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**JAPANESE
SEMICONDUCTOR
INDUSTRY
CONFERENCE**

JUNE 21, 1984

TOKYO, JAPAN



**Dataquest Incorporated
Dataquest Japan Limited**

Subsidiaries of A.C. Nielsen Company

JAPANESE SEMICONDUCTOR
INDUSTRY CONFERENCE

EAST MEETS WEST IN VLSI

JUNE 21, 1984

TOKYO, JAPAN

DATAQUEST INCORPORATED
1290 RIDDER PARK DRIVE
SAN JOSE, CALIFORNIA 95131

PHONE: (408) 971-9000
TELEX: 171973

DATAQUEST JAPAN LIMITED
AZABU HEIGHTS, SUITE 711
1-5-10 ROPPOGI, MINATO-KU
TOKYO 106, JAPAN
PHONE: (3) 582-1441
TELEX: J32768

JSIS CONFERENCE
TOKYO, JAPAN
JUNE 21, 1984

INTRODUCTION	9:00 A.M.
ECONOMIC OUTLOOK	9:20 A.M.
SEMICONDUCTOR OUTLOOK	9:50 A.M.
BREAK	10:30 A.M.
COMPANY PROFILES	11:00 A.M.
THE SEMICONDUCTOR START-UP PHENOMENON	11:45 A.M.
LUNCH	12:15 P.M.
DR. TANAKA, TOKYO UNIVERSITY	1:00 P.M.
VLSI PRODUCT REVIEW	1:30 P.M.
MANUFACTURING EQUIPMENT	2:30 P.M.
BREAK	3:15 P.M.
EFFECTS OF IC PROLIFERATION	3:45 P.M.
SUMMARY	4:30 P.M.
PANEL: QUESTIONS AND ANSWERS	5:00 P.M.
REFRESHMENTS	5:30 P.M. TO 7:00 P.M.

D U N A N D B R A D S T R E E T

- FOUNDED IN 1841
- TOTAL REVENUES 1983 \$2.5B (ADJUSTED FOR ACQUISITION OF A.C. NIELSEN)
- WORLD'S LARGEST CREDIT INFORMATION AND MARKET RESEARCH COMPANY
- MORE THAN 46,000 EMPLOYEES
- PURCHASED A.C. NIELSEN ON MAY 17, 1984

D A T A Q U E S T C H A R T E R

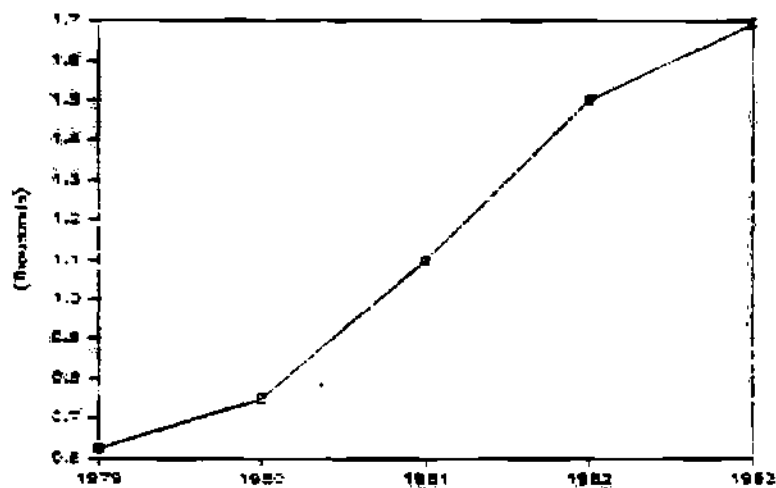
- TO PROVIDE SPECIALIZED MARKET RESEARCH AND SUPPORT TO DECISION MAKERS, THROUGH AN ON-GOING SERVICE
- TO STAFF EACH AREA WITH INDUSTRY PROFESSIONALS WITH RECENT INDUSTRY EXPERIENCE
- TO PROVIDE CUSTOM CONSULTING TO CLIENTS ONLY
- TO PROVIDE A WORLDWIDE DATA BASE ON STRATEGIC ELECTRONIC INDUSTRIES
- TO HOST TOP MANAGEMENT CONFERENCES

DATAQUEST BACKGROUND

- FOUNDED IN 1971
- SUBSIDIARY OF A.C. NIELSEN COMPANY SINCE 1978
- RECOGNIZED EXPERTISE IN HIGH-TECHNOLOGY INDUSTRY MARKETS
- STAFF HAS BOTH INDUSTRY MANAGEMENT AND MARKET RESEARCH EXPERIENCE
- OFFICES WORLDWIDE
 - SAN JOSE, CALIFORNIA
 - TOKYO, JAPAN
 - LONDON, ENGLAND
 - PARIS, FRANCE
 - KRONBERG, WEST GERMANY

TECHNOLOGY SERVICES

SUBSCRIBER GROWTH



DATAQUEST TECHNOLOGY SERVICES

SEMICONDUCTOR GROUP

- SEMICONDUCTOR INDUSTRY SERVICE
- JAPANESE SEMICONDUCTOR INDUSTRY SERVICE
- EUROPEAN SEMICONDUCTOR INDUSTRY SERVICE
- SEMICONDUCTOR USER INFORMATION SERVICE

DESIGN AND MANUFACTURING AUTOMATION GROUP

- CAD/CAM
- ROBOTICS

INFORMATION SYSTEMS GROUP

- COMPUTER INDUSTRY SERVICES
- TELECOMMUNICATIONS
- DISPLAY TERMINAL
- GRAPHICS TERMINAL
- OFFICE AUTOMATION

PERIPHERALS GROUP

- ELECTRONIC PRINTER
- COMPUTER STORAGE
- COPYING AND DUPLICATING

D A T A Q U E S T S P E A K E R S

MAX NANSEKI

GENE NORRETT

OSAMU OHTAKE

LANE MASON

CURRENT ECONOMIC
SITUATION

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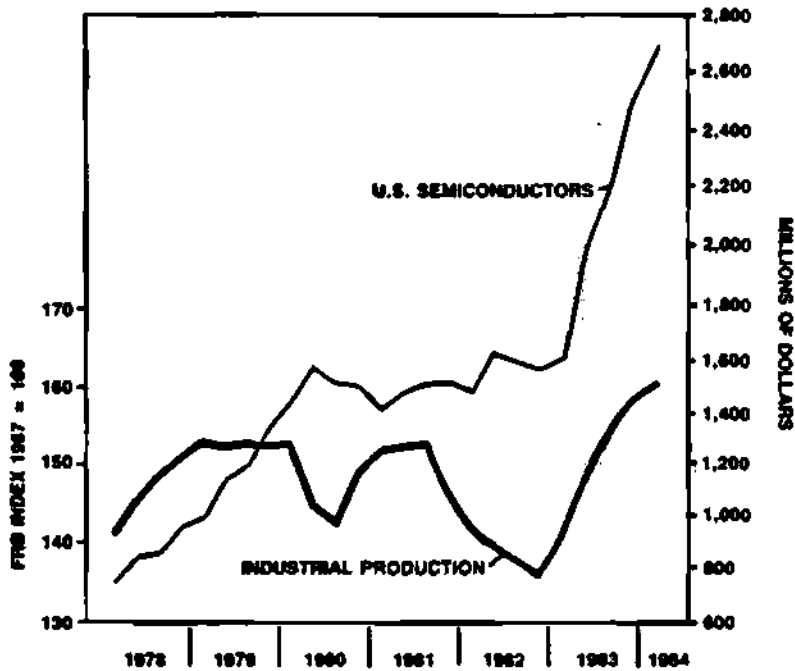
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U. S. E C O N O M I C F O R C E S*

	<u>1982</u>	<u>1983</u>	<u>1984</u>
GNP DEFLATOR	6.0%	4.2%	4.6%
GNP	(1.9%)	3.3%	4.9%
BUSINESS FIXED EXPENDITURES	(4.7%)	0.5%	8.3%
INDUSTRIAL PRODUCTION	(8.2%)	6.6%	9.3%
PRIME RATE	14.7%	10.6%	11.5%

*1975 = 100%

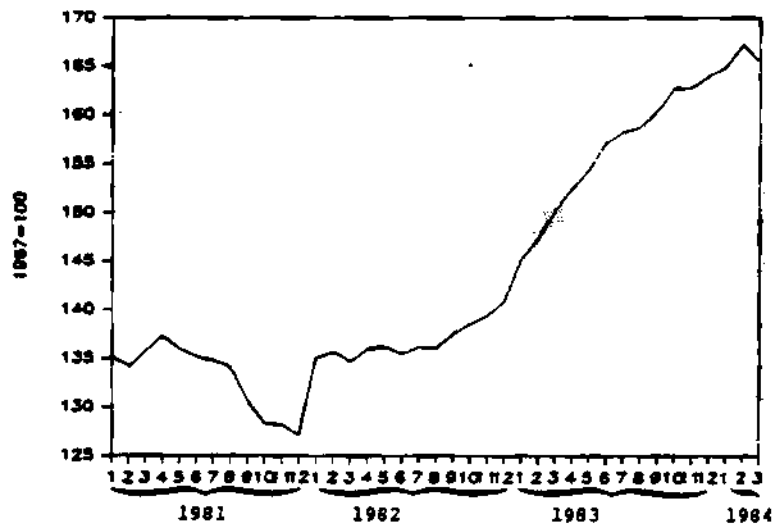
I N D U S T R I A L P R O D U C T I O N V S .
U . S . S E M I C O N D U C T O R C O N S U M P T I O N



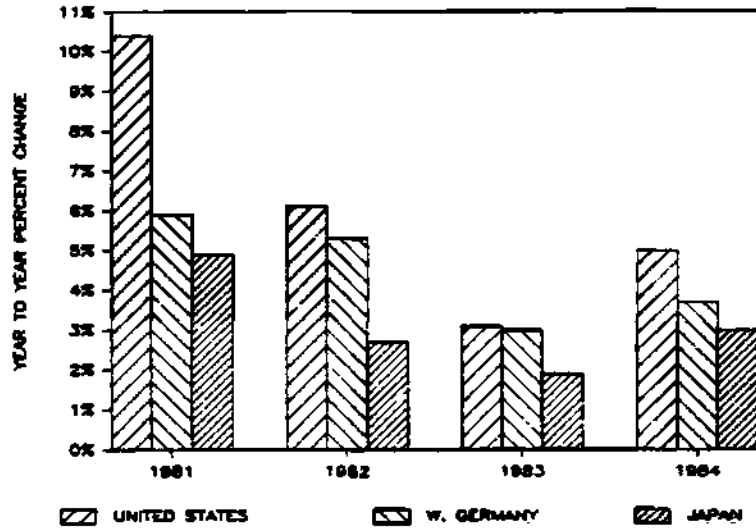
U. S. A.
12 LEADING INDICATORS

- | | |
|-------------------------------|-----------------------------------|
| ● WORK WEEK | ● HOUSING STARTS |
| ● INITIAL UNEMPLOYMENT CLAIMS | ● VENDOR PERFORMANCE |
| ● NEW ORDERS--CONSUMER | ● TOTAL INVENTORY |
| ● NEW BUSINESS FORMATION | ● SENSITIVE MATERIAL PRICES |
| ● STOCK PRICES (S&P500) | ● M2 SUPPLY |
| ● PLANTS AND EQUIPMENT | ● BUSINESS AND CONSUMER BORROWING |

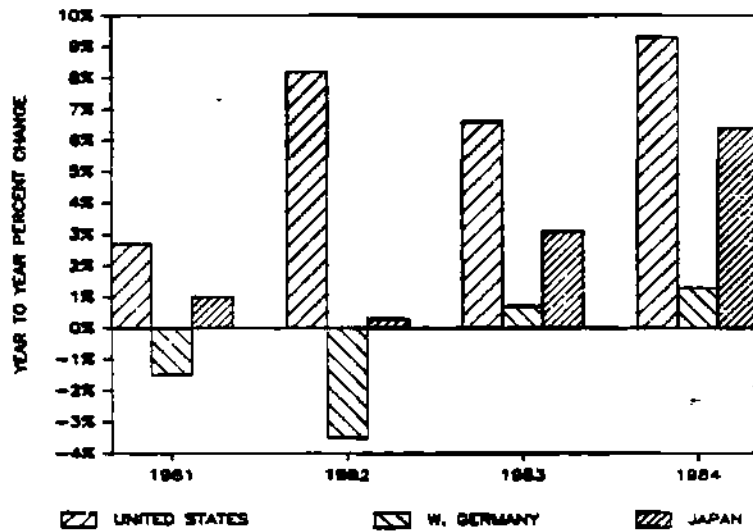
12 U. S. LEADING INDICATORS



COMPARISON OF INTERNATIONAL
CONSUMER PRICES



COMPARISON OF INTERNATIONAL
INDUSTRIAL PRODUCTION



U. S. E C O N O M Y

(ANNUAL RATES)

● RETAIL SALES (APRIL)	UP 2.9%
● HOUSING STARTS (APRIL)	UP 19.3%
● INTEREST RATES	UP 1%
● LEADING INDICATORS (MARCH)	DOWN 1.1%

J A P A N E S E E C O N O M I C F O R C E S *

	<u>CY 1982</u>	<u>CY 1983</u>	<u>CY 1984</u>
GNP DEFLATOR	2.0%	1.2%	2.4%
GNP	3.0%	3.2%	4.3%
FIXED CAPITAL FORMATION	1.6%	(1.6%)	4.2%
INDUSTRIAL PRODUCTION	0.3%	3.6%	6.4%
OFFICIAL DISCOUNT RATE	5.5%	5.4%	5.0%

*1975 = 100%

J A P A N 1 9 8 3 I N R E V I E W

- MANY CATEGORIES SHOWED IMPROVEMENT
- HIGHEST EVER BALANCE OF TRADE
- UNEMPLOYMENT INCREASING
- CONSUMER PRICES LOW
- SUNRISE INDUSTRIES FLOURISHING

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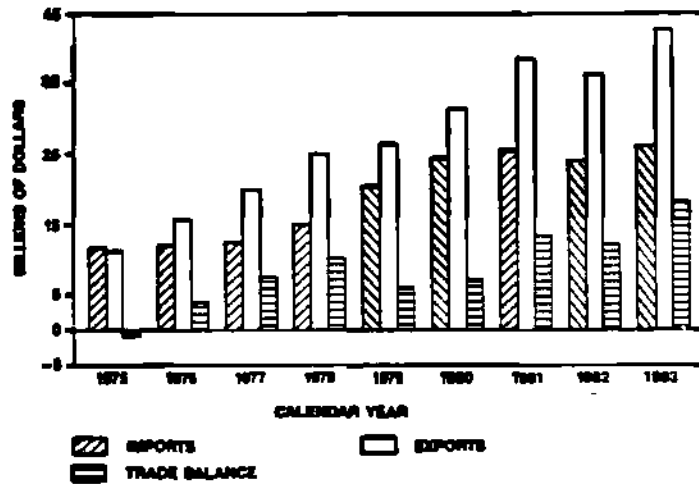
JAPANESE INDUSTRIAL PRODUCTION

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
TOTAL	100.0	101.0	101.3	104.9	105.6
PERCENT CHANGE	4.6	1.0	0.3	3.6	6.4
MANUFACTURING	100.0	101.0	101.4	104.9	105.7
PERCENT CHANGE	4.7	1.0	0.4	3.6	6.5
ELECTRICAL AND ELECTRONIC	100.0	113.9	125.2	149.7	179.4
PERCENT CHANGE	19.8	13.9	9.9	19.6	20.0
COMPUTER	100.0	114.6	137.7	165.2	205.8
PERCENT CHANGE	91.9	14.6	20.2	20.0	24.6
TUBE AND SEMICONDUCTOR	100.0	114.6	137.7	172.1	232.3
PERCENT CHANGE	14.8	14.6	20.2	25.0	35.0
DISCRETE AND IC	100.0	131.3	154.3	219.9	317.5
PERCENT CHANGE	14.8	31.3	17.5	42.5	44.4

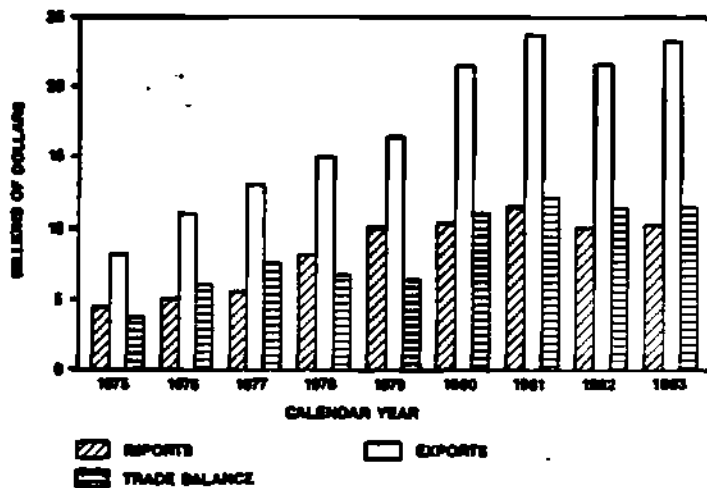
JAPANESE BALANCE OF TRADE

- JAPAN--UNITED STATES
- JAPAN--WESTERN EUROPE
- JAPAN--SOUTHEAST ASIA

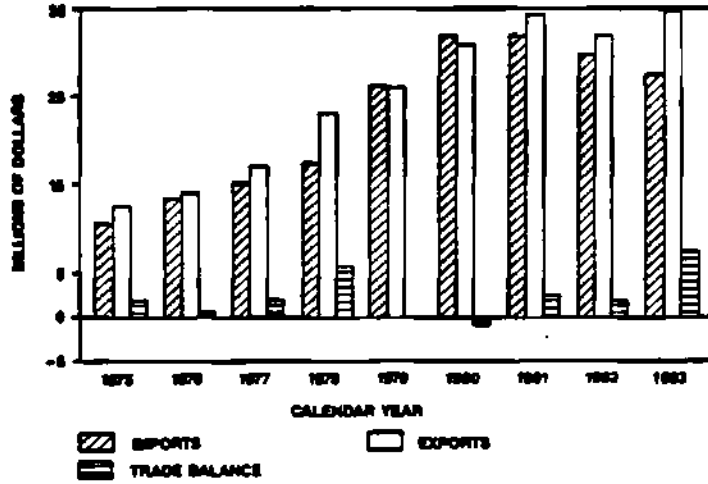
JAPAN - U. S. TRADE BALANCE



JAPAN - WESTERN EUROPE TRADE BALANCE



JAPAN - SOUTHEAST ASIA
TRADE BALANCE



SEMICONDUCTOR

INDUSTRY

OUTLOOK

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WORLD SEMICONDUCTOR
INDUSTRY PROFILE

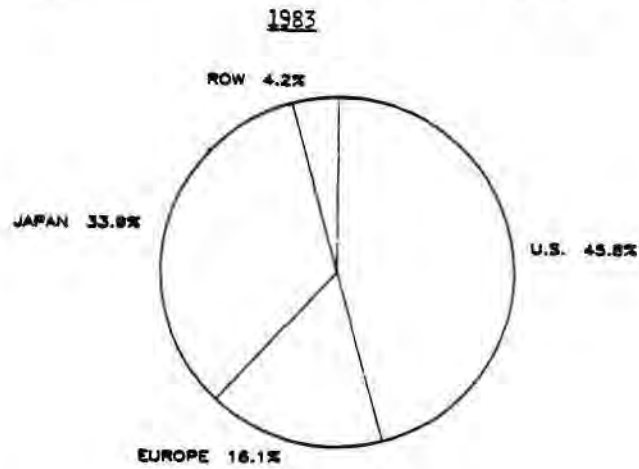
	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1983/1984</u>
SIZE				
MERCHANT	\$14.9B	\$18.8B	\$25.4B	35.1%
CAPTIVE	\$ 2.3B	\$ 2.8B	\$ 3.5B	25.0%
NUMBER OF COMPANIES	183	200	220	10.0%
5-YR. GROWTH RATE	20%	22%	21.5%	-
EMPLOYMENT	550,000	660,000	740,000	12.0%
ANNUAL CAPITAL EXPENDITURES	\$ 3.3B	\$ 5.3B	\$ 6.6B	24.5%
ANNUAL R&D EXPENDITURES	\$ 1.8B	\$ 2.3B	\$ 2.9B	26.1%

WORLD SEMICONDUCTOR PROFILE

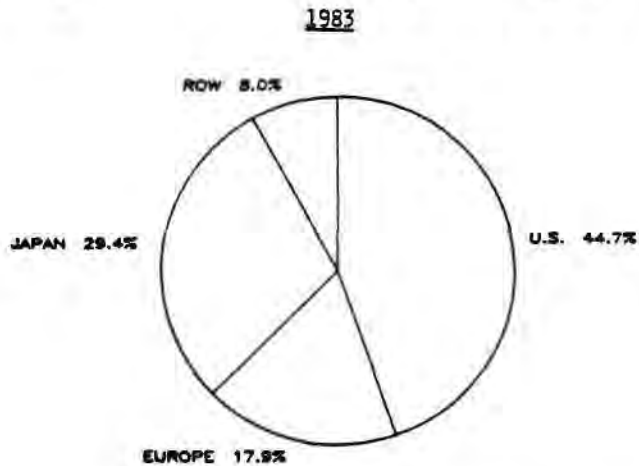
	<u>1982</u>	<u>1983</u>
IC	72.0%	75.6%
BIPOLAR DIGITAL	16.0	16.5
MOS	36.7	41.0
LINEAR	19.3	18.1
DISCRETE	22.7	19.1
OPTO	<u>5.3</u>	<u>5.3</u>
TOTAL	100.0%	100.0%

WORLD SEMICONDUCTOR PROFILE

<u>FACTORY SHIPMENTS</u>	<u>1982</u>	<u>1983</u>
UNITED STATES	46.0%	45.8%
JAPAN	31.6%	33.9%
WESTERN EUROPE	18.5%	16.1%
ROW	3.9%	4.2%

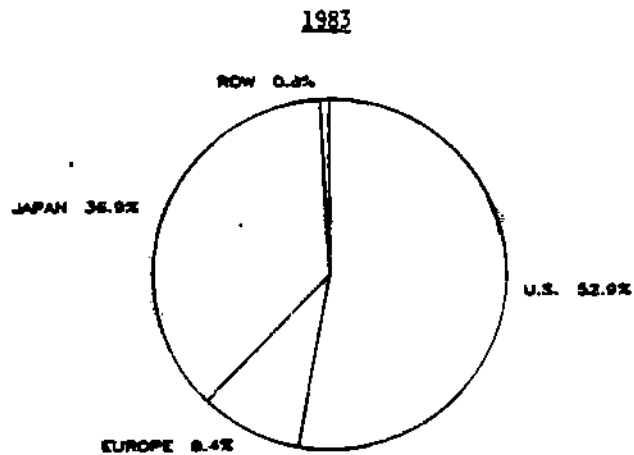


<u>REGIONAL CONSUMPTION</u>	<u>1982</u>	<u>1983</u>
UNITED STATES	44.3%	44.7%
JAPAN	27.2%	29.4%
WESTERN EUROPE	21.0%	17.9%
ROW	7.5%	8.0%



WORLD SEMICONDUCTOR PROFILE

<u>MANUFACTURER</u>	<u>1982</u>	<u>1983</u>
U.S. COMPANIES	54.5%	52.9%
JAPANESE COMPANIES	34.3%	36.9%
WESTERN EUROPEAN COMPANIES	11.0%	9.4%
ROW COMPANIES	0.2%	0.8%



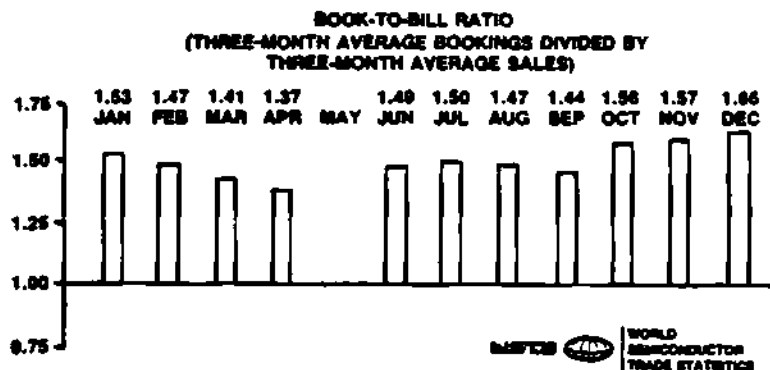
TOTAL SEMICONDUCTOR
CONSUMPTION / CAPITA

<u>REGION</u>	<u>1983</u>	<u>1984</u>
JAPAN	\$38.27	\$46.59
UNITED STATES	\$31.56	\$39.28
WEST GERMANY	\$19.10	\$22.43
UNITED KINGDOM	\$11.25	\$13.34
FRANCE	\$12.52	\$14.74

ESTIMATED SEMICONDUCTOR
GROWTH BY REGION

REGION	1983-1988 CAGR %
UNITED STATES	23.4%
JAPAN	23.8%
WESTERN EUROPE	19.6%
ROW INCLUDING ASIA	26.1%
TOTAL	22.7%

SEMICONDUCTOR FLASH REPORT
FOR U. S. MARKET



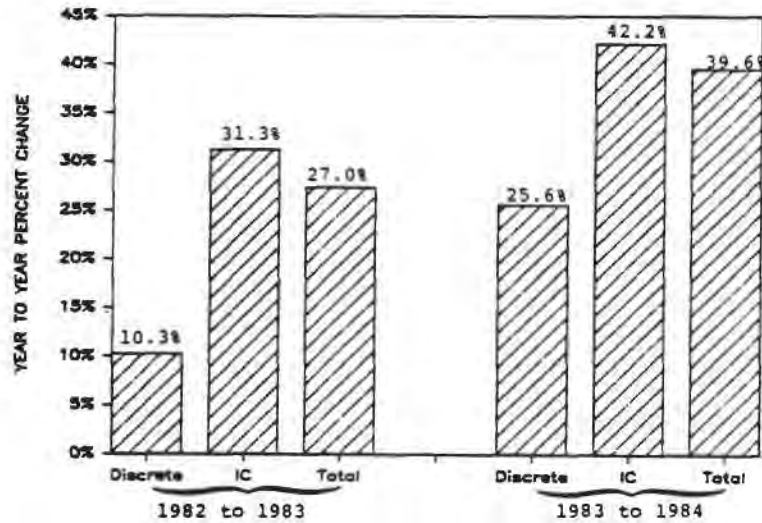
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ESTIMATED U. S.
SEMICONDUCTOR CONSUMPTION

(MILLIONS OF DOLLARS)

	<u>1982</u>	<u>1983</u>	<u>1984</u>
DISCRETE DEVICES	\$1,248	\$1,377	\$ 1,730
INTEGRATED CIRCUITS	<u>5,364</u>	<u>7,044</u>	<u>10,071</u>
TOTAL	\$6,612	\$8,421	\$11,801

ESTIMATED U. S.
SEMICONDUCTOR CONSUMPTION

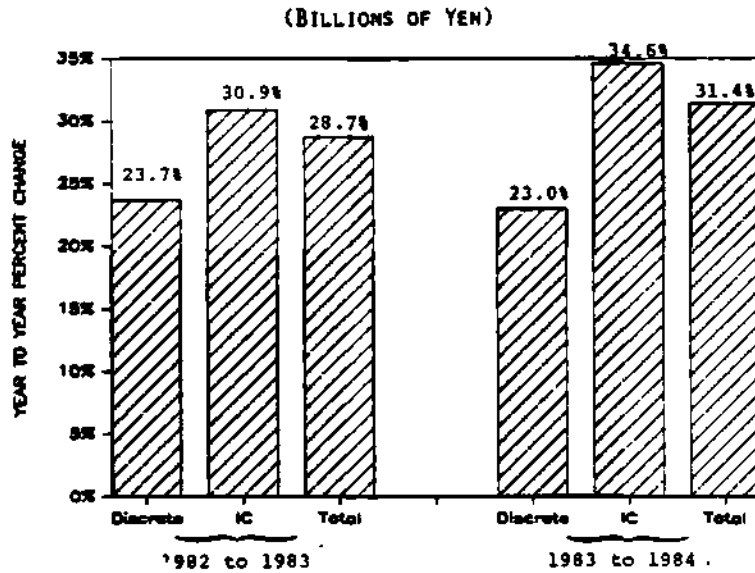


ESTIMATED JAPANESE
SEMICONDUCTOR CONSUMPTION

(BILLIONS OF YEN)

	<u>1982</u>	<u>1983</u>	<u>1984</u>
DISCRETE DEVICES	¥ 301	¥ 372	¥ 457
INTEGRATED CIRCUITS	<u>728</u>	<u>953</u>	<u>1,282</u>
TOTAL	¥1,029	¥1,325	¥1,739

ESTIMATED JAPANESE
SEMICONDUCTOR CONSUMPTION



ESTIMATED WEST EUROPEAN
SEMICONDUCTOR CONSUMPTION

(MILLIONS OF DOLLARS)

	<u>1982</u>	<u>1983</u>	<u>1984</u>
DISCRETE	\$1.121	\$1.057	\$1.131
IC	<u>1.968</u>	<u>2.323</u>	<u>3.081</u>
TOTAL	\$3.089	\$3.387	\$4.212

ESTIMATED ROW
SEMICONDUCTOR CONSUMPTION

(MILLIONS OF DOLLARS)

	<u>1982</u>	<u>1983</u>	<u>1984</u>
DISCRETE	\$ 457	\$ 532	\$ 687
IC	<u>585</u>	<u>914</u>	<u>1,331</u>
TOTAL	\$1,042	\$1,446	\$2,018

ESTIMATED WORLD
SEMICONDUCTOR CONSUMPTION

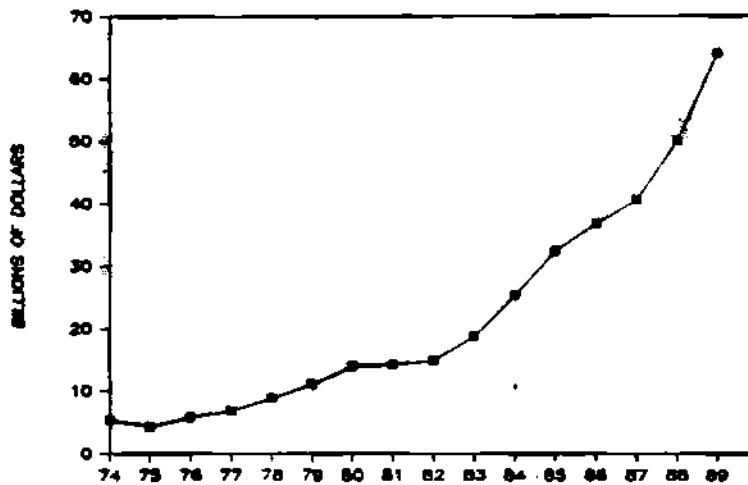
(MILLIONS OF DOLLARS)

	<u>1982</u>	<u>1983</u>	<u>1984</u>
DISCRETE	\$ 4,112	\$ 4,555	\$ 5,493
IC	<u>10,787</u>	<u>14,228</u>	<u>19,883</u>
TOTAL	\$14,899	\$18,783	\$25,376

WORLD SEMICONDUCTOR FORECAST

	1983-1989 CAGR %
IC	25.5%
BIPOLAR DIGITAL	13.8%
MOS TOTAL	31.7%
MEMORY	31.4%
MICRO	35.8%
LOGIC	33.0%
LINEAR	16.3%
DISCRETE	8.2%
OPTO	18.4%
TOTAL	22.7%

ESTIMATED WORLD SEMICONDUCTOR
INDUSTRY GROWTH



CAPACITY OF SEMICONDUCTOR
INDUSTRY

- RISING VERY RAPIDLY
- VLSI GETTING TOP ATTENTION
- LEAD TIMES SHORTENING
- ALLOCATION IN LSTTL, 64K DRAM, AND
8-BIT MICROCONTROLLERS

SEMICONDUCTOR MAKERS

THE BILLION DOLLAR CLUB
MANUFACTURERS PRODUCING
AT A RATE GREATER THAN \$1 BILLION

<u>1981</u>	<u>1984</u>	<u>1985</u>
3	9	11

SEMICONDUCTOR USERS

\$100 MILLION USERS

1977	1
1979	7
1981	17
1983	25

COMPANY

PROFILES

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COMPANY PROFILES

ADVANCED MICRO DEVICES

- SHOOTING FOR \$1B IN 1984
- PROPRIETARY CIRCUITS
- INTEL SECOND SOURCE
- ADDING 2 FABs IN TEXAS
- EMPHASIS ON JAPANESE MARKET IN 1984
- TELECOM MARKET FOCUS

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	329	505	53.5
IC	329	505	53.5
BIPOLAR DIGITAL	158	260	64.6
MOS	151	224	48.3
LINEAR	20	21	5.0
DISCRETE	0	0	0
OPTO	0	0	0

COMPANY PROFILES

FAIRCHILD

- 9 PERCENT SALES GROWTH IN 1983
- SEMICONDUCTOR TOP MANAGEMENT FROM TI
- PRODUCT STRENGTH IN BIPOLAR
- EFFORTS TO RE-ENTER MOS
- SOLD OPTO BUSINESS

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	412	450	9
IC	333	373	12
BIPOLAR DIGITAL	206	235	14
MOS	50	48	(4)
LINEAR	77	90	17
DISCRETE	64	70	9
OPTO	15	7	(53)

COMPANY PROFILES

INTEL

- LEADERSHIP POSITION IN MPUS
- BOOKINGS CONTROL SYSTEM
- SPECIALTY DRAM STRATEGY
- NUMBER 2 IN MOS BEHIND NEC
- STRENGTHENING CMOS PORTFOLIO
- FIRST AMONG MAJORS IN 6" WAFERS
- NEW 6" FAB IN ISRAEL

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR.	625	775	24
IC	625	775	24
BIPOLAR DIGITAL	52	55	6
MOS	573	720	26
LINEAR	0	0	0
DISCRETE	0	0	0
OPTO	0	0	0

COMPANY PROFILES

MOTOROLA

- NECK AND NECK WITH TI
- MAJOR SUCCESS IN WORKSTATION MPUS
- STRENGTHENING JAPANESE MARKET PRESENCE
- FIRST WITH AUTOMATED ASSEMBLY IN THE UNITED STATES
- CMOS LEADERSHIP
- STABLE TOP MANAGEMENT

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	1,219	1,547	27
IC	791	1,060	34
BIPOLAR DIGITAL	203	242	19
MOS	425	607	43
LINEAR	163	211	60
DISCRETE	419	472	13
OPTO	9	15	67

COMPANY PROFILES

NATIONAL

- SIGNED MAJOR AGREEMENT WITH TI
- RESOLVED IBM AND U.S. GOVERNMENT SUITS
- STRONG CMOS TIES WITH MOTOROLA
- NUMBER 2 IN LINEAR BEHIND TI
- WEAK MEMORY OFFERINGS
- BECOMING MORE PEOPLE/SERVICE ORIENTED

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	673	845	26
IC	620	790	27
BIPOLAR DIGITAL	165	210	27
MOS	235	300	28
LINEAR	220	280	27
DISCRETE	44	45	2
OPTO	9	10	11

COMPANY PROFILES

TEXAS INSTRUMENTS

- TOP MANAGEMENT RESTRUCTURING
- JOINING SRC AND WSTS PROGRAM
- NUMBER 1 IN LINEAR
- STRENGTHENING HCMOS PORTFOLIO
- NUMBER 1 U.S. SUPPLIER IN JAPAN
- TIE UP WITH NATIONAL ON 32-BIT DEVICE
- MANY SECOND-SOURCE AGREEMENTS

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	1,305	1,638	26
IC	1,155	1,535	33
BIPOLAR DIGITAL	520	667	28
MOS	400	572	43
LINEAR	235	296	29
DISCRETE	90	48	(47)
OPTO	60	55	(9)

COMPANY PROFILES

FUJITSU

- EMPHASIZING OA
- INTEL SECOND SOURCE
- LARGE INTERNAL DEMAND
- STRONG WORLDWIDE GATE ARRAY CAPABILITY
- DEVELOPING 4M-BIT BUBBLE MEMORY

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	465	688	48
IC	427	618	45
BIPOLAR DIGITAL	129	174	35
MOS	280	418	49
LINEAR	18	26	44
DISCRETE	23	35	52
OPTO	15	35	133

COMPANY PROFILES

HITACHI

- MOTOROLA SECOND SOURCE
- NUMBER 1 IN MOS MEMORIES
- NUMBER 3 IN WORLDWIDE MOS MARKET
- STRONG ECL AND LS MARKET POSITION
- NUMBER 1 JAPANESE SUPPLIER IN THE UNITED STATES
- RECOVERING FROM IBM SUIT

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	877	1,237	41
IC	607	912	50
BIPOLAR, DIGITAL	111	144	30
MOS	390	638	64
LINEAR	106	130	23
DISCRETE	240	291	21
OPTO	30	34	13

COMPANY PROFILES

MATSUSHITA

- GREW 41 PERCENT IN 1983
- HEAVY SEMICONDUCTOR CAPITAL INVESTMENT
- CONSUMER MARKET EMPHASIS
- DEVELOPING GAAS TECHNOLOGY FOR LSI
- EMERGENCE AS INTERNATIONAL SEMICONDUCTOR SUPPLIER

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	426	590	41
IC	249	357	47
BIPOLAR DIGITAL	7	13	86
MOS	89	160	80
LINEAR	153	184	27
DISCRETE	146	188	29
OPTO	31	45	45

COMPANY PROFILES

MITSUBISHI

- MOVING FROM HEAVY ELECTRIC TO ELECTRONICS
- NEW U.S. FACTORY FOR LSI AND PCS
- TECHNOLOGY STRENGTH IN SEMICONDUCTOR MANUFACTURING EQUIPMENT
- 1M DRAM EMPHASIS

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	338	445	32
IC	244	337	38
BIPOLAR DIGITAL	44	47	7
MOS	137	189	37
LINEAR	63	101	60
DISCRETE	94	108	15
OPTO	0	0	0

COMPANY PROFILES

NEC

- GOING IT ALONE IN MPUS
- NUMBER 1 IN MOS IN 1983
- NUMBER 1 IN PCs IN JAPAN
- GATE ARRAY EMPHASIS
- TAKING ON INTEL IN EPROMS (1M-BIT)
- NUMBER 2 JAPANESE SUPPLIER IN THE UNITED STATES
- HIGH-VOLUME, LOW-PRICE EMPHASIS

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	1.075	1.418	32
IC	791	1.093	38
BIPOLAR DIGITAL	89	115	29
MOS	547	786	44
LINEAR	155	192	24
DISCRETE	262	298	14
OPTO	22	27	23

COMPANY PROFILES

TOSHIBA

- WORLD'S LARGEST SUPPLIER OF CMOS
- HAD EXCELLENT 1983 REVENUE GROWTH
- 68000 SECOND SOURCE
- BRINGING UP 2 MOS VLSI FABs AND 1 NEW RESEARCH CENTER
- NUMBER 3 IN THE UNITED STATES AMONG JAPANESE SUPPLIERS
- MAJOR COMMITMENT TO CMOS GATE ARRAYS

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	714	983	38
IC	428	613	43
BIPOLAR DIGITAL	16	21	31
MOS	311	458	47
LINEAR	101	134	33
DISCRETE	217	272	25
OPTO	69	98	42

C O M P A N Y P R O F I L E S

PHILIPS/SIGNETICS

- PROBLEMS WITH WEAK EUROPEAN MARKET
- MAJOR COMMITMENT TO SURFACE MOUNTING
- SECOND SOURCE WITH FAIRCHILD ON ECL GATE ARRAYS
- STRONG IN SPEECH SYNTHESIS
- SECOND SOURCE WITH GI ON E²
- SIGNETICS GREW 45 PERCENT IN MOS--STILL SMALL

PHILIPS ONLY
SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	457	469	3
IC	230	246	7
BIPOLAR DIGITAL	34	29	(15)
MOS	61	87	43
LINEAR	135	130	(4)
DISCRETE	208	204	(2)
OPTO	19	19	0

SIGNETICS ONLY
SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	340	435	28
IC	340	435	28
BIPOLAR DIGITAL	244	307	26
MOS	38	55	45
LINEAR	58	73	26
DISCRETE	0	0	0
OPTO	0	0	0

COMPANY PROFILES

SIEMENS

- POOR 1983 REVENUE GROWTH
- SETTING UP 2ND VLSI FACTORY IN AUSTRIA
- EXTENSIVE REBRANDING OF JAPANESE PRODUCTS
- POSSIBLE SECOND SOURCE TO INTEL ON 80186
- JOINT VENTURE WITH FUJI ELECTRIC ON ICs
- TRYING HARD IN MOS DRAMS
- FAIRCHILD SECOND SOURCE FOR ECL GATE ARRAYS

SALES \$M

	<u>1982</u>	<u>1983</u>	<u>% GROWTH</u>
TOTAL SEMICONDUCTOR	329	333	1
IC	160	178	11
BIPOLAR DIGITAL	56	36	(36)
MOS	64	80	25
LINEAR	40	62	55
DISCRETE	131	114	(13)
OPTO	38	41	8

COMPANY PROFILES

THOMSON

- MAJOR COMPANY RESTRUCTURING
- POOR 1983 REVENUES
- SECOND SOURCE TO 68XX/68XXX MPU AND TO AMD 29XX/29XXX
- STRONG TIES WITH FRENCH GOVERNMENT TO DEVELOP TECHNOLOGY
- PURSUING SECOND SOURCING IN GATE ARRAYS

SALES \$M

	<u>1982</u>	<u>1983</u>	% GROWTH
TOTAL SEMICONDUCTOR	176	141	(19)
IC	54	64	21
BIPOLAR DIGITAL	2	6	200
MOS	21	21	0
LINEAR	31	37	19
DISCRETE	122	77	(37)
OPTO	0	0	0

SEMICONDUCTOR

START-UP

PHENOMENON

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SEMICONDUCTOR START-UPS
MAJOR PRODUCT FOCUS

GALLIUM ARSENIDE	5
BIPOLAR DIGITAL	1
LINEAR	4
CUSTOM, SEMICUSTOM, FOUNDRY	21
MOS MEMORY & LOGIC	15
DISCRETE	3
WAFER SCALE INTEGRATION	2
OTHER	<u>6</u>
TOTAL	57

LOCATION OF SEMICONDUCTOR
START-UPS -- 1978-1984

SILICON VALLEY	37
OTHER WESTERN U.S.	9
OTHER U.S.	5
TAIWAN/KOREA	5
EUROPE	<u>1</u>
TOTAL	57

THE NEW CHALLENGES THE OLD
IN VLSI MEMORY
-- START-UPS SINCE 1978 --

<u>COMPANY</u>	<u>START DATE</u>	<u>LEAD FUNDING</u>	<u>PRODUCTS</u>
CYPRESS SEMICONDUCTOR	1982	U.S.-VENTURE	FAST SRAM
EXEL MICROELECTRONICS	1983	U.S.-VENTURE	EEPROM
INMOS	1978	UK GOV'T	FAST SRAM/DRAM
INTEGRATED DEVICE TECH.	1981	U.S.-VENTURE	FAST SRAM
INTERNATIONAL CMOS TECH.	1983	U.S.-VENTURE	CMOS/EEPROM
LATTICE SEMICONDUCTOR	1983	U.S.-VENTURE	FAST SRAM/EEPROM
MICRON TECHNOLOGY	1979	U.S.-VENTURE	DRAM
MODERN ELECTROSYSTEMS	1983	HYUNDAI-KOREA	SRAM/EEPROM
SEEQ	1981	U.S.-VENTURE	EPROM/EEPROM
TRISTAR	1983	SAMSUNG-KOREA	DRAM
VISIC	1983	U.S.-VENTURE	FAST RAM
VITELIC	1984	TAIWAN/U.S.- VARIOUS	CMOS DRAM
XICOR	1978	U.S.-VENTURE	EEPROM/NVRAM

ESTIMATED SHARE OF IC REVENUES
BY START-UPS SINCE 1978

(MILLIONS OF DOLLARS)

	<u>1980</u>	<u>1982</u>	<u>1984</u>	<u>1986</u>	<u>1988</u>	<u>1990</u>
TOTAL ICs	\$9,660	\$10,651	\$19,883	\$30,360	\$42,502	\$69,500
TOTAL START-UPS	\$ 0	\$ 137	\$ 725	\$2,400	\$5,500	\$14,000
PERCENT	0.0%	1.3%	3.6%	8%	13%	20%

IMPACT OF START-UPS
ON INDUSTRY LEADERS

● FORGING NEW MARKETS

ALTERA	ELECTRICALLY PROGRAMMABLE GATE ARRAYS
EXEL	HIGH-SPEED EEPROMS
SEEQ	EEPROMS
VITELIC	CMOS DRAMS
MSI, MOSAIC SYSTEMS	WAFER SCALE INTEGRATION
XICOR	NVRAMS, EEPROMS
MANY START-UPS	GATE ARRAYS, CUSTOM LOGIC
MANY	GALLIUM ARSENIDE ICs

● ESTABLISHING NEW LEVELS OF DEVICE PERFORMANCE AND TECHNOLOGY

CYPRESS	20NS 4K CMOS SRAM
EXEL	PROGRAMMABLE PERIPHERAL CONTROLLER
	HIGH-SPEED EEPROMS
IDT	FAST CMOS SRAMS
INMOS	HIGH-SPEED SRAM LEADER
	64K DRAM WITH NIBBLE MODE
MICRON TECHNOLOGY	SMALLEST 64K DRAM DIE
ZYTREX	HIGH-SPEED CMOS LOGIC

● CHALLENGING MAINSTREAM PRODUCTS

LINEAR TECHNOLOGY	LINEAR CIRCUITS
MICRON TECHNOLOGY	DRAMS
MODERN ELECTROSYSTEMS INC.	SRAMS, EEPROMS
S MOS SYSTEMS	CMOS MEMORY
TRISTAR	64K DRAMS
UNITED MICROELECTRONICS	PHONE CHIPS, ROMS
VLSI TECHNOLOGY	ROMS

V L S I P R O D U C T R E V I E W

MEMORY

MICRO DEVICES

APPLICATION-SPECIFIC ICs

GALLIUM ARSENIDE

WAFER SCALE INTEGRATION

BUBBLE MEMORY

DIGITAL SIGNAL PROCESSING

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MEMORY MARKET PARAMETERS -- 1980

	MARKET SIZE (<u>\$M</u>)	ASP/BIT (<u>MC</u>)	UNITS SHIPPED (<u>M</u>)	BITS SHIPPED (<u>x10⁹</u>)
DRAM	\$1.031	30.4	229	3,390
SRAM	\$ 491	137.3	107	357
EPROM	\$ 539	75.4	50	715
ROM	\$ 322	16.1	95	2,002
EEPROM	\$ 32	261.0	14	12
BIPOLAR PROM	\$ 415	150.0	80	275
BIPOLAR RAM	\$ 160	220.0	31	73

SEMICONDUCTOR MEMORY
WORLDWIDE MARKET SIZE

(MILLIONS OF DOLLARS)

	<u>1980</u>	<u>1981</u>
DRAM	\$1.031	\$1.878
SRAM	\$ 491	\$ 713
EPROM	\$ 539	\$ 795
ROM	\$ 322	\$ 545
EEPROM	\$ 32	\$ 103
CMOS X	10X	14X
OTHER MOS MEM.	\$ 45	\$ 60
BIP. PROM	\$ 415	\$ 370
BIP. RAM	\$ 160	\$ 190
TTL	\$ 95	\$ 70
ECL	\$ 65	\$ 120
TOTAL	\$3.033	\$4.654

PRICE TRENDS -- MOS MEMORY
1980 - 1983

(MILLICENTS PER BIT)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>CUMULATIVE DECLINE</u>
DRAM	30.4	13.2	8.4	6.4	79%
SRAM	137.3	80.2	44.6	36.7	73%
EPROM	75.4	28.9	16.3	10.7	86%
ROM	16.1	10.9	7.3	4.4	73%
EEPROM	261.3	205.0	151.2	124.8	52%

WORLDWIDE SEMICONDUCTOR
MEMORY MARKET
PRODUCERS' SHARES

	<u>1980</u>	<u>1983</u>
U.S.	74%	50%
JAPAN	25	46
EUROPE	<u>1</u>	<u>4</u>
	100%	100%

EAST MEETS WEST
IN SEMICONDUCTOR MEMORY

SEMICONDUCTOR MEMORY REVENUES
TOP 10 PRODUCERS IN 1983
(MILLIONS OF DOLLARS)

	<u>1983 REVENUES</u>	<u>RANK CHANGE SINCE 1980</u>
HITACHI	\$552	+5
TEXAS INST.	\$421	-1
FUJITSU	\$368	+7
NEC	\$365	+1
INTEL	\$335	-3
MOTOROLA	\$248	-2
AMD	\$242	+2
TOSHIBA	\$221	+4
ROSTEK	\$215	-6
MITSUBISHI	\$210	+8

WORLDWIDE MOS MEMORY MARKET

REVENUE AND UNIT GROWTH--1983 TO 1984

(MILLIONS OF DOLLARS OR UNITS)

		<u>1983</u>	<u>1984</u>	<u>GROWTH</u>
DRAM	VALUE	\$1,878	\$4,070	117%
	UNITS	620	1,020	65%
SRAM	VALUE	\$ 713	\$1,140	60%
	UNITS	220	300	35%
EPROM	VALUE	\$ 795	\$1,190	50%
	UNITS	180	250 (35)	36%
ROM	VALUE	\$ 545	\$ 665	22%
	UNITS	210	215	2%
EEPROM	VALUE	\$ 103	\$ 180	75%
	UNITS	25	40	60%
OVERALL	VALUE	\$4,070	\$6,800	67%
	UNITS	1,260	1,830	45%

WORLDWIDE BIPOLAR MEMORY MARKET

(MILLIONS OF DOLLARS OR UNITS)

		<u>1983</u>	<u>1984</u>
TTL RAM	VALUE	\$ 95	\$100
	UNITS	32	33
ECL RAM	VALUE	\$130	\$150
	UNITS	28	33
RAM TOTAL	VALUE	\$225	\$250
	UNITS	60	66
BIPOLAR PROM	VALUE	\$370	\$475
	UNITS	115	152
OVERALL	VALUE	\$595	\$725
	UNITS	175	218

MEMORY PAPERS AT ISSCC

	<u>1980</u>		<u>1984</u>	
	<u>NVM</u>	<u>RAM</u>	<u>NVM</u>	<u>RAM</u>
TOTAL	7	9	7	23
BIPOLAR	1	2	0	1
MOS (CMOS)	6	7	7	19
GAAS	0	2	5	9
	0	0	0	3
TOTAL	16		30	
U.S.	9		11	
JAPAN	7		18	
EUROPE	0		1	
TOTAL PAPERS	90		111	
MEMORY	16		30	
MEMORY %	18%		27%	
DISCUSSIONS	11		10	
MEMORY PAPERS	1		3	
MEMORY %	9%		30%	

ISSCC MEMORY PAPERS
-- 1980 TO 1984 --

- INCREASING FRACTION OF TOTAL PAPERS AND DISCUSSIONS IS MEMORY-RELATED
- INCREASING FRACTION IS MOS (VS. BIPOLAR) TECHNOLOGIES
- INCREASING FRACTION OF MOS IS CMOS
- INCREASING FRACTION IS RAM (VS. NVM/ROM)
- INCREASING FRACTION OF PAPERS IS JAPANESE

EAST MEETS WEST IN VLSI MEMORY
DYNAMIC RAM

CUMULATIVE UNIT SHIPMENTS THROUGH 1983

	<u>1K</u>	<u>4K</u>	<u>16K</u>	<u>64K</u>	<u>256K</u>
U.S. MAKERS	100%	89%	60%	34%	8%
JAPANESE MAKERS	0	8	37	65	92
EUROPEAN MAKERS	<u>0</u>	<u>3</u>	<u>3</u>	<u>1</u>	<u>0</u>
	100%	100%	100%	100%	100%
PEAK YEAR FOR UNITS	1975	1978	1983	1986?	1989?
UNITS (MILLIONS)	20	77	297	1,250?	4,000?
PEAK YEAR FOR SALES	1974	1977	1980	1985?	1988?
SALES (MILLIONS OF DOLLARS)	\$83	\$200	\$884	\$2,450?	\$5,625?

64K DYNAMIC RAM
1983 FORECASTS

<u>FORECAST DATE</u>	<u>UNITS FORECAST (MILLIONS)</u>
MAY 1981	200
AUGUST 1982	250
FEBRUARY 1983	280
JULY 1983 (LAST YEAR)	315
ACTUAL	371

M O S S T A T I C R A M

- RISING PRICES ON MOST PRODUCTS IN 1984
- MARKET DISORDER CAUSED BY SHIFTS IN SUPPLIER BASE
- ALL SUPPLIERS OF 8Kx8 SRAMS ARE JAPANESE
- SECOND-GENERATION FAST SRAMS ARE OFTEN CMOS;
64K FAST SRAMS ARE ALL CMOS
- PSEUDOSTATIC RAMS APPEARING FROM HITACHI, INTEL,
NEC; POTENTIAL MAJOR IMPACT IN 2-4 YEARS

E A S T M E E T S W E S T I N V L S I M E M O R Y

VLSI: 2-MICRON MINIMUM FEATURE SIZE

350,000 TRANSISTOR COMPLEXITY

EXAMPLES: MOST 64K SRAMS
MOST 256K DRAMS
SOME 256K EPROMs
SOME 256K OR GREATER ROMs

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
TOTAL VLSI MEMORY UNITS (MILLIONS)	7	65	335	1125
VLSI PERCENTAGE OF TOTAL MEMORY UNITS	0.5%	3.9%	14.0%	36.1%
PERCENT MADE BY JAPAN	87%	83%	?	?
PERCENT MADE BY U.S. OR EUROPE	13%	17%	?	?

M O S E P R O M

- STRONG PRICES AND STRONG UNIT GROWTH IN 1984
- CMOS SLOW TO TAKE HOLD
- PLASTIC PACKAGED OTP--EXPECT 35 MILLION UNITS IN 1984
- INTEL CONTINUES AS MARKET LEADER.....BUT AMD CHALLENGING

Q U A R T E R L Y E E P R O M P R O D U C T I O N R A T E

(MILLIONS OF DOLLARS)

	<u>1982</u> <u>Q2</u>	<u>1983</u> <u>Q2</u>	<u>1984</u> <u>Q2</u>
NVRAMS	\$ 2	\$ 3	\$ 6
EEPROMS			
<2K	10	15	20
2K-8K	2	2	3
>16K	<u>3</u>	<u>7</u>	<u>15</u>
TOTAL	\$17	\$27	\$44

M O S E E P R O M

- 1984 MARKET MORE ORDERLY THAN 1983
 - STANDARDS
 - SECOND SOURCES
 - MANUFACTURABLE DEVICES
- STEADY MARKET GROWTH AT LOW DENSITIES
- 16K DENSITY GROWTH STRONG IN 1984;
1984/1983 UP 250 PERCENT
- 64KS--4 VENDORS WITH PARTS NOW ON MARKET; COULD BE
12 OR MORE IN 6-9 MONTHS

1984 EEPROM VENDOR / PRODUCT MATRIX

	<u>NVRAM</u>	<u>≤2K</u>	<u>4K/8K</u>	<u>16K</u>	<u>32K</u>	<u>64K</u>
AMD						NMOS
EXEL				YES	CMOS	CMOS
GENERAL INST.	YES	YES	YES/YES	WITHDRN		1NMOS SS
HITACHI				MNOS		MNOS
HUGHES-SSD	256		YES/YES	WITHDRN		CMOS
INMOS						SNOS
INTEL	4K			SEVERAL		NMOS
MATSUSHITA		YES				
MITSUBISHI		YES				
MOTOROLA		YES		YES	NMOS	NMOS
NATIONAL		YES		YES		CMOS
NCR	YES	YES	/MNOS	MNOS	MNOS	MNOS
NEC				NMOS		
PHILIPS		YES				
ROCKWELL				NMOS		SEEQ SS
SEEQ				NMOS	NMOS	CMOS
SGS-ATES	1K					
SIEMENS		YES				
SONY		YES				
TI		YES				
TOSHIBA						
XICOR	256-4K	YES	X2804A/	X2816A		NMOS
TOTALS	6	11	4	10	4	13

EEPROM MARKET --
IMPORTANT FEATURES
OF TODAY'S MARKET

SOME DEVICE STANDARDS ARE (ALMOST) UNIVERSALLY ACCEPTED:

FUNCTION: TOTAL 5-VOLT OPERATION
LATCHED DATA AND ADDRESSES
ON BOARD CLOCKS

PERFORMANCE: 10,000 CYCLE ENDURANCE
10-YEAR DATA RETENTION

SOME COMPATIBILITY OF DESIGN OR FORMAL SECOND SOURCES EXIST:

XICOR: SEEQ, EXEL AT 16K (X2816A)
INMOS LICENSE OF GENERAL INSTRUMENT AT 64K
NCR NVRAMS COMPATIBLE WITH XICOR'S
ROCKWELL-SEEQ SS AT 16K AND 64K

SOME HIGH-FEATURE AND HIGH-DENSITY DEVICES IN PRODUCTION:

16K: MORE THAN 400K UNITS PER MONTH
64K: MORE THAN 5K UNITS PER MONTH

PROSPECTS OF MANUFACTURABLE, HIGH-DENSITY DEVICES IMPROVING

KEY AGENDA ITEMS FOR EEPROM
MARKET DEVELOPMENT

I. STEADY, SIGNIFICANT PRICE IMPROVEMENTS

- MASTERY OF MANUFACTURING PROCESSES
- NEW, SMALLER CELL STRUCTURE
- SCALING

II. CONTINUED EMERGENCE OF ORDERLY SUPPLY

- SECOND SOURCES
- CONTINUITY OF PRODUCTION
- INCREASED AMOUNTS OF FUNCTIONAL
STANDARDIZATION THROUGHOUT SUPPLIER BASE

III. IMPROVED PERFORMANCE TO USER

- FASTER WRITE CYCLES
- FASTER READ TIMES
- IMPROVED RELIABILITY
- IMPROVED ENDURANCE
- EASE-OF-USE FEATURES

M O S R O M

- VIDEO GAMES BUBBLE WORKED THROUGH; GROWTH RESUMED
BASED ON PERSONAL AND HOME COMPUTER
- HITACHI CMOS IMPACT: NO. 1 CMOS ROM SUPPLIER IN
1983
- STABLE MARKET AT 64K, 128K
STRONG GROWTH AT 256K, 1MB
- TEMPORARY RESPITE FROM EPROM PRESSURE...BUT WAIT
UNTIL MARKET TURNS DOWN

C M O S S T A T U S - M I D - 1 9 8 4

<u>PRODUCT</u>	<u>NO. OF VENDORS</u>	<u>SHARE OF REVENUE</u>
CMOS ROMs	15	18%
CMOS EPROMs	9	8%
CMOS DRAMS	2 (AT LEAST 9 AT 256K)	1%
CMOS SRAMs	18	60%
CMOS EEPROMs	1 (AT LEAST 6 OR 7 AT 64K)	3%

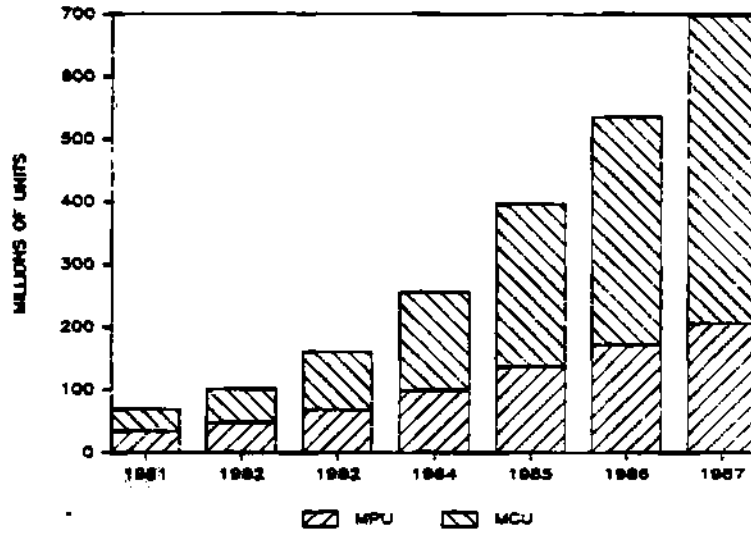
CMOS IS COMING.....BUT IT'S NOT HERE YET

S E M I C O N D U C T O R M E M O R Y M A R K E T
1 9 8 3 A N D 1 9 8 8

	<u>1983</u>	<u>1988</u>
TOTAL MARKET (\$M)	\$4.654	\$16.380
MOS MEMORY	\$4.070	\$15.483
CMOS SHARE OF MOS MEMORY	14%	70%
BIPOLAR MEMORY	\$ 560	\$ 1.041
% OF TOTAL MEMORY	12%	6%
DRAM OR IRAM	\$1.878	\$ 8.175
DRAM SHARE OF RAM	72%	76%
SRAM	\$ 713	\$ 2.287
CMOS SHARE OF SRAM	55%	90%
EPROM	\$ 795	\$ 2.167
OTP SHARE OF EPROM	2%	75%

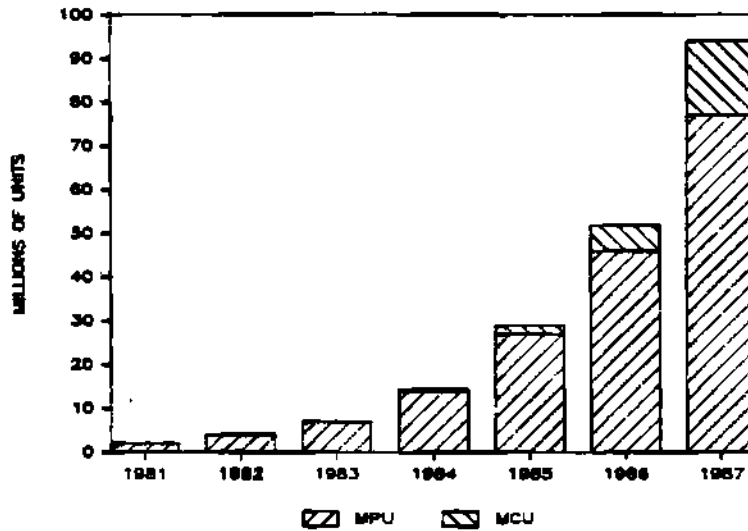
M I C R O D E V I C E S

WORLD SHIPMENTS
8-BIT MPUS/MCUS



M I C R O D E V I C E S

WORLD SHIPMENTS
16-BIT MPUS/MCUS



M I C R O D E V I C E S

MPUS 1983

- Z-80 LARGEST VOLUME MPU
 - 40 PERCENT OF TOTAL 8-BIT SHIPMENTS
 - MULTIPLE SECOND SOURCES
 - JAPANESE MANUFACTURERS HAVE 27 PERCENT OF TOTAL
- COLECO'S ADAM FAILED. 6502 MPU
- TI 44/9 COMPUTER FAILED. 9900 MPU
- COMMODORE SECOND SOURCE INTERNALLY, 8088
- IBM SECOND SOURCE INTERNALLY, 8086
- BOOK-TO-BILL 1.66

M I C R O D E V I C E S

MCUS 1983

- JAPANESE MANUFACTURERS LARGEST IN MCUS
 - 77 PERCENT 4-BIT
 - 35 PERCENT 8-BIT

➤ 59.15% TOTAL
- 4-BIT VERSUS 8-BIT LENGTH--69/31 PERCENT
- RANKING: NEC NUMBER 1, TOSHIBA NUMBER 2

M I C R O D E V I C E S

- MORE THAN A BILLION MICROCONTROLLERS AND MICRO-PROCESSORS SHIPPED SINCE 1985
- MORE THAN 30 MAJOR MANUFACTURERS
- MORE THAN 39 BASIC MICROCONTROLLER TYPES
- MORE THAN 40 BASIC MICROPROCESSOR TYPES;
5 TYPES ACCOUNT FOR 85 PERCENT OF THE MARKET

M I C R O D E V I C E S

- DEVICES/DIE INCREASING
 - 100K TO 400K NOW
 - 700K BY 1986
 - 1 MILLION DEVICES SOON
- HIGHER CLOCK SPEEDS
 - 10 MHZ TO 25 MHZ NOW
 - 50 MHZ 3 TO 5 YEARS
 - 100 MHZ COMING

M I C R O D E V I C E S

- WORD-LENGTH TRENDS
 - 8-BIT HIGHEST VOLUME
 - 16-BIT GAINING VOLUME
 - 32-BIT DESIGNS IN PROGRESS

- CMOS PROCESS
 - LOW POWER CONSUMPTION
 - LESS HEAT DISSIPATION
 - REQUIRED FOR LARGE DIE
 - BETTER RELIABILITY

M I C R O D E V I C E S

- DEVICE COMPLEXITY
 - LARGER ON-CHIP ROM
 - INTEGRATED I/O FUNCTION
 - WIDER INTERNAL DATA PATHS
 - PIPELINED ARCHITECTURE
 - INSTRUCTION CACHE

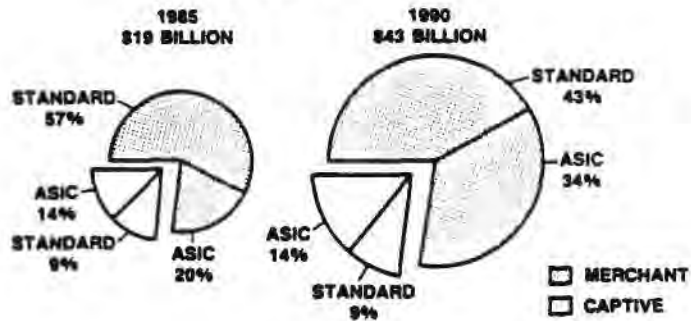
- NON-VOLATILE RAM

M I C R O D E V I C E S

- NEW PACKAGES
 - HIGH PIN COUNT PACKAGES
 - MORE PACKAGE STYLES
 - ONE-TIME-PROGRAMMABLE EPROM
- SERIAL INTERCONNECT
- MULTIPLEXED PINS
- USER-DEFINABLE I/O PINS
- COPROCESSORS

A S I C

ESTIMATED ASIC SHARE OF IC SHIPMENTS
BY U.S. COMPANIES



A S I C T E C H N O L O G Y - - T O D A Y

- EVOLUTION TO STRUCTURED ELEMENTS
- CMOS FOR LOW POWER AND SPEED
- CHIP CARRIER AND PIN-GRID PACKAGING
- TREND TOWARD INDUSTRY STANDARDS

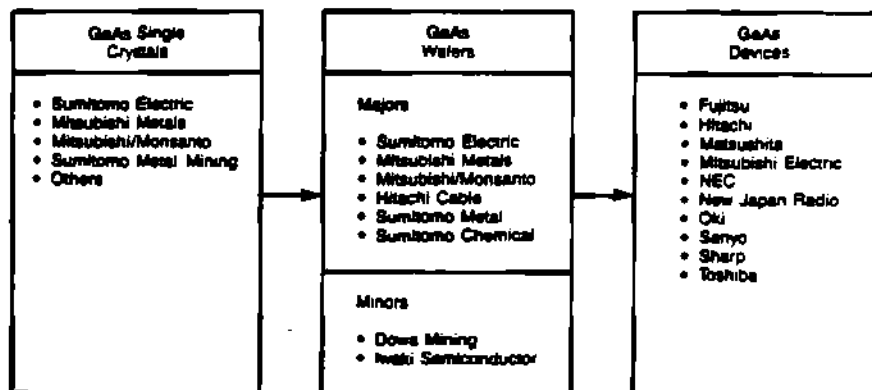
A S I C

JAPANESE-U.S. ASIC TIE-UPS

<u>YEAR</u>	<u>JAPANESE COMPANY</u>	<u>U.S. COMPANY</u>	<u>TECHNOLOGY</u>	<u>ARRANGEMENT</u>
1981	TOSHIBA	LSI LOGIC	CMOS GATE ARRAYS	JOINT DEVELOPMENT OF 1,000-10,000 PRODUCTS
1982	RICOH	VLSI TECHNOLOGY AND CUSTOM MOS ARRAYS	CMOS GATE ARRAYS	RICOH PROVIDING ALL WAFERS
1982	FUJITSU	UNGERMANN-BASS	CUSTOM BIPOLAR CMOS GATE ARRAYS	UNGERMANN-BASS DESIGNS AND DEVELOPS VLSI ETHERNET CHIPS; FUJITSU PRODUCES AND MARKETS
1982	ASAHI CHEMICAL	AMI	CUSTOM CMOS LSIS	ASAHI DESIGN CENTER IN TOKYO
1982	mitsubishi	SPERRY ELECTRIC	CMOS GATE ARRAYS	MITSUBISHI OFFERS ARRAYS AND SELLS SPERRY PRODUCTS IN JAPAN
1982	KANEMATSU SEMICONDUCTOR	MICRO-CIRCUIT ENGINEERING	SEMICUSTOM GATE ARRAYS (LINEAR, DIGITAL/ANALOG HYBRIDS)	KANEMATSU IMPORTS MCE ARRAYS
1983	SUWA SEIKOSHA	S MOS SYSTEMS	CMOS GATE ARRAYS	S MOS DEVELOPS DESIGNS FOR JAPANESE PRODUCTION
1984	FUJITSU	TEXAS INSTRUMENTS	BIPOLAR AND CMOS GATE ARRAYS	FUJITSU SECOND-SOURCING TO TI

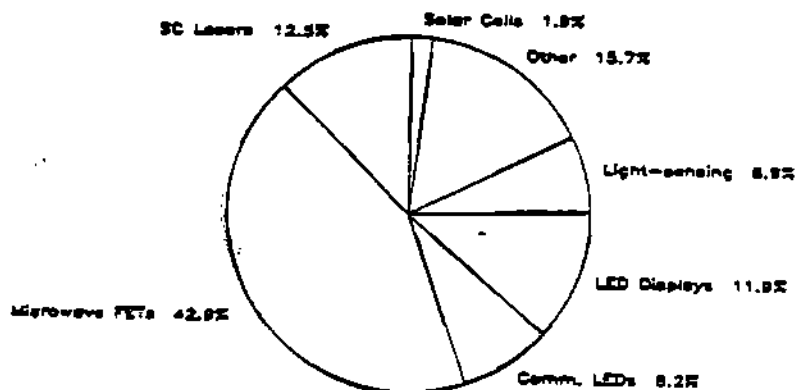
GALLIUM ARSENIDE

STRUCTURE OF THE GAAS INDUSTRY IN JAPAN



GALLIUM ARSENIDE

JAPANESE GALLIUM ARSENIDE PRODUCTION, BY DEVICE
(1983)



STRATEGIC PRODUCTS

● BUBBLE MEMORIES

- 1984 \$150M
- MOSTLY CAPTIVE
- FUJITSU--THE LEADER--4M-BIT

● DIGITAL SIGNAL PROCESSING

- 1984 MARKET APPROXIMATELY \$300M
- TELECOM AND SPEECH SYNTHESIS MARKETS
- NICHE MARKET INTEREST
- CMOS WILL DOMINATE
- 5 OR 6 JAPANESE COMPANIES INTERESTED

STRATEGIC PRODUCTS

● WAFER SCALE INTEGRATION

- CONNECTING CHIPS ON WAFER
- INCREASE PACKING DENSITY
- SHORTER PROPOGATION DELAY
- COMPANIES USING WSI:
 - . TRILOGY SYSTEM--ECL
 - . MOSAIC SYSTEMS--CMOS
 - . WAFER SCALE INTEGRATION INC.--CMOS
- COMPANIES RESEARCHING WSI
 - . MANY!!!

MANUFACTURING EQUIPMENT

STATUS

-64-

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J A P A N E S E S E M I C O N D U C T O R I N D U S T R Y
E S T I M A T E D P R O D U C T I O N T R E N D S

(BILLIONS OF YEN)

	FISCAL YEAR			CAGR 1980-1984
	1980	1983	1984	
DISCRETE	¥ 246.9	¥ 319.6	¥ 383.5	11.6%
OPTO	47.0	93.6	117.0	25.6%
BIPOLAR	260.5	475.7	618.4	24.1%
MOS	<u>309.7</u>	<u>663.6</u>	<u>1,028.6</u>	35.0%
TOTAL	¥ 864.1	¥1,552.5	¥2,147.5	25.6%

J A P A N E S E S E M I C O N D U C T O R
M A N U F A C T U R I N G E Q U I P M E N T
E S T I M A T E D P R O D U C T I O N T R E N D S

(BILLIONS OF YEN)

	FISCAL YEAR			CAGR 1980-1984
	1980	1983	1984	
WAFER PROCESSING	¥49.0	¥110.9	¥171.9	35.7%
ASSEMBLY	16.3	29.7	39.9	25.1%
TEST	<u>11.1</u>	<u>49.8</u>	<u>69.7</u>	58.3%
TOTAL	¥76.4	¥190.4	¥281.5	36.5%

MAJOR JAPANESE EQUIPMENT
ESTIMATED PRODUCTION TRENDS

(BILLIONS OF YEN)

	<u>FISCAL YEAR</u>			<u>CAGR 1980-1984</u>
	<u>1980</u>	<u>1983</u>	<u>1984</u>	
ANDO-ELECTRIC	¥ 7.3	¥11.5	¥16.2	21.1%
APPLIED MAT.--JAPAN	3.0	15.0	24.0	68.2%
CANON	10.0	15.0	21.0	20.4%
DISCO	6.6	11.4	15.4	23.6%
NIKON	3.0	18.4	30.0	77.8%
SHINKAWA	7.4	14.0	20.2	28.5%
TAKEDA-RIKEN	9.4	23.0	32.4	36.3%
TOKYO ELECTRON	19.2	38.0	53.0	28.9%
TOKYO-OMKA	5.7	11.5	15.6	28.6%
ULVAC	<u>8.0</u>	<u>13.0</u>	<u>18.0</u>	22.5%
TOTAL	¥79.6	¥159.3	¥245.8	32.6%

P L A N T S I T I N G I N J A P A N

U.S. AND WEST EUROPEAN COMPANIES

FAIRCHILD TEST

HOECHST (HAS R&D LAB)--NEW FACTORY, 1985

LTX--NEW FACTORY, 1985

MATERIALS RESEARCH CORP. (MRC)

MONSANTO--NEW FACTORY, 1985

SHIPLEY (PHOTO RESIST)--FACTORY UNDER CONSTRUCTION

TELEDYNE

PLANT SITING IN THE U. S.

JAPANESE COMPANIES

INTERNATIONAL LEADFRAME (MITSUI)

KONSAKUSHO--LEADFRAME

KYOCERA--PACKAGES

OSAKA TITANIUM--SILICON WAFERS

SHINETSU HANDOTAI--SILICON WAFERS

SHINKO ELECTRIC--LEADFRAME

JOINT VENTURE TRENDS

1984

<u>U.S. COMPANY</u>	<u>JAPANESE COMPANY</u>	<u>PRODUCT</u>
GENUS U.S.A.	C. ITOH	CVD
INTEGRATED AUTOMATION	KISHIMOTO	CVD
MENTOR GRAPHICS	MARUBENI HYTEC CO.	GRAPHICS
VEECO	KOKUSAI	ION BEAM ETCHING EQUIPMENT
GEN RAD	TOKYO ELECTRON	TEST EQUIPMENT
HEWLETT-PACKARD	YOKOGAMA-HOKUSHIN	LINEAR IC TEST EQUIPMENT

JOINT VENTURE TRENDS

1984 (CONTINUED)

<u>U.S. COMPANY</u>	<u>JAPANESE COMPANY</u>	<u>PRODUCT</u>
DOW CORNING (HEMLOCK S/C)	SHINETSU	SILICON
ANICON	SUMITOMO ELECTRONIC SYSTEMS	CVD EQUIPMENT
ULVAC	L'AIR LIQUIDE	PLASMA-ETCHING TECHNOLOGY
KAYEX USA (SUBSIDIARY OF GENERAL ELECTRIC)	KOYO LINDBERG	CRYSTAL GROWING; SLICING AND POLISHING EQUIPMENT

NEW PLAYERS IN JAPAN

SEMICONDUCTOR EQUIPMENT AND MATERIALS

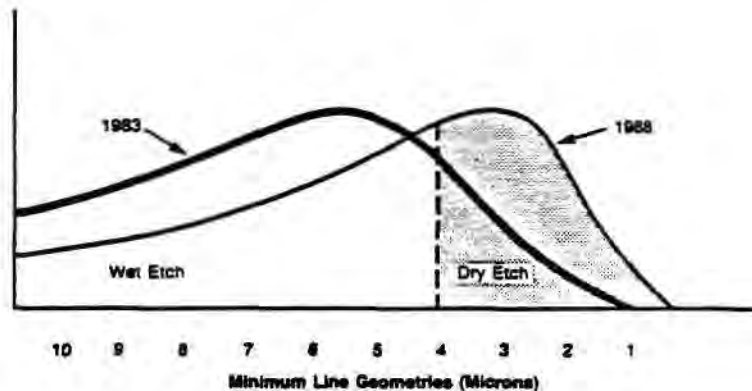
MINEBEA	MINIATURE BALL BEARING MANUFACTURER-- TESTING EQUIPMENT
KOKUSAI	SPUTTERS AND CVD EQUIPMENT--MOVING INTO ION BEAM EQUIPMENT
KOMATSU	TOP CONSTRUCTION MACHINERY MANUFACTURER-- EPITAXIAL GROWING
NIPPON MINING	CRUDE OIL AND COPPER REFINING--ELECTRONIC MATERIALS
KOBE STEEL Co.	STEEL COMPANY--SEMICONDUCTORS PLATING-- THROUGH JOINT VENTURE WITH KITAMURA MEKKI (50-50)

NEW PLAYERS IN JAPAN

SEMICONDUCTOR EQUIPMENT AND MATERIALS (CONTINUED)

YOKOGAWA-HOKUSHIN	MAJOR INDUSTRIAL MEASURING EQUIPMENT MANUFACTURER--ENTERED LINEAR IC TEST EQUIPMENT MARKET
SHOWA OIL Co.	OIL REFINING COMPANY--SILICON SINGLE-CRYSTAL SOLAR CELLS AND SOLAR BATTERIES
SUMISHO ELECTRIC SYSTEMS	TRADING COMPANY--MANUFACTURES DRY ETCHING MACHINES DEVELOPED BY GCA USA
TOYO SODA	CHEMICALS--PHOTO MASKMAKING
KISHIMOTO SANGYO	TRADING COMPANY--MANUFACTURES WAFER TRANSPORT SYSTEMS

SEMICONDUCTOR PROCESSING EVOLUTION



S I L I C O N T R E N D S

ESTIMATED PERCENTAGE OF SQUARE INCHES

	<u>1983</u>	<u>1984</u>	<u>1985</u>
LESS THAN 4-INCHES	35.5%	23.0%	20.0%
4-INCHES	57.0	63.0	56.0
5-INCHES	6.0	11.0	15.0
6-INCHES	<u>1.5</u>	<u>3.0</u>	<u>9.0</u>
TOTAL	100.0%	100.0%	100.0%

S I L I C O N T R E N D S

- INCREASED NEED FOR PURITY
- NEW FACTORIES EVERYWHERE
- EMERGENCE OF 6" MAGNETIC CZ TECHNOLOGY
- INCREASING INTEREST IN GAAS IN JAPAN
- PRICES STABILIZING/LEAD TIMES STRETCHING
- WAFER SUPPLY EXPECTED TO GROW 20 PERCENT THROUGH 1989

S I L I C O N T R E N D S

ESTIMATED WORLDWIDE SILICON CONSUMPTION
(MILLIONS OF SQUARE INCHES)

	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1983/1984</u> <u>CAGR %</u>
U.S. MERCHANTS	396	554	792	43%
U.S. CAPTIVES	107	128	168	31%
JAPAN	239	365	560	53%
WESTERN EUROPE	82	88	120	38%
ROW	<u>5</u>	<u>6</u>	<u>10</u>	<u>68%</u>
TOTAL	829	1,141	1,650	45%

S I L I C O N T R E N D S

ESTIMATED WAFER STARTS

	<u>1983</u>	<u>1984</u>	<u>1984</u>
LESS THAN 4-INCHES	51.9%	38.0%	36.3%
4-INCHES	44.3	54.7	51.3
5-INCHES	3.3	6.1	8.9
6-INCHES	<u>0.5</u>	<u>1.2</u>	<u>3.5%</u>
TOTAL:	100.0%	100.0%	100.0%

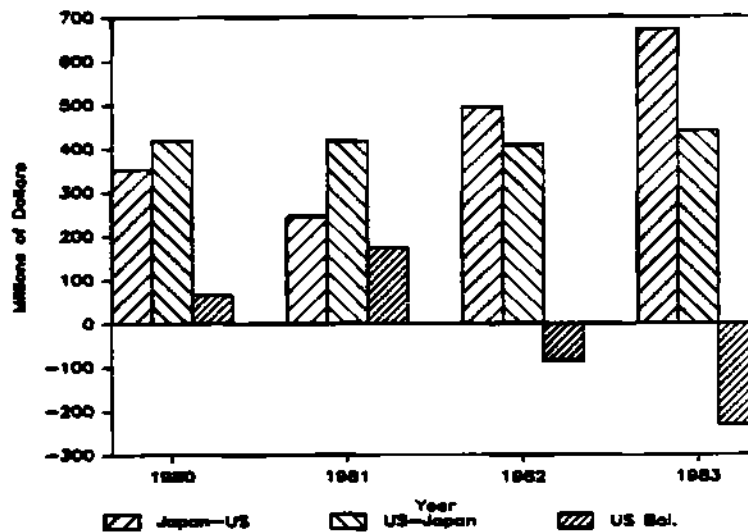
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ESTIMATED U.S. VS. JAPANESE BALANCE OF TRADE

(MILLIONS OF DOLLARS)

	1982	1983	1984F
TOTAL SEMICONDUCTOR	(\$ 85.7)	(\$226.5)	(\$500)
TOTAL INTEGRATED CIRCUIT	(\$ 82.0)	(\$230.3)	(\$510)
TOTAL MOS MEMORY	(\$274.8)	(\$410.5)	(\$750)
TOTAL MOS LOGIC	\$ 31.8	\$ 15.7	(\$ 50)

E F F E C T S O F I C P R O L I F E R A T I O N



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SEMICONDUCTOR RESEARCH COOPERATIVE (SRC)

- U.S. SEMICONDUCTOR NON-PROFIT CONSORTIUM
- PROMOTES SEMICONDUCTOR RESEARCH IN UNIVERSITIES
- HEADQUARTERS IN RESEARCH TRIANGLE, NORTH CAROLINA
- STATUS:
 - \$12M--1982
 - \$30M--1983

E F F E C T S O F I C P R O L I F E R A T I O N

SRC RESEARCH AREAS

- DEVICE MODELING
- SHALLOW JUNCTION FABRICATION TECHNIQUES
- METHODS FOR REMOVING IMPURITIES
- USE OF PLASMA PROCESSING TO GROW AND DEPOSIT FILMS AT LOW TEMPERATURES
- DEVELOPMENT OF NEW INSTRUMENTS TO DETECT PARTICULATES IN THE 10- TO 100-ANGSTROM RANGE

EFFECTS OF IC PROLIFERATION

MICROELECTRONICS AND COMPUTER CORPORATION (MCC)

- CONSORTIUM OF 15 U.S. ELECTRONICS COMPANIES
- 110 EMPLOYEES IN AUSTIN, TEXAS
- MEMBERS CONTRIBUTE DOLLARS AND PEOPLE FOR AT LEAST THREE YEARS
- PATENTS BELONG TO THE MEMBER COMPANIES FOR THREE YEARS
- FUNDING GOAL OF \$324M

EFFECTS OF IC PROLIFERATION

MCC RESEARCH AREAS

- SEMICONDUCTOR PACKAGING AND INTERCONNECTS
- SOFTWARE TECHNOLOGY
- VLSI/CAD
- ADVANCED COMPUTER ARCHITECTURE

E F F E C T S O F I C P R O L I F E R A T I O N

JAPANESE GOVERNMENT FUNDING FOR ADVANCED
TECHNOLOGY R&D PROJECTS
(MILLIONS OF DOLLARS)

<u>PROJECT</u>	<u>1983</u>	<u>PROJECTED TOTAL</u>
1. SUPER-COMPUTER	\$ 6.6	\$104.5
2. OPTOELECTRONICS	14.4	81.8
3. NEXT GENERATION INDUSTRIES	N/A	472.7
4. NEW FUNCTION ELEMENTS	6.2	13.6
5. SOFTWARE DEVELOPMENT	N/A	30.1
6. FOURTH-GENERATION COMPUTER	12.2	234.6*
7. FIFTH-GENERATION COMPUTER	<u>11.6</u>	<u>45.5</u>
TOTAL FUNDS	\$51.0	\$982.8

N/A = NOT AVAILABLE

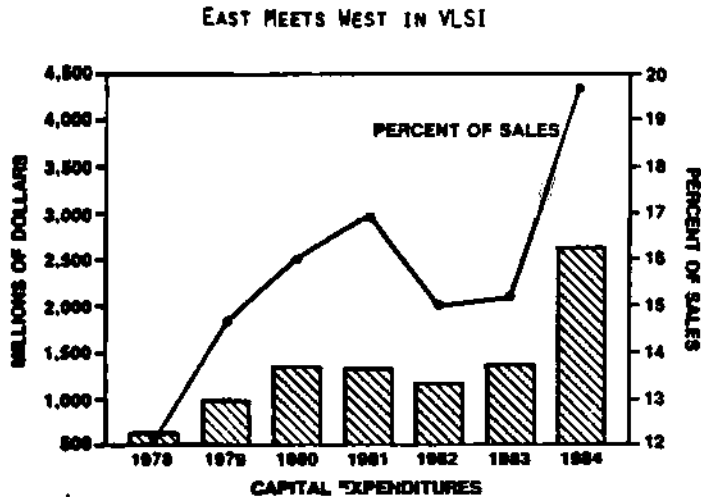
*MITI FUNDS; DOES NOT INCLUDE PRIVATE FUNDING OF \$302.3 MILLION

EFFECTS OF IC PROLIFERATION

EAST MEETS WEST IN VLSI

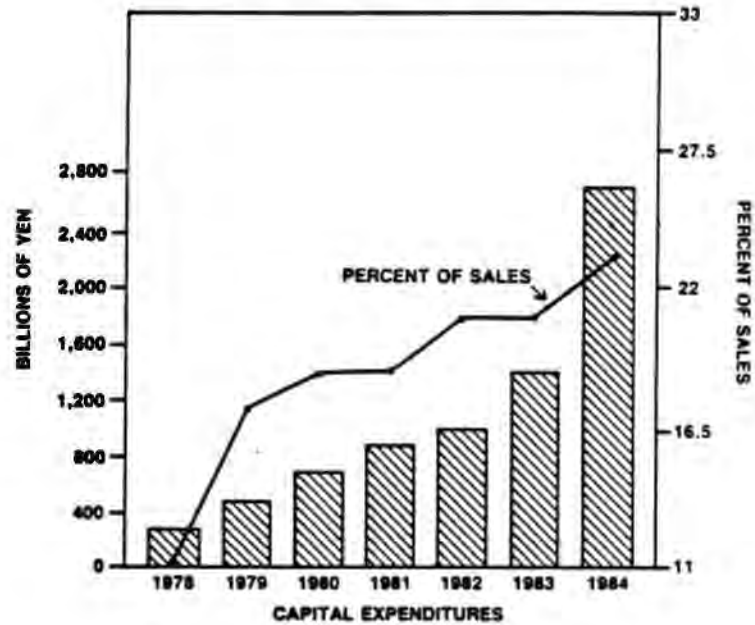
- SEMICONDUCTOR FACTORIES
 - U.S. HAS 7 FACTORIES IN JAPAN
 - JAPAN HAS 6 FACTORIES IN THE UNITED STATES
- UNITED STATES HAS APPROXIMATELY 11 PERCENT OF JAPANESE MARKET; JAPAN HAS APPROXIMATELY 12 PERCENT OF THE U.S. MARKET
- UNITED STATES AND JAPAN HAVE PARITY IN MOS MEMORIES AND MPUS/MCUs
- CAPITAL INVESTMENT 1984
 - U.S. \$2.6B
 - JAPAN \$2.7B (FISCAL YEAR)
- TOP 10 MANUFACTURERS' REVENUES
 - 5 JAPANESE HAVE 48 PERCENT
 - 5 U.S. HAVE 52 PERCENT

CAPITAL EXPENDITURES OF U.S. SEMICONDUCTOR MANUFACTURERS (FISCAL YEARS)



CAPITAL EXPENDITURES OF JAPANESE
SEMICONDUCTOR MANUFACTURERS
(FISCAL YEARS)

EAST MEETS WEST IN VLSI



EFFECTS OF IC PROLIFERATION

EAST MEETS WEST IN VLSI

ISSCC TECHNICAL PAPERS BY COUNTRY OF ORIGIN

COUNTRY	1979	1980	1981	1982	1983
UNITED STATES	65%	68%	61%	66%	51%
JAPAN	21	25	25	29	42
WESTERN EUROPE	14	7	14	5	7
	100%	100%	100%	100%	100%
TOTAL (EXCLUDING PANEL SESSIONS)	97	90	89	101	97

E F F E C T S O F I C P R O L I F E R A T I O N

E A S T M E E T S W E S T I N V L S I

- AEA AND SEMI OPEN OFFICES IN TOKYO
- EIAJ HAS JAPAN ELEC. BUREAU IN NEW YORK
- JAPAN HAS VAN ISSUE;
UNITED STATES PASSES COPYRIGHT PROTECTION FOR SEMICONDUCTOR
- RESEARCH CENTERS

<u>U.S.</u>	<u>JAPAN</u>
NORTH CAROLINA	TOKYO
TEXAS	IBARAKI
CALIFORNIA	KANAGAWA
WASHINGTON	KUMAMOTO
MASSACHUSETTS	KYOTO
GEORGIA	OITA

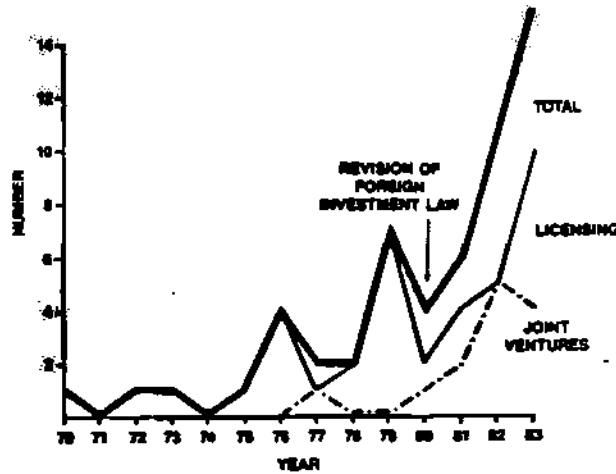
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K O R E A N S E M I C O N D U C T O R S A L E S A N D I N V E S T M E N T S
(MILLIONS OF DOLLARS)

	<u>S A L E S</u>		<u>I N V E S T M E N T S</u>	
	<u>1983</u>	<u>1984</u>	<u>1983</u>	<u>1984</u>
KOREAN ELECTRONIC COMPANY	\$30	\$ 45	\$15	\$ 25
SAMSUNG SEMICONDUCTOR	25	45	20	60
GOLD STAR SEMICONDUCTOR	5	15	15	40
KOREAN INSTITUTE OF ELECTRONIC TECHNOLOGY (KIET)	1	2	6	6
HYUNDAI ELECTRONICS	0	1	25	45
DAE WOO ELECTRONICS	<u>1</u>	<u>2</u>	<u>10</u>	<u>20</u>
TOTAL	\$62	\$110	\$91	\$196

EFFECTS OF IC PROLIFERATION

U.S.-JAPANESE SEMICONDUCTOR JOINT VENTURES AND LICENSING AGREEMENTS



EFFECTS OF IC PROLIFERATION

U.S.-JAPANESE LICENSING AGREEMENTS

AREA	U.S. COMPANY	JAPANESE COMPANY
MPUs MCUs	INTEL	FUJITSU
		NEC
		mitsubishi
	TEKTRONIX	NEC
	ZILOG	TOSHIBA
		SHARP
	AMI	NEC
	MOTOROLA	HITACHI
MPUs	SMC	NEC
DRAMs	H-P	HITACHI
	MOTOROLA	HITACHI
	NATIONAL	OKI
	SEMICONDUCTOR	
SEMICONDUCTOR TECHNOLOGY	SMC	HITACHI
		FUJITSU
		NEC
		TOSHIBA

EFFECTS OF IC PROLIFERATION

EAST MEETS WEST IN VLSI

<u>YEAR SIGNED</u>	<u>U.S. START-UP</u>	<u>ASIAN COMPANY</u>	<u>AGREEMENT</u>
1979	NATIONAL MICROELECTRONICS	UNITED MICROELECTRONICS	NMC IS UMC'S U.S. SUBSIDIARY
1980	WEITEK	TOSHIBA	GRAPHICS CHIPS
1981	VLSI TECHNOLOGY & SEEQ	AMKOR (SISTER COMPANY OF ANAM OF KOREA)	AMKOR ASSEMBLING IC PRODUCTS
1982	MICRO-CIRCUIT ENGINEERING	KANEMATSU SEMICONDUCTOR	SEMICUSTOM GATE ARRAYS
1982	LSI LOGIC	TOSHIBA, FUJITSU, GOLD STAR	H-CMOS GATE ARRAYS FOUNDRY/CAD TOOLS
1982	WEITEK	UNITED MICROELECTRONICS	64K NMOS ROMs

EFFECTS OF IC PROLIFERATION

EAST MEETS WEST IN VLSI (CONTINUED)

<u>YEAR SIGNED</u>	<u>U.S. START-UP</u>	<u>ASIAN COMPANY</u>	<u>AGREEMENT</u>
1983	VLSI TECHNOLOGY	RICOH	NMOS AND CMOS MASK ROMs
1983	CUSTOM MOS ARRAYS	RICOH	CMOS AND BI-CMOS GATE ARRAYS
1983	ACRIAN	BHARAT, INDIA	RF COMMUNICATION DEVICES
1983	MICRON TECHNOLOGY	SAMSUNG SEMICONDUCTOR	64K DRAM TECHNOLOGY
1983	S MOS SYSTEMS	SUMA SEIKOSHA	CMOS MEMORY AND LOGIC
1983	MODERN ELECTROSYSTEMS	HYUNDAI	NMOS AND CMOS MEMORY AND MCUs; MEI IS HYUNDAI'S U.S. SUBSIDIARY
1983	TRISTAR SEMICONDUCTOR	SAMSUNG SEMICONDUCTOR	NMOS & CMOS MEMORY; TRISTAR IS SAMSUNG'S U.S. SUBSIDIARY
1983	EXEL MICROELECTRONICS	TRISTAR SEMICONDUCTOR	16K EEPROMs

