

438

PROCEEDINGS AT SEMICON WEST

May 23, 1984

Dunfey's Hotel

MEMORY MARKETS

Lane Mason

Semiconductor Industry Service

MEMORY TRENDS

- CONTINUES TO DRIVE TECHNOLOGY
- EXPLOSIVE { UNIT
REVENUE } GROWTH
- UNCERTAIN DIRECTION IN PACKAGING

Nielsen  Dataquest

Semiconductor Industry Service

MEMORY TECHNOLOGY TRENDS

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
2U MIN FEATURE SIZE - UNITS	6M	65M	335M	1125M
(350K Tx/CHIP)				
- % OF UNITS	0.5%	3.9%	14.0%	36.1%
CMOS				
- % OF UNITS	9%	13%	16%	24%

Nielsen  **Dataquest**

WORLDWIDE MOS MEMORY MARKET
(MILLIONS OF DOLLARS OR UNITS)

		<u>1983</u>	<u>1984</u>	<u>GROWTH</u>
DRAM	VALUE	\$1878	\$4070	117%
	UNITS	620	1020	65%
SRAM	VALUE	\$ 713	\$1140	60%
	UNITS	220	300	35%
EPROM	VALUE	\$ 795	\$1190	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	\$4070	\$6800	67%
	UNITS	1260	1830	45%

- STABLE AND RISING PRICES: 1984 vs. 1983
- DYNAMIC RAM MARKET 1984 AS BIG AS MOS MEMORY MARKET IN 1983
- MIX RICHER IN HIGHER DENSITY, HIGHER ASP DEVICES
- START UPS, CAPACITY; POTENTIAL FOR SIGNIFICANT PRICE EROSION 1985-1986

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PACKAGING OPPORTUNITIES

SO PACKAGES

SMD

(P) (L) LCC

SIP

ZIP

DIP : SIDE BRAZED CERAMIC

CERDIP

PLASTIC

CHIP ON BOARD

PLASTIC PACKAGED EPROMS

MULTICHIP MODULES

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PACKAGING OPPORTUNITIES

DRIVING FORCES:

- NEED FOR HIGHER PACKING DENSITY IN SYSTEMS
- LARGER DIE AT 256K/1MB LEVEL MAY FORCE ABANDONMENT OF 300 MIL P-DIP
- NEED FOR LESS EXPENSIVE COMPONENT AND MEMORY SUBSYSTEM
- VALUE-ADDED FOR SEMI HOUSES AND DIE BROKERS
- TREMENDOUS EXPANSION IN SMALL SYSTEMS
- IMPROVEMENT IN PACKAGING MATERIALS

OBSTACLES

- INSTALLED BASE/TECHNOLOGY FOR DIP
- LACK OF CLEAR CONSENSUS ON PACKAGE TYPE
- SUBSYSTEM TEST PROBLEMS

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MICROPROCESSOR MARKETS

Mel Thomsen

MICROPROCESSOR TRENDS

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

TESTING ISSUES

- OLD PROBLEMS STILL HERE
 - DC MEASUREMENT TIME
 - TIME/PIN MUST BE HIGHER
 - 120 TO 180 PIN PACKAGES
 - USERS WANT 10 TO 1 IMPROVEMENT IN TEST TIME

TESTING ISSUES

- ◆ TOUGH NEW PROBLEMS COMING
 - INSTRUCTION CACHE MEMORY
 - MUST TRIGGER ON BUS ACTIVITY
 - NO LONGER TESTING SYNCHRONOUS PARTS

- ◆ HIGHER CLOCK SPEEDS
 - 25 TO 50 MHz
 - 100 MHz AND HIGHER COMING
 - 20 PICOSECOND TIME RESOLUTION

MARKET ENVIRONMENT

- MORE THAN A BILLION MICROCONTROLLERS AND MICROPROCESSORS SHIPPED SINCE 1975
- MORE THAN 30 MAJOR MANUFACTURERS
- 39 BASIC MICROCONTROLLER TYPES
- 40 BASIC MICROPROCESSOR TYPES--
- FIVE OF THEM ACCOUNT FOR 85 PERCENT OF THE MARKET

MICROPROCESSOR TRENDS

- 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

MICROPROCESSOR TRENDS

- 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

MICROPROCESSOR TRENDS

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

- NON-VOLATILE RAM

JAPAN EQUIPMENT INDUSTRY

Gene Norrett

JAPANESE SEMICONDUCTOR INDUSTRY ESTIMATED PRODUCTION TRENDS

(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	309.7	663.6	1,028.6	35.0%
TOTAL	¥ 864.1	¥ 1,552.5	¥ 2,147.5	25.6%

SOURCE: DATAQUEST

JAPANESE SEMICONDUCTOR MANUFACTURING EQUIPMENT ESTIMATED PRODUCTION TRENDS

(Billions of Yen)

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

SOURCE: DATAQUEST

MAJOR JAPANESE EQUIPMENT MANUFACTURERS PRODUCTION TRENDS

(Billions of Yen)

	FISCAL YEAR			CAGR
	1980	1983	1984	1980-1984
ANDO-ELECTRIC	¥ 7.3	¥ 11.5	¥ 16.2	22.1%
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-OHKA	5.7	11.5	15.6	28.6%
ULVAC	8.0	13.0	18.0	22.5%
TOTAL OF ABOVE COMPANIES	<u>¥79.6</u>	<u>¥170.8</u>	<u>¥245.8</u>	32.6%

SOURCE: DATAQUEST

PLANT SITING IN THE U.S.

JAPANESE COMPANIES

**INTERNATIONAL LEADFRAME (MITSUI)
KOHSAKUSHO--LEADFRAMES
KYOCERA--PACKAGES
OSAKA TITANIUM--SILICON WAFERS
SHINETSU HANDOTAI--SILICON WAFERS
SHINKO ELECTRIC--LEADFRAMES**

PLANT SITING IN JAPAN

U.S. AND 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)--UNDER CONSTRUCTION

TELEDYNE

JOINT VENTURE TRENDS

1984

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

JOINT VENTURE TRENDS (Continued)

1984

U.S. COMPANY	JAPANESE COMPANY	PRODUCT
DOW CORNING (HEMLOCK S/C)	SHINETSU HANDOTAI	MATERIALS
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--SEMICONDUCTOR PLATING--THROUGH JOINT VENTURE WITH KITAMURA MEKKI (50-50%)

NEW PLAYERS IN JAPAN (Continued)

SEMICONDUCTOR EQUIPMENT AND MATERIALS

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 MASK MAKING
KISHIMOTO SANGYO	TRADING COMPANY--MANUFACTURES WAFER TRANSPORT SYSTEMS

EDA DRIVEN BY VLSI ADVANCEMENTS

- ◆ MICROPROCESSORS
- ◆ MICROCONTROLLERS
- ◆ MICROPERIPHERALS
- ◆ DYNAMIC RAMS
- ◆ ASICS

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REST OF WORLD SEMICONDUCTOR INDUSTRY

(Millions of Dollars)

	FISCAL YEAR			CAGR 1980-1984
	1980	1983	1984	
DISCRETE	\$416	\$ 455	\$ 531	6.3%
OPTO	120	150	175	10.0%
BIPOLAR	307	464	610	18.7%
MOS	143	450	721	50.0%
TOTAL	\$986	\$1,519	\$2,037	20.0%

SOURCE: DATAQUEST

KOREAN SEMICONDUCTOR SALES AND INVESTMENTS

(Millions of Dollars)

	<u>SALES</u>		<u>INVESTMENTS</u>	
	1983	1984	1983	1984
KOREAN ELECTRIC COMPANY	\$30	\$ 45	\$15	\$ 25
SAMSUNG SEMICONDUCTOR	25	45	20	60
GOLD STAR SEMICONDUCTOR	5	15	15	45
KOREAN INSTITUTE OF ELECTRONIC TECHNOLOGY (KIET)	1	2	6	6
HYUNDAI ELECTRONICS	0	1	25	45
DAEWOO ELECTRONICS	1	2	10	20
TOTAL	<u>\$62</u>	<u>\$110</u>	<u>\$91</u>	<u>\$201</u>

SOURCE: DATAQUEST

SUMMARY

- **1984 JAPANESE SEMICONDUCTOR GROWTH 38.3 PERCENT IN YEN AND 44 PERCENT IN U.S. DOLLARS**
- **1984 JAPANESE SEMICONDUCTOR EQUIPMENT GROWTH 48 PERCENT IN YEN AND 55 PERCENT IN U.S. DOLLARS**
- **TEN JOINT VENTURES BETWEEN JAPAN AND THE WEST AS OF APRIL 1984**
- **TEN MAJOR NEW PLAYERS IN THIS EXPLOSIVE INDUSTRY**
- **1984 ROW SEMICONDUCTOR GROWTH 34 PERCENT**
- **1984 KOREAN SEMICONDUCTOR CAPITAL INVESTMENTS TWO TIMES SALES REVENUES**

ASIC MARKETS

Howard Bogert

Semiconductor Industry Service

WHAT IS AN ASIC?

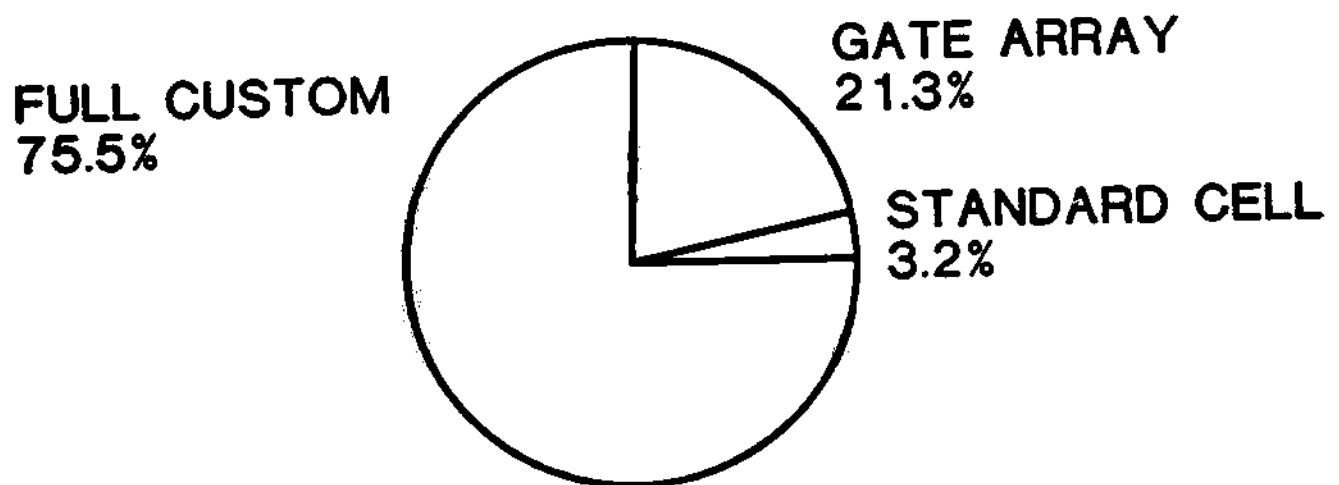
- CUSTOM
- GATE ARRAY
- STANDARD CELL
- PROGRAMMABLE ARRAY LOGIC (PAL[®])

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MARKET OVERVIEW

WORLDWIDE ASIC MARKET

1983 SHIPMENTS = \$1.59 BILLION

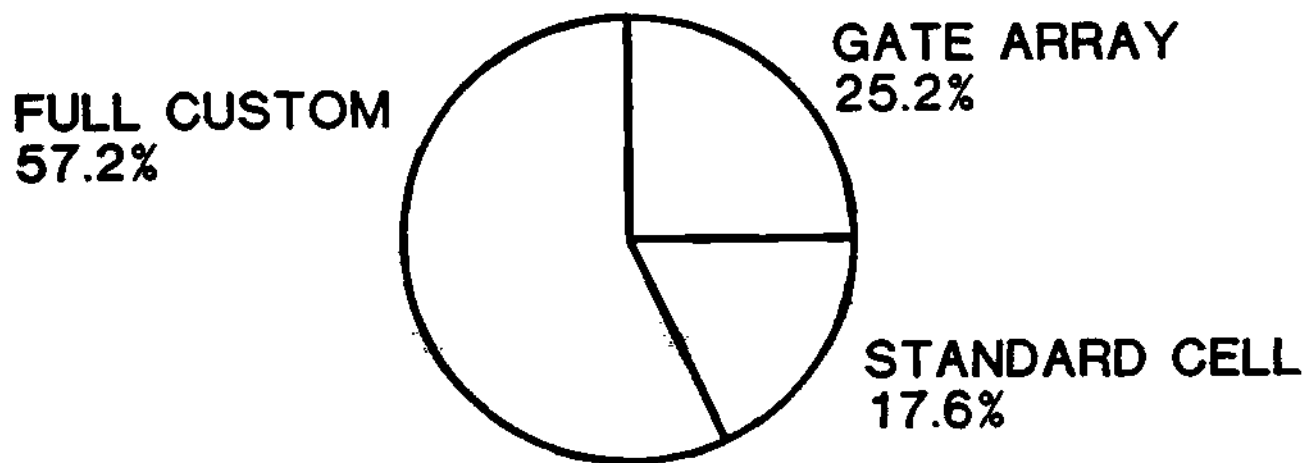


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MARKET OVERVIEW

WORLDWIDE ASIC MARKET

1989 SHIPMENTS - \$7.68 BILLION



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ASIC TECHNOLOGY -- TODAY

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

CAD/CAM

Ken McKenzie

CAD TOOLS--TODAY

- **MULTIUSER**
- **SHARED RESOURCE**
- **STAR OR CLUSTERED COMMUNICATIONS**
- **TASKS VS. USERS--PERFORMANCE LIMITS**
- **COMPLEX MULTIUSER SOFTWARE**

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CAD TOOLS - - THE FUTURE

- SINGLE DEDICATED USER
- LOOSE-COUPLED 16-BIT AND 32-BIT MPUS
- HIGH-SPEED LAN COMMUNICATIONS
- STANDALONE/MULTITASKING
- OPERATOR-SENSITIVE SOFTWARE (NLI, AI)

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CAD TOOLS - - THE FUTURE

- CAD TOOLS SMALLER THAN TODAY'S PCS
- INTERNAL 1MB TO 4MB RAM
- TRANSPARENT VIRTUAL MEMORY
- VOICE I/O
- LOCAL OPTICAL DISK

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CAPITAL SPENDING IN THE 80's

Robert McGeary

SEMICONDUCTOR INDUSTRY OVERVIEW
UNITED STATES AND JAPANESE COMPANIES

	1983	1984	1985	1986	1987	1988	CAGR (1983-19
WORLDWIDE	18713	25450	33085	38047	39950	49937	21.69%
US	9895	13061	16980	19527	20503	25629	20.97%
JAPAN	6915	9086	11358	12550	15048	18690	22.00%

CAPITAL SPENDING SUMMARY

UNITED STATES AND JAPAN

	1983	1984	1985	1986	1987	1988
UNITED STATES	1501	2778	2938	4468	4547	6065
CHANGE		85%	42%	13%	2%	33%
JAPAN	1656	2601	3362	3958	5207	6660
CHANGE		57%	29%	18%	31%	28%

CAPITAL SPENDING AS A PERCENT OF REVENUE

WATCH OUT!

	1983	1984	1985	1986	1987	1988
UNITED STATES COMPANIES	22%	20%	22%	22%	21%	23%
JAPANESE COMPANIES	24%	29%	30%	31%	35%	36%

US COMPANY CAPITAL SPENDING LAGS SALES BY 7 MONTHS

JAPANESE COMPANY CAPITAL SPENDING LEADS SALES BY 6 MONTHS

EQUIPMENT ISSUES IN THE 80'S

THE LINE WIDTH BARRIER EXISTS!

LINE WIDTH DISTRIBUTION SLIDE (1983, 1988)

PROCESSING SLACK

- o SILICIDE VERSES METAL STRAPPING
- o MULTILEVEL RESIST SCHEMES
- o MONITORING AND END POINT DETECTION
- o SILICON CONTROL AND EPITAXY
- o DIFFUSION CONTROL
- o MATERIAL CONTROL

PARTNERS IN PROCESS

FOR COMPETITIVE DEVICES AT CURRENT LINE GEOMETRIES

PAYBACK FOR EQUIPMENT DOLLARS

IMPROVING YIELDS

IMPROVING QUALITY

MEANS

TIGHTER DEVICE SPECIFICATIONS

IMPROVED COMPETITIVE POSITION

COMPUTER CONTROL AND AUTOMATION

MORE BANG FOR THE BUCK

o SCHEDULING

DECREASE WIP

DECREASE QUEING

INCREASE EQUIPMENT UTILIZATION

o CONTAMINATION CONTROL

DECREASE OPERATOR INVOLVEMENT

REMOVE PAPER FROM FAB

ISLANDS OF AUTOMATION

