS SRAMs

Device	Description	Speed (ns)
HM-2064	64K 8Kx8	120, 150
HM-6116	16K 2Kx8	120
HM-6504	4K 4Kx1	200
HM-6514	4K 1Kx4	200
HM-6561	1K 256Kx4	220
HM-65161	16K 2Kx8, I/O Multiplexed	70, 80, 90
HM-65162	16K 2Kx8, I/O Multiplexed	70
HM-65262	16K 16Kx1, I/O Separated	70
HM-65682	16K 4Kx4, I/O Multiplexed	70, 80, 90
HM-65261	16K 16Kx1, I/O Separated	60, 70, 85
HM-65141	16K 8Kx8	55, 70, 90
HM-65642	16K 8Kx8	150
HM-65681	16K 4Kx4, I/O Multiplexed	55, 70, 85
HM-65682	16K 4Kx4	45, 55
HM-65728	16K 2Kx8, I/O Multiplexed	35, 45, 55
HM-65747	4K 4Kx1, I/O Separated	25, 35, 45
HM-65748	4K 1Kx4	25, 35, 45
HM-65767	16K 16Kx1, I/O Separated	25, 35, 45
HM-65768	16K 4Kx4, I/O Multiplexed	25, 35, 45,
HM-65787	64K 64Kx1, I/O Separated	25, 35, 45
HM-65788	64K 16Kx4, I/O Multiplexed	25, 35
HM-65789	64K, Output Enable	25, 35
HM-20256	256K 32Kx8	100, 120, 150

Dual-Port SRAMs

HM-65231	CMOS 2Kx8 Synchronous	55, 90
HM-65232	CMOS 2Kx8	25, 35
HMC-6207	CMOS Dual-Port RAM Controller	55, 70

CMOS Linear Arrays

Family	Process	Gates	Functions
MA Series	3-Micron, 1-Layer Metal	228 to 1,139	Op Amps, Oscillator, Comparator
MB Series	2-Micron, 2-Layer Metal	810 to 11,250	Test Mode, Sscillator Op Amps, ALU, Counters, UART, ROM

Microcomponents

Device	Description	
MPUs		
8086	HMOS 16-Bit MPU; 5, 8 MHz	
80C86	CMOS 16-Bit MPU; 5, 8 MHz	
8088	HMOS 8-, 16-Bit MPU; 5, 8 MHz	
80C88	CMOS 8-, 16-Bit MPU; 5, 8 MHz	
MCUs		
8031/51	HMOS 8-Bit MCU with 4K ROM	
80C31/C51	CMOS 8-Bit MCU with 4K ROM	
8032/52	HMOS 8-Bit MCU with 8K ROM	
80C32/C52	CMOS 8-Bit MCU with 8K ROM	
83C154	80C52 8-Bit with 16K ROM	
MPRs		
82716/VSDD	Video Storage Display Device	
82C43A	Interface	

Telecommunications Circuits

HC305X	Serial PCM Codec-Filter Family	
29C48	CMOS Combo	
29C53	CMOS Digital Loop Controller	
HC5542	X.21 Protocol Controller	
HC555X	Monolithic CMOS Codec-Filter Serial Interface	
HC5570	300-Baud Modem	

DSP

MS2010	16x16 Parallel Multiplier/Accumulator	45ns
MS2516	16x16 Parallel Multiplier	45ns

Development Tool

VDT 716	Development Tool for 82716 Video Storage Display Device	

Maxim Integrated Products, Inc.
120 San Gabriel Drive
Sunnyvale, CA 94086
408/737-7600

ESTABLISHED: May 1983
NO. OF EMPLOYEES: 172

BOARD

Name	Affiliation
John F. Gifford	Maxim Integrated Products, Inc., president
Paul Bancroft	Bessemer Venture Partners L.P., limited partner
B. Kipling Hagopian	Brentwood Associates, general partner
Orion L. Hoch	Litton Industries, Inc., president/CEO
Stephen L. Merrill	Merrill, Pickard, Anderson & Eyre, general partner

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	John F. Gifford	Intersil	President/CEO
VP Mktg/Sales	Frederick Beck	Intersil	SR VP WW Sales/Mktg
VP Operations	Dr. Steven Combs	GE	Mng Dir Process Tech
VP R&D	David J. Fullagar	Intersil	VP Engineering
VP Finance/Admin	John H. Trollman	DEST Corp.	VP Finance

FINANCING

Date	Round	Sources	Amount
1983	Round 1	Bessemer Venture Partners; Brentwood Associates; DSV Partners; Merrill, Pickard, Anderson & Eyre; Venad; overseas venture capital	$4.9M
Feb. 1985	Round 2	Adler & Co.; Bessemer Venture Partners; Brown Boveri; Brentwood Associates; DSV Partners; De Monet Industries; Merrill, Pickard, Anderson & Eyre	$5.5M
	Lease	Bank of America; Bank of the West	$5.3M
Sept. 1985	Round 3	Bessemer Venture Partners; BNP Ventures; Brentwood Associates; DSV Partners; Merrill, Pickard, Anderson & Eyre; Rothschild, Inc.	$6.4M

March 1986	R&D	Venture Technology Funding	$1.2M
Feb. 1988		Initial public offering	N/A

BACKGROUND

Maxim Integrated Products, Inc., designs, manufactures, and markets a broad range of linear and mixed-signal ICs for the analog market. The Company's objective is to develop and market both industry-standard and proprietary linear ICs using a diversity of process technologies.

Currently, the Company offers 200 products that are available in a number of packaging options including surface-mounted package technology. Products are designed for computer and peripherals, instrumentation, process control, communications, military, factory automation, and medical applications.

The Company sees its primary competitors as Analog Devices and Intersil. The competition with Intersil is intense and is expected to intensify further as the result of a second-source agreement giving Intersil the right to select and license up to 10 circuits designed by the Company.

In September 1987, Maxim announced that it had formed a MIL-STD-883C group and expected to be compliant in the fourth quarter. Myrna Hyatt, who recently joined the Company as manager of military programs and quality assurance, reports to Ken Huening, manager of quality assurance and operations. Ms. Hyatt was formerly JAN program manager at Intersil. About 20 people, 10 percent of the present employees, are dedicated to the group. Among the first products will be the MAX232 a single-chip transceiver.

Maxim plans to install a small wafer fabrication capability in 1988. The facility will be used for development or improvement of advanced manufacturing processes and, to a limited extent, for establishment of a second source for certain manufacturing processes. Maxim has subcontracted wafer fabrication to four unnamed silicon foundries and ships processed wafers to subcontractors located primarily in the Philippines and South Korea. Maxim tests processed wafers and conditions and tests each finished product individually.

Maxim was founded by John F. Gifford, Frederick Beck, Dr. Steven Combs, and David J. Fullagar, all former employees of Intersil's Analog IC Product Division. Maxim purchased a 30,000-square-foot facility in Sunnyvale, California, from Si-Fab. In February 1988, the Company completed the sale of 2.3 million shares of common stock. Maxim is using the proceeds to prepay $3.6 million in long-term debt incurred when it purchased a new facility in October 1987. The remaining amount will be applied to equipment and other expenses for the new facility. The facility houses the Company's executive offices, engineering, and all services connected with its manufacturing.

The Company's products are sold worldwide through 63 sales representative organizations and electronics distributors. Domestic distributors are Anthem Electronics, Bell Industries, Hall-Mark Electronics, and Pioneer Electronics. In fiscal 1987, about 38 percent of sales was from the United States, 37 percent from Europe, 17 percent from Japan, and 8 percent from ROW. Among the Company OEM users are AT&T, Brown Boveri, GEC Card Technology (an affiliate of General Electric Company plc), Hewlett-Packard, IBM, McDonnell Douglas, NEC, Siemens, and Tokyo Electric Co., Ltd.

Recent Highlights

Jan. 1987 — Maxim offered a family of RS-232 components designed for specific uses such as digital PBX or modem interfaces. The following are the devices:

- MAX230 and MAX231 digital PBX interfaces
- MAX232/233/235/236 general-purpose interfaces
- MAX234/237/239 modem interfaces

July 1987 — Maxim offered an MPU supervisory circuit that tracks power levels to reset processor functions and switch over to battery backup. The device is designed for laptops and industrial control.

July 1987 — Maxim offered the MAX452 family of CMOS video multiplexers/amplifiers.

Dec. 1987 — Dallas filed a suit against Maxim Integrated Products. The suit is in response to warnings by Maxim that Dallas is violating certain receiver/transmitter patents held by Maxim.

Feb. 1988	Maxim offered 1.7 million shares of common stock in an initial public offering. Maxim is using the proceeds to prepay $3 million in long-term debt incurred in the acquisition of its new facility, with the remaining amount going toward equipment and other expenses for the new facility.

ALLIANCES

Intersil	1984	Maxim and Intersil entered into an agreement that resolved legal proceedings between them. Under the agreement, Maxim granted Intersil the right to select, by July 1989, up to 10 circuits designed by Maxim for manufacture and sale on a royalty basis. Intersil granted Maxim certain rights to Intersil products, trade secrets, and patent rights. Intersil has selected three of Maxim's proprietary products.
	April 1986	Maxim and Intersil signed a second-source agreement.
Brown Boveri	Feb. 1985	Maxim agreed to design and manufacture devices for Brown Boveri.

SERVICES

Design
Test

MANUFACTURING

Technology

Metal-gate CMOS for 1.5 to 18V operation
Metal-gate CMOS for 5 to 40V operation
Silicon-gate CMOS-DMOS for up to 150V operation
High-density/low-noise, analog silicon-gate CMOS
Low-noise, precision bipolar for up to 44V operation

Facilities

Sunnyvale, CA	30,000 sq. ft.	Design and test

PRODUCTS

Multiplexers

Device	Description
MAX310	RF-Video, 8-Channel Multiplexer/Demultiplexer
MAX311	RF-Video, Differential 4-Channel Multiplexer/Demultiplexer
MAX358/HI508A	Fault-Protected, 8-Channel Multiplexer
MAX359/HI509A	Fault-Protected, Differential 4-Channel Multiplexer
MAX368/HI508L	Fault-Protected, 8-Channel Latched Multiplexer
MAX369/HI509L	Fault-Protected, Differential 4-Channel Latched Multiplexer
DG508	8-Channel CMOS Analog Multiplexer
DG509	Differential 4-Channel CMOS Analog Multiplexer

CMOS Analog Switches

MAX331/DG201/211	Quad-SPST, Normally Closed Switch
MAX332/DG202/212	Quad-SPST, Normally Open Switch
DG300	TTL-Compatible, Dual-SPST, Normally Open Switch
DG301	TTL-Compatible, SPDT Switch
DG302	TTL-Compatible, Dual-DPST, Normally Open Switch
DG303	TTL-Compatible, Dual-SPDT Switch
DG304/IH5041	Dual-SPST, Normally Open Switch
DG305	SPST Switch
DG306/DG384/IH5045	Dual-DPST, Normally Open Switch
DG307/DG390/IH5043	Dual-SPDT Switch
DG381	Dual-SPST, Normally Closed Switch
DG387/IH5042	SPDT Switch
IH5040	SPST, Normally Open Switch
IH5044	DPST, Normally Open Switch
IH5048	Low Charge Injection, Dual-SPST, Normally Open Switch
IH5049	Low Charge Injection, Dual-DPST, Normally Open Switch
IH5050	Low Charge Injection, SPDT Switch
IH5051	Low Charge Injection, Dual-SPDT Switch
IH5140	Low-Power, Fast-SPST, Normally Open Switch
IH5341	Low-Power, Fast Dual-SPST, Normally Open Switch
IH5342	Low-Power, Fast-SPDT Switch
IH5343	Low-Power, Fast Dual-SPDT Switch
IH5144	Low-Power, Fast-DPST, Normally Open Switch
IH5145	Low-Power, Fast Dual-DPST, Normally Open Switch
IH5341	Dual-SPST, Normally Open RF-Video Switch
IH5352	Quad-SPST, Normally Open RF-Video Switch

A/D Converters

Device	Description
MAX136	Low-Power, 3.5-Digit Converter with LCD Display Hold
AD578	High-Speed, 3-Micron, 12-Bit Converter
ICL7106	3.5-Digit Converter with Direct LCD Drivers
ICL7107	3.5-Digit Converter with Direct LED Drivers
ICL7109	12-Bit Converter with Three-State Binary Output
ICL7116	3.5-Digit Converter with LCD Display Hold
ICL7117	3.5-Digit Converter with LED Display Hold
ICL7126/7136	Low-Power, 3.5-Digit Converter with Direct LCD Drivers
ICL7129	4.5-Digit Converter with Multiplexed LCD Drivers
ICL7129A	Low-Noise, 4.5-Digit Converter with Multiplexed LCD Drivers
ICL7135	4.5-Digit Converter with Multiplexed BCD Output
ICL7137	Low-Power, 3.5-Digit A/D Converter with Direct LED Drivers
MAX136	Low-Power, 3.5-Digit Converter with LCD Display Hold
AD578	High-Speed, 3-Micron, 12-Bit Converter
ICL7106	3.5-Digit Converter with Direct LCD Drivers
ICL7107	3.5-Digit Converter with Direct LED Drivers
ICL7109	12-Bit Converter with Three-State Binary Output
ICL7116	3.5-Digit Converter with LCD Display Hold
ICL7117	3.5-Digit Converter with LED Display Hold
ICL7126/7136	Low-Power, 3.5-Digit Converters with Direct LCD Drivers
ICL7129	4.5-Digit Converter with Multiplexed LCD Drivers
ICL7129A	Low-Noise, 4.5-Digit Converter with Multiplexed LCD Drivers
ICL7135	4.5-Digit Converter with Multiplexed BCD Output
ICL7137	Low-Power, 3.5-Digit A/D Converter with Direct LED Drivers

Operational Amplifiers/Buffers

MAX400	Super-Low-Offset Op Amp
MAX420/421/430	+/- 15V Chopper-Stabilized Op Amps
MAX422/423	Low-Power, +/- 15V Chopper-Stabilized Op Amps
MAX460	High-Accuracy Fast Buffer
BB3553	Very-Fast-Buffer Amplifier
BB3554	Wideband, Fast-Settling Op Amp
ICL7611/7612/7614/7616	Low-Power, Single Op Amps
ICL7621/7622	Low-Power, Dual Op Amps
ICL7631/7632	Low-Power, Triple Op Amps
ICL7641/7642	Low-Power, Quad Op Amps
ICL7650/7652	Chopper-Stabilized Op Amps
LH0033	Fast-Buffer Amplifier
LH0063	Very-Fast-Buffer Amplifier
LH0101	Power Op Amp
OP07	Precision Op Amp

Display Drivers/Counters

Device	Description
ICM7211	4-Digit LCD Decoder/Driver
ICM7212	4-Digit LED Decoder/Driver
ICM7217	4-Digit LED, Presettable Up/Down Counter
ICM7218	8-Digit, Multiplexed LED Decoder/Driver
ICM7224/7225	4.5-Digit LCD, High-Speed Counters/Decoders/Drivers
MAX7231	8-Digit, Triplexed LCD Decoder/Driver
MAX7232	10-Digit, Triplexed LCD Decoder/Driver
MAX7233	4-Digit, Triplexed LCD Decoder/Driver
MAX7234	5-Digit, Triplexed LCD Decoder/Driver
MAX74C945/947	4-Digit Up/Down Counters/Decoders/Drivers

Interface

MAX232	+5V Powered, Dual-RS-232 Transmitter and Receiver

Switched Capacitor Filter

MF10	Dual, Second-Order, Universal Switch Capacitor Filter

Timers/Counters

ICM7240/7250/7260	Programmable RC Timers/Counters
ICM7242	Fixed RC Timer/Counter
ICM7555	Low-Power, General-Purpose Timer
ICM7556	Low-Power, General-Purpose Dual Timer

Power Supply Circuits

MAX600	Low-Cost AC-DC Regulator (110/220VAC to 5VDC-Full Wave)
MAX601	Low-Cost AC-DC Regulator(110/220VAC to 5VDC-Half Wave)
MAX602	Low-Cost AC-DC Regulator(8V RMS to 5VDC-Full Wave)
MAX610	AC-DC Regulator (110/220VAC to 5VDC-Full Wave)
MAX611	AC-DC Regulator (110/220VAC to 5VDC-Half Wave)
MAX612	AC-DC Regulator (8V RMS to 5VDC-Full Wave)
MAX630	CMOS Micropower, Step-Up Switching Regulator
MAX631	CMOS +5V Fixed/Adjustable Output, Step-Up Switching Regulator
MAX632	CMOS +12V Fixed/Adjustable Output, Step-Up Switching Regulator
MAX633	CMOS +15V Fixed/Adjustable Output, Step-Up Switching Regulator
MAX634	CMOS Micropower, Inverting Switching Regulator
MAX635	CMOS -5V Fixed/Adjustable Output, Inverting Switching Regulator

Power Supply Circuits (Continued)

Device	Description
MAX636	CMOS -12V Fixed/Adjustable Output, Inverting Switching Regulator
MAX637	CMOS -15V Fixed/Adjustable Output, Inverting Switching Regulator
MAX638	CMOS +5V Fixed/Adjustable, Step-Down Switching Regulator
MAX641	CMOS +5V Fixed/Adjustable, 10-Watt Step-Up Switching Regulator
MAX642	CMOS +12V Fixed/Adjustable, 10-Watt Step-Up Switching Regulator
MAX643	CMOS +15V Fixed/Adjustable, 10-Watt Step-Up Switching Regulator
MAX663	CMOS +5V/Adjustable Micropower, Positive Voltage Regulator
MAX664	CMOS -5V/Adjustable Micropower, Negative Voltage Regulator
MAX666	CMOS +5V/Adjustable Voltage Regulator with Low-Battery Detection
MAX680	+5V to +/- 10V Voltage Converter
MAX690/91	MPU Watchdog/Battery, Switchover/Reset Generators
MAX8211	Programmable Voltage Detector
ICL7660	+5V to -5V Voltage Converter
ICL7663	Low-Power, Programmable, Positive Voltage Regulator
ICL7664	Low-Power, Programmable, Negative Voltage Regulator
ICL7665	Low-Power, Under-/Overvoltage Detector

Voltage References

MAX670/671	+10V Kelvin-Connected Precision References
AD2700/2710	+10V Precision References
AD2701	-10V Precision Reference
ICL8069	1.2V Voltage Reference
REF01	+10V Precision Voltage Reference
REF02	+5V Precision Voltage Reference

MCE Semiconductor Inc.
U.S. Headquarters
1111 Fairfield Drive
West Palm Beach, FL 33407
305/845-2837
Fax: 305/863-8275
Telex: 441 405 (MCE UI)

ESTABLISHED: 1977
NO. OF EMPLOYEES (U.S.): 85

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President & Chief Executive Officer	J. Richard Stanmeyer
Director Marketing	Richard McCargar
Controller	James Fitzgerald
R&D Coordinator	Dr. Fawzi Hamzawi

FINANCING: Not available

BACKGROUND

MCE Semiconductor Inc. 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 with financing 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: Not available

SERVICES

Foundry	Bipolar and CMOS (2.5-Micron, Dual-Layer Metal)
Design	CMOS and Bipolar Gate Arrays, Cell Libraries
CAD	Calma GDS II, SPICE
Manufacturing	

MANUFACTURING

Technology

2.5- to 5.0-micron metal-gate CMOS
2.5- to 4.0-micron silicon-gate CMOS
2.5-micron bipolar
4-inch wafers

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/control
	15,000 sq. ft.	Planned facility
Munich, West Germany	12,000 sq. ft.	Design center, sales and marketing

PRODUCTS

Standard Cell

Family	Process	Linewidth (Microns)	Delay (ns)	Gates/Functions
MCE Unicell	Bipolar	4.0	7	Op Amps, References, Comparators

Gate Arrays

Family	Process	Linewidth (Microns)	Delay (ns)	Gates/Functions
MCE MGA	CMOS	5.0	8	220 to 285
MCE MGA	CMOS	5.0	10	21 Gates, 38 MSI, Bias Generator, Comparator, Op Amp
MCE SGA	CMOS	9.0	5	15 Gates, 13 MSI, Comparator, Op Amp, Bias Generator

Linear IC

Family	Process	Linewidth (Microns)	Delay (ns)	Gates
MCE Uniray	Bipolar	5.0	15	38 to 220

Standard ICs

Data Converters
Voltage Regulators
Comparators
Audio Power Amplifiers
BIFET Operational Amplifiers

MemTech Technology Corporation
101 Blue Ravine Road
Folsom, CA 95630
916/351-3100
Fax: 916/985-6804

ESTABLISHED: December 1986
NO. OF EMPLOYEES: 60

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman/CEO	Richard H. Loeffler	Helix Systems	Chairman/CEO
President/COO	William H. Almond	Eaton	GM Microlitho-graphy Division
VP Sales/Mktg	Joseph J. Rutherford	Materials Progress	VP Mktg/Sales

FINANCING: Not available

BACKGROUND

MemTech Technology Corporation is dedicated to the manufacture of bubble memory devices and related products. The Company was formed to acquire the business, principal assets, technology, and R&D capability of Intel Corporation's Magnetic Operation. The Company's leveraged buyout was initiated by the two founders, Richard H. Loeffler and William H. Almond, as well as an additional equity partner, Golodetz Corporation.

The Company is concentrating primarily on military and industrial applications of bubble memory technology. Recently, MemTech won a contract from the Wright-Patterson Air Force Base Avionics Laboratory to conduct work on advanced bubble memory devices. MemTech also works closely with General Electric on the Milstar Satellite program.

MemTech is headquartered in Folsom, California. The Company occupies more than 65,000 square feet of manufacturing space for device manufacture and assembly in Folsom, Santa Clara, and Santa Rosa, California. In addition, MemTech has a network of sales and customer service support operations located throughout the world.

In April 1987, MemTech purchased the Crystal Division of Materials Progress Corporation, the only remaining U.S. supplier of gadolinium gallium garnet (GGG) substrates. GGG are the base materials essential for the manufacture of bubble memory devices.

ALLIANCES: Not available

SERVICES

- Design
- Engineering
- Manufacturing
- Assembly
- Test

FACILITIES

Folsom, CA	32,000 sq. ft.	Engineering, assembly, test, marketing, and sales
Santa Clara, CA	20,000 sq. ft.	Component fabrication, engineering
Santa Rosa, CA	13,000 sq. ft.	Crystal products division

PRODUCTS

Bubble Memory Subsystem Building Blocks

Device	Description
BPK70AZ/7220 Controller	1Mb Components
BPK74AZ/7225 Controller	4Mb Components

Board-Level Products

SBC-254/-264	Nonvolatile Memory Boards
BCK10	Bubble Cassettes
BX251	Bubble Memory Boards
PCB-75/76	Bubble Cards

Micro Linear Corporation
2092 Concourse Drive
San Jose, CA 95131
408/433-5200
Fax: 408/432-0295
Telex: 275906

ESTABLISHED: October 1983
NO. OF EMPLOYEES: 100

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Art Stabenow	National	Sr VP/Analog Div
VP Marketing	Charles Gopen	Daisy Systems	GM IC Layout Div
VP WW Sales	Tim Cox	National	
VP Engineering	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	Fairfield Ventures; Founders, Adler & Co.; Oak Investment Partners; Richard Reardon	$ 4.0M
	Lease	California First Bank; Western Technology Investors	$ 3.5M
Nov. 1985	Round 2	Round-1 investors, Accel Partners, Grace Ventures, Greenwood Funds, Harvest Ventures, Institutional Venture Partners, International Industrial Interests, Investors in Industry, Kyocera International, Montgomery Ventures, Tadiran, Xerox Venture Capital	$12.0M
	Lease	Burnham Leasing Corp.; California First Bank	$ 6.2M
Feb. 1986	Round 3	Round-1 and -2 investors, Aeneas Venture Corp., First Analysis Corp., GE Pension Fund, Kuwait & Middle East Financial Services, Northern Telecom, Schroeder Ventures, United Technical Services, U.S. Venture Partners	$15.3M

BACKGROUND

Micro Linear Corporation designs, manufactures, and markets linear and mixed linear/digital ASICs. The Company offers both proprietary and enhanced alternative sources of standard products from other large suppliers.

Micro Linear offers standard and semicustom ASICs that use a bipolar process. In addition, Micro Linear offers standard products using a CMOS process. Products are designed primarily for 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 simplify the development of ASIC products containing analog functions.

ALLIANCES

IMP	June 1984	IMP and Micro Linear codeveloped a 10V CMOS process; IMP provides foundry services for Micro Linear.
Rockwell	1985	Rockwell invested $1.2 million in Micro Linear and received ASIC linear product technology; Rockwell provides wafers.
Toko	Oct. 1985	Toko will make bipolar devices for Micro Linear at its Saitama, Japan, plant.
Analog Design Tools	July 1986	Micro Linear will integrate both its micro- and macrocell libraries into Analog Design Tools' workbench CAE system.
Daisy Systems	Aug. 1986	Daisy Systems agreed to port Micro Linear's FB300 and FB900 cell libraries to Daisy's workstations.
IMP/ MBB	Aug. 1986	IMP and Micro Linear agreed to transfer ASIC design know-how to Messerschmitt Bolkow Blohm (MBB) over a three-year period.

SERVICES

Design
Test

MANUFACTURING

Technology

Bipolar
12V, 16Hz, dual-layer metal
36V, 300 MHz, dual-layer metal
12V, 3 GHz, dual-layer metal (1988)

3.0-micron, dual-layer polysilicon CMOS

Facilities

San Jose, CA	48,000 sq. ft.	Design, test

PRODUCTS

Bipolar Analog Arrays

Family	Linewidth (Microns)	Interconnect
FB900	10.0	Single-Layer Metal
FB300	8.0	Dual-Layer Metal
FB3400	8.0	Dual-Layer Metal
FB3600	7.0	Dual-Layer Metal

Standard Linear Products

Device	Description
Disk Drives	Bipolar Standard and Semicustom ICs for Read/Write, Data Recovery, and Servo Actuator Control
Telecommunications	CMOS Products for Conditioning Analog Phone Lines; Programmable Attenuators, Equalizer, Loopback, and Tone Signaling
Data Converters	12-Bit and 8-Bit ADC with Serial and Parallel Interfaces

CAD

Micro Linear Provides Libraries of Devices and Macro Models for its Bipolar ASIC Products. The Libraries Run on Industry-Standard Platforms such as ViewLogic, Analog Design Tools, and Daisy Workstations.

Micron Technology, Inc.
2805 East Columbia Road
Boise, ID 83706
208/383-4000
Fax: 208/343-2536

ESTABLISHED: October 1978
NO. OF EMPLOYEES: 1,479

BOARD

Joseph L. Parkinson, chairman
Ward D. Parkinson, vice chairman
Robert A. Lothrop
Thomas T. Nicholson
Allen T. Noble
Douglas R. Pitman
Donald J. Simplot
John R. Simplot
Ronald C. Yanke
Randall W. Chance

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
CEO	Joseph L. Parkinson	Private law firm	Partner-Attorney
President/COO	Juan A. Benitez	Mostek	Ops Mgr
Exec VP	Randall W. Chance	Mostek	Engineer
VP Sales/Mktg	James W. Garret	Wescon Marketing	Owner
VP Finance/Treas	Leslie A. Gill	Citizens Ntl Bank	Pres Assist
VP/Gen Counsel	Lawrence L. Grant	Private law firm	Attorney
VP Quality	Edward Heitzeberg	NSC	Prod Engr
VP R&D	Thomas M. Trent	Motorola	Dsn Engr

FINANCING

Date	Sources	Amount
June 1984	Public offering of common stock	$25.0M
May 1985	Public offering of convertible subordinated debentures	$25.0M
Aug. 1986	Public offering of common stock	$13.4M
Jan. 1987	Private placement	$13.5M

BACKGROUND

Micron Technology, Inc., designs, manufactures, and markets DRAM, SRAM, and video RAM components primarily for computer applications. The Company also manufactures and markets add-in memory boards, electronic cameras, image sensors, and burn-in and test systems.

Micron produces primarily 64K, 256K, and 1Mb DRAMs, with 256K DRAMs accounting for the majority of sales in fiscal 1987. The Company is currently one of two North America-based companies producing DRAMs. It benefits from the foreign market value controls, particularly for 256K DRAMs.

In 1987, Micron added CMOS capability and expanded its product line to include CMOS 256K SRAMs, 256K video RAMs, and 1Mb DRAMs. The Company has begun production and sales of several memory board products designed for IBM PC XT/AT and compatible systems, the Commodore Amiga, and Macintosh PCs. This development is an important element of the Company's diversification strategy. The board products include a 2MB and a 4MB device that is fully equipped with Micron's 256K DRAMs.

The Company's products are marketed directly to computer manufacturers and through an international network of distributors and sales representatives. Among Micron's distributors are Anthem Electronics Inc., Hall-Mark Electronics, and Wyle Laboratories Electronics Marketing Group.

Recent Highlights

Sept. 1985	Micron filed an antidumping petition with the United States Department of Commerce and the International Trade Commission (ITC), charging Japanese DRAM makers with dumping 64K DRAMS in the U.S. market at prices below fair market value.
May 1986	The ITC found that exports of 64K DRAMs from Japan have injured U.S. manufacturers. Antidumping investigation concluded with the imposition of penalty duties.
July 1986	Samsung purchased a 2.7 percent interest in Micron for $5 million as part of an out-of-court settlement for 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 technologies for a 1.0 percent royalty if sales exceed one million parts.

Aug. 1986	Micron offered 2.3 million shares of common stock in a public offering and raised $13.4 million. The proceeds were used to pay off part of its current long-term debt to Idaho First National Bank. Micron pledged its assets to Idaho First National to keep its major lines of credit open.
Oct. 1986	Micron dismissed, without prejudice, a suit that it filed against six Japanese manufacturers and their U.S. subsidiaries.
Feb. 1987	Micron offered about 3.5 million shares of common stock to foreign institutional investors and raised $13.5 million. Net proceeds were used to repay loans under Micron's bank line of credit and for working capital.
June 1987	Micron discontinued its EEPROM program, which was launched in August 1987, and is concentrating on its 1Mb DRAM and SRAM products.
Dec. 1987	Micron shipped prototype samples of a 256K video RAM (VRAM). Micron plans to begin volume shipments in March.
Jan. 1988	Micron shipped prototype samples of its fast 256K SRAM and began production of 64K and 16K SRAMs.
March 1988	Micron began construction of a 100,000-square-foot facility adjacent to its present site. The facility will include a 6-inch wafer fabrication plant.
March 1988	Micron and Intel Corporation entered into an agreement allowing Intel to market Micron DRAMs under Intel's label. Initial offerings will be 256K DRAMs. Micron also issued Intel a warrant for the purchase of 600,000 shares of Micron stock at a price of $19.375 per share.
March 1988	Micron announced that it will redeem its 14 percent convertible subordinated debentures on April 15.
April 1988	Micron purchased 1.6 million shares of Standard Microsystems Corporation (SMC) common stock from the C.B. Equities Group at $6.03 per share.

ALLIANCES

ITT/STC	Jan. 1983	Micron granted ITT Industries a worldwide nonexclusive license to manufacture and sell 64K DRAMs. In April 1983, ITT assigned the license to Standard Telephone and Cable plc (STC) as a result of the sale of ITT's U.K. division to STC.
Samsung	June 1983	Micron granted Samsung Semiconductor and Telecommunications a license for 64K DRAMS. Samsung provided Micron with cash. The agreement was later extended to include Micron's 256K DRAM.
	July 1986	Samsung purchased a 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 technologies for a 1.0 percent royalty.
Commodore	Aug. 1983	Micron licensed Commodore to produce Micron's 64K DRAM. This agreement is no longer in effect.
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 Barvon Research Inc. (BRI). BRI agreed to design a number of ASICs that Micron will manufacture and sell.
Intel	March 1988	Micron and Intel Corporation entered into an agreement allowing Intel to market Micron DRAMs under Intel's label. Initial offerings will be 256K DRAMs. Micron also issued Intel a warrant for the purchase of 600,000 shares of Micron stock at a price of $19.375 per share.
SMC	April 1988	Micron purchased 1.6 million shares of SMC common stock from the C.B. Equities Group at $6.03 per share.

SERVICES

Design Consulting
IC and Board Manufacture
Assembly
Test

MANUFACTURING

Technology

NMOS
1.0-micron double-metal CMOS
Custom packaging

Facilities

Boise, ID	30,000 sq. ft.	Fab I	NMOS, CMOS 5-inch wafers, 64K and 256K DRAMs
	17,000 sq. ft.	Fab II	NMOS, CMOS 5-inch wafers, 1Mb DRAMs, SRAMs
	78,000 sq. ft.		Test and assembly
	25,000 sq. ft.		Expansion for R&D and memory board production to be completed in July 1988
	100,000 sq. ft.		Office building and 6-inch wafer fabrication facility to be completed in January 1989

PRODUCTS

DRAMs

Device	Description	Access Time (ns)
MT4264	64Kx1, NMOS, Page Mode	100-200
MT1128	128Kx1, NMOS, Page Mode	100-200
MT4067	64Kx4, NMOS, Page Mode	80-150
MT1259	256Kx1, NMOS, Page Mode	80-150
MT4C4256	256Kx4, CMOS, Static Column	80-150
MT4C4258	256Kx4, CMOS, Static Column	80-150
MT4C1024	1Mb x 1, CMOS, Fast Page Mode	80-150
MT4C1025	1Mb x 1, CMOS, Nibble Mode	80-150
MT4C1026	1Mb x 1, CMOS, Static Column	80-150

Modules

Device	Description	Access Time (ns)
MT8068	64Kx8, NMOS, Page Mode	100-200
MT9068	64Kx9, NMOS, Page Mode	100-200
MT4259	256Kx4, NMOS, Page Mode	80-150
MT5259	256Kx5, NMOS, Page Mode	80-150
MT8259	256Kx8, NMOS, Page Mode	80-150
MT9259	256Kx9, NMOS, Page Mode	80-150
MT88512	512Kx8, NMOS, Page Mode	80-150
MT89512	512Kx9, NMOS, Page Mode	80-150
MT8C8024	1Mb x 8, CMOS, Fast Page Mode	80-150
MT8C8025	1Mb x 8, CMOS, Nibble Mode	80-150
MT8C8026	1Mb x 8, CMOS, Static Column	80-150
MT8C9024	1Mb x 9, CMOS, Fast Page Mode	80-150
MT8C9025	1Mb x 9, CMOS, Nibble Mode	80-150
MT8C9026	1Mb x 9, CMOS, Static Column	80-150

SRAMs

MT5C1608	2Kx8, CMOS, Chip Enable (CE), Output Enable (OE)	25-45
MT5C1607	4Kx4, CMOS, Separate I/O, Hi-Z	25-45
MT5C1606	4Kx4, CMOS, Separate I/O	25-45
MT5C1605	4Kx4, CMOS, CE, OE	25-45
MT5C1604	4Kx4, CMOS, CE	25-45
MT5C1601	16Kx1, CMOS, CE	25-45
MT5C6408	8Kx8, CMOS, CE, OE	25-45
MT5C6407	16Kx4, CMOS, Separate I/O, Hi-Z	25-45
MT5C6406	16Kx4, CMOS, Separate I/O, CE	25-45
MT5C6405	16Kx4, CMOS, CE, OE	25-45
MT5C6404	16Kx4, CMOS, CE	25-45
MT5C6401	64Kx1, CMOS, CE	25-45
MT5C2568	32Kx8, CMOS, CE, OE	35-55
MT5C2565	64Kx4, CMOS, CE, OE	35-55
MT5C2564	64Kx4, CMOS, CE	35-55
MT5C2561	256Kx1, CMOS, CE	35-55

Video RAM

MT42C4064	64Kx4, CMOS, Page Mode	100-150

System Products

Add-In Memory Boards for IBM and Compatibles, Commodore Amiga, Apple Macintosh
AMBYX Burn-In/Test System
MicronEye Electronic Camera
Idetix Digitizing Camera System
Image Sensor

Microwave Monolithics
465 East Easy Street
Simi Valley, CA 93065
805/584-6642

ESTABLISHED: April 1982
NO. OF EMPLOYEES: 20

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Daniel Ch'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: Not available

SERVICES

- Design
- Manufacturing
- Test

MANUFACTURING

Technology

- 0.5-micron GaAs fine-line capability

Facilities

Simi Valley, CA	8,000 sq. ft.	Two Class-100 clean rooms

PRODUCTS

MMICs

Microwave Technology, Inc.
4268 Solar Way
Fremont, CA 94538
415/651-6700
Fax: 415/651-2208

ESTABLISHED: May 1982
NO. OF EMPLOYEES: 230

BOARD

Name	Affiliation
Thomas R. Baruch	Microwave Technology, Inc., president
Dr. M. Omori	Microwave Technology, Inc., vice president of engineering
C.C. Bond	New Enterprises Associates
Irwin Federman	Advanced Micro Devices
Dr. P. Kaminski	Hambrecht & Quist

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Thomas 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 Engineering	Dr. Masa Omori	Avantek	Eng Mgr
VP Marketing	David Gray	EM Systems	Sales Mgr
VP Ops	John Sorai	Watkins-Johnson	Subsystems Div Mgr
President/MMI Subsidiary	Joseph Lee	Litton	President

FINANCING

Date	Round	Amount
Aug. 1983	Round 1	$4.8M
Not available	Round 2	$4.3M
June 1985	Round 3	$1.0M

Investors were the Allstate Insurance Company, Concord Partners, New Enterprise Associates, T. Rowe Price, Sequoia Capital, and U.S. Venture Partners.

BACKGROUND

Microwave Technology, Inc., (MwT) is a vertically integrated manufacturer of GaAs-based microwave components and subassemblies. MwT designs, manufactures, and markets GaAs epitaxial materials, GaAs FET devices, MMICs, hybrid MICs, and microwave components and subassemblies. The Company's products are designed for defense-related applications.

MwT produces both ultralow-noise and medium-power GaAs FETs and AlGaAs HEMT devices for applications ranging from 0.5 GHz to 40.0 GHz. The devices are produced with gate lengths from 0.1 to 0.25 micron. The Company is developing a family of high-performance MMIC products and has completed a series of 2- to 6-GHz MMIC amplifiers. Products in the 2- to 18-GHz and 6- to 16-GHz ranges are in development.

The Company also offers GaAs FET amplifiers from 0.5 to 26.5 GHz that use MMIC and hybrid MIC modules.

In 1987, MwT acquired Monolithic Microsystems, Inc. of Santa Cruz, California. Monolithic Microsystems makes detector log video amplifiers (DLVAs), log video amplifiers (LVAs), and threshold detectors based on proprietary monolithic LVA ICs. Products are used in various EW systems and other defense electronic applications. Monolithic Microsystems will operate as a wholly owned subsidiary of MwT and will continue its manufacturing in its 8,200-square-foot Santa Cruz facility.

ALLIANCES: Not available

SERVICES

Design
Manufacturing
Test

MANUFACTURING

Technology

GaAs

Facilities

Fremont, CA	50,000 sq. ft.	Design, manufacturing
	6,000 sq. ft.	Class-1000 clean room

PRODUCTS

- GaAs Epitaxial Materials
- GaAs FET Amplifiers, 0.5 to 26.5 GHz
- GaAs MMIC Amplifiers, 2 to 6 GHz
- GaAs MIC Microwave Products
- Thin-Film Hybrids
- Log Amplifiers
- Detector Log Video Amplifiers

Mietec N.V.
Westerring 15
9700 Oudenaarde, Belgium
055-33-2211
Fax: 055-318-112
Telex: 85739 MIETEC

ESTABLISHED: March 1983
NO. OF EMPLOYEES: 280

BOARD

Jo Cornu, chairman

COMPANY EXECUTIVES

Position	Name	Prior Company
General Manager/CEO	Jean-Pierre Liebaut	Matra-Harris
Business Development Manager	Eric Schutz	Motorola
Director, Marketing & Sales	Alain Gilot	Mostek

FINANCING: Investment in the Company totals $48.2 million.

BACKGROUND

Mietec N.V. designs mixed analog and digital ASICs, using a cell-based library of digital and analog cells. The Company's ASIC products are split into two categories: user-specific ICs (USICs) and application-specific standard products (ASSPs) for dedicated uses.

The Company is capable of designing devices using CMOS (for low-power, high-density applications), BIMOS (for high-voltage applications, 70V), and SBIMOS (a multipurpose technology) processes. A proprietary development software support tool called Mietec Analog/Digital Engineering (MADE) allows the development and simulation of digital and analog functions simultaneously.

Mietec is a joint venture, 49.8 percent of which is owned by Alcatel Bell Telephone Company; 49.2 percent is owned by GIMV, a Flanders regional investment company; and 1.0 percent is owned by a private investment bank. Mietec is a major supplier of the ASIC products for the Alcatel System 12 and is working on the next generation of Alcatel exchanges based on ISDN.

ALLIANCES

Sprague	1983	Mietec entered a cross-licensing agreement with Sprague for a BIMOS process.
STM	1987	Mietec, SGS-Thomson, and Alcatel agreed to the transfer of a 1.2-micron CMOS process.

SERVICES

Design
Foundry (CMOS, NMOS, BIMOS)
Manufacturing
Assembly
Test

MANUFACTURING

Technology

5.0-, 3.0-, and to 2.4-micron NMOS
3.0- and 2.4-micron CMOS
VMOS
BICMOS
Single and double-layer metal

Facilities

Oudenaarde, Belgium	The manufacturing center is situated on a 40,000-square-meter site with 10,000 square meters of floor space. A wafer fab is equipped with more than 2,000 square meters of clean rooms, of which 400 square meters are Class 10. Potential capacity is 150,000 wafers per year. The fab is suitable for technologies of 1 micron or lower.
Brussels, Belgium	The customer design center includes VAX 8500, VAX 750, MICROVAX, Tektronix, GPX2, and Daisy equipment, in addition to VALID workstations.

Modular Semiconductor, Inc.
2334 Walsh Avenue, Suite G
Santa Clara, CA 95051
408/748-1501
Fax: 408/748-0348

ESTABLISHED: September 1983
NO. OF EMPLOYEES: 11

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Arockiyaswami Venkidu	Faraday Electronics	Dir Engr
Dir Mfg	Dr. Lenin Anne	Hewlett-Packard	Sr Engr

FINANCING: Not available

BACKGROUND

Modular Semiconductor, Inc., was founded by individuals from Hewlett-Packard, Signetics, and Synertek to design, develop, manufacture, and market VLSI ICs, using a 1.0-micron CMOS process technology.

The Company is focusing on data communications chips, memories, semi-custom and custom designs, VME bus chip sets, and telecommunications products. Modular Semiconductor began manufacturing with a 2-micron CMOS process and is now offering 1.5-micron technology, with plans to use a 1.0-micron process in three years.

ALLIANCES

Panatech/ Ricoh	Nov. 1984	Modular Semiconductor made a five-year, three-way agreement with Panatech and Ricoh of Japan. Modular provided Ricoh with its CMOS designs and process technology for 16K SRAMs and 256K DRAMs. 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

MANUFACTURING

Technology

1.5-micron CMOS

Facilities

Santa Clara, CA	6,000 sq. ft.	Design

PRODUCTS

CMOS SRAM

Device	Description	Access Time (ns)
MS6168	16K	55
MS6167	16K	55

Microperipherals

MS88C681	CMOS DUART
MS88C691	UART
MS16C450/82C50	PC UART
MS16C550	VME Support Circuits
MS68C153	IBM 3270 Protocol Interface Circuit

Molecular Electronics Corporation
4030 Spencer Street MS108
Torrance, CA 90503-2417
213/214-1485
Fax: 213/542-1270

ESTABLISHED: 1984
NO. OF EMPLOYEES: 12

BOARD

George Reynolds, chairman
Dr. Vladimir Rodov
Dr. Paul Kaminski
Parker Dale
Martin Knestrick
Jay McKie

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman/CEO	George Reynolds	Primary Energy Technology, Inc.	CEO
President/Dir R&D	Dr. Vladimir Rodov	TRW	Sr. Scientist
VP Dir Medical Bus	David Gibson	Chiron Ophthalmics	Founder/Dir R&D

FINANCING: Molecular Electronics has raised more than $5 million in three rounds of financing.

BACKGROUND

Molecular Electronics Corporation (MEC) is developing technology for the formation, deposition, and commercial application of biomolecular membranes, or biomembranes, in the fields of electronics, optics, and biomedicine.

A biomembrane is a structural analog of the membrane that surrounds every living cell. MEC's proprietary technology enables the formation and deposition of highly ordered, perfectly uniform organic films onto a variety of substrate surfaces, with thickness control down to 10 angstroms. The Company's technology and know-how include a patented biomembrane production technology, called MonoFab, and the molecular engineering and synthesis of biomembrane materials with the desired physical, electronic, optical, and biological properties.

MEC has developed several potential commercial applications of the core biomolecular membrane technology (BMT). The first is an ultrathin, uniform, high-resolution e-beam resist (MonoResist) that has a demonstrated resolution down to 1.0 micron. The second is an ultra-thin anticorrosive lubricant (MonoGuard) for rigid disk magnetic media. The third is a perfectly uniform antireflection coating (MonoArc) for pellicles.

The Company has also demonstrated a 20-angstrom biomembrane dielectric on GaAs devices. Outside of semiconductor applications, the Company has demonstrated unique biocompatible properties of biomembranes as coatings for medical implants, including intra-ocular lenses, and is developing drug delivery and surface-active (binding) sites applications (e.g., biosensors).

The MEC business plan calls for partnerships with corporations on both the electronic and medical applications of its technology. The Company believes that its technology will lead to new classes of organic/inorganic hybrid semiconductors and dielectric spacers for quantum devices in electronics and, ultimately, will represent the key enabling technology for bioelectronics including the biochip.

ALLIANCES: Alliances exist but information is not available.

SERVICES

R&D Contracts and Molecular Coatings

MANUFACTURING

Currently on a pilot scale

Facilities

Torrance, CA	7,500 sq. ft.	Headquarters, R&D lab (including Class-10 clean room, surface analytic, electronics, and chemistry sections)

MOS Electronics Corporation
914 West Maude Avenue
Sunnyvale, CA 95086
408/733-4556
Fax: 408/773-8415

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 79	VP Finance
Ntl Sales Mgr	Eric Nagel	Intel	Dist Sales Mgr

FINANCING

Date	Round	Sources	Amount
1983	Seed	Founders	$1.0M
1984	Round 1	Pacific Electric Wire & Cable (Taiwan)	$2.0M

BACKGROUND

MOS Electronics Corporation (MOSel) designs, manufactures, and markets CMOS SRAMs and a family of specialty memory products for the dual-port cache control and telecommunications markets. The Company is using its SRAMs to build a base that will enable it to design specialty memories including cache tag RAMs; video RAMs; and radiation-hardened, 6-transistor RAMs.

MOSel does front-end R&D and marketing at its headquarters in Sunnyvale, California. Hyundai, Sharp, Taiwan Semiconductor, and UMC Manufacturing Corporation provide foundry services. Assembly and test are also subcontracted.

Recent Highlights

Jan. 1987	MOSel offered the MS6130, a 1Kx8 dual-port RAM for use in 32-bit parallel computer applications, offering a 55ns address access time and a 30ns output enable time for no-wait operation with 25-MHz MPUs.
March 1987	MOSel offered the MS7201 CMOS FIFO with access times of 50ns, 65ns, and 120ns.

ALLIANCES

Fuji Electric	Sept. 1985	Fuji Electric and MOSel signed an agreement whereby Fuji Electric will supply 4-inch and 6-inch wafers, using MOSel 1.5- and 2.0-micron process technology. The companies will jointly develop CMOS 16K and 64K SRAMs for MOSel under an OEM contract.
UMC	Oct. 1985	MOSel transferred rights to an EEPROM, a 2Kx8 SRAM, and a 2-micron process to UMC in Taiwan in exchange for fab capacity.
Hyundai	Feb. 1986	MOSel provided 8Kx8 and 1Mb SRAMs and 1.2- and 1.5-micron CMOS process technologies to Hyundai in exchange for foundry capacity under a discounted OEM contract.
Sharp	June 1986	MOSel provided a 256K SRAM design based on a 1.2-micron CMOS process. Sharp provides 256K SRAMs under a favorable OEM contract.

SERVICES

Design
Test

MANUFACTURING

Technology: MOSel offers four high-performance bipolar CMOS (H-BICMOS) processes with minimum dimensions as follows:

Drawn (Microns)	Effective (Microns)
2.0	1.5
1.5	1.1
1.2	0.8
1.0	0.8

Facilities

Sunnyvale, CA	6,000 sq. ft.	Design and test

PRODUCTS

Bytewide SRAMs

Device	Description	Access Time (ns)
MS6516	2Kx8	45-100
MS6264	8Kx8	45-120
MS62256	32Kx8	55-85
MS88128	128Kx8	55-150

Fast SRAMs

MS6167	16Kx1	45-70
MS6168	4Kx4	45-70
MS6287	64Kx1	45-70
MS6288	16Kx4	45-70

Specialty Memories

MS7201	512x9 FIFO	65-120
MS6130	1Kx8 Dual Port	55-120
MS6132	2Kx8 Dual Port	

Nihon Information Center Co., Ltd.
6-11-3 Nishi Shinjuku
Shinjuku-ku, Tokyo 160
Japan
03-348-1631
Fax: 03-346-2846
Telex: 232-4821

ESTABLISHED: 1977
NO. OF EMPLOYEES: N/A

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President/CEO	Yoshihisa Ogawa
Dir/Chief Engr	Kuniyuki Takyu
Exec Dir Mktg/Sales	Masao Nawa

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.

Also 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. 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 currently markets 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

MANUFACTURING

Technology

2.0-micron CMOS

Facilities: Not available

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)

HYPER-KIT 5
PCP (Page Compiler Processor)

Special Hyperboard	A subsystem using the VR-FIP; includes an MC68020 CPU, buffers, and a VERSA bus for a host computer interface
NIC Publications System, NIC LSI	An electronic publishing system based on the chip, boards, and subsystems

NMB Semiconductor Corporation
9730 Independence Avenue
Chatsworth, CA 91311
818/341-3355

ESTABLISHED: April 1984
NO. OF EMPLOYEES: 75

BOARD

Name	Affiliation
Takumi Tamura	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	Mitsuo Ishikawa	Minebea	Sr Mng Dir
Executive VP	William C. Connell	NMB (USA)	Vice President
Dir Mfg & R&D	Shosuke Shinoda	Matsushita	Dir MOS Process

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

NMB Semiconductor Corporation designs, manufactures, and markets 256K and 1Mb DRAMs and also offers foundry services. The Company was Japan's first start-up to build a VLSI facility capable of fabricating products with submicron geometries. Designs and technology were acquired initially through licensing agreements and technology exchanges with Inmos and other U.S. companies to bring existing processes on-line quickly.

NMB Semiconductor is a wholly owned subsidiary of NMB Technologies, which is, in turn, a subsidiary of the multinational Minebea Co. Ltd., of Tokyo, Japan. NMB Technologies was formed in early 1988 and consolidates Minebea's U.S. activities, which consist of NMB Semiconductor, Hi-Tek Corp., IMC Components Corp., and NMB Audio Research Corp. NMB Technologies is organized into a Memory Division (NMB Semiconductor), a Keyboard Division (Hi-Tek), an axial fan division (IMC Components), and an Audio Research Division (NMB Audio Research). NMB Technologies conducts the marketing for all products manufactured by the subsidiaries including DRAMs, hybrid ICs, switching power supplies, keyboards, inductors, DC servo and step motors, and AC and DC tube axial cooling fans.

All foundry manufacturing and manufacturing for NMB Semiconductor's DRAMs are conducted by Minebea in a $125 million, fully automated facility in Tateyama, Japan. Foundry customers include Inmos Corporation and Vitelic Corporation.

ALLIANCES

Minebea Co.	1984	NMB is the subsidiary of and is financed by Minebea.
Inmos	June 1984	NMB obtained a five-year license to produce Inmos' 256K CMOS DRAM in exchange for cash, royalties, and 50 percent of the 256K DRAM output. The companies also planned to codevelop the technology for Inmos' 64K and 1Mb DRAMs.
Vitelic	Nov. 1985	Vitelic granted a license to NMB Semiconductor for its 1Mb CMOS DRAM in exchange for one-third of NMB Semiconductor's plant capacity.
National	Sept. 1986	National contracted NMB to manufacture fast SRAMs at the Tateyama fab. This agreement was canceled.

TI	Nov. 1987	NMB agreed to supply Texas Instruments (TI) with TI-designed, 1Mb field RAMs. Initially, NMB shipped 100,000 units a month.
Alliance Semiconductor	Dec. 1987	Alliance Semiconductor signed a five-year agreement with NMB Semiconductor, covering 256K and 1Mb DRAMs. NMB will manufacture and sell the devices worldwide.

SERVICES

Manufacturing

MANUFACTURING

Technology

1.0- to 2.0-micron CMOS
5-inch wafers

Facilities

Tateyama, Japan	200,000 sq. ft.	
	43,000 sq. ft.	Class-1 clean room

PRODUCTS

DRAMs

Device	Description	Speed
AAA2800	256Kx1 Static Column Mode	60 to 80ns
AAA2801	256Kx1 Page Mode	60 to 80ns
1M100	1Mb x 1 Fast Page Mode	100 to 200n
1M101	1Mb x 1 Nibble Mode	100 to 200ns
1M102	1Mb x 1 Static Column Mode	100 to 200n
1M104	256Kx4 Fast Page Mode	100 to 200ns
1M105	256Kx4 Static Column Mode	100 to 200ns
1M200	1Mb x 1 Fast Page Mode	60 to 80ns
1M201	1Mb x 1 Nibble Mode	60 to 80ns
1M202	1Mb x 1 Static Column Mode	60 to 80ns
1M204	256Kx4 Fast Page Mode	60 to 80ns
1M205	256Kx4 Static Column Mode	60 to 80ns

NovaSensor
1055 Mission Court
Fremont, CA 94539
415/490-9100
Fax: 415/770-0645
Telex: 990010

ESTABLISHED: October 1985
NO. OF EMPLOYEES: 75

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Copresident/CEO	Janusz Brysek	IC Sensors	Founder/President
Copresident/COO	Joseph R. Mallon	Kulite Semiconductor	VP Engineering
Exec VP Technology	Kurt Peterson	Transensory Devices	Founder/VP Tech
Dir Adv Sensor Dev	Phil Barth	Stanford University	Sr Rsch Assoc
Dir QA	Dilip Vyas	Sensym	Mgr QA

FINANCING

NovaSensor was funded by Solarton Electronics Inc., a division of Schlumberger, for an undisclosed amount.

BACKGROUND

NovaSensor was formed to develop, manufacture, and market the next generation of solid-state sensors and unique silicon-based mechanical microstructures. In the sensor field, the Company is focusing its design and development efforts on the physical parameters of pressure, acceleration, flow, and force. In the area of silicon-based mechanical microstructures, NovaSensor is focusing its efforts on the development of flow restrictors, programmable microvalves, microswitches, nozzles, fluidics components, and micropositioners.

The Company was formed by Janusz Bryzek, Joseph R. Mallon, and Kurt Peterson. The team was joined by Phil Barth, a sensor technologist from Stanford University.

The Company is housed in a 32,000-square-foot facility that became operational in the summer of 1987 and includes a 4-inch wafer-processing line, assembly, and test.

First packaged devices were the TO-5 and TO-8 piezoresistive pressure sensors compensated over the range of 0° to 70° centigrade.

In September 1987, IC Sensors filed a suit against NovaSensor, claiming that the firm misappropriated information and trade secrets. The suit also names Mr. Bryzek, NovaSensor's president and CEO and the former vice president and director at IC Sensors.

ALLIANCES: Not available

SERVICES

- Development
- Design
- Engineering
- CAD
- Manufacturing
- Assembly
- Test

MANUFACTURING

Full-capability wafer fabrication for solid-state sensors, silicon microstructures, and transducer lines on 4-inch wafers. The facility is capable of producing more than 30 million sensors per year.

Facilities

Fremont, CA	22,000 sq,. ft.	Manufacturing
	3,500 sq. ft.	Class-1000 clean room

PRODUCTS

- Low-Pressure Sensors (1 psi) with High Output and Low Linearity
- High-Pressure sensors (5,000 psi)
- Acceleration Sensors
- Isolated Metal Diaphragm Transducers
- On-Chip Laser-Trimmable Pressure Transducers

Novix Inc.
19925 Stevens Creek Blvd., Suite 280
Cupertino, CA 95015
408/255-2750

ESTABLISHED: March 1984
NO. OF EMPLOYEES: 20

BOARD

Name	Affiliation
John Peers	Novix Inc.
Ed Mack	Consultant
Ron Osborne	Faultless Starch
Peter Johnson	

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	John Peers	Technology Industries Inc.	President

FINANCING

Date	Round	Sources	Amount
March 1984	Round 1	Sysorex International Inc., Technology Industries Inc.	$1.0M

BACKGROUND

Novix develops and markets MPUs and development tools that implement a FORTH-in-silicon architecture. In 1986, Novix introduced the NC Series of 16-bit MPUs, which are high-level language, direct-execution (no microcode) MPUs. The MPUs are manufactured using 1.25-micron HCMOS and typically perform in excess of 20 mips. Other products include CPU boards, the ND4000 development system, a C compiler, and a FORTH operating environment. The Company states that the approach can be implemented in HCMOS, ECL, and GaAs. A 3-micron CMOS gate array was designed using Novix-developed technology.

Novix designs products for the artificial intelligence, embedded controller, cryptographics, robotics, and machine vision markets. Future plans also include implementing gallium arsenide in its product lines. The Company subcontracts all production and assembly.

Novix founders included Charles Moore, who invented the FORTH language in 1969, John Peers, 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 R&D partnership was renamed Novix Inc.

In October 1986, Novix established an office in Belgium and signed nine European distributors.

In January 1987, John Golden and Robert Murphy formed a new company, named QSD, which applies the FORTH-in-silicon architecture to the military market.

Recent Highlights

Feb. 1987	Novix put its 16-bit NC4016 MPU on an STD bus card measuring 4.5 x 6.5 inches. The NB4300 card supports 20-bit addressing and can be used as master or slave bus control.
April 1987	Novix introduced the NS4100, a high-speed coprocessor/real-time controller board for IBM PCs or compatibles. The board is built with the Company's NC4016 MPU.

ALLIANCES

Sysorex	March 1984	Sysorex International participated in first-round financing.
Harris	July 1986	Harris added the Novix FORTH language MPU to its ASIC library as part of a licensing agreement covering MPU and MCU products based on the FORTH engine.

SERVICES

R&D
Design
Test

MANUFACTURING

Technology

3- and 1.25-micron CMOS

Facilities

Cupertino, CA	6,000 sq. ft.	Design, test

PRODUCTS

Microprocessors

Device	Description	Features
NC4016	16-Bit	64K Words Direct and 128-Gigaword On-Chip Memory Addressing, 10 to 12 mips
NC5116	16-Bit	2-Megaword Direct and 128-Gigaword On-Chip Memory Addressing, 20 to 25 mips
NC6116	16-Bit	2-Megaword Direct and 128-Gigaword On-Chip Memory Addressing, plus UARTS, FIFO, CTC, SCSI, on Chip Stacks, 20 to 25 mips

CPU Boards

Device	Description
NB4000	Novix Beta Board with 28-Kword RAM, 8 mips, CPU, Program and Data Memory, I/O, Memory Interface, FORTH
NB4100	IBM PC Add-In Board with 64-Kwords RAM, 8 mips, CPU, Program and Data Memory, I/O, Memory Interface, FORTH
NB4200	Turbo Frame 4000 with 8-Kwords RAM, 8 mips, CPU, Program and Data Memory, I/O, Memory Interface, FORTH
NB4300	Novix STD Bus CPU Board with 64-Kwords RAM, 8 mips, CPU, Program and Data Memory, I/O, Memory Interface, FORTH

Development Tools

ND4000	Standalone System with Disk Controller, 10MB Hard Disk, Power Supply/Case, 360KB Floppy Disk, and Breadboard Development Area
Novix Empress	Comprehensive Superset FORTH-83 Operating Environment
Novix C	Full K and R and ANSI

Opto Diode Corp.
914 Tourmaline Drive
Newbury Park, CA 91320

ESTABLISHED: 1981
NO. OF EMPLOYEES: N/A

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President	James Kim	Rockwell

FINANCING: Not available

BACKGROUND

Opto Diode Corp. (ODC) was formed in 1981 by James Kim, formerly with Rockwell's Collins division in Dallas, Texas. ODC offers semicustom high-reliability devices made to customer specifications. The Company is occupying a 10,000-square-foot facility in Newbury Park, California.

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 European market.

ALLIANCES: Not available

SERVICES

Design

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	Not available	Not available

FINANCING: Not available

Sources	Amount
Bank of Communications, Fortune Plastic Manufacturing Co.; Opto Tech Corp.	$2.5M

BACKGROUND

Opto Tech is offering GaAs-based products, silicon wafers, and photoresistor 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 off from Fine Microelectronics and is owned by local investors and the Bank of Communications.

ALLIANCES: None

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

GaAs
Silicon

Facilities

Hsinchu, Taiwan	9,175 sq. ft.

PRODUCTS

LED
Transistors
Photodiodes
Phototransistors
Infrared Devices

Orbit Semiconductor, Inc.
1230 Bordeaux Drive
Sunnyvale, CA 94086
408/744-1800
Fax: 408/747-1263

ESTABLISHED: November 1985
NO. OF EMPLOYEES: 100

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Gary Kennedy	Comdial Semiconductor	VP/GM
VP Finance	Joseph Wai	Comdial Semiconductor	Controller
VP Technology	Steve Kam	Comdial Semiconductor	Dir Technology

FINANCING: Not available

BACKGROUND

Orbit Semiconductor, Inc., specializes in quick-turn, high-reliability foundry work with emphasis on 1.5-micron CMOS including either a double-poly or double-metal process. Other processes include 2.0- to 5.0-micron CMOS, HMOS, single- or double-poly, single- or double-metal, double-poly/double-metal, and multiple-layer poly.

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.

The Company also offers computer-aided design services, which include layout from customer-provided logic drawings, design rule checking, data sizing, and conversion and Versatec plots. Orbit also acts as a prime contractor for providing photoplates.

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, began offering 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 5 days for NMOS and 10 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 high-reliability commercial and military-oriented users. In 1987, Orbit added specialized processing such as p-well radiation-hardened CMOS and CCD manufacturing. The 2-micron radiation-hardened CMOS offers a total dose of radiation of up to 1 megarad.

Orbit's North American customers include Amber Engineering, Cardiac Pacemakers, Crystal Semiconductor, Dallas Semiconductor, General Electric, General Motors, Honeywell, Hughes, Intermedics, ITT, Johns Hopkins University, Lotus Designs, Macronix, Martin Marietta, Motorola, RCA, Rockwell, Silicon General, and VLSI Design Associates. The Company's overseas customers include British Petroleum, Tadiron, and Thomson CSF.

Recent Highlights

March 1988 Orbit ordered $1.4 million of 1:1 model 1100 lithography systems from General Signal's Ultratech Stepper unit. The order marks the first purchase of steppers by Orbit. Installation will be completed by the end of March.

ALLIANCES: Not available

SERVICES

Foundry: HMOS, CMOS, Charge-Coupled Device Processing
Prototype Manufacturing
Volume Manufacturing
Assembly
Packaging

MANUFACTURING

Technology

1.5-micron silicon-gate, double-poly, double-metal CMOS
2.0- to 5.0-micron CMOS single- or double-poly, single- or double-metal
2.0- to 5.0-micron HMOS single- or double-poly, single- or double-metal
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: 75

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Donald A. Bond	Sanders	VP/GM Microwave
Sr VP Tech Dev	Allen Podell	A.F. Podell Assoc.	President
VP Bus Dev	Frank Russell	Avantek	Sales Mgr
VP Engr	Pang Ho	Geotech	President
Dir Sys & Plan	Wayne Moyers	RCA	Mgr Mktg Dev

FINANCING

Date	Round	Sources	Amount
Aug. 1985	Round 1	IAI, Sand Hill Financial Corp., Shaw Ventures, Vanguard Associates	$5.0M
Sept. 1986	Round 2	Institutional Investment Partners, Oak Investment Partners	$3.5M

BACKGROUND

Pacific Monolithics, Inc., designs and manufactures monolithic ICs (MMICs) based on GaAs, as well as microwave subsystems based on its GaAs MMICs. The Company offers more than 200 microwave macrocells (PM Cells) for semicustom IC design for consumer, communications, and defense applications. Company strengths include yield-tolerant design techniques, advanced packaging technology, a proprietary CAD/CAE system, and foundry services.

The Company participated as a team member on several contracts for the Department of Defense, including Phase 0 and Phase 1 of the Microwave/Millimeter-Wave IC (MIMIC) program. The contracts were in the areas of communication, radar, electronic warfare, and smart weapons for the army, navy, and air force.

Pacific Monolithics has developed a set of monolithic GaAs subsystem building blocks for microwave signal processing. The Company's ASIC cell library includes amplifiers, mixers, oscillators, couplers, combiners, switches, attenuators, phase shifters, modulators, and demodulators.

In April 1986, Pacific Monolithics introduced three MMIC devices that were offered in 5V, commercial grade, 8-lead, surface-mount packages. The devices were an 0.8- to 3-GHz converter, a 3- to 6-GHz converter, and a 5- to 6-GHz converter.

In March 1986, the Company relocated from a 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 several foundry services, including Triquint and COMSAT.

ALLIANCES: Not available

SERVICES

Design
Assembly

MANUFACTURING

Technology

GaAs

Facilities

Sunnyvale, CA	22,000 sq. ft.	
	6,000 sq. ft.	Class-100 clean room

PRODUCTS

Converters
Amplifiers
Oscillators
Attenuators
Active Isolators
Phase Shifters
Switches

Performance Semiconductor Corporation
610 East Weddell Drive
Sunnyvale, CA 94089
408/734-8200

ESTABLISHED: 1984
NO. OF EMPLOYEES: 175

BOARD

Name	Affiliation
Dr. Thomas A. Longo, chairman	Performance Semiconductor Corporation
Robert Zicarelli	Northwest Venture Partners
B. Kipling Hagopian	Brentwood Associates
William Bowes	U.S. Venture Partners
Dr. James Meindl	Stanford University

COMPANY EXECUTIVES

Position	Name	Prior Company
President	Dr. Thomas A. Longo	Schlumberger
VP Ops	David Maxwell	Fairchild
VP Mktg/Sales	Les Welborne	Fairchild
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 Mgmt.; Brentwood Assoc.; DSV Partners; IAI Venture Partners; NorthStar Ventures; Northwest Venture Capital Mgmt.; Rotan MOSel Technology Partners; Taylor & Turner; U.S. Venture Partners; Venwest Partners (Westinghouse Electric Corp.)	$11.3M
	Lease	Westinghouse Electric Corp.	$6.6M

Nov. 1986	Round 1	Advanced Technology Ventures; Albion Ventures; Asset Mgmt.; Brentwood Assoc.; DSV Partners; Harvard Mgmt.; IAI Venture Partners; NorthStar Ventures; Northwest Venture Capital; Reynolds Creek Ltd. Partnership; L.F. Rothschild; Taylor & Turner; Unterberg Towbin; U.S. Venture Partners; Venwest Partners	$10.0M

BACKGROUND

Performance Semiconductor Corporation designs, develops, manufactures, and markets high-speed SRAMs, MPUs, and logic devices for military, industrial, and telecommunications applications. The Company was founded by Dr. Thomas A. Longo, David Maxwell, and Gerald Herzog.

Performance Semiconductor is using an advanced single CMOS process known as performance advanced CMOS engineered (PACE) technology. PACE uses 0.8-micron and 0.7-micron effective channel lengths to give 500ps loaded internal gate delays. PACE also includes two-level metal and epitaxial substrates.

The Company's products include CMOS SRAMs at levels of complexity of 1K to 64K; a 40-MHz, 16-bit MPU that executes the 1750A instruction set; and two support functions, the processor interface circuit (PIC) and MMU combination. In 1987, Performance offered an 8ns 1K SRAM organized as 256x4 and a new series of TTL I/O 16K SRAMs featuring an address access time of between 12ns and 15ns. In 1987, the Company also signed an agreement with MIPS Computer Systems, allowing Performance to manufacture and market MIPS' 32-bit RISC MPU, floating-point coprocessor, and other peripherals.

In March 1985, Performance leased a 26,000-square-foot facility where it conducts research and development and all manufacturing. The Company has developed it into a Class-1 facility that uses 6-inch wafers. In 1987, Performance achieved military 883C compliance and shipped both 64K SRAMs and the 1750A processor compliant with the 883C.

In January 1988, Performance announced that it had signed a nationwide franchising agreement with Schweber Electronics, putting in place its North American distributor network. A nationwide franchise was previously signed with Zeus Components in July 1987.

Recent Highlights

Sept. 1987 Performance offered the VSI chip, which incorporates bus interface features for intelligent controller applications. The device provides 32-bit VMEbus address decoding as well as interrupt and mailbox facilities.

Nov. 1987	Performance presented information on its 40-MHz VHSIC-level PACE 1750A system at the GOMAC conference. The system is a CMOS three-chip set consisting of a CPU, a processor interface chip, and an MMU/combination support chip. The set is said to provide system performance greater than 2 mips.
Nov. 1987	Performance signed an agreement with MIPS Computer Systems, allowing Performance to manufacture and market MIPS' 32-bit RISC MPU, floating-point coprocessor, and other peripherals. Performance will also sell the MIPS software environment with the chips.

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 U.S. Air Force Wright Aeronautical Laboratories.
MIPS Computer Systems	Nov. 1987	Performance signed an agreement with MIPS Computer Systems, allowing Performance to manufacture and market MIPS' 32-bit RISC MPU, floating-point coprocessor, and other peripherals. Performance will also sell the MIPS software environment with the chips.

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

1.25-micron CMOS (0.7- and 0.8-micron effective channel lengths, 5- and 6-inch wafers)

Facilities

Sunnyvale, CA	26,000 sq. ft.	Manufacturing
	5,000 sq. ft.	Class-1 clean room

PRODUCTS

CMOS SRAMs

Device	Density	Organization	Speed (ns)	Features
P4C422	1K	256x4	8	
P4C147	4K	4Kx1	10	
P4C148	4K	1Kx4	10	
P4C149	4K	1Kx4	10	Fast CS
P4C150	4K	1Kx4	10	Separate I/O, Reset
P4C151	4K	1Kx4	10	Comparator
P4C116	16K	2Kx8	15	300-Mil Package
P4C168	16K	4Kx4	12	
P4C169	16K	4Kx4	12	Fast CS
P4C170	16K	4Kx4	12	Output Enable
P4C1682/1681	16K	4Kx4	15	Separate I/O
P4C164	64K	8Kx8	20	300-Mil Package
P4C187	64K	64Kx1	12	
P4C188	64K	16Kx4	20	
P4C198	64K	16Kx4	20	Output Enable
P4C1982/1981	64K	16Kx4	20	Separate I/O
P4C163	72K	8Kx9	20	300-Mil Package

Pace Logic CMOS Family

74PCT273/374 250-MHz Toggle Rates
74PCT373/533 Gated Latches
74PCT241/244 Bus Drivers
74PCT245/545/640/643/645 Transceivers

Microcomponents

PACE 1750A Family	16-Bit MPUs	20-, 30-, and 40-MHz; Includes 32-Bit and 48-Bit Floating-Point Arithmetic Processing

Photonic Integration Research, Inc.
1357 Perry Street
Columbus, OH 43201
614/424-3313
Fax: 614/424-3320

ESTABLISHED: July 1987
NO. OF EMPLOYEES: 10

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President	Dr. Tadashi Miyashita	NTT
General Manager	Shigeki Sakaguchi	NTT
Chief Supervisor	Shin Sumida	NTT

FINANCING

Date	Round	Sources	Amount
July 1987	Round 1	Batelle Research Institute, Mitsubishi Electric Corporation, Nippon Telephone & Telegraph	$10.0M

BACKGROUND

Photonic Integration Research, Inc. (PIRI), was formed to develop basic optical IC technology for commercial applications. The Company is the result of a joint venture between Nippon Telegraph and Telecommunications (NTT), Mitsubishi Electric Corporation of Japan, and the Batelle Memorial Institute. NTT owns 49 percent of the Company; Mitsubishi owns 41 percent and Batelle owns 10 percent.

PIRI president, Dr. Tadashi Miyashita, was formerly head of the Optoelectronic Materials Section of the Electronics Materials Department at NTT's Ibaraki Electrical Communications Laboratories. Shigeki Sakaguchi and Shin Sumida were also previously at NTT's Ibaraki Telecommunications Laboratories where the optical IC technology was invented.

In addition to developing commercial applications for optical waveguide technology, PIRI will also develop applied components that will be made available to equipment manufacturers for use in such end products as optical communications equipment, optical measuring equipment, automobiles, and airplanes. The Company expects advancement in the technology to lead to greater miniaturization and increased utilization of fiber optics.

PIRI is located in the Batelle Memorial Institute's Columbus, Ohio, facilities.

PLX Technology Corporation
520 Weddell Drive, Suite 3
Sunnyvale, CA 94089
408/747-1711

ESTABLISHED: May 1986
NO. OF EMPLOYEES: N/A

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Michael Salameh	Hewlett-Packard	Mktg Manager
VP R&D	Wei-Ti Liu	AMD	R&D
VP Prod Plan	D. James Guzy, Jr.	AMD	R&D

FINANCING: Not available

BACKGROUND

PLX Technology Corporation was formed to offer CMOS programmable interface devices for MPU-based systems. The Company's first product, introduced in May 1987, was the PLX 448--an erasable programmable logic device (EPLD). The device has electrical and architectural features that are geared specifically for bus interface applications. The PLX 448 includes four 48mA drivers and four 24mA drivers that can drive VMEbus, Nubus, Micro Channel bus, proprietary buses, and memory buses directly. PLX is the only supplier that offers the high-drive capability. The device is fabricated using a 1.5-micron CMOS EPROM process and offers a propagation delay from input to high-drive-current output as low as 25ns.

ALLIANCES: None

SERVICES

Design
Test

MANUFACTURING

Technology

1.5-micron CMOS

PRODUCTS

Device	Description
PLX 448	PLD with 24mA and 48mA High-Drive Current
VSB 1200	Master Module Interface Device with Single-Level Arbiter, Bus Requester, Bus Controller
VME 1200	VMEbus Master Controller with Single-Level System Arbiter, Bus Requester, Driver
VME 2000	VMEbus Slave Module Interface Device
MCA 1200	Micro Channel Bus Controller and Local Arbiter
VSB 2000	VSB Slave Module Interface Device

Powerex, Inc.
Hillis Street
Youngwood, PA 15697
412/925-7272
Fax: 412/925-4393

ESTABLISHED: January 1986
NO. OF EMPLOYEES: 675

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President/CEO	Ronald Whigham	Westinghouse Electric Corporation
COO	Stanley R. Hunt	Westinghouse Electric Corporation
Vice President	James R. Myler	Westinghouse Electric Corporation

FINANCING: Powerex received initial funding from Westinghouse Electric Corporation (45 percent), General Electric Company (45 percent), and Mitsubishi Electric America (10 percent) for an undisclosed amount.

BACKGROUND

Powerex, Inc., manufactures and markets thyristors and rectifiers rated greater than 50 amperes. The Company also offers power transistors, Darlington, FETMOD, and MOSBIP modules. Powerex is a service-oriented company, providing just-in-time delivery, and has developed business partnership arrangements with many key customers. The Company has more than 100 accounts, including electric companies, railroads, and government agencies.

Powerex is the result of a joint venture among Westinghouse Electric, General Electric, and the U.S. subsidiary of Mitsubishi Electric Corporation. The purpose of the joint venture was to form a company that would be a leading supplier of power semiconductors in the United States. To create the new entity, Westinghouse combined its semiconductor division with General Electric's high-power rectifier and thyristor business. Mitsubishi contributed working capital and technology for a 10 percent ownership.

The Company is developing high-power semiconductor devices and plans to supply intelligent-power hybrid circuits that combine a power element (e.g., power transistor) with a logic/control element.

The Company has wafer fab operations in Youngwood, Pennsylvania; Auburn, New York; and Massey, France. Assembly plants are located in Puerto Rico, France, and Singapore.

Recent Highlights

Jan. 1986	Powerex received licenses and technological know-how for Darlington transistor modules, and GTOs from Mitsubishi; it received all thyristor and rectifier technology from Westinghouse, General Electric, and Mitsubishi.
Aug. 1986	Powerex assumed exclusive sales responsibilities for Mitsubishi Darlington transistor modules in North America.
Aug. 1986	Powerex reached an agreement with Mitsubishi to build a world-class automated assembly facility in France for isolated modules.
Sept. 1987	Powerex purchased GE/RCA's low-power thyristor product line. The Company also signed a technology-licensing agreement with GE/RCA for MOSFET, IGBT, and MCT products and received exclusive sales rights for all MCTs rated greater than 100 amperes.
Dec. 1987	Powerex started up a new wafer fab in Youngwood. The new fab is capable of producing complex geometry devices. Powerex also produced its first isolated modules for quality conformance testing in France.

SERVICES

Manufacturing
Assembly

MANUFACTURING

Technology:

Not available

Facilities:

Youngwood, PA 225,000 sq. ft.

PRODUCTS

Standard Rectifiers
Fast Recovery Rectifiers
Phase-Control Thyristors
Thyristors for Pulse Applications
Inverter-Grade SCRs
Reverse Conducting Thyristors
Gate Turn-Off (GTO) Thyristors
Triacs
Thyristor and Diode Modules
Power Transistor Modules
Darlington Modules
FETMOD Isolated MOSFET Modules
MOSBIP Hybrid Isolated Modules

PromTech
1885 Lundy Avenue, Suite 202
San Jose, CA 95131
408/434-9550
Fax: 408/434-9832

ESTABLISHED: 1984
NO. OF EMPLOYEES: 7

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Dr. Paul Ouyang	Universal Semi	Exec VP

FINANCING

Date	Round	Sources	Amount
1984	Seed	Private	$0.5M

BACKGROUND

PromTech was formed to combine the high-speed EPROM expertise of the founding members with custom and semicustom design. The Company has been working on contracts to design custom memory devices. PromTech is also developing a 1Mb and 4Mb EPROM in the 70ns access range and plans to announce the products late in 1988.

ALLIANCES

1984 PromTech licensed technology to an unnamed Japanese company.

1987 PromTech licensed its EPROM technology to Yamaha Corp. Yamaha will develop a new ASIC standard chip that combines the EPROM technology with its own voice- and image-processing capabilities.

SERVICES

Design

MANUFACTURING

Technology

1.2-, 1.5-, and 2.0-micron single-metal, double-poly CMOS

Facilities

San Jose, CA	2,000 sq. ft.	Administration, design, R&D

PRODUCTS: To be announced

Quasel Taiwan Company, Limited
15 Industrial E. Road II
Science-Based Industrial Park
Hsinchu, Taiwan
035/773-381
Fax: 035/775-909

ESTABLISHED: 1984
NO. OF EMPLOYEES: 35

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President	Chien-Chih Chen

FINANCING

Date	Round	Sources	Amount
Sept. 1984	Round 1	Taiwanese banks, U.S. pension funds, venture capital	$ 4.0M
Oct. 1984	Round 2	Bank of Communications; Development Fund of the Executive Yuan; and others	$16.0M
	Lease		$18.5M

BACKGROUND

Quasel, Inc., was founded to be a commodity supplier of high-performance RAMs (HRAMs) hybrids combining DRAMs and SRAMs. Quasel formed a manufacturing subsidiary in Taiwan, Quasel Taiwan Company, Limited, to take advantage of the lower cost, highly skilled engineering talent available there, thus establishing a highly competitive manufacturing facility.

Quasel Taiwan was capitalized for $16 million. In-house wafer fabrication began in January 1986. The Company uses United Microelectronic Corporation's ion-implantation and sputtering facilities to complement its own Class-10 clean room. Operations take place in a 279-square-meter plant in the Hsinchu Science-Based Industrial Park.

Products include a 64Kx1 series of NMOS DRAMs, 256K HCMOS devices with a 64Kx4 structure, and 256K CMOS SRAMs with the same structure.

ALLIANCES

Taiwanese Investors	Oct. 1984	Quasel established a joint manufacturing subsidiary with Taiwanese investors at a capitalized $16 million, $8 million of which was derived from Taiwanese investors.
ERSO	May 1985	Technology license

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

NMOS
CMOS and HCMOS

Facilities: Not available

PRODUCTS

64Kx1 Series of NMOS DRAMs
64Kx4 HCMOS DRAMs
64Kx4 CMOS SRAMs

Ramax Limited
55 Macquarie Street, 6th Floor
G.P.O. Box 3908
Sydney NSW 2000
Australia

ESTABLISHED: 1987
NO. OF EMPLOYEES: N/A

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Executive Director	Peter J. Solomon
Mgr of Product and Tech Development	Dr. Bruce Godfrey

FINANCING

Date	Round	Sources	Amount
June 1987	Round 1	State of Victoria, Australia	$850,000

BACKGROUND

Ramax Limited was formed to offer high-speed, nonvolatile memory technology using a ferroelectric process. The Company licensed the technology from Ramtron, an Australian R&D company located in Colorado Springs, Colorado.

Ramax is an Australia-based company that was formed through a $45 million joint venture among Australia's state of Victoria and other investors. A development company owned by the state of Victoria is providing $850,000 for which the the state will receive between 7 and 13 percent equity in the Company, with the balance in first-round equity coming from both U.S. and Australian investors.

Peter J. Solomon is executive director of Ramax and Dr. Bruce Godfrey is manager of product and technological development. Dr. Godfrey was an adjunct assistant professor at the University of Colorado and is one of the researchers involved in developing the Ramtron technology.

In June 1987, Ramax licensed high-speed nonvolatile memory technology using a ferroelectric semiconductor process and a companion technology that uses a thin-film process from Ramtron. Ramax acquired a 12 percent stake in Ramtron for $9 million and paid $6 million in licensing fees.

Initially, the Company is producing prototype silicon-based circuits, using Ramtron's technology. Future plans include the manufacture of GaAs circuits, using the ferroelectric thin-film technology under the terms of a license giving it exclusive worldwide rights to use the Ramtron technology on GaAs.

The ferroelectric random access memory (FRAM) devices are expected to have the cell dimensions of a DRAM and the nonvolatility of an EPROM. The process uses ferroelectric potassium nitrite that requires only five additional masks and is adaptable to conventional semiconductor production line equipment.

ALLIANCES

Ramtron	June 1987	Ramax licensed high-speed nonvolatile memory technology using a ferroelectric semiconductor process and a companion technology that uses a thin-film process from Ramtron. Ramtron, located in Colorado Springs, Colorado, developed the ferroelectric technology. Ramax acquired a 12 percent stake in Ramtron for $9 million and paid $6 million in licensing fees.

SERVICES

Development
Manufacturing

MANUFACTURING

Facilities: Not available

PRODUCTS: To be announced

Ramtron Corporation
1873 Austin Bluffs Parkway
Colorado Springs, CO 80918
719/594-4455

ESTABLISHED: May 1984
NO. OF EMPLOYEES: 30

BOARD

Name	Affiliation
Ross M. Lyndon-James, cochairman	Ramtron Corporation, president/CEO
Glen R. Madland	Integrated Circuit Engineering, chairman
Brian L. Harcourt	Newtech Group, executive director
Dr. Steward S. Flaschen	Consultant
Charles W. Missler	Resdel Industries, Inc., chairman

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Ross M. Lyndon-James		
Exec VP/COO	Dr. Fred Gnadinger	Inmos	Founder
VP Mktg/Sales	Karl Stjernquist	Honeywell	Dir/GM Dig Prod
VP Finance/Admin	William Skolout	Inmos	Controller

FINANCING

Date	Round	Source	Amount
May 1984	Round 1	Amtec Securities Corporation	$5M

BACKGROUND

Ramtron Corporation was formed to research, develop, and market a new generation of nonvolatile semiconductor products that integrate ferroelectric and semiconductor materials, using established silicon manufacturing techniques. By applying novel ferroelectric circuit designs, materials, and processing techniques, Ramtron has produced the first practical ferroelectric random access memory (FRAM).

Ramtron is a subsidiary of Newtech Development Corporation of Australia. Initial funding was principally from Amtek Securities Corporation. In 1987, Ramtron was reincorporated in Delaware.

Ramtron is organized into the following departments:

- Advanced FRAM department--Develops high-density 2 to 4Mb FRAMs for computer memory boards that replace floppy disks

- Smart sensors department--Develops devices that incorporate the FRAM technology into a programmable universal transducer interface (UTI) chip

- Military electronics department--Specializes in military-specified electronics for computers in space, telecommunications, radiation-hardened memory systems, and other military applications

- Smart devices department--Applies FRAMs to products such as smartcards, smart tags, security devices, smart watches, toys, and other consumer applications

The Company licensed potassium nitrite technology from George Rohrer whose company, Technovation Corporation, owns a minority interest in Ramtron. In 1976, Mr. Rohrer patented a method for placing the ferro-electric thin-films into standard ICs. Newtech Development Corporation of Australia negotiated an agreement with Mr. Rohrer for the patent and formed Ramtron to conduct R&D programs at the University of Colorado in a new $5 million research lab.

In the third quarter of 1986, feasibility of the integration of ferro-electric thin-films into standard silicon-based microelectronics-processing techniques was demonstrated. Ramtron then began the commercial phase of its ferroelectric operations.

Ramtron uses a thin film of a ceramic PZT (lead zirconate titanate) compound between two metal electrodes to form a digital memory capacitor. Nonvolatile operation results from the film's two stable polarization states, and the PZT film remains ferroelectric from below -80° to above 350° centigrade. Ramtron believes that the ferroelectric process can be used with silicon-based CMOS/bipolar and GaAs technologies.

Initial markets for the FRAMs include industrial, military, and aerospace applications in which nonvolatility is essential. These are markets that have traditionally used EEPROMs, ROMs, and memories with battery backup. The Company is developing several applications for its FRAMs, including smart sensors, smartcards, smart tags, smart watches, and smart toys. It plans to license partners to produce and distribute these products.

The Company is demonstrating its first product, the FMx 801, a 1K CMOS nonvolatile SRAM organized as 256Kx1 and featuring a read-write cycle time of 100ns. Future products planned are a 2Kx8 and an 8Kx8 SRAM-based FRAM and a one-transistor FRAM cell that provides density equal to or greater than current DRAMs.

Ramtron has established contract development programs with General Motors, the National Science Foundation, the Naval Surface Weapons Center, and Ramax Limited of Australia. In 1985, Ramtron and General Motors entered into a development and evaluation agreement and license option arrangement. General Motors paid a fee of $1.9 million to Ramtron. The contract was to demonstrate the feasibility of ferroelectric technology in special environments such as space and automotive applications. In June 1986, Ramax, an Australian start-up, licensed the silicon and GaAs rights of Ramtron's technology for $6 million and made an equity investment of $9 million for 12 percent of the Company.

ALLIANCES

General Motors	1985	Ramtron entered into a product development contract with General Motors to demonstrate ferroelectric feasibility in special environments such as space and automotive applications. The contract includes options for manufacturing licenses.
Ramax	June 1987	Ramax licensed Ramtron's FRAM technology and a companion technology. Ramax also acquired a 12 percent stake in Ramtron for $9 million and paid $6 million in licensing fees.

SERVICES

R&D
Design

MANUFACTURING

Technology

3.0-micron CMOS
1.5-micron CMOS is planned

Facilities: Not available

NCR is providing foundry services for Ramtron. Ramtron plans to build an R&D and manufacturing facility that will be ready in the fourth quarter of 1988.

PRODUCTS

FMx 801	256x1 FRAM	Available
FM 1408	2Kx8 FRAM	Future Product
FM 1608	8Kx8 FRAM	Future Product

Samsung Semiconductor, Inc.
3725 North First Street
San Jose, CA 95134
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
1983	Lease	SST	$7.0M

BACKGROUND

Samsung Semiconductor, Inc., (formerly Tristar Semiconductor) designs, manufactures, and markets a broad range of products including NMOS and CMOS memories, logic devices, microprocessors and peripherals, and power MOSFETs. The Company began its operations as a DRAM supplier and, through strategic alliances, has licensed designs to expand its product portfolio quickly.

Building on its base of CMOS DRAM technology with the addition of a new 80,000-square-foot R&D facility in San Jose, California, Samsung is amassing a portfolio of proprietary products. In 1988, the Company plans to introduce 1Mb DRAMs; 64K and 256K SRAMs with 70ns, 80ns, and 100ns access times; fast CMOS logic; and PLDs with initial speeds of 25ns and 35ns, followed by a 15ns model. Later in the year, Samsung plans to introduce 64K EEPROMs and fast SRAMs with access times down to 20ns and densities of up to 256K, microperipherals running at 10 MHz, a DRAM controller, and AC/ACT CMOS standard logic. These products were developed at two Korean R&D facilities, as well as in Samsung's new San Jose R&D center. In addition, the Company will be producing the PLD and DRAM controllers in the San Jose facility.

Samsung is a wholly owned subsidiary of Samsung Semiconductor and Telecommunications, Ltd. (SST), of the Samsung Group, a Korean conglomerate. SST's investment in Samsung totals $550 million.

Recent Highlights

Feb. 1987	Samsung formally opened its $36 million national headquarters in San Jose. The facility, which Samsung purchased for $5 million, houses administration, R&D operations, and a research fab. Included in the 80,000-square-foot facility is a 12,000-square-foot Class-1 fab with 6-inch wafer processing equipment. Currently, 50 percent of the Company's 10,000 wafer-start-per-month capacity is devoted to R&D. The Company employs 250 people at the site and plans to increase the employment to 400 within a year.
June 1987	Samsung Semiconductor, Goldstar Semiconductor Inc., and Hyundai Electrical Engineering Co. announced that they are preparing to launch full-scale production of a 1Mb DRAM chip jointly developed by the three South Korean firms last year.
June 1987	Samsung Semiconductor agreed to supply Intel with 64K, 256K, and 1Mb DRAMs, which Intel will sell to its customers in the United States. Shipments from Korea will begin in July.

ALLIANCES

SST	1983	Samsung Semiconductor is set up as a U.S. subsidiary.
Exel	1983	Exel granted Samsung a license to second-source its 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 in exchange for cash. The agreement was later extended to include Micron's 256K DRAM.

Micron Technology	July 1986	Samsung acquired a 2.7 percent interest in Micron for $5 million as part of an out-of-court settlement of a suit brought against Samsung. Micron claimed that Samsung failed to pay for materials and provide certain technology according to a 64K DRAM exchange pact. Micron obtained rights to the Samsung SRAM and EEPROM technologies for a 1 percent royalty, if sales exceeded 1 million units. The prior agreement was terminated.
Intel	Jan. 1985	Intel granted Samsung a license to second-source certain microcomponents.
	June 1987	Samsung agreed to supply Intel with 64K and 256K DRAMs, which Intel will sell to its customers in the United States. Shipments from Korea began in July.
Zytrex	June 1985	Zytrex and Samsung signed a three-year technology/fab agreement. Samsung second-sourced Zytrex's LSI logic devices; Zytrex provided its proprietary ICE-MOS process. Zytrex is no longer in business.
Mostek	1986	Mostek and Samsung signed an agreement covering Mostek's 256K DRAM technology.
IXYS	Jan. 1986	IXYS and Samsung signed an agreement allowing Samsung to receive IXYS' power MOS technology in exchange for low- and medium-range power devices; IXYS will manufacture its high-current power MOS devices in Samsung's facility overseas.
Goldstar/ Hyundai	1986	Goldstar, Samsung, and Hyundai agreed to cooperate on a 1Mb DRAM.

SERVICES

Design
Prototyping
Manufacturing

MANUFACTURING

Technology

1.0- and 1.5-micron CMOS, NMOS, bipolar
4.-, 5-, and 6-inch wafers

Facilities

San Jose, CA	80,000 sq. ft.	Administration, R&D, manufacturing
	12,000 sq. ft.	Class-1 clean room

The facility has a capacity of 10,000 wafer starts per month

PRODUCTS

Linear	Device	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 Voltage Regulator
	LM723	Adjustable Precision
	MC78	Positive Voltage Regulator
	MC79	Negative Voltage Regulator
Comparators	LM311	Single Comparator
	LM339	Quad Comparator
	LM393	Dual Comparator
Data Converters	KS25C02/25C03	8-Bit Successive Aprox Register
	KS25C04	12-Bit Successive Aprox Register
	KSV3100	8-Bit and 10-Bit Flash Converter
Interface	MC1488/1489	Quad Line RS232 Receiver
Other	KA2181/2182/2183	Remote Control Preamp
	KA2580/2588	8CH Source Driver
	KA2803	Ground Default Detector
	KA2804	Zero-Voltage Switch

Telecommunications	LM567	Tone Decoder
	KA2410/2411	Tone Ringer
	KA2412	Subset Amplifier
	KA2413/5808	DTMF
	MC3361	FM IF Amplifier
	KS5804/5805	Pulse Dialer
Transistors	Power MOSFET	
	General-Purpose Transistors	
	Low-Noise Amplifier Transistors	
	High-Voltage Transistors	
	Darlington Transistors	
Logic	KS54/74AHCT Family of Advanced High-Speed CMOS	
	KS54/74HCTLS Family of High-Speed CMOS	
Memory	64K, 128K, and 256K DRAMs	
	16K and 64K SRAMs	
	16K and 64K EEPROMs	

Saratoga Semiconductor Corporation
10500 Ridgeview Court
Cupertino, CA 95014
408/864-0500
Fax: 408/446-4416

ESTABLISHED: September 1985
NO. OF EMPLOYEES: 105

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 Engineering	Walford Ho	Amdahl	Mgr Design Engr
VP Marketing	Scott Harmon	Fairchild	Dir Marketing
VP Sales	Phil Lulewicz	Storage Technology	VP Sales
VP Military Prod	F.L. Rosebrooks	EE Technology	Pres/CEO
Dir Technology	Dr. Wen Ko	IBM	Sr Technician

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; MBW Venture Partners; Merril, Pickard, Anderson & Eyre; Southwest Partners	$ 8.3M
March 1987	Round 3	Previous investors, Bank of America, John Hancock Venture Capital, HLM Management; New York Life Insurance, Security Pacific Capital, T. Rowe Price Associates	$11.5M $ 7.6M

BACKGROUND

Saratoga Semiconductor Corporation designs, manufactures, and markets high-performance specialty memories based on a BICMOS process and design technology. Products include TTL SRAMs, FIFOs, and cache tag RAMs and are designed for applications in the computer, workstation, telecommunications, data communications, instrumentation, and military markets.

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 remain to complete the development of the ICs needed for the new Amdahl 5890 computer. As a result, the engineers were given generous incentives to finish the project, which was successfully completed during that year. Simultaneously, Mr. Wang and his teammates designed, developed, and produced their first BICMOS ECL chip. On August 30, 1985, the founders terminated their employment with Amdahl and formed Saratoga Semiconductor.

In September 1985, Saratoga acquired a Class-10 wafer fab facility in Cupertino, California, from Trilogy. Within a year, the founders completed development of the proprietary wafer fabrication technology that they call Self-Aligned Bipolar CMOS (SABIC II) that combines bipolar and CMOS processes on the same circuit. Today, the Company is using an enhanced second-generation BICMOS process technology to drive all new products. Fabrication and wafer test are done at the Cupertino facility. Assembly and test are performed overseas.

Recent Highlights

Feb. 1987	Saratoga offered the SSM6167, a 16Kx1, and the SSM6116, a 2Kx8 BICMOS SRAM available with an access time of 20, 25, and 35ns.
March 1987	Saratoga raised $17 million in third-round financing. The funds will be used for working capital and company expansion, as the firm seeks to reach a positive cash flow.
March 1987	Saratoga offered four new 16K TTL BICMOS SRAMs organized as 4Kx4 and with address access times of 20ns, 25ns, and 35ns.
July 1987	Saratoga offered four new BICMOS FIFOs organized as 64Kx4, with a data setup time of 2ns, data hold time of 1ns, and data throughput time of 15ns.
July 1987	Saratoga offered five 64K TTL BICMOS SRAMs organized as 16Kx4 and with access times of 25ns and 35ns.

Nov. 1987 Saratoga offered four 16K SRAM devices, each with a 15ns access time.

Nov. 1987 Saratoga signed Wyle Laboratories Marketing Group to market its line of BICMOS SRAMs, tag cache memories, and FIFO memories.

Dec. 1987 Saratoga offered 8ns and 10ns versions of its 4K ECL BICMOS SRAM.

Dec. 1987 Saratoga offered a new family of BICMOS cache tag RAMs that feature address access times of 15ns, 25ns, and 35ns.

March 1988 Saratoga introduced four new FIFOs. The SSL7409S and SSL7409C are organized as 64x9 and handle an operating frequency of 50 MHz and a clock frequency of 40 MHz. The 7413S/C devices are organized as 64x5 with speeds of up to 50 MHz.

March 1988 Saratoga appointed Scott Harmon vice president of marketing. Mr. Harmon joins Saratoga from Fairchild where he was director of marketing for the advanced processor (Clipper) division.

March 1988 Dr. Wen Ko, formerly an officer of tactical fabs, joined Saratoga as director of technology. Dr. Ko has been with IBM, Fairchild, and AMD in senior technical positions.

April 1988 Saratoga announced four 64K TTL BICMOS self-timed registered SRAMs that feature a 20ns cycle time and a clock-to-output time of 8ns.

ALLIANCES: None

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

2.0-, 1.5-micron BICMOS
4-inch wafers

Facilities

Cupertino, CA	30,000 sq. ft.	Office, manufacturing
	12,000 sq. ft.	Class-10 clean room

PRODUCTS

TTL SRAMs

Device	Description	Speed (ns)
SSM2148	1Kx4, Common I/O, Power Down	20-35
SSM2149	1Kx4, Common I/O	20-35
SSM2150	1Kx4, Separate I/O	20-35
SSM6167	16Kx1	20-35
SSM6168	4Kx4, Common I/O	20-35
SSM6170	4Kx4, Common I/O, Output Enable	20-35
SSM6171	4Kx4, Separate I/O, Transparent Write	20-35
SSM6172	4Kx4, Separate I/O	20-35
SSM6116	2Kx8, Common I/O	20-35
SSM7188	16Kx4, Common I/O	20-55
SSM7166	16Kx4, Common I/O, Output Enable	20-55
SSM7198	16Kx4, Output Enable, Two Chip Selects	20-55
SSM7161	16Kx4, Separate I/O, Transparent Write	20-55
SSM7162	16Kx4, Separate I/O	20-55
SSM7192	16Kx4, Latched Output	20-45
SSM7193	16Kx4, Registered Output	20-45
SSM7194	16Kx4, Registered, Output Enable	20-45
SSM7195	16Kx4, Latched, Output Enable	20-45
SSM7164	8Kx8, Common I/O	25-55

ECL SRAMs

SSM10/10470	4Kx1, 10K/100K ECL	10, 15
SSM10/100474	1Kx4, 10K/100K ECL	8, 10, 15
SSM10/100480	16Kx1, 10K/100K ECL	10, 15
SSM10/100484	4Kx4, 10K/100K ECL	10, 15
SSM10/100490	64Kx1, 10K/100K ECL	10, 15, 20
SSM10/100494	16Kx1, 10K/100K ECL	10, 15, 20

FIFOs

SSL7401	64x4	10-50 MHz
SSL7403	64x4, with Output Enable	10-50 MHz
SSL7402	64x5	10-50 MHz
SSL7404	64x5, with Output Enable	10-50 MHz
SSL7413	64x5, with Flags	10-50 MHz
SSL7409	64x9	10-50 MHz
SSL7201	512x9	15-50 MHz
SSL7202	1Kx9	15-50 MHz
SSL7203	2Kx9	20-50 MHz

Cache Tag RAMs

SSL4180	4Kx4, Totem Pole Output	15, 20, 25
SSL4181	4Kx4, Open Drain Output	15, 20, 25
SSL2152	2Kx9, Totem Pole Output	20, 25
SSL2154	2Kx9, Open Drain Output	20, 25

SEEQ Technology, Inc.
1849 Fortune Drive
San Jose, CA 95131
408/432-9550

ESTABLISHED: January 1981
NO. OF EMPLOYEES: 475

BOARD

Name	Affiliation
E. Floyd Kvamme, chairman	Kleiner, Perkins, Caufield & Byers
John W. Larson	Brobeck, Phleger & Harrison

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	J. Daniel McCranie	Harris	Grp VP Sales
VP Finance/CFO	Patrick Brennan	NSC	VP/Treasurer
VP COO	John Ekiss	Zoran	President
VP Engineering	Dr. Philip J. Salsbury	Intel	Div Dir EEPROMs
VP QA & Rel	Tom Endicott	Signetics	Mgr Rel & QA
VP Sales & Mktg	Brian Currie	Micro Linear	VP WW Sales
VP Intl Sales	Philip Ortiz	CDI	Dir Mktg/Sales
VP/GM Flash Div	Mike Villot	Motorola	Dir Mktg MPUs

FINANCING

Date	Round	Sources	Amount
March 1981	Initial	Kleiner, Perkins, Caufield & Byers; Hillman Ventures	$15.0M
Sept. 1983		Initial public offering	$20.0M
March 1985		Private placement	$14.0M
Oct. 1986	Private placement	Bridge Capital; GE Venture Capital; Hillman Ventures; John Hancock; Kleiner, Perkins, Caufield & Byers	$ 6.0M

BACKGROUND

SEEQ Technology, Inc., designs, manufactures, and markets nonvolatile semiconductor memory devices used in defense electronics, industrial, and data processing applications. SEEQ specializes in EEPROM processes for applications that require both nonvolatility and in-circuit programmability.

SEEQ products are grouped strategically into three classifications: EEPROM products that support nonvolatile memory needs, EEPROM microprocessors, and telecommunication circuits. SEEQ's EEPROMs range in density from 4K to 256K and offer benefits such as page-mode writes, 1M cycle endurance, silicon signature, and DiTrace as standard features. The Company's flash EEPROMs combine in-circuit programmability and the density of UV EPROMs. The Company's 8-bit, single-chip MCUs feature on-board EEPROMs for applications that allow on-chip reprogramming of code and data. SEEQ also offers enhanced Ethernet data link controllers and CMOS Manchester coder/decoder circuits.

SEEQ Technology was founded by Gordon Campbell, Dr. 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.

Four domestic and two international sales offices manage a network of sales representatives in the United States, Canada, Europe, and Japan. Three national and three regional distributors serve the United States and Canada.

Recent Highlights

Nov. 1986	General Instrument filed a countersuit against SEEQ, charging violation of a product and two process patents.
Nov. 1986	Monolithic Memories Inc. (MMI) purchased a 16 percent equity in SEEQ for $4 million. The two firms also agreed to a four-year joint product and technology program to codevelop CMOS EEPROM-based PLDs. MMI's equity investment will fund the program. MMI does not intend to increase the interest or seek a seat on the SEEQ board.
Dec. 1986	SEEQ was certified to supply its products under MIL-STD-883, Rev C, Class B specifications. SEEQ's 28C256 256K EEPROM is developed according to Class B specifications.
Dec. 1986	SEEQ and Motorola signed an engineering development agreement to develop a high-performance EEPROM microcomputer.
Feb. 1987	SEEQ reincorporated in Delaware.
Feb. 1987	SEEQ introduced the 28C64 CMOS EEPROM configured as 8Kx8. It is said to use one-third the power of most industry-standard 64K EEPROMs.

March 1987	SEEQ offered the 2804A, a CMOS 4K EEPROM with an on-chip timer. It is organized as 512x8 bits and has a 250ns access time and a 10ms write time. It allows an automatic erase and write time-out.
Aug. 1987	John Ekiss joined SEEQ as vice president of operations and chief operating officer. Mr. Ekiss was formerly president of Zoran Corporation.
Oct. 1987	SEEQ and National Semiconductor signed a four-year agreement to develop and market a new family of CMOS flash EEPROMs. The companies will share technology and marketing rights to SEEQ's 512K and 1Mb EEPROM and National's 256K flash EEPROM. Both will manufacture the products.
Oct. 1987	SEEQ signed a $1.4 million contract to supply 256K EEPROMs to Hamilton Standard, a division of United Technologies Corporation (UTC). The CMOS EEPROMs, configured as 32Kx8, will be used in military flight tape recorders.

ALLIANCES

Amkor	1981	SEEQ signed Amkor to assemble its IC products.
Rockwell	July 1982	SEEQ signed an exclusive licensing agreement to provide its 16K EEPROM and 16K UV EPROM technology to Rockwell. In exchange, Rockwell paid SEEQ $5.0 million, leased $5.5 million of SEEQ's equipment, and agreed to pay a 3 percent royalty on sales of these products.
TI	Aug. 1982	SEEQ licensed its EEPROM technology to Texas Instruments in exchange for its TMS7000 8-bit MCU.
Silicon Compilers	1983	SEEQ announced that it would manufacture the Silicon Compiler, Inc. (SCI) 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.

MMI	Nov. 1986	MMI acquired 16 percent of SEEQ for $4 million. The firms have also agreed to a four-year joint development program for CMOS EEPROM-based PLDs.
Motorola	Dec. 1986	SEEQ and Motorola signed an engineering development agreement to develop a high-performance EEPROM microcomputer.
National	Oct. 1987	SEEQ and National Semiconductor signed a four-year agreement to develop and market a new family of CMOS flash EEPROMs. The companies also share technology and marketing rights to SEEQ's 512K and 1Mb EEPROM and National's 256K flash EEPROM. Both will manufacture the products.
Hamilton-Standard	Oct. 1987	SEEQ signed a $1.4 million contract to supply CMOS 256K EEPROMs to Hamilton-Standard, a division of UTC. The EEPROMs, configured as 32Kx8, will be used in military flight tape recorders.

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

2.0-micron, double-poly, floating-gate CMOS
1.25-micron, double-poly, floating-gate CMOS
4-inch wafers

Facilities

San Jose, CA	120,000 sq. ft.	Administration, design, manufacturing

PRODUCTS

EEPROMs

Device	Description	Speed (ns)
52B13	2Kx8 Latched	200-350
52B33	8Kx8 Latched, 10K Cycles/Byte	200-350
2804	512x8 Latched, Timed, 10K Cycles/Byte	250-350
2816	2Kx8 Latched, Timed, 10K Cycles/Byte	200-350
5516	2Kx8 Latched, Timed, 1M Cycles/Byte	200-350
2817	2Kx8 Latched, Timed, Ready/Busy, 10K Cycles/Byte	200-350
5517	2Kx8 Latched, Timed, Ready/Busy, 1M Cycle/Byte	200-350
2864	8Kx8 Latched, Timed, Ready/Busy	250-350
28C64	64K CMOS Page Mode	250-350
28C65	64K CMOS Page Mode, Ready/Busy	250-350
28C256	256K CMOS Page Mode	250-350
38C16	2Kx8 High-Speed CMOS	35-70
38C32	4Kx8 High-Speed CMOS	35-70
48128	16Kx8 Flash	170-300
48C512	64Kx8 CMOS Flash	200
48C1024	128Kx8 CMOS Flash	200

EPROMs

2764	8Kx8	160-450
27128	16Kx8	200-450
27C256	32Kx8	200-450

Other Products

72720	Self-Adaptive, Single-Chip MPU with 16K EEPROM	10/16 MHz
8003	Ethernet Data Link Controller	
8020/8023	10-MHz Manchester Encoder/Decoder	
8005	Advanced Ethernet Data Link Controller	

Sensym, Inc.
1255 Reamwood Avenue
Sunnyvale, CA 94089
408/744-1500
Telex: 176376

ESTABLISHED: October 1982
NO. OF EMPLOYEES: 120

BOARD

Name	Affiliation
Dennis Dauenhauer	Sensym, Inc.
Roger J. Barry	Crosspoint Venture Partners, partner
Robert L. Cummings	Robertson, Colman & Stephens, partner

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO/COO	Dennis Dauenhauer	National	Grp Dir Transducers
VP Mktg/Sales	W. Frederick Jones	Varian Associates	Div Mgr
VP Hybrid Ops	Saeed Nasiri	Not available	
VP Semi Ops	Fred Adamic	National	Linear Prod Line Mgr

FINANCING

Date	Round	Sources	Amount
Oct. 1982	Round 1	Crosspoint Venture Partners; Robertson, Colman & Stephens	$1.0M
	Round 2	Crosspoint Venture Partners; Med-Tec Ventures; National Semiconductor; Robertson, Colman & Stephens	$1.5M
Aug. 1986	Round 3	Becton & Dickinson	$1.5M

BACKGROUND

Sensym, Inc., designs, manufactures, and markets a complete line of IC accelerometers and IC pressure sensors and transducers including absolute, differential. and gauge types ranging from 0 to 1 psi to 0 to 5,000 psi. The Company provides devices with a variety of coatings, isolators, and special packages made specifically to handle various media, from dry air to hostile environments such as steam, water, freon, and high humidity. Products are used in many applications 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 United States-built products and offers the National Semiconductor transducer product line as well as numerous product additions. Round two of financing, completed in 1984, assisted in the expansion of Sensym's manufacturing capacity.

Sensym is a market-driven company that works closely with its customers to develop new products. The Company distributes its products through a nationwide network of representatives and distributors and through sales offices in Europe and Japan.

Recent Highlights

Aug. 1987	Sensym leased 20,405 square feet of research and development space at 1244 Reamwood Avenue, Sunnyvale. The additional space will be used for the development and manufacture of digital electronic tire gauges.

ALLIANCES

Abbott Labs	Sensyn has a technology agreement with Abbott Labs of Mountain View, California.
Becton-Dickenson	Sensym has a technology agreement with Becton-Dickenson of Sandy, Utah.
Metravib	Sensym has a technology agreement with Metravib of France.
Michelin	Sensym has a technology agreement with Michelin of France
NSC	Sensym second-sourced the NSC transducer product line.

SERVICES

Custom Linear IC Design
4-Inch Bipolar Linear Foundry Services
Manufacturing
Assembly

MANUFACTURING

Technology

Bipolar
4-inch wafers

Facilities

Sunnyvale, CA	40,000 sq. ft.	Manufacturing, engineering, administration
	20,405 sq. ft.	Corporate offices, R&D, marketing and sales
	1,500 sq. ft.	Class-100 clean room

PRODUCTS AND SERVICES

Custom Pressure Sensors
Disposable Blood Pressure Sensors
Tape Tension Pressure Sensors
Energy Management Pressure Sensors
Medical Instrumentation Pressure Sensors
Barometric Pressure Sensors
Engine Diagnostic System Sensors
Accelerometers
Digital Tire Gauges
Digital Pressure Gauges
Sensor-Based Subsystems

SID Microelectronica S. A.
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 Electronics
Jose B. Amorim	SID S.A. Servicos Tecnicos
Yuichi Tsukamoto	SHARP S.A. Equipamentos Electronics
Jose Papa, Jr.	FIESP

COMPANY EXECUTIVES

Position	Name	Prior Company
President	Matias Machline	Not available
VP R&D	Adalberto Machado	Ford-Brazil
VP Finance	Luis Paulo Rosenberg	Not Available
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 Microelectronics S. A. designs, manufactures, and markets small and medium transistors and linear devices. The Company plans to introduce hybrid circuits, surface-mounted device technology, 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

MANUFACTURING

Technology

3.0-micron bipolar

PRODUCTS

- Small-Signal Transistors
- Medium-Power Transistors
- Linear ICs

Sierra Semiconductor Corporation
2075 North Capitol Avenue
San Jose, CA 95132
408/263-9300
Fax: 408/263-3337
Telex: 384467

ESTABLISHED: November 1983
NO. OF EMPLOYEES: 250

BOARD:

Name	Affiliation
Donald T. Valentine, chairman	Sequoia Capital
Charlie C. Bass	Ungermann-Bass
James V. Diller	Sierra Semiconductor Corporation
Kheng-Nam Lee	Singapore Technology Corporation, Inc.
Robert J. Schreiner	Borg-Warner Electronics
Hans Severiens	MIP Equity Fund

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	James V. Diller	National	VP MOS Mem Ops
Pres/Sierra B.V.	Dr. Stephen Forte	AMI	VP WW Mktg/Sales
VP Mktg/Sales	John T. Reynolds	National	Group Mktg Dir
VP Design	Andrew G. Varadi	National	VP Technology
VP Opns	Edward Boleky	Intel	Mgr Mem Prod
VP Finance	C. Stephen Cordial	TI	Div Controller
Mng Dir Chartered Semi	John Hambridge	Fairchild	VP Logic Division

FINANCING

Date	Round	Sources	Amount
Jan. 1984	Round 1	Arscott, Norton & Assoc.; Asset Mgmt.; Associated Venture Investors; Bay Partners; Borg-Warner Electronics; Investors in Industry; Mohr, Davidow Ventures; Sequoia Capital; Sutter Hill Ventures; Technology Venture Investors; Venrock Associates	$ 7.7M
April 1985	Round 2	Initial investors; Bryan and Edwards; Burr, Egan, Deleage & Co.; Litton Industries; Suez Technology Fund; Tellabs, Inc.	$15.0M

Date	Round	Sources	Amount
Oct. 1986	Round 3	Asset Mgmt.; Associated Venture Investors; Bay Partners; Berkeley International; Borg-Warner; Churchill International; Hambrecht & Quist; Litton Fund; MIP Equity Fund; Mohr, Davidow; Sequoia Capital; Singapore Technology Corporation; Suez Technology Fund; Sutter Hill Ventures; Technology Venture Investors; Venrock Association	$18.4M
Sept. 1987	Round 4	Convertible debentures, Berkeley International	$10.0M

BACKGROUND

Sierra Semiconductor Corporation is a service-oriented supplier of CMOS ASICs with a complementary portfolio of standard products that include memory and linear digital ICs. The Company specializes in designs that combine analog, digital, and/or EEPROM memory technology on one chip. Products target telecommunications, data communications, computer and peripherals, and selected industrial applications.

The Company's proprietary Triple Technology makes the integration of analog, digital, and EEPROM memory on a single IC possible. Sierra's products are fabricated on 5-inch wafers, using 1.5-, 2.0-, and 3.0-micron CMOS process technology. Currently, Sierra conducts its own manufacturing and test but, from time to time, also uses foundries to augment internal capability. A recent joint venture company established in Singapore ensures adequate manufacturing and test resources for the foreseeable future.

Sierra is considered to be strong in circuits combining analog and digital technology and is also considered to have a strong cell library. The Company has an EE cell library--only two other suppliers (NCR and National Semiconductor) have such a library. Sierra's initial strategy was to develop a portfolio of CMOS standard products that demonstrated Sierra's Triple Technology. Sierra's long-term strategy is to expand its custom and cell-based products to 70 percent of sales and identify new markets and applications that benefit from the combination of digital, analog, and EE nonvolatile memory. At the end of 1987, Sierra's sales were about evenly split between standard and custom products.

Sierra has established two joint ventures in the last two years. In June 1986, Sierra formed a corporation in the Netherlands, named Sierra Semiconductor B.V. The $9 million in equity funding for the venture came from the Netherlands-based MIP Equity Fund. The headquarters, which opened in October 1986, houses a design center, technical support and services, and marketing and sales for Sierra's standard and cell-based ICs. In January 1987, Dr. Stephen Forte was appointed president of the operation.

In November 1987, Sierra, National Semiconductor, and Singapore Technology Corporation formed a joint venture company in Singapore, named Chartered Semiconductor Pte. Ltd. The company is located at a 170,000-square-foot site in the Singapore Science Park. Initial capacity will be 5,000 6-inch wafers per month. The new firm will fabricate and test CMOS wafers and ASIC devices primarily for Sierra and National. Initial wafer starts are scheduled for the first quarter of 1989.

Singapore Technology holds 74 percent of the company; Sierra holds 17 percent, and National the remaining 9 percent. Sierra will contribute its Triple Technology CMOS process and technical management, while National will provide CMOS process technology and technical support to construct the clean room facility. Singapore Technology Corporation also participated in Sierra's third round of financing.

Sierra sells its products through manufacturers' representatives and distributors in North America and Asia. In Europe, the Company sells its products through Sierra Semiconductor B.V. headquartered in the Netherlands and also through manufacturers' representatives.

Recent Highlights

June 1986	MIP Equity Fund invested $9 million in Sierra and Sierra Semiconductor B.V. The latter is located in the Netherlands and operates as a design and service center. Additional funding through government grants was assured. In January 1987, Dr. Forte joined Sierra as president of the subsidiary.
Oct. 1986	Sierra completed third-round financing for $18.4 million. In addition to discussing an investment, Singapore Technology Corp. and Sierra discussed establishing a joint venture in Singapore for a design center and semiconductor manufacturing facility.
Dec. 1986	Sierra introduced the SC11270 and SC11289 DTMF receivers.

Dec. 1986	Sierra introduced the SC11401/11402/11403/11404 8-bit video DACs, which are compatible with RS-170 and RS-323 specifications.
Dec. 1986	Sierra announced that its cell library is now supported on Mentor Graphics workstations.
Jan. 1987	Sierra and National Semiconductor announced a jointly developed family of 8-bit CMOS MCUs. The first members in the family of flexible controllers are called SC44820, SC44821, and SC44822 by Sierra and COP820C, COP821C, and COP822C by National Semiconductor.
May 1987	Sierra sampled a CMOS 2,400-bps modem chip set based on its initial 1,200-bps modem chip set, which is second-sourced by VLSI Technology. The SC11006 is the 2,400-bps modem, and the SC11009 and SC11011 are companion controllers. The SC11009 is for parallel bus applications, such as the PC XT/AT or compatibles, and the SC11011 supports RS-232 applications.
Sept. 1987	Sierra ported the MIXsim behavioral modeling tools to the Mentor Graphics Idea workstation.
Nov. 1987	Sierra, National Semiconductor, and Singapore Technology Corporation formed a joint venture company in Singapore, named Chartered Semiconductor Pte. Ltd. Singapore Technology holds 74 percent of the company; Sierra holds 17 percent, and National the remaining 9 percent.

<u>ALLIANCES</u>

National	July 1984	Sierra and National signed 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.

National	Nov. 1987	Sierra, National, and Singapore Technology Corporation formed a joint venture company, named Chartered Semiconductor Pte. Ltd. The new firm, located in the Singapore Science Park, will fabricate and test CMOS wafers and ASIC devices primarily for Sierra and National. Initial capacity will be 5,000 6-inch wafers per month. Singapore Technology holds 74 percent of the company, Sierra 17 percent, and National 9 percent. Sierra and National are providing process technology and technical assistance.
VLSI Technology	Jan. 1985	Sierra and VLSI have an agreement that provides for the exchange of technical information and the mutual sharing of developments in ASIC software, design expertise, and products. VLSI is also a second source for Sierra's custom and analog standard products.
Mentor	Dec. 1986	Sierra announced that its cell library is now supported on Mentor Graphics workstations.
	Sept. 1987	Sierra's MIXsim behavioral modeling tools are available on Mentor Graphics' Idea workstation.

SERVICES

Design
Foundry Silicon-Gate CMOS
Prototype Manufacturing

MANUFACTURING

Technology

2.0-micron single- and double-poly, double-metal CMOS
3.0-micron single- and double-poly CMOS
1.5-micron available in 1988
5-inch wafers

Facilities

San Jose, CA	71,000 sq. ft.	Headquarters, administration, marketing, design, and test
Santa Clara, CA	16,000 sq. ft.	Engineering, wafer fabrication

PRODUCTS

CMOS Cell Library

Process	Linewidth	Cells
Si-Gate CMOS	2.0-micron	280 Digital Cells, 50 Analog Cells, 25 EEPROM Cells, RAM, ROM, PLA, 2901, Multiply

EEPROMs

Device	Description
SC22001/22002	CMOS 256-Bit Serial EEPROM
SC22011/22012	CMOS 1,024-Bit Serial EEPROM
SC22101	CMOS 128x8 Multiplexed EEPROM
SC22102	CMOS 256x8 Multiplexed EEPROM
SC22104	CMOS 512x8 Multiplexed EEPROM

Microcomponents

SC44820/44821/44822	8-Bit CMOS MCUs

Linear

Data Communication

SC11000/11001/11005	CMOS 1,200-Baud Modem Filters
SC11002/SC22003	CMOS 300-Baud Modem
SC11004/SC11014	CMOS 1,200-Baud Modem
SC11006	CMOS 2,400-Baud Modem
SC11007/SC11008	CMOS Modem Controller
SC11009	SC11006 Companion Controller for Parallel Bus
SC11011	SC11006 Companion Controllers for RS-232
SC11015	CMOS 1,200-Baud Modem with Programmable Receiver Gain Amplifier

Telecommunications

SC11202/11203/11204/11270	DTMF Receiver
SC11270/11289	DTMF Receivers
SC11280/11289/11290	DTMF Transceiver
SC11301/11302	Codec Filter Combo

PRODUCTS

Computer/Peripheral

SC11401/11402/11403/11404	8-Bit Video DACs

Developmental Tools

SCDS	Custom Design System
MIXsim	Behavioral Modeling Tools

Si-Fab Corporation
27 Janis Way
Scotts Valley, CA 95066
408/438-6800
Fax: 408/438-6800, Ext. 107

ESTABLISHED: 1980
NO. OF EMPLOYEES: 30

BOARD: Not available

COMPANY EXECUTIVE

Position	Name
President	Leon Pearce

FINANCING: Not available

BACKGROUND

Si-Fab Corporation provides process design and engineering services, as well as quick-turn CMOS foundry services. The Company filed for Chapter-11 protection during the economic downturn in the semiconductor industry and reorganized its management and systems. Consequently, Si-Fab's business outlook and sales have increased substantially.

ALLIANCES: Not available

SERVICES

- Process Design
- Custom IC Design
- Engineering Services
- Thin-Film Coating Services
- Quick-Turn CMOS Foundry

MANUFACTURING

Technology

- 1.5-micron SOS, CMOS, NMOS, and PMOS
- 2-inch and 5-inch wafers

Facilities

Scotts Valley, CA	12,000 sq. ft.	Plant
	5,000 sq. ft.	Clean rooms

PRODUCTS

Aftermarket Technology
Unprocurable Parts
Proprietary Products

Silicon Systems, Inc.
14351 Myford Road
Tustin, CA 92680
714/731-7110

ESTABLISHED: 1981
NO. OF EMPLOYEES: 1,000

BOARD

Dr. Carmelo J. Santoro
C. Richard Kramlich
Sanford Kaplan
George T. Pfifer
C.V. Prothro
Henry T. Segerstrom

COMPANY EXECUTIVES

Position	Name
Chairman/Chief Executive Officer	Dr. Carmelo J. Santoro
Sr VP Engineering	Gary Kelson
Sr VP Manufacturing Operations	William Healey
Sr VP Sales & Marketing	Rick Goerner
Sr VP, Chief Financial Officer	Richard Holder

BACKGROUND

Silicon Systems, Inc. (SSi), designs, manufactures, and markets standard and custom application-specific ICs for recording and recovering data for disk drive heads, as well as other chips for disk drive control and interfacing to external systems. SSi is one of the largest suppliers of these circuits.

Building on similarity of recording and communications technologies, the Company has branched into telecommunications. SSi has developed modem and other communications chips, challenging the dominance of companies such as Exar, Mitel, and Rockwell Semiconductor.

Silicon Systems also provides custom chip development using mixed digital and analog circuitry. In 1986, the Company entered the industrial/automotive market sector with products for signal control and analog/digital signal processing.

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 recently licensed selected OEM customers to use its design tools and will serve as a manufacturing foundry for these customers.

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 a wafer fab to become a manufacturing company. Dr. Carmelo Santoro changed the focus from a custom IC design house to an integrated marketing and sales operation with manufacturing capabilities.

Recent product developments are allowing the Company to expand into automotive, industrial, and disk applications.

SSi's headquarters, design engineering, fabrication, and test activities are located in its Tustin, California, facility. Additional design engineering facilities are located in Grass Valley, California, and in the San Francisco Bay Area. In March 1986, SSi had a grand opening for a new $5 million assembly and test plant in Singapore. The facility supplies 90 percent of SSi's plastic DIP, quad, and surface-mount package assembly requirements.

Recent Highlights

Jan. 1987	SSi offered a three-chip set 2,400-bps modem to support V.22 bis, V.22, V.21, and Bell 212A and 103 operating modes, both synchronous and asynchronous.
April 1987	SSi sampled a complete disk drive electronic chip set that features read/write amplifiers, pulse detection, data separation, motor control and head positioning, and SCSI interface in an 8-chip set.
Nov. 1987	SSi sampled the K224, a single-chip modem capable of handling V.22 bis running at 2,400 bps. The K224 completes the K family of single-chip modems first introduced in 1985. The K224 is a monolithic CMOS chip that is built on 3-micron geometries and uses double-metal polysilicon layers. It integrates both digital DSP and analog circuits on a single chip.
April 1988	SSi announced that it will open a design center in California's Silicon Valley.

ALLIANCES

Rogers	Nov. 1985	SSi and Rogers formed a joint venture to design, manufacture, and market value-added intelligent flexible subsystems, called SMARTFLEX Systems. While initially focused on rotating memory applications, the joint venture charter will also serve industrial, automotive, and military markets.
RCA	Feb. 1986	SSi and RCA signed an agreement allowing RCA to second-source SSi's monolithic modem ICs. RCA gained rights to SSi's analog CMOS process, and SSi gained rights to RCA's digital 2-micron CMOS process. RCA also agreed to supply SSi with CMOS wafers over a three-year period.
Ferranti	March 1986	Ferranti signed an agreement allowing SSi to 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.
Oki Electric	Sept. 1986	SSi and Oki signed an agreement allowing Oki to second-source its K-series modems including the K212, K221, and K222. Oki will pay SSi royalties, furnish DSP chips, and provide foundry services on CMOS technologies down to 1.5 microns for a five-year period.
Cirrus Logic	Oct. 1986	Cirrus Logic and SSi agreed to exchange controller and buffer manager functions and mutually second-source the devices. Both chips will be processed via a 2-micron CMOS technology.

SERVICES

Design
Foundry Silicon-Gate CMOS and Bipolar
Manufacturing

MANUFACTURING

Technology

CMOS and bipolar

Facilities

Tustin, CA	Building A	83,000 sq. ft.	Manufacturing
	Building B	57,000 sq. ft.	Headquarters, test
	Building C	82,000 sq. ft.	Marketing and sales, product development
Grass Valley, CA		12,600 sq. ft.	Design center
Singapore		50,000 sq. ft.	Assembly and test

PRODUCTS

Microperipherals

HDD Read/Write Amplifiers

2-, 4-, 5-, 6-, 8-, and 10-Channel Ferrite Read/Write Circuits
4-, 6-, and 8-Channel Thin-Film Read/Write Circuits
Servo Preamplifiers (Ferrite and Thin Film)

HDD Pulse Detection

Read Data Processor (MFM and RLL Coding)

HDD Data Recovery

Data Separator and Write Precompensation Circuit
Data Synchronizer/1, 7 RLL ENDEC
Data Synchronizer/2, 7 RLL ENDEC
Data Synchronizer/MFM ENDEC

HDD Head Positioning

Servo Demodulators
Servo Controller
Servo Motor Driver

HDD Spindle Motor Control

Two-Phase Winchester Motor Speed Controller
Three-Phase Winchester Motor Speed Controller
Three-Phase Delta Winchester Motor Speed Controller

HDD Controller/Interface

SCSI Controller
Storage Controller
Dual-Port Buffer Controller
Winchester Disk Drive Support Logic

Floppy Disk Drive Circuits

Data Synchronizer and Write Circuit
2-, 4-Channel Floppy Disk Read/Write Circuit
Port Expander Floppy Disk Drive

Tape Drive Circuit

4-Channel Magnetic Tape Read Circuit

Telecommunications

Modems/Modem Support

Bell 212A/103 Single-Chip Modem; 1,200/300 bps
CCITT V.23, V.22, V.21 Single-Chip Modem
V.22, V.21, Bell 212A Single-Chip Modem
V.22, V.21, Bell 212A+ Single-Chip Modem with UART
V.22 Bis Single-Chip Modem
2,400-bps Modem Analog Front End with Coded DSP and uC
1,200-Baud FSK Modem
Modem Filter
Universal Asynchronous Receiver/Transmitter (UART)

Tone Signaling

Integrated DTMF Receiver
5V, Low-Power DTMF Receiver
DTMF Receiver with Dial-Tone Reject Filter
DTMF Transceiver
DTMF Transceiver with Call Progress Detection
DTMF Transceiver with Call Progress and Early Detection
Call Progress Tone Detector
Precise Call Progress Tone Detector

Telephony/Digital Telecommunications

Integrated MFR1 Receiver
DS-1 Line Interface
2,048Kb PCM Interface Unit
T1 Transmitter
T1 Receiver
4-Wire Loopback/Loopback
12x8x1 Crosspoint Switch

SIMTEK Corporation
1465 Kelly Johnson Boulevard, Suite 301
Colorado Springs, CO 80902

ESTABLISHED: May 1987
NO. OF EMPLOYEES: N/A

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Chairman/CEO	Dr. Richard Petritz	Inmos	Founder
President/COO	Dr. Gary Derbenwick	Inmos	Mgr Technology
VP Operations	Dennis Ryden		
VP Engineering	Ralph Sokel	Inmos	CAD Development

BACKGROUND

SIMTEK Corporation was formed to manufacture and market a broad range of advanced products. The Company will initially focus on new memory components for consumer, commercial, and military markets.

Dr. Petritz, a founder of Mostek and Inmos, will serve as chairman and chief executive officer of the Company and Dr. Derbenwick, who was formerly product technology manager at Inmos, will serve as president and chief operating officer.

Initial capitalization was from Nippon Steel Corporation of Japan, which owns about 20 percent of the Company and has a seat on the board. Nippon Steel produced about 28 million tons of steel in 1986 and reported sales of $15 billion. The investment by Nippon Steel is part of its diversification plan to expand into other businesses.

SIMTEK will begin production in 1988.

S-MOS Systems, Inc.
2460 North First Street
San Jose, CA 95131
408/922-0200
Fax: 408/922-0238

ESTABLISHED: November 1983
NO. OF EMPLOYEES: 60

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Daniel S. Hauer	Micro Power	VP/Custom Prod
VP Finance/Admin	Fumiyoshi Kanazawa	Epson-America	Accounting Mgr
Dir Engineering	John Conover	Siliconix	Engr Mgr
Dir Marketing	Joel Silverman	IMI	Dir Mktg
Dir Strat Accts	David O. Perry	Elmo Semicon	Dir Mktg

BACKGROUND

S-MOS Systems, Inc., offers advanced CMOS LSI and VLSI IC design and production with an emphasis on ASICs and the integration of system building blocks into single-chip solutions.

The Company's product line comprises three segments--ASICs, standard products, and silicon foundry. ASIC sales account for about 50 percent of annual revenue, with standard products and silicon foundry each accounting for about 25 percent.

S-MOS' ASIC products use gate array, cell-based, and a proprietary compiled-cell custom (CC Custom) approach. Standard products include memories, LCD drivers and controllers, telecommunications devices, MCUs, image-sensing and LSI synchronous devices. Silicon foundry services include 4-, 5-, and 6-inch wafers. Advanced packaging is also offered including EIAJ-standard plastic quad flat packs.

S-MOS works closely with its Japanese affiliate Seiko Epson. Design, engineering, and marketing of its products takes place at S-MOS' headquarters in San Jose, California. Manufacturing is done at Seiko Epson's plant in Fujimi, Japan. The plant is capable of producing 40,000 4-inch, 3-micron wafers; 20,000 5-inch, 1.5-micron wafers; and 20,000 6-inch, 1.2-micron wafers per month.

Also located at the S-MOS headquarters is a newly established R&D facility. The R&D center is a joint venture between S-MOS and Seiko Epson and is staffed by engineers from both companies. One of the primary objectives is to develop new design software technologies to keep pace with advancements in fabrication processes.

Recent Highlights

Feb. 1987	S-MOS introduced CC Custom, an IC design system featuring low-cost, fast, easy-to-use custom design tools. CC Custom is able to use dissimilar geometries and cell sizes on the same row of cells in a particular design. It will also complete full-custom designs in 14 to 16 weeks. S-MOS also introduced a 1.2-micron gate array.
June 1987	S-MOS offered the SED-3064F a CMOS LSI 8x8 crosspoint switch array with built-in address decoder and switch memory control. Each switch comes with a data reset mechanism, and any one crosspoint can be selected and turned on or off.
Jan. 1988	S-MOS expanded the availability of its LADS design software to include IBM PS/2, Sun-3, DEC VAX, and IBM mainframe computer systems.

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 for production in Japan.
IMI	April 1984	International Microcircuits, Inc., (IMI) and S-MOS signed a two-year agreement to second-source respective 2-micron CMOS gate arrays and to share cell-based libraries.
AMCC	May 1985	Seiko and AMCC entered into a BICMOS joint development effort. Seiko's 1.5-micron CMOS process is merged with AMCC's bipolar process to produce a 1.5-micron BICMOS process.

Siliconix	Nov. 1985	S-MOS and Siliconix signed an 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 and S-MOS signed an agreement licensing Lattice's high-speed SR64K5 64K SRAM to Seiko Epson.
Xilinx	1986	Xilinx and S-MOS signed a 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
- Foundry
- Manufacturing
- Assembly
- Test

MANUFACTURING

Technology

1.2-, 1.5-, and 3.0-micron silicon-gate CMOS
4-, 5-, and 6-inch wafers

Facilities

San Jose, CA	15,000 sq. ft.	Marketing, sales, engineering, and administration

PRODUCTS

Memory

Device	Description	Access Time (ns)
SRAM		
SRM 2114C	1,024x4	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

Description	Access Time (ns)
EPROM	
64K	150-300
128K	250-300
256K	200-300
EEPROM	
64K	150-300
128K	250-300
256K	200-300
ROM	
64K	350-450
128K	250
256K CMOS	250
128Kx8	250

MPU Family

Device	Description	Access Time (ns)
SMC 84C00	Z80 MPU	
SMC 82C37	DMA Controller	
SMC 82C51	Communications Interface	
SMC 82C54	Interval Timer	
SMC 82C55	Peripherals Interface	
SMC 82C59	Interrupt Controller	

Telecommunications

Modem

STC 9471	300-bps FSK Modem CCITT C21
STC 9472C	300-bps FSK Modem Bell 103
STC 9120	1,200-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
SED 3064F	8x8 Crosspoint Switch Array with Built-In Address Decoder and Switch Memory Control

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 (Microns)	Delay (ns)	Gates
SLA 5000	Si-Gate	3.0	3.0	413 to 3,082
SLA 6000	Si-Gate	2.0	1.5	820 to 6,204
SLA 7000	Si-Gate	1.5	1.2	2,232 to 9,250

CMOS Cell Library

Family	Process	Linewidth (Microns)	Delay (ns)	Cells
SSC 1000	Si-Gate	2.0	1.5	131 MSI, RAM, ROM, PLA

CAD Tools

C.C. Custom	IC Design System Featuring 1.5-Micron Twin-Well Silicon-Gate CMOS Process and Gate Delays of less than 1ns
LADS	Logic Array Design System

Solid State Optronics Inc.
442 Queens Lane
San Jose, CA 95112
408/436-1390
Fax: 408/436-1392

ESTABLISHED: June 1982
NO. OF EMPLOYEES: 4

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President	Zag Kadah	Electro-Trol, Inc.
Marketing	Sid Kadah	UC Berkeley

FINANCING: Zag Kadah holds 100 percent of the Company.

BACKGROUND

Solid State Optronics, Inc. designs and manufactures solid-state relays, photoresistors, and thyristors. The Company was founded by Zag Kadah in 1982. Prior to founding the Company, Mr. Kadah was employed at Electro-Trol, Inc., as vice president in charge of the optoelectronics division. In 1979, Mr. Kadah founded Power Interface, a company that pioneered the development of an IC to drive back SCRs in solid-state relays.

The Company subcontracts manufacturing to a company in Asia; assembly is done in the Philippines.

ALLIANCES: Not available

SERVICES

Design
Silicon Processing for Detectors and Sensors

MANUFACTURING

Technology

Bipolar
Dielectric isolation
DMOS
GaAs and GaAlAs

Facilities

San Jose, CA	1,200 sq. ft.	R&D, design, engineering, and assembly

PRODUCTS

Input/Output Modules
Interrupters
Photodiodes
Photo Arrays
Silicon Photo Detectors
Solid State Relays
Hybrid Optoelectronic Modules

Spectrum Microdevices
5330A Spectrum Drive
Frederick, MD 21701
301/695-0868
Fax: 301/831-4032

ESTABLISHED: 1980
NO. OF EMPLOYEES: 20

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Vice President/General Manager	Marvin L. Harding
Director Operations	William K. Bowers

FINANCING: Not available

BACKGROUND

Spectrum Microdevices is a part of Fairchild Communications & Electronics Company, which, in turn, is part of Fairchild Industries. 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 100 percent.

In 1986, Spectrum Microdevices, then known as Insouth Microsystems, moved from Auburn, Alabama, to Frederick, Maryland. Some members of the management and design group, including General Manager Marvin L. Harding, were transferred to coordinate component manufacturing more closely with Fairchild Communications & Electronics Company in Germantown, Maryland. Fairchild Communications & Electronics Company, Spectrum Microdevices' major customer, manufactures avionics and telecommunications equipment. The move was completed in September 1986 and the Company's name was changed in early 1987.

SERVICES

- Design
- Manufacturing
- Assembly
- Test

MANUFACTURING

Technology

2.0-micron CMOS

Facilities

Frederick, MD	2,500 sq. ft.	Administration
	12,500 sq. ft.	Manufacturing, assembly, test

PRODUCTS

Military Hybrids/Custom Monolithic Assembly and Test
Surface Mount for Military

Synaptics, Inc.
2860 Zanker Road, Suite 105
San Jose, CA 95134
408/434-0110

ESTABLISHED: 1986
NO. OF EMPLOYEES: 5

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
President	Federico Faggin

FINANCING

Date	Round	Sources	Amount
May 1986	Seed	Avalon Ventures; Sprout Group; Technology Venture Investors	$0.6M
June 1987	Round 1	Kleiner, Perkins, Caufield & Byers; Sprout Group; Technology Venture Investors	$1.5M

BACKGROUND

Synaptics, Inc., was formed to develop a family of neural network interpret circuits for use in intelligent sensors and pattern recognition applications. The Company is in a research stage and does not expect to introduce products for some time.

The Company hopes to develop devices with the ability to sense and process real-world signals in real time and to learn, without prior knowledge embedded in its program.

The basic research is guided by a scientific advisory committee, chaired by Professor Carver Mead of Caltech. Mr. Mead, a leading force in the development of silicon computer design methodology for VLSI, has been modeling neural networks with analog VLSI systems.

Synergy Semiconductor Corporation
3450 Central Expressway
Santa Clara, CA 95051
408/730-1313
Fax: 408/737-0831

ESTABLISHED: 1987
NO. OF EMPLOYEES: 35

BOARD

Name	Affiliation
Sven E. Simonson, chairman	Sequoia Capital
Ralph O. Cognac	Synergy Semiconductor Corporation
William J. Harding	J.H. Whitney & Company
Glenn M. Mueller	Mayfield Fund
Kenneth G. Wolf	Synergy Semiconductor Corporation

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Kenneth G. Wolf	Motorola	VP ASIC Div
VP Prod Ops	George W. Brown	AMD	Prod Mgr Bipolar RAMs
VP Mktg/Sales	Ralph O. Cognac	IDT	VP Mktg
VP Technology	Larry J. Pollock	IDT	VP Corp Engr
VP Prod Dev	Thomas S. Wong	AMD	Dsn Engr Mgr
VP Mfr Ops	E. Marshall Wilder	AMD	Mgr Dir MOS SRAMs

FINANCING

Date	Round	Sources	Amount
July 1987	Round 1	Mayfield Fund; Sequoia Capital; Suez Technology Fund	$3.9M
Feb. 1988	Round 2	Broventure Capital Mgmt.; Matrix Partners; Mayfield Fund; Menlo Ventures; Merrill, Pickard, Anderson & Eyre; Oak Investment Partners; Stanford University Engineering; Sequoia Capital; J.H. Whitney	$9.0

BACKGROUND

Synergy Semiconductor Corporation was formed to offer ultrahigh-performance bipolar ECL memory and logic products for the commercial and military markets. The Company is in its product development stage and plans to begin offering ECL bipolar products that will serve the needs of the high-performance computer and ATE markets in the second half of 1988. Its first product will be a 4K memory chip with an access time of less than 5ns.

Synergy was cofounded by Ralph O. Cognac, Larry J. Pollock, George W. Brown, Thomas S. Wong, and E. Marshall Wilder. All of the founders worked together at Advanced Micro Devices where they developed the advanced bipolar technology called IMOX. Mr. Cognac and Mr. Pollock also played key roles while at Integrated Device Technology, a leading supplier of high-speed CMOS memory and logic products.

Kenneth G. Wolf joined the Company as president and CEO in July 1987. Mr. Wolf was previously employed at Motorola for 22 years in management positions. At various times, he was responsible for the bipolar memory, bipolar logic, and ASIC divisions.

In January 1988, Synergy Semiconductor purchased Zoran Corporation's Santa Clara, California, wafer fabrication clean room and a portion of the 50,000-square-foot manufacturing and office facility.

ALLIANCES: Major strategic alliances are as yet unnamed.

SERVICES

- Design
- Fabrication
- Assembly
- Test

MANUFACTURING

Technology

- 1.5-micron bipolar ECL
- 4-inch wafers

Facilities

Santa Clara, CA	30,000 sq. ft.	Administration and manufacturing
	7,000 sq. ft.	Class-10 clean room

PRODUCTS: ECL memory and logic products will be introduced in the fourth quarter of 1988.

Tachonics Corporation
107 Morgan Lane
Plainsboro, NJ 08536
609/275-2501
Fax: 609/275-2591

ESTABLISHED: June 1985
NO. OF EMPLOYEES: 65

BOARD

Name	Affiliation
Robert A. Nafis, chairman	Grumman; president, Electronic Systems Division

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Dr. Chuni L. Ghosh	ITT	Mgr GaAs Products
VP Digital Prod	Steven Goodspeed	Fairchild	Digital Dsn Mgr
VP Microwave Prod	Dr. Douglas Maki	GE	Mgr M/W IC Lab
Treasurer	Gary L. Symansky	Grumman	Controller (Current)
Secretary	Raymond Nightengale	Grumman	VP (Current)

FINANCING

Date	Round	Sources	Amount
1985	Initial	Grumman Corporation	$15M-$20M

BACKGROUND

Tachonics, a division of Grumman Corporation, designs, develops, and manufactures custom GaAs microwave and digital ICs and also offers foundry services.

In June 1987, Tachonics established a GaAs IC standard product and foundry facility in Plainsboro, New Jersey. Initial capacity is 300 3-inch wafer starts per week. In addition, Tachonics offered its first commercial product, a cell library with a basic set of 35 SSI and MSI building blocks including standard ECL interfaces. Primary software support is the VLSI Technology tool set that resides on the Apollo ring network. In addition, Tachonics has Mentor engineering workstations on the Apollo network.

In December 1987, Tachonics offered the TCSW-0500 and TCSW-0600, two broadband GaAs MMIC switches. The 0500 is a single-pole, single-throw (SPST) version, while the 0600 is single pole, double throw (SPDT). Both switches provide isolation of 50dB at 1 GHz and 40dB at 8 GHz.

Recent Highlights

March 1987	California Micro Devices (CMD) signed an agreement with Tachonics to produce GaAs-based ICs. CMD will provide cell design and tools in the 0.5- to 1.0-micron range. Tachonics will manufacture the commercial and military products. Initial products will be a series of gate arrays from 500 to 2,500 gates with radiation-hardened capability.
June 1987	Tachonics established a GaAs IC standard product and foundry facility in Plainsboro, New Jersey. Initial capacity is 300 3-inch wafer starts per week. The Company also announced that it is developing a fully self-aligned gate E/D digital process and a 0.5-micron microwave process. Digital capability includes a cell library based on typical gate speed-power characteristics of 100 ps/500uW. Tachonics provides support for Mentor workstations on the Apollo network.
Oct. 1987	Tachonics and GigaBit Logic (GBL) agreed to second-source GaAs standard and ASIC ICs developed by each other. GBL will also transfer data bases, schematics, and test specs of the Picologic cell-based families to Tachonics. The companies will also codevelop cell libraries to support future GaAs technologies.
Dec. 1987	Tachonics offered the TCSW-0500 and TCSW-0600, two broad-band GaAs MMIC switches. The 0500 is a single-pole, single-throw (SPST) version, while the 0600 is single pole, double throw (SPDT). Both switches provide isolation of 50dB at 1 GHz and 40dB at 8 GHz.

ALLIANCES

Grumman	July 1985	Tachonics was formed as a subsidiary of the Grumman Corporation. Grumman invested $15 million to $20 million in the Tachonics plant and equipment.

CMD	March 1987	California Micro Devices (CMD) signed an agreement with Tachonics to produce GaAs-based ICs. CMD will provide cell design and tools in the 0.5- to 1.0-micron range. Tachonics will manufacture the commercial and military products. Initial products will be a series of gate arrays from 500 to 2,500 gates with radiation-hardened capability.
GBL	Oct. 1987	Tachonics and GBL agreed to second-source GaAs standard and ASIC ICs developed by each other. GBL will also transfer data bases, schematics, and test specs of the Picologic cell-based families to Tachonics. The companies will also codevelop cell libraries to support future GaAs technologies.

SERVICES

- Foundry
- Microwave and digital circuit design
- Manufacturing
- Assembly
- Test
- Subsystem manufacturing

MANUFACTURING

Technology

- 1.0-micron GaAs gate length for digital
- 0.5-micron GaAs gate length for microwave
- 3-inch wafers

Facilities

Plainsboro, NJ	38,400 sq. ft.	
	6,000 sq. ft.	Class-10 clean room

PRODUCTS

Cell-Based Library

35 Cells with ECL Interfaces

MMIC Switches

Amplifiers and Attenuators

About 40 Products in Chip and Packaged Form, Useful in the DC to 20-GHz Frequency Ranges

Hybrid Switches

Seven Products for Microwave Switching with High Isolation in the DC to to 6-GHz Frequency Ranges

Taiwan Semiconductor Manufacturing
Company, Limited
1F No. 9, Industriale E. 4th Road
Science-Based Industrial Park
Hsinchu, Taiwan
(035) 961240
Fax: (035) 942616

North American Office
3150 Almaden Expressway, Suite 111
San Jose, CA 95118
408/978-1322
Fax: 408/978-1365

ESTABLISHED: 1986
NO. OF EMPLOYEES: 300

BOARD

Dr. Morris Chang, chairman

COMPANY EXECUTIVES

Position	Name	Prior Company
President/CEO	Jim Dykes	General Electric Company
VP Fab-1 Operations	F.C. Tseng	ERSO
VP Operations	Klaus Wiemel	Thomas Group
VP Marketing	Stephen L. Pletcher	General Electric Company
VP Finance	Jackson Horng	Philips

FINANCING

Date	Round	Sources	Amount
1986	Round 1	Executive Yuan Development Fund (48.3%); N.V. Philips (27.5%); China American Petrochemical; Formosa Chemicals & Fiber; Formosa Plastics; Nan Ya Plastics; Central Investment Holding Co.; Asia Polymer Corp.; China General Plastics; Mabuchi Taiwan; USI Far East Corp.; Yao Hua Glass; ADI Corp.; Tai Yuen Textile; Union Petrochemical	$48.0M
1988	Round 2	Same as above	$29.0M

BACKGROUND

Taiwan Semiconductor Manufacturing Company, Limited (TSMC), was formed to provide one-stop semiconductor manufacturing services including wafer fabrication, probing test, packaging, final test, and burn-in for a wide variety of ICs.

Taiwan's Executive Yuan, or Legislature, earmarked funds from its development fund for a 48.0 percent stake in the Company. N.V. Philips has a 27.5 percent share in the $150 million investment in TSMC and an option to purchase controlling interest in the Company. The remainder is held by other Taiwanese firms.

In 1987, Dr. Morris Chang, former president and chief executive officer of General Instrument Corporation and president of the Industrial Technology Research Institute (ITRI) in Hsinchu, Taiwan, was made chairman of TSMC. Dr. Chang is also chairman of United Microelectronics Corporation. Also in 1987, Jim Dykes joined TSMC as president and chief executive officer. Mr. Dykes had set up General Electric Company's Semiconductor Division. Stephen L. Fletcher, who had been vice president of sales and marketing for GE Semiconductor, was named director of a new North American and European marketing and sales operation of TSMC.

In early 1987, TSMC made its first wafer shipment from its facility, which is capable of producing 10,000 6-inch wafers per month. It is equipped to produce chips, using 1.5-, 2.0-, and 3.0-micron CMOS and NMOS processes. TSMC began volume production in early 1988.

In December 1987, TSMC received approval to build a second manufacturing facility in Taipei, Taiwan. The new facility, which is scheduled for completion by year-end 1989, will cost about $220 million and will nearly quadruple the Company's capacity. The planned 65,000-square-foot fab facility will have a production capacity of 30,000 6-inch wafers per month. It is designed for submicron processes; however, initial production will be done via a 1.2-micron process. In the future, TSMC plans to convert a portion of the capacity to 8-inch wafers and also to shrink its processes to the submicron level by 1990.

When the Company begins volume production, it expects about 25 percent of its production to be for Philips, 25 percent by Taiwanese firms, and the remainder by U.S. manufacturers.

ALLIANCES

Philips	1986	N.V. Philips has a 27.5 percent share in the $150 million investment in TSMC, with the remainder held by the government and Taiwanese firms. Philips has an option to purchase controlling interest in the Company.

SERVICES

- Foundry
- Packaging
- Test
- Burn-in

MANUFACTURING

Technology

- 3.0-micron silicon-gate NMOS and CMOS p-well
- 2.0-, 1.5-, and 1.25-micron silicon-gate CMOS n-well
- 6-inch wafers
- Submicron processes and 8-inch wafer compatibility planned by 1990

Facilities

Taiwan	21,000 sq. ft.	Manufacturing Class-1 and Class-10 clean rooms

A second $220 million 65,000-square-foot facility is planned for completion in 1989. The facility will have a production capacity of 30,000 6-inch wafers per month.

Telcom Devices Corporation
914 Tourmaline Drive
Newbury Park, CA 91320
805/499-0335

ESTABLISHED: 1986
NO. OF EMPLOYEES: Not Available

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President	James Kim	Rockwell
VP Engr	Ock-Ky Kim	Rockwell
Dir Opto Mtls	Larry Perillo	Rockwell

FINANCING: Not available

BACKGROUND

Telcom Devices Corporation was formed in early 1986 to offer indium gallium arsenide (InGaAs) photodiodes and indium gallium phosphide (InGaP) light-emitting diodes.

Founders James Kim, Ock-Ky Kim, and Larry Perillo are former Rockwell engineers. Telcom Devices is a subsidiary of Opto Diode Corp. (ODC) and is operating from ODC's facilities in Newbury Park, California. Both companies share clean room and manufacturing space.

Telcom Devices began volume production of its first products in May 1986. The products were InGaAs PIN photodiodes for fiber-optic applications and included the Planar 13PD100 and Planar 15PD100.

Teledyne Monolithic Microwave
1274 Terra Bella Avenue
Mountain View, CA 94043
415/962-6879
Fax: 415/968-6533

ESTABLISHED: 1984
NO. OF EMPLOYEES: 21

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Executive Director	Dr. James Ewan
Director Technology	Dr. Steven Ludvik
Director Applications	Dr. Robert Mandal

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 bases in preparation for spinning-off as an independent company some time in the next two to three years.

TMMIC is a merchant supplier committed to providing the most advanced performance solid-state components and subsystems to the electronic warfare and radar communities. TMMIC provides system designers with multipurpose building blocks using state-of-the-art monolithic and hybrid GaAs technologies. TMMIC's building blocks consist of multi-octave and decade-plus bandwidth amplifiers, attenuators, switches, and equalizers, which are available as components or in subsystems.

SERVICES

Design and manufacturing of wideband EW systems, components, and circuits

MANUFACTURING

Technology

GaAs

Facilities

Mountain View, CA	14,000 sq. ft.	Design, manufacturing

PRODUCTS

- Amplifiers
- Attenuators
- Switches
- Mixers

Three-Five Systems, Inc.
10230 S. 50th Place
Phoenix, AZ 85044
602/496-0035

ESTABLISHED: April 1985
NO. OF EMPLOYEES: 235

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	David R. Buchanan	Camax	Chairman/CEO
VP Operations	Marvin R. Byrd	Semi Design	President
VP Mktg/Sales	Dennis R. Riccio	Eaton	VP Sales/Semi Equip
Dir European Ops	Martin Woolfenden	National	Marketing Manager
Dir Engineering	Dr. Carl Derrington	Motorola	Prod Mgr, Sensors
Dir Manufacturing	Joseph Riccio	Motorola	Area Sales Mgr
Dir LCD Program	John C. Powers	Alphasil	LCD Manager

FINANCING

Date	Round	Sources	Amount
Sept. 1987	Round 2	Continental Illinois Venture Corporation; National Semiconductor Corp.; OptoVen Partners	$5.5M

BACKGROUND

Three-Five Systems, Inc. produces and markets custom and semicustom products that combine silicon and GaAs technologies for the consumer, industrial, telecommunications, and computer markets.

The Company is headquartered in a 40,000-square-foot facility in Tempe, Arizona. The facility houses all corporate functions as well as a quick-turn prototype manufacturing area. In 1987, Three-Five consolidated its domestic operations in Phoenix, Arizona, and eliminated a facility in Troy, New York.

The Company was formed via a leveraged buyout of National Semiconductor's Optoelectronics business unit and was named Three-Five Semiconductor. The Company's founders are Frank Shroff, John Gragg, Dennis Riccio, Joe Riccio, and Brent Fox. Three-Five received acquisition funding, which was completed in December 1985, from Continental Illinois Venture Corporation (Chicago, Illinois) and OptoVen of Phoenix, an investment company formed specifically to invest in Three-Five.

In 1987, the Company changed its name from Three-Five Semiconductor Corporation to Three-Five Systems to reflect a shift from a front-end semiconductor emphasis to a broader systems approach. The Company has reorganized into two groups. The optoelectronics group supplies all existing and future standard products, and the display group is responsible for Application-Specific Integrated Displays (ASIDs) as well as other technologies that may be added. In September 1987, Three-Five raised $5.5 million in second-round financing, which was used to expand its technical staff and facilities to support the Company's thrust into new opto product areas. In March 1988, Three-Five initiated a further round of financing to support the Company's thrust into LCDs.

Currently, 400 products that were developed by the Company while it was a division of NSC are offered by Three-Five and include infrared and custom devices. New products include custom plastic LCDs (PLCDs). In the long term, the Company will focus on PLCDs and GaAs-based products, optoelectronics (standard and custom), and integrated optoelectronic ICs. The Company will also focus on display systems, such as LED and LCD, with a higher degree of electronic control.

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

GaAs

Facilities

Tempe, AZ	40,000 sq. ft.	Manufacturing

PRODUCTS

Standard and Custom Optoelectronic LED Products

Topaz Semiconductor Inc.
1971 North Capitol Avenue
San Jose, CA 95132-3799
408/942-9100
Fax: 408/942-1174

ESTABLISHED: March 1985
NO. OF EMPLOYEES: 37

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Thomas Cauge	Semi-Processes Inc.	VP Opns
Dir Marketing	Bruce Watson	Semi-Processes Inc.	Prod Mktg Mgr
Dir Engineering	Paul Denham	Semi-Processes Inc.	Engr Mgr
Dir Sales	Robert Vosburgh	Marconi Instruments	Sales Mgr

FINANCING

Date	Round	Sources	Amount
1985	Seed	Private	$1.5M

BACKGROUND

Topaz Semiconductor designs and manufactures advanced field-effect transistors (FETs) and CMOS/DMOS ICs. Topaz, a company representing a partial buyout 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 Semiconductor 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 those of Topaz Semiconductor insures a continued source of SPI products, as well as contribution to the faster expansion of Topaz Semiconductor.

With the financial backing of Hytek, a significant number of new Topaz products has been added. These products include medium-power lateral DMOS discretes (high-voltage and ultralow-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 initially has 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 assembly operations to companies in Thailand, Malaysia, and Taiwan.

Recent Highlights

March 1987	Topaz offered the CDG2214N, an analog switch with a CMOS-compatible control input. The device combines CMOS and DMOS processes and switches analog signals of +/- 10V with CMOS logic levels.
April 1987	Topaz offered the CDG201B, a low-insertion-loss quad analog switch that is TTL-compatible and pin- and function-compatible with standard CMOS devices.
April 1987	Topaz offered the CDG211CJ, a quad single-pole, single-throw analog switch with TTL-compatible control input.
June 1987	Topaz offered the SD5400 series of DMOS analog switches in 14-lead, small-outline packages. Power dissipation is 546 milliwatts and the series operates from 0 to 70 degrees centigrade.
June 1987	Topaz offered the SD1202, a 200V, n-channel enhancement-mode vertical D-MOSFET with a high gate standoff of 100V.
June 1987	Topaz offered the SD1500BD, a 600V enhancement-mode vertical D-MOSFET.
Jan. 1988	Topaz offered the CDG4460J, a 6-bit digital-controlled attenuator for video frequencies of 10.7 to 30 MHz, with attenuation of 0.25dB per step.
Feb. 1988	Topaz offered the SD220/SD221 series of 60V, 9-ohm/100V, 12-ohm n-channel enhancement-mode lateral D-MOSFETs for ultrahigh-speed display driver applications.

ALLIANCES

Hytek Microsystems	July 1985	Topaz was acquired by Hytek Microsystems and operates as a wholly owned subsidiary. Hytek and Topaz cooperate on development of precision, standard hybrid circuits.

SERVICES

Design
Manufacturing

MANUFACTURING

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

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 10 (underhood)

PRODUCTS

Lateral DMOS FETs
DMOS Power FETs
DMOS FET Ultralow Leakage
High-Voltage DMOS Power FETs
Vertical DMOS FETs
Dual-Gate DMOS FETs

DMOS FET Switches
Ultrahigh-Speed, Low-Cost Switches
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 Arrays
Quad DMOS FET Driver Arrays
Quad DMOS FET Analog switch Arrays
FET Ultrahigh-Speed Dual Drivers
4:1 Monolithic CMOS/DMOS Analog Multiplexers

Triad Semiconductors International
5575 Tech Center Drive
Colorado Springs, CO 80936
719/528-8574
Fax: 719/528-8875

ESTABLISHED: October 1985
NO. OF EMPLOYEES: 42

BOARD

Pieter Niessen, chairman
David Angel
Raymond Bullens

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Michael Burton	Inmos	Mgr Commercial Ops
Sr VP Engr/Mfr Ops	Chuck Gregory	GE	Mgr Engr Ops CICC
Sr VP Sales/Mktg	Bruce Threewitt	AMD	Dir Prod Dev
Sr VP Finance/Admin	Robert Verheecke	Syntelligence	VP Finance/Admin
VP Product Dev	O. Fred Jones	Inmos	Strat Mktg Mgr
VP Technology	William Slemmer	Inmos	App Dsn Mgr

FINANCING

Date	Round	Sources	Amount
1985	Initial	AMRO Bank; Founders; The Limburg Investment Bank; private placement; grants and subsidies from the Dutch government	$8.0M

BACKGROUND

Triad Semiconductors International (Triad) designs, develops, and markets specialty memory ICs for use in high-performance data and algorithmic processors, digital telecommunications and video applications, image/voice synthesis and recognition and other artificial intelligence applications, and advanced industrial instrumentation and control systems. Triad's high-performance specialty memories are based on CMOS technology, but the Company plans to use other technologies if and when appropriate.

The Company has defined 24 products. Within the next 12 months, it plans to introduce 5 products including a monolithic 256-color graphics palette chip with RAM and DAC on-chip and a 2Kx9 and 4Kx9 FIFO, 64Kx4 Fast Industry Standard (FIS) latched and registered version. Future product introductions will include a writable control store chip, 1Kx48 CAM, 128Kx8 cached DRAM, and a second-generation monolithic color graphics chip.

The parent company of Triad is registered in the Netherlands. The Company conducts back-end services, such as testing in the Netherlands, and plans to add design activities to serve the EEC market. The Company has a joint venture with Rood Testhouse in Europe to guarantee engineering and test capacity in exchange for business committed by Triad. Operations are centralized in the United States and are headquartered in Colorado Springs, Colorado.

Triad has adopted a strategy of developing a worldwide network of corporate alliances with industrial partners to obtain core product designs and then applying its expertise to add value-enhancing features. In October 1987, Triad negotiated an alliance with a Japanese semiconductor manufacturer, giving Triad access to advanced process technologies, fabrication capacity, a second source, and joint R&D. Triad also has foundry alliances with AT&T and Seiko and plans additional alliances with a U.S. and a European company. Assembly is conducted by Lingsen in Taiwan and Swire in Hong Kong.

Applied Marketing Technology, based in the United Kingdom, has been signed as the Company's representatives in the EEC. Other representatives are being set up in the Far East and the United States.

ALLIANCES

Japanese Company	Triad negotitated an agreement with a Japanese semiconductor company, giving Triad access to advanced process technologies, fabrication capacity, a second source, and joint R&D.
AT&T	Triad signed a foundry alliance with AT&T, which is manufacturing the fast latched/registered pipelined memories.
Seiko	Triad signed a foundry alliance with Seiko, which is manufacturing the monolithic color palette.
Rood Testhouse	Triad signed an agreement with Rood Testhouse in Europe, guaranteeing engineering and test capacity in exchange for business committed by Triad.

SERVICES

Product Development
Design
Test

MANUFACTURING

Technology

1.2- and 1.5-micron CMOS
Double-metal, double-poly process
Double-metal, single-poly process

Facilities

Colorado Springs, CO	15,000 sq. ft.	Corporate headquarters, design
The Netherlands	25,000 sq. ft.	European headquarters

PRODUCTS

Product	Availability
256-Color Graphics Palette Chip	Q2 1988
16Kx4 Fast Industry Standard (FIS)	Q2 1989
16Kx4 Latched and Registered Memory	Q2 1988
64Kx4 FIS	Q3 1988
2Kx9 FIFO	Q4 1988
64Kx4 Latched and Registered Memory	Q1 1989
4Kx9 FIFO	Q1 1989
Writable Control Store	Q1 1989
1Kx48 LAN CAM	Q2 1989

TriQuint Semiconductor, Inc.
Group 700
P.O. Box 4935
Beaverton, OR 97076
503/644-3535
Fax: 503/644-3198

ESTABLISHED: January 1984
NO. OF EMPLOYEES: 100

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Alan D. Patz	Tektronix	GM GaAs ICs
VP Business Dev	Dr. Thomas Reeder	Tektronix	Chief Scientist
Dir Mktg/Sales	Dennis C. Powers		
Mgr QA	Richard Allen	Tektronix	Div Mfg Mgr
VP Engr & Dig Prod	Dr. Binoy Rosario	Tektronix	Design Manager
VP R&D	Dr. Richard Koyama	Tektronix	Technical Manager
Dir Finance/Admin	Richard Sasaki	Tektronix	Financial Mgr
VP Mfg	Dr. Gordon Roper	Tektronix	Principal Engr
VP Foundry Prod	Dr. Ajit Rode	Tektronix	IC Process Engr
VP Microwave Prod	Philips Snow		

BACKGROUND

TriQuint designs, develops, manufactures and markets microwave, linear, and GHz digital GaAs IC components. TriQuint also offers a broad range of foundry services. The Company's products are used in high-performance applications such as fiber-optic telephone communication, high-speed computer interfaces, instruments, and military systems.

The Company evolved from research on GaAs ICs that began in Tektronix Laboratories in 1978. Several of TriQuint's founders were leaders on the Tektronix research team. In 1984, TriQuint was formally established as a majority-owned subsidiary with the entrepreneurial freedom to establish a broad portfolio of long-term manufacturing contracts.

Recent Highlights

Feb. 1987	TriQuint sampled six new members of its Q-Logic line. They include a pair of dual-modulus counters for GHz-frequency synthesizers and two pairs of multiplexers and demultiplexers for use in high-speed fiber-optic communication. In addition, TriQuint offered semicustom design options and services using over 230 cells in its Q-Logic standard cell library. TriQuint will design and build the semicustom chips, or the customer can do the electrical design and simulation.
June 1987	TriQuint offered its first GaAs DACs. They are 8-bit D/A converters and feature 400 Msample-per-second speeds. The new GIGADACs clip along at 600 Msamples per second and 1 Gsample per second.
June 1987	TRW Components and TriQuint agreed jointly to develop and supply Class-S level GaAs devices for space applications. TriQuint will provide microwave and digital GaAs technology in addition to foundry services.
Aug. 1987	TriQuint offered the TQ1135 and TQ1136, multiplexer/demultiplexer (MUX/DEMUX) chip sets for use in commercial fiber-optic systems.
Nov. 1987	TriQuint offered the TQ3000, a 3,000-gate array that features 1,020 cells and 64 I/Os. The TQ3000, which can perform at up to 1 GHz, is produced with a 1-micron GaAs E- and D-MESFET process. The new array is supported by Daisy, Mentor, and Tek/CAE workstations.
Oct. 1987	TriQuint introduced the TQ6330, an ultrafast pin driver, and the TQ6331 line receiver pair.
Feb. 1988	TriQuint announced a radio-frequency/large-scale integration (RF/LSI) GaAs IC foundry service named the QED/A process.
March 1988	TriQuint introduced the QLSI cell-based library, a GHz LSI cell-based library that supports LSI applications of up to 6,000 equivalent gates and toggle rates of up to 2 GHz.
March 1988	Microwave Semiconductor Corporation and TriQuint agreed to provide customers with GDS-II tape interchangeability and equivalent performance for GaAs analog and digital ICs and MMICs.

ALLIANCES

Tektronix	Jan. 1984	Tektronix spun off TriQuint, remaining the parent company and completing a sales agreement with the new subsidiary.
EEsof	May 1986	EEsof and TriQuint teamed up 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.
TRW	June 1987	TRW Components and TriQuint agreed jointly to develop and supply class-S level GaAs devices for space applications. TriQuint will provide microwave and digital GaAs technology in addition to foundry services.
MSC	March 1988	Microwave Semiconductor Corporation and TriQuint agreed to provide customers with GDS-II tape interchangeability and equivalent performance for GaAs analog and digital ICs and MMICs.

SERVICES

Design
Foundry
Manufacturing
Assembly
Packaging

MANUFACTURING

Technology

1.0- and 0.5-micron gate length depletion mode MESFET processes capable of fabricating D-MESFETs

1.0- and 0.5-micron gate length enhancement/depletion mode MESFET processes capable of fabricating E- and D-MESFETs

3-inch wafers

Facilities

Beaverton, OR	25,000 sq. ft.	Administration, engineering, manufacturing
	12,000 sq. ft.	Class-100 clean room

PRODUCTS

Foundry

1A/1D Process	1.0-Micron Gate Length Depletion Mode MESFET for D-MESFET, Schottky Diodes, Implanted Resistors, MIM Capacitors, and Airbridge Inductors
HA Process	0.5-Micron Gate Length Depletion Mode MESFET Process for Both 0.5- and 1.0-Micron D-MESFETs, Schottky Diodes, Implanted Resistors, Precision Nichrome Resistors, MIM Capacitors, and Airbridge Inductors
QED Process	1.0-Micron Gate Length Enhancement/Depletion Mode MESFET for E- and D-MESFETs, Schottky Diodes, Implanted Resistors, and Airbridge Inductors
QED/A Process	An Enhanced Version of the QED Process that Allows the Mixing of Low-Power Digital LSI Circuits and Precision Analog Circuits on a Single Die

Gate Arrays

Family	Linewidth	Delay	Gates
TQ3000			3,000
Q-Chip	1.0 Micron	0.15ns	140

Cell-Based Library

Family	Cells
Q-Logic	1,000 Gates, Data Encoders/Decoders, MUX/DEMUX, Counters, Dividers, Prescalers
QLSI	6,000 Gates, ZFL Cells, SCFL Cell Family

MMICs (Die and Components)

TQ9111	1- to 8-GHz Amplifier
TQ9141	1- to 10-GHz Power Divider
TQ9151	1- to 10-GHz SPDT Switch
TQ9161	1- to 10-GHz Variable Attenuator

Digital Products

TQ1111	4-Bit Ripple Counter
TQ1112	4-Bit Synchronous Counter
TQ1121	Divide by 4/5
TQ1123	Divide by 4/5, Reset
TQ1131	Pgm 8:1, 16:1 MUX
TQ1132	Pgm 1:8, 1:16 DEMUX
TQ1133	4:1 MUX
TQ1134	1:4 DEMUX
TQ1135	12:1 MUX
TQ1136	12:1 DEMUX

Linear ICs

TQ6330	Pin Driver
TQ6331	Line Receiver
TQ6111-D	8-Bit DAC, 600 Ms/S, Die Form
TQ6111-M	8-Bit DAC, 600 Ms/S, Ceramic Package
TQ6111-BI	8-Bit DAC, 600 Ms/S, Board Module, Instrumentation Version
TQ6111-BV	8-Bit DAC, 600 Ms/S, Board Module, Video Version
TQ6112-D	8-Bit DAC, 1,000 Ms/S, Die Form
TQ6112-M	8-Bit DAC, 1,000 Ms/S, Ceramic Package
TQ6112-BI	8-Bit DAC, 1,000 Ms/S, Board Module, Instrumentation Version
TQ6112-BV	8-Bit DAC, 600 Ms/S, Board Module, Video Version
EK-TQ6101	GIGADAC Evaluation Kit

United Microelectronics Corp.
#3 Industrial Road
Hsinchu City
Taipei, Taiwan
(035) 773131
Telex: 31476 UMCHSC
Fax: 035 774 767

ESTABLISHED: September 1979
NO. OF EMPLOYEES: 950

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
R&D Director	M.K. Tsai	ERSO	Design Manager
Plant Director	Hyley Huang	ERSO	Process Manager

FINANCING: Total capital, as of December 1987, was $34.9 million.

Date	Round	Sources	Amount
1979	Round 1	Bank of Communications; China Development Corp.; Kuang Hua Investment Co.; Ministry of Economic Affairs; Orient Semiconductor; Sampo; Teco; Walsin-Lihwa Electric Wire & Cable; Yao Hua Glass Co.	$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. UMC provides foundry services to major U.S. and domestic IC design companies.

In 1983, UMC funded Unicorn Microelectronics, a design center, in San Jose, California. National Microelectronic Corporation is the U.S. sales and distribution arm for UMC's foundry services and products.

In December 1987, UMC started construction of a $170 million VLSI plant II, with a planned capacity of 30,000 units of 6-inch wafers per month.

In 1987, UMC elected Dr. Morris Chang chairman. Dr. Chang is also the chairman of Taiwan Semiconductor Manufacturing Corporation and president of the Industrial Technology Research Institute (ITRI) in Hsinchu, Taiwan. Dr. Chang was a vice president at Texas Instruments and chief executive officer at General Instrument Corporation.

Recent Highlights

Nov. 1986	National Semiconductor filed a suit against UMC charging theft of trade secrets, fraud, breach of contract and fiduciary obligations, unfair competition, conversion, interference, and conspiracy. The suit concerns the marketing by UMC of a real-time clock part and a UART, which National claims was based on designs received from National under a fab agreement. National is seeking $10 million in damages. UMC filed a countersuit against National in the United States, alleging that National has made false statements in an effort to interfere with UMC's economic relationships.
Dec. 1987	UMC started construction of its $170 million VLSI plant II, with a planned capacity of 30,000 units of 6-inch wafers per month.
Jan. 1988	UMC reported fiscal 1987 sales of $90 million.

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.

Honeywell/ Synertek	July 1985	UMC gained nonexclusive product licenses for 18 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.
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.
TRW	April 1986	UMC successfully developed 1.25-micron VLSI products with TRW.
SMC	June 1986	UMC signed a contract with SMC to cooperate on a computer IC.

SERVICES

Design	Gate Arrays, standard cell, full custom
Foundry	CMOS, NMOS
Prototype Manufacturing	
Production Manufacturing	

MANUFACTURING

Technology

5.0- and 2.0-micron silicon-gate NMOS
3.0- to 1.2-micron single/double metal/poly CMOS
5.0-micron silicon-/metal-gate CMOS
18V high-voltage CMOS
10V poly capacitor analog CMOS
2.0-micron CMOS EPROM
4-inch wafers

Facilities

Taiwan	92,000 sq. ft.	Total space
	17,000 sq. ft.	Wafer fab

PRODUCTS

Memory

Device	Description	Process	Access Time
UM4501	512x9 Parallel FIFO	CMOS	50-120ns
UM4502	1,024x9 Parallel FIFO	CMOS	50-120ns
UM2332/2333	4Kx8 ROM	NMOS	250-450ns
UM2364/2366	8Kx8 ROM	NMOS	200-450ns
UM23128	16Kx8 ROM	NMOS	200-450ns
UM23256	32Kx8 ROM	NMOS	200-450ns
UM23C256	32Kx8 ROM	CMOS	N/A
UM2148/2149	1Kx4 High-Speed SRAM	NMOS	45-70ns
UM6104	1Kx4 SRAM	CMOS	120-250ns
UM6116	2Kx8 High-Speed SRAM	CMOS	70-120ns
UM6167	16Kx1 High-Speed SRAM	CMOS	45-55ns
UM6168	4Kx4 High-Speed SRAM	CMOS	45-55ns

Consumer ICs

Device	Description
UM3128/3135	8-Digit Solar Cell CMOS Calculator
UM3161	Simple Melody Generator
UM3481	Multi-Instrument Melody Generator
UM3491	Dual-Tone Melody Generator
UM3511A	Melody Organ Generator
UM3521/3522	Paper Organ
UM3561/3562	Three-Siren Sound Generator
UM3621/3641/3763	Voice Control IC
UM3750/3751	Encoder/Decoder
UM5000	Speech Synthesizer
UM5102	Voice Processor for Answering Machines
UM3205	LCD Countdown Timer
UM3206	4-Digit Countdown/Countup Timer
UM3210/3211	Analog LCD Watch
UM3216/3217	Digital LCD Watch
UM3262	Analog Clock
UM3280	World Time Clock
UM3711/3712	Sensor Touch-Controlled Dimmer

Microcomponents

UM8048/35/49/39	8-Bit Single-Chip MCU
UM8051/8031	8-Bit Single-Chip MCU
UM6502/6507/6512	8-Bit MPU
UM6845/9007	CRT Controller

PRODUCTS

Microcomponents

Device	Description
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 and Driver
UM82C88	Bus Controller
UM82C01	Capacitance Keyboard Encoder
UM82288	Bus Controller for iAPX286 Processors
UM82284	Clock Generator/Ready Interface for iAPX286 Processors
UM8253/8254	Programmable Interval Timer
UM8259A	Programmable Interrupt Controller
UM2661	EPCI IC
UM2681	DUART
UM6520/6521	Peripheral Interface Adapter (PIA)
UM6522	Video Interface Adapter (VIA)
UM6532	RAM I/O Timer Array
UM6551	Asynchronous Communications Interface Adapter (ACIA)
UM146818	Real-Time Clock Plus RAM (RTC)

New Microcomponent Products

UM82C086	Single Chip for 10-MHz PC XT
UM82C286/82C287	Two-Chip Set for PC AT
UM85C301	System Support for PS/2 Model 30
UM85C302	I/O Support for PS/2 Model 30
UM85C313	FCD Support for PS/2 Model 30
UM85C314	Single-Chip MCGA
UM85C303	Single-Chip FDC for PS/2 Model 30
UM85C304	Singe-Chip MCGA and MGA
UM82290	Two Serial Ports and One Parallel Port
UM82C550	Advanced ACE
UM82C50A	CMOS ACE
UM82C450	COS ACE
UM486	Single-Chip Monochrome Graphics Adapter
UM487	Single-Chip MGA and CGA
UM85C561/85C562	Micro Channel Interface Chip
UM53C80	SCSI Bus Controller

PRODUCTS

Data Converter ICs

Device	Description
UM7106/7107	3-1/2-Digit A/D Converter
UM7126	Digit A/D Converter
UM70C171	CMOS DAC

Telecommunications

UM9151/40992/40993	Simple Pulse Dialer
UM91603C/91610/91611	Repertory Pulse Dialer
UM9169	Simple Tone Dialer
UM91213C/D	Tone/Pulse Dialer
UM91230	Tone/Pulse Redialer
UM91250	Repertory Tone/Pulse Dialer
UM9160/91531	Slave T/P Dialer
UM9161	Direct Access Adapter
UM92100	Crosspoint
UM9203/9204/92870	DTMF Receiver

ASICs

Mask Programmable Logic Arrays

UA10MP/UA20MP

Gate Arrays

Product	Linewidth	Gates
UA1000 Series	N/A	N/A
UA1200 Series	3.0 Microns	300 to 920
UA1300 Series	2.0 Microns	1,200 to 3,000

Cell-Based Libraries

Product	Description
UASTD30 Series	3.0-Micron, 1 Layer Poly, 1 Layer Metal
UASTD20 Series	2.0-Micron, 1 Layer Poly, 1 Layer Metal
UASTD15 Series	1.5-Micron Series, 1 Layer Poly, 2 Layers Metal

Silicon Compilers

Data Path Module, PLA Module, PAD Module, FIFO Module, RAM Module, ROM Module, Random Logic Module, and User-Specific Module

Universal Semiconductor Inc.
1925 Zanker Road
San Jose, CA 95112
408/436-1906
Fax: 408/436-1125

ESTABLISHED: April 1978
NO. OF EMPLOYEES: 50

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company
President	Vic Hejmadi	Investment Management Intl.
Chief Operating Officer	Jack Yuan	Hewlett-Packard
Chief Financial Officer	George Yan	Burroughs
VP Sales/Marketing	J. Michael Wilson	AMD
VP Operations	Alan Sabanosh	Harris
VP Engineering	Les Foster	Supertex
VP Design	Harry Peterson	Fairchild
VP Quality	Uday Koppiker	Motorola

FINANCING

Date	Round	Sources	Amount
1979	Round 1	Aetna; Allstate Insurance; Michigan Capital; Montgomery Securities; U.S. Venture Partners	$3.0M
Aug. 1985	Round 2	Aetna; Chartered Electronics Industries; Michigan Capital; U.S. Venture Partners	$2.0M
Aug. 1986	Round 3	Investment Management International	$5.0M

BACKGROUND

Universal Semiconductor was formed to develop and produce high-speed, high-density 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 an R&D lab and as a small-volume manufacturer. Financing secured in early 1979 enabled the firm to redefine its business to include custom IC fabrication, manufacturing of standard memory products, and technological and engineering services.

In August 1986, Investment Management International (IMI) acquired Universal Semiconductor and the product rights to Telmos, Inc., a manufacturer of analog ICs.

Universal recently announced the development of a high-voltage CMOS/DMOS technology utilizing a radiation-hardened dielectric isolation fabrication process. The smart power technology allows 500V n- and p-channel transistors to be integrated on the same chip with 15V signal-processing CMOS transistors.

This capability, coupled with the Company's established ISO-RAD technology, makes it possible for Universal to produce products suited for military and aerospace applications in telecommunications, signal processing, instrumentation, robotics, and computers. The ISO-RAD technology is a mixed-signal analog and digital silicon-gate 15V CMOS technology that will withstand one megarad of total dosage of gamma radiation.

Product offerings include gate arrays with complexities of up to 6,000 gates, high-performance analog/digital arrays, high-voltage arrays, high-voltage standard products, CMOS flash converters, and video and instrumentation DACs. The Company also supports a 68000-series family including 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 CMOS gate arrays from 360 to 1,800 gates.
	June 1983	Siliconix announced that it would set up a design center for Universal's silicon-gate arrays in Swansea, Wales.
Western Digital	Aug. 1983	Universal granted Western Digital a license to second-source Universal's CMOS gate arrays.

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.
Silicon Systems	Aug. 1986	Universal acquired a second-source agreement between Telmos and Silicon Systems for the fabrication of the Company's analog/digital arrays.

SERVICES

Design
Manufacturing
Assembly
Test

MANUFACTURING

Technology

1.5- to 5.0-micron silicon-gate CMOS (p-well)
1.5- to 5.0-micron silicon-gate CMOS (n-well)
Analog/digital CMOS (15V)
High-voltage CMOS/DMOS ICs (200V and 500V)

Facilities

San Jose, CA	29,500 sq. ft.	Total area
	4,000 sq. ft.	Class-100 clean room
	480 sq. ft.	Class-10 clean modules

PRODUCTS

CMOS Gate Arrays

Family	Process	Linewidth (Microns)	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 6,000

Analog/Digital Arrays

Family	Process	Linewidth (Microns)	Digital Gates	Analog Cells
USI-6000	Si-Gate (15V)	4.0 Digital 6.0 Analog	135-660	VCO Filters, Bandgap References, Op Amp, A/D Converters, Switch Cap Filter, High-Speed Comparator

Standard Products

Device	Description
High-Voltage	
USH5008	180V Analog Switch
USH5800	250V Push-Pull Driver
USH 5801/5802	450V Octal Drivers
USH 5501/5511/5551	High-Voltage Photovoltaic Relays
Analog Conversion	
USC1070 Series	7-Bit CMOS Flash Converter
USC1850 Series	8-Bit CMOS High-Speed Video DAC
USC1863	Triple 6-Bit DAC
USC1841	Quad 8-Bit Instrumentation DAC
Digital	
USC-SL2002	Dual-Channel NRZI Encoder/Decoder
USC-SL3000	Manchester Encoder/Decoder
USC-SL6000 Series	9-Bit Bidirectional Registers with Parity
USC68HC138	Address Decoder
USC68HC551	Asynchronous Communications Interface Adapter
USC68HC908	Programmable Interrupt Controller

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408/433-6000
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ESTABLISHED: December 1983
NO. OF EMPLOYEES: 80

BOARD

Name	Affiliation
Alex Au	Vitelic Corporation, president/CEO
Teruaki Aoki	Sony Corporation, deputy senior general manager
Neill Brownstein	Bessemer Venture Partners, L.P., general partner
Kazuo Inamori	Kyocera Corporation, chairman
Harry Marshall	J.H. Whitney & Company, general partner
Jim Riley	Dataquest Incorporated, senior vice president

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Alex Au	Fairchild	Dir Research
Exec VP/COO	Will Kauffman	Intel	VP Quality & Rel
VP Sales/Mktg	Gary Ater	NMB	VP/GM US Ops
VP R&D	Michael Barry	Fairchild	Dir CMOS/VLSI Lab
VP Asian Ops	John Seto	Hyundai	Dir Operations
VP Finance/Admin	Art Wang	Raychem	GM Malaysia and Thailand
VP Taiwan Corp	Chun Ho		

FINANCING

Date	Round	Sources	Amount
March 1984	Round 1	Bessemer Venture Partners; INCO Securities Corp.; Kyocera International; Oak Investment Partners; Oxford Venture Fund; Waverley Vencap; J.H. Whitney	$7.0M
Aug. 1985	Round 2	Original investors; Pathfinders Chappell; Sony Corporation	$7.2M
Aug. 1987	Round 3	Bessemer Venture Partners; INCO Venture Capital Management; Kyocera; Oak Investment Partners; Oxford Venture Fund; Sony; Waverley; J.H. Whitney	$2.0M

BACKGROUND

Vitelic designs, develops, manufactures, and markets high-performance specialty memory devices based on 1.2-micron CMOS manufacturing technology. The Company specializes in application- and customer-specific memory devices. Vitelic was founded by Alex Au, former director of VLSI research at Fairchild Camera and Instrument Corporation.

In 1987, Vitelic established a customer-specific memory business to serve the needs of board-level and system designers. The focus of the new department will be on supermini, supermicro, and high-performance workstations, as well as graphics and image-processing products.

Vitelic contracts all manufacturing to several Asian manufacturers through various licensing agreements.

Recent Highlights

June 1987	Vitelic offered the low-power 16Kx4 SRAM V61C62 family, which features an access time of 45ns.
June 1987	Vitelic offered a series of three high-speed CMOS 16K SRAMs with an access time as fast as 35ns.
July 1987	Will Kauffman joined Vitelic as executive vice president and chief operating officer. He is responsible for all engineering and manufacturing functions including design, product and process development, and product quality. Most recently, he was vice president of quality and reliability at Intel.
July 1987	Vitelic offered two new 2Kx8 dual-port RAMs available with access times of 55ns, 70ns, and 90ns. The V61C32 is a fully arbitrated device featuring simultaneous/asynchronous access on two SRAM ports.
Aug. 1987	Vitelic raised $2.0 million in third-round financing.
Aug. 1987	Vitelic received a complaint filed by Intel for patent infringement. Vitelic believes that it has no liability with respect to this action.
Dec. 1987	Vitelic offered the V53C256 and V53C258, its first 256K high-performance DRAMs. Both are organized as 256Kx1 and feature an access time as fast as 70ns, fast page mode, and static column functions.

ALLIANCES

Kyocera	March 1984	Kyocera participated in the first-round financing of Vitelic.
ERSO	May 1984	ERSO and Vitelic agreed to codevelop EPROMs and 64K and 256K CMOS DRAMs.
Sony	June 1985	Vitelic and Sony signed an agreement giving Sony access to Vitelic's 256K CMOS DRAM and 64K SRAM technologies in exchange for fab capacity.
NMB	July 1985	Vitelic granted a license for its 1Mb DRAM to NMB in exchange for one-third of NMB's plant capacity.
Hyundai	July 1985	Hyundai obtained a license to produce Vitelic memory products in exchange for manufacturing capacity. Vitelic memory products include 16K CMOS SRAMs, and 64K, 256K, and 1Mb CMOS DRAMs.
Philips	March 1986	Philips and Vitelic agreed to a broad-ranging agreement that gave Vitelic access to Philips' process technology. In exchange, Vitelic would design a family of high-performance CMOS SRAMs for manufacture, use, license, and sale by both companies.
Sanyo	Oct. 1986	Sanyo and Vitelic would jointly develop a high-speed 64K SRAM family. Sanyo would manufacture the SRAMs, using 1-micron process technology. The agreement includes the manufacture of the products that Vitelic designs for Philips, using Philips' process developed by Tokyo Sanyo.

SERVICES

Design
Engineering Services
Test

MANUFACTURING

Technology

2.0- to 1.0-micron CMOS (n-well)
VICMOS III

Facilities

San Jose, CA	33,000 sq. ft.	Headquarters and design
Taiwan		Engineering and test

PRODUCTS

	Device	Organization	Access Time (ns)
CMOS DRAM	V53C256/258	256Kx1	70-100
	V53C466/464	64Kx4	70-100
	V53C100102	1Mbx1	80-120
	V53C104/105	256Kx4	80-120
CMOS SRAM	V63C64	8Kx8	25-45
	V61C16	2Kx8	35-70
	V61C68	4Kx4	35-55
	V61C67	16Kx1	35-55
Dual-Port RAM	V61C32	2Kx8	55-90
FIFO	V61C01	512x9	25-65
	V61C02/3	1Kx9	25-65
Video RAM	V53C261	64Kx4	80-100

Vitesse Semiconductor Corporation
741 Calle Plano
Camarillo, CA 93010
805/388-3700

ESTABLISHED: July 1984
NO. OF EMPLOYEES: 80

BOARD

Name	Affiliation
Pierre R. Lamond, chairman	Sequoia Capital, general partner
Dr. T.J. Rodgers	Cypress Semiconductor Corp., president

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Dr. Louis Tomasetta	Rockwell	Dir R&D Center
Executive VP	Patrick Hoffpauir	VLSI Technology	GM ASIC Ops
VP Sales	Neil Rappaport	AMCC	Ntl Sales Mgr
VP Engineering	Ira Deyhimy	Rockwell	Mgr IC Engr
VP Operations	James Mikkelson	Hewlett-Packard	Mgr Process Dev
VP Finance/CFO	Michael A. Russell	Avicon Intl	VP Finance/CFO

FINANCING

Date	Round	Sources	Amount
Aug. 1984	Round 1	Norton Company	$30.0M
Feb. 1987	Round 2	Bryan & Edwards; New Enterprises Assoc.; The Norton Company; Oxford Venture Corp.; Robertson, Colman & Stephens; Sequoia Capital; Spectra Enterprises; Walden Capital; J.H. Whitney	$10.0M
Jan. 1988	Round 3	Previous investors; Hook Partners; Mohr Davidow Ventures; Morgenthaler Ventures; Oak Investment Partners; Singapore Development Board	$ 8.1M

BACKGROUND

Vitesse Semiconductor Corporation designs, manufactures, and markets cost-effective digital gallium arsenide (GaAs) large-scale ICs for the high-performance marketplace and offers foundry services on a contract basis. Products are manufactured using enhancement/depletion mode transistors and self-aligned gate technology according to silicon manufacturing techniques. Its first products were commercial versions of a family of GaAs ICs, including gate arrays, RAMs, and logic products.

Initially, the Company was organized into two divisions--the Integrated Circuits Division, which was responsible for GaAs IC designs, and the Digital Products Division, which was developing a minisupercomputer product. Early in 1987, the Integrated Circuits Division raised $10 million, establishing an independent company, and was renamed Vitesse Semiconductor Corporation. Dr. Louis Tomasetta, formerly president of the IC Division, is president and CEO of the new company. Dr. Tomasetta was director and program manager of the $40 million DARPA GaAs pilot program at Rockwell International.

Vitesse remains in the existing 45,000-square-foot facility and will use the additional funding raised in 1987 to develop additional products and expand into higher-volume production. The building is designed specifically for the production of LSI-level digital ICs in GaAs. Approximately 12,000 square feet have been designated as clean room area, and half of that area is a Class-10 clean room.

In March 1987, Pierre R. Lamond was elected chairman of the board. Mr. Lamond organized the $10 million financing of Vitesse Semiconductor and also serves on the boards of Convex Computer, Cypress Semiconductor, and several other private companies. In October 1987, Dr. T.J. Rodgers, president and CEO of Cypress Semiconductor Corporation, joined the board of Vitesse Semiconductor.

Vitesse has established a nationwide network of manufacturers' representatives to sell its foundry services and products. In June 1987, Vitesse signed Zeus as its first distributor to sell its 29G00 family of products.

Recent Highlights

June 1987 Vitesse and Ford Microelectronics agreed to second-source each others' IC foundry services. The companies will develop common design rules.

June 1987 Vitesse offered GaAs versions of the 2900 family of slice processors, produced through a licensing agreement with Advanced Micro Devices.

Aug. 1987 Vitesse signed an agreement allowing E-Systems to use Vitesse's proprietary GaAs technology in its current and future programs. E-Systems also has an option to purchase design, packaging, and test technologies. The agreement allows Vitesse to participate in the EW systems market through E-Systems' military programs.

Sept. 1987 Vitesse agreed to develop a GaAs cell library for VLSI Technology's design tools. Vitesse would develop the library and VLSI would provide technical information and assistance in the porting effort. When the library is completed, designers will be able to go to VLSI for the IC design tools and to Vitesse for the library and fabrication. VLSI plans to extend the library to its compiler library.

Sept. 1987 Vitesse offered its first digital GaAs ICs fabricated with an E- and D-MESFET transistor process. They include a family of 1,500- and 4,500-gate arrays. The arrays combine ultrahigh-speed, moderate-power and high-speed, very-low-power cells and are tailored for telecom fiber-optic MUX/DEMUX, computer, backplane, tester, and instrumentation applications.

Vitesse also offered the VS12G22E, a 256x4 SRAM with an access time of 3ns. The device is ECL RAM-compatible, has 1.5-watt power dissipation, and is radiation hardened.

Oct. 1987 Vitesse announced that Dr. T.J. Rogers had joined the board of directors.

Oct. 1987 Vitesse and Ford Microelectronics agreed to second-source each others' IC foundry services. The companies will develop common design rules.

Dec. 1987 Vitesse signed a sales and marketing agreement with TRW Components International Inc. (TRWCI) covering logic, memory, and ASIC products. Vitesse will supply high-performance wafers, die, and packaged devices to TRWCI which TRWCI will assemble, test, qualify, and sell the devices to the space-quality, Class-S level market. In addition, the companies will work to solve the radiation problems found in logic and memory products.

Jan. 1988 Vitesse raised $8.1 million in second-round financing. Approximately $4 million was raised from previous investors and $4 million from new investors. The funds will be used to expand its sales network worldwide and to broaden its product offerings, which target the high-speed computing, telecommunications, and aerospace markets.

Jan. 1988	Vitesse introduced the VS8001, a 1.25-GHz 12-to-1 multiplexer, and the VS8002 1-to-12 demultiplexer with ECL-compatible parallel I/O. The devices offer 12-bit parallel-to-serial and serial-to-parallel data conversion for communications applications. A unique feature is a self-test path designed to allow the devices to test each other.
March 1988	Vitesse announced that it has developed the VS8010, a MUX/DEMUX with control logic that meets the Synchronous Optical Network (SONET) standard at the 1.2-Gbit/second communications rate.
March 1988	Vitesse was selected by DARPA to develop GaAs SRAMs for its use as fast-cache memories. The award is in support of the DARPA-sponsored high-speed GaAs MIPS (Microprocessor without Interlocked Pipe Stages) RISC MPU development program. The SRAMs will be supplied to McDonnell Douglas and Texas Instruments, two contractors developing the MPUs.

ALLIANCES

Norton	July 1984	The initial investment of $30 million in Vitesse was provided by the Norton Company, a $1.3 billion company of Worcester, Massachusetts.
AMD	Nov. 1985	Vitesse and AMD agreed to develop and manufacture AMD's AM2900 family of MPUs in gallium arsenide.
TRW	Dec. 1986	Vitesse signed a sales and marketing agreement with TRW Components International Inc. (TRWCI) covering logic, memory, and ASIC products. Vitesse will supply high-performance wafers, die, and packaged devices to TRWCI, which will assemble, test, qualify, and sell to the space-quality, Class-S level market. The companies will also cooperate to solve the radiation problems found in logic and memory products.
E-Systems	Aug. 1987	Vitesse signed an agreement allowing E-Systems to use Vitesse's proprietary GaAs technology in its current and future programs. E-Systems also has an option to purchase design, packaging, and test technologies. The agreement allows Vitesse to participate in the EW systems market through E-Systems' military programs.

VLSI Technology	Sept. 1987	Vitesse will develop a GaAs cell library for VLSI's design tools. VLSI will provide technical information and assist in the porting effort. When the library is completed, both companies will market the tools, which Vitesse will use internally. VLSI will extend the tools to its silicon compiler library; Vitesse will own the library and provide fabrication.
Ford	Oct. 1987	Vitesse and Ford Microelectronics agreed to second-source each others' IC foundry services. The companies will develop common design rules.

SERVICES

GaAs Foundry
Design
Manufacturing
Packaging
Test

MANUFACTURING

Technology

GaAs E/D MESFET
1.25 microns
3-inch wafers

Facilities

Camarillo, CA	45,000 sq. ft.	
	6,000 sq. ft.	Class-10 clean room

PRODUCTS

Foundry

LSI Enhancement/Depletion Mode Process, 1.25-Micron Feature Size, Sub-100ps Gate Delays

	Device	Description
Gate Arrays	VSC1500	Structured Cell Array
	VSC4500	Gate Array

SRAMS	VS12G422E	256x4 SRAM, 3,4,5ns
	VS12G422T	256x4 SRAM, 4,6,8ns, TTL I/O
Microcomponents	VS29G01	4-Bit Slice Processor
	VS29G02	Look-Ahead Carry Generator
	VS29G10	Microcontroller
Standard Products	VS8001	12:1 MUX at 1.2 GHz
	VS8002	1:12 DEMUX at 1.2 GHz
	VS8010	SONET MUX/DEMUX

VLSI Design Associates, Inc.
910 Campisi Way
Campbell, CA 95008
408/371-7400

ESTABLISHED: May 1980
NO. OF EMPLOYEES: 40

BOARD

Name

Mark R. Guidry, chairman, president, CFO
Carolyn C. Guidry, secretary
Richard S. Miller, VP analog products
K. Venkateswaran, VP digital products

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CFO	Mark Guidry	Fairchild Semiconductor	Manager
VP Analog Prod	Richard Miller	Fairchild Semiconductor	Manager
VP Digital Prod	K. Venkateswaran	Fairchild Semiconductor	Manager

FINANCING: Initial capital was provided by founders, receivable financing by Saratoga National Bank.

BACKGROUND

VLSI Design Associates was formed to provide application-specific IC design, prototyping, and production services for electronic systems OEMs. The Company specializes in mixed analog and digital devices. Products are developed using the Company's standard cells and automated design tools. Proprietary design rules allow for multisource wafer fabrication. The Company has established strategic alliances with production foundries.

In 1984, the Company introduced its first standard IC product--the V3829 floppy disk separator. The offering was followed by the V8500, a SCSI bus interface device introduced in 1986, and the V8580, a SCSI bus host device introduced in 1987. In March 1988, the Company announced the VDA-176, the first product in a family of RAMDAC devices. The device features a 256x18 SRAM color look-up table with triple 6-bit D/A converters for use as a color palette in computer graphics systems. A pipeline design allows pixel rates of up to 80 MHz. A pixel word mask allows displayed colors to be changed in a single write cycle, rather than by modifying the look-up table.

SERVICES

Design
Prototypes
High-Rel Processing
Test

MANUFACTURING

Technology

1.2- to 5-micron CMOS

Facilities

Campbell, CA	8,000 sq. ft.	Design and test

PRODUCTS

Device	Description
V3829	Floppy Disk Separator
V8500	SCSI Bus Interface Device
V8580	SCSI Bus Host Device
VDA-176	Color Palette RAMDAC

VLSI Technology, Inc.
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San Jose, CA 95131
408/434-3000
Fax: 408/263-2511
Telex: 278807

ESTABLISHED: August 1979
NO. OF EMPLOYEES: 1,300

BOARD

Name	Affiliation
Alfred J. Stein, Chairman	VLSI Technology, Inc.
Pierre S. Bonelli	Sema-Metra
David C. Evans	Evans & Sutherland Computer Corporation
James Fiebiger	VLSI Technology, Inc.
James J. Kim	AMKOR Electronics, Inc.
Dodge Chu	Wang Laboratories, Inc.

COMPANY EXECUTIVES

Position	Name
Chairman/CEO	Alfred J. Stein
President/COO	James Fiebiger
VP/GM ASIC Division	Douglas G. Fairbairn
VP ASIC Memory Division	Mark Siegel
VP Sales and Marketing	William Caparelli
VP Finance	Kenneth A. Goldman
VP Product Marketing, ASICs Products	Peter Bagnall
VP Logic and Government Products	Douglas Bartek
VP Personnel	Ernst W. Hirt
VP Manufacturing Operations	Leon Humble
VP Europe	Dieter Mezger
VP Design Centers, ASIC Division	Atiq Raza
VP Wafer Fabrication	David N. Ledvina

FINANCING

Date	Round	Sources	Amount
Dec. 1980	Round 1	Advanced Technology Ventures; Evans & Sutherland; Hambrecht & Quist; Kleiner, Perkins, Caulfield & Byers; Rothschild, Inc.; Venrock Associates	$10.0M
Aug. 1981	Round 2	Bendix Corp.	$17.0M

Feb. 1983	Round 3	Initial public offering	$53.0M
Jan. 1984	Round 4	Wang Laboratories, Inc.	$34.0M
April 1986	Round 5	Second public offering	$33.0M
April 1987	Round 6	Bond offer	$57.5M

BACKGROUND

VLSI Technology, Inc., is a broad-based supplier of products that include memories, proprietary logic products, ASICs, and ASIC design tools. The Company provides a total ASIC solution including IC design software and libraries for gate arrays, cell-based ICs, silicon compilers, and full-custom designs. In addition, VLSI's CMOS and HMOS wafer fabrication facilities are geared specifically for multiple processes and quick turnaround.

VLSI continues to design and introduce advanced memory products, not only to generate revenue, but to keep its service standards and manufacturing technology at 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. In 1987, VLSI offered the VT7C122 1K SRAM with access and cycle times of 15ns and 20ns respectively; 16K RAMS; and the VT7132A and VT7142A, two dual-port SRAMs with a 30ns access time; in addition to other memory devices.

VLSI offers a wide range of other logic products, many of which are designed for data communications and telecommunications applications. These 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.

In the last year, VLSI expanded its technological base to include a CMOS five-chip set for an integrated IBM PC AT-compatible motherboard that, in the standard configuration, is said to reduce the total circuit count of a system to 36. In addition, Oak Technology and VLSI agreed to codevelop IBM PS/2 logic chips, using VLSI's software tools. First products will be a three-chip set and a video graphics array, due in the second quarter of 1988. VLSI also signed an agreement with Vitesse to develop a GaAs cell library for VLSI Technology's design tools.

The Company's corporate headquarters and primary manufacturing facilities are located in San Jose, California. In June 1987, VLSI broke ground for a 250,000-square-foot, 6-inch wafer fab facility in San Antonio, Texas. The facility is expected to be operation in late 1988. The plant will be equipped with a Class-1 clean room and, initially, will be used for fabricating CMOS ASIC devices with minimum feature sizes down to 1.2 microns. Two divisions, the Application-Specific Logic Division and the Government Products Division, are located in Phoenix, Arizona. Virtually all of its assembly and much of its final product testing are subcontracted to third parties, namely, AMKOR Electronics, Inc., and Rockwell International.

Products are available through offices of Arrow Electronics and Schweber Electronics, as well as from a network of franchised sales representatives and authorized independent design centers.

The Company was formed by three individuals who were involved in the formation of Synertek. Jack Baletto was formerly Synertek's director of marketing; Dan Floyd, Synertek's former vice president of manufacturing; and Gunnar Wetlessen, Synertek's former manager of memory products and process technology.

In 1987, Dataquest reported that the Company showed an increase in gate array revenue, from $5.5 million in 1986 to $25.0 million in 1987. The increase advanced VLSI Technology from 30th place to 11th place in the marketplace.

Recent Highlights

Jan. 1986 VLSI signed an eight-year lease for up to 50,000 square feet of R&D, engineering, and pilot manufacturing space in the International Microelectronics Innovation Center (IMIC) at the Arizona State University Research Park in Tempe, Arizona.

Dec. 1986 VLSI acquired Visic, Inc., for $525,000. Visic operates as a wholly owned subsidiary of VLSI and maintains its own board of directors with members from both Visic and VLSI. VLSI manufactures products designed by Visic and markets under the VLSI label.

Dec. 1986 Evans & Sutherland (E&S), a maker of image generators, announced that it may sell part of its interest in VLSI Technology to help finance its design of a high-performance, general-purpose computer. E&S will continue to have access to VLSI's foundry where its semicustom graphics chips are made.

Jan. 1987	VLSI offered the VT16AM8, a 16K dual-port RAM that has an access time of 60ns. The left port is 16 bits wide, and the right port is 8 bits wide, to allow simultaneous, independent access by both 8- and 16-bit MPUs.
Feb. 1987	VLSI Technology upgraded its ASIC operations into a separate division, joining the memory, logic, and government divisions. The ASIC Division accounts for about 70 percent of VLSI's sales. Douglas G. Fairbairn, formerly vice president of design and technology and founder of VLSI, has been promoted to the new position of vice president and general manager of the new ASIC Division.
Feb. 1987	VLSI beta-tested two new silicon compilers, the state machine and datapath compilers, that speed the design cycle and can send output to gate arrays for quick-turn manufacturing.
Feb. 1987	VLSI offered the VT7C122 1K SRAM with access and cycle times of 15ns. It is organized as 256Kx4 and is designed to facilitate the expansion of memory arrays.
March 1987	VLSI and Acorn Computers Ltd., England, introduced a RISC MPU and three key peripherals as a cluster for 32-bit workstations. The circuits were jointly developed by the two companies with VLSI's CAD tools and are being fabricated by VLSI with its 2-micron CMOS process.
March 1987	VLSI and Thomson-Mostek signed an agreement for mutual second-sourcing and memory product development. Each company gave five memory designs for second-sourcing, including FIFOs, dual-port RAMs, cache-tag RAMs, and SRAMs.
March 1987	VLSI offered the VL16C452, a CMOS dual-asynchronous communications device that includes a Centronics-style printer interface. The device drives the printer interface directly, without external buffers.
April 1987	VLSI Technology sold $57.5 million worth of 7 percent subordinated debentures convertible to common stock. Proceeds were used to fund new ASIC designs, defray expenses incurred by the acquisition of Visic, Inc., and finance the new fab in San Antonio.
April 1987	VLSI Technology repurchased a $7.6 million warrant issued to Bendix Corporation in 1981.

April 1987 Zilog agreed to allow VLSI to second-source its Super8 MCU. VLSI would manufacture and market the Super8, the Z8038 FIFO I/O interface unit, and the Z8060 FIFO buffer unit and FIFO expander.

May 1987 VLSI offered a CMOS five-chip set for an integrated IBM PC AT-compatible motherboard that, in the standard configuration, reduces the total circuit count of a system to 36. The set supports 1Mb DRAMs and can be used in systems with clock speeds of up to 12 MHz. The devices are fabricated in 2-micron CMOS and are designed from VLSI Technology's library of core cells. The set includes the following:

- VL82C100 PC AT peripheral controller
- VL82C101 PC AT system controller
- VL82C102 PC AT memory controller
- VL82C103 PC AT address buffer
- VL82C104 PC AT data buffer

June 1987 VLSI broke ground on a 250,000-square-foot, 6-inch wafer fab facility in San Antonio. The plant is equipped with a Class-1 clean room and, initially, will fabricate CMOS ASIC devices with minimum feature sizes down to 1.2 microns. The Company plans feature sizes below 1.0 micron. The facility is expected to begin operation with 100 employees in late 1988.

July 1987 VLSI offered the VT7132A and VT7142A dual-port SRAMs organized as 2,048 8-bit words and with a 30ns access time. Each port can be used to access the memory array independently, because the ports have separate address, input/output, chip enable, output enable, write enable, busy, and interrupt control pins.

July 1987 VLSI Technology agreed to allow GE Solid State to produce and market its VGT10 and VGT100 families of CMOS gate arrays. The VGT10 ranges from 1,600 to 10,000 gates and uses a 2-micron process, the VGT100 ranges from 12,000 to 67,000 gates and uses a 1.5-micron process.

Aug. 1987 Mark Siegel was named vice president of the Application-Specific Memory Products Division. He replaces David Handorf who left the Company to become president of ZyMOS. Mr. Siegel also serves on the board of directors of VLSI's Visic subsidiary, with Visic president Joel Karp reporting to him. Mr. Siegel comes from Signetics Corporation where he was vice president and general manager of the ASIC division.

Aug. 1987	VLSI Technology's Government Products Division in Phoenix has been certified for production of devices fully compliant with MIL-STD-883C, paragraph 1.2.1. The division also offered two high-speed SRAMs, the VM64KS5 and VM65KS4 64K SRAMs with an access time of 45ns.
Sept. 1987	Vitesse will develop a GaAs cell library for VLSI Technology's design tools. VLSI will provide technical information and assist in the porting effort. When the library is completed, both companies will market the tools, which Vitesse will use internally. VLSI will extend the tools to its silicon compiler library; Vitesse will own the library and provide fabrication.
Nov. 1987	VLSI and Daisy offered a design kit for Daisy's CAE workstation that can design gate arrays with up to 50,000 usable gates. The kit also supports standard cells.
Nov. 1987	VLSI offered the VL83C11, a general-purpose SCSI bus transceiver circuit. The 2-micron CMOS device is intended for use with the NCR 53C86 SCSI protocol controller family.
Nov. 1987	Oak Technology and VLSI will codevelop IBM PS/2 logic chips, using VLSI's software tools. First products will be a three-chip set and a video graphics array, due in the first quarter of 1988. VLSI will manufacture the chips; both companies will market the chips.
Dec. 1987	James R. Fiebiger was named president and chief operating officer, replacing Henri Jarrat who resigned in December.
Dec. 1987	VLSI completed the conversion to 5-inch wafers.
Dec. 1987	VLSI reincorporated in Delaware.
April 1988	VLSI and Harris Semiconductor signed an agreement to codevelop a radiation-hardened gate array family named VGH. The family will be based on VLSI Technology's high-density VGT200 gate array family and Harris' GAMMA III radiation-hardened VHSIC-like CMOS process. The agreement also provides for future cooperation between Harris and VLSI in commercial and non-radiation-hardened military gate arrays.
April 1988	VLSI and Sanyo Electric Company signed an agreement allowing Sanyo to manufacture and market VLSI Technology's 32-bit VL86C010 ACORN RISC machine IC family worldwide.

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's preferred stock; $2 million in R&D funding, and a $15 million equipment lease line.
Ricoh	1982	Ricoh provided all wafers.
	1983	VLSI and Ricoh agreed to exchange technology for NMOS and CMOS mask ROMs. VLSI provided 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, an R&D center set up by the Korean government, signed an agreement under which VLSI licensed its 32K ROM technology in exchange for silicon foundry services. VLSI also trained members of KIET in implementing the process and using 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 $34.0 million. In addition, VLSI developed custom products for Wang's office automation products. Evans & Sutherland purchased 10 percent of VLSI's stock.
Visic	Feb. 1984	VLSI and Visic agreed to design and market CMOS RAM technology and products. Products included were 64Kx1 and 16Kx4 CMOS DRAMs.
	1987	VLSI acquired Visic for about $525,000.
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 in exchange for foundry services.

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 that design circuits using Silicon Compilers' design system.
Western Digital	1984	Western Digital (WD) and VLSI entered a three-year joint agreement under 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 Systems (ICS).
Rockwell	1985	VLSI and Rockwell agreed on the joint development of 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 would develop analog standard cells for VLSI's library.
Honeywell	April 1985	VLSI acquired the manufacturing and marketing rights to devices previously produced by Synertek, including a CRT controller, interface circuits, a 4K SRAM, and a 16K ROM.
National Semiconductor	April 1985	National Semiconductor supplied CMOS EPROM technology to VLSI. VLSI manufactured the part and supplied wafers to National.
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 were 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.
	Nov. 1987	VLSI and Daisy offered a design kit for Daisy's CAE workstation that can design gate arrays with up to 50,000 usable gates. The kit also supports standard cells.

Zilog	June 1985	VLSI and Zilog reached a five-year agreement under 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 (HP) that allows HP to use selected VLSI design tools on HP workstations.
MEM	1985	VLSI transferred its process technology to Microelectronics-Marin (MEM) for new manufacturing capacity to be installed by MEM and used by VLSI.
Olivetti	1985	VLSI and Olivetti established a joint design center in Italy.
Bull Group	1985	Bull was licensed to use VLSI's design technology for development of computer products.
University of Louvain	1985	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 Systems	1986	Mosaic Systems and VLSI agreed to build die and plug them together on the Mosaic process after applying high-density packaging techniques.
Intel	1986	VLSI and Intel codeveloped a single-chip interface for the Intel-based Multibus II system bus architecture. VLSI manufactures the part; both companies market the device.
Acorn Computers	May 1986	VLSI and Acorn Computers of Cambridge, Great Britain, introduced high-performance, single-chip 32-bit RISC and associated controller chips. Acorn will develop systems with the new ICs; VLSI will market them worldwide.
TCMC	March 1987	VLSI and Thomson-Mostek (TCMC) signed an agreement covering second-sourcing and product development. Each company gave five memory designs for second-sourcing, including FIFOs, dual-port RAMs, cache-tag RAMs, and SRAMs.

Zilog	May 1987	Zilog agreed to allow VLSI to second-source its Super8 MCU, Z8038 FIFO I/O interface unit, Z8060 FIFO buffer unit, and FIFO expander.
GE Solid State	July 1987	VLSI Technology agreed to allow GE Solid State to produce and market its VGT10 and VGT100 families of CMOS gate arrays. The VGT10 ranges from 1,600 to 10,000 gates and uses a 2-micron process; the VGT100 ranges from 12,000 to 67,000 gates and uses a 1.5-micron process.
Vitesse	Sept. 1987	Vitesse will develop a GaAs cell library for VLSI's design tools. VLSI will provide technical information and assist in the porting effort. Both companies will market the tools, which Vitesse will use internally. VLSI plans to extend the tools to its silicon compiler library; Vitesse will own the library and provide fabrication.
Oak Technology	Nov. 1987	Oak Technology and VLSI will codevelop IBM PS/2 logic chips, using VLSI's software tools. First products will be a three-chip set and a video graphics array, due in the first quarter of 1988. VLSI will manufacture the chips; both companies will market the chips.
Harris	April 1988	VLSI and Harris Semiconductor signed an agreement to codevelop a radiation-hardened gate array family named VGH. The family will be based on VLSI Technology's high-density VGT200 gate array family and Harris' GAMMA III radiation-hardened VHSIC-like CMOS process. The agreement also provides for future cooperation between Harris and VLSI in commercial and non-radiation-hardened military gate arrays.
Sanyo	April 1988	VLSI and Sanyo Electric Company signed an agreement allowing Sanyo to manufacture and market VLSI Technology's 32-bit VL86C010 ACORN RISC machine IC family worldwide.

SERVICES

Design
Foundry
Manufacturing

MANUFACTURING

Technology

3.0-, 2.0-, 1.5-, 1.25-micron silicon-gate HMOS and HCMOS
(4- and 5-inch wafers)

Facilities

San Jose, CA	220,000 sq. ft.	Corporate headquarters, manufacturing, design, sales and marketing
Phoenix, AZ	50,000 sq. ft.	Application-specific logic and government products
San Antonio, TX	250,000 sq. ft.	6-inch wafer fab facility with Class-1 clean room
Munich, West Germany		European headquarters

PRODUCTS

Application-Specific Memory Products

ROMs	256K 512K 1Mb ROM (150ns)
SRAMs	16Kx4 HCMOS SRAM (35ns) 2Kx8 HCMOS SRAM (20ns) 4Kx4 8Kx8
Dual-Port RAM	1Kx8 (100ns) 2Kx8 (30ns)

CMOS Gate Arrays

Family	Process	Linewidth (Microns)	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 (Microns)	Delay (ns)	Cells
Cell Compiler	CMOS	1.5	16.0	10 Gates, 16 MSI, RAM, ROM, PLA, All Are User Customized
Cell Compiler	CMOS	1.5	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

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 into Standard Cell Layouts
Multiplier Compiler, 2-Microns for Military Applications, Digital Signal-Processing, and High-Performance Computer Applications

VTC Incorporated
2401 East 86th Street
Bloomington, MN 55425-2702
612/851-5200
Fax: 612/851-5199
Telex: 857113

ESTABLISHED: May 1984
NO. OF EMPLOYEES: 550

BOARD

Name	Affiliation
D. Pennie	Control Data Corporation
R. Lillestrand	Control Data Corporation
J. Buckner	Control Data Corporation
D. Powers	Control Data Corporation
G. Garretson	Control Data Corporation

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
Acting President/CEO	D.B. Griffith	Control Data	VP/GM
VP/CFO	J.R. Martin	Fairchild	Div Controller
VP Operations	E.M. Schnable	National	Operations Mgr
VP Resources	D.A. Orton	Fairchild	Engr Mgr

FINANCING: From 1984 through 1987, VTC financed its capital equipment and facility requirements with operating leases totaling about $75 million. In July 1987, employees of VTC, who collectively owned 51 percent of the Company, sold their ownership interest to Control Data Corporation (CDC), giving CDC 100 percent of VTC's common stock.

BACKGROUND

VTC Incorporated designs, manufactures, and markets a broad line of high-performance linear and digital ICs, using bipolar and CMOS process technologies. The Company also offers a wide range of semicustom and custom ASICs, as well as a portfolio of standard products for the aerospace, telecommunications, and computer markets.

In the linear area, products include linear signal-processing (LSP) devices and and mass storage devices. The signal-processing devices include very fast operational amplifiers, buffers, comparators, transconductance amplifiers, and sample/hold and data converters. These products are the highest-performance products in their respective classes, rivaling expensive hybrid circuits. In the mass storage area, the Company offers a full line of preamplifiers, data separators, channel devices, voltage-controlled oscillators, and tape drive servo controllers. These devices have speeds and features available from only a few suppliers and are aimed at the high-performance end of the market.

VTC is perceived to have very good cell-based libraries in bipolar and CMOS technologies. Products manufactured using the libraries are often modified and turned into standard parts. VTC also provides a complete set of CAD tools supporting its libraries.

The Company is also perceived to have a leadership position in the following linear areas: preamplifiers for disk drives and ultrahigh-speed op amps. VTC is expected to have 1988 sales of about $50 million and plans to be a $100 million company by 1990.

In the first quarter of 1986, VTC occupied an additional 170,000-square-foot facility. The facility includes a 30,000-square-foot Class-1/Class-10 clean room. The Company makes its 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 June 1987, VTC signed a merger agreement under which it became a wholly owned subsidiary of Control Data Corporation, its largest investor and major customer. Terms were not disclosed. Control Data has invested $56 million in VTC since it was founded and holds nonvoting preferred shares convertible to 49 percent of the Company's voting stock.

Recent Highlights

Jan. 1987	Integrated Device Technology (IDT) agreed to allow VTC to second-source its FCT product line of TTL-compatible CMOS logic devices.
March 1987	TRW Components International and VTC signed a three-year agreement to cross sample space-quality, Class-S devices. VTC will supply TRW with unpackaged ICs that meet Class-S specs; TRW will assemble, test, qualify, and market the devices. They include radiation-hardened CMOS SRAMs, comparators, amps, and transceivers.

April 1987	VTC was awarded a $7.5 million contract from the Control Data Corp., Government Systems Division to supply chips for the U.S. Navy's AN/AYK-14(V) standard airborne computer. The contract calls for the production of five VLSI chip-types designed with VTC's 1-micron CMOS standard cell library.
May 1987	VTC agreed to provide its 1.6- and 1.0-micron two-layer metal CMOS process to users of Genesil, the silicon development system offered by Silicon Compilers Systems Inc. (SCS). VTC will also develop a radiation-hardened cell and other macrocells for the system.
May 1987	VTC offered the VL3000, a 6-GHz linear/digital bipolar cell library. It allows users to mix linear and digital circuits on the same chip, without redesigning at the transistor level. The library contains more than 100 predefined linear, digital, and memory functions.
June 1987	VTC became a wholly owned subsidiary of CDC. Terms were not disclosed.
Sept. 1987	VTC won a contract to design, develop, and manufacture a VME bus interface IC (VMIC) for the VME Technology Consortium. The VMIC combines interface, bus arbitration, and interrupt-handling components and will use a 1-micron CMOS cell-based process with embedded PLA.

ALLIANCES

CDC	Oct. 1984	Control Data Corporation invested $56 million in VTC and holds nonvoting preferred shares convertible to 49 percent of the Company's voting stock. The arrangement includes a fabrication technology license.
	1987	VTC became a wholly owned subsidiary of CDC. Terms were not disclosed.
	1987	VTC was awarded a $7.5 million contract from CDC's Government Systems Division to supply chips for the U.S. Navy's AN/AYK-14(V) standard airborne computer. The contract calls for the production of five VLSI chips designed with VTC's 1-micron CMOS cell library.

Silicon Compilers	May 1986	VTC agreed to provide its 1.6- and 1.0-micron two-layer metal CMOS process to users of Genesil, the silicon development system offered by SCI. VTC will also develop a radiation-hardened cell for Genesil and additional macrocells for SCI's silicon compiler system.
IDT	Jan. 1987	IDT agreed to allow VTC to second-source its FCT product line of TTL-compatible CMOS logic devices.
TRW	March 1987	TRW Components International and VTC signed a three-year agreement to cross sample space-quality, Class-S devices. VTC will supply TRW with unpackaged ICs that meet Class-S specs; TRW will assemble, test, qualify, and market the devices. They include radiation-hardened CMOS SRAMs, comparators, amps, and transceivers.
VME Technology Consortium	Sept. 1987	VTC won a contract to design, develop, and manufacture a VME bus interface IC (VMIC) for the VME Technology Consortium. The VMIC combines interface, bus arbitration, and interrupt-handling components and will use a 1-micron CMOS cell-based process with embedded PLA.

SERVICES

Design
Foundry
Manufacturing
Assembly
Test

MANUFACTURING

Technology

3.0- and 2.0-micron bipolar linear
2.0-micron bipolar digital
1.2- and 0.9-micron two-layer metal CMOS

Facilities

Bloomington, MN	140,000 sq. ft.	Headquarters, manufacturing
	30,000 sq. ft.	Class-1 and Class-10 clean rooms
	20,000 sq. ft.	Manufacturing

PRODUCTS

Gate Arrays

Family	Process	Linewidth (Microns)	Delay (ns)	Gates
VG6000	CMOS	1.6	0.7	8,000
VJ800	1-GHz Bipolar	3.0	N/A	1,600 Active Components
VJ900	6-GHz Bipolar	2.0	N/A	382 Active Components

Cell Library

Family	Process	LEFF (Microns)	Delay (ns)	Cells
VL1000	Bipolar	3.0	1.50	170 Cells: 100 Digital, 70 Analog
VL2000	Bipolar	2.0	0.30	88 Cells: ECL or TTL I/O
VL3000	Bipolar	2.0	0.40	120 Cells: 90 Digital, 30 Analog
VL5000	CMOS	1.0	0.57	26 Gates, 27 MSI, 8 I/O, 20 LSI

Silicon Compiler

Family	Process	Linewidth (Microns)	Cells
VL7000	CMOS	1.6	RAM, ROM, FIFO, PLA
VL8000	CMOS	1.0	RAM, ROM, FIFO, PLA

Linear Signal Processing

Operational Transconductance Amplifiers (OTA)

Transconductance Amp, 75-MHz Bandwidth
Transconductance Amp with Buffer, 75-MHz Bandwidth
Dual-Transconductance Amp, 75-MHz Bandwidth
Dual-Transconductance Amp with Buffer, 75-MHz Bandwidth

Video Amplifiers

Low-Noise 733 Video Amp
Low-Noise 592 Video Amp

Operational Amplifiers

High-Speed Precision Op Amp
High-Speed, Fast-Settling Op Amp
Dual High-Speed Precision Op Amp
Quad High-Speed Precision 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
Sample and Hold Amplifier
Low-Voltage Amplifier
Unity Gain Buffer Amplifiers

Data Converters

8-Bit Flash A/D, 250 MHz
8-Bit Video DAC, 200 to 300 MHz
V/F Converter, 0-20 MHz
12-Bit DAC, 125ns Settling Time
12-Bit A/D, 2 and 5 Microsecond Conversion Rates

Comparators

Very Fast Comparator, 2.0ns and 1.9ns Delays
Ultrafast Comparator, 2.0ns and 1.9ns Delays
TTL Comparator, 6.0ns and 6.5ns Delays
Ultrafast Dual Comparator, 2.5ns and 2.8ns Delays
Dual TTL Comparator, 8.0ns and 8.5ns Delays

Line Drivers

NTDS Driver/Receiver

Mass Storage

Disk Drive Read/Write Preamplifiers, Ferrite Heads
Disk Drive Read/Write Preamplifiers; Center-Tapped, Thin-Film Heads
Disk Drive Read/Write Preamplifiers, Thin-Film Heads
Disk Drive Read/Write Preamplifiers, Vertical Heads

Servo Preamplifier, Ferrite Head
Servo Preamplifier, Ferrite Head, Low Noise
Servo Preamplifier, Thin-Film Head

Mass Storage

Disk Drive Read Channel
Disk Drive Read/Write Channel
Tape Drive Clock Synchronizer
Tape Write Driver

V54/74 FCT/ACT Interface Logic Family

Octal Buffers and Line Drivers
10-Bit Buffers and Line Drivers
Octal Bus Transceivers
9-Bit and 10-Bit Bus Transceivers
Octal D-Type Transparent Latches
9-Bit and 10-Bit D-Type Transparent Latches
Octal D-Type, Edge-Triggered Flip-Flops
9-Bit and 10-Bit D-Type, Edge-Triggered Flip-Flops
Dual 4-Bit D-Type, Edge-Triggered Flip-Flops

WaferScale Integration, Inc.
47280 Kato Road
Fremont, CA 94538
415/656-5400

ESTABLISHED: August 1983
NO. OF EMPLOYEES: 103

BOARD

Name	Affiliation
Dr. Eli Harari, Chairman	WaferScale Integration, Inc.
Ralph Ungermann	Ungermann-Bass
Harry Marshall	J.H. Whitney
Jim Swartz	Accel Partners
Donald K. Grierson	WaferScale Integration, Inc.
Richard Santilli	RCA Corporation
Henry Kressel	Warburg Pincus Capital Partners

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Sheldon Taylor	Intel	GM Prog Memory Ops
VP Technology	Stephen C. Su	Synertek	Dir Adv Tech
VP ASIC Prod	Zel A. Diel	GigaBit Logic	VP Prod Dev
VP Marketing	Shira Shamssian	Gnostic Concepts	Chairman/CEO
VP Sales	Robert Casel	Oki Semiconductor	VP Sales/Mktg
Dir Finance	Robert J. Barker	MMI	Mgr Finance
Dir Ops	James H. Henshaw	Intel	Mgr SRAM/Mil Ops

FINANCING

Date	Round	Sources	Amount
Feb. 1984	Round 1	Accel Partners; Adler & Co.; Bessemer; Genevest (Switzerland); Intergraph; Oak Investment Partners; Robertson, Colman & Stephens; Smith Barney Venture Corp.; Tadiran (U.S.) Inc.; Venture Partners II; Warburg-Pincus; J.H. Whitney;	$16.1M
	Lease	Bank of America; Bateman Eichler Leasing Corp.; Equitec	

Nov. 1984	Round 2	Original investors; Baillie Gifford & Co. (Scotland); Continental Illinois Venture Corp.	$ 8.5M
April 1986	Round 3	Original investors; Intergraph Corp.; RCA Corporation; Sharp Corporation	$13.0M
July 1987	Round 4	Accel Partners; Adler; Bessemer Venture Partners; GE/RCA; Intergraph Corp.; Kyocera; Robertson, Colman & Stephens; Warburg Pincus; J.H. Whitney	$ 8.0M

BACKGROUND

WaferScale Integration, Inc. (WSI), designs and manufactures high-performance CMOS reprogrammable ICs that incorporate advanced CMOS EPROM capability.

WSI offered an 8Kx8 RPROM (UV erasable reprogrammable PROM) in the first quarter of 1986. In mid-1987, WSI introduced two 256K CMOS EPROMs that use the Company's patented, self-aligned split gate EPROM technology. The EPROMs feature an access time of 55ns and provide one- and two-chip program-store solutions for 16- and 32-bit MPU and DSP applications. WSI also supplies high-speed CMOS bit-slice processors and peripheral circuits.

In addition, the Company offers the capability to combine EPROM, SRAM, and complex system logic functions on a single IC in its CMOS macroblock cell library. The macroblock library provides VLSI EPROM, SRAM, and a family of high-performance bit-slice processor cells (from 4 bits to 32 bits). The library also contains bit-slice peripherals cells including microprogram controllers, variable pipelines, FIFOs, multipliers, bus registers, and register files.

WSI focuses on high-performance markets that include telecommunications, minicomputers, local area networking, digital signal-processing, array processing, high-resolution color graphics, and military avionics and communication. WSI market involvement presently includes 55 percent office automation, 25 percent telecommunications, 15 percent military, and 5 percent other. The Company is directing efforts to balance office automation, telecommunications, and military to roughly 30 percent each by 1990.

WSI has leveraged its partnerships with Altera Corporation, GE Solid State, Intergraph Corporation, Kyocera Corporation, and Sharp Corporation to invest its capital into advancing its technology and realigning products to match market shifts.

Sharp and GE Solid State have invested in WSI through equity positions, and both companies hold WSI technology licenses. Altera and Intergraph are two additional strategic alliances involving either equity and/or technology. The Kyocera alliance involves equity and distribution of WSI products in Japan.

WSI's products are manufactured at Sharp Corporation's plant at Fukuyama, Japan. The facility produces 5-inch wafers with 1.2-micron CMOS VLSI circuits in a Class-1 clean room environment. In the United States, GE/RCA manufactures circuits for WSI in a Class-10 facility, using 1.0-micron CMOS on 5-inch wafers.

WSI's products are sold worldwide through a sales network that includes a combination of regional and direct sales managers, manufacturers' representative companies, and components distributors.

Recent Highlights

Jan. 1987 Altera and WSI announced a 5-year technology relationship to develop a new family of standalone microsequencer products with wafers manufactured by Sharp of Japan.

Jan. 1987 WSI offered the WS57C43, a 4Kx8 RPROM that features an address access time as fast as 55ns and output enable time as fast as 20ns.

March 1987 WSI offered the WS57C128, a 16Kx8 CMOS EPROM with an access time of up to 50ns and output enable time of down to 25ns.

March 1987 WSI offered the WS57C53, a 4Kx8 EPROM with an access time of 55ns and an output enable time of down to 20ns.

March 1987 WSI offered the WS57C65, a 4Kx16 CMOS EPROM with access time versions from 90ns down to 55ns.

April 1987 WSI offered the WS27C64F, a CMOS 8Kx8 EPROM that has memory access times ranging from 90ns to 200ns.

May 1987 WSI offered the WS59510, a 16X16 parallel multiplier/accumulator that is a 16-bit parallel multiplier followed by a 35-bit accumulator. It operates at a multiply/accumulate throughput of 30ns at a clock rate of 33 MHz.

June 1987 WSI offered the WS57C43, a 4Kx8 RPROM with an address access time of down to 55ns and output enable time of down to 20ns.

June 1987	WSI offered the WS57C49B, an 8Kx8 CMOS RPROM with an access time of 35ns for commercial devices
June 1987	WSI received a patent on its self-aligned split-gate CMOS EPROM process.
July 1987	WSI raised $8.0 million in fourth-round financing.
July 1987	WSI and GE/RCA expanded the terms of their previous EPROM agreement to include U.S. manufacturing. Under a long-term foundry agreement, WSI will be guaranteed volume capacity at GE/RCA's new 5-inch wafer fab module in Findley, Ohio. WSI will transfer its 1.2-micron fast CMOS EPROM process to Findley. GE/RCA will use the process to manufacture ASIC circuits and second-source some of WSI's EPROM memory products.
Nov. 1987	Zel A. Diel was named vice president of ASIC products, which is a new position. He is responsible for all of WSI's ASIC programs and will oversee WSI's line of CMOS bit-slice processors and peripherals. Prior to joining WSI, Mr. Diel was vice president of product development at GigaBit Logic.
Nov. 1987	WSI offered the MagicPro, an IBM PC XT-/AT-based engineering programmer designed to program WSI programmable products on a prototype basis.

ALLIANCES

Sharp	Dec. 1984	WSI agreed to allow Sharp to use its technology and produce a 64K CMOS EPROM. WSI received manufacturing capacity and royalties. Development and production of 256K CMOS EPROMS were planned.
	Oct. 1985	WSI and Sharp expanded the 1984 agreement to include WSI's 1.6-micron CMOS technology in exchange for royalties and foundry capacity.

GE/RCA Sharp	March 1986	GE/RCA and Sharp signed a five-year agreement with WSI to develop an advanced cell library. WSI's library of LSI macrocells will be combined with cell libraries from GE/RCA and Sharp. The companies also jointly developed 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.
	July 1987	WSI and GE/RCA expanded the terms of their previous EPROM agreement to include U.S. manufacturing. Under a long-term foundry agreement, WSI will be guaranteed volume capacity at GE/RCA's new 5-inch wafer fab module in Findley, Ohio. WSI will transfer its 1.2-micron fast CMOS EPROM process to Findley. GE/RCA will use the process to manufacture ASIC circuits and second-source some of WSI's EPROM memory products.
Altera Sharp	Jan. 1987	Altera and WSI announced a five-year technology relationship to develop a new family of standalone microsequencer products with wafers manufactured by Sharp of Japan.

SERVICES

Design

MANUFACTURING

Technology

SCMOS I: 2.0-micron, double-metal CMOS
SCMOS II: 1.2-micron, double-metal CMOS
4- and 5-inch wafers

Facilities

Fremont, CA	66,000 sq. ft.	Design and test

PRODUCTS

Memory

Device	Organization	Access Time
WS57C191/291	2Kx8 RPROM	45ns
WS57C43	4Kx8 RPROM	35, 55ns
WS57C49	8Kx8 RPROM	35, 55ns
WS57C51	16Kx8 RPROM	40, 70ns
WS27C64	8Kx8 Byte-Wide EPROM	55, 90ns
WS57C128	16Kx8 Byte-Wide EPROM	55, 90ns
WS57C256	32Kx8 Byte-Wide EPROM	55, 90ns
WS57C65	4Kx16 Word-Wide EPROM	55ns
WS57C257	16Kx16 Word-Wide EPROM	55ns

Microcomponents

WS5901	4-Bit Bit-Slice Processor	43 MHz
WS59016	16-Bit Bit-Slice Processor	432 MHz
WS59032	32-Bit Bit-Slice Processor	25 MHz
WS5910	Microprogram Controller	30 MHz
WS59520	Multilevel Pipeline Register	45 MHz
WS59510	16X16 Multiplier/Accumulator	30ns
WS59820	16-Bit Bidirectional Bus Interface Register	50 MHz

ASICs

Modular Cell Library	Combines EPROM and System Functions with 1.2-Micron Technology to Produce Devices with Sub-1.0ns Delay. Functions Include 4-Bit to 32-Bit Bit-Slice Processors, Microprogram Controllers, Variable Pipelines, FIFOs, Multipliers, Bus Registers, Register Files, ROM, RAM, PLD, 75 Gates, and 26 MSI.

Weitek Corporation
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408/738-8400
Fax: 408/739-4374
Telex: 910-339-9545

ESTABLISHED: 1981
NO. OF EMPLOYEES: 134

BOARD

Name	Affiliation
G. Leonard Baker	Sutter Hill Ventures
Arthur J. Collmeyer	Weitek Corporation
David House	Intel Corporation
Gerald Lodge	InnoVen Partners
Arthur Reidel	Alex Brown
James Patterson	Quantum Corporation

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Arthur Collmeyer	Calma	VP/GM Microelec Div
VP Sales	Robert T. Derby	Intel	Dir WW Sales/Mktg
VP Operations	Steven Farnow	Visic	Dir Ops
VP Marketing	John F. Rizzo	Apple	Mktg Mgr
VP Finance	A. Brooke Seawell	Southwall Tech	VP Finance/Admin
VP Admin	John Steihart	Stanford Univ	Dir Sloan Program
VP Corp Dev	Ed Sun	Hewlett-Packard	Mgr IC Resch Lab
VP IC R&D	John J. Barnes	SGS-Thomson	Dir Tech Dev

FINANCING

Date	Round	Sources	Amount
Jan. 1981	Round 1	InnoVen	$1.0M
Feb. 1982	Round 2	InnoVen, Sutter Hill Ventures	$1.3M
March 1983	Round 3	InnoVen; Institutional Venture Partners; Merrill, Pickard, Anderson & Eyre; Sutter Hill Ventures	$2.2M
Jan. 1986	Round 4	All of the above, Alex Brown; Glynn Capital	$3.0M

BACKGROUND

Weitek designs, manufactures, and markets digital signal-processing circuits for high-performance numerics-processing applications. The Company's goal is to make arithmetic-processing power available on a broad scale to systems developers. The Company's product strategy is to offer a complete range of products, including building blocks that achieve maximum system performance, attached processors for maximum price/performance, and coprocessors for the lowest system cost.

In March 1988, Weitek introduced three new products. The WTL2364 multiplier/WTL2365 ALU chip set is a double-precision vector floating-point processor chip set that implements the IBM 370 Basic Floating-Point Facility standard. It is capable of 32 million floating-point operations per second (mflops) for single-precision operations and up to 16 mflops for double-precision operations. The WTL3364 and WTL3164 are two 64-bit floating-point processors that operate at a peak rate of 20 mflops for the 100ns speed grade. The floating-point processors each integrate a 64-bit multiplier, 64-bit ALU, a divide/square-root unit, 32-word by 64-bit six-port register file, and status and control logic on one chip.

Currently, the Company purchases wafers in the foundry market from VLSI Technology Inc. Long-term wafer processing is guaranteed under agreements with Cypress Semiconductor, Hewlett-Packard Company, and Intel Corporation. Processes available to Weitek are 2.0-micron NMOS and 1.5-micron double-metal CMOS from Intel, 1.2-micron CMOS from HP, 1.2-micron double-metal CMOS from Cypress, and 1.5-micron NMOS and CMOS from VLSI Technology Inc.

Weitek was founded in 1981 by Godfrey Fong, Dr. Edmund Sun, and Dr. Chi-Shin Wang and operated initially as a custom design house specializing in ROMs. In 1985, the Company began offering advanced circuit design semiconductors that use advanced concepts in numerics processing.

Recent Announcements

Feb. 1987	Weitek offered a new high-performance floating-point coprocessor board, the WTL1167, for Intel's 80386 32-bit MPU. The WTL1167 plugs into a 121-pin socket, called the extended math coprocessor (EMC) socket, which is a superset of the 80387 socket. C, FORTRAN, and Pascal compilers support the WTL1167.
May 1987	Hewlett-Packard will incorporate the Weitek model 2264/65 chip set for high-performance, floating-point computation in current and future HP Precision Architecture computers. HP will also manufacture the chip, using a 1.2-micron CMOS process.

June 1987	Weitek and Intergraph announced that Intergraph's new model 360 engineering and modeling workstations offer the Weitek 2264/2265 vector floating-point processor for those applications requiring high-speed arithmetic computation.
July 1987	Weitek announced that its XL-8032 and XL-8000 numerics processors are featured in the GP2 graphics processor included in the new CXP line of workstations from Sun Microsystems. In addition, the Sun-4/200 series of workstations features Weitek's 1164 and 1165 numerics coprocessors.
July 1987	Weitek announced that the 1167 high-speed floating-point coprocessor is available as an option in Convergent Technologies' new Server PC, a high-performance departmental server for networked PCs and terminals.
Sept. 1987	Weitek and Compaq Computer Corporation announced that the WTL1167 floating-point coprocessor will be available as an option for the new COMPAQ DESKPRO 386/20.
Sept. 1987	Weitek announced that its 1167 floating-point coprocessor is supported in the new AT&T PC 6386 systems. Both the 16- and 20-MHz versions of the AT&T PC 6386 feature the Intel 80386 MPU and a special socket for the Weitek coprocessor.
March 1988	Weitek introduced three new products. The WTL3364 and WTL3164 are two 64-bit floating-point processors that operate at a peak rate of 20 mflops for the 100ns speed grade. The processors each integrate a 64-bit multiplier, 64-bit ALU, divide/square-root unit, 32-word X 64-bit six-port register file, and status and control logic. The WTL2364 multiplier and WTL2365 ALU chip set is a double-precision vector floating-point processor chip that implements the IBM 370 Basic Floating-Point Facility standard. The chip set is capable of 32 mflops for single-precision operations and up to 16 mflops for double-precision operations.
April 1988	Weitek announced that the WTL1167 floating-point coprocessor is featured as an option in the new Sun 386 workstation family.

ALLIANCES

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 would second-source and for which Intel would provide foundry services on 6-inch NMOS and CMOS wafer-processing equipment.
NSC	Oct. 1985	National Semiconductor announced that it would design, manufacture, and market an interface chip.
Step Engineering	March 1986	Step Engineering agreed to produce development tools for the debugging and microcoding of Weitek's floating-point integer processor designs.
Quadtree	April 1986	Weitek announced that Quadtree Software would develop behavioral simulators for the WTL2264/2265 chip sets.
HP	May 1987	Hewlett-Packard would incorporate the Weitek model 2264/2265 chip set for high-performance, floating-point computation in current and future HP Precision Architecture computers. HP would manufacture the chip, using a 1.2-micron CMOS process.

SERVICES

Design

MANUFACTURING

Technology

2.0- and 1.5-micron NMOS
1.2-micron, one-level metal CMOS
1.5-, 1.2-, 1.0-, 0.8-micron, two-level CMOS

Facilities

Sunnyvale, CA	50,000 sq. ft.	Administration, design, R&D

PRODUCTS

Device	Description	Speed
16-Bit Integer Family		
WTL2516	16x16 Parallel Multiplier	38ns
WTL2517	16x16 Parallel Multiplier	38ns
WTL2010	16x16 Multiplier/Accumulator	45ns
WTL2245	16x16 Multiplier/Accumulator	45ns
32-Bit Floating-Point Family		
WTL1232/1233	Multiplier/Adder	10 mflops
WTL3132	Data Path Unit	20 mflops
WTL3332	Data Path Unit	20 mflops
64-Bit Vector Floating-Point Family		
WTL1264/1265	Multiplier/Adder	8 mflops
WTL2264/2265	Multiplier/ALU	20 mflops
WTL2364/2365	Multiplier/ALU, Double-Precision	32 mflops
64-Bit Floating-Point Coprocessor Family		
WTL1167	80386 Coprocessor	3.5 mflops
WTL1164/1165	Multiplier/Adder/Divider	3.5 mflops
WTL3164	Data Path Unit	100ns, 20 mflops
WTL3364	Data Path Unit	100ns, 20 mflops
XL-Series Family		
XL-8000	32-Bit Integer Processor	8 mips
XL-8032	32-Bit Single-Precision Processor	8 mips, 20 mflops
XL-8064	64-Bit Double-Precision Processor	7 mips, 20 mflops
XL-8136	Program Sequencing Unit	
XL-8137	Integer-Processing Unit	

Development Tools for the XL-Series Family

XL-Series C Compiler-Based Software Development Environment
XL-Series FORTRAN-Based Software Development Environment

PS-8000	XL-Series Prototyping System for the XL-8000
PS-8032	XL-Series Prototyping System for the XL-8032
PS-8064	XL-Series Prototyping System for the XL-8064

Functional Simulators for All Weitek Components

Wolfson Microelectronics Limited
Lutton Court,
20 Bernard Terrace
Edinburgh, EH8 9NX Scotland
031/667-9386
Fax: 031/667-5176
Telex: 727659

ESTABLISHED: January 1985
NO. OF EMPLOYEES: 28

BOARD: Not available

COMPANY EXECUTIVES

Position	Name
Managing Director	David Milne
Technical Director	James Reid
Finance Manager	Neil Hattersley

FINANCING: Not available

BACKGROUND

Wolfson Microelectronics Limited designs, manufactures, and markets ASICs and specializes in the development of complex mixed analog and digital circuits. The Company offers IC design using semicustom and full-custom approaches including gate arrays with up to 20,000-gates, cell-based libraries in 3.0-, 2.0-, 1.5-, and 1.2-micron CMOS technology, and full-custom design using a range of CMOS and bipolar technologies.

Wolfson Microelectronics Limited evolved from the Wolfson Microelectronics Institute at Edinburgh University. The Company, although completely autonomous, retains its technological links with the academic research activities of the university.

The Company has developed an extensive CAD capability based on a network of Sun workstations to provide an integrated design environment for semicustom and structured custom design. The emphasis of its work has been signal processing. The Company has developed a 2-micron digital library of macro cells with variable parameters for digital designs and an extensive analog library of linear and nonlinear functions.

ALLIANCES: Wolfson has manufacturing arrangements with AMS, Fujitsu, Mietec, and SGS-Thomson.

SERVICES

System Analysis
Design
Assembly
Test

MANUFACTURING

Technology

All processes are for second-sourcing capability.

1.2-, 1.5-, 2.0-, 3.0-Micron SPSM/SPDM CMOS Digital Process
2.0-Micron SPDM BIMOS Analog Process
2.0-Micron SPDM CMOS Analog Process
3.0-Micron DPDM/DPSM CMOS Analog Process
4.0-Micron DPSM CCD Analog Process
5.0-Micron DPSM CMOS Analog Process

PRODUCTS

Current Products

WM 2020	Dual 15-Pt Tapped Delay Line
WM 2210	Dual 15-Pt Tapped Delay and Integrate
WM 2120	64-Pt Programmable Transversal Filter
WM 2130	256-Pt Programmable Transversal Filter
PWM 213	512-Pt Correlator Module
PWM 215	1,024-Pt VME Correlator Module

Future Products

WM 3201	Fifth Order, Low-Pass Elliptical Continuous Time Filter; Cutoff 5 KHz to 50 KHz
WM 33XX	Semicustom Switched Capacitor Family
WM 5110	128-Pt Complex Digital Programmable Transversal Filter
WM 5120	Digital Programmable Transversal Filter Controller

Xicor, Inc.
851 Buckeye Court
Milpitas, CA 95035
408/432-8888
Fax: 408/432-0640
Twx: 910-379-0033

ESTABLISHED: 1978
NO. OF EMPLOYEES: 803

BOARD

Name	Affiliation
Raphael Klein, chairman	Xicor, Inc., president/CEO
S. Allen Klein	Business Advisor
Julius Blank	Business Consultant
Andrew W. Elder	Xytec International Industries, CEO
Hans G. Dill	Business Consultant

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Raphael Klein	Intel	R&D Prog Mgr
Exec VP Sales/Mktg/Ops	Ari Schifirin	Data General	MOS Mgr
VP Intellectual Prop	William H.Owen, III	Intel	Sr Dsn Engr
VP Strat Planning	Wallace Tchon	Intel	Sr Staff Engr
VP Tech Dev/ Corp Prod Assur	John Caywood	Intel	Mgr Reliability
VP Finance	Klaus Hendig	NBK	Dir Finance
VP Manufacturing	Manuel Mere	IBM	Mgr Mem Ops

FINANCING

Date	Source	Amount
April 1987	Public offering	$22.8M
March 1988	Public offering	$17.0M

BACKGROUND

Xicor, Inc., focuses on designing, developing, manufacturing, and marketing EEPROMs and NOVRAMs. Xicor also offers the EEPOT, an electronically controlled potentiometer that incorporates the Company's memory technology. The Company's product base is 33 percent computer, 14 percent appliance and automotive, 25 percent military, 13 percent industrial controls, and 15 percent telecommunications electronics.

Xicor's strategy is to apply its EE technology toward the development of innovative products that combine nonvolatility and in-system data alterability. Xicor's EEPROMs also offer on-chip, software-controlled write protection that prevents writing to the device during power-up, power-down, and any other unexpected system condition. The Company's NOVRAMs combine a RAM with an EEPROM on the same chip, enabling the device to transfer data from the RAM to the EEPROM in the case of a power failure. The EEPOT offers advantages of automated assembly calibration and elimination of potentiometer access problems.

Xicor also manufactures EEPROMs and NOVRAMs that comply with all requirements of MIL-STD-883 Revision C for Class-B products. The Company received JAN certification for its manufacturing operations in September 1986. Since then, Xicor has received QPL II listing for the X2816A (16Kx8 EEPROM). The QPL I screening and quality conformance inspections will be forthcoming. Xicor is about to apply for QPL II listing for its X2864A (8Kx8 EEPROM) and proceed with qualification.

Xicor's products operate over a wide temperature range and are available in a variety of package options, including plastic, ceramic, and surface mount. In addition to offering standard DIP and LCC, Xicor offers PLCC, SOIC, flat pack, pin-grid array, and sidebraze packages. Products are based on silicon-gate NMOS technology, with several recent introductions based on CMOS. The Company conducts all of its wafer manufacturing and most testing in-house. Assembly is contracted to companies in Taiwan and Korea.

Xicor intends to maintain its leadership position in the EEPROM market through continued efforts to advance its process technology and by identifying new applications for its products. Current product developments are all using a 1.2-micron CMOS process technology. Products include 16K, 64K, 256K, and 1Mb EEPROMs. A 4Mb CMOS EEPROM that will use a 0.8-micron technology is in early development.

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 include Julius Blank, formerly with Fairchild and Nortec, and S. Allen Kline and Paul I. Myers, Jr., both formerly with Intersil.

In November 1987, Xicor established subsidiaries in West Germany and Britain to market its products in Europe. Xicor GmbH, located in Munich, West Germany, is headed by Rick Orlando and is fully staffed to support the German and southern European markets. Xicor Ltd., located in Oxford, United Kingdom, is headed by David Lathan and supports the British and northern European markets. Europe has accounted for 20 percent of Xicor's sales since 1985. Xicor also markets its products in the United States and internationally through a direct sales team and a network of independent sales representatives and nonexclusive distributors.

In March 1988, Xicor completed the sale of 2.59 million shares of common stock in an underwritten public offering. The net proceeds of $19.25 million will be used to establish a second facility adjacent to an existing 4-inch wafer plant in Milpitas, California. The new facility, which will cost about $20 million to build and equip, will be capable of 0.8-micron CMOS 6-inch wafers and will be used to produce the 1Mb CMOS EEPROM currently under development.

Recent Highlights

Oct. 1986	Xicor's California wafer fab facility demonstrated compliance with MIL-M-38510 and MIL-STD-976 requirements. Assembly and test locations have also been approved for product assurance, Class B. Products approved are the X2816A 16K and X2864A 64K EEPROM.
Jan. 1987	Xicor's X28256 EEPROM device met compliance with MIL-STD-883C Class-B qualifications. The qualification effects all versions of the X28256, which consists of four 256K EEPROMs in 32-pad leadless chip carriers. Xicor's 1Mb CMOS EEPROM is also available with 883C-compliant components.
April 1987	Xicor offered 2.2 million shares of common stock in an underwritten public offering. Net proceeds of $22.8 million were used for general corporate purposes.
June 1987	Xicor and Intel terminated a 1985 R&D and technology exchange agreement. Xicor granted Intel warrants to purchase 200,000 shares of common stock at $13 per share. Intel paid $6.5 million for R&D directed toward developing EEPROMs, and both companies cross-licensed their EEPROM technologies. Intel helped Xicor obtain $2.0 million in lease financing in exchange for 241,562 shares of common stock at $10 per share.
Nov. 1987	Xicor established subsidiaries in West Germany and Britain. Xicor GmbH, located in Munich, is headed by Rick Orlando and is fully staffed to support the German and southern European markets. Xicor Ltd., located in Oxford is headed by David Lathan and supports the British and northern European markets. Europe has accounted for 20 percent of Xicor's sales since 1985.
Dec. 1987	Xicor introduced a 1Mb EEPROM module that contains four CMOS 256K EEPROMs surface-mounted on a standard, 20-pin, dual-in-line package.

Dec. 1987	Xicor offered the X24C16 CMOS 16K EEPROM. The device has serial interface and software protocol allowing operation on a two-wire bus.
Dec. 1987	Xicor reported fourth-quarter revenue of $23.1 million and a net profit of $3.2 million. Fiscal 1987 revenue was $64.7 million and net profit was $7.6 million.
March 1988	In March 1988, Xicor completed the sale of 2.59 million shares of common stock in an underwritten public offering. The net proceeds of $19.25 million will be used to establish a second $20 million facility adjacent to an existing 4-inch wafer plant in Milpitas. The new facility will be capable of 0.8-micron CMOS 6-inch wafers and will be used to produce the 1Mb CMOS EEPROM currently under development.

ALLIANCES

Intel	Aug. 1985	Xicor and Intel signed an R&D and technology exchange agreement. Intel paid $6.5 million for R&D directed toward developing EEPROMs, and both companies cross-licensed their EEPROM technology. Intel assisted Xicor in obtaining $2 million in lease financing in exchange for 241,562 shares of common stock at $10 per share. Intel made the last payment to Xicor on the $6.5 million R&D agreement in June 1986.
	June 1987	Xicor and Intel terminated the R&D effort. The cross-licensing and royalty obligations remain in force. Xicor granted Intel warrants to purchase 200,000 shares of common stock at $13 per share.

SERVICES

Design
Manufacturing
Test

MANUFACTURING

Technology

2.0-micron NMOS and CMOS
1.2-micron CMOS double-layer metal in pilot production
4-inch wafers
0.8-micron and 6-inch CMOS wafers planned

Facilities

Milpitas, CA	Building 1	45,000 sq. ft.	Manufacturing, R&D
		2,000 sq. ft.	Class-10 clean room
		17,600 sq. ft.	Class-100 clean room
	Building 2	32,000 sq. ft.	Quick-turn assembly and test
	Building 3	73,600 sq. ft.	Future manufacturing capacity
		25,000 sq. ft.	Class-1 clean room under construction

PRODUCTS

EEPROMs

Device	Description	Access Time (ns)
X2804	4K, 512x8, 8 Bits Accessed in Parallel	250-450
X2816	16K, 2Kx8, 8 Bits Accessed in Parallel	250-450
X28C64	64K, 8Kx8, 8 Bits Accessed in Parallel	70-450
X28256	256K, 32Kx8, 8 Bits Accessed in Parallel	250-350
X28C256	256K, 32Kx8, 8 Bits Accessed in Parallel	250-350
XM28C010	1Mb Module, 8 Bits Accessed in Parallel	200

Serial EEPROMs

Device	Description	Clock Frequency
X2402	2K, 256x8	100 kHz
X2404	4K, 512x8	100 kHz
X24C04	4K, 512x8	100 kHz
X24C16	16K, 2,048x8	100 kHz

NOVRAMs

Device	Description	Clock Frequency
X2210	256 Bits, 64x4, 4 Bits Accessed in Parallel	250, 300
X2201	1K, 1,024x1, 1 Bit Accessed at a Time	300
X2212	1K, 256x4, 4 Bits Accessed in Parallel	250, 300
X2001	1K, 128x8, 8 Bits Accessed in Parallel	200, 250, 300
X2004	4K, 512x8, 8 Bits Accessed in Parallel	200, 250, 300

Serial NOVRAMs

X2444	256 Bits, 16x16	1 MHz

EEPOT Potentiometers

Device	Resistance Range
X9103	0 to 10,000 ohms
X9503	0 to 50,000 ohms
X9104	0 to 100,000 ohms

Xilinx Incorporated
2069 Hamilton Avenue
San Jose, CA 95125
408/559-7778
Fax: 408/559-7114

ESTABLISHED: February 1984
NO. OF EMPLOYEES: 110

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President	Bernard Vonderschmitt	Zilog	VP/GM IC Div
VP Admin	James Barnett	Zilog	Prod Line Dir
VP Eng	Ross Freeman	Zilog	Dir Eng
VP Sales	R. Scott Brown	Menlo Corp.	VP Sales
VP Ops	Frank Myers	Exel	VP Ops
VP Mktg	Wes Patterson	VLSI	Dir Ops
VP Finance/CFO	Gordon Steel	Pyramid	VP Finance/Admin

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	Round-1 investors, Berry Cash Southwest Partnership, InterFirst Venture Co., Interwest Partners, Matrix Partners, Morgan Stanley, Rainier Venture Partners	$8.3M
Jan. 1987	Round 3	Round-1 investors; Fleming Ventures Ltd., InterFirst Venture Co., Interwest Partners, Matrix Partners, Morgan Stanley, Rainier Venture Partners, Security Pacific	$3.4M

BACKGROUND

Xilinx Incorporated is the leading supplier of user-programmable gate arrays for the ASIC market. The Xilinx Logic Cell Array (LCA) uses specially designed static memory cells to store logic and interconnection configuration information generated by Xilinx design software.

The Company was founded by James Barnett, Ross Freeman, and Bernard Vonderschmitt, all formerly with Zilog. Xilinx introduced its first logic cell array, which consists of 1,000 to 1,500 equivalent two-input NAND gates, in November 1985. Since then, products with complexities of up to 9,000 gates have been added and are the largest available today. Designs are performed on PC ATs.

The Company has set up several barriers to entry, including patents, extensive development system software, advanced CMOS process technology, and alternative sources. Advanced Micro Devices is a second source of the Company's logic cell arrays and development system. Xilinx has a foundry arrangement with Seiko Epson, which produces the devices in the Suwa, Japan, plant.

The Company's devices and associated development systems are sold by a sales force that includes five sales offices in North America and one each in the United Kingdom and in Japan; eight field-application engineers; 60 manufacturer's representatives worldwide; 54 North American distributor branches, including Hamilton-Avnet, Insight and Western Microtechnology; and 15 international distributor locations.

Recent Highlights

Jan. 1987	Xilinx raised $3.4 million in third-round financing.
Oct. 1987	Xilinx offered the XC3020, the first in a family of 1.2-micron, user-programmable gate arrays with 1,800 to 2,400 two-input NAND gates and a 40-MHz system clock rate.
Nov. 1987	Xilinx introduced the XC3090, a 9,000-gate, user-programmable gate array.
Nov. 1987	Xilinx's user-programmable gate arrays are available on Viewlogic Systems' Workview workstation. The support allows design and logic simulation on IBM PC ATs.

ALLIANCES

Seiko Epson	Dec. 1985	Xilinx and Seiko Epson agreed to codevelop LCAs and development systems. Seiko Epson will manufacture the LCAs, using Xilinx's proprietary technology. The companies also agreed on the joint development of Seiko Epson's CMOS process. Seiko Epson gained nonexclusive marketing rights to the LCA product in Japan.

MMI/AMD	June 1986	Xilinx and MMI signed a three-year agreement allowing MMI to manufacture and market Xilinx's LCAs and development system. The first product transferred was the XC2064, a 1,200-gate device. Xilinx will supply future members 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

Technology

1.2-micron double-metal silicon-gate CMOS
6-inch wafers

Facilities

San Jose, CA	31,000 sq. ft.	R&D, design, and test

PRODUCTS

Logic Cell Arrays (LCAs)

Device	Description
XC2018	1,800 gates
XC2064	1,500 gates
XC3020	2,000 gates
XC3030	3,000 gates
XC3042	4,200 gates
XC3064	6,400 gates
XC3090	9,000 gates

XACT Gate Array Development System with In-Circuit Emulation
LCA Development System, Hardware and Software
XC2064, UART Design with Encryption/Decryption

XTAR Corporation
9951 Business Park Avenue, Suite A
San Diego, CA 92131
619/271-4440

ESTABLISHED: September 1982
NO. OF EMPLOYEES: 15

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
CEO	Emmett J. Powers	Universal Rsch Labs	Project Manager
President	Anthony J. Miller	Universal Rsch Labs	Dir Engineering
VP Engr	Terrence Coleman	Universal Rsch Labs	Chief Engineer

BACKGROUND

XTAR electronics designs, develops, and manufactures graphics microprocessors, video shift registers, board-level products, and graphics systems. The Company concentrates on the design and development of new products.

XTAR funded the formation of the Company and development 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 two 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.

ALLIANCES: Not available

SERVICES

- Design
- Software Development

MANUFACTURING

Technology

- 3.0-micron CMOS and NMOS
- 1.2-micron CMOS
- 4-inch wafers

Facilities

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

PRODUCTS

X1001/1002	Graphics MPU Chip Set
X1003	Video Shift Register

Zoran Corporation
3450 Central Expressway
Santa Clara, CA 94051
408/720-0444
Fax: 408/749-8057

ESTABLISHED: 1983
NO. OF EMPLOYEES: 70

BOARD: Not available

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	Dale Williams	Rockwell Intl	VP/GM Far East Ops
Exec VP/CTO	Dr. Levy Gerzberg	Stanford Elec Labs	Assoc Dir
VP/GM Far East Ops	Noboru Iino	Rockwell Intl	Tokyo Ops Dir

FINANCING

Date	Round	Sources	Amount
Aug. 1983	Round 1	Adler & Company; Elron Electronics Industries, Ltd., Israel	$ 3.5M
1984	Round 2	Previous investors	$ 1.5M
Oct. 1985	Round 3	Previous 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
April 1987	Round 4	Adler & Company; Concord Partners Elron Electronics Industries, Ltd.; Grace Ventures Corp.; Kleiner, Perkins, Caufield & Byers; Mitsui & Co. Inc.; Montgomery Securities; Vista Ventures; Welsh, Carson, Anderson & Stowe	$ 6.8M

BACKGROUND

Zoran Corporation designs, manufactures, and markets proprietary systems processors and programmable peripherals devices for the digital signal-processing (DSP) market. The Company is focusing on a unique systems design approach and combines VLSI and DSP to integrate DSP functions on single chips.

In June 1986, the Company offered two digital filter processors (DFPs) and a vector signal processor (VSP) in addition to hardware support tools for the VSP. During 1987, Zoran offered new VSP devices, including a VLSI product that implements the IEEE 32-bit FFT algorithm and two 25-MHz and 30-MHz products. In addition, Zoran offered an image compression processor (ICP), which is a scaled-down version of the VSP.

To accelerate the implementation of its processors in end-user products, the Company has embedded algorithms and high-level instructions in 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, a privately held company, was cofounded by Dr. Levy Gerzberg and Yuval Almog. Prior to founding Zoran, Dr. Gerzberg was associate director of 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.

In December 1987, Dale Williams joined Zoran as president and chief executive officer from Rockwell, replacing John Ekiss who resigned in May. Mr. Williams was formerly vice president and general manager of Rockwell International's Far East Operations, divisional manager with Intel, and founder of Monolithic Memories. Mr. Williams will be expanding the Company's marketing effort, particularly in Japan, and directing the Company's move into telecommunications and instrumentation products.

In December 1987, Zoran sold its fabrication facility to Synergy Semiconductor for $4.0 million in cash and notes. The Company stated that the fab, purchased at low cost from Storage Technology in late 1985, served its purpose of facilitating the rapid development of Zoran's first three product families to get to market quickly. In 1988, many of Zoran's customers are entering production, a situation that would outstrip the capacity of the R&D fab. The cost of expanding the fab's capacity and upgrading it to a more advanced process technology was not justified in light of the availability of existing foundries worldwide.

In April 1988, Zoran announced that it opened a Far Eastern headquarters facility in Tokyo, Japan. Heading the facility will be General Manager Noboru Iino, formerly Tokyo operational director at Rockwell Semiconductor. Under Mr. Iino's direction, the facility will provide local user-application engineering support, as well as marketing and sales direction. The Company hopes to capture a share of the DSP applications in the growing Japanese data compression market.

Zoran has a direct sales force with offices in Santa Clara and Los Angeles, California; Boston, Massachusetts; Chicago, Illinois; Tokyo, Japan; and Paris, France; and a worldwide network of manufacturers' sales representatives.

Recent Highlights

Dec. 1986	Zoran offered a low-cost version of its VSP (VSP-10) and two personal computer development boards for the VSP. The VSP-10 is optimized for DSP applications and operates at 10 MHz versus 20 MHz for the VSP-20. The VSP-10 is aimed at instrumentation, medical imaging, and telecommunications applications. To support the VSP chips, Zoran also introduced two development boards, the VSPX and VSPE, for use with an IBM PC XT or PC AT.
March 1987	Zoran introduced Support Tool Environment (STE), a development tool kit that addresses VSP and DFP. Zoran embedded the basic algorithms required in fixed, on-chip logic.
April 1987	Zoran raised $6.8 million in fourth-round financing.
May 1987	John Ekiss resigned as president and CEO of Zoran.
June 1987	Zoran offered an ICP, which is a scaled-down version of the VSP. The device is pin-compatible with the VSP-161, with its instruction set reduced for image applications. The device, which the Company says is the first in the marketplace, targets electronic publishing, satellite, electronic camera, picture data base, and broadcasting applications.
Nov. 1987	Zoran offered the ZR33891-25, a 25-MHz digital filter processor; and ZR33891-30, a 30-MHz digital filter processor. The devices are upgraded digital filter processors designed for imaging, HDTV, and digital radio applications.

Dec. 1987	Dale Williams joined Zoran as president and chief executive officer; Mr. Williams came to Zoran from Rockwell. He will be expanding the Company's marketing effort, particularly in Japan, and directing the Company's move into telecommunications and instrumentation products.
Dec. 1987	Zoran sold its 50,000-square-foot fabrication facility for $4.0 million in cash and notes.
Dec. 1987	Zoran offered the ZR34161 VSP in a 52-pin, ceramic J-leaded package. The device is available in 15-, 20-, and 25-MHz speeds.
Jan. 1988	Zoran and Toshiba agreed to a technology and manufacturing alliance.
March 1988	Zoran and SGS-Thomson agreed to a technology and manufacturing alliance.
April 1988	Zoran announced that it has opened a Far Eastern headquarters facility in Tokyo, Japan. Heading the facility will be General Manager Noboru Iino, formerly Tokyo operations director at Rockwell Semiconductor. Under Mr. Iino's direction, the facility will provide local user applications with engineering support, as well as marketing and sales direction. The Company hopes to capture a share of the DSP applications in the growing Japanese data compression market.

ALLIANCES

IMP	June 1983	IMP and Zoran codeveloped a CMOS PROM technology.
Toshiba	Jan. 1988	Zoran and Toshiba agreed to a technology and manufacturing alliance.
SGS-Thomson	March 1988	Zoran and SGS-Thomson agreed to a technology and manufacturing alliance.

SERVICES

Design
Manufacturing

MANUFACTURING

Technology

1.0- to 2.0-micron, two-level metal CMOS
4-inch, 5-inch, and 6-inch wafers

Facilities

Santa Clara, CA	Headquarters, design
Haifa, Israel	Design center

PRODUCTS

Digital Filter Products

Device	Description
ZR33491	Four Cells; 8x8-Bit Arithmetic; 15, 20 MHz
ZR33881	Eight Cells; 8x8-Bit Arithmetic; 15, 20 MHz
ZR33891	Eight Cells; 9x9-Bit Arithmetic; 15, 20, 25, 30 MHz

Vector Signal Processors

ZR34161	16-Bit Block, Floating-Point DSP; 20, 25 MHz
ZR34325	32-Bit IEEE, Floating-Point DSP; 25 MHz

Image Compression Processor

ZR36010	Discrete Cosine Transform Processor; 20, 25 MHz

PC Boards

VSPX	ZR34161 Array Processor Board for IBM AT, 16K RAM, 10 MHz
VSPE	ZR34161 Array Processor Board for IBM XT, 16K RAM, 20 MHz
VSPD	ZR34161 Array Processor Board for IBM AT, 64K RAM, 20 MHz, I/O
DFPB	ZR39481/881 Digital Filter Board for IBM AT; 15, 20 MHz

Development Tool Software

VSPS	ZR34161 Simulator
VSPA	ZR34161 Assembler
DFPS	Digital Filter Design Software

ZyMOS Corporation
477 North Mathilda Avenue
Sunnyvale, CA 94086
408/730-8800
Fax: 408/730-5456

ESTABLISHED: 1978
NO. OF EMPLOYEES: 300

BOARD

Name	Affiliation
W.C. Kim, chairman	Daewoo Corporation, chairman
Frank Zarb	Lazard Freres, senior partner
Jerome Jacobson	Retired
K.H. Lee	Daewoo Heavy Industries, Ltd., president
Alex Young	ZyMOS Corporation, executive vice president
B.J. Chang	ZyMOS Corporation, vice president administration
Pat Gordon	Intermedics, vice president of technology

COMPANY EXECUTIVES

Position	Name	Prior Company	Prior Position
President/CEO	David Handorf	VLSI Technology	GM Spec Mem
Exec VP/GM Std Prod	Alex W. Young	Intel	Mgr Telecom
VP/GM CSIC	Eli Porat		
VP Admin	B.J. Chang	Daewoo	Dir/GM
VP Mktg/Sales	Brian Currie	Micro Linear	VP WW Sales

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 Corporation designs, manufactures, and markets VLSI devices using cell-based design techniques. The Company also markets a proprietary design automation system, the ZyP system, which combines CAD software with ZyMOS' cell libraries. Three cell libraries are currently incorporated in the ZyP system that includes RAM, ROM, a core MPU, analog op amps, and comparators.

In 1987, ZyMOS began introducing integrated chip sets for the IBM PC AT and XT. In January, ZyMOS offered the PC On A Chip (POACH), a two-chip set that the Company says replaces more than half of the devices on an IBM PC AT motherboard, including nine of the major 80286 peripheral logic devices. In the same month, ZyMOS introduced the following eight Intel 86 family peripherals that will be included in its 1.8-micron CMOS SuperCell library:

- 8237A DMA Controller
- 8254 Programmable Interval Timer
- 8255 Programmable Peripheral Interface
- 8259A Programmable Interrupt Controller
- 8284 Clock Generator
- 8288 Bus Controller
- 6818 Real-Time Clock
- 74LS612 Memory Mapper

In mid-1987, ZyMOS offered the POACH/ATB a CMOS buffer chip for the IBM PC AT, that can be used interchangeably as a data or address buffer and the POACH/XT88, a CHMOS device that integrates the major logic functions of the IBM PC XT, including all peripherals. Late in 1987, Intel announced that it will market ZyMOS' POACH AT system logic set bundled with its 80286 MPU. The parts will be sold as the 82X3X multi-functional peripherals. Intel will purchase the devices from ZyMOS, which will have them manufactured for Intel at a foundry.

In December 1987, ZyMOS announced that it would offer the ZyVGA, a single-chip VGA, in the first quarter of 1988. It has a 50-MHz, maximum-dot clock and is said to support 16 colors from a palette of 256. The device is compatible with VGA, CGA, EGA, and Hercules. An evaluation board was to be sampled in February.

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. The present name, ZyMOS, was adopted in late 1980.

In 1979, Intermedics, Inc., acquired 47 percent of ZyMOS for $10 million and also provided lease guarantees for $5 million. Intermedics, one of ZyMOS' major customers, is a manufacturer of heart pacemakers in Freeport, Texas. The acquisition enabled the firm to construct a fabrication facility that became operational in November 1980. In 1981, ZyMOS received additional financing from Intermedics for $4 million to upgrade its 5-inch fab to 3 microns. In 1983, ZyMOS filed an IPO of 3.75 million shares and raised $46.9 million. The funds were used to reduce indebtedness and to equip the Company's wafer fab for 2-micron CMOS.

In April 1986, Daewoo Corporation, a $7.7 billion Korean conglomerate, purchased the 47 percent held by Intermedics to gain a controlling interest in ZyMOS. Daewoo purchased an undisclosed number of shares from Intermedics and purchased new shares from ZyMOS, giving the Company a direct cash infusion. Daewoo was the first Korean company to take control of an American chip maker. Daewoo allows ZyMOS to operate as an independent company. Daewoo views ZyMOS as a manufacturing source and is treated as a preferred customer. Daewoo also has not limited ZyMOS in its marketing efforts in the Far East.

In May 1987, David Handorf, formerly of VLSI Technology Inc. where he was general manager of application-specific memories, joined ZyMOS as president and CEO. Mr. Handorf will be responsible for additional customizable standard products, particularly for telecommunications and data communications applications.

In January 1988, ZyMOS announced that it had sold its wafer fabrication equipment to Daewoo and cut employment by 100 people. The move lowers ZyMOS' fixed costs and positions the Company for profitability. AT&T and others will produce the Company's products. ZyMOS also established two product lines. Alex Young, executive vice president, is general manager of standard products, which include the POACH and VGA graphics chips. Eli Porat, vice president, is general manager of customer-specific products that use integrated building blocks to design standard products.

COMPANY HIGHLIGHTS

Jan. 1987	ZyMOS offered POACH, a VLSI two-chip set that replaces more than half of the devices on an IBM PC AT motherboard, including nine of the major 80286 peripheral logic devices.
Jan. 1987	ZyMOS introduced eight Intel family peripherals that will be included in its 1.8-micron CMOS SuperCell library.
March 1987	ZyMOS offered the POACH/ATB, a CMOS buffer chip for the IBM PC AT, that can be used interchangeably as a data or address buffer. It includes parity generation and checking logic, a RAM RAS/CAS address multiplier, address bus latches, and a low-byte data bus latch.

May 1987	David Handorf joined ZyMOS as president and CEO. He came to ZyMOS from VLSI Technology Inc. where he was general manager of application-specific memories. Mr. Handorf will be responsible for additional customizable standard products, particularly for telecommunications and data communications applications.
May 1987	ZyMOS offered the Poach/XT88, a CHMOS device that integrates the major logic functions of the IBM PC XT, including all peripherals.
Oct. 1987	ZyMOS will manufacture and incorporate the Austek A3852 Microcache as part of the ZyMOS POACH chip set. The A3852 is a cache controller.
Nov. 1987	Intel will market ZyMOS' POACH AT system logic set bundled with its 80286 MPU. The parts will be sold as the 82X3X multifunctional peripherals. Intel will purchase the devices from ZyMOS, which will have them manufactured for Intel at a foundry.
Dec. 1987	ZyMOS announced that it will offer the ZyVGA, a single-chip VGA, in the first quarter of 1988. It has a 50-MHz, maximum-dot clock and is said to support 16 colors from a palette of 256. The device is compatible with VGA, CGA, EGA, and Hercules. An evaluation board will be sampled in February.
Jan. 1988	ZyMOS reported fourth-quarter revenue of $8.3 million and a net loss of $2.8 million for the period ending November 1, 1987. The Company reported fiscal 1987 revenue of $25.2 million and a net loss of $10.8 million.
Jan. 1988	ZyMOS sold its wafer fabrication equipment to Daewoo and cut employment by 100 people. The move lowers ZyMOS' fixed costs and positions the Company for profitability. AT&T and others will produce the Company's products. ZyMOS also established two product lines. Alex Young, executive vice president, is general manager of standard products, which include the POACH and VGA graphics chips. Eli Porat, vice president, is general manager of customer-specific products that use integrated building blocks to design standard products.

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 microns.
Intel	Jan. 1983	ZyMOS provided its ZyP CAD system for Intel's CHMOS I process. The companies agreed to codevelop a standard cell library.
	July 1984	ZyMOS provided its ZyP design automation system for Intel's CHMOS II process. ZyMOS is also licensed to manufacture Intel's 80C49 8-bit MCU.
	Nov. 1987	Intel will market ZyMOS' POACH AT system logic set bundled with its 80286 MPU. The parts will be sold as the 82X3X multifunctional peripherals. Intel will purchase the devices from ZyMOS, which will have them manufactured for Intel at a foundry.
General Instrument	Aug. 1983	ZyMOS signed an agreement with General Instrument (GI), allowing GI to use ZyP software and Zy40000 to design custom and standard circuits and to develop the Zy40000 standard cell library. GI provides 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	April 1986	Daewoo Corporation, a $7.7 billion Korean conglomerate, acquired a controlling interest in ZyMOS. Daewoo purchased an undisclosed number of shares from Intermedics, a company that owned 47 percent of ZyMOS, and purchased 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.
Austek	Oct. 1987	Austek agreed to allow ZyMOS to manufacture and sell Austek's A38152 Microcache controller as part of ZyMOS' POACH chip set for Intel 80386-based systems.

SERVICES

Design
Test

MANUFACTURING

Technology

5.0-, 4.0-, and 3.0-micron silicon-gate NMOS
5.0-, 4.0-, 3.0-, 2.0-, and 1.3-micron silicon-gate CMOS
4-inch wafers

Facilities

Sunnyvale, CA	93,000 sq. ft.	Total space
	13,000 sq. ft.	Class-10 clean room

PRODUCTS

CMOS Cell Libraries

Family	Linewidth (Microns)	Delay (ns)	Cells
Zy-DP3/6000	2.0	4	RAM, ROM, PLA, 2900 Family, 82XX Peripherals
Zy40000	5.0	6	RAM, ROM, PLA, 80C49 MCU
ZyDP-11/50000	3.0	12	RAM, ROM, PLA, 80C49 MCU

Microcomponents

Device	Description
POACH	A VLSI Two-Chip Set that Replaces more than Half of the Devices on an IBM PC AT Motherboard, including Nine of the Major 80286 Peripheral Logic Devices
POACH/ATB	A CMOS Buffer Chip for the IBM PC AT that can be used Interchangeably as a Data or Address Buffer. It includes Parity Generation and Checking Logic, a RAM RAS/CAS Address Multiplier, Address Bus Latches, and a Low-Byte Data Bus Latch
POACH/XT88	A CHMOS Device that Integrates the Major Logic Functions of the IBM PC XT, Including all Peripherals
ZyVGA	VGA that Supports 16 Colors from a Palette of 256, with a 50-MHz, Maximum-Dot Clock

CAD Tools

ZyPAWS I	CAD System for 3- and 5-Micron Standard Cells with 350 Cells, Including MPUs, RAMs, and ROMs
ZySPICE	Circuit Simulator
ZyPSIM	Logic Simulator
ZyPART	Artwork-Generation Software Package
POACH-1/POACH-2	MPR Functions for the IBM PC AT Motherboard
POACH-3	MPR functions for the IBM PC or PC XT Motherboards, Replacing Seven LSI Components

Linear Products

Single-Supply Comparator
Single- and Dual-Supply DAC
Single-Supply Op Amp