





### HIGHLIGHTS OF THE MOS MICROCONTROLLER FORECAST

Points worth noting about Dataquest's MOS microcontroller forecast include the following:

- Microcontroller revenue is expected to exceed \$2.5 billion in 1988 and to exceed \$3 billion annually by 1991, as shown in Figure 1.
- Unit shipments of 4-bit microcontrollers remain strong, with a forecast CAGR of 9.1 percent through 1993.
- Shipments of 8-bit microcontrollers are expected to climb steadily, overtaking those of 4-bit microcontrollers this year.
- The market for 16-bit microcontrollers has been slow to materialize, but emerging applications, such as antiskid braking and recent product introductions, are expected to fuel growth in the next five years.
- Dataquest anticipates a mild downturn in overall semiconductor consumption beginning in mid-1989 and extending through mid-1990. However, both years are expected to show positive growth in microcomponent unit consumption. According to this industry model, the next cyclical downturn will occur in 1993.

### Figure 1

#### Estimated Worldwide MOS Microcontroller Consumption 1983–1993



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### COMPARISON WITH EARLIER FORECASTS

Microcontroller unit shipment projections have increased substantially over the February 1988 forecast. The average selling price (ASP) for 4- and 16-bit microcontrollers remained unchanged, while 8-bit ASPs strengthened for the forecast period. Forecast revenue for both 4- and 8-bit microcontrollers increased significantly as a result.

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### WORLDWIDE MOS MICROCONTROLLER FORECAST

Dataquest's MOS microcontroller forecast is presented in Tables 1 through 9. The tables included in this forecast are as follows:

- Table 1-Worldwide MOS Microcontroller Revenue Forecast
- Table 2-Worldwide MOS Microcontroller Unit Shipment Forecast
- Table 3—Worldwide MOS Microcontroller ASP Forecast
- Table 4--Estimated Worldwide MOS Microcontroller Revenue, 1979-1983
- Table 5-Estimated Worldwide MOS Microcontroller Revenue, 1984-1987
- Table 6---Estimated Worldwide MOS Microcontroller Unit Shipments. 1979-1983
- Table 7-Estimated Worldwide MOS Microcontroller Unit Shipments, 1984-1987
- Table 8-Estimated Worldwide MOS Microcontroller ASPs, 1979-1983
- Table 9-Estimated Worldwide MOS Microcontroller ASPs, 1984-1987

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### Table 1

### Worldwide MOS Microcontroller Revenue Forecast (Millions of Dollars)

	<u>19</u>	<u>88</u>	19	989	]	990	1	991	1	992	1	993	CAGR <u>1988-1993</u>
4-Bit MCU	\$ 9	44.7	\$	991.4	\$	979.0	\$1.	081.3	\$1.	174.6	\$1.	181.8	4.6%
Growth	1	9.2%	•	4.9%	•	(1.2%)		10.4%		8.5%	•	0.6%	
8-Bit MCU	\$1,5	76.3	\$1,	654.4	\$1,	626.0	\$1,	911.0	\$2,	219.6	\$2,	267.8	7.5%
Growth	2	1.8%		5.0%		(1.7%)		17.5%		16.1%		2.2%	
16-Bit MCU	\$	15.0	\$	17.9	\$	30.0	\$	58.1	\$	125.6	\$	219.1	70.9%
Growth	1	9.4%		19.1%		67.5		93.3%	1	16.4%		74.4%	
Total													
Revenue	\$2,5	36.0	\$2,	663.7	\$2,	635.0	\$3,	050.3	\$3,	519.8	\$3,	668.7	7.7%
Growth	2	8.0		5.0%		(1.1%)		15.8%		15.4%		4.2%	
										So	urce	e: Dat	aquest

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### Table 2

### . Worldwide MOS Microcontroller Unit Shipment Forecast (Millions of Units)

<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	CAGR <u>1988–1993</u>
470.0	533.0	550.0	625.0	695.0	725.0	9.1%
19.8%	13.4%	3.2%	13.6%	11.2	4.3%	
485.0	580.5	600.0	735.0	895.0	965.0	14.8%
45.5%	19.7%	3.4%	22.5%	21.8%	7.8%	
1.2	1.8	3.5	7.5	18.0	35.0	96.3%
50.0%	50.0%	94.4%	114.3	140.0%	94.4%	
956.2	1,115.3	1,153.5	1,367.5	1,608.0	1,725.0	12.5%
31.6%	16.6%	3.4%	18.6%	17.6%	7.3%	
	1988 470.0 19.8% 485.0 45.5% 1.2 50.0% 956.2 31.6%	1988         1989           470.0         533.0           19.8%         13.4%           485.0         580.5           45.5%         19.7%           1.2         1.8           50.0%         50.0%           956.2         1,115.3           31.6%         16.6%	1988         1989         1990           470.0         533.0         550.0           19.8%         13.4%         3.2%           485.0         580.5         600.0           45.5%         19.7%         3.4%           1.2         1.8         3.5           50.0%         50.0%         94.4%           956.2         1,115.3         1,153.5           31.6%         16.6%         3.4%	1988         1989         1990         1991           470.0         533.0         550.0         625.0           19.8%         13.4%         3.2%         13.6%           485.0         580.5         600.0         735.0           45.5%         19.7%         3.4%         22.5%           1.2         1.8         3.5         7.5           50.0%         50.0%         94.4%         114.3%           956.2         1,115.3         1,153.5         1,367.5           31.6%         16.6%         3.4%         18.6%	1988         1989         1990         1991         1992           470.0         533.0         550.0         625.0         695.0           19.8%         13.4%         3.2%         13.6%         11.2%           485.0         580.5         600.0         735.0         895.0           485.0         580.5         600.0         735.0         895.0           45.5%         19.7%         3.4%         22.5%         21.8%           1.2         1.8         3.5         7.5         18.0           50.0%         50.0%         94.4%         114.3%         140.0%           956.2         1,115.3         1,153.5         1,367.5         1,608.0           31.6%         16.6%         3.4%         18.6%         17.6%	198819891990199119921993470.0533.0550.0625.0695.0725.019.813.43.213.611.24.3485.0580.5600.0735.0895.0965.045.519.73.422.521.87.81.21.83.57.518.035.050.050.094.4114.3140.094.4956.21,115.31,153.51,367.51,608.01.725.031.616.63.418.617.67.3

Source: Dataquest November 1988

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### Table 3

### Worldwide MOS Microcontroller ASP Forecast

							CAGR
	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u> 1988-1993</u>
4-Bit MCU	\$ 2.01	\$1.86	\$1.78	\$1.73	\$1.69	\$1.63	(4.1%)
Growth	(0.5%)	(7.5%)	(4.3%)	(2.8%)	(2.3%)	(3.6%)	
8-Bit MCU	\$ 3.25	\$2.85	\$2.71	\$2.60	\$2.48	\$2.35	(6.3%)
Growth	(16.2%)	(12.3%)	(4.9%)	(4.1%)	(4.6%)	(5.2%)	
16-Bit MCU	\$12.54	\$9.96	\$8.58	\$7.74	\$5.98	\$6.26	(13.0%)
Growth	(20.3%)	(20.6%)	(13.9%)	(9.8%)	(9.8%)	(10.3%)	
Aggregate							
ASP	\$ 2.65	\$2.39	\$2.28	\$2.23	\$2.19	\$2.13	(4.3%)
Growth	(8.4%)	(9.9%)	(4.4%)	(2.4%)	(1.9%)	(2.8%)	

Source: Dataquest November 1988

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### Table 4

### Estimated Worldwide MOS Microcontroller Revenue 1979–1983 (Millions of Dollars)

	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	CAGR <u>1979-1983</u>
4-Bit MCU	\$110.4	\$206.6	\$267.1	\$253.0	\$257.9	23.6%
Growth		87.1%	29.3%	(5.3%)	1.9%	
8-Bit MCU	\$ 75.3	\$108.7	\$136.2	\$173.2	\$267.3	37.2%
Growth		44.3	25.3%	27.1%	54.4%	
16-Bit MCU	\$ 0.05	\$ 0.15	\$ 0.9	\$ 0.9	\$ 1.1	118.1%
Growth		200.0%	500.0%	(5.6%)	33.0%	
Total						
Revenue	\$185.8	\$315.4	\$404.2	\$427.0	\$526.3	29.7%
Growth		69.8%	28.2%	5.6%	23.3%	

### Table 5

### Estimated Worldwide MOS Microcontroller Revenue 1984–1987 (Millions of Dollars)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	CAGR <u>1984–1987</u>
4-Bit MCU	\$ 475.8	\$ 382.3	\$ 554.7	\$ 792.4	18.5%
Growth	84.3%	(19.0%)	45.1%	42.9%	
8-Bit MCU	\$ 930.3	\$ 728.0	\$ 853.4	\$1,293.6	11.6%
Growth	248.1%	(21.7%)	17.2%	51.6%	
16-Bit MCU	\$ 0.7	\$ 4.0	\$ 7.0	\$ 12.6	167.2%
Growth	(41.6%)	506.4%	74.7%	80.1%	
Total					
Revenue	\$1,406.7	\$1,114.3	\$1,415.1	\$2,098.6	14.3%
Growth	167.3%	(20.8%)	27.0%	48.3%	
				Source:	" Dataquest November 1988

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### Table 6

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### Estimated Worldwide MOS Microcontroller Unit Shipments 1979–1983 (Millions of Units)

						CAGR
	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1979-1983</u>
4-Bit MCU	50.5	96.1	133.5	158.2	171.9	35.8%
Growth		90.3%	38.9%	18.5%	8.7%	
8-Bit MCU	11.6	21.7	34.9	54.1	90.6	67.2%
Growth		87.6%	60.6%	55.0%	67.4%	
16-Bit MCU	0.001	0.005	0.04	0.05	0.09	208.0%
Growth		400.0%	700.0%	25.0%	80.0%	
Total						
Units	62.1	117.8	168.5	212.4	262.6	43.4%
Growth		89.8%	43.0%	26.1%	23.7%	

### Table 7

#### Estimated Worldwide MOS Microcontroller Unit Shipments 1984–1987 (Millions of Units)

					CAGR
	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1984–1987</u>
4-Bit MCU	193.4	177.0	271.9	392.3	26.5%
Growth	12.5%	(8.5%)	53.6%	44.3%	
8-Bit MCU	163.5	163.6	224.0	333.4	26.8%
Growth	80.5%	0.1%	36.9%	48.8%	
16-Bit MCU	0.06	0.23	0.4	0.8	137.1%
Growth	(33.3%)	283.3%	73.9%	100.0%	
Total					
Units	357.0	340.8	496.3	726.5	26.7%
Growth	35.9%	(4.5%)	45.6%	46.4%	
				Source:	Dataquest

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#### Table 8

### Estimated Worldwide MOS Microcontroller ASPs 1979--1983

	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	CAGR <u>1979–1983</u>
4-Bit MCU Growth	\$ 2.19	\$ 2.15 (1.6%)	\$ 2.00 (6.9%)	\$ 1.60 (20.1%)	\$ 1.50 (6.2%)	(9.0%)
8-Bit MCU Growth	\$ 6.50	\$ 5.00 (23.1%)	\$ 3.90 (22.0%)	\$ 3.20 (17.9%)	\$ 2.95 (7.8%)	(17.9%)
16-Bit MCU Growth	\$50.00	\$30.00 (40.0%)	\$22.50 (25.0%)	\$17.00 (24.4%)	\$12.56 (26.1%)	(29.2%)
Aggregate ASP Growth	\$ 2.99	\$ 2.68 (10.5%)	\$ 2.40 (10.4%)	\$ 2.01 (16.2%)	\$ 2.00 (0.3%)	(9.5%)

### Table 9

### Estimated Worldwide MOS Microcontroller ASPs 1984–1987

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	CAGR <u>1984–1987</u>
4-Bit MCU	\$ 2.46	\$ 2.16	\$ 2.04	\$ 2.02	(6.4%)
Growth	64.0%	(12.2%)	(5.6%)	(1.0%)	
8-Bit MCU	\$ 5.69	\$ 4.45	\$ 3.81	\$ 3.88	(12.0%)
· Growth	92.9%	(21.8%)	(14.4%)	1.8%	
16-Bit MCU	\$11.00	\$17.40	\$17.48	\$15.74	12.7%
Growth	(12.4%)	58.2%	0.5%	(10.0%)	
Aggregate ASP	\$ 3.94	\$ 3.27	\$ 2.85	\$ 2.89	(9.8%)
Growth	96.6%	(17.0%)	(12.8%)	1.3%	

Source: Dataquest November 1988

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### HIGHLIGHTS OF THE MOS MICROCONTROLLER FORECAST

Points worth noting about Dataquest's MOS microcontroller forecast include the following:

- Microcontroller revenue exceeded \$2.7 billion in 1988 and is expected to exceed \$3 billion in 1989, as shown in Figure 1.
- Unit shipments of 4-bit microcontrollers remain strong, with a forecast CAGR of 10.8 percent through 1994.
- Shipments of 8-bit microcontrollers still trail those of 4-bit microcontrollers this year, but the gap is narrowing.
- The market for 16-bit microcontrollers, other than the Ford engine controller, has been slow to materialize, but emerging applications, such as antiskid braking and recent product introductions, are expected to fuel growth in the next five years.
- Dataquest anticipates a mild downturn in overall semiconductor consumption beginning in mid-1989 and extending through mid-1990. However, both years are expected to show positive growth in microcomponent unit consumption. According to this industry model, the next cyclical downturn will occur in 1994.

#### Figure 1

### Estimated Worldwide MOS Microcontroller Consumption 1984–1994



### **COMPARISON WITH EARLIER FORECASTS**

Dataquest has restated 16-bit microcontroller unit shipments for 1987 to include estimated shipments of the Intel-designed 8061 to Ford Motor Company. Previously, Dataquest considered this product to be a full-custom design for a single customer, and thus did not account for shipments of this product in the microcontroller totals. Although the product still is exclusive to Ford, the 8061 is now multiply sourced. To not include this product severely underestimates the 16-bit microcontroller market.

Microcontroller revenue for 1987 was reapportioned between 8-bit and 16-bit microcontrollers to account for this change, affecting the average selling prices (ASPs) of both product categories.

### WORLDWIDE MOS MICROCONTROLLER FORECAST

Dataquest's MOS microcontroller forecast is presented in Tables 1 through 9. The tables included in this forecast are as follows:

- Table 1 Worldwide MOS Microcontroller Revenue Forecast
- Table 2Worldwide MOS Microcontroller Unit Shipment Forecast
- Table 3 Worldwide MOS Microcontroller ASP Forecast
- Table 4
   Estimated Worldwide MOS Microcontroller Revenue, 1979–1983
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- Table 6Estimated Worldwide MOS Microcontroller Unit Shipments, 1979–1983
- Table 7Estimated Worldwide MOS Microcontroller Unit Shipments, 1984–1988
- Table 8
   Estimated Worldwide MOS Microcontroller ASPs, 1979–1983
- Table 9
   Estimated Worldwide MOS Microcontroller ASPs, 1984–1988

### Table 1

### Worldwide MOS Microcontroller Revenue Forecast (Millions of Dollars)

	1	989	<u>1990</u>		<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	CAGR <u>1989–1994</u>
4-Bit MCU	\$1,	172.2	\$1,183	.4	\$1,401.4	\$1,608.8	\$1,823.3	\$1,910.4	10.3%
Growth		15.2%	1.	0%	18.4%	14.8%	13.3%	4.8%	
8-Bit MCU	\$2,	001.0	\$2,023	. 8	\$2,521.1	\$3,230.0	\$4,237.5	\$4,639.8	18.3%
Growth		18.6%	1.	18	24.6%	28.1%	31.2%	9.5%	
16-Bit MCU	\$	50.9	\$ 52	. 8	\$ 61.7	\$ 134.3	\$ 244.3	\$ 300.6	42.7%
Growth		8.3%	з.	8%	16.9%	117.5%	81.9%	23.0%	
Total									
Revenue	\$3,	224.0	\$3,260	.0	\$3,984.2	\$4,973.0	\$6,305.1	\$6,850.8	16.3%
Growth		17.2%	1.	1%	22.2%	24.8%	26.8%	8.7%	

Note: Columns may not add to totals shown because of rounding.

Source:	Dataq	luest
	July	1989

### Table 2

### Worldwide MOS Microcontroller Unit Shipment Forecast (Millions of Units)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	CAGR <u>1989–1994</u>
4-Bit MCU	595.0	610.0	715.0	825.0	935.0	995.0	10.8%
Growth	18.7%	2.5%	17.2%	15.4%	13.3%	6.4%	
8-Bit MCU	575.0	597.0	735.0	950.0	1,250.0	1,385.0	19.2%
Growth	26.4%	3.8%	23.1%	29.3%	31.6%	10.8%	
16-Bit MCU	6.0	6.3	7.5	18.0	35.0	45.0	49.6%
Growth	9.1%	5.0%	19.0%	140.0%	94.4%	28.6%	
Total							
Units	1,176.0	1,213.3	1,457.5	1,793.0	2,220.0	2,425.0	15.6%
Growth	22.3%	3,2%	20.1%	23.0%	23.8%	9.2%	

Source: Dataquest July 1989

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### Table 3

### Worldwide MOS Microcontroller ASP Forecast

							CAGR
	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1989-1994</u>
4-Bit MCU	\$1.97	\$1.94	\$1.96	\$1.95	\$1.95	\$1.92	(0.5%)
Growth	(3.0%)	(1.5%)	1.0%	(0.5%)	0	(1.5%)	
8-Bit MCU	\$3.48	\$3.39	\$3.43	\$3.40	\$3.39	\$3.35	(0.8%)
Growth	(6,2%)	(2.6%)	1.2%	(0.9%)	(0.3%)	(1.2%)	
16-Bit MCU	\$8.48	\$8.38	\$8.23	\$7.46	\$6.98	\$6.68	(4.7%)
Growth	(0.8%)	(1.2%)	(1.8%)	(9.4%)	(6,4%)	(4.3%)	
Aggregate							
ASP	\$2.74	\$2.69	\$2.73	\$2.77	\$2.84	\$2.83	0.6%
Growth	(4.2%)	(2.0%)	1.7%	1.5%	2.4%	(0.5%)	

Source: Dataquest July 1989

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### Table 4

### Estimated Worldwide MOS Microcontroller Revenue 1979–1983 (Millions of Dollars)

	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	CAGR <u>1979–1983</u>
4-Bit MCU	\$110.4	\$206.6	\$267.1	\$253.0	\$257.9	23.6%
Growth		87.1%	29.3%	(5.3%)	1.9%	
8-Bit MCU	\$ 75.3	\$108.7	\$136.2	\$173.2	\$267.3	37.2%
Growth		44.3%	25.3%	27.1%	54.4%	
16-Bit MCU	\$ 0.05	\$ 0.15	\$ 0.9	\$ 0.9	\$ 1.1	118.1%
Growth	·	200.0%	500.0%	(5.6%)	33.0%	
Total						
Revenue	\$185.8	\$315.4	\$404.2	\$427.0	\$526.3	29.7%
Growth	-	69.8%	28.2%	5.6%	23.3%	

### Table 5

### Estimated Worldwide MOS Microcontroller Revenue 1984–1988 (Millions of Dollars)

		<u>1984</u>		<u>1985</u>		<u>1986</u>		<u>1987</u>		<u>1988</u>	CAGR <u>1984–1988</u>
4-Bit MCU	\$	475.8	\$	382.3	\$	554.7	\$	792.4	\$1	,017.2	20.9%
Growth		84.5%		(19.6%)		45.1%		42.9%		28.4%	
8-Bit MCU	\$	930.3	\$	728.0	\$	853.4	\$1	,277.3	\$1	,687.3	16.0%
Growth		248.1%		(21.7%)		17.2%		49.7%		32.1%	
16-Bit MCU	\$	0.7	\$	4.0	\$	7.0	\$	29.1	\$	47.0	190.5%
Growth		(41.6%)		506.4%		74.7%		315.8%		61.8%	
Total											
Revenue	\$1	L,406.7	\$]	1,114.3	\$1	1,415.1	\$2	,098.8	\$2	,751.6	18.3%
Growth		167.3%		(20.8%)		27.0%		48.3%		31.1%	

Source: Dataquest July 1989

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### Table 6

### Estimated Worldwide MOS Microcontroller Unit Shipments 1979–1983 (Millions of Units)

	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	CAGR <u>1979-1983</u>
4-Bit MCU	50.5	96.1	133.5	158.2	171.9	35.8%
Growth	-	90.3%	38.9%	18.5%	8.7%	
8-Bit MCU	11.6	21.7	34.9	54.1	90.6	67.2%
Growth	-	87.6%	60.6%	55.0%	67.4%	
16-Bit MCU	0.001	0.005	0.04	0.05	0.09	208.0%
Growth	-	400.0%	700.0%	25.0%	80.0%	
Total						
Units	62.1	117.8	168.5	212.4	262.5	43.4%
Growth	-	89.8%	43.0%	26.1%	23.7%	

### Table 7

### Estimated Worldwide MOS Microcontroller Unit Shipments 1984–1988 (Millions of Units)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	CAGR <u>1984–1988</u>
4-Bit MCU	193.4	177.0	271.9	392.3	501.1	26.9%
Growth	12.5%	(8.5%)	53.6%	44.3%	27.7%	
8-Bit MCU	163.5	163.6	224.0	333.5	454.8	29.1%
Growth	80.5%	0.1%	36.9%	48.9%	36.4%	
16-Bit MCU	0.06	0.23	0.4	3.4	5.5	209.4%
Growth	(33.3%)	283.3%	73.9%	750.0%	61.8%	
Total						
Units	357.0	340.8	496.3	729.2	961.4	28.1%
Growth	35.9%	(4.5%)	45.6%	46.9%	31.8%	

Source: Dataquest July 1989

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### Table 8

### Estimated Worldwide MOS Microcontroller ASPs 1979–1983

	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	CAGR <u>1979–1983</u>
4-Bit MCU Growth	\$ 2.19	\$ 2.15 (1.6%)	\$ 2.00 (6.9%)	\$ 1.60 (20.1%)	\$ 1.50 (6.2%)	(9.0%)
8-Bit MCU Growth	\$ 6.50	\$ 5.00 (23.1%)	\$ 3.90 (22.0%)	\$ 3.20 (17.9%)	\$ 2.95 (7.8%)	(17.9%)
16-Bit MCU Growth	\$50.00	\$30.00 (40.0%)	\$22.50 (25.0%)	\$17.00 (24.4%)	\$12.56 (26.1%)	(29.2%)
Aggregate ASP Growth	\$ 2.99	\$ 2.68 (10.5%)	\$ 2.40 (10.4%)	\$ 2.01 (16.2%)	\$ 2.00 (0.3%)	(9.5%)

### Table 9

### Estimated Worldwide MOS Microcontroller ASPs 1984–1988

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	CAGR <u>1984–1988</u>
4-Bit MCU	\$ 2.46	\$ 2.16	\$ 2.04	\$ 2.02	\$2.03	(4.7%)
Growth	64.0%	(12.2%)	(5.6%)	(1.0%)	0.5%	
8-Bit MCU	\$ 5.69	\$ 4.45	\$ 3.81	\$ 3.83	\$3.71	(10.1%)
Growth	92.9%	(21.8%)	(14.4%)	0.5%	(3.1%)	
16-Bit MCU	\$11.00	\$17.40	\$17.48	\$ 8.55	\$8.55	(6.1%)
Growth	(12,4%)	58.2%	0.5%	(51.1%)	0	
Aggregate ASP	\$ 3.94	\$ 3.27	\$ 2.85	\$ 2.88	\$2.86	(7.7%)
Growth	96.6%	(17.0%)	(12.8%)	0.9%	(0.6%)	

Source: Dataquest July 1989

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### HIGHLIGHTS OF THE MOS MICROCONTROLLER FORECAST

Points worth noting about Dataquest's MOS microcontroller forecast include the following:

- Microcontroller revenue exceeded \$2.7 billion in 1988 and is expected to exceed \$3 billion in 1989, as shown in Figure 1.
- Unit shipments of 4-bit microcontrollers remain strong, with a forecast CAGR of 10.8 percent through 1994.
- Shipments of 8-bit microcontrollers still trail those of 4-bit microcontrollers this year, but the gap is narrowing.
- The market for 16-bit microcontrollers, other than the Ford engine controller, has been slow to materialize, but emerging applications, such as antiskid braking and recent product introductions, are expected to fuel growth in the next five years.
- Dataquest anticipates a mild downturn in overall semiconductor consumption beginning in mid-1989 and extending through mid-1990. However, both years are expected to show positive growth in microcomponent unit consumption. According to this industry model, the next cyclical downturn will occur in 1994.

#### Figure 1

### Estimated Worldwide MOS Microcontroller Consumption 1984–1994



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SIS Prod., Mkt., & Tech. 0004352

Source: Dataquest July 1989

### **COMPARISON WITH EARLIER FORECASTS**

Dataquest has restated 16-bit microcontroller unit shipments for 1987 to include estimated shipments of the Intel-designed 8061 to Ford Motor Company. Previously, Dataquest considered this product to be a full-custom design for a single customer, and thus did not account for shipments of this product in the microcontroller totals. Although the product still is exclusive to Ford, the 8061 is now multiply sourced. To not include this product severely underestimates the 16-bit microcontroller market.

Microcontroller revenue for 1987 was reapportioned between 8-bit and 16-bit microcontrollers to account for this change, affecting the average selling prices (ASPs) of both product categories.

### WORLDWIDE MOS MICROCONTROLLER FORECAST

Dataquest's MOS microcontroller forecast is presented in Tables 1 through 9. The tables included in this forecast are as follows:

Table 1	Worldwide MOS Microcontroller Revenue Forecast
Table 2	Worldwide MOS Microcontroller Unit Shipment Forecast
Table 3	Worldwide MOS Microcontroller ASP Forecast
Table 4	Estimated Worldwide MOS Microcontroller Revenue, 1979-1983
Table 5	Estimated Worldwide MOS Microcontroller Revenue, 1984-1988
Table 6	Estimated Worldwide MOS Microcontroller Unit Shipments, 1979-1983
Table 7	Estimated Worldwide MOS Microcontroller Unit Shipments, 1984-1988
Table 8	Estimated Worldwide MOS Microcontroller ASPs, 1979-1983
Table 9	Estimated Worldwide MOS Microcontroller ASPs, 1984–1988

#### Table 1

### Worldwide MOS Microcontroller Revenue Forecast (Millions of Dollars)

	1	989	1990	2	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	CAGR <u>1989-1994</u>
4-Bit MCU	\$1,	172.2	\$1,18	3.4	\$1,401.4	\$1,608.8	\$ \$1,823.3	\$1,910.4	10.3%
Growth		15.2%	1	.0%	18.49	14.89	13.3%	4.8%	
8-Bit MCU	\$2,	001.0	\$2,02	3.8	\$2,521.3	\$3,230.0	\$4,237.5	\$4,639.8	18.3%
Growth		18.6%	1	.1%	24.69	28.19	31.2%	9.5%	
16-Bit MCU	\$	50.9	\$ 5	2.8	\$ 61.7	\$ 134.3	\$ \$ 244.3	\$ 300.6	42.7%
Growth		8.3%	3	. 8%	16.99	117.5	81.9%	23.0%	
Total									
Revenue	\$3,	224.0	\$3,26	0.0	\$3,984.2	\$4,973.0	\$6,305.1	\$6,850.8	16.3%
Growth		17.2%	1	.1%	22.29	24.89	26.8%	8.7%	,

Note: Columns may not add to totals shown because of rounding.

Source:	Dataquest	
	July 1989	

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### Table 2

#### Worldwide MOS Microcontroller Unit Shipment Forecast (Millions of Units)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	CAGR <u>1989–1994</u>
4-Bit MCU	595.0	610.0	715.0	825.0	935.0	995.0	10.8%
Growth	18.7%	2.5%	17.2%	15.4%	13.3%	6.4%	
8-Bit MCU	575.0	597.0	735.0	950.0	1,250.0	1,385.0	19.2%
Growth	26.4%	3.8%	23.1%	29.3%	31.6%	10.8%	
16-Bit MCU	6.0	6.3	7.5	18.0	35.0	45.0	49.6%
Growth	9.1%	5.0%	19.0%	140.0%	94.4%	28.6%	
Total							
Units	1,176.0	1,213.3	1,457.5	1,793.0	2,220.0	2,425.0	15.6%
Growth	22.3%	3.2%	20.1%	23.0%	23.8%	9.2%	

Source: Dataquest July 1989

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### Table 3

### Worldwide MOS Microcontroller ASP Forecast

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	CAGR <u>1989–1994</u>
4-Bit MCU	\$1.97	\$1.94	\$1.96	\$1.95	\$1.95	\$1.92	(0.5%)
Growth	(3.0%)	(1.5%)	1.0%	(0.5%)	0	(1.5%)	
8-Bit MCU	\$3.48	\$3.39	\$3.43	\$3.40	\$3.39	\$3.35	(0.8%)
Growth	(6.2%)	(2.6%)	1.2%	(0.9%)	(0.3%)	(1.2%)	· -
16-Bit MCU	\$8.48	\$8.38	\$8.23	\$7.46	\$6.98	\$6.68	(4.7%)
Growth	(0.8%)	(1.2%)	(1.8%)	(9.4%)	(6.4%)	(4.3%)	
Aggregate							
ASP	\$2.74	\$2.69	\$2.73	\$2.77	\$2.84	\$2.83	0.6%
Growth	(4.2%)	(2.0%)	1.7%	1.5%	2.4%	(0.5%)	

Source: Dataquest July 1989

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### Table 4

#### Estimated Worldwide MOS Microcontroller Revenue 1979–1983 (Millions of Dollars)

	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	1979-1983
4-Bit MCU	\$110.4	\$206.6	\$267.1	\$253.0	\$257.9	23.6%
Growth		87.1%	29.3%	(5.3%)	1.9%	
8-Bit MCU	\$ 75.3	\$108.7	\$136.2	\$173.2	\$267.3	37.2%
Growth		44.3%	25.3%	27.1%	54.4%	
16-Bit MCU	\$ 0.05	\$ 0.15	\$ 0.9	\$ 0.9	\$ 1.1	118.1%
Growth		200.0%	500.0%	(5.6%)	33.0%	
Total						
Revenue	\$185.8	\$315.4	\$404.2	\$427.0	\$526.3	29.7%
Growth		69.8%	28.2%	5.6%	23.3%	

### Table 5

### Estimated Worldwide MOS Microcontroller Revenue 1984–1988 (Millions of Dollars)

		<u>1984</u>		<u>1985</u>		<u>1986</u>		<u>1987</u>		<u>1988</u>	CAGR <u>1984–1988</u>
4-Bit MCU	\$	475.8	\$	382.3	\$	554.7	\$	792.4	\$1	,017.2	20.9%
Growth		84.5%		(19.6%)		45.1%		42.9%		28.4%	
8-Bit MCU	\$	930.3	\$	728.0	\$	853.4	\$1	,277.3	\$1	,687.3	16.0%
Growth		248.1%		(21.7%)		17.2%		49.7%		32.1%	
16-Bit MCU	\$	0.7	\$	4.0	\$	7.0	\$	29.1	\$	47.0	190.5%
Growth		(41.6%)		506.4%		74.7%		315.8%		61.8%	
Total											
Revenue	\$2	1,406.7	\$:	1,114.3	\$:	1,415.1	\$2	,098.8	\$2	,751.6	18.3%
Growth		167.3%		(20.8%)		27.0%		48.3%		31.1%	

Source: Dataquest July 1989

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### Table 6

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### Estimated Worldwide MOS Microcontroller Unit Shipments 1979–1983 (Millions of Units)

	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	CAGR 1979-1983
4-Bit MCU	50.5	96.1	133.5	158.2	171.9	35.8%
Growth	-	90.3%	38.9%	18.5%	8.7%	
8-Bit MCU	11.6	21.7	34.9	54.1	90.6	67.2%
Growth	-	87.6%	60.6%	55.0%	67.4%	
16-Bit MCU	0.001	0.005	0.04	0.05	0.09	208.0%
Growth	-	400.0%	700.0%	25.0%	80.0%	
Total						
Units	62.1	117.8	168.5	212.4	262.6	43.4%
Growth	_	89.8%	43.0%	26.1%	23.7%	

### Table 7

### Estimated Worldwide MOS Microcontroller Unit Shipments 1984–1988 (Millions of Units)

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	CAGR <u>1984–1988</u>
4-Bit MCU	193.4	177.0	271.9	392.3	501.1	26.9%
Growth	12.5%	(8.5%)	53.6%	44.3%	27.7%	
8-Bit MCU	163.5	163.6	224.0	333.5	454.8	29.1%
Growth	80.5%	0.1%	36.9%	48.9%	36.4%	
16-Bit MCU	0.06	0.23	0.4	3.4	5.5	209.4%
Growth	(33.3%)	283.3%	73.9%	750.0%	61.8%	
Total						
Units	357.0	340.8	496.3	729.2	961.4	28.1%
Growth	35.9%	(4.5%)	45.6%	46.9%	31.8%	

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Source: Dataquest July 1989

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### Table 8

### Estimated Worldwide MOS Microcontroller ASPs 1979–1983

	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	CAGR 1979-1983
4-Bit MCU	\$ 2.19	\$ 2.15	\$ 2.00	\$ 1.60	\$ 1.50	(9.0%)
Growth		(1.6%)	(6.9%)	(20.1%)	(6.2%)	
8-Bit MCU	\$ 6.50	\$ 5.00	\$ 3.90	\$ 3.20	\$ 2.95	(17.9%)
Growth		(23.1%)	(22.0%)	(17.9%)	(7.8%)	
16-Bit MCU	\$50.00	\$30.00	\$22.50	\$17.00	\$12.56	(29.2%)
Growth		(40.0%)	(25.0%)	(24.4%)	(26.1%)	
λggregate λSP	\$ 2.99	\$ 2.68	\$ 2.40	\$ 2.01	\$ 2.00	(9.5%)
Growth		(10.5%)	(10.4%)	(16.2%)	(0.3%)	

### Table 9

### Estimated Worldwide MOS Microcontroller ASPs 1984–1988

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	_ CAGR <u>1984–1988</u>
4-Bit MCU	\$ 2.46	\$ 2.16	\$ 2.04	\$ 2.02	\$2.03	(4.7%)
Growth	64.0%	(12.2%)	(5.6%)	(1.0%)	0.5%	
8-Bit MCU	\$ 5.69	\$ 4.45	\$ 3.81	\$ 3.83	\$3.71	(10.1%)
Growth	92.9%	(21.8%)	(14.4%)	0.5%	(3.1%)	
16-Bit MCU	\$11.00	\$17.40	\$17.48	\$ 8.55	\$8.55	(6.1%)
Growth	(12.4%)	58.2%	0.5%	(51.1%)	0	
Aggregate ASP	\$ 3.94	\$ 3.27	\$ 2.85	\$ 2.88	\$2.86	(7.7%)
Growth	96.6%	(17.0%)	(12.8%)	0.9%	(0.6%)	

Source: Dataquest July 1989

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### Worldwide Microcontroller Executive Summary

#### MARKET OVERVIEW

Microcontrollers are everywhere. Typically, microcontrollers are used for controlling and monitoring equipment and real-time events. Their data-handling capability is designed for simple integer data types. Microcontrollers are used in cars, TVs, stereos, VCRs, personal computers, microwave ovens, and other consumer products.

Trends in microcontrollers are as follows:

- Higher level of integration
- Higher reliability
- Denser packaging
- More interrupt-driven tasks
- More I/O on single chip
- More memory on-chip
- One-time-programmable chips

#### MARKET SIZE

Total microcontroller revenue was more than \$1.1 billion in 1985, down approximately 21 percent from 1984. Microcontroller manufacturers whose revenue decreased by more than 21 percent during 1985 also lost market share. Total MCU revenue has grown at a compound annual rate (CAGR) of more than 28.6 percent since 1980. This means that the industry has nearly tripled in the last four years.

Microcontroller unit shipments numbered more than 338 million during 1985, down only 5 percent from 1984 shipments. MCU shipments have increased at a CAGR of more than 23.5 percent since 1980.

There were 29 worldwide merchant manufacturers of microcontrollers during 1985; of these, only 8 were Japanese. Of these 8 Japanese manufacturers, NEC, Toshiba, Matsushita, and Hitachi were the top 4 manufacturers, shipping more than 50 percent of total MCUs worldwide.

### Worldwide Microcontroller Executive Summary

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#### MARKET FORECAST

During 1986, microcontroller revenue is expected to increase approximately 27 percent, to \$1.4 billion, from 1985 revenue. During the next five years, from 1986 through 1991, microcontroller revenue is expected to grow at an 18 percent CAGR. Unit growth is expected to increase slightly more than revenue. Estimated 1986 unit shipments of 434 million and 1991 unit shipments of 1.2 billion reflect a 22.9 percent CAGR during this time.





The tables and figures in this section are organized as follows:

- Figure 1 Estimated Market Shares of Leading Manufacturers and Products for 4-Bit Microcontrollers, 1988
- Figure 2 Estimated Market Shares of Leading Manufacturers and Products for 8-Bit Microcontrollers, 1988
- Figure 3 Estimated Market Shares of Leading Manufacturers and Products for 16-Bit Microcontrollers, 1988
- Table 1Estimated Market Share by Word Length for Microcontrollers, 1985–1988
- Figure 4 Estimated Market Share by Word Length for Microcontrollers, 1985–1988
- Table 2Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers,<br/>1985-1988
- Figure 5 Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1988
- Table 3Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit<br/>Microcontrollers, 1985-1988
- Figure 6 Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1988



Figure 1





Figure 2





Source: Dataquest September 1989

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### Table 1

#### Estimated Market Share by Word Length for Microcontrollers 1985–1988 (Thousands of Units)

	1985	<u>1986</u>	1987	<u>1988</u>
4-Bit				
Shipments	177,038	271,883	392,332	501,075
Percent	51.9%	54.8%	53.8%	51.9%
8-Bit				
Shipments	163,599	224,001	333,362	454,022
Percent	48.0%	45.1%	45.7%	47.0%
16-Bit				
Shipments	232	399	3,311	5,461
Percent	0.1%	0.1%	0.5%	0.6%
Total Shipments	340,869	496,283	729,005	966,019
		So	urce: Data	quest

### Figure 4

#### Estimated Market Share by Word Length for Microcontrollers 1985–1988



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September 1989

### Table 2

### Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1985-1988 (Thousands of Units)

_	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
4-Bit Shipments	177,038	271,883	392,332	501,075
U.S. Companies (%)	16.3%	17.8%	11.8%	7.7%
Japanese Companies (%)	80.8%	79.8%	86.3%	90.5%
European Companies (%)	3.0%	2.3%	1.9%	1.8%
8-Bit Shipments	163,599	224,001	333,362	454,022
U.S. Companies (%)	42.7%	34.8%	35.3%	36.4%
Japanese Companies (%)	43.2%	50.0%	53.1%	54.7%
European Companies (%)	14.1%	15.2%	11.6%	8.9%
16-Bit Shipments	232	399	3,311	5,461
U.S. Companies (%)	94.8%	67.7%	96.6%	98.7%
Japanese Companies (%)	0	0	0.1%	0.2%
European Companies (%)	5.2%	32.3%	3.3%	1.2%
Total Shipments	340,869	496,283	729,005	960,558
U.S. Companies (%)	29.0%	25.5%	22.9%	38.4%
Japanese Companies (%)	62.7%	66.3%	70.7%	73.1%
European Companies (%)	8.3%	8,2%	6.4%	5.1%

Source: Dataquest September 1989

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Figure 5



0004762-5

Source: Dataquest September 1989

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### Table 3

### Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1985-1988 (Thousands of Units)

	<u>1985</u>	1986	<u>1987</u>	<u>1988</u>
4-Bit Shipments	177,038	271,883	392,332	501,075
Percent PMOS	10.0%	4.9%	2.5%	1.2%
Percent NMOS	34.8%	29.8%	24.3%	13.6%
Percent CMOS	55.2%	65.2%	73.2%	85.2%
8-Bit Shipments	163,599	224,001	333,362	454,022
Percent NMOS	79.5%	67.8%	59.2%	48.4%
Percent CMOS	20.5%	32.2%	40.8%	51.6%
16-Bit Shipments	232	399	3,311	5,461
Percent NMOS	100.0%	100.0%	19.9%	33.2%
Percent CMOS	0	0	80.1%	66.8%
Total Shipments	340,869	496,283	729,005	960,558
Percent PMOS	5.2%	2.7%	1.3%	0.6%
Percent NMOS	56.3%	47.0%	40.2%	30.1%
Percent CMOS	38.5%	50.3%	58.4%	69.2%

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Source: Dataquest September 1989

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Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1988 CMOS 51.6% PMOS 1.2% NMOS 13.6% NMOS 48.4% 4-Bit 8-Bit

Figure 6



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The tables and figures in this section are organized as follows:

- Figure 1 Estimated Market Shares of Leading Manufacturers and Products for 4-Bit Microcontrollers, 1987
- Figure 2 Estimated Market Shares of Leading Manufacturers and Products for 8-Bit Microcontrollers, 1987
- Figure 3 Estimated Market Shares of Leading Manufacturers and Products for 16-Bit Microcontrollers, 1987
- Table 1
   Estimated Market Share by Word Length for Microcontrollers, 1980–1984
- Table 2Estimated Market Share by Word Length for Microcontrollers, 1985–1987
- Figure 4 Estimated Market Share by Word Length for Microcontrollers, 1980–1987
- Table 3Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers,<br/>1980-1984
- Table 4Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers,<br/>1985-1987
- Figure 5 Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1987
- Table 5Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit<br/>Microcontrollers, 1980-1984
- Table 6Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit<br/>Microcontrollers, 1985-1987
- Figure 6 Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1987



333.4 Million Units

0003601-2

Source: Dataquest April 1989

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Figure 3



Estimated Market Shares of Leading Manufacturers and Products for 16-Bit Microcontrollers 1987

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### Table 1

#### Estimated Market Share by Word Length for Microcontrollers 1980–1984 (Thousands of Units)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
4-Bit					
Shipments	96,080	133,549	158,183	171,945	193,435
Percent	81.5%	79.3%	74.5%	65.5%	54.2%
8-Bit					
Shipments	21,740	34,931	54,114	90,615	163,510
Percent	18.5%	20.7%	25.5%	34.5%	45.8%
16-Bit					
Shipments	8	36	50	89	123
Percent	*	*	*	•	*
Total Shipments	117,828	168,516	212,347	262,649	357,068

\*Calculated value is less than 0.1%.

Source: Dataquest April 1989

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### Table 2

#### Estimated Market Share by Word Length for Microcontrollers 1985–1987 (Thousands of Units)

	1985	1986	<u>1987</u>
4-Bit	2		
Shipments	177,038	271,883	392,332
Percent	51.9%	54.8%	54.0%
8-Bit			
Shipments	163,599	224,001	333,362
Percent	48.0%	45.1%	45.9%
16-Bit			
Shipments	232	399	685
Percent	0.1%	0.1%	0.1%
Total Shipments	340,869	496,283	726,379
		Source:	Dataquest
			April 1989

#### Figure 4

#### Estimated Market Share by Word Length for Microcontrollers 1980–1987



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#### Table 3

### Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1980-1984 (Thousands of Units)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
4-Bit Shipments	96,080	133,549	158,183	171,945	193,435
U.S. Companies (%)	65.2%	40.5%	28.2%	2 0.3%	19.2
Japanese Companies (%)	34.8%	59.5%	71.7%	79.2%	79.3%
European Companies (%)	0	0	0.1%	0.5%	1.4%
8-Bit Shipments	21,740	34,931	54,114	90,615	163,510
U.S. Companies (%)	73.3%	68.3%	61.0%	57.6%	51.7%
Japanese Companies (%)	15.5%	20.1%	27.1%	31.3%	36.6%
European Companies (%)	11.2%	11.7%	11.8%	11.0%	11.7%
16-Bit Shipments	8	36	50	89	123
U.S. Companies (%)	100.0%	100.0%	100.0%	100.0%	100.0%
Japanese Companies (%)	0	0	0	0	0
European Companies (%)	0	0	0	0	<b>0</b> .
Total Shipments	117,828	168,516.	212,347	262,649	357,068
U.S. Companies (%)	66.7%	46.2%	36.6%	33.24	34.1%
Japanese Companies (%	) 31.2%	51.3%	60.3%	62.7%	59.7%
European Companies (%	) 2.1%	2.4%	3.1%	4.1%	6.2%

Source: Dataquest April 1989

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### Table 4

### Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1985-1987 (Thousands of Units)

	<u>1985</u>	<u>1986</u>	<u>1987</u>
4-Bit Shipments	177,038	271,883	392,332
U.S. Companies (%)	16.3%	17.8%	11.8%
Japanese Companies (%)	80.8%	79.8%	86.3%
European Companies (%)	3.0%	2.3%	1.9%
8-Bit Shipments	163,599	224,001	333,362
U.S. Companies (%)	42.7%	34.8%	35.3%
Japanese Companies (%)	43.2%	50.0%	53.1%
European Companies (%)	14.1%	15.2%	11.6%
16-Bit Shipments	232	399	685
U.S. Companies (%)	94.8%	67.7%	83.6%
Japanese Companies (%)	0	0	0.3%
European Companies (%)	5.2%	32.3%	16.1%
Total Shipments	340,869	496,283	726,379
U.S. Companies (%)	29.0%	. 25.5%	22.6%
Japanese Companies (%)	62.7%	66.3%	71.0%
European Companies (%)	8.3%	8.2%	6.4%

Source: Dataquest April 1989

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Figure 5



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Source: Dataquest April 1989

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### Table 5

#### Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1980-1984 (Thousands of Units)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
4-Bit Shipments	96,080	133,549	158,183	171,945	193,435
Percent PMOS	66.3%	52.0%	35.2%	22.0%	14.9%
Percent NMOS	14.4%	19.4%	23.5%	30.5%	32.2%
Percent CMOS	19.3	28.6%	41.3	47.5%	52.9%
8-Bit Shipments	21,740	34,931	54,114	90,615	163,510
Percent NMOS	100.0%	99.7%	96.8%	91.4%	90.0%
Percent CMOS	O	0.3%	3.2	8.6%	10.0%
16-Bit Shipments	8	36	50	89	123
Percent NMOS	100.0%	100.0%	100.0%	100.0%	100.0%
Percent CMOS	0	0	0	0	0
Total Shipments	117,828	168,516	212,347	262,649	357,068
Percent PMOS	54.1%	41.2%	26.2%	14.4%	8.1
Percent NMOS	30.2%	36.1%	42.2%	51.5%	58.7
Percent CMOS	15.8%	22.7%	31.6%	34.1%	33.3%

Source: Dataquest April 1989

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### Table 6

#### Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1985-1987 (Thousands of Units)

	<u>1985</u>	<u>1986</u>	<u>1987</u>
4-Bit Shipments	177,038	271,883	392,332
Percent PMOS	10.0%	4.9%	2.5
Percent NMOS	34.8%	29.8	24.3%
Percent CMOS	55.2%	65.2%	73.2%
8-Bit Shipments	163,599	224,001	333,362
Percent NMOS	79.5%	67.8%	59.2%
Percent CMOS	20.5%	32.2%	40.8%
16-Bit Shipments	232	399	685
Percent NMOS	100.0%	100.0%	96.1%
Percent CMOS	0	0	3.9%
Total Shipments	340,869	496,283	726,379
Percent PMOS	5.2%	· 2.7N	1.3%
Percent NMOS	56.3%	47.0%	40.4%
Percent CMOS	38.5%	50.3%	58.3%

Source: Dataquest April 1989

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Figure 6

Estimated Market Share by Process Technology



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Source: Dataquest April 1989

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The tables and figures in this section are organized as follows:

- Figure 1 Estimated Market Shares of Leading Manufacturers and Products for 4-Bit Microcontrollers, 1988
- Figure 2 Estimated Market Shares of Leading Manufacturers and Products for 8-Bit Microcontrollers, 1988
- Figure 3 Estimated Market Shares of Leading Manufacturers and Products for 16-Bit Microcontrollers, 1988
- Table 1
   Estimated Market Share by Word Length for Microcontrollers, 1975–1979
- Table 2
   Estimated Market Share by Word Length for Microcontrollers, 1980–1984
- Table 3Estimated Market Share by Word Length for Microcontrollers, 1985–1988
- Figure 4 Estimated Market Share by Word Length for Microcontrollers, 1980–1988
- Table 4Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers,<br/>1975-1979
- Table 5Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers,1980-1984
- Table 6Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers,<br/>1985-1988
- Figure 5 Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1988
- Table 7Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit<br/>Microcontrollers, 1975-1979
- Table 8Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit<br/>Microcontrollers, 1980-1984
- Table 9Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit<br/>Microcontrollers, 1985-1988
- Figure 6 Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1988

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### Table 1

#### Estimated Market Share by Word Length for Microcontrollers 1975–1979 (Thousands of Units)

	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
4-Bit					
Shipments	500	760	3,400	15,959	50,525
Percent	94.0%	75.2%	79.3%	87.8%	81.3%
8-Bit					
Shipments	32	251	885	2,218	11,592
Percent	6.0%	24.8%	20.7%	12.2%	18.7%
16-Bit					
Shipments	0	0	0	0	5
Percent	0	0	0	0	*
Total Shipments	532	1,011	4,285	18,177	62,122

\*Calculated value is less than 0.1%.

Source:	Dataquest	
	September	1989

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#### Table 2

#### Estimated Market Share by Word Length for Microcontrollers 1980–1984 (Thousands of Units)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
4-Bit					
Shipments	96,080	133,549	158,183	171,945	193,435
Percent	81.5%	79.3%	74.5%	65.5%	54.2%
8-Bit					
Shipments	21,740	34,931	54,114	90,615	163,510
Percent	18.5%	20.7%	25.5%	34.5%	45.8%
16-Bit					
Shipments	8	36	50	89	123
Percent	*	*	*	*	*
Total Shipments	117,828	168,516	212,347	262,649	357,068

\*Calculated value is less than 0.1%.

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Source: Dataquest September 1989

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#### Table 3 Estimated Market Share by Word Length for Microcontrollers 1985–1988 (Thousands of Units)

	1985	1986	<u>1987</u>	1988
4-Bit				
Shipments	177,038	271,883	392,332	501,075
Percent	51.9%	54.8%	53.8%	51.9%
8-Bit				
Shipments	163,599	224,001	333,362	454,022
Percent	48.0%	45.1%	45.7%	47.0%
16-Bit				
Shipments	232	399	3,311	5,461
Percent	0.1%	0.1%	0.5%	0.6%
Total Shipments	340,869	496,283	729,005	966,019

Source: Dataquest September 1989

Figure 4

#### Estimated Market Share by Word Length for Microcontrollers 1980–1988



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### Table 4

### Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1975-1979 (Thousands of Units)

	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
4-Bit Shipments	500	760	3,400	15,959	50,525
U.S. Companies (%)	100.0%	100.0%	100.0%	88.0%	73.8%
Japanese Companies (%)	0	0	0	12.0%	26.2%
European Companies (%)	0	0	0	0	0
8-Bit Shipments	32	251	885	2,218	11,592
U.S. Companies (%)	100.0%	100.0%	100.0%	99.3%	91.1%
Japanese Companies (%)	0	0	0	0.7%	8.5%
European Companies (%)	0	0	0	0	0.4%
16-Bit Shipments	. 0	٥	0	0	5
U.S. Companies (%)	0	0	0	0	100.0%
Japanese Companies (%)	0	0	0	0	0
European Companies (%)	0	0	0	0	0
Total Shipments	532	1,011	4,285	18,177	62,122
U.S. Companies (%)	100.0%	100.0%	100.0%	89.4%	77.1%
Japanese Companies (%)	0	0	0	10.6%	22.9%
European Companies (%)	0	0	0	0	0.1%

Source: Dataquest September 1989

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### Table 5

#### Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1980-1984 (Thousands of Units)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
4-Bit Shipments	96,080	133,549	158,183	171,945	193,435
U.S. Companies (%)	65.2%	40.5%	28.2%	0.3%	19.2%
Japanese Companies (%)	34.8%	59.5%	71.7%	79.2%	79.3%
European Companies (%)	0	0	0.1%	0.5%	1.4%
8-Bit Shipments	21,740	34,931	54,114	90,615	163,510
U.S. Companies (%)	73.3%	68.3%	61.0%	57.6%	51.7%
Japanese Companies (%)	15.5%	20.1%	27.1%	31.3%	36.6%
European Companies (%)	11.2%	11.7%	11.8%	11.0%	11.7%
16-Bit Shipments	8	36	50	89	123
U.S. Companies (%)	100.0%	100.0%	100.0%	100.0%	100.0%
Japanese Companies (%)	0	0	0	0	0
European Companies (%)	0	0	0	0	0
Total Shipments	117,828	168,516	212,347	262,649	357,068
U.S. Companies (%)	66.7%	46.2%	36.6%	33.2%	34.1%
Japanese Companies (%)	31.2%	51.3%	60.3%	62.7%	59.7%
European Companies (%)	2.1%	2.4%	3.1%	4.1%	6.2%

Source: Dataquest September 1989

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### Table 6

### Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1985-1988 (Thousands of Units)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
4-Bit Shipments	177,038	271,883	392,332	501,075
U.S. Companies (%)	16.3%	17.8%	11.8%	7.7%
Japanese Companies (%)	80.8%	79.8%	86.3%	90.5%
European Companies (%)	3.0%	2.3%	1.9%	1.8%
8-Bit Shipments	163,599	224,001	333,362	454,022
U.S. Companies (%)	42.7	34.8%	35.3%	36.4%
Japanese Companies (%)	43.2%	50.0%	53.1%	54.7%
European Companies (%)	14.1%	15.2%	11.6%	8.9%
16-Bit Shipments	232	399	3,311	. 5,461
U.S. Companies (%)	94.8%	67.7%	96.6%	98.6%
Japanese Companies (%)	0	0	0.1%	0.2%
European Companies (%)	5.2%	32.3%	3.3%	1.2%
Total Shipments	340,869	496,283	729,005	960,558
U.S. Companies (%)	29.0%	25.5%	22,9%	38.4%
Japanese Companies (%)	62.7%	56.3%	70,7%	73.1%
European Companies (%)	8.3%	8.2%	6.4%	5.1%

Source: Dataquest September 1989

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Figure 5



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Source: Dataquest September 1989



### Table 7

#### Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1975-1979 (Thousands of Units)

	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
4-Bit	500	760	3,400	15,959	50,525
Percent PMOS	100.0%	100.0%	100.0%	80.4%	75.3%
Percent NMOS	0	0	0	14.9%	14.9%
Percent CMOS	0	0	0	4.7%	9.8%
8-Bit	32	251	885	2,218	11,592
Percent NMOS	100.0%	100.0%	100.0%	100.0%	100.0%
Percent CMOS	0	0	0	0	0
16-Bit	0	0	0	0	5
Percent NMOS	0	0	0	0	100.0%
Percent CMOS	o	0	0	0	0
Total Shipments	532	1,011	4,285	18,177	62,122
Percent PMOS	94.0%	75.2%	79.3%	70.6%	61.2%
Percent NMOS	6.0%	24.8%	20.7%	25.3%	30.8%
Percent CMOS	0	0	0	4.2%	8.0%

Source: Dataquest September 1989

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### Table 8

#### Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1980-1984 (Thousands of Units)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
4-Bit Shipments	96,080	133,549	158,183	171,945	193,435
Percent PMOS	66.3%	52.0%	35.2%	22.0%	14.9%
Percent NMOS	14.4%	19.4%	23.5%	30.5%	32.2%
Percent CMOS	19.3%	28.6%	41.3%	47.5%	52.9%
8-Bit Shipments	21,740	34,931	54,114	90,615	163,510
Percent NMOS	100.0%	99.7%	96.8%	91.4%	90.0%
Percent CMOS	0	0.3%	3.2%	8.6%	10.0%
16-Bit Shipments	8	36	50	89	123
Percent NMOS	100.0%	100.0%	100.0%	100.0%	100.0%
Percent CMOS	0	0	0	0	0
Total Shipments	117,828	168,516	212,347	262,649	357,068
Percent PMOS	54.1%	41.2%	26.2%	14.4%	8.1%
Percent NMOS	30.2%	36.1%	42.2%	51.5%	58.7%
Percent CMOS	15.8%	22.7%	31.6%	34.1%	33.3%

Source: Dataquest September 1989

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### Table 9

#### Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1985-1988 (Thousands of Units)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
4-Bit Shipments	177,038	271,883	392,332	501,075
Percent PMOS	10.0%	4.9%	2.5%	1.2%
Percent NMOS	34.8%	29.8%	24.3%	13.6%
Percent CMOS	55.2%	65.2%	73.2%	85.2%
8-Bit Shipments	163,599	224,001	333,362	454,022
Percent NMOS	79.5	67.8%	59.2%	48.4%
Percent CMOS	20.5%	32.2%	40.8%	51.6%
16-Bit Shipments	232	399	3,311	5,461
Percent NMOS	100.0%	100.0%	19.9%	33.2%
Percent CMOS	0	0	80.1%	66.8%
Total Shipments	340,869	496,283	729,005	960,558
Percent PMOS	5.2%	2.7%	1.3%	0.6%
Percent NMOS	56.3%	47.0%	40.2%	30.1%
Percent CMOS	- 38.5%	50.3%	58.4%	69.2%

Source: Dataquest September 1989

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Figure 6



Source: Dataquest September 1989

The tables and figures in this section are organized as follows:

Table 1	Estimated Microcontroller Unit Shipments by Word Length, 1975-1986
Figure 1	Estimated Microcontroller Unit Shipments by Word Length, 1975-1986
Table 2	Estimated Market Share by Manufacturer for all Microcontrollers, 1975-1980, 1981-1986
Figure 2	Estimated Market Share by Manufacturer for all Microcontrollers, for 1985 and 1986
Table 3	Estimated Market Share by Region for all Microcontrollers, 1981–1986
Figure 3	Estimated Market Share by Region for all Microcontrollers, 1981–1986

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### Table 1

#### Estimated Microcontroller Unit Shipments by Word Length 1975–1986 (Thousands of Units)

	<u>197</u>	<u>5 1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
4-Bit						
Shipments	50	00 76	0 3,400	15,959	50,525	96,080
Percent	93.9	98% 75.1	7% 79.35%	87.80%	81.33%	81.54%
8-Bit						
Shipments	:	32 25	1 885	2,218	11,592	21,740
Percent	б.	02% 24.8	3% 20.659	12.20%	18.66%	18.45%
16-Bit						
Shipments					5	8
Percent					<u>0.01</u> %	<u>    0.01</u> %
Total Shipments	5	32 1,01	1 4,285	18,177	62,122	117,828
Percent	100.0	00% 100.0	0% 100.00	100.00%	100.00%	100.00%
	1001		1000	1084	1005	1086
	<u>1981</u>	1985	7983	<u>1984</u>	1993	7300
4-Bit						
Shipments	133,549	158,183	171,945	193,435	177,038	259,171
Percent	79.25%	74.49%	65.47%	54.17%	52.02%	55.90%
8-Bit						
Shipments	34,931	54,114	90,615	163,510	163,067	204,084
Percent	20.73%	25.48%	34.50%	45.79%	47.91%	44.02%
16-Bit						
Shipments	36	50	89	123	232	399
Percent	0.02%	<u>    0.03</u> %	<u>    0.03</u> %	<u>    0.03</u> %	0.07%	<u>    0.09</u> %
Total Shipments	168,516	212,347	262,649	357,068	340,337	463,654
Percent	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Dataquest October 1987

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*\**:

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Figure 1

Estimated Microcontroller Unit Shipments by Word Length 1975–1986



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### Table 2

#### Estimated Market Share by Manufacturer for all Microcontrollers 1975–1980

	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
NEC				8.33%	14.14%	15.04%
Mitsubishi						
Matsushita					7.08	8.76
Toshiba						
National				12.79	9.03	10.02
Hitachi				2.26	1.05	1.21
Motorola				0.50	1.29	1.30
Texas Instruments	9.40%	30.66%	65.93%	51.71	42.02	37.35
Philips						0.02
Intel			2.45	2.86	4.22	5.03
Oki						0.08
Sharp					0.58	5.60
Thomson						
Fujitsu						0.54
Signetics					0.29	0.11
SGS						• •
General Instrument				2.48	6.60	4.75
Siemens						0.02
Others	<u>90.60</u>	69.34	31.62	19.07	13.70	10.17
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

(Continued)

### Table 2 (Continued)

#### Estimated Market Share by Manufacturer for all Microcontrollers 1981–1986

	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
NEC	16.53%	20.49%	20.39%	23.75%	21.34%	19.22%
Mitsubishi					4.44	12.46
Matsushita	7.42	7.64	9.54	8.10	9.41	9.81
Toshiba	0.21	7.73	11.11	9.29	10.31	8.98
National	7.80	9.10	9.64	9.40	8.55	7.46
Motorola	2.99	4.52	6.53	6.41	7.81	7.26
Hitachi	11.57	10.55	9.26	8.23	8.86	7.01
Texas Instruments	23.47	12.39	4.84	2.63	1.58	4.01
Philips	0.22	0.60	1.37	2.89	3.52	3.96
Intel	4.96	5.48	6.18	7.60	4.43	3.87
Oki	0.33	1.23	2.48	2.46	2.67	2.66
Sharp	7.84	5.89	5,30	4.68	3.17	2.12
Thomson			0.06	0.99	1.97	1.82
Fujitsu	7.46	6.81	4.68	3.00	*	*
Signetics	0.00	0.08	0.81	2.15	1.91	1.30
SGS					**	1.17
General Instrument	2.45	1.98	2.52	2.65	2.19	1.15
Siemens	0.50	1.03	1.08	1.09	1.28	1.04
Others	6,25	4.48	4.30	4.68	<u>    6.56</u>	4.70
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

\*Consolidated with Others due to insufficient data. \*\*Less than 1 percent in previous years and consolidated with Others.

> Source: Dataquest October 1987

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Estimated Market Share by Manufacturer for all Microcontrollers 1985 and 1986



Source: Dataquest October 1987

### Table 3

### Estimated Market Share by Region for all Microcontrollers 1981–1986 (Thousands of Units)

	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Europe						
Shipments	1,475	4,517	8,978	21,500	26,944	46,721
Percent	0.88%	2.13%	3.42%	6.00%	7.92%	10.08%
Japan						
Shipments	86,524	128,129	164,560	213,265	212,718	295,953
Percent	51.34%	60.34%	62.65%	59.52%	62.50%	63.83%
United States						
Shipments	80,517	79,701	89,111	123,545	100,675	120,980
Percent	<u>47,78</u> %	<u>37.53</u> %	<u>33.93</u> %	<u>34.48</u> %	<u>29.58</u> %	<u>_26.09</u> %
Total Shipments	168,516	212,347	262,649	358.310	340,337	463,654
Percent	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Dataquest October 1987

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Figure 3





Source: Dataquest October 1987



## **Microcontroller Application Market Overview**

Microcontrollers are microprocessors that are specially configured to monitor and control mechanisms and processes rather than manipulate data. The systems they are embedded in are often called real-time control systems; microcontrollers always incorporate some form of timer structure to allow synchronization with the outside or "real" world.

There are many useful configurations of microcontroller systems that require more than a single microcontroller. A network of microcontrollers can be used for interprocessor communications. One or more microcontroller might be required to communicate with a CRT terminal used to supervise or monitor the system. Another might be a simple CRT terminal design based on a microcontroller that needs one serial port for communication and another for driving a slave printer.

Other microcontrollers serve as intelligent controllers for remote peripherals. However, they can also be used as intelligent front-end helpers for a microprocessor, which can extensively off-load control functions for the CPU.

The wide base of applications cuts across all industry segments. The following six application segments list microcontroller applications.

#### CONSUMER APPLICATIONS

Consumer products are the largest users of microcontrollers. In fact, some applications use several 4-bit MCUs in a single product. Feature content and low cost are the most important issues for use in consumer products. High performance is secondary. Typical consumer applications are listed below:

- Home entertainment
  - Video tape recorders
  - Television tuners and decoders
  - Clock radios
  - Music synthesizers
  - High-end video games
  - Automatic hi-fi turntables
  - Compact audio disk players
  - Laser disk drives
- Appliances
  - Rice cookers
  - Microwave ovens
  - Washers and dryers
  - Food processors
  - Sewing machines
  - Electric ranges
- Household environment
  - Air conditioners/heat pumps
  - Smart thermostats
  - Security systems
  - Lighting control
  - Utility meters
- Games and education
  - Language translators
  - Teaching toys
  - Games

#### INDUSTRIAL APPLICATIONS

Microcontrollers are widely used in industrial products. Although a new microcontroller may be ideally suited to an application and provide cost and performance benefits, market acceptance must wait until the end product is revised. Industrial products frequently require 6 to 18 months from product concept to initial production, so there is a long gestation period between early samples and volume production. In addition, the introduction and market acceptance of the final product may take several months, thereby lengthening the microcontroller life cycle. Industrial products often are sold to equipment manufacturers, so an intermediate product design phase may affect the life cycle of a microcontroller.

Typical industrial applications of microcontrollers are listed below:

- Motor control
- Medical instrumentation
- Scales
- Liquid and gas chromatographs
- Vending machines
- Oscilloscopes
- Beverage dispensers
- Speech recognition
- Speech synthesis

- Elevators
- Power tools
- Gas pumps
- Timers
- Machinery control

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- Process control
- Robot control
- Numerical control
- Intelligent transducers

#### COMMUNICATIONS APPLICATIONS

With the merging of communications and computer technologies in various systems such as videotex and teletext, electronic communications will be vital to the social and economic development of every industrialized country. Several telephone equipment suppliers have created PABXs using microcontrollers. These systems are more reliable, easier to maintain, easier to upgrade, and less expensive than competitive equipment based on more traditional ICs. Listed below are several applications of MCUs in the communication field:

- Telephones CB radios
- Pagers
  Facsimile
- Videotex Intelligent line card control
- Modems

#### AUTOMOTIVE APPLICATIONS

#### Smart Cars--Safe and Friendly Too

Auto makers have been forced to incorporate more and more hightechnology electronics. Government standards on safety, exhaust emissions, and fuel efficiency have pushed automotive designs beyond the bounds of traditional mechanics. Some of today's autos have seven microprocessors or microcontrollers, and future cars may have twice that number. Listed below are some typical applications of microcontrollers and microprocessors in automobiles:

- Engine control
- Electronic fuel injection
- Emission control
- Exhaust gas recirculation
- Automatic transmission control
- 0il service reminder
- Engine system diagnostics
- Transmission control
- Navigation aids
- Voice pattern recognition
- Electronically controlled air suspension
- Spark advance
- Choke control
- Digital speedometers

- Ignition controllers
- Trip computers
- Antiskid braking
- Voice information system
- Climate control
- Instrumentation cluster
- Vehicle security
- Steering
- Obstacle warning
- Axle loading
- Component condition
- Failure warning
- Routing
- Driver performance
- Component performance

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#### DATA PROCESSING APPLICATIONS

Microcontrollers are used widely in business applications because they are the building blocks to automate the collection and transmission of vital information. In addition to computers and communications, several other business-related MCU applications are listed below:

- Electronic typewriters
  Time clocks
- Credit card verification
  Postage meters
- Turnstile counters
  Bar code readers
- Electronic locks
  Food scales
- Parts counting and weighing
  Plotters
- Freezer alarms
  Winchester disk drives
- Copying machines
  Tape drives
- Cash registers
  Impact and nonimpact
  printers

Personal computers have been one of the fastest-growing market segments. Microcontrollers are so prevalent in personal computers that it is common to find three or more in a typical system: one or more controlling the printer, one controlling the keyboard, and one controlling the disk drive. Microcontrollers are frequently used as interface devices between a host computer and peripheral equipment.

#### MILITARY APPLICATIONS

Military applications include the following:

- Missile control
- Torpedo guidance control
- Smart munitions
- Aerospace guidance systems

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### SECOND QUARTER 1987 WORLDWIDE UNIT SHIPMENTS

During the second quarter of 1987, microcontroller unit shipments increased approximately 7.0 million units or just over 5.0 percent from first quarter 1987 shipments. Estimated worldwide shipments of all microcontrollers totaled approximately 143.1 million units.

Figure 1 illustrates the growth in 4- and 8-bit microcontroller shipments from the second quarter of 1986 through the second quarter of 1987.

### Figure 1

### 4- and 8-Bit Microcontroller Unit Shipments Second Quarter 1986 through Second Quarter 1987 (Millions of Units)



Source: Dataquest January 1988

Table 1 shows the change in total microcontroller unit shipments from the first quarter of 1987 through the second quarter of 1987. Figure 2 illustrates the percent change in 8-bit microcontrollers from the second quarter of 1986 through the second quarter of 1987. Table 2 shows the change in leading 8-bit MCU shipments from the first quarter of 1987 through the second quarter of 1987. The most growth was displayed by the 8051 and 8048 devices in this quarter.

During second quarter 1987, approximately 79 percent of all 8-bit CMOS MCU shipments were Japanese manufactured and shipped. Table 3, which provides market share information by technology for 8-bit MCUs, shows a steady increase in the CMOS share of the market for the period.

Table 4 shows the market share changes in shipments (not consumption) by geographical region for 4- and 8-bit MCUs, from the second quarter of 1986 through the second quarter of 1987.

### Table 1

### Total Microcontroller Unit Shipments First Quarter 1987 through Second Quarter 1987 (Thousands of Units)

	01	01/1987		02/1987		
MCU	<u>Units</u>	Percent of <u>Shipments</u>	<u>Units</u>	Percent of <u>Shipments</u>	Growth <u>01 to 02</u>	
4-Bit	73,760	54.2%	78,056	54.5%	5.8%	
8-Bit	62,291	45.7	64,966	45.4	4.3%	
16-Bit	118	1	117	<u>    0.1</u>	(0.9%)	
Total	136,169	100.0%	143,139	100.0%	5.1%	

Source: Dataquest January 1988

Figure 2





Table	2
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### Leading 8-Bit Microcontroller Unit Shipments First Quarter 1987 through Second Quarter 1987 (Thousands of Units)

		1/1987	02	Percent	
Device	<u>Units</u>	Percent of <u>Shipments</u>	<u>Units</u>	Percent of <u>Shipments</u>	Growth <u>01 to 02</u>
6805	9,450	15.2%	9,593	14.8%	1.5%
8049	8,629	13.9	8,438	13.0	(2.2%)
8051	6,752	10.8	7,037	10.8	4.2%
8048	3,515	5.6	3,643	5.6	3.6%
Others	<u>33,945</u>	54.5	36,255	<u>    55.8</u>	6.8%
Total	62,291	100.0%	64,966	100.0%	4.3%

Source: Dataquest January 1988 ŝ,

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### Table 3

Market Share by Technology for 8-bit Microcontrollers Second Quarter 1986 through Second Quarter 1987

<u>Device</u>	Tech.	02/86	<u>03/86</u>	<u>04/86</u>	<u>01/87</u>	<u>02/87</u>
8-Bit MCU	CMOS NMOS	27.7 72.3	28.1 71.9	30.0% _70.0	31.3% <u>68.7</u>	32.8 <u>67.2</u>
Total		100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest January 1988

#### Table 4

### Market Share by Region for 4- and 8-Bit Microcontrollers Second Quarter 1986 through Second Quarter 1987

<u>Device Type</u>	Region	<u>02/86</u>	<u>03/86</u>	<u>04/86</u>	<u>01/87</u>	<u>02/87</u>
<b>4</b> →Bit	United States	18.0%	18.0%	19.9%	17,7%	16.8%
	Japan	79.7	79.6	77.6	79.8	80.8
	Europe	2.3	2.4	2.5	2.5	2.4
	Total	100.0%	100.0%	100.0%	100.0%	100.0%
8-Bit	United States	36.4%	37.4%	39.9%	40.3%	39.5%
	Japan	46.8	46.2	43.6	44.4	44.9
	Europe	_16.7	16.4	16.6	15.3	<u>15.6</u>
	Total	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown due to rounding.

Source: Dataquest January 1988

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### FIRST QUARTER 1987 WORLDWIDE UNIT SHIPMENTS

During the first quarter of 1987, microcontroller unit shipments increased approximately 4.8 million units or 4 percent from fourth quarter 1986 shipments. Estimated worldwide shipments of all microcontrollers totaled approximately 122.2 million units. Shipments of all types of microcontrollers increased. Shipments of 8-bit MCU devices accounted for approximately 48 percent of total microcontrollers shipped in first quarter 1987.

Figure 1 illustrates the growth in 4- and 8-bit microcontroller shipments from the first quarter of 1986 through the first quarter of 1987.

### Figure 1





Source: Dataquest January 1988

Table 1 shows the change in total microcontroller unit shipments from the fourth quarter of 1986 through the first quarter of 1987. Figure 2 illustrates the percent change in 8-bit microcontrollers from the first quarter of 1986 through the first quarter of 1987.

The 8049 made the largest gain in the first quarter, growing a little more than 15 percent. The three other leading 8-bit microcontrollers experienced moderate growth, gaining 3 to 5 percent over the fourth quarter. Table 2 compares first quarter 1987 shipments with fourth quarter 1986 shipments for the top 8-bit microcontrollers.

#### Table 1

### Total Microcontroller Unit Shipments Fourth Quarter 1986 through First Quarter 1987 (Thousands of Units)

		<u>Q4/86</u> Q1/87		01/87	Percent	
<u>Device</u>	<u>Units</u>	Percentage of <u>Shipments</u>	<u>Units</u>	Percentage of <u>Shipments</u>	Growth <u>04 to 01</u>	
4-Bit	62,512	53.3%	64,060	52.4%	2.48%	
8-Bit	54,721	46.6	57,989	47.5	5.97%	
16-Bit	107	<u>0.1</u>	118	0.1	10.28%	
Total	117,340	100.0%	122,167	100.0%	4.11%	

Source: Dataquest January 1988

Figure 2





Table 2

### Leading 8-Bit Microcontroller Unit Shipments Fourth Quarter 1986 through First Quarter 1987 (Thousands of Units)

		04/86		01/87		
<u>Device</u>	Units	Percentage of <u>Shipments</u>	Units	Percentage of <u>Shipments</u>	Growth <u>04 to 01</u>	
6805	- 8,865	16.2%	9,270	16.0%	4.57%	
8049	7,423	13.6	8,549	14,7	15.17	
8051	6,446	11.8	6,617	11.4	2.65%	
8048	3,297	6.0	3,424	5.9	3.85%	
Others	<u>28,690</u>	_52.4	<u>30,129</u>	52.0	5.02	
Total	54,721	100.0%	57,989	100.0%	5.97%	

Source: Dataquest January 1988

Japanese suppliers have long controlled the 4-bit MCU market, shipping more than 75 percent of the total market demand. The 8-bit MCU market, as highlighted in Table 3, is much more evenly balanced. U.S. and Japanese suppliers each ship approximately 42 percent of the market demand. Europe is also strong in 8-bit microcontrollers, supplying more than 16 percent of shipments.

Table 4 shows the ratio between NMOS and CMOS shipments of 8-bit MCUs. During first quarter 1987 approximately 79 percent of all 8-bit CMOS MCU shipments were supplied by Japanese manufacturers.

### Table 3

#### Market Share by Region for 4- and 8-bit Microcontrollers First Quarter 1986 through First Quarter 1987

<u>Device</u>	Region	01/86	02/86	<u>03/86</u>	<u>04/86</u>	<u>01/87</u>
4-Bit	United States	20.1	20.7	20.2%	22.7%	20.5%
	Japan	77.2	76.7	77.1	74.4	76.7
	Europe		2.6	2.7	2.9	<u>_2.8</u>
	Total	100.0%	100.0%	100.0%	100.0%	100.0%
8-Bit	United States	39.2%	37.8%	38.0%	41.6%	42.1%
	Japan	44.1	44.7	45.4	41.2	41.6
	Europe	<u>16.7</u>	<u>17,5</u>	16.6	<u>17.2</u>	16.3
	Total	100.0%	100.0%	100.0%	100.0%	100.0%

#### Table 4

#### Market Share by Technology for 8-Bit MCU Shipments

<u>Device</u>	Region	01/86	02/86	<u>03/86</u>	<u>04/86</u>	<u>01/87</u>
8-Bit MCU	CMOS NMOS	23.4% <u>76.6</u>	25.2 <b>%</b> 74.8	27.3 <u>72.7</u>	27.5% _ <u>72.5</u>	26.5% <u>73.5</u>
	Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest January 1988

#### FOURTH QUARTER 1986 WORLDWIDE UNIT SHIPMENTS

During the fourth quarter of 1986, microcontroller unit shipments increased slightly (0.4 percent) from third quarter 1986 shipments. Estimated worldwide shipments of all microcontrollers totaled approximately 113.7 million units. Shipments of 8-bit MCU devices, which accounted for approximately 45 percent of total microcontrollers shipped in fourth quarter 1986, decreased slightly.

Figure 1 illustrates the growth in 4- and 8-bit microcontroller shipments from the fourth quarter of 1985 through the fourth quarter of 1986.

Table 1 shows the change in total microcontroller unit shipments from the third quarter of 1986 through the fourth quarter of 1986. Figure 2 illustrates the percent change in 8-bit microcontrollers from the fourth quarter of 1985 through the fourth quarter of 1986.

#### Figure 1



### 4- and 8-Bit Microcontroller Unit Shipments Fourth Quarter 1985 through Fourth Quarter 1986

Table 1

### Total Microcontroller Unit Shipments Third Quarter 1986 through Fourth Quarter 1986 (Thousands of Units)

	03	03/1986		04/1986		
MCU	<u>Units</u>	Percent of Shipments	<u>Unițs</u>	Percent of Shipments	Growth <u>Q3 to 04</u>	
4-Bit	61,947	54.7%	62,512	55.0%	0.9%	
8-Bit	51,255	45.2	51,104	44.9	(0.3%)	
16-Bit	117	0.1	127	0.1	8.5%	
Total	113,319	100.0%	113,743	100.0%	0.4%	

Source: Dataquest December 1987

### Figure 2

#### Quarterly Percent Change in 8-Bit Microcontroller Unit Shipments Fourth Quarter 1985 through Fourth Quarter 1986



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Table 2 shows the changes in estimated shipments of leading 8-bit microcontrollers from the third quarter of 1986 through the fourth quarter of 1986. During this period, only the 8051 registered strong growth.

### Table 2

#### 8-Bit Microcontroller Shipments Third Quarter 1986 through Fourth Quarter 1986 (Thousands of Units)

	0;	<u>03/1986</u>		<u>Q4/1986</u>		
<u>Device</u>	Units	Percent of <u>Shipments</u>	<u>Units</u>	Percent of Shipments	Growth <u>03 to 04</u>	
8049	7,622	14.9%	7,699	15.1%	1.0%	
6805	7,557	14.7	7,413	14.5	(1.9%)	
8051	4,855	9.5	5,381	10.5	10.8%	
8048	3,583	7.0	3,226	6.3	(10.0%)	
Others	<u>27,638</u>	53.9	<u>27,385</u>	53.6	(0.9%)	
Total	51,255	100.0%	51,104	100.0%	(0.3%)	

Source: Dataquest December 1987

Table 3 shows the market share changes in shipments (not consumption) by geographical region for 4- and 8-bit MCUs, from fourth quarter 1985 through fourth quarter 1986. Table 4 shows market share by technology for 8-bit microcontrollers for the same period. During fourth quarter 1986, approximately 80.3 percent of all 8-bit CMOS MCU shipments were Japanese-manufactured and shipped.

Table 3

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Market Share by Region for 4- and 8-Bit Microcontrollers Fourth Quarter 1985 through Fourth Quarter 1986

	Region	04/85	<u>01/86</u>	<u>02/86</u>	<u>Q3/86</u>	<u>04/86</u>
4-Bit	United States	14.3%	19.6%	20.7%	20.2%	22.7%
	Japan	82.8	77.8	76.7	77.1	74.4
	Europe	<u>2, 9</u>	2.7	2.6	2.7	2.9
	Total	100.0%	100.0%	100.0%	100.0%	100.0%
8-Bit	United States	44.1%	40.0%	38.3%	37.1%	38.6%
	Japan	42.4	44.4	45.4	46.8	44.1
	Europe	<u>13.5</u>	15.6	16.3	16.1	<u>17.3</u>
	Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest December 1987

### Table 4

Market Share by Technology for Microcontrollers Fourth Quarter 1985 through Fourth Quarter 1986

<u>Device</u>	<b>Technology</b>	04/85	<u>01/86</u>	<u>02/86</u>	<u>03/86</u>	04/86
8-Bit MCU 8-Bit MCU	CMOS NMOS	21.6% <u>78.4</u>	23.3% <u>76.7</u>	25.2% <u>74.8</u>	26.6% <u>73.4</u>	26.3% <u>73.7</u>
Total		100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest December 1987

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### THIRD QUARTER 1986 WORLDWIDE UNIT SHIPMENTS

During the third quarter of 1986, microcontroller unit shipments increased approximately 4.9 million units or 5.0 percent from second quarter 1986 shipments. Estimated worldwide shipments of all microcontrollers totaled approximately 103.7 million units. Shipments of all types of microcontrollers increased.

Figure 1 illustrates the growth in 4- and 8-bit microcontroller shipments from the third quarter of 1985 through the third quarter of 1986.

### Figure 1

### 4- and 8-Bit Microcontroller Unit Shipments Third Quarter 1985 through Third Quarter 1986 (Millions of Units)



Source: Dataquest December 1987

Table 1 shows the change in total microcontroller unit shipments from the second quarter of 1986 through the third quarter of 1986. Most growth was displayed by the 8051 and 8049 in this quarter. Figure 2 illustrates the percent change in 8-bit micro-controllers from the third quarter of 1985 through the third quarter of 1986. Table 2 shows the change in leading 8-bit MCU shipments from the second quarter of 1986 through the third quarter of 1986.

The leading 8-bit microcontrollers in third quarter 1986---the 8049, 6805, 8051, and 8048--accounted for approximately 49.4 percent of the total 8-bit MCU market.

During third quarter 1986, approximately 75.7 percent of all 8-bit CMOS MCU shipments were Japanese manufactured and shipped. Table 3 shows market share by technology for 8-bit MCUs.

Table 4 shows the market share changes in shipments (not consumption) by geographical region for 4- and 8-bit MCUs, from the third quarter of 1985 through the third quarter of 1986.

### Table 1

### Total Microcontroller Unit Shipments Second Quarter 1986 through Third Quarter 1986 (Thousands of Units)

	Q	2/1986	98603/1986		Percent
MCU	<u>Units</u>	Percent of <u>Shipments</u>	<u>Units</u>	Percent of <u>Shipments</u>	Growth <u>02 to 03</u>
4-Bit	53,688	54.3%	58,057	56.0%	8.1%
8-Bit	45,038	45.6	45,521	43.9	1.1%
16- <b>Bi</b> t	98	0.1	117		19.4%
Total	98,824	100.0%	103,695	100.0%	4.9%

Source: Dataquest December 1987

Figure 2





Source: Dataquest December 1987

### Table 2

### Leading 8-Bit Microcontroller Unit Shipments Second Quarter 1986 through Third Quarter 1986 (Thousands of Units)

	03	2/1986	03/1986		Percent Growth <u>Q2 to Q3</u>
Device	Units	Percent of Shipments	ent of Percent of ments Units Shipments		
8049	6,970	15.5%	7,333	16.1%	5.21%
6805	7,108	15.8	7,010	15.4	(1.38%)
8051	4,119	9.1	4,455	9.8	8.16%
8048	3,698	8.2	3,703	8.1	0.14%
Others	23,143	51.4	23,020	50.6	(0.53%)
Total	45,038	100.0%	45,521	100.0%	1.07%

Source: Dataquest December 1987

### Table 3

### Market Share by Technology for 8-bit Microcontrollers Third Quarter 1985 through Third Quarter 1986

<u>Device</u>	Tech.	03/85	<u>04/85</u>	<u>01/86</u>	02/86	<u>Q3/86</u>
8-Bit MCU 8-Bit MCU	CMOS NMOS	20.4% 79.6	21.6% 78.4	<b>21.5%</b> 78.5	22.1% <u>77.9</u>	21.6% _78,4
Total		100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest December 1987

### Table 4

### Market Share by Region for 4- and 8-Bit Microcontrollers Third Quarter 1985 through Third Quarter 1986

<u>Device Type</u>	Region	<u>03/85</u>	Q4/85	<u>01/86</u>	<u>02/86</u>	<u>03/86</u>
4-Bit	United States	16.1%	14.3%	20.3%	21.2%	21.5%
	Japan	81.0	82.9	76.9	76.1	75.6
	Europe	2,9	2.8	2.8	2.7	2.9
	Total	100.0%	100.0%	100.0%	100.0%	100.0%
8_Bit	United States	44.7%	44.1%	41.5%	40.8%	41.2%
	Japan	41.5	42.4	43.6	43.9	44.4
	Europe	13.8	<u>13.5</u>	<u>14.9</u>	15.3	14.4
	Total	100.0%	100.0%	100.0%	100.0%	100.0%
				Sour	ce: Datag	uest

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#### SECOND QUARTER 1986 WORLDWIDE UNIT SHIPMENTS

During the second quarter of 1986, microcontroller unit shipments increased approximately 6.6 million units or 7.2 percent from first quarter 1986 shipments. Estimated worldwide shipments of all microcontrollers totaled approximately 98.8 million units. Shipments of all types of microcontrollers increased. Shipments of 8-bit MCU devices accounted for approximately 45 percent of total microcontrollers shipped in second quarter 1986.

Figure 1 illustrates the growth in 4- and 8-bit microcontroller shipments from the second quarter of 1985 through the second quarter of 1986.

#### Figure 1

#### 4- AND 8-BIT MICROCONTROLLER UNIT SHIPMENTS SECOND QUARTER 1985 THROUGH SECOND QUARTER 1986 (Millions of Units)



Source: Dataquest April 1987

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Table 1 shows the change in total microcontroller unit shipments from the first quarter of 1986 through the second quarter of 1986. Most growth was displayed by the 6805 and 8051 in this quarter. Figure 2 illustrates the percent change in 8-bit microcontrollers from the second quarter of 1985 through the second quarter of 1986. Table 2 shows the change in leading 8-bit MCU shipments from the first quarter of 1986 through the second quarter of 1986.

#### Table 1

#### TOTAL MICROCONTROLLER UNIT SHIPMENTS FIRST QUARTER 1986 THROUGH SECOND QUARTER 1986 (Thousands of Units)

	Q	1/1986	<u>0</u> 2/1986		Percent
MCU	<u>Units</u>	Percent of <u>Shipments</u>	<u>Units</u>	Percent of <u>Shipments</u>	Growth <u>01 to 02</u>
4-Bit	50,900	55.2%	53,688	54.3%	5.5%
8-Bit	41,241	44.7	45,038	45.6	9.2%
16-Bit	81	<u>_0.1</u>	98	<u>0.1</u>	21.0%
Total	92,222	100.0%	98,824	100.0%	7.2%

Source: Dataquest April 1987

Figure 2

#### QUARTERLY PERCENT CHANGE IN 8-BIT MICROCONTROLLER UNIT SHIPMENTS SECOND QUARTER 1985 THROUGH SECOND QUARTER 1986 (Percent)



Source: Dataquest April 1987

Table 2

#### LEADING 8-BIT MICROCONTROLLER UNIT SHIPMENTS FIRST QUARTER 1986 THROUGH SECOND QUARTER 1986 (Thousands of Units)

		C	01/1986		<u>Q2/1986</u>	
			Percent of		Percent of	Growth
<u>Ranking</u>	<u>Device</u>	<u>Units</u>	<u>Shipments</u>	<u> Units</u>	<u>Shipments</u>	<u>Q1 to Q2</u>
1	6805	6,393	15.5%	7,108	15.8%	11,2%
2	8049	6,493	15.7	6,970	15.5	7.4%
3	8051	3,720	9.0	4,119	9.1	10.7%
4	8048	3,413	8.3	3,698	8.2	8.4%
5	Others	<u>21,221</u>	51.5	<u>23,143</u>	<u>. 51.4</u>	9.1%
	Total	41,241	100.0%	45,038	100.0%	9.2%

Source: Dataquest April 1987

The leading 8-bit microcontrollers in second quarter 1986--the 6805, 8049, 8051, and 8048--represented approximately 48.6 percent of the total 8-bit MCU market. During this period, Japanese manufacturers shipped more than 70 percent of 8048 and 8049 devices worldwide, while U.S. manufacturers shipped approximately 75 percent of 8051 and 6805 devices worldwide.

Table 3 shows the market share changes in shipments (not consumption) by geographical region for 4- and 8-bit MCUs, from the second quarter of 1985 through the second quarter of 1986.

#### Table 3

#### MARKET SHARE BY REGION FOR 4- AND 8-BIT MICROCONTROLLERS SECOND QUARTER 1985 THROUGH SECOND QUARTER 1986

<u>Device Type</u>	<u>Region</u>	02/85	<u>03/85</u>	<u>04/85</u>	<u>01/86</u>	<u>02/86</u>
4-Bit	United States	16.5%	16.3%	14.3%	20.3%	21.2%
	Japan	80.5	80.7	82.8	76.9	76.1
	Europe	3.0	3.0	2.9	2.8	2.7
	Total	100.0%	100.0%	100.0%	100.0%	100.0%
8-Bit	United States	42.5%	44.4%	44.1%	41.5%	40.8%
	Japan	43.9	41.8	42.4	43.6	43.9
	Europe	13.6	<u>13.8</u>	<u>13.5</u>	<u>14.9</u>	<u>15.3</u>
	Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest April 1987

#### FIRST QUARTER 1986 WORLDWIDE UNIT\_SHIPMENTS

During the first quarter of 1986, microcontroller unit shipments increased approximately 8 million units or 9.5 percent from fourth quarter 1985 shipments. Estimated worldwide shipments of all microcontrollers totaled approximately 92.5 million units. Shipments of all types of microcontrollers increased. Shipments of 8-bit MCU devices accounted for approximately 45 percent of total microcontrollers shipped in first quarter 1986.

Figure 1 illustrates the growth in 4- and 8-bit microcontroller shipments from the first quarter of 1985 through the first quarter of 1986.

#### Figure 1

### 4- AND 8-BIT MICROCONTROLLER UNIT SHIPMENTS FIRST QUARTER 1985 THROUGH FIRST QUARTER 1986 (Millions of Units)



Source: Dataquest February 1987

Table 1 shows the change in total microcontroller unit shipments from the fourth quarter of 1985 through the first quarter of 1986. Both the 8048 and 8049 displayed growth in this quarter. Figure 2 illustrates the percent change in 8-bit microcontrollers from the first quarter of 1985 through the first quarter of 1986. Table 2 shows the change in leading 8-bit MCU shipments from the fourth quarter of 1985 through the first quarter of 1986.

#### Table 1

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### TOTAL MICROCONTROLLER UNIT SHIPMENTS FOURTH QUARTER 1985 THROUGH FIRST QUARTER 1986 (Thousands of Units)

		Q	04/1985		01/1986		
MCU	•	<u>Units</u>	Percent of <u>Shipments</u>	<u>Units</u>	Percent of Growtl Shipments 04 to (	Growth <u>Q4 to Q1</u>	
4-Bit		45,635	54.0%	50,900	55.0%	11.5%	
8-Bit		38,848	45.9	41,567	44.9	7.0%	
16-Bit		<u>71</u>	<u>0.1</u>	81	<u>_0.1</u>	14.1%	
Total		84,554	100.0%	92,548	100.0%	9.5%	

Source: Dataquest February 1987

#### Figure 2

### QUARTERLY PERCENT CHANGE IN 8-BIT MICROCONTROLLER UNIT SHIPMENTS FIRST QUARTER 1985 THROUGH FIRST QUARTER 1986 (Percent)



Source: Dataquest February 1987 Ξ.

#### Table 2

#### LEADING 8-BIT MICROCONTROLLER UNIT SHIPMENTS FOURTH QUARTER 1985 THROUGH FIRST QUARTER 1986 (Thousands of Units)

		04	04/1985		01/1986		
			Percent of		Percent of	Growth	
<u>Ranking</u>	<u>Device</u>	<u>Units</u>	<u>Shipments</u>	<u>Units</u>	<u>Shipments</u>	<u>04 to 01</u>	
1	8049	5,999	15.4%	6,491	15.6%	8.2%	
2	6805	6,776	17.5	6,393	15.4	(5.7%)	
3	8051	, 3,855	9.9	3,692	8.9	(4.2%)	
4	8048	3,110	8.0	3,415	8.2	9.8%	
5	Others	<u>19,108</u>	49.2	<u>21,576</u>	_51.9	12.9%	
	Total	38,848	100.0%	41,567	100.0%	7.0%	

Source: Dataquest February 1987

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The key 8-bit microcontrollers in first quarter 1986--the 8049, 6805, 8051, and 8048--represented approximately 48 percent of the total 8-bit MCU market. During this period, Japanese manufacturers shipped more than 66 percent of 8048 and 8049 devices worldwide, while U.S. manufacturers shipped approximately 78 percent of 8051 and 6805 devices worldwide.

Table 3 shows the market share changes in shipments (not consumption) by geographical region for 4- and 8-bit MCUs, from the first quarter of 1985 through the first quarter of 1986.

#### Table 3

#### MARKET SHARE BY REGION FOR 4- AND 8-BIT MICROCONTROLLERS FIRST QUARTER 1985 THROUGH FIRST QUARTER 1986

<u>Device Type</u>	Region	<u>01/85</u>	<u>02/85</u>	<u>Q3/85</u>	<u>04/85</u>	<u>Q4/86</u>
4-Bit	United States	17.5%	16.5%	16.3%	14.3%	20.3%
	Japan	79.5	80.5	80.7	82.8	76.9
	Europe	3.0	<u> </u>	3.0	<u>    2.9</u>	2.8
	Total	100.0%	100.0%	100.0%	100.0%	100.0%
8-Bit	United States	44.8%	42,2%	44.7%	43.8%	42.1%
	Japan	42.3	44.0	41.5	42.6	43.2
·	Europe	<u>12.9</u>	13.8	<u>13.8</u>	<u>13.6</u>	<u>14.7</u>
	Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest February 1987

Over the past year, the rate of change of market share experienced in the 8-bit MCU market has slowed down, but there is increased variability in the 1986 4-bit MCU market over the previous quarter.

#### THIRD QUARTER 1985 WORLDWIDE UNIT SHIPMENTS

During the third quarter of 1985, microcontroller unit shipments decreased approximately 1.9 million units or 2.3 percent from second quarter 1985 shipments. Estimated worldwide shipments of all microcontrollers totaled approximately 82 million units. Shipments of 4-bit microcontrollers decreased slightly, and shipments of 8-bit microcontrollers decreased 4.3 percent. Shipments of 8-bit MCU devices accounted for approximately 46.5 percent of total microcontrollers shipped in third quarter 1985.

Figure 1 illustrates the growth in 4- and 8-bit microcontroller shipments from the third quarter of 1984 through the third quarter of 1985.

#### Figure 1





Source: DATAQUEST April 1986

Table 1 shows the change in total microcontroller unit shipments from the second quarter of 1985 through the third quarter of 1985. The 8048 lost the greatest market share during this quarter while the 6805 displayed significant growth. Figure 2 illustrates the percent change in 8-bit microcontrollers from the third quarter of 1984 through the third quarter of 1985. Table 2 shows the change in leading 8-bit MCU shipments from the second quarter of 1985 through the third quarter of 1985.

#### Table 1

### TOTAL MICROCONTROLLER UNIT SHIPMENTS SECOND QUARTER 1985 THROUGH THIRD QUARTER 1985 (Thousands of Units)

	Q	2/1985	Q3/1985		Percent
MCU	Units	Percent of Shipments	Units	Percent of Shipments	Growth Q2 to Q3
4-Bit	43,859	52.3%	43,699	53.4%	(0.4%)
8-Bit	39,854	47.6	38,123	46.5	(4.3%)
16-Bit	55	0.1	56		1.8%
Total	83,768	100.0%	81,878	100.0%	(2.3%)

Source: DATAQUEST April 1986

#### Figure 2

#### QUARTERLY PERCENT CHANGE IN 8-BIT MICROCONTROLLER UNIT SHIPMENTS THIRD QUARTER 1984 THROUGH THIRD QUARTER 1985 (Percent)



Table 2

#### LEADING 8-BIT MICROCONTROLLER UNIT SHIPMENTS SECOND QUARTER 1985 THROUGH THIRD QUARTER 1985 (Thousands of Units)

Ranking	Device	Q2/1985		<u>Q3/1985</u>		Percent
		<u>Units</u>	Percent of Shipments	Units	Percent of Shipments	Growth <u>Q2 to Q3</u>
1	8049	6,178	15.5%	5,555	14.6%	(10.1%)
2	6805	4,755	11.9	5,505	14.4	15.8%
3	8051	3,830	9.6	3,774	9.9	(1.5%)
4	8048	4,470	11.2	3,575	9.4	(20.0%)
5	Others	20,621	51.8	19,714	<u>51.7</u>	(4.4%)
	Total	39,854	100.0%	38,123	100.0%	(4.3%)

Source: DATAQUEST April 1986

The key 8-bit microcontrollers in third quarter 1985--the 8049, 6805, 8051, and 8048--had approximately 48.3 percent of the total 8-bit MCU market. During this period, Japanese manufacturers shipped more than 66 percent of 8048 and 8049 devices worldwide, while U.S. manufacturers shipped approximately 77 percent of 8051 and 6805 devices worldwide.

Table 3 shows the market share changes in shipments (not consumption) by geographical region for 4- and 8-bit MCUs, from the third quarter of 1984 through the third quarter of 1985.

#### Table 3

#### MARKET SHARE BY REGION FOR 4- AND 8-BIT MICROCONTROLLERS THIRD QUARTER 1984 THROUGH THIRD QUARTER 1985

Device Type	<u>Region</u>	<u>03/84</u>	<u>Q4/84</u>	<u>Q1/85</u>	<u>Q2/85</u>	<u>Q3/85</u>
4-Bit	United States	. 21.2%	18.8%	17.5%	16.5%	16.3%
	Japan	77.3	78.7	79.5	80.5	80.7
	Europe	1.5	2.5	3.0	3.0	3.0
	Total	100.0%	100.0%	100.0%	100.0%	100.0%
8-Bit	United States	49.1%	46.7%	44.8%	42.28	44.7%
	Japan	40.2	41.5	42.3	44.0	41.3
	Europe	10.7	11.8	12.9	13.8	14.0
	Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: DATAQUEST April 1986

We saw the U.S. manufacturers continue to lose market share of the 8-bit microcontroller market in the third quarter of 1985 from the same quarter a year earlier, but at a slower pace from that experienced from the second quarter of 1984 to the second quarter of 1985.

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## **Microcontroller Shipments—Fourth Quarter 1985**

#### FOURTH QUARTER 1985 WORLDWIDE UNIT SHIPMENTS

During the fourth quarter of 1985, microcontroller unit shipments increased approximately 2 million units or 2.6 percent from third quarter 1985 shipments. Estimated worldwide shipments of all microcontrollers totaled approximately 84.4 million units. Shipments of all types of microcontrollers increased slightly. Shipments of 8-bit MCU devices accounted for approximately 46 percent of total microcontrollers shipped in fourth quarter 1985.

Figure 1 illustrates the growth in 4- and 8-bit microcontroller shipments from the fourth quarter of 1984 through the fourth quarter of 1985.

#### Figure 1

#### 4- AND 8-BIT MICROCONTROLLER UNIT SHIPMENTS FOURTH QUARTER 1984 THROUGH FOURTH QUARTER 1985 (Millions of Units)



## Microcontroller Shipments—Fourth Quarter 1985

Table 1 shows the change in total microcontroller unit shipments from the third quarter of 1985 through the fourth quarter of 1985. The 8048 lost the greatest market share during this quarter while the 6805 displayed significant growth. Figure 2 illustrates the percent change in 8-bit microcontrollers from the fourth quarter of 1984 through the fourth quarter of 1985. Table 2 shows the change in leading 8-bit MCU shipments from the third quarter of 1985 through the fourth quarter of 1985.

#### Table 1

### TOTAL MICROCONTROLLER UNIT SHIPMENTS THIRD QUARTER 1985 THROUGH FOURTH QUARTER 1985 (Thousands of Units)

	Q	3/1985	0	Percent		
MCU	<u>Units</u>	Percent of <u>Shipments</u>	<u>Units</u>	Percent of <u>Shipments</u>	Growth <u>03 to 04</u>	
4-Bit	44,187	53.7%	45,635	54.0%	3.3%	
8- <b>Bi</b> t	38,060	46.2	38,726	45.9	1.8%	
16-Bit	56	0.1	71	<u>0.1</u>	26.8%	
Total	82,303	100.0%	84,432	100.0%	2.6%	

Source: Dataquest September 1986

## Microcontroller Shipments—Fourth Quarter 1985

#### Figure 2

#### QUARTERLY PERCENT CHANGE IN 8-BIT MICROCONTROLLER UNIT SHIPMENTS FOURTH QUARTER 1984 THROUGH FOURTH QUARTER 1985 (Percent)



Table 2

#### LEADING 8-BIT MICROCONTROLLER UNIT SHIPMENTS THIRD QUARTER 1985 THROUGH FOURTH QUARTER 1985 (Thousands of Units)

Ranking	Device	03/1985		04/1985		Percent
		<u>Units</u>	Percent of Shipments	<u>Units</u>	Percent of Shipments	Growth <u>Q3 to Q4</u>
1	6805	5,505	14.5%	6,776	17.5%	23.1%
2	8049	6,520	17.1	5,902	15.2	(9.5%)
3	8051	3,931	10.3	3,930	10.2	
4	8048	4,241	11.1	3,280	8.5	(22.7%)
5	Others	17,863	47.0	18,838	48.6	5.5%
	Total	38,060	100.0%	38,726	100.0%	1.7%

Source: Dataquest September 1986
Microcontroller Shipments—Fourth Quarter 1985

The key 8-bit microcontrollers in fourth quarter 1985--the 6805, 8049, 8051, and 8048--had approximately 51.4 percent of the total 8-bit MCU market. During this period, Japanese manufacturers shipped more than 66 percent of 8048 and 8049 devices worldwide, while U.S. manufacturers shipped approximately 77 percent of 8051 and 6805 devices worldwide.

Table 3 shows the market share changes in shipments (not consumption) by geographical region for 4- and 8-bit MCUs, from the fourth quarter of 1984 through the fourth quarter of 1985.

#### Table 3

#### MARKET SHARE BY REGION FOR 4- AND 8-BIT MICROCONTROLLERS FOURTH QUARTER 1984 THROUGH FOURTH QUARTER 1985

Device Type	Region	<u>04/84</u>	<u>01/85</u>	<u>02/85</u>	<u>03/85</u>	<u>04/85</u>
4-Bit	United States	18.8%	17.5%	16.5%	16.3%	14.3%
	Japan	78.7	79.5	80.5	80.7	82.8
	Europe	2.5	3.0	3.0	3.0	2.9
	Total	100.0%	100.0%	100.0%	100.0%	100.0%
8-Bit	United States	46,7%	44.8%	42.2%	44.7%	43.8%
	Japan	41.5	42.3	44.0	41.5	42.6
	Europe	11.8	12.9	13.8	13.8	13.6
	Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest September 1986

We saw the U.S. manufacturers continue to lose market share of the 8-bit microcontroller market in the third quarter of 1985 from the same quarter a year earlier, but at a slower pace from that experienced from the second quarter of 1984 to the second quarter of 1985.

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The tables and figures in this section are organized as follows:

- Table 1Estimated Market Share by Product Type for 4-Bit Microcontrollers,1975-1979
- Table 2Estimated Market Share by Product Type for 4-Bit Microcontrollers,1980-1984
- Table 3Estimated Market Share by Product Type for 4-Bit Microcontrollers,1985-1988
- Figure 1 Estimated Market Share by Product Type for 4-Bit Microcontrollers, 1987 and 1988
- Table 4Estimated Market Share by Process Technology for 4-Bit Microcontrollers,1975-1979
- Table 5Estimated Market Share by Process Technology for 4-Bit Microcontrollers,<br/>1980-1984
- Table 6Estimated Market Share by Process Technology for 4-Bit Microcontrollers,<br/>1985-1988
- Figure 2 Estimated Market Share by Process Technology for 4-Bit Microcontrollers, 1980-1988



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## Table 1

### Estimated Market Share\* by Product Type for 4-Bit Microcontrollers 1975-1979

	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
TMS1000	10.0%	40.8%	83.1%	58.9%	51.7%
uCOM-4	0	0	0	9.4	15.4
COPS	0	0	0	14.6	11.1
MN1400	0	0	0	0	8.7
PPS-4	90.0	59.2	16.9	14.3	7.7
S2000	0	0	0	0.2	2.8
HMCS-40	0	0	0	2.6	1.3
SM-3	0	0	0	0	0.7
14100	0	0	0	0.1	0.6
Total	100.0%	100.0%	100.0%	100.0%	100.0%

\*Based on units shipped

Source: Dataquest July 1989

## Table 2

## Estimated Market Share\* by Product Type for 4-Bit Microcontrollers 1980-1984

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
uPD75XX	0	2.4%	5.1%	8.8%	16.3%
COPS	12.0%	8.6	10.4	12.7	15.2
HMCS-40	1.5	14.2	13.0	12.0	11.6
MN1400	10.7	8.4	9.2	10.7	10.5
uCOM-4	15.4	14.8	16.2	12.2	8.8
SM-5	5.0	8.0	5.9	6.0	6.3
MN1500	0	0.9	1.0	3.7	4,4
TMS1000	45.8	29.6	16.4	6.9	4.3
TLCS-43	0	0	2.1	5.4	4.1
Series-40	0.1	0.4	1.5	3.2	3.3
TLCS-47	0	0	0.4	1.8	3.3
MB884X	0	6.9	6.3	4.4	3.2
T Series	0	0	5.2	5.7	3.1
TLCS-46	0	0	1.8	2.1	1.7
B885X	0.2	1.5	2.0	1.8	1.4
PPS-4	6.0	1.9	1.1	1.0	1.1
SM-4	1.2	1.2	1.2	1.0	1.0
SM-3	0.6	0.7	0.6	0.5	0.4
141000	0.2	0.1	0.1	0.1	0
S2000	1.2	0.3	0.4	<u>0.1</u>	0
Total	100.0%	100.0%	100.0%	100.0%	100.0%

\*Based on units shipped

Source: Dataquest July 1989 .

## Table 3

## Estimated Market Share\* by Product Type for 4-Bit Microcontrollers 1985-1988

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
uPD75XX	17.8%	15.4%	12.2%	12.7%
MN1500	б.4	10.2	10.7	9.9
TLCS-47	4.4	8.3	6.0	8.4
COPS	16.2	13.8	10.1	7.8
HMCS-400	0	0	8.2	5.3
HMCS-40	12.6	8.1	6.6	4.3
SM (4-Bit)	5.9	3.4	2.4	4.3
M5046X/56X	0	0	3.3	4.0
uCOM75X	0	1.4	4.3	3.6
M5072/76	0	0	3.8	2.8
T SERIES	3.2	1.7	1.6	2.8
M5043X/44X	0	0	3.6	2.6
uCOM-4	5.6	2.1	0.9	1.3
MN1400	11.6	6.4	3.0	1.7
TMS1000	2.2	5.9	3.4	1.6
SERIES-40	3.7	2.7	1.7	1.5
MB884X	3.2	2.4	1.8	1.4
M509X	0	0	0.5	1.3
TLCS-42	0.7	1.4	1.0	0.9
TLCS-43	3.2	1.0	0.6	0.9
MN1700	0	0	0.5	0.9
MB885X	1.2	1.3	1.0	0.8
MB8850X	0	0	0.1	0.7
MB8840X	0	0	0.5	0.4
MB882XX	0	0	0.2	0.3
TLCS~46	1.2	0.1	0.1	0.1
PPS-4	0.8	0.4	0.2	0.1
TLCS-470	0	0.1	0.3	0
141000	0	0	0	0
Unspecified	0	<u>3.7</u>	_11.3	<u>17.7</u>
Total	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding. \*Based on units shipped

> Source: Dataquest July 1989

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Figure 1



## Table 4 Estimated Market Share by Process Technology for 4–Bit Microcontrollers 1975–1979 (Thousands of Units)

	<u>1975</u>	<u>1976</u>	1977	<u>1978</u>	<u>1979</u>
NMOS					
Shipments	0	0	0	2,375	7,530
Percent	0	0	0	14.9%	14.9%
CMOS					
Shipments	0	0	0	755	4,961
Percent	0	0	0	4.7%	9.8%
PMOS					
Shipments	500	760	3,400	12,829	38,034
Percent	100%	100%	100%	80.4%	<u>    75.3</u> %
Total Shipments	500	760	3,400	15,959	50,525
				Source:	Dataquest July 1989

## Table 5

### Estimated Market Share by Process Technology for 4-Bit Microcontrollers 1980-1984 (Thousands of Units)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
NMOS					
Shipments	13,813	25,970	37,167	52,468	62,240
Percent .	14.4%	19.4%	23.5%	30.5%	32.2%
CMOS					
Shipments	18,574	38,129	65,382	81,638	102,358
Percent	19.3%	28.6%	41.3%	47.5%	52.9%
PMOS					
Shipments	63,693	69,450	55,634	37,839	28,837
Percent	<u>   66.3</u> %	52.0%	<u>35.2</u> %	<u>     22.0</u> %	<u>    14.9</u> %
Total Shipments	96,080	133,549	158,183	171,945	193,435

Source: Dataquest July 1989

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## Table 6

### Estimated Market Share by Process Technology for 4-Bit Microcontrollers 1985-1988 (Thousands of Units)

	1985	1986	1987	1988
NMOS				87 - 1969-1968-1
Shipments	61,576	81,153	95,288	68,117
Percent	34.8%	29.8%	24.3%	14.5%
CMOS				
Shipments	97,694	177,357	287,360	426,966
Percent	55.2%	65.2%	73.2%	85.2%
PMOS				
Shipments	17,768	13,373	9,684	5,992
Percent	%	4.9%	2.5%	<u>    1.3</u> %
Total Shipments	177,038	271,883	392,332	501,075

Source: Dataquest July 1989

## Figure 2

### Estimated Market Share by Process Technology for 4–Bit Microcontrollers 1980–1988



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The tables and figures in this section are organized as follows:

Table 1	Estimated Market Share by Product Type for 4-Bit Microcontrollers, 1980-1984
Table 2	Estimated Market Share by Product Type for 4-Bit Microcontrollers, 1985-1987
Figure 1	Estimated Market Share by Product Type for 4-Bit Microcontrollers, 1986 and 1987
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Table 7	Estimated Market Share by Process Technology for 4-Bit Microcontrollers, 1980-1984
Table 8	Estimated Market Share by Process Technology for 4-Bit Microcontrollers, 1985-1987
Figure 4	Estimated Market Share by Process Technology for 4-Bit Microcontrollers, 1980-1987

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## Table 1

## Estimated Market Share by Product Type for 4-Bit Microcontrollers 1980-1984

•	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
uPD <b>75XX</b>	0	2.4%	5.1%	8.8%	16.3%
COPS	12.0%	8.6	10.4	12.7	15.2
HMCS-40	1.5	14.2	13.0	12.0	11.6
MN1400	10.7	8.4	9.2	10.7	10.5
uCOM-4	15.4	14.8	16.2	12.2	8.8
SM-5	5.0	8.0	5.9	6.0	6.3
MN1500	0	0.9	1.0	3.7	4.4
TMS1000	45.8	29.6	16.4	6.9	4.3
TLCS-43	0	0	2.1	5.4	4.1
SERIES-40	0.1	0.4	1.5	3.2	3.3
TLCS-47	0	0	0.4	1.8	3.3
MB884X	0	6.9	6.3	4.4	3.2
T SERIES	0	0	5.2	5.7	3.1
TLCS-46	0	0	1.8	2.1	1.7
MB885X	0.2	1.5	2.0	1.8	1.4
PPS-4	6.0	1.9	1.1	1.0	1.1
SM-4	1.2	1.2	1.2	1.0	1.0
SM-3	0.6	0.7	0.6	-0.5	0.4
141000	0.2	0.1	0.1	0.1	0
\$2000	. <u>1.2</u>	0.3	0.4	0.1	0
Total	100.0%	100.0%	100.0%	100,0%	100.0%

Source: Dataquest September 1988

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## Table 2

### Estimated Market Share by Product Type for 4-Bit Microcontrollers 1985-1987

	<u>1985</u>	<u>1986</u>	<u>1987</u>
uPD75XX	17.8%	15.4%	12.2%
MN1500	6.4	10.2	10.7
COPS	16.2	13.8	10.1
HMCS-400	0	0	8.2
HMCS-40	12.6	8.1	6.6
TLCS-47	4.4	8.3	6.0
uCOM75X	0	1.4	4.3
M5072/76	0	0	3.8
M5043X/44X	0	0	3.6
TMS1000	2.2	5.9	3.4
M5046X/56X	0	ō	3.3
MN1400	11.6	6.4	3.0
SM (4-Bit)	5.9	3.4	2.4
MB884X	3.2	2.4	1.8
SERIES-40	3.7	2.7	1.7
T SERIES	3.2	1.7	1.6
TLCS-42	0.7	1.4	1.0
MB885X	1.2	1.3	1.0
uCOM-4	5.6	2.1	0.9
TLCS-43	3.2	1.0	0.6
MN1700	0	0	0.5
M509X	. 0	0	0.5
MB8840X	0	- 0	0.5
TLCS-470	0	0.1	0.3
PPS-4	0.8	0.4	0.2
MB882XX	· 0	0	0.2
MB8850X	0	0	0.1
TLCS-46	1.2	0.1	0.1
M50XXX	0	10.2	0
141000	0	0	0
Unspecified	0	3.7	<u>11.3</u>
	100.0%	100.0%	100.0%

Source: Dataquest September 1988

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## Table 3

## Estimated Market Share by Manufacturer for 4-Bit Microcontrollers 1980-1984

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Eurotechnique	0	0	0.1%	0.5%	0
Fujitsu	0.2%	8.4	8.2	6.2	4.6%
Gould Semiconductor	1.2	0.3	0.4	0.1	0
Hitachi	1.5	14.2	13.0	12.0	11.6
Matsushita	10.7	9.4	10.2	14.4	15.0
Motorola	0.2	0.1	0.1	0.1	0
National	12.0	8.6	10,2	12.2	13.8
NEC	15.4	17.2	21.3	21.0	25.0
Oki	0.1	0.4	1.5	3.2	3.3
Rockwell	6.0	1.9	1.1	1.0	1.1
SGS-Thomson	0	0	0	0	1.4
Sharp	6.9	9.9	7.8	7.5	7.7
Texas Instruments	45.8	29.6	15.4	6.9	4.3
Toshiba	0	0	9.5	<u>14.9</u>	<u>12.2</u>
	100.0%	100.0%	100.0%	100.0%	100.0%

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## Table 4

## Estimated Market Share by Manufacturer for 4-Bit Microcontrollers 1985-1987

	<u>1985</u>	<u>1986</u>	<u>1987</u>
Fujitsu	4.4%	3.7%	3.6%
Hitachi	12.6	8.1	14.8
Matsushita	18.0	16.6	14.3
Mitsubishi	0	10.2	11.3
Motorola	0	0	0
National	13.3	11.5	8.1
NEC	23.4	18.9	17.4
Oki ·	3.7	2.7	1.7
Rockwell	0.8	0.4	0.2
SGS-Thomson	3.0	2.3	1.9
Sharp	5.9	3.4	2.4
Texas Instruments	2.2	5.9	3.4
Toshiba	12.7	12.6	9.6
Others	0	3.7	<u>11.3</u>
	100.0%	100.0%	100.0%

Source: Dataguest September 1988

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Figure 2

Estimated Market Share by Manufacturer for 4-Bit Microcontrollers 1986 and 1987





Source: Dataquest September 1988

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## Table 5

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## Estimated Market Share by Region for 4-Bit Microcontrollers 1980--1984 (Thousands of Units)

	<u>1980</u>	<u>1981</u>	1982	<u>1983</u>	<u>1984</u>
United States					
Shipments	62,660	54,039	44,553	34,945	37,215
Percent	65.2%	40.5%	28.2%	20.3%	19.2%
Japan					
Shipments	33,420	79,510	113,440	136,160	153,430
Percent	34.8%	59.5%	71.7%	79.2%	79.3%
Europe					
Shipments	0	0	190	840	2,790
Percent	0	0	0.18	0.5%	<u>    1.4</u> %
Total Shipments	96,080	133,549	158,183	171,945	193,435

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Source: Dataquest September 1988

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## Table 6

## Estimated Market Share by Region for 4-Bit Microcontrollers 1985–1987 (Thousands of Units)

<u>1985</u>	<u>1986</u>	<u>1987</u>
28,804	48,458	46,160
16.3%	17.8%	11.8%
142,992	217,095	338,657
80.8%	79.8%	86.3%
5,242	6,330	7,515
<u> </u>	2.3%	1.9%
177,038	271,883	392,332
	<u>1985</u> 28,804 16.3% 142,992 80.8% 5,242 <u>3.0</u> %	1985198628,80448,45816.3%17.8%142,992217,09580.8%79.8% $5,242$ 6,330 $3.0$ %2.3%177,038271,883

Source: Dataquest September 1988

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## Figure 3





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## Table 7

## Estimated Market Share by Process Technology for 4-Bit Microcontrollers 1980-1984 (Thousands of Units)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
NMOS					
Shipments	13,813	25,970	37,167	52,468	62,240
Percent	14.4%	19.4%	23.5%	30.5%	32.2%
CMOS		•			
Shipments	18,574	38,129	65,382	81,638	102,358
Percent	19.3%	28.6%	41.3%	47.5%	52,9%
PMOS					
Shipments	63,693	69,450	55,634	37,839	28,837
Percent	<u>    66.3</u> %	<u>    52.0</u> %	<u>35.2</u> %	22.0%	14,9%
Total Shipments	96,080	133,549	158,183	171,945	193,435

Source: Dataquest September 1988

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## Table 8

## Estimated Market Share by Process Technology for 4-Bit Microcontrollers 1985-1987 (Thousands of Units)

	<u>1985</u>	<u>1986</u>	<u>1987</u>
NMOS			
Shipments	61,576	81,153	95,288
Percent	34.8%	29.8%	24.3%
CMOS			
Shipments	97,694	177,357	287,360
Percent	55.2%	65.2%	73.2%
PMOS			
Shipments	17,768	13,373	9,684
Percent	10.0%	4.9%	%
Total Shipments	177,038	271,883	392,332

Source: Dataquest September 1988

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Figure 4

### Estimated Market Share by Process Technology for 4-Bit Microcontrollers 1980-1987



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The tables and figures in this section are organized as follows:

- Table 1Estimated Market Share by Manufacturer for 4-Bit Microcontrollers,1975-1979
- Table 2Estimated Market Share by Manufacturer for 4-Bit Microcontrollers,1980-1984
- Table 3Estimated Market Share by Manufacturer for 4-Bit Microcontrollers,1985-1988
- Figure 1 Estimated Market Share by Manufacturer for 4-Bit Microcontrollers, 1987 and 1988
- Table 4Estimated Market Share by Region for 4-Bit Microcontrollers, 1975-1979
- Table 5Estimated Market Share by Region for 4-Bit Microcontrollers, 1980-1984
- Table 6
   Estimated Market Share by Region for 4–Bit Microcontrollers, 1985–1988
- Figure 2 Estimated Market Share by Region for 4-Bit Microcontrollers, 1980-1988

## Table 1

## Estimated Market Share\* by Manufacturer for 4–Bit Microcontrollers 1975–1979

<u>Manufacturer</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
Gould/AMI	0	0	0	0.2%	2.8%
Hitachi	0	0	0	2.6	1.3
Matsushita	0	0	0	0	8.7
Motorola	0	0	0	0.1	0.6
National	0	0	0	14.6	11.1
NEC	0	0	0	9.4	15.4
Rockwell	90.0%	59.2%	16.9%	14.2	7.7
Sharp	0	0	0	0	0.7
Texas Instruments	10.0	40.8	_83.1	58.9	<u>51.7</u>
Total	100.0%	100.0%	100.0%	100.0%	100.0%

\*Based on units shipped

## Table 2

## Estimated Market Share\* by Manufacturer for 4-Bit Microcontrollers 1980-1984

<u>Manufacturer</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Eurotechnique	0	0	0.1%	0.5%	0
Fujitsu	0.2%	8.4%	8.3	6.2	4.6%
Gould Semiconductor	1.2	0.3	0.4	· 0.1	0
Hitachi	1.5	14.2	13.0	12.0	11.6
Matsushita	10.7	9.4	10.2	14.4	15.0
Motorola	0.2	0.1	0.1	0.1	0
National	12.0	8.6	10.2	12.2	13.8
NEC	15.4	17.2	21.3	21.0	25.0
Oki	0.1	0.4	1.5	3.2	3.3
Rockwell	6.0	1.9	1,1	1.0	1.1
SGS-Thomson	0	0	0	0	1.4
Sharp	6.9	9.9	7.8	7.5	7.7
Texas Instruments	45.8	29.6	16.4	6.9	4.3
Toshiba	0	0	<u>9.5</u>	14.9	12.2
Total	100.0%	100.0%	100.0%	100.0%	100.0%

\*Based on units shipped

## Table 3

## Estimated Market Share\* by Manufacturer for 4-Bit Microcontrollers 1985-1988

<u>Manufacturer</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Fujitsu	4.4%	3.7%	3.6%	3.5%
Hitachi	12.6	8.1	14.8	9.6
Matsushita	18.0	16.6	14.3	12.5
Mitsubishi	0	10.2	11.3	10.7
National	13.3	11.5	8.1	6.1
NEC	23.4	18.9	17.4	17.5
Oki	3.7	2.7	1.7	1.5
Rockwell	0.8	0.4	0.2	0.1
SGS-Thomson	3.0	2.3	1.9	1.8
Sharp	5.9	3.4	2.4	4.3
Texas Instruments	2.2	5.9	3.4	1.6
Toshiba	12.7	12.6	9.6	13.2
Others	0	3.7	11.3	<u>17.7</u>
Total	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding. \*Based on units shipped



Table 4 Estimated Market Share by Region for 4–Bit Microcontrollers 1975–1979 (Thousands of Units)

Region	<u>1975</u>	<u>1976</u>	1977	<u>1978</u>	<u>1979</u>
United States					
Shipments	500	760	3,400	14,049	37,310
Percent	100.0%	100.0%	100.0%	88.0%	73.8%
Japan					
Shipments	0	0	0	1,910	13,215
Percent	0	0	0	12.0%	26.2%
Europe					
Shipments	0	0	0	0	0
Percent	0	0	0	0	0
Total Shipments	500	760	3,400	15,959	50,525
				Source:	Dataquest

July 1989



## Table 5

### Estimated Market Share by Region for 4-Bit Microcontrollers 1980-1984 (Thousands of Units)

Region	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
United States					
Shipments	62,660	54,039	44,553	34,945	37,215
Percent	65.2%	40.5%	28.2%	20.3%	19.2%
Japan					
Shipments	33,420	79,510	113,440	136,160	153,430
Percent	34.8%	59.5%	71.7%	79.2%	79.3%
Europe					
Shipments	0	0	190	840	2,790
Percent	0	0	0.1%	0.5%	1.4%
Total Shipments	96,080	133,549	158,183	171,945	193,435

Table 6

### Estimated Market Share by Region for 4-Bit Microcontrollers 1985-1988 (Thousands of Units)

Region	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
United States				
Shipments	28,804	48,458	46,160	38,575
Percent	16.3%	17.8%	11.8%	7.7%
Japan				
Shipments	142,992	217,095	338,657	453,650
Percent	80.8%	79.8%	86.3%	90.5%
Europe				
Shipments	5,242	6,330	7,515	8,850
Percent	3.0%	2.3%	<u>    1.9</u> %	<u>    1.8</u> %
Total Shipments	177,038	271,883	392,332	501,075
			Source:	Dataquest
				OUTA T202

Figure 2

### Estimated Market Share by Region for 4-Bit Microcontrollers 1980-1988



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# Microcontroller Historical Shipment Data 1975–1989





A Semiconductor Industry Service Report

## Published by Dataquest Incorporated

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## **Table of Contents**

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This booklet is divided into three major sections.

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Chapter 1	4-Bit Microcontrollers
Chapter 2	8-Bit Microcontrollers
Chapter 3	16-Bit Microcontrollers

## **4-Bit Microcontrollers**

The following section includes historical 4-bit microcontroller unit shipments by year, manufacturer, product name, and process technology.

The tables are organized as follows:

Т	able	1	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Manufacturer, 1975-1979
Т	able	2	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Manufacturer, 1980-1984
Т	able	3	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Manufacturer, 1985-1989
Т	able	4	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1975-1976
Т	able	5	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1977
Т	able	6	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1978
T	able	7	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1979
T	able	8	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1980
Т	able	9	Estimated	4-Bit	Microcontroller	Unit	Shipments	bу	Quarter for 1981
Т	able	10	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1982
T	able	11	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1983
T	able	12	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1984
T	able	13	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1985
T	able	14	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1986
T	able	15	Estimated	4-Bit	Microcontroller	Unit	Shipments	ьу	Quarter for 1987
Т	able	16	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1988
Т	able	17	Estimated	4-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1989

## Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1975-1979 (Thousands of Units)

	Product	Process	1975	1976	1977	1978	1979
Gould/AMI	S2000	N	0	0	0	29	1,425
Hitachi	HMCS-40	P/N/C	0	0	0	410	655
Matsushita	MN1400	P/N/C	0	0	0	0	4,400
Motorola	141000	С	0	0	0	20	285
National	COPS	N/C	0	0	0	2,325	5,600
NEC	aCOM-4	P/C	0	0	0	1,500	7,800
Rockwell	PP\$-4	P/N	450	450	575	2,275	3,900
Sharp	SM-3	P	0	0	0	0	360
п	TMS1000	P/C	50	310	2,825	9,400	26,100
Total 4-	Bit MCUs		500	760	3,400	15,959	50,525

Source: Dataquest (June 1990)

.

## Table 2

## Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984

(Thousands of Units)

	Product	Process	1980	1981	1982	1983	1984
Eurotechnique	COPS	N/C	0	0	190	- 840	0
Fujitsu	MB884X	N	0	9,200	9,900	7,500	6,100
	MB885X	С	185	2,050	3,150	3,110	2,720
Gould/AMI	S2000	N	1,120	390	566	115	0
Hitachi	HMCS-40	P/N/C	1,425	19,000	20,600	20,600	22,400
Matsushita	MN1400	P/N/C	10,300	11,250	14,580	18,420	20,400
	MN1500	N	20	1,250	1,620	6,360	8,600
Motorola	141000	С	240	149	112	130	80
National	COPS	N/C	11 <b>,500</b>	11,500	16,200	21,000	26,700
NEC	uCOM-4	P/C	14,800	19,800	25,700	21,000	16,930
	uPD75XXX	С	0	3,200	8,000	15,100	31,500
Oki	Series-40	С	90	550	2,450	5,480	6,400
Rockwell	PPS-4	P/N	5,800	2,500	1,675	1,800	2,135
SGS-Thomson	COPS	N	0	0	0	0	2,790
Sharp	SM-3	Р	600	920	990	840	800
	SM-4	С	1,200	1,600	1,950	1,750	1,840
	SM-5	С	4,800	10,690	9,400	10,350	12,190
т	TMS1000	P/C	44,000	39,500	26,000	11 <b>,900</b>	8,300
Toshiba	<b>T-Scries</b>	С	0	0	8,300	9,800	6,000
	TLCS-43	N	0	0	3,300	9,200	8,000
	TLCS-46	С	0	0	2,900	3,580	3,250
	TLCS-47	N	0	0	600	3,070	6,300
Total 4-B	it MCUs		96,080	133,549	158,183	171,945	193,435

Source: Dataquest (June 1990)

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## Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1985-1989 (Thousands of Units)

	Product	Process	1985	1986	1987	1988	1989
Fujitsu	MB882XX	С	0	0	760	1,400	1,470
	MB8840X	N	0	0	1,843	1,910	2,440
	MB884X	N	5,634	6,580	7,160	6,840	7,570
	MB8850X	С	0	0	485	7,680	15,700
	MB885X	С	2,156	3,425	3,742	6,180	10,280
	MB886XX	С	0	0	0	0	300
	MB887XX	С	0	0	0	0	700
Hitachi	HMCS-40	P/N/C	22,352	21,919	25,900	18,400	14,800
	HMCS-400	С	NA	NA	32,100	28,700	43,000
Matsushita	MIN1400	P/N/C	20,600	17,420	11,875	8,400	4,100
	MN1500	N	11,300	27,680	42,090	49,580	48,700
	MN1700	С	0	0	2,085	4,700	7,000
Mitsubishi	M5043X/44X	С	0	0	13,995	13,200	18,000
	M5046X/56X	С	0	0	13,105	19,800	32,500
	M5072/76	C	0	0	15,054	14,100	19,000
	M509X	С	0	0	2,056	6,430	13,000
	M50XXX	С	0	27,844	0	0	0
Motorola	141000	С	4	0	0	0	0
National	COP400	N/C	23,500	31,273	31,970	30,450	33,400
NEC	uCOM-4	P/C	9,920	5,700	3,680	6,450	6,300
	uPD75XX	N/C	0	3,900	16,810	17,850	19,500
	uPD75XXX	С	31,590	41,920	47,670	63,600	85,500
Oki	Series-40	С	6,614	7,217	6,689	7,580	9,800
Rockwell	PPS-4	Р	1,400	1,160	790	325	235
Sanyo	LC65/66XX	С	0	0	0	31,000	70,000
	LM64XX	N	0	0	0	400	550
SGS-Thomson	COPS	N	5,242	6,330	7,515	8,850	7,645
Sharp	SM-Series <sup>1</sup>	С	10,370	9,140	9,510	21,750	36,100
	Custom	С	0	0	0	9,000	44,000
Sony	SPC500	с	0	0	0	8,500	23,000
Π	TMS1000	P/C	3,900	16,025	13,400	9,300	10,400
Toshiba	T-Series	С	5,580	4,600	6,265	14,050	15,200
	TLCS-42	N/C	1,250	3,850	4,060	4,650	6,600
	TLCS-43	N	5,672	2,600	2,209	4,650	890
	TLCS-46	С	2,198	400	202	480	230
	TLCS-47	N	7,756	7,200	5,935	9,890	2,050
	TLCS-47	с	0	15,300	17,497	32,250	41,500
	TLCS-470	С	0	400	1,360	100	21,400
Total 4-B	it MCUs		177.038	261.883	347.812	468.445	672.860

Note: Totals for 1986, 1987, and 1988 have been adjusted to remove Dataquest's previous estimate for unsurveyed companies. Totals now reflect actual survey results. Additionally, because of the receipt of new information, 1988 numbers have been restated for many Japanese companies. Sharp SM-Series totaled in 1985. NA = Not available Source: Dataquest (June 1990)

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## Table 4

## Estimated 4-Bit Microcontroller Unit Shipments by Quarter 1975-1976 · (Thousands of Units)

	Product	Process	1 <b>97</b> 5	Q1/76	Q2/76	Q3/76	Q4/76	1976
Rockwelt	PPS-4	P	450	100	110	120	120	450
Π	TMS1000	P/C	50	60	75	75	100	310
Total	4-Bit MCUs		500	160	185	195	220	760

Source: Dataquest (June 1990)

## Table 5

## Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1977 (Thousands of Units)

	Product	Process	Q1/77	Q2/77	Q3/77	Q4/77	1977
Rockwell	PPS-4	Р	145	145	140	145	575
π	TMS1000	P/C	225	400	1,000	1,200	2,825
Total 4-	Bit MCUs		370	545	1,140	1,345	3,400

Source: Dataquest (June 1990)

.

## Table 6

## Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1978 (Thousands of Units)

	Product	Process	Q1/78	Q2/78	Q3/78	Q4/78	1978
Gould	S2000	N	0	9	8	12	29
Hitachi	HMCS-40	P/N/C	85	95	110	120	410
Motorola	141000	С	0	0	5	15	20
National	COPS	C/N	300	500	675	850	2,325
NEC	UCOM-4	P/C	150	225	525	600	1,500
Rockwell	PPS-4	P	400	550	675	650	2,275
Π	TMS1000	P/C	1,400	1,800	3,000	3,200	9,400
Total	4-Bit MCUs		2,335	3,179	4,998	5,447	15,959

Source: Dataquest (June 1990)

## Q3/79 Q4/79 Product Q1/79 Q2/79 1979 Process Gould S2000 1,425 Ν 50 300 675 400 Hitachi HMCS-40 P/N/C 130 150 175 200 655 1,400 4,400 Matsushita **MN1400** P/N/C 500 800 1,700 Motorola 141000 С 30 75 90 90 285 National COPS C/N 900 1,100 1,500 2,100 5,600 NEC P/C 1,300 2,300 7,800 UCOM-4 1,100 3,100 Rockwell PPS-4 P 600 1,100 1,100 1,100 3,900 1 Sharp SM-3 P 1 1 1 360 26,100 Π TMS1000 P/C 4,200 5,400 7,500 9,000 Total 4-Bit MCUs 7,510 10,225 14,740 17,690 50,525

Table 7

## Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1979 (Thousands of Units)

<sup>1</sup>No quarterly data available for Sharp SM-3.

Source: Dataquest (June 1990)

## Table 8

## Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1980 (Thousands of Units)

-	Product	Process	Q1/80	Q2/80	Q3/80	Q4/80	1980
Fujitsu	8850	С	10	25	50	100	185
Gould	S2000	N	180	340	490	110	1,120
Hitachi	HMCS-40	P/N/C	225	300	400	500	1,425
Matsushita	<b>MN1400</b>	P/N/C	2,200	3,000	3,000	2,100	10,300
	MN1500	N	0	0	S	20	20
Motorola	141000	С	70	50	60	60	240
National	COPS	C/N	2,700	3,200	2,800	2,800 ·	11,500
NEC	UCOM-4	P/C	3,300	4,200	4,000	3,300	14,800
Okci	Series-40	с	10	15	25	40	90
Rockwell	PPS-4	P	1,400	i, <b>700</b>	1,700	1,000	5,800
Sharp	SM-3	Р	120	140	160	180	600
	SM-4	с	250	280	320	350	1,200
	SM-5	С	490	800	1,550	1,960	4,800
ТІ	TMS1000	P/C	11,000	12,500	10,000	10,500	44,000
Total 4	Bit MCUs		21.955	26.550	24.555	23.020	96.080

S = Sampled

Source: Dataquest (June 1990)

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## Table 9

## Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

	Product	Process	Q1/81	Q2/81	Q3/81	Q4/81	1981
Eurotech.	COP	C/N	0	0	0	S	S
Fujitsu	884X	N	1,600	2,300	2,500	2,800	9,200
	8850	С	200	500	600	750	2,050
Gould	S2000	N	100	100	100	90	390
Hitachi	HMCS-40	P/N/C	3,000	4,400	6,000	5,600	19,000
Matsushita	MN1400	P/N/C	2,340	2,610	3,240	3,060	11,250
	MN1500	N	260	290	360	340	1,250
Motorola	141000	С	40	80	10	19	149
National	COPS	C/N	2,500	2,600	3,000	3,400	11,500
NEC	UCOM-4	P/C	4,000	5,100	4,900	5,800	19,800
	uPD-75XXX	С	0	0	1,500	1,700	3,200
Oki	Series-40	с	75	120	155	200	550
Rockwell	PPS-4	P	900	700	500	400	2,500
Sharp	SM-3	P	200	230	250	240	920
	SM-4	с	380	400	420	400	1,600
	SM-5	С	2,490	2,800	2,800	2,600	10,690
П	TMS1000	P/C	10,000	10,000	10,500	9,000	39,500
Total	4-Bit MCUs		28,085	32,230	36,835	36,399	133,549

S = Sampled Source: Dataquest (June 1990)

## Product Q1/82 Q2/82 Q3/82 Q4/82 1982 Process Eurotech. COP C/N S S 80 110 190 Fujitsu 884X N 2,800 2,300 9,900 2,500 2,300 8850 С 800 800 800 750 3,150 Gould \$2000 N 100 200 185 81 566 Hitachi 4,600 4,400 20,600 HMCS-40 P/N/C 6,000 5,600 Matsushita **MN1400** P/N/C 3,420 3,730 3,830 3,600 14,580 **MIN1500** N 380 410 420 410 1,620 ¢ Motorola 141000 20 28 25 39 112 16,200 National COPS C/N 3,500 4,700 5,000 3,000 25,700 NEC UCOM-4 P/C 6,000 7,200 7,000 5.000 8,000 uPD75XXX С 1,800 1,800 2,200 2,200 Oki С 250 Series-40 420 830 950 2,450 PPS-4 Rockwell P 500 1,675 425 350 400 Sharp SM-3 P 250 260 240 240 990 SM-4 С 500 550 450 450 1,950 ÷ SM-5 С 2,500 2,500 2,200 2,200 9,400 П 8,000 TMS1000 P/C 7,000 6,000 5,000 26,000 Toshiba **T-Series** С 1,200 2,000 2,500 2,600 8,300 TLCS-43 N 500 600 700 1.500 3,300 2,900 TLCS-46 С 500 600 1,100 700 TLCS-47 100 250 200 C/N 50 600 40,860 Total 4-Bit MCUs 38,995 40,148 38,180 158,183

## Table 10

Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1982 (Thousands of Units)

S = Sampled

Source: Dataquest (June 1990)

## Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

	Product	Process	Q1/83	Q2/83	Q3/83	Q4/83	1983
Eurotech.	COP	C/N	130	160	250	300	840
Fujitsu	884X	N	2,100	1,900	1,750	1,750	<b>7,500</b>
	8850	С	775	775	780	780	3,110
Gould	S2000	N	40	40	30	5	115
Hitachi	HMCS-40	P/N/C	4,800	4,800	5,400	5,600	20,600
Matsushita	MN1400	P/N/C	4,100	4,480	4,940	4,900	18,420
	MN1500	N	710	1,500	2,100	2,050	6,360
Motorola	141000	с	35	36	36	23	130
National	COPS	C/N	4,500	5,500	5,500	5,500	21,000
NEC	UCOM-4	P/C	5,000	5,000	5,500	5,500	21,000
	uPD75XXX	С	2,500	2,900	4,500	5,200	15,100
Oki	Series-40	с	1,100	1,380	1,500	1,500	5,480
Rockwell	PPS-4	P	350	550	600	300	1,800
Sharp	SM-3	P	220	220	200	200	840
	SM-4	С	425	450	425	450	1,750
	SM-5	С	2,400	2,500	2,650	2,800	10,350
П	TMS1000	P/C	4,000	3,000	2,500	2,400	11,900
Toshiba	T-Series	Ċ	3,100	2,400	2,500	1,800	9,800
	TLCS-43	N	2,200	2,200	2,400	2,400	9,200
	TLCS-46	С	800	800	1,000	980	3,580
	TLCS-47	C/N	350	600	800	1,320	3,070
Total 4	-Bit MCUs		39,635	41,191	45,361	45,758	171,945

Source: Dataquest (June 1990)

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## Product Process Q1/84 Q2/84 Q3/84 Q4/84 1984 Fujitsu 884X Ν 1.600 1,500 1,500 1,500 6,100 8850 $\mathbf{C}$ 770 750 650 550 2,720 Hitachi HMCS-40 P/N/C 5,600 5,600 5,600 5,600 22,400 Matsushita **MN1400** P/N/C 5,200 5,200 5,000 5,000 20,400 **MN1500** Ν 2,100 2,300 2,100 2,100 8,600 С Motorola 141000 40 24 11 80 5 National COPS C/N 8.000 6,500 26,700 6,100 6,100 NEC UCOM-4 P/C 4,910 4,340 3,840 16,930 3,840 uPD75XXX С 5,510 7,570 9,210 9,210 31,500 Oki С 6,400 Series-40 1.600 1.600 1.600 1.600 Rockwell PPS-4 P 370 600 750 2,135 415 Р 800 Sharp SM-3 200 200 200 200 SM-4 С 460 460 1,840 460 460 C SM-5 3,000 3.000 3.190 3.000 12.190 ΤT TMS1000 P/C 2,200 2,100 2,000 2,000 8,300 Thomson COPS Ç/N 300 560 730 1,200 2,790 Toshiba С 1,400 **T-Series** 1,500 1,500 6,000 1,600 TLCS-43 Ν 2,400 2,400 1,600 1,600 8,000 TLCS-46 С 1,000 1.000 600 650 3,250 TLCS-47 C/N 1,400 1,700 1,800 6,300 1,400 Total 4-Bit MCUs 46,205 48,164 50,001 49,065 193,435

Table 12

Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

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Source: Dataquest (June 1990)

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## 1985 Product Process Q1/85 Q2/85 Q3/85 Q4/85 Pojitsu 884X N 1,450 1,392 1,392 1,400 5,634 8850 С 550 528 528 550 2,156 Hitachi HMCS-40 P/N/C 5,600 5,376 5,376 6,000 22,352 P/N/C Matsushita **MN1400** 5,000 4,800 4,800 6,000 20,600 2,800 4,300 **MIN1500** N 2,100 2,100 11,300 С Motorola 141000 0 0 0 4 4 5,200 23,500 National COPS C/N 6,500 6,000 5,800 NEC UCOM-4 P/C 2,730 2,330 1,610 9,920 3,250 uPD75XXX С 7,180 8,170 8,550 7,690 31,590 **Oki** С 1,650 Series-40 1,700 1,632 1,632 6,614 PPS-4 P Rockwell 400 300 340 1,400 360 Sharp **SM-Series** С 2,490 2,490 2,695 2.695 10,370 TI TMS1000 P/C 1,000 950 950 1,000 3,900 Thomson COPS C/N 1,350 1,296 1,296 1,300 5,242 Toshiba **T-Series** С 1,500 1,440 1,440 1,200 5,580 TLCS-42 N/C 0 0 350 900 1,250 TLCS-43 N 1.600 1,536 1,536 1,000 5,672 TLCS-46 С 300 624 624 2,198 650 TLCS-47 C/N 1,800 1,728 2,500 7,756 1,728 44,124 43,092 44,187 45,635 177,038

Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

Total 4-Bit MCUs Source: Dataquest (June 1990)

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	Product	Process	Q1/86	Q2/86	Q3/86	Q4/86	1986
Fujitsu	884X	N	1,535	1,620	1,680	1,745	6,580
	885X	С	720	860	900	945	3,425
Hitachi	HMCS-40	P/N/C	6,010	5,500	5,174	5,235	21,919
Matsushita	MN1400	P/N/C	4,500	4,000	4,600	4,320	17,420
	MN1500	N	5,700	7,100	7,480	7,400	27,680
Mitsubishi	50XXX	С	5,994	7,450	6,500	7,900	27,844
National	COPS	C/N	5,950	6,928	8,435	9,960	31,273
NEC	UCOM-4	P/C	1,500	1,250	1,570	1,380	5,700
	uPD75XX	с	0	0	1,750	2,150	3,900
	uPD75XXX	С	8,470	10,420	11,920	11,110	41,920
Okci	Series-40	С	1,860	1,900	1,820	1,637	7,217
Rockwell	PPS-4	Р	400	300	210	250	1,160
Sharp	SM-Series	С	2,700	2,030	2,150	2,260	9,140
TI	TMS1000	P/C	4,000	4,170	3,845	4,010	16,025
Thomson	COPS	C/N	1,405	1,450	1,675	1,800	6,330
Toshiba	T-Series	С	900	1,100	1,200	1,400	4,600
	TLCS-42	N/C	850	1,000	1, <b>00</b> 0	1,000	3,850
	TLCS-43	N	700	850	650	400	2,600
	TLCS-46	С	200	100	50	50	400
	TLCS-47	C/N	4,400	5,200	6,700	6,200	22,500
	TLCS-470	С	0	0	100	300	400
Total 4	-Bit MCUs		57,794	63,228	69,409	71,452	261,883

## Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

Source: Dataquest (June 1990)

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## Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

	Product	Process	Q1/87	Q2/87	Q3/87	Q4/87	1987
Fujitsu	882XX	С	120	150	225	265	760
	884X	N	1,705	1,765	1,800	1,890	7,160
	884XX	N	410	450	478	505	1,843
	885X	с	882	905	940	1,015	3,742
	885XX	С	100	110	125	150	485
Hitachi	HMCS-40	P/N/C	6,300	6,405	6,520	6,675	25,900
	HMCS-400	С	7,600	8,000	8,000	8,500	32,100
Matsushita	MN1400	P/N/C	4,500	3,500	1,885	1,990	11,875
	MN1500	N	7,250	11,000	11, <b>60</b> 0	12,240	42,090
	MN1700	С	0	0	1,015	1,070	2,085
Mitsubishi	M5043X/44X	с	3,393	3,294	3,767	3,541	13,995
	M5046X/56X	С	2,141	3,213	3,996	3,755	13,105
	M5072/76	С	2,701	2,908	4,337	5,108	15,054
	M509X	С	156	152	727	1,021	2,056
National	COPS	N/C	8,770	8,500	8,200	6,500	31,970
NEC	uCOM-4	P/C	970	110	1,300	1,300	3,680
	uPD75XX	N/C	3,500	4,610	5,000	3,700	16,810
	uPD75XXX	С	11,000	10,970	13,500	12,200	47,670
Oki	Series-40	С	1,650	1,584	1,740	1,715	6,689
Rockwell	PPS-4	P/N	185	155	150	300	790
Sharp	SM-Series	С	2,170	1,820	2,170	3,350	9,510
п	TMS1000	P/C	4,400	4,500	2,900	1,600	13,400
SGS-Thomson	COPS	N	1,810	1,880	1,925	1,900	7,515
Toshiba	T-Series	C	1,600	1,460	1,580	1,625	6,265
	TLCS-42	N/C	1,000	1,100	980	980	4,060
	TLCS-43	N	550	560	574	525	2,209
	TLCS-46	С	50	62	48	42	202
	TLCS-47	N	1,600	1,500	1,475	1,360	5,935
	TLCS-47	С	4,300	4,220	4,405	4,572	17,497
	TLCS-470	С	300	340	350	370	1,360
Total 4-E	it MCUs		81,1 <u>13</u>	85,223	91,712	89,764	347,812

Source: Dataquest (June 1990)

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	Product	Process	Q1/88	Q2/88	Q3/88	Q4/88	1988
Fujitsa	MB882XX	C	320	350	380	350	1,400
	MB8840X	N	400	450	500	560	1,910
	MB884X	N	1,640	1,650	1,750	1,800	6,840
	MB8850X	С	700	900	2,880	3,200	7,680
	MB885X	С	900	900	2,000	2,380	6,180
Hitachi	HMCS-40	P/N/C	5,000	5,000	4,100	4,300	18,400
	HMCS-400	С	6,000	6,000	8,200	8,500	28,700
Matsushita	MN1400	P/N/C	2,100	2,200	2,000	2,100	8,400
	MIN1500	N	12,180	13,370	11,730	12,300	49,580
	MN1700	с	1,100	1,300	1,100	1,200	4,700
Mitsubishi	M5043X/44X	с	3,000	3,500	3,300	3,400	13,200
	M5046X/56X	с	4,900	5,300	5,600	4,000	19,800
	M5072/76	С	2,900	3,300	4,100	3,800	14,100
	M509X	С	530	1,600	2,100	2,200	6,430
National	COP400	N/C	7,550	7,500	7,300	8,100	30,450
NEC	uCOM-4	P/C	2,700	1,350	1,300	1,100	6,450
	uPD75XX	N/C	4,050	4,350	4,750	4,700	17,850
	uPD75XXX	С	13,050	14,750	18,200	17,600	63,600
Oki	Series-40	с	1,600	1,680	2,000	2,300	7,580
Rockwell	PPS-4	Р	150	70	55	50	325
Sanyo	LC65/66XX	С	0	0	15,000	16,000	31,000
	LM64XX	N	0	0	200	200	400
SGS-Thomson	COPS	N	1,743	2,427	2,457	2,223	8,850
Sharp	CUSTOM	С	0	0	4,000	5,000	9,000
	SM-Series	С	3,750	4,300	5,100	8,600	21,750
Sony	SPC500	С	0	0	4,000	4,500	8,500
π	TMS1000	P/C	1,700	2,300	2,100	3,200	9,300
Toshiba	<b>T-Series</b>	с	3,400	3,500	3,550	3,600	14,050
	TLCS-42	N/C	1,000	1,150	1,200	1,300	4,650
	TLCS-43	N	1,000	1,150	1,200	1,300	4,650
	TLCS-46	С	150	130	100	100	480
	TLCS-47	N	2,140	2,210	2,580	2,960	9,890
	TLCS-47	с	7,200	8,190	8,410	8,450	32,250
	TLCS-470	С	0	0	0	100	100
Total 4-F	Bit MCUs		92.853	100.877	133.242	141.473	468.445

## Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

Source: Dataquest (June 1990)

## Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1989 (Thousands of Units)

	Product	Process	Q1/89	Q2/89	Q3/89	Q4/89	1989
Fujitsu	M8886XX	С	0	0	100	200	300
	M8887XX	С	0	100	200	400	700
	MB882XX	С	360	365	370	375	1,470
	MB8840X	N	580	600	620	640	2,440
	MB884X	N	1,830	1,875	1,915	1,950	7,570
	MB8850X	С	3,520	3,680	4,000	4,500	15,700
	MB885X	С	2,400	2,480	2,600	2,800	10,280
Hitachi	HMCS-40	P/N/C	4,300	4,000	3,500	3,000	14,800
	HMCS-400	С	9,000	10,000	11,500	12,500	43,000
Matsushita	MIN1400	P/N/C	2,000	2,100	0	0	4,100
	MN1500	N	10,700	12,000	14,000	12,000	48,700
	MN1700	С	1,600	1,700	1,800	1,900	7,000
Mitsubishi	M5043X/44X	C	4,500	4,500	4,500	4,500	18,000
	M5046X/56X	С	6,500	8,000	9,000	9,000	32,500
	M5072/76	С	4,500	4,000	5,500	5,000	19,000
	M509X	С	3,000	3,000	3,500	3,500	13,000
National	COP400	N/C	7,600	8,400	7,400	10,000	33,400
NEC	uCOM-4	P/C	1,500	1,600	1,600	1,600	6,300
	uPD75XX	С	4,800	4,900	4,900	4,900	19,500
	uPD75XXX	N/C	19,500	21,000	23,000	22,000	85,500
Oki	Series-40	С	2,300	2,400	2,400	2,700	9,800
Rockwell	PPS-4	P	90	90	15	40	235
Sanyo	LC65/66XX	С	17,000	17,500	17,500	18,000	70,000
	LM64XX	N	200	150	100	100	550
SGS-Thomson	COPS	N	2,173	2,010	1,855	1,607	7,645
Sharp	CUSTOM	С	11,000	12,000	10,000	11,000	44,000
	SM-Series	С	8,900	9,500	8,900	8,800	36,100
Sony	SPC500	С	5,300	5,800	6,000	5,900	23,000
т	TMS1000	P/C	3,300	2,600	2,000	2,500	10,400
Toshiba	<b>T-Series</b>	С	4,800	4,000	3,600	2,800	15,200
	TLCS-42	N/C	1,600	1,300	1,800	1,900	6,600
	TLCS-43	N	170	100	120	500	890
	TLCS-46	С	150	30	30	20	230
	TLCS-47	N	650	300	600	500	2,050
	TLCS-47	с	9,000	10,500	11 <b>,000</b>	11,000	41,500
	TLCS-470	с	3,900	5,000	6,000	6,500	21,400
Total 4-B	it MCUs		158,723	167,580	171,925	174,632	672,860
Source: Dataquest f.	June 1990)						

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## **8-Bit Microcontrollers**

The following section includes historical 8-bit microcontroller unit shipments by year, manufacturer, product name, and process technology.

The tables are organized as follows:

Table	1	Estimated	8-Bit	Microcontroller	Unit	Shipments	bу	Manufacturer, 1975-1979
Table	2	Estimated	8-Bit	Microcontroller	Ųnit	Shipments	by	Manufacturer, 1980-1984
Table	3	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Manufacturer, 1985-1989
Table	4	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1975-1976
Table	5	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1977
Table	6	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1978
Table	7	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1979
Table	8	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1980
Table	9	Estimated	8-Bit	Microcontroller	Ųnit	Shipments	by	Quarter for 1981
Table	10	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1982
Table	11	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1983
Table	12	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1984
Table	13	Estimated	8-Bit	Microcontroller	Unit	Shipments	bу	Quarter for 1985
Table	14	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1986
Table	15	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1987
Table	16	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1988
Table	17	Estimated	8-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1989

## Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1975-1979 (Thousands of Units)

	Product	Process	1975	1976	1977	1978	1979
AMD	8048	N	0	0	0	0	23
Fairchild	387X	N	0	0	15	23	510
	F8	N	27	181	655	630	650
General Instrument	PIC1650	N	0	O	0	450	4,100
Intel	802X	N	0	O	0	0	160
	8048/35	N	0	0	105	480	1,950
	8049/39	N	0	0	0	10	210
	8748	N	0	0	0	30	300
Mostek	387X	N	0	0	20	350	1,470
	F8	N	5	70	90	160	470
Motorola	387X	N	0	0	0	70	500
	6801/03	N	0	0	0	0	13
	6805	N	0	0	0	0	3
National	8049/39	N	0	0	0	0	10
NEC	8048/35	N	0	0	0	15	735
	8049/39	N	0	0	0	0	250
Rockwell	6500/XX	N	0	0	0	0	8
SGS	387X	N	0	0	0	0	50
Signetics	8048/35	N	0	0	0	0	180
Total 8-Bit M	CUs		32	251	885	2,218	11,592

Source: Dataquest (June 1990)

## Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

	Product	Process	1980	1981	1982	1983	1984
AMD	8048	N	138	240	320	190	40
	8049	N	0	35	105	110	10
	8051	N	0	0	0	376	2,260
AMI	6801/03	N	0	0	0	220	1,080
	6805	N	0	0	60	120	540
Eurotechnique	8048/35	N	0	0	9	16	0
	8049/39	N	0	0	36	95	0
	8050/40	N	0	0	121	225	0
Fairchild	387X	N	1,795	3,100	1,750	1,370	1,075
	F8	N	620	745	845	680	74
Fujitsu	MBL8048/35	N	150	400	335	350	425
	MBL8049/39	N	300	925	1,080	1,325	1,510
General Instrument	PIC1652/54	N	0	0	0	1,017	1,650
	PIC1655/57	N	0	0	0	2,854	4,305
	PIC165X	N	5,600	4,125	4,200	0	0
	PIC1670/72	N	0	0	0	2,111	2,975
	PIC16C58	с	0	0	0	638	475
	PIC7000/1	N	0	0	0	0	10
	PIC7020/40	N	0	0	0	0	57
	PIC7041	N	0	0	0	0	13
Hitachi	6301	С	0	0	210	722	1,472
	6305	С	0	0	140	540	950
	6801/03	N	0	190	635	1,035	1,902
	6805	N	0	300	825	1,420	2,766
Intel	802X	N	810	1,525	2,050	1,395	1,050
	8048/35	N	3,750	4,800	5,200	5,250	3,825
	8049/39	N	715	1,230	1,870	2,085	2,960
	8050/40	N	0	0	0	300	490
	8051/31	N	0	25	- 460	3,530	12,900
	8052/32	N	0	0	0	37	213
	80C48/35	С	0	0	0	18	10
	80C49/39	С	0	0	0	140	230
	80C51/31	С	0	0	0	140	265
	8748	N	650	775	1,530	2,065	2,500
	8749	N	O	3	450	960	2,030
	8751	N	0	4	70	320	795
Intersil	80C48/35	с	0	0	0	0	44

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## Table 2 (Continued)

## Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

	Product	Process	1980	1981	1982	1983	1984
Matra-Harris	8048	N	0	0	6	48	130
	8051	N	0	0	0	0	635
	80C48	С	0	0	0	0	20
Matsusitita	MN1800	С	0	0	17	28	40
Mostek	387X	N	2,105	2,485	2,030	1,660	1,425
	38P7X	N	0	0	0	0	148
	F8	N	205	110	33	190	195
Motorola	146805	С	0	95	635	1,886	4,389
	1468705	С	0	0	0	5	34
	387X	N	635	700	425	126	60
	6801/03	N	195	1,655	3,320	7,111	7,920
	6804	N	0	0	0	0	36
	6805	N	460	2,335	4,775	6,934	8,332
	68701	N	0	33	78	364	199
	68705	N	0	64	262	584	1,904
	68HC11	С	0	0	0	0	3
National	8048/35	N	45	460	995	1,450	2,775
	8049/39	N	175	710	1,125	1,290	2,190
	8050/40	N	50	405	880	1,270	1,940
	807X	N	31	70	53	60	35
	80C48/35	С	0	0	60	245	40
NCR	6500/1/11	N	0	0	0	215	600
NEC	8021/22	N	10	140	200	245	470
	8041	N	0	0	0	· 0	2,220
	8048/35	N	1,990	1,900	2,440	3,360	7,750
	8049/39	N	920	2,125	4,200	5,950	7,210
	80C48/35	С	0	0	230	940	2,020
	80C49/39	С	0	0	151	650	1,770
:4	8741	N	0	0	0	0	380
	8748	N	0	195	510	1,090	2,050
	8749	N	0	0	29	255	1,010
	uPD78XX	N	0	490	2,050	4,960	11,780
<b>G</b>	80C48/35	с	0	0	25	203	450
	80C49/39	С	0	0	135	827	1,960
Philips	8021/22	N	0	120	280	360	650
	8048/35	N	19	250	810	940	3,110
	8049/39	N	0	0	95	320	2,930
•	8050/40	N	0	0	0	0	10
	8051/31	N	0	0	0	40	1,160

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## Table 2 (Continued)

## Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

	Product	Process	1980	1981	1982	1983	1984
Philips	8051/31	N	0	0	0	40	1,160
(Continued)	80C49/39	C	0	0	0	0	3
	84XX	N	0	0	80	1,940	2,500
RCA	1804A	С	0	0	0	4	23
	6805/68HC05	С	0	0	0	0	7
Rockwell	6500/XX	N	108	345	315	930	1,350
SGS	Z8	N	0	0	0	0	123
	387X	N	95	260	700	1,159	1,489
Sharp	Z8	N	0	0	165	980	1,950
Siemens	8021	N	0	40	95	60	28
	802XX	N	20	720	1,780	1,480	1,098
	8048/35	N	0	85	300	270	405
	8051/31	N	0	0	15	1,030	2,382
Signetics	8048/35	N	135	0	141	1,055	4,609
	8049/39	N	0	0	25	545	946
	8050/40	N	0	0	8	400	355
	8051/31	N	0	0	0	126	1,792
Synertek	Z8	N	0	2	90	135	24
т	TMS7000	N	0	22	255	715	990
Thomson (EFCIS) <sup>1</sup>	6801/03	N	0	0	0	55	150
	6805	N	0	0	0	100	600
Toshiba	8048/35	N	0	130	615	1,440	3,680
	8049/39	N	0	219	555	1,230	3,900
	80C49/39	С	0	0	142	850	2,170
Zilog	Z8	N	14	344	683	851	2,055
Total 8-Bit N	ICUs		21,740	34,931	54,114	90,615	163,510

<sup>b</sup>Thomson acquired EFCIS in 1984. Source: Dataquest (June 1990)

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## Estimated 8-Bit Microcontroller Unit Shipments By Manufacturer 1985-1989 (Thousands of Units)

	Product	Process	1985	1986	1 <b>987</b>	1988	1989
AMD	8051/31	N	1,610	1,700	2,240	2,110	1,755
	80515/535	N	0	0	0	0	34
	8053	N	0	0	287	510	1,220
	80C51/31	С	0	0	134	1,055	1,550
	80C521/321	С	0	0	0	0	435
	80C5292/3292	С	0	0	0	0	1,040
	8751	N	71	112	133	217	295
	8753	N	0	0	77	145	155
	89C51	С	0	0	0	0	105
Fujitsu	8048/35	N	185	328	528	80	120
	8049/39	N	707	862	1,132	162	280
	8051/31	N	0	403	1,098	153	240
	80C49/39	С	0	105	2,300	350	585
	MB897XX	С	0	0	0	1,631	2,200
Gould/AMI <sup>1</sup>	6801/03	N	576	21	31	7	0
	6805	N	402	127	39	4	0
Harris (GE-SS/RCA) <sup>2</sup>	6805	N	0	0	0	355	266
	68HC05	с	120	359	805	1,430	2,705
Hitachi	6301	С	2,008	5,200	8,100	11,550	14,000
	6305	С	1,386	4,242	7,250	11,150	10,600
	63701	С	0	0	1,599	1,780	1,950
	63705	С	0	0	1,299	1,220	770
	63P01	С	0	0	645	1,040	1,130
	63P05	С	0	0	865	1,425	1,550
	6801/03	N	1,515	3,557	5,200	5,610	4,300
	6805	N	2,902	5,275	7,160	8,350	5,700
	68P01	N	0	0	545	944	1,010
	68P05	N	0	0	620	1,010	975
-	H8/532	С	0	0	0	0	200
Intel	802X	N	222	93	54	10	0
	8048/35	N	1,365	595	1,067	1,500	1,140
	8049/39	N	1,530	2,401	7,475	13,100	8,720
	8050/40	N	240	225	542	1,200	1,520
	8051/31	N	6,800	6,998	12,700	13,800	12,220
	8052/32	N	269	1,600	1,885	5,800	10,560
	80C49/39	С	112	20	0	0	0
	80C51/31	С	785	2,000	3,165	6,200	10,800
	8748	N	1,310	800	<b>69</b> 3	800	690
	8749	N	<u>1,445</u>	2,247	3,625	3,500	3,085

(Continued)

## Table 3 (Continued)

## Estimated 8-Bit Microcontroller Unit Shipments By Manufacturer 1985-1989

(Thousands of Units)

	Product	Process	1985	1986	1987	1988	1989
Intel (Continued)	8751	N	843	692	941	1,000	905
	8752	С	0	0	30	350	680
	87C51	C	0	0	100	500	820
Intersil	80C48/35	С	30	20	0	0	0
	80C49/39	С	9	10	0	0	0
Matra-Harris	8051/31	С	0	0	0	116	290
	8052/32	С	0	0	0	0	45
	80C51/31	N	20	418	1,033	712	310
	80C52/32	С	10	387	1,324	2,190	2,610
	80C752	N	1,400	1,340	429	98	0
	83C154	С	0	0	83	660	2,945
Matsushita	MN1800/70/80	С	131	400	1,070	4,620	11,900
Microchip	PIC1652/54	N	1,515	1,700	4,063	5,242	4,065
Technology <sup>3</sup>	PIC1655/57	N	3,295	1,400	1,073	903	0
	PIC1670/72	N	2,135	1,190	460	286	269
	PIC16C52/C54	С	0	0	0	0	1,329
	PIC16C58	С	256	77	0	0	0
	PIC16E57	N	66	229	32	0	0
	PIC7000/1	N	26	234	696	130	0
	PIC7020/40	N	140	484	1,985	615	0
	PIC7041	N	12	22	33	0	0
	PIC70XX	N	0	0	0	990	275
Mitsubishi	8048/35	N	0	0	515	200	130
	8049/39	N	0	0	1,691	1,300	650
	8050/40	N	0	0	208	154	160
	80C49/39	С	0	0	2,614	690	950
	M507XX	С	0	0	23,706	22,900	20,500
	M509XX	C	0	0	13,082	25,100	24,000
	M50XXX	C	15,125	29,906	0	0	0
Mostek <sup>4,3</sup>	387X	N	867	969	795	0	0
	38P7X	N	297	145	90	0	0
	F8	N	1 <b>95</b>	299	136	0	0
Motorola	146805	С	4,071	4,705	5,422	6,598	4,802
	1468705	С	48	93	0	0	0
	387X	N	174	199	0	0	0
	6801/03	N	8,007	8,526	8,918	8,253	7,189
	6804	N	501	1,495	4,357	3,900	4,980
	6805	N	10,777	13,559	19,716	27,042	28,141
	68701	N	278	431	0	. 0	0

(Continued)

Microcoatroller Historical Shipment Data, 1975-1989

Table 3 (Continued)

Estimated 8-Bit Microcontroller Unit Shipments By Manufacturer 1985-1989

	Units)
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		Product	Process	1985	1986	1987	1988	1989
Motorola	(Continued)	68704	z	13	82	0	¢	•
		68705	Z	2,641	3,861	0	0	0
		68HC05	υ	0	0	4,678	12,676	44,569
		68HC11	U	67	969 9	3,975	9,389	17,220
National		8048/35	z	2,200	390	425	315	245
		8049/39	Z	1,910	1,650	2,095	1,950	4,050
		8050/40	z	1,500	1,280	1,838	2,210	1,435
		807X	Z	ŝ	0	0	0	0
		COP800	U	0	0	10	1,555	4,930
National		F8	z	287	304	138	45	0
		387X	Ż	357	10	0	0	0
NCR		6500/1	z	640	1,027	397	747	330
		6500/11	Ż	0	0	0	371	14
NEC		8021/22	Ż	350	100	<b>4</b>	70	25
		8041	z	2,860	2,550	1,750	1,290	1,000
		8048/35	z	2,860	3,940	4,360	2,570	2,120
		8049/39	z	5,160	5,350	4,830	3,360	3,360
		80C48/35	υ	1,800	1,360	970	740	1,100
		80C49/39	υ	2,060	2,110	2,680	3,430	3,440
		8741	z	850	480	330	370	702
		8748	Ż	1,660	1,370	590	650	620
		8749	Z	2,060	1,930	3,300	1,820	1,635
		WD78XX	Z	11,450	18,390	24,140	32,210	36,100
		WD78XXX	Ż	Ð	0	0	500	2,700
		V25	υ	0	0	0	ŝ	150
<u>Oki</u>		80C154	υ	0	87	894	1,630	4,450
		80C48/35	U	537	520	428	385	<del>4</del> 00
		80C49/39	υ	1,950	2,720	3,133	3,462	2,600
		80C51/31	υ	0	1,772	2,721	3,100	2,960
Philips		8021/22	z	470	138	172	15	0
		8048/35	z	1,430	289	285	215	230
		8049/39	Z	2,550	2,186	1,810	1,230	1,032
		8050/40	Z	100	393	1,780	215	110
		8051/31	Z	1,100	700	1,840	1,400	1,205
		80C49/39	υ	145	240	514	665	725
		80C51/31	U	o	81	620	1,220	1,715
		84CXX	υ	0	15	1,150	2,520	3,330
		84XX	z	6,200	14,325	10,810	9,580	10,445
RCA		1804A	υ	13	Ξ	80	¢	0

Chapter 2

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## Table 3 (Continued)

## Estimated 8-Bit Microcontroller Unit Shipments By Manufacturer 1985-1989 (Thousands of Units)

Rockwell   6500/XX   N   1,310   2,550   3,855   4,230   4,180     Saryo   LC86XXX   C   0   0   0   000   1,900     SG3*   367X   N   2,200   4,811   3,922   0   0     SGS*Thomson*   387X   N   0   0   0   3,236   3,761     387X   N   0   0   0   110   63   6601/03   3,761     387X   N   0   0   0   110   63   6601/03   N   0   0   1,829   1,428     6805   N   0   0   0   1,829   1,428     6805   N   0   0   0   1,70   1,200     SM-Series   C   0   0   1,70   1,200   2,44   8,55     Siemens   8021   N   1,38   0   0   0   0   0   0   1,303   1,445		Product	Process	1985	1986	1987	1988	1989
	Rockwell	6500/XX	N	1,310	2,550	3,855	4,230	4,180
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Sanyo	LC86XXX	С	0	0	0	800	1,900
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		LM88XX	N	0	0	0	200	400
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	SGS <sup>3</sup>	387X	N	2,200	4,811	3,922	0	0
SGS-Thomson <sup>3</sup> 387X N 0 0 0 3,236 3,761   38P7X N 0 0 0 110 63   6801/03 N 0 0 0 1,829 1,428   6805 N 0 0 2,797 5,298   F8 N 0 0 0 21 0   Z8 N 0 0 0 444 855   Sharp CUSTOM C 0 0 0 1,200   SM-Series C 0 0 0 0 0 0   8021 N 1,538 667 51 66 39 3,434 1,223   8051/31 N 2,497 2,194 4,555 5,123 4,945   8051/31 N 2,563 760 111 18 0   8051/31 N 2,563 760 111 18 0   8051/31 N 2,563 760 1111 18 0		Z8	N	244	601	665	0	0
38P7X   N   0   0   0   110   63     6801/03   N   0   0   1,829   1,428     6805   N   0   0   2,797   5,298     F8   N   0   0   2,797   5,298     Sharp   CUSTOM   C   0   0   444   855     Sharseics   C   0   0   0   444   855     Siemens   8021   N   426   686   590   425   535     Siemens   8021   N   1,538   667   51   66   39     8051/31   N   2,497   2,194   4,055   5,123   4,945     8051/31   N   2,697   2,194   4,057   3,573     8051/31   N   2,563   760   111   18   0     8051/31   N   2,563   760   111   18   0     8050/40   2,777   2,731 <td>SGS-Thomson<sup>5</sup></td> <td>387X</td> <td>N</td> <td>0</td> <td>0</td> <td>0</td> <td>3,236</td> <td>3,761</td>	SGS-Thomson <sup>5</sup>	387X	N	0	0	0	3,236	3,761
6801/03   N   0   0   0   1,829   1,428     6805   N   0   0   0,2797   5,298     F8   N   0   0   0,2797   5,298     Z8   N   0   0   0,100   1,200     Z8   N   0   0   0,110   1,200     Sharp   CUSTOM   C   0   0   11,200     Z8   N   426   686   590   425   535     Siemens   8021   N   1,38   0   0   0   0     8048/35   N   194   956   1,733   1,345   1,223     8051/31   N   2,497   2,194   4,055   5,123   4,945     8051/35   N   0   126   768   1,974   3,573     8052/32   N   2,563   760   111   18   0     8051/31   N   2,362   2,687   2,731		38P7X	N	0	0	0	110	63
6805   N   0   0   0   2,797   5,298     F8   N   0   0   0   21   0     Z8   N   0   0   0   244   855     Sharp   CUSTOM   C   0   0   0   1,200     Z8   N   426   686   590   425   535     Siemens   8021   N   138   0   0   0   0     8048/35   N   194   956   1,733   1,345   1,223     8051/31   N   2,497   2,194   4,055   5,123   4,945     8051/31   N   2,467   2,714   4,055   5,123   4,945     8051/31   N   2,563   760   111   18   0     8051/31   N   2,362   2,687   2,731   4,038   2,921     8050/40   N   2,735   468   0   0   3   4,033		6801/03	N	0	0	0	1,829	1,428
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		6805	N	0	0	0	2,797	5,298
Z8   N   0   0   0   444   855     Sharp   CUSTOM   C   0   0   0   170   1,200     SM-Series   C   0   0   530   425   1,500     Z8   N   426   686   590   425   535     Siemens   8021   N   138   0   0   0   0     8042/35   N   1,538   667   51   666   39     8048/35   N   2,497   2,194   4,055   5,123   4,945     8051/31   N   2,497   2,194   4,055   5,123   4,945     8051/35   N   0   126   768   1,974   3,573     Signetics   8048/35   N   2,563   760   111   18   0     8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541		F8	N	0	0	0	21	0
Sharp   CUSTOM   C   0   0   0   170   1,200     SM-Series   C   0   0   530   425   1,500     Z8   N   426   686   590   425   535     Siemens   8021   N   138   0   0   0   0     802XX   N   1,538   667   51   66   39     8048/35   N   194   956   1,733   1,345   1,223     8051/31   N   2,497   2,194   4,055   5,123   4,9455     8051/31   N   2,497   2,194   4,055   3,573     8052/32   N   0   111   18   0     8048/35   N   2,563   760   1111   18   0     8051/31   N   2,352   2,373   4,038   2,921   8051/31   4,033   4,033   4,033   1,053   4,250     8051/31   C   0<		Z8	N	0	0	0	444	855
SM-Series   C   0   0   530   425   1,500     Z8   N   426   686   590   425   535     Siemens   8021   N   138   0   0   0   0     802XX   N   1,538   667   51   66   39     8048/35   N   194   956   1,733   1,345   1,223     8051/31   N   2,497   2,194   4,055   5,123   4,945     8051/32   N   0   1713   1,431   2,642   3,520     Signetics   8048/35   N   2,563   760   111   18   0     8051/31   N   2,362   2,687   2,731   4,038   2,921     8051/31   N   2,362   2,687   2,731   4,038   2,921     8051/31   C   0   0   5   44     80C51/31   C   0   0   233   1,653   4,0	Sharp	CUSTOM	С	0	0	0	170	1,200
Z8   N   426   686   590   425   535     Siemens   8021   N   138   0   0   0   0     802XX   N   1,538   667   51   66   39     8048/35   N   194   956   1,733   1,345   1,223     8051/31   N   2,497   2,194   4,055   5,123   4,945     8051/32   N   0   126   768   1,974   3,573     8052/32   N   0   173   1,431   2,642   3,520     Signetics   8048/35   N   2,563   760   111   18   0     8050/40   N   2,777   273   723   698   0     8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     80451/31   C   0   0   0   0 <td></td> <td>SM-Series</td> <td>С</td> <td>0</td> <td>0</td> <td>530</td> <td>425</td> <td>1,500</td>		SM-Series	С	0	0	530	425	1,500
Siemens   8021   N   138   0   0   0     802XX   N   1,538   667   51   66   39     8048/35   N   194   956   1,733   1,345   1,223     8051/31   N   2,497   2,194   4,055   5,123   4,945     8051/35   N   0   126   768   1,974   3,573     8052/32   N   0   713   1,431   2,642   3,520     Signetics   8048/35   N   2,563   760   111   18   0     8051/31   N   2,352   2,687   2,731   4,038   2,921     8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     8052/31   C   0   0   0   5   44     8052/31   C   0   0   23   1,653		Z8	N	426	686	590	425	535
802XX   N   1,538   667   51   66   39     8048/35   N   194   956   1,733   1,345   1,223     8051/31   N   2,497   2,194   4,055   5,123   4,945     8051/35   N   0   126   768   1,974   3,573     8052/32   N   0   713   1,431   2,642   3,520     Signetics   8048/35   N   2,563   760   111   18   0     8051/31   N   2,362   2,667   2,731   4,038   2,921     8051/31   N   2,362   2,687   2,731   4,038   2,921     8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     80C451   C   0   0   0   5   44     80C51/31   C   0   0   16   77<	Siemens	8021	N	138	0	0	0	0
8048/35   N   194   956   1,733   1,345   1,223     8051/31   N   2,497   2,194   4,055   5,123   4,945     8051/35   N   0   126   768   1,974   3,573     8052/32   N   0   713   1,431   2,642   3,520     Signetics   8048/35   N   2,563   760   111   18   0     8059/40   N   2,352   2,687   2,731   4,038   2,921     8050/40   N   2,362   2,687   2,731   4,038   2,921     8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     80C451   C   0   0   255   44     80C51/31   C   0   0   263   1,653   4,250     82C451   C   0   0   10   0 <td< td=""><td></td><td>802XX</td><td>N</td><td>1,538</td><td>667</td><td>51</td><td>66</td><td>39</td></td<>		802XX	N	1,538	667	51	66	39
8051/31   N   2,497   2,194   4,055   5,123   4,945     80515/35   N   0   126   768   1,974   3,573     8052/32   N   0   713   1,431   2,642   3,520     Signetics   8048/35   N   2,563   760   111   18   0     8049/39   N   1,235   1,741   2,000   2,449   3,797     8050/40   N   2,77   273   723   698   0     8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     80C451   C   0   0   0   5   44     80C51/31   C   0   0   2,83   1,653   4,250     83C451   C   0   0   111   19   1,00   0     8400   N   0   0   0   16 <td></td> <td>8048/35</td> <td>N</td> <td>194</td> <td>956</td> <td>1,733</td> <td>1,345</td> <td>1,223</td>		8048/35	N	194	956	1,733	1,345	1,223
Signetics   80515/35   N   0   126   768   1,974   3,573     Signetics   8052/32   N   0   713   1,431   2,642   3,520     Signetics   8048/35   N   2,563   760   111   18   0     8050/40   N   2,752   1,741   2,000   2,449   3,797     8050/40   N   277   273   723   698   0     8051/31   N   2,362   2,667   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     80C451   C   0   0   0   55   44     80C51/31   C   0   0   233   1,653   4,250     820451   C   0   0   243   1,653   4,250     8400   N   0   30   43   10   0     87C451   C   0   0   10 </td <td></td> <td>8051/31</td> <td>N</td> <td>2,497</td> <td>2,194</td> <td>4,055</td> <td>5,123</td> <td>4,945</td>		8051/31	N	2,497	2,194	4,055	5,123	4,945
Signetics   8052/32   N   0   713   1,431   2,642   3,520     Signetics   8048/35   N   2,563   760   111   18   0     8049/39   N   1,235   1,741   2,000   2,449   3,797     8050/40   N   2,77   273   723   698   0     8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     8052/31   C   0   0   0   55   44     80C51/31   C   0   60   283   1,653   4,250     83C451   C   0   0   27   0   0     8400   N   0   30   43   10   0     87C451   C   0   0   15   98     87C51   C   0   0   0   77     Sony		80515/35	N	0	126	768	1,974	3,573
Signetics   8048/35   N   2,563   760   111   18   0     8049/39   N   1,235   1,741   2,000   2,449   3,797     8050/40   N   2,77   273   723   698   0     8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     8052/32   N   5   456   1,541   1,958   4,033     8052/31   C   0   0   0   55   44     8051/31   C   0   600   283   1,653   4,250     8362451   C   0   0   27   0   0     8400   N   0   30   43   10   0     8441   C   0   0   115   98     87C51   C   0   0   0   77     Sony   SPC700		8052/32	N	0	713	1,431	2,642	3,520
8049/39   N   1,235   1,741   2,000   2,449   3,797     8050/40   N   277   273   723   698   0     8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     80C451   C   0   0   0   55   444     80C51/31   C   0   600   283   1,653   4,250     83C451   C   0   0   27   0   0     8400   N   0   30   43   10   0     8441   C   0   0   128   18   0     87C51   C   0   0   0   316   316     87C51   C   0   0   0   77   35     Sony   SPC700   C   0   0   0   316     17   TMS700	Signetics	8048/35	N	2,563	760	111	18	0
8050/40   N   277   273   723   698   0     8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     80C451   C   0   0   0   55   44     80C51/31   C   0   60   283   1,653   4,250     83C451   C   0   0   27   0   0     8400   N   0   30   43   10   0     8400   N   0   30   43   10   0     8400   N   0   30   43   10   0     8441   C   0   0   115   98     87C51   C   0   0   0   316     87C751   C   0   0   800   5,400     11   TMS3700   C   0   0   0   176		8049/3 <del>9</del>	N	1,235	1,741	2,000	2,449	3,797
8051/31   N   2,362   2,687   2,731   4,038   2,921     8052/32   N   5   456   1,541   1,958   4,033     80C451   C   0   0   0   55   44     80C51/31   C   0   60   283   1,653   4,250     83C451   C   0   0   27   0   0     8400   N   0   30   43   10   0     8400   N   0   30   43   10   0     8441   C   0   0   128   18   0     87C451   C   0   0   10   15   98     87C51   C   0   0   0   77   70     Sony   SPC700   C   0   0   8800   5,400     TI   TMS7000   N   1,396   2,555   6,600   8,800   9,800     Thomson <sup>5</sup> 6		8050/40	N	277	273	723	698	0
8052/32 N 5 456 1,541 1,958 4,033   80C451 C 0 0 0 55 44   80C51/31 C 0 60 283 1,653 4,250   83C451 C 0 0 27 0 0   8400 N 0 30 43 10 0   8441 C 0 0 128 18 0   87C451 C 0 0 10 15 98   87C51 C 0 0 0 316   87C51 C 0 0 0 316   87C51 C 0 0 0 77   Sony SPC700 C 0 0 8300 5,400   TI TMS370 C 0 0 0 176   Thomson <sup>5</sup> 6801/03 N 337 906 1,131 0 0   6805 N 1,129 1,190 2,182 0 0 <td></td> <td>8051/31</td> <td>N</td> <td>2,362</td> <td>2,687</td> <td>2,731</td> <td>4,038</td> <td>2,921</td>		8051/31	N	2,362	2,687	2,731	4,038	2,921
80C451 C 0 0 55 44   80C51/31 C 0 60 283 1,653 4,250   83C451 C 0 0 27 0 0   8400 N 0 30 43 10 0   8400 N 0 30 43 10 0   8401 C 0 0 128 18 0   8441 C 0 0 10 15 98   87C451 C 0 0 0 316   87C51 C 0 0 0 316   87C751 C 0 0 0 77   Sony SPC700 C 0 0 800 5,400   TI TMS370 C 0 0 0 176   Thomson <sup>5</sup> 6801/03 N 337 906 1,131 0 0   6805 N 1,129 1,190 2,182 0 0 0		8052/32	N	5	456	1,541	1,958	4,033
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		80C451	С	0	0	0	55	44
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		80C51/31	С	0	60	283	1,653	4,250
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		83C451	С	0	0	27	0	0
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		8400	N	0	30	43	10	0
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		8441	С	0	0	128	18	0
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		87C451	С	0	0	10	15	98
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		87C51	С	0	0	0	0	316
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		87C751	С	0	0	0	0	77
TI   TMS370   C   0   0   0   0   176     TMS7000   N   1,396   2,555   6,600   8,800   9,800     Thomson <sup>5</sup> 6801/03   N   337   906   1,131   0   0     6805   N   1,129   1,190   2,182   0   0	Sony	SPC700	С	0	0	0	800	5,400
TMS7000   N   1,396   2,555   6,600   8,800   9,800     Thomson <sup>5</sup> 6801/03   N   337   906   1,131   0   0     6805   N   1,129   1,190   2,182   0   0	TI	TMS370	С	0	0	0	0	176
Thomson <sup>5</sup> 6801/03   N   337   906   1,131   0   0     6805   N   1,129   1,190   2,182   0   0		TMS7000	N	1,396	2,555	6,600	8,800	9,800
6805 N 1,129 1,190 2,182 0 0	Thomson <sup>5</sup>	6801/03	N	337	906	1,131	0	0
		6805	N	1,129	1,190	2,182	0	0

## Table 3 (Continued)

## Estimated 8-Bit Microcontroller Unit Shipments By Manufacturer 1985-1989 (Thousands of Units)

	Product	Process	1985	1986	<b>198</b> 7	1988	1989
Toshiba	8048/35	N	4,504	1,150	1,171	890	500
	8049/39	N	5,207	2,350	1,760	1,485	740
	80C48/35	С	0	1,000	2,950	3,200	1,700
	80C49/39	с	2,925	2,280	3,600	4,200	3,250
	80C50/40	С	0	520	851	820	900
	TLCS-870	С	0	0	0	0	130
	TLCS-90	С	0	0	0	850	2,850
Zilog	Z8	N	2,099	3,112	3,422	5,025	6,500
Total 8-B	it_MCUs		163,599	212,931	299,470	377,476	458,699

Note: Totals for 1986, 1987, and 1988 have been adjusted to remove Dataquest's previous estimate for unsurveyed companies. Totals now reflect actual movey results. Additionally, because of the receipt of new information, 1988 numbers have been restated for many Japanese companies. Gould Semiconductor acquired AMI, 1985.

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Harris sequired GE Solid State and RCA, 1988.

General Instrument's Microclectronics Division spun off a new company under the name Microchip Technology, 1987.

Thomson Components acquired Mostek, forming Thomson Components-Mostek Corporation (TCMC), 1985. SGS and Thomson merged, forming SGS-Thomson, 1987. (TCMC lost independent identity with the merger.)

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"National acquired Fairchild, 1987.

Source: Dataquest (June 1990)

## Table 4

## Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1975-1976 (Thousands of Units)

	Product	Process	1975	Q1/76	Q2/76	Q3/76	Q4/76	1976
Fairchild	F8	N	27	8	33	70	70	181
Mostek	F8	N	5	5	15	20	30	70
Total	8-Bit MCUs		32	13	48	90	100	251

Source: Dataquest (June 1990)

## 8-Bit Microcontrollers

## Table 5

## Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1977 (Thousands of Units)

	Product	Process	Q1/77	Q2/77	Q3/77	Q4/77	1977
Fairchild	3870	N	0	0	0	15	15
	F8	N	100	130	180	245	655
Intel	8048	N	0	15	30	60	105
Mostek	F8	N	10	15	25	40	90
	3870	N	0	0	5	15	20
Total 8	-Bit MCUs		110	160	240	375	885

Source: Dataquest (June 1990)

## Table 6

## Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1978 (Thousands of Units)

	Product	Process	Q1/78	Q2/78	Q3/78	Q4/78	1978
Fairchild	F8	N		130	190	200	630
	3870	N	3	5	5	10	23
General Instrument	PIC1650	N	75	95	105	175	450
Intel	8048	N	60	100	150	170	480
	8748	N	0	0	5	25	30
	8049/3 <del>9</del>	N	0	0	0	10	10
Mostek	3870	N	20	50	75	205	350
	F8	N	50	30	35	45	160
Motorola	3870	N	5	10	15	40	70
NEC	8048/35	N	0	0	0	15	15
Total 8	Bit MCUs		323	420	580	895	2,218

Source: Dataquest (June 1990)

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	Product	Process	Q1/79	Q2/79	Q3/79	Q4/79	1979
AMD	8048	N	0	S	3	20	23
Fairchild	F8	N	150	150	180	170	650
	3870	N	40	50	120	300	510
General Instrument	PIC1650	N	300	950	1,250	1,600	4,100
Intel	8048	N	190	390	570	800	1,950
	8748	N	50	75	75	100	<b>30</b> 0
	8049/39	N	20	30	60	100	210
	8021/22	N	10	20	50	80	160
Mostek	3870	N	260	300	425	485	1,470
	F8	N	90	125	125	130	470
Motorola,	6801/03	N	0	S	3	10	13
	6805	N	0	O	S	3	3
	3870	N	80	125	125	170	500
National	8049/39	N	0	0	S	10	10
NEC	8048/35	N	- 25	160	250	300	735
	8049/39	N	0	S	100	150	250
Rockwell	6500/1	N	0	S	3	5	8
SGS-ATES	387X	N	5	10	15	20	50
Signetics	8048/35	N	15	30	60	75	180
Total 8-Bit M	CUs		1,235	2,415	3,414	4,528	11,592

## Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1979 (Thousands of Units)

S = Sampled Source: Dataquest (June 1990)

## Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1980 (Thousands of Units)

	Product	Process	Q1/80	Q2/80	Q3/80	Q4/80	1980
AMD	8048	N	5	38	40	55	138
Fairchild	F8	Ň	170	150	150	150	620
	3870	N	345	380	550	520	1,795
Fajitsa	8048	N	0	S	50	100	150
	8049	N	0	S	100	200	300
General Instrument	PIC1650	N	1,700	1,700	1,100	1,100	5,600
Intel	8048	N	1,000	1,000	750	1,000	3,750
	8049/39	N	140	175	175	225	715
	8021/22	N	· 110	200	200	300	810
	8748	N	125	160	140	225	650
Mostek	3870	N	530	570	455	550	2,105
	F8	N	55	70	45	35	205
Motorola	6801/03	N	15	35	70	75	195
	6805	N	10	50	250	150	460
	3870	N	150	150	160	175	635
National	807X	N	S	5	10	16	31
	8050/40	N	5	10	15	20	50
	8048/35	N	S	5	15	25	45
	8049/39	N	25	40	50	60	175
NEC	8048/35	N	610	470	450	460	1,990
	8021	N	0	S	S	10	10
	8049/39	N	200	250	170	300	920
Philips	8048/35	N	2	5	5	7	19
Rockwell	6500/1	N	8,	15	35	50	108
SGS-ATES	387X	N	20	25	30	20	<b>95</b> .
Siemens	802XX	N	0	S	5	15	20
Signetics	8048/35	N	60	60	10	5	135
Zilog	<b>Z8</b>	N	S	3	5	б	14
Total 8-Bit M	CUs		5,285	5,566	5,035	5,854	21,740

S = Sampled Source: Dataquest (June 1990)

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## Q3/81 Product Process Q1/81 Q2/81 Q4/81 AMD Ν Ν Ð Fairchild F8 Ν N 3.100 Fujitsu N N General Instrument PIC1650 N 1,000 1.100 1,025 1,000 4,125 Hitachi 6801/03 N Ν Intel N 8021/22 N 1,525 N S S £ S N N 1,300 Ν 1,100 1,200 1,200 4,800 8049/39 Ν 1,230 Mostek N 2,485 **F8** N C Motorola N N 2,335 6801/03 Ν 1,655 N Ν National 8050/40 Ν 807X Ν 8048/35 N 8049/39 N NEC N 8048/35 ٠N 1.900 8049/39 Ν 2,125 uPD78XX N N Philips 8048/35 N N 8021/22 Rockwell 6500/1 Ν 387X Ν SGS-ATES

## Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

(Continued)

## Table 9 (Continued)

## Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

8048/35 8021 802XX	N N N	S S	10 5	35 20	40	85
8021 802XX	N N	S	5	20	15	
802XX	N			20	15	40
	**	20	50	300	350	720
Z8	N	0	0	S	2	2
TMS7000	N	0	2	5	15	22
8048/35	N	25	30	35	40	130
8049/39	N	39	50	60	70	219
Z8	. <b>N</b>	15	24	100	205	344
CUs		7,027	8,005	9,258	10,641	34,931
	Z8 TMS7000 8048/35 8049/39 Z8 Ws	Z8 N TMS7000 N 8048/35 N 8049/39 N Z8 N	Z8   N   0     TMS7000   N   0     8048/35   N   25     8049/39   N   39     Z8   N   15     Us   7,027	Z8   N   0   0     TMS7000   N   0   2     8048/35   N   25   30     8049/39   N   39   50     Z8   N   15   24     Us   7,027   8,005	Z8   N   0   0   S     TMS7000   N   0   2   5     8048/35   N   25   30   35     8049/39   N   39   50   60     Z8   N   15   24   100     Us   7,027   8,005   9,258	Z8   N   0   0   S   2     TMS7000   N   0   2   5   15     8048/35   N   25   30   35   40     8049/39   N   39   50   60   70     Z8   N   15   24   100   205     CUs   7,027   8,005   9,258   10,641

Source: Dataquest (June 1990)

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			(Thousands of	' Units)			
	Product	Process	Q1/82	Q2/82	Q3/82	Q4/82	1982
AMD	8048	z	75	80	80	58	320
	8049	Z	15	25	30	35	105
	6805	Z	o	S	s	8	8
Eurotechnique	8048/35	N	s	1	ω	UR.	6
	8049/39	z	S	1	10	25	36
	8050/40	Z	s	1	50	70	121
Fairchild	3870	Z	600	600	250	300	1,750
	F8	Z	175	250	220	200	845
Fujitsu	8048	Z	90	80	80	85	335
	8049	Z	260	260	270	290	1,080
General Instrument	PIC1650	Z	1,100	1,100	1,000	1,000	4,200
Hitachi	6301	â	21	42	63	84	210
	6305	c	14	28	42	56	140
	6801/03	Z	125	150	170	190	635
	6805	Z	150	195	225	255	825
Intel	8021/22	Z	500	600	500	450	2,050
	8048	Z	1,300	1,350	1,300	1,250	5,200
	8049/39	Z	450	500	450	470	1,870
	8051	Z	30	50	80	300	460
	8748	z	230	400	450	450	1,530
	8749	z	30	100	150	170	450
	8751	Z	10	10	20	30	70
Matra-Harris	8048	Z	Ð	s	1	U.	6
Matsushita	MN1800	Z	s	S	7	10	17
Mostek	3870	Z	600	580	450	400	2,030
	F8	Z	15	10	6	2	33
Motorola	146805	n	8	8	160	350	635
	3870	N	75	100	130	120	425
	6801/03	Z	875	770	775	900	3,320
	6805	Z	875	930	1,450	1,520	4,775
	68701	Z	18	20	20	20	78
	68705	Z	42	40	<b>5</b> 5	85	262
National	8048/35	z	170	225	300	300	995
	8049/39	Z	300	375	200	250	1,125
	8050/40	z	200	260	200	220	880
	807X	Z	15	20	~	10	53
	80C48/49	Ċ	0	0	20	40	60
NEC	8021	Ż	50	50	<b>5</b> 0	50	200
	9048/35	Z	700	700	590	450	2,400
	8049/39	N	1,000	1,200	1,000	1,000	4,200
							(Continued)

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Chapter 2

Table 10

Microcontroller Historical Shipment Data, 1975-1989

Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1982

## Chapter 2 ,

## Table 10 (Continued)

	Product	Process	Q1/82	Q2/82	Q3/82	Q4/82	1982
NEC	80C48/35	с	0	10	110	110	230
(Continued)	80C49/39	с	0	5	46	100	151
	8748	N	100	160	50	200	510
	8749	N	1	3	5	20	29
	uPD78XX	N	350	500	600	600	2,050
Oki	80C48	С	0	O	5	20	25
	80C49	С	0	10	40	85	135
Philips	8021/22	N	60	70	70	80	280
	8048/35	N	150	175	225	260	810
	8049/39	N	10	15	30	40	95
	84XX	N	0	S	10	70	80
Rockwell	6500/1	N	70	80	80	85	315
SGS	387X	N	130	180	170	220	700
Sharp	<b>Z</b> 8	N	20	25	50	70	165
Siemens	8021	N	20	25	25	25	95
	802XX	N	410	450	470	450	1,780
	8048/35	N	50	70	90	90	300
	8051/31	N	0	S	S	15	15
Signetics	8048/35	N	0	6	55	80	141
	8049/39	N	0	S	10	15	25
	8050/40	N	0	S	2	6	8
Synertek	<b>Z</b> 8	N	5	5	30	50	90
Π	TMS7000	N	35	50	70	100	255
Toshiba	8048/35	N	50	115	220	230	615
	8049/39	N	90	140	160	165	555
	80C49/39	С	5	12	50	75	142
Zilog	<b>Z8</b>	N	220	180	140	143	683
Total 8-Bit	MCUs		11,946	13,454	13,71 <b>8</b>	14,996	54,114

## Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1982 (Thousands of Units)

S = Sampled Source: Dataquest (June 1990)

1975-1989	
Data,	
Shipment	
Historical	
Microcontroller	

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# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

	Product	Process	Q1/83	Q2/83	Q3/83	04/83	1983
AMD	8048	Z	8	50	25	55	190
	8049	Ż	8	22	25	30	110
	8051	z	1	10	125	180	376
EFCIS	6801/03	Z	s	10	5	25	55
	6805	Z	S	20	35	45	100
Burotechnique	8048/35	Ż	7	6	-	1	16
	8049/39	z	4	55	-	-	95
	8050/40	Ż	100	125	-	1	225
<b>Fairchild</b>	3870	z	300	350	340	380	1,370
	F8	Ż	210	220	150	100	680
Fujitsu	8048	X	8	96	85	85	350
	8049	Z	320	325	340	340	1,325
General Instrument	PIC1652/54	z	170	217	220	410	1,017
	PIC1655/57	z	670	603	766	815	2,854
	PIC1670/72	z	530	390	466	725	2,111
	PIC16C58	z	130	290	58	160	638
Gould	6801	N	ŝ	S	S	220	220
	6805	N	40	10	ŝ	65	120
Hitachi	6301	U	150	162	190	220	72
	6305	U	100	120	150	170	540
	6801/03	z	210	235	275	315	1,035
	6805	Z	300	335	375	410	1,420
Intel	8021/22	Z	425	370	320	280	1,395
	8048	Z	1,300	1,300	1,300	1,350	5,250
	8049/39	z	500	510	525	550	2,085
	8050/40	Z	ŝ	70	110	120	300
	8051	N	320	610	800	1,800	3,530
	8052/32	N	S	10	12	15	37
	80C48/35	IJ	e.	S	ŝ	ŝ	18
	80C49/39	U	S	40	50	50	140
	80C51/31	U	S	40	50	50	140
	8748	z	470	445	550	600	2,065
	8749	z	180	180	250	350	<del>8</del> 60
	8751	Z	35	8	75	150	320
Matra-Harris	8048	Z	7	6	12	20	<b>4</b> 8
Matsushita	MN1800	Z	7	7	7	7	<b>58</b>
Mostek	3870	Z	430	430	40	400	1,660
	F8	Z	50	45	23	70	190
Motorola	146805	U	465	<b>4</b> 6	387	594	1,886
	1468705	ບ		-	1	5	ا د
							(Continued)

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			(Thousands of	f Units)		ł	
	Product	Process	Q1/83	Q2/83	Q3/83	Q4/83	1983
Motorola	3870	N	75	20	16	15	126
(Continued)	6801/03	Z	910	1,100	2,296	2,805	7,111
	6804	Z	0	0	s	S	S
	6805	N	1,520	1,600	2,024	1,790	6,934
	68701	z	65	100	141	58	364
	68705	z	8	150	176	168	584
National	8048/35	Z	320	340	375	415	1,450
	8049/39	z	300	320	320	350	1,290
	8050/40	Z	275	305	330	360	1,270
	807X	Z	15	15	15	15	8
	80C48/49	c	55	50	ŝ	75	245
NCR	6500/1	z	S	8	80	110	. 215
NBC	8021	Z	30	50	28	80	245
	8048/35	z	550	550	700	1,560	3,360
	8049/39	Z	1,450	1,600	1,600	1,300	5,950
	80C48/35	a	125	125	210	480	940
	80C49/39	Q	100	100	160	290	650
	8748	Z	200	400	250	240	1,090
	8749	Z	35	100	8	8	255
	uPD78XX	Z	650	1,150	1,300	1,860	4,960
Oldi	80C48	C	30	43	50	80	203
	80C49	Ċ	100	137	200	390	827
Philips	8021/22	Z	70	96	8	110	360
	8048/35	Z	280	200	230	230	940
	8049/39	Z	8	8	100	100	320
	8051/31	z	0	5	10	25	40
	84XX	Z	190	530	620	600	1,940
RCA	1804A	Q	S	s	2	2	4
Rockwell	6500/1	Ż	150	300	250	230	930
SGS-ATES	387X	Z	254	245	300	360	1,159
Sharp	Z8	z	80	150	300	450	086
Siemens	8021	N	25	u	25	s	8
	802XX	Z	380	300	300	500	1,480
	8048/35	z	8	50	40	8	270
	8051/31	Z	8	250	300	420	1,030
Signetics	8048/35	Z	220	265	280	290	1,055
	8049/39	Z	110	135	150	150	545
	8050/40	Z	90	110	100	100	400
	8051/31	Z	ω	ω	40	80	126
Synenek	Z8	z	60	25	30	20	135
							(Continued)

# Table 11 (Continued)

#### Chapter 2

#### Table 11 (Continued)

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

	Product	Process	Q1/83	Q2/83	Q3/83	Q4/83	1983
m	TMS7000		130	175	190	220	715
Toshiba	8048/35	N	280	340	400	420	1,440
	8049/39	N	250	270	300	410	1,230
	80C49/39	С	120	190	300	240	850
Zilog	Z8	N	150	190	211	300	851
Total 8-	Bit MCUs		1 <b>7,598</b>	20,451	23,550	29,016	90,615

Taken over by Thomson S = Sampled Source: Dataquest (June 1990)

#### Table 12

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

	Product	Process	Q1/84	Q2/84	Q3/84	Q4/84	1984
AMD	8048	N	35	5	0	0	40
	8049	N	5	5	0	0	10
	8051	N	385	575	900	400	2,260
AMI	6801	N	240	260	280	300	1,080
	6805	N	105	105	150	180	540
Fairchild	387X	N	346	282	285	162	1,075
	F8	N	26	19	20	9	74
Fujitsu	8048	N	90	95	120	120	425
	8049	N	350	360	400	400	1,510
General Instrument	7000/1	N	0	1	5	4	10
	7020/40	N	0	15	20	22	57
	7041	N	0	5	5	3	13
	PIC1652/54	N	425	435	435	355	1,650
	PIC1655/57	N	975	1,150	1,200	980	4,305
	PIC1670/72	N	775	780	780	640	2,975
	PIC16C58	N	165	110	110	90	475
Hitachi	6301V	С	300	325	367	480	1,472
	6305	С	200	215	215	320	950
	6801/03	N	360	400	572	570	1,902
	6805	N	490	570	856	850	2,766
Intel	802X	N	250	250	300	250	1,050
	8048/35	N	1,325	1,000	800	700	3,825
	8049/39	N	560	900	800	700	2,960
	8050/40	N	130	130	130	100	490
	8051/31	N	2,300	3,800	3,600	3,200	12,900
	8052/32	N	18	50	65	80	213
	80C48/35	С	5	5	0	0	10
	80C49/39	С	55	55	60	60	230
	80C51/31	С	50	50	80	85	265
	8748	N	625	625	625	625	2,500
	874 <del>9</del>	N	390	390	600	650	2,030
	8751	N	200	200	200	195	795
Intersil	80C48/35	С	0	0	12	32	44
Matra-Harris	8048	N	30	40	40	20	130
	8051	N	20	15	250	350	635
	80C48	С	0	0	10	10	20
Matsushita	MN1800	N	10	10	10	10	40
Mostek	387X	N	375	400	300	350	1,425
	38P7X	N	0	0	58	90	148
	F8	N	40	40	40	75	195

(Continued)

		-	l'nousands of	Units)			
	Product	Process	Q1/84	Q2/84	Q3/84	Q4/84	1984
Motorola	146805	C	790	1,109	1,238	1,252	4,389
	1468705	C	4	4	19	7	34
	387X	z	10	11	16	23	60
	6801/03	N	2,151	2,055	1,849	1,865	7,920
	6804	Z	0	0	7	29	36
	6805	N	1,993	1,772	2,379	2,188	8,332
	68701	Y	50	56	56	37	199
	68705	Z	358	493	535	518	1,904
	68HCII	a	0	0	0	3	з
National	8048/35	Z	575	600	800	800	2,775
	8049/39	N	390	400	700	700	2,190
	8050/40	Z	465	475	500	500	1,940
	807X	N	10	10	10	S	35
	80C48/35	Q	30	10	0	Q	40
NCR	6500/1	N	150	150	150	150	600
NEC	8021/22	N	100	110	130	130	470
	8041	Q	0	0	1,110	1,110	2,220
	8741	G	o	0	190	190	380
	8048/35	z	1,970	2,190	2,350	1,240	7,750
	8049/39	ï	2,050	1,360	1,900	1,900	7,210
	80C48/35	c	570	610	420	420	2,020
	80C49/39	C	410	360	500	500	1,770
	8748	Z	520	620	550	360	2,050
	8749	Y	230	200	290	290	1,010
	uPD78XX	N	2,360	2,880	3,270	3,270	11,780
	80C48/35	a	100	120	140	8	450
	80C49/39	ი	450	500	560	450	1,960
Philips	8021/22	N	160	150	170	170	650
	8048/35	N	460	650	1,000	1,000	3,110
	8049/39	Z	380	650	900	1,000	2,930
	8050/40	N	0	0	0	10	10
	80C49	G	0	0	0	ι,	ŝ
	8051/31	N	8	300	400	400	1,160
	84XX	N	500	400	700	900	2,500
RCA	1804A	C	2	s	0	· 10	23
	6805	Z	0	н	1	S	7
Rockwell	6500/1	Z	325	475	350	200	1,350
SOS	387X	Z	375	344	420	350	1,489
	Z8	Z	0	110	0	13	123
Sharp	Z8	N	475	475	500	500	1,950
							(Continued)

Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984

Table 12 (Continued)

Microcontroller Historical Shipment Data, 1975-1989

Chapter 2

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.

#### Table 12 (Continued)

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

	Product	Process	Q1/84	Q2/84	Q3/84	Q4/84	1984
Siemens	8021	N	5	- 6	9	8	28
	802XX	N	306	221	306	265	1,098
	8048/35	N	91	141	108	65	405
	8051/31	N	522	533	662	665	2,382
Signetics	8048/35	N	540	1,263	1,386	1,420	4,609
	8049/39	N	150	162	244	390	946
	8050/40	N	100	90	85	80	355
	8051/31	N	85	125	692	890	1,792
Synertek	<b>Z8</b>	N	9	9	4	2	24
m	TMS7000	N	240	250	250	250	990
Thomson <sup>t</sup>	6801/03	N	30	30	15	75	150
	6805	N	50	120	130	300	600
Toshiba	8048/35	N	400	480	1,300	1,500	3,680
	8049/39	N	500	500	1,300	1,600	3,900
	80C49/39	С	280	290	750	850	2,170
Zilog	Z8	N	435	675	450	495	2,055
Total 8-Bi	t MCUs		33,871	38,222	46,507	44,910	163,510

Thomson acquired EPCIS, Source: Dataquest (June 1990)

#### Table 13

	Product	Process	Q1/85	Q2/85	Q3/85	Q4/85	1985
AMD	8051/31	N	250	400	360	600	1,610
	8751	N	2	15	14	40	71
Fairchild	387X	N	148	90	52	67	357
	F8	N	33	60	80	114	287
Fujitsu	8048/35	N	60	40	40	45	185
	8049/39	N	200	180	162	165	707
General Instrument	PIC1652/54	N	350	400	425	340	1,515
	PIC1655/57	N	975	840	790	690	3,295
	PIC1670/72	N	650	550	510	425	2,135
	PIC16C58	с	85	77	69	25	256
	PIC16E57	N	5	8	8.	45	66
	PIC7000/1	N	б	5	5	10	26
	PIC7020/40	N	25	40	45	30	140
	PIC7041	N	3	3	3	3	12
Gould/AMI <sup>1</sup>	6801/03	N	290	250	16	20	576
	6805	N	175	158	32	37	402
Hitachi	6301V	с	420	425	383	780	2,008
	6305	С	280	290	261	555	1,386
	6801/03	N	385	400	360	370	1,515
	6805	N	552	560	625	1,165	2,902
Intel	802X	N	125	35	32	30	222
	8048/35	N	400	350	315	300	1,365
	8049/39	N	420	400	360	350	1,530
	8050/40	N	100	50	45	45	240
	8051/31	N	2,500	1,500	1,500	1,300	6,800
	8052/32	N	80	68	61	60	269
	80C49/39	С	40	30	27	15	112
	80C51/31	С	100	150	275	260	785
	8748	N	525	250	275	260	1,310
	874 <del>9</del>	N	410	300	275	460	1,445
	8751	N	275	200	248	120	843
Intersil	80C48/35	С	8	8	7	7	30
	80C49/39	С	3	2	2	2	9
Matra-Harris	8051	N	450	300	300	350	1,400
	8052	N	0	0	0	20	20
	80C51	С	0	0	0	10	10
Matsushita	MIN1800	С	10	24	32	65	131
Mitsubishi	M50XXX	С	3,200	4,050	3,900	3,975	15,125

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

(Continued)

			(Thousands of	Units)			
Matan	1 1/2004	, numero	Cort	510 COND	1 Mg	1 00%	4 071
MOTOFOLA	140000 1468705	<u>ი</u> ი	8 7 cn <sup>t</sup> T	ريد 7	1,000 7	1,050 26	48
	387X	V	14	ස	8	32	174
	6801/03	z	1,840	2,246	2,265	1,656	8,007
	6804	Z	33	116	158	194	501
	6805	Z	2,284	2,258	2,779	3,456	10,777
	68701	Z	37	80	80	81	278
	68704	N	0	•	4	6	13
	68705	N	613	532	745	751	2,641
	68HC11	G	ú	00	10	44	67
National	8048/35	Z	800	690	480	230	2,200
	8049/39	N	700	500	370	340	1,910
	8050/40	N	500	380	320	300	1,500
	807X	z	رب م	•	o	ð	5
NCR	6500/1	N	160	110	180	190	<b>540</b>
NEC	8021/22	Z	130	120	8	\$	350
	8041	N	1,130	450	600	680	2,860
	8048/35	Z	1,090	570	600	600	2,860
	8049/39	N	1,820	1,030	1,120	1,190	5,160
	80C48/35	Ċ	710	470	340	280	1,800
	80C49/39	C	690	550	360	460	2,060
	8741	N	270	270	170	140	850
	8748	Z	480	550	340	290	1,660
	8749	Z	460	<b>64</b> 0	550	410	2,060
	uPD78XX	z	2,680	2,740	2,510	3,520	11,450
	80C48/35	Q	150	135	124	128	537
	80C49/39	Q	560	440	440	510	1,950
Philips	8021/22	N	170	150	110	<del>4</del> 5	470
	8048/35	N	700	400	200	130	1,430
	8049/39	N	1,000	700	500	350	2,550
	8050/40	Z	20	20	20	40	100
	8051/31	N	350	300	250	200	1,100
	80C49/39	Q	15	50	50	30	145
	84XX	z	1,100	1,300	1,800	2,000	6,200
RCA	1804A	Q	S	3	Ψ	2	13
	6805/68HC05	a	20	10	25	8	120
Rockwell	6500/XX	Z	150	400	360	400	1,310
SOS	387X	Z	530	550	495	62.5	2,200
	Z8	N	55	47	42	100	244
Sharp	Z8	z	23	23	190	190	426

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Table 13 (Continued) ted 8-Bit Microcontroller Unit Shipments by Quarte

8-Bit Microcontrollers

#### Chapter 2

#### Table 13 (Continued)

	Product	Process	Q1/85	Q2/85	Q3/85	Q4/85	1985
Siemens	8021	N	24	54	30	30	138
	802XX	N	295	427	468	348	1,538
	8048/35	N	40	57	57	40	194
	8051/31	N	700	630	567	600	2,497
Signetics	8048/35	N	1,400	400	463	300	2,563
	8049/39	N	400	200	250	385	1,235
	8050/40	N	92	50	60	75	277
	8051/31	N	870	400	417	675	2,362
	8052/32	N	0	0	0	5	5
1	TMS7000	N	400	350	316	330	1,396
homson	6801/03	N	65	59	53	160	337
	6805	' N	350	315	284	180	1,129
CMC (Mostek) <sup>2</sup>	387X	N	273	159	211	224	867
	38 <b>P</b> 7X	N	112	80	61	44	297
	F8	N	62	51	42	40	195
`oshiba	8048/35	N	1,600	1,404	1,000	500	4,504
	8049/39	N	1,700	1,530	1,377	600	5,207
	80C49/39	С	900	675	650	700	2,925
<b>تانع</b>	Z8	N	564	550	495	490	2,099
Total 8-Bit J	MCUs		45,746	39,722	38,425	39,706	163,599

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

 'AMI was acquired by Gould Semiconductor.
 '5,740
 55,722
 55,722
 55,720

 'AMI was acquired by Gould Semiconductor.
 'Thomson Components acquired Mostek Corporation from United Technologies, forming Thomson Components—Mostek Corporation (TCMC).
 Source: Datequest (June 1990)

#### Table 14

	Product	Process	Q1/86	Q2/86	Q3/86	Q4/86	1986
AMD	8051/31	N	350	350	450	550	1,700
	8751	N	30	35	22	25	112
Fairchild	387X	N	9	1	0	0	10
	F8	N	27	89	98	90	304
Pajitsa	8048/35	N	55	73	92	108	328
-	8049/39	N	192	208	224	238	862
	8051/31	N	65	88	116	134	403
	80C49/39	С	15	20	34	36	105
General Instrument	PIC1652/54	N	400	500	400	400	1,700
	PIC1655/57	N	300	300	400	400	1,400
	PIC1670/72	N	200	490	250	250	1,190
	PIC16C58	С	32	45	0	0	77
	PIC16E57	N	57	60	52	60	229
	PIC7000/1	N	14	20	100	100	234
	PIC7020/40	N	134	150	100	100	484
	PIC7041	N	3	5	6	8	22
Gould Semiconductor	6801/03	N	16	4	0	1	21
	6805	N	42	48	10	27	127
Hitachi	6301	С	950	1,265	1,175	1,810	5,200
	6305	с	760	955	1,152	1,375	4,242
	6801/03	N	520	840	1,062	1,135	3,557
Intel	6805	N	1,180	1,360	1,425	1,310	5,275
	802X	N	30	25	20	18	93
	8048/35	N	130	140	160	165	595
	8049/39	N	415	450	746	790	2,401
	8050/40	N	50	52	65	58	225
	8051/31	N	1,422	1,626	1,965	1,985	6,998
	8052/32	Ň	150	170	548	732	1,600
	80C49/39	С	0	5	5	10	20
	80C51/31	с	300	310	588	802	2,000
	8748	N	200	200	200	200	800
	8749	N	500	512	535	700	2,247
	8751	N	150	155	175	212	692
Intersil	80C48/35	С	2	3	5	10	20
	80C49/39	с	2	3	4	1	10
Matra-Harris	8051	N	358	362	280	340	1,340
	8052	N	20	105	123	170	418
	80C51	С	10	70	107	200	387
Matsushita	MN1800	С	70	100	110	120	400
Mitsubishi	M50XXX	С	6,860	7,250	7,606	8,190	29,906
Motorola	146805	С	1,002	1,050	1,030	1,623	4,705

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

(Continued)

#### Table 14 (Continued)

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

	Product	Process	Q1/86	Q2/86	Q3/86	Q4/86	1986
	1468705	С	23	25	22	23	93
	387X	N	98	40	20	41	199
	6801/03	Ň	2,116	2,053	2,101	2,256	8,526
	6804	N	184	254	541	516	1,495
	6805	N	3,131	3,399	3,290	3,739	13,559
	68701	N	92	152	125	62	431
	68704	N	10	10	33	29	82
	68705	N	779	961	1,004	1,117	3,861
	68HC11	C	120	142	180	254	696
National	8048/35	N	100	50	130	110	390
	8049/39	N	350	250	550	500	1,650
	8050/40	N	330	320	330	300	1,280
NCR	6500/1	N	255	230	265	277	1,027
NEC	8021/22	N	40	10	20	30	100
	8041	N	730	730	580	510	2,550
	8048/35	N	900	950	990	1,100	3 <b>,940</b>
	8049/39	N	1,150	1,530	1,450	1,220	5,350
	80C48/35	С	330	580	230	220	1,360
	80C49/39	С	410	540	470	690	2,110
	8741	N	280	60	50	90	480
	8748	N	410	300	460	200	1,370
	8749	N	530	430	520	450	1,930
	uPD78XX	N	3,850	4,580	5,200	4,760	18,390
Okci	80C154	С	0	0	12	75	87
	80C48/35	С	130	135	130	125	520
	80C49/39	С	590	650	790	690	2,720
	80C51	С	150	282	520	820	1 <b>,772</b>
Philips	8021/22	N	35	38	40	25	138
	8048/35	N	75	69	70	75	289
	8049/39	N	550	550	550	536	2,186
	8050/40	N	90	95	100	108	393
	8051/31	N	150	160	180	210	700
	80C49/39	С	50	55	65	70	240
	80C51/31	С	5	15	26	35	81
	84CXX	С	0	0	0	15	15
	84XX	N	3,200	3,400	4,000	3,725	14,325
RCA	1804A	С	4	2	2	3	11
	6805/68HC05	С	55	65	88	151	359
Rockwell	6500/XX	N	450	640	510	950	(Continued)

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# Table 14 (Continued)

	Product 387X	Process	Q1/86 852	Q2/86 1,301	Q3/86 1,030	Q4/86 1,628
	Z8	z	194	153	147	
Sharp	Z8	N	230	160	142	
Siemens	802XX	N	340	304	15	
	8048/35	N	26	8	431	
	8051/31	Z	321	573	733	
	80515/35	N	Đ	0	13	
	8052/32	Z	81	117	219	-
Signetics	8048/35	N	225	215	230	Ŭ
	8049/39	N	<b>4</b> 5	450	46	
	8050/40	N	68	70	5	Ű
	8051/31	N	650	<b>6</b> 5	712	
•	8052/32	Z	87	102	126	•
	80C51/31	C	ŝ	7	10	Ŭ
	8400	N		<b>6</b>	13	-
п	TIMS7000	ï	450	470	78	
Thomson	6801/03	'Z	200	235	22	-
	6805	N	260	290	31(	0
TCMC (Mostek)	387X	N	255	239	22	Un
	38P7X	N	8	38	2	90
	<b>F8</b>	N	23	151	-1	ð
Toshiba	8048/35	z	250	250	35	•
	8049/39	N	550	550	65	0
	80C48/35	C	200	200	30	•
	80C49/39	C	400	480	80	ē
	80C50/40	C	100	120	20	0
Zilog	<b>Z</b> 8	N	710	835	רר	ð

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

Total 8-Bit MCUs Source: Dataquest (June 1990)

45,746

51,295

56,156

59,734

212,931

•							
7,475	2.100	2.700	1360	1315	Z 2	8049/39	
1,067	262	255	265	285	Z	8048/35	
1 067	С. с.		26	200	z :	801025	11841
<b>54</b>	Q	11	16	18	Z	802X	Intel
620	200	175	145	100	n	68P05	
545	180	165	115	85	a	68P01	
7,160	2,120	1,790	1,685	1,565	Z	6805	
5,200	1,350	1,300	1,300	1,250	z	6801/03	
865	300	250	190	125	c	63P05	
645	225	175	145	100	Ċ	63P01	
1,299	458	385	276	180	a	63705	
1,599	680	449	320	150	n	63701	
7,250	2,100	1,850	1,700	1,600	n	6305	
8,100	2,500	2,000	1,800	1,800	o	6301	Hitachi
<b>9</b> 6	6	ω	22	<del></del>	z	6805	
31	15	6	2	~	N	6801/03	Gould Semiconductor
2,300	800	650	500	350	C	80C49/39	
1,098	305	276	265	252	N	8051/31	
1,132	315	280	285	252	Z	8049/39	
528	155	135	126	112	Z	8048/35	Pujitsu
77	25	22	20	10	Z	8753	
133	42	35	30	26	z	8751	
134	8	24	s	15	c	80C51/31	
287	150	115	22	0	Z	8053	
2,240	640	626	538	436	X.	8051/31	AMD
1987	Q4/87	Q3/87	Q2/87	Q1/87	Process	Product	İ

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Microcontroller Historical Shipment Data, 1975-1989

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#### Table 15 (Continued)

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

	Product	Process	Q1/87	Q2/87	Q3/87	Q4/87	1987
Microchip	PIC1652/54	N	758	960	1,300	1,045	4,063
Technology <sup>1</sup>	PIC1655/57	N	350	347	126	250	1,073
	PIC1670/72	N	80	120	135	125	460
	PIC16E57	N	15	10	7	0	32
	PIC7000/1	N	145	160	175	216	696
	PIC7020/40	N	475	525	505	480	1,985
	PIC7041	N	6	6	15	6	33
Mitsubishi	M507XX	C	5,773	5,783	6,174	5,976	23,706
	M509XX	С	1,076	2,295	4,978	4,733	13,082
	8048/35	N	140	61	28	286	515
	8049/39	N	448	344	375	524	1,691
	8050/40	N	52	35	83	38	208
	80C49/39	С	1,859	221	310	224	2,614
Motorola	146805	С	1,163	1,381	1,428	1,450	5,422
	6801/03	N	2,256	2,267	2,232	2,163	8,918
	6804	N	853	1,149	970	1,385	4,357
	6805	N	4,918	4,785	4,923	5,090	19,716
	68HC05	С	714	974	1,316	1,674	4,678
	68HC11	с	402	696	1,290	1,587	3,975
National	8048/35	N	102	103	120	100	425
	8049/39	N	465	480	650	500	2,095
	8050/40	N	350	368	550	570	1,838
	COP800	С	0	0	0	10	10
National <sup>2</sup>	F8	N	48	40	20	30	138
NCR	6500/1	N	165	170	60	2	397
NEC	8021/22	N	0	20	10	10	40
	8041	N	380	540	480	350	1,750
	8048/35	N	1,020	1,070	1,170	1,100	4,360
	8049/39	N	1,000	1,350	1,430	1,050	4,830
	80C48/35	С	220	320	230	200	970
	80C49/39	С	710	450	690	830	2,680
	8741	N	80	90	70	90	330
	8748	N	130	180	200	80	590
	8749	N	840	680	730	1,050	3,300
	uPD78XX	N	5,980	5,420	6,140	6,600	24,140
Okci	80C154	С	75	95	350	374	894
	80C48/35	С	125	110	100	93	428
	80C49/39	С	699	734	890	810	3,133
	80C51	С	790	591	660	680	2,721

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	Estimated 8-I	Sit Microcont	roller Unit Sh housands of U	ipments by Q (Inits)	uarter for 19	87	
	Product	Process	Q1/87	Q2/87	Q3/87	Q4/87	1987
Philips	8021/22	z	35	8	45	32	172
,	8048/35	Z	75	70	95	<b>4</b> 5	285
	8049/39	N	430	450	500	430	1,810
	8050/40	N	8	754	856	80	1,780
	8051/31	N	320	460	550	510	1,840
	80C49/39	Q	74	120	160	160	514
	80C51/31	Q	8	110	210	240	620
	84CXX	a	110	350	380	310	1,150
	84XX	Z	2,880	3,190	2,540	2,200	10,810
RCA	1804A	Q	J.	2	1	0	80
	6805/68HC05	n	190	170	155	290	<b>305</b>
Rockwell	6500/XX	N	986	925	<b>9</b> 9	1,050	3,855
SGS-Thomson <sup>3</sup> (M)	387X	Y	230	175	200	190	795
(M)	38P7X	Z	<b>3</b> 0	20	20	20	\$
(M)	F8	N	56	50	20	10	136
(S)	387X	Z	1,254	1,222	958	488	3,922
(S)	Z8	Z	131	163	233	138	<b>3</b> 8
Э	6801/03	N	295	280	276	280	1,131
Ð	6805	N	530	585	502	565	2,182
Sharp	SM-Series	c	110	185	110	125	530
	Z8	Z	120	225	120	125	<b>3</b> 90
Siemens	802XX	Z	17	12	9	13	51
	8048/35	N	507	<b>54</b> 1	372	313	1,733
	8051/31	z	812	987	1,147	1,109	4,055
	80515/35	N	164	164	202	238	768
	8052/32	Z	316	362	406	347	1,431
Signetics	8048/35	N	48	25	22	16	111
	8049/39	N	488	<b>502</b>	514	496	2,000
	8050/40	N	80	220	218	205	723
	8051/31	N	680	685	700	666	2,731
	8052/32	Z	155	450	<b>4</b> 54	472	1,541
-	80C51/31	Q	8	69	73	76	283
	83C451	o	1	S	ę	12	27
	8400	N	10	11	10	12	43
	8441	a	0	36	4	48	128
	87C451	G	0	2	3	5	10
н	TMS7000	N	1,100	1,600	1,800	2,100	6,600
Toshiba	8048/35	Z	300	310	286	275	1,171
	8049/39	Z	500	400	435	425	1,760
	80C48/35	C	400	650	800	1,100	2,950
į							(Continued)

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Microcontroller Historical Shipment Data, 1975-1989

Table 15 (Continued)

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#### Table 15 (Continued)

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

	Product	Process	Q1/87	Q2/87	Q3/87	Q4/87	1987
Toshiba	80C49/39	С	800	850	900	1,050	3,600
(Continued)	80C50/40	С	200	225	210	216	851
Zilog	<b>Z</b> 8	N	863	863	858	838	3,422
Total 8-Bit	MCUs		65,376	70,619	80,807	82,668	299,470

General instrument's Microelectronics Division spun off as a separate company under the name Microchip Technology. National acquired Fairchild. 'SGS and Thomson Computerts merged, forming SGS-Thomson. TCMC (Mostek) was folded into newly established company. Source: Dataquest (June 1990)

Microcontroller Historical Shipment Date, 1975-1989

# Table 16

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

	Product	Provec	01/88	02/88	03/88	04/88	1988
AMD	8051/31	N	00	570	95	8 0	2.110
	8053	Z	120	110	140	140	510
	80C51/31	U	180	220	230	524	1,055
	8751	z	45	52	55	65	217
	8753	Z	30	33	35	47	145
Fujitsu	8048/35	z	10	10	30	8	8
	8049/39	Z	20	23	8	8	162
	8051/31	N	20	23	53	55	153
	80C49/39	Ų	53	33	120	120	350
	<b>MB897XX</b>	υ	320	350	456	505	1,631
Gould/AMI	6801/03	Z	L	0	0	•	7
	6805	X	4	0	0	0	4
Hamis (GE-SS/RCA) <sup>1</sup>	6805	z	8	100	75	<u>8</u>	355
	68HC05	ŋ	225	350	275	580	1,430
Hitachi	6301	U	2,700	2,900	3,000	2,950	11,550
	6305	U	2,500	2,800	2,950	2,900	11,150
	63701	U	685	695	200	200	1,780
	63705	v	470	480	130	140	1,220
	63P01	U	240	260	270	270	1,040
	63P05	Ų	325	360	370	370	1,425
	6801/03	Z	1,350	1,410	1,450	1,400	5,610
	6805	Z	2,100	2,110	2,140	2,000	8,350
	68P01	Z	225	235	242	242	£
	68P05	Z	230	250	265	265	1,010
Intel	802X	z	10	•	0	o	10
	8048/35	z	300	400	200	300	1,500
	8049/39	Z	3,300	3,400	3,100	3,300	13,100
	8050/40	Ż	400	200	300	300	1,200
	8051/31	Z	3,800	3,700	3,400	2,900	13,800
	8052/32	z	1,000	1,300	1,500	2,000	5,800
	80C51/31	U	1,200	1,400	1,600	2,000	6,200
	8748	Z	<b>500</b>	<b>300</b>	200	200	800
	8749	z	800	<b>8</b> 6	1,000	<b>00</b> 8	3,500
	8751	z	200	300	300	200	1,000
	8752	U	\$	100	100	100	350
	87C51	υ	100	100	100	200	<b>200</b>
Matra-Harris	8051/31	z	<del>4</del>	77	16	10	<b>9</b> 8
	8052/32	Z	246	200	105	161	712
	80C51/31	U	419	540	620	611	2,190
							(Continued)

#### Table 16 (Continued)

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

	Product	Process	Q1/88	Q2/88	Q3/88	Q4/88	1988
Matra-Harris	80C52/32	с	80	150	208	222	660
(Continued)	83C154	С	0	20	41	55	116
Matsushita	MN1800/70/80	С	460	730	1,030	2,400	4,620
Microchip Technology	PIC1652/54	N	1,000	1,285	1,472	1,485	5,242
	PIC1655/57	N	250	202	221	230	903
	PIC1670/72	N	100	76	60	50	286
	PIC7000/1	N	50	80	0	0	130
	PIC7020/40	N	360	255	0	0	615
	PIC70XX	N	410	276	304	0	990
Mitsubishi	8048/35	N	30	70	60	40	200
	8049/39	N	430	370	250	250	1,300
	8050/40	N	25	49	40	40	154
	80C49/39	С	200	140	150	200	690
	M507XX	С	5,800	6,600	5,000	5,500	22,900
	M509XX	· C	5,800	5,800	7,000	6,500	25,100
Motorola	146805	С	1,587	1,694	1,942	1,375	6,598
	6801/03	N	2,045	1,960	2,134	2,114	8,253
	6804	N	1,012	828	1,040	1,020	3,900
	6805	N	5,859	7,032	7,226	6,925	27,042
	68HC05	С	2,004	2,900	4,009	3,763	12,676
	68HC11	С	1,870	2,077	2,513	2,929	9,389
National	8048/35	N	80	. 100	50	85	315
	8049/39	N	430	500	550	470	1,950
	8050/40	N	650	725	625	210	2,210
	COP800	С	300	300	650	305	1,555
	F8	N	20	10	10	5	45
NCR	6500/1	N	150	250	285	62	747
	6500/11	N	2	200	136	33	371
NEC	8021/22	N	10	10	25	25	70
	8041	Ň	420	350	260	260	1,290
	8048/35	N	880	400	790	500	2,570
	8049/39	N	730	850	950	830	3,360
	80C48/35	С	210	210	160	160	740
	80C49/39	С	750	950	930	800	3,430
	8741	N	120	90	80	80	370
	8748	N	120	170	180	180	650
	8749	N	320	510	500	490	1,820
	uPD78XX	N	7,050	8,300	8,430	8,430	32,210
	uPD78XXX	N	0	0	200	300	500
	V25	<u> </u>	0	0	2	3	5

(Continued)

#### Chapter 2

#### Table 16 (Continued)

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

Oki         00C48/35         C         90         95         90         110         33           80C154         C         350         360         420         500         1,6           80C49/39         C         800         812         890         960         3,44           80C51/31         C         650         670         950         830         3,10           Philips         8021/22         N         10         5         0         0         122           8048/35         N         60         60         45         50         22           8049/39         N         420         370         220         220         1,22           8051/40         N         95         60         30         30         22           8051/31         N         450         350         300         300         1,44           80C49/39         C         170         170         160         165         66           80C51/31         C         270         250         350         350         1,22           84XX         N         2,150         2,500         2,530         9,51         3,22		Product	Process	Q1/88	Q2/88	Q3/88	Q4/88	1988
80C154         C         350         360         420         500         1,60           80C49/39         C         800         812         890         960         3,44           80C51/31         C         650         670         950         830         3,14           80C51/21         C         650         670         950         830         3,14           80C51/31         N         10         5         0         0         122           8050/40         N         95         60         30         300         22           8051/31         N         450         350         300         300         1,44           80C49/39         C         170         170         160         165         66           80C51/31         C         270         250         350         800         820         2,53           84XX         N         2,150         2,400         2,500         2,530         9,551           Saryo         LC86XXX         C         0         0         400         400         422           SGS-Thomson         387X         N         1,930         200         300	Oki	00C48/35	С		95	90	110	385
80C49/39C $800$ $812$ $890$ $960$ $3,44$ $80C51/31$ C $650$ $670$ $950$ $830$ $3,16$ $8021/22$ N $10$ 5002 $8048/35$ N $60$ $60$ $45$ $50$ 2 $8050/40$ N $955$ $60$ $30$ $300$ 220 $8051/31$ N $450$ $350$ $300$ $300$ $1,46$ $8054/99$ C $170$ $170$ $160$ $165$ $66$ $80C51/31$ C $270$ $250$ $350$ $350$ $1,22$ $84XX$ N $2,150$ $2,400$ $2,500$ $2,530$ $9,55$ $84XX$ N $2,150$ $2,400$ $2,500$ $2,530$ $9,55$ Rockwell $6500/XX$ N $1,930$ $200$ $300$ $4,22$ SanyoLC86XXXC00 $400$ $860$ LM88XXN $0$ 0 $100$ $100$ $220$ SGS-Thomson $387X$ N $18$ $26$ $33$ $33$ $11$ $6801/03$ N $362$ $494$ $408$ $565$ $1,82$ $6805$ N $754$ $739$ $644$ $660$ $2,75$ $F8$ N $111$ $10$ 0 $0$ $22$ $8051/31$ N $325$ $100$ $100$ $400$ $8051/31$ N $325$ $100$ $100$ $400$ $8051/31$ N $325$ $100$ <td></td> <td>80C154</td> <td>С</td> <td>350</td> <td>360</td> <td>420</td> <td>500</td> <td>1,630</td>		80C154	С	350	360	420	500	1,630
80C51/31         C         650         670         950         830         3,10           Philips         8021/22         N         10         5         0         0         5           8048/35         N         60         60         45         50         22           8049/39         N         420         370         220         220         123           8050/40         N         95         60         30         300         220           8051/31         N         450         350         300         300         1,44           80C49/39         C         170         170         160         165         66           80C51/31         C         270         250         350         800         820         2,53           84XX         N         2,150         2,400         2,500         2,530         9,55           Sanyo         LC86XXX         C         0         0         400         402           SGS-Thomson         387X         N         1,097         848         760         531         3,22           SGS-Thomson         387X         N         1,097         848		80C49/39	С	800	812	890	960	3,462
Philips         8021/22         N         10         5         0         0           8048/35         N         60         60         45         50         22           8049/39         N         420         370         220         220         1,23           8050/40         N         95         60         30         300         22           8051/31         N         450         350         300         300         1,46           80549/39         C         170         170         160         165         66           80C51/31         C         270         250         350         820         2,53           84XX         N         2,150         2,400         2,500         2,530         9,55           Rockwell         6500/XX         N         1,800         1,930         200         300         4,23           Sanyo         LM83XX         N         0         0         100         100         22,75           Sanyo         1.087X         N         1,80         133         33         11           6801/03         N         362         494         408         565 <t< td=""><td></td><td>80C51/31</td><td>с</td><td>650</td><td>670</td><td>950</td><td>830</td><td>3,100</td></t<>		80C51/31	с	650	670	950	830	3,100
8048/35         N         60         60         45         50         22           8049/39         N         420         370         220         220         1,23           8050/40         N         95         60         30         300         220           8051/31         N         450         350         300         300         1,44           80C49/39         C         170         170         160         165         66           80C51/31         C         270         250         350         800         820         2,53           84XX         N         2,150         2,400         2,500         2,530         423           84XX         N         2,150         2,400         200         300         4,23           Sanyo         LC86XXX         C         0         0         400         80           Sanyo         LC86XXX         N         1,800         1,930         200         300         4,23           Sanyo         LC86XXX         N         0         0         100         20         32           SGS-Thomson         387X         N         1,62         444	Philips	8021/22	N	10	5	0	0	15
8049/39         N         420         370         220         220         1,22           8050/40         N         95         60         30         300         22           8051/31         N         450         350         300         300         1,40           80C49/39         C         170         170         160         165         66           80C51/31         C         270         250         350         350         1,22           84CXX         C         350         550         800         820         2,53           84XX         N         2,150         2,400         2,500         2,530         9,50           Sanyo         LC86XXX         C         0         0         400         400         420           Sanyo         LC86XXX         N         1,097         848         760         531         3,23           Sanyo         JK8XX         N         1,097         848         760         531         3,23           Sanyo         JK8XX         N         1,097         848         760         531         3,23           SGS-Thomson         387X         N         162 <td></td> <td>8048/35</td> <td>N</td> <td>60</td> <td>60</td> <td>45</td> <td>50</td> <td>215</td>		8048/35	N	60	60	45	50	215
8050/40         N         95         60         30         30         22           8051/31         N         450         350         300         300         1,44           80C49/39         C         170         170         160         165         66           80C51/31         C         270         250         350         350         1,22           84CX         C         350         550         800         820         2,53           84CX         N         2,150         2,400         2,500         2,530         9,53           Sanyo         LC86XX         C         0         0         400         400         400           Sanyo         LC86XX         C         0         0         100         100         22           Sanyo         LC86XX         N         1,097         848         760         531         3,23           Sanyo         LC86XX         N         1,097         848         760         2,31         3,23           SGS-Thomson         387X         N         1,097         848         760         2,31         3,23           SGS-Thomson         387X         N		8049/39	N	420	370	220	220	1,230
8051/31         N         450         350         300         300         1,44           80C49/39         C         170         170         160         165         66           80C51/31         C         270         250         350         350         1,22           84CXX         C         350         550         800         820         2,53           84XX         N         2,150         2,400         2,500         2,530         9,55           Rockwell         6500/XK         N         1,800         1,930         200         300         4,22           Sanyo         LC86XXX         C         0         0         400         400         88           Sanyo         LM88XX         N         0         0         100         100         20           SGS-Thomson         387X         N         1,097         848         760         531         3,23           38P7X         N         18         26         33         33         11           6805         N         714         408         565         1,82           5805         N         714         640         660 <t< td=""><td></td><td>8050/40</td><td>N</td><td>95</td><td>60</td><td>30</td><td>30</td><td>215</td></t<>		8050/40	N	95	60	30	30	215
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		8051/31	N	450	350	300	300	1,400
80C51/31         C         270         250         350         350         1,22           84CXX         C         350         550         800         820         2,53         9,56           84XX         N         2,150         2,400         2,500         2,530         9,56           Rockwell         6500/XX         N         1,800         1,930         200         300         4,22           Sanyo         LC86XXX         C         0         0         400         400         80           SGS-Thomson         387X         N         1,097         848         760         531         3,23           38F7/X         N         18         26         33         33         10           6801/03         N         362         494         408         565         1,82           6805         N         754         739         644         660         2,79           F8         N         11         10         0         0         2           Sharp         CUSTOM         C         0         0         80         90         17           Siemens         802XX         N         24 <td></td> <td>80C49/39</td> <td>С</td> <td>170</td> <td>170</td> <td>160</td> <td>165</td> <td>665</td>		80C49/39	С	170	170	160	165	665
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		80C51/31	с	270	250	350	350	1,220
84XXN $2,150$ $2,400$ $2,500$ $2,530$ $9,530$ Rockwell6500/XXN $1,800$ $1,930$ $200$ $300$ $4,22$ SanyoLC86XXXC00 $400$ $400$ $860$ LM88XXN00100 $100$ $200$ SGS-Thomson $387X$ N $1,097$ $848$ $760$ $531$ $3,223$ $38P7X$ N $18$ $26$ $33$ $33$ $111$ $6801/03$ N $362$ $494$ $408$ $565$ $1,823$ $6805$ N $754$ $739$ $644$ $660$ $2,75$ $F8$ N $111$ $10$ $0$ $0$ $226$ SharpCUSTOMC $0$ $0$ $80$ $90$ $117$ Stemens $802XX$ N $24$ $11$ $12$ $19$ $06$ Siemens $802XX$ N $24$ $11$ $12$ $19$ $06$ Signetics $8051/31$ N $1,176$ $1,477$ $1,231$ $1,239$ $5,123$ Signetics $8052/32$ N $643$ $722$ $565$ $712$ $2,644$ Signetics $8048/35$ N $897$ $634$ $718$ $600$ $2,44$ Signetics $8048/35$ N $877$ $125$ $140$ $150$ $565$		84CXX	С	350	550	800	820	2,520
Rockwell         6500/XX         N         1,800         1,930         200         300         4,23           Sanyo         LC86XXX         C         0         0         400         400         86           Sanyo         LC86XXX         N         0         0         100         100         20           SGS-Thomson         387X         N         1,097         848         760         531         3,23           38P7X         N         18         26         33         33         11           6801/03         N         362         494         408         565         1,85           6805         N         754         739         644         660         2,75           6805         N         711         10         0         0         2           F8         N         11         10         0         0         2           Sharp         CUSTOM         C         0         0         80         90         17           SM-Series         C         125         100         100         100         42           Siemens         802XX         N         24         11		84XX	N	2,150	2,400	2,500	2,530	9,580
Sanyo         LC86XXX         C         0         0         400         400         680           SGS-Thomson         387X         N         1,097         848         760         531         3,23           38P7X         N         1,097         848         760         531         3,23           38P7X         N         18         26         33         33         14           6801/03         N         362         494         408         565         1,82           6805         N         754         739         644         660         2,75           F8         N         11         10         0         0         2           Sharp         CUSTOM         C         0         0         80         90         17           Sharp         CUSTOM         C         0         0         80         90         17           Sharp         Z8         N         125         100         100         100         400           Siemens         802XX         N         24         11         12         19         60           Signetics         8048/35         N         304	Rockwell	6500/XX	N	1,800	1,930	200	300	4,230
LM88XX         N         0         0         100         100         20           SGS-Thomson         387X         N         1,097         848         760         531         3,22           38P7X         N         18         26         33         33         14           6801/03         N         362         494         408         565         1,82           6805         N         754         739         644         660         2,75           F8         N         11         10         0         0         2           Z8         N         136         148         89         71         44           Sharp         CUSTOM         C         0         0         80         90         17           Sharp         Z8         N         125         100         100         44           Sharp         Z8         N         125         100         100         44           Siemens         802XX         N         24         11         12         19         6           Signetics         8051/31         N         1,176         1,477         1,231         1,239	Sanyo	LC86XXX	с	0	0	400	400	800
SGS-Thomson       387X       N       1,097       848       760       531       3,23         38P7X       N       18       26       33       33       14         6801/03       N       362       494       408       565       1,82         6805       N       754       739       644       660       2,75         F8       N       11       10       0       0       2         Z8       N       136       148       89       71       44         Sharp       CUSTOM       C       0       0       80       90       17         SM-Series       C       125       100       100       100       42         Siemens       802XX       N       24       11       12       19       6         8048/35       N       325       387       308       325       1,34         8051/31       N       1,176       1,477       1,231       1,239       5,12         8052/32       N       643       722       565       712       2,64         Signetics       8048/35       N       8       0       0       10		LM88XX	N	0	0	100	100	200
38P7X       N       18       26       33       33       14         6801/03       N       362       494       408       565       1,82         6805       N       754       739       644       660       2,75         F8       N       11       10       0       0       2         Z8       N       136       148       89       71       44         Sharp       CUSTOM       C       0       0       80       90       17         Sharp       CUSTOM       C       0       0       80       90       17         Sharp       CUSTOM       C       0       0       80       90       17         Siemens       802XX       N       125       100       100       100       42         Siemens       802XX       N       24       11       12       19       6         8048/35       N       325       387       308       325       1,34         8051/31       N       1,176       1,477       1,231       1,239       5,12         8052/32       N       643       722       565       712	SGS-Thomson	387X	N	1,097	848	760	531	3,236
6801/03       N       362       494       408       565       1,82         6805       N       754       739       644       660       2,79         F8       N       11       10       0       0       2         Z8       N       136       148       89       71       44         Sharp       CUSTOM       C       0       0       80       90       17         SM-Series       C       125       100       100       100       42         Siemens       802XX       N       225       100       100       100       42         Siemens       802XX       N       24       11       12       19       6         Siemens       802XX       N       325       387       308       325       1,34         Signetics       8048/35       N       304       411       536       723       1,97         Signetics       8048/35       N       80       0       0       10       10         Signetics       8048/35       N       8       0       0       10       10         Signetics       8048/35       N		38 <b>P7X</b>	N	18	26	33	33	110
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		6801/03	N	362	494	408	565	1,829
F8N1110002Z8N136148897144SharpCUSTOMC00809017SM-SeriesC12510010010042Z8N12510010010042Siemens802XXN2411121968048/35N3253873083251,348051/31N1,1761,4771,2311,2395,1280515/35N3044115367231,978052/32N6437225657122,64Signetics8048/35N80010108050/40N273126149150665		6805	N	754	739	644	660	2,797
Z8       N       136       148       89       71       44         Sharp       CUSTOM       C       0       0       80       90       17         SM-Series       C       125       100       100       100       42         Z8       N       125       100       100       100       42         Siemens       802XX       N       24       11       12       19       0         8048/35       N       325       387       308       325       1,34         8051/31       N       1,176       1,477       1,231       1,239       5,12         8051/35       N       304       411       536       723       1,97         8051/35       N       304       411       536       712       2,64         Signetics       8048/35       N       8       0       0       1       1         8049/39       N       497       634       718       600       2,44         8050/40       N       273       126       149       150       66		F8	N	11	10	0	0	21
Sharp         CUSTOM         C         0         0         80         90         17           SM-Series         C         125         100         100         100         42           Z8         N         125         100         100         100         42           Siemens         802XX         N         24         11         12         19         6           8048/35         N         325         387         308         325         1,34           8051/31         N         1,176         1,477         1,231         1,239         5,12           8051/35         N         304         411         536         723         1,97           8052/32         N         643         722         565         712         2,64           Signetics         8048/35         N         8         0         0         1           8049/39         N         497         634         718         600         2,44           8050/40         N         273         126         149         150         665		<b>Z</b> 8	N	136	148	89	71	444
SM-Series         C         125         100         100         100         42           Z8         N         125         100         100         100         42           Siemens         802XX         N         24         11         12         19         6           8048/35         N         325         387         308         325         1,34           8051/31         N         1,176         1,477         1,231         1,239         5,12           8051/35         N         304         411         536         723         1,97           8052/32         N         643         722         565         712         2,64           Signetics         8048/35         N         8         0         0         10         1           8052/32         N         643         722         565         712         2,64           Signetics         8048/35         N         8         0         0         10         1           8050/40         N         273         126         149         150         665	Sharp	CUSTOM	С	0	0	80	90	170
Z8         N         125         100         100         100         42           Siemens         802XX         N         24         11         12         19         6           8048/35         N         325         387         308         325         1,34           8051/31         N         1,176         1,477         1,231         1,239         5,12           8051/35         N         304         411         536         723         1,97           8052/32         N         643         722         565         712         2,64           Signetics         8048/35         N         8         0         0         10         1           8052/32         N         643         722         565         712         2,64           Signetics         8048/35         N         8         0         0         10         1           8050/40         N         497         634         718         600         2,44		SM-Series	С	125	100	100	100	425
Siemens         802XX         N         24         11         12         19         0           8048/35         N         325         387         308         325         1,34           8051/31         N         1,176         1,477         1,231         1,239         5,12           8051/35         N         304         411         536         723         1,97           8052/32         N         643         722         565         712         2,64           Signetics         8048/35         N         8         0         0         10         1           8049/39         N         497         634         718         600         2,44           8050/40         N         273         126         149         150         660		<b>Z</b> 8	N	125	100	100	100	425
8048/35         N         325         387         308         325         1,34           8051/31         N         1,176         1,477         1,231         1,239         5,12           80515/35         N         304         411         536         723         1,97           8052/32         N         643         722         565         712         2,64           Signetics         8048/35         N         8         0         0         10         1           8049/39         N         497         634         718         600         2,44           8050/40         N         273         126         149         150         665	Siemens	802XX	N	24	11	12	19	66
8051/31         N         1,176         1,477         1,231         1,239         5,12           8051/35         N         304         411         536         723         1,97           8052/32         N         643         722         565         712         2,64           Signetics         8048/35         N         8         0         0         10         1           8049/39         N         497         634         718         600         2,44           8050/40         N         273         126         149         150         660		8048/35	N	325	387	308	325	1,345
80515/35         N         304         411         536         723         1,97           8052/32         N         643         722         565         712         2,64           Signetics         8048/35         N         8         0         0         10         1           8049/39         N         497         634         718         600         2,44           8050/40         N         273         126         149         150         660		8051/31	N	1,176	1,477	1,231	1,239	5,123
8052/32         N         643         722         565         712         2,64           Signetics         8048/35         N         8         0         0         10         1           8049/39         N         497         634         718         600         2,44           8050/40         N         273         126         149         150         66		80515/35	N	304	411	536	723	1,974
Signetics         8048/35         N         8         0         0         10         1           8049/39         N         497         634         718         600         2,44           8050/40         N         273         126         149         150         660		8052/32	N	643	722	565	712	2,642
8049/39 N 497 634 718 600 2,44 8050/40 N 273 126 149 150 66	Signetics	8048/35	N	8	0	0	10	18
8050/40 N 273 126 149 150 66		8049/39	N	497	634	718	600	2,449
		8050/40	N	273	126	149	150	698
8051/31 N 950 1,057 1,081 950 4,03		8051/31	N	950	1,057	1,081	950	4,038
8052/32 N 220 468 790 480 1,95		8052/32	N	220	468	790	480	1,958
80C451 C 26 6 13 10 5		80C451	С	26	6	13	10	55
80C51/31 C 299 415 499 440 1,65		80C51/31	С	299	415	499	440	1,653
8400 N 10 0 0 1		8400	N	10	0	0	0	10
. 8441 C 16 2 0 0 1		8441	С	16	2	0	0	18
<u>87C451 C 4 0 5 6 1</u>		87C451	С	4	0	5	6	15

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#### Chapter 2

#### Table 16 (Continued)

#### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

	Product	Process	Q1/88	Q2/88	Q3/88	Q4/88	1988
Sony	SPC700	c	0	0	300	500	800
π	TM\$7000	N	1,600	2,200	2,600	2,400	8,800
Toshiba	8048/35	N	220	220	225	225	890
	8049/39	N	370	370	375	370	1,485
	80C48/35	С	800	800	800	800	3,200
-	80C49/39	С	1,000	1,050	1,050	1,100	4,200
	80C50/40	с	200	200	205	215	820
	TLCS-90	С	50	150	250	400	850
Zilog	<b>Z</b> 8	N	925	1,300	1,500	1,300	5,025
Total 8-B	it MCUs		86,461	95,231	98,323	97,461	377,476

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'Hamis acquired GE Solid State and RCA, 1988. Source: Dataquest (June 1990)

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#### Table 17

#### Estimated 8-bit Microcontroller Unit Shipment by Quarter for 1989 (Thousands of Units)

	Product	Process	Q1/89	Q2/89	Q3/89	Q4/89	1989
AMD	8051/31	N	525	530	450	250	1,755
	80515/535	N	6	10	8	10	34
	8053	N	270	300	350	300	1,220
	80C51/31	С	450	350	360	390	1,550
	80C521/321	С	30	100	130	175	435
	80C5292/3292	С	100	275	310	355	1,040
	8751	N	75	75	75	70	295
	8753	N	25	45	45	40	155
	89C51	С	0	10	30	65	105
Fujitsu	8048/35	N	30	30	30	30	120
	8049/39	N	70	70	70	70	280
	8051/31	N	60	60	60	60	240
	80C49/39	С	130	140	150	165	585
	MB897XX	С	522	528	550	600	2,200
Harris (GE-SS/RCA)	6805	N	53	88	65	60	266
	68HC05	С	355	600	750	1,000	2,705
Hitachi	6301	С	3,200	3,300	3,500	4,000	14,000
	63 <b>05</b>	С	2,800	2,700	2,600	2,500	10,600
	63701	С	300	400	550	700	1,950
	63705	С	160	180	200	230	7 <b>7</b> 0
	63P01	С	275	280	285	290	1,130
	63 <b>P05</b>	С	380	385	390	395	1,550
	6801/03	N	1,300	1,100	1,000	900	4,300
	6805	N	1,800	1,600	1,300	1,000	5,700
	68P01	N	245	250	255	260	1,010
	68P05	N	265	250	240	220	975
	H8/532	С	10	40	50	100	200
Intel	8048/35	N	400	290	250	200	1,140
	8049/39	N	2,400	2,320	2,000	2,000	8,720
	8050/40	N	400	320	450	350	1,520
	8051/31	N	2,600	3,120	3,500	3,000	12,220
	8052/32	N	2,200	2,460	3,200	2,700	10,560
	80C51/31	С	2,100	2,800	3,000	2,900	10,800
	8748	N	200	180	175	135	690
	874 <del>9</del>	N	600	670	1,000	815	3,085
	8751	N	200	230	265	210	905
	8752	С	90	40	210	340	680
	87C51	<u> </u>	100	260	200	260	820
							(Continued)

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#### Table 17 (Continued)

#### Estimated 8-bit Microcontroller Unit Shipment by Quarter for 1989 (Thousands of Units)

	Product	Process	Q1/89	Q2/89	Q3/89	Q4/89	1989
Matra-Harris	8052/32	N	150	100	60	0	310
	80C51/31	¢	625	640	690	655	2,610
	80C52/32	С	370	590	875	1,110	2,945
	80C752	с	0	0	10	35	45
	83C154	C	55	75	70	90	290
Matsushita	MN1800/70/80	С	2,300	2,600	4,000	3,000	11,900
Microchip Technology	PIC1652/54	N	1,192	1,232	992	649	4,065
	PIC1670/72	N	88	81	58	42	269
	PIC16C52/C54	С	168	350	355	456	1,329
	PIC70XX	N	66	64	54	91	275
Mitsubishi	8048/35	N	40	40	40	10	130
	8049/39	N	200	150	150	150	650
	8050/40	N	40	40	40	40	160
	80C49/39	С	250	250	250	200	950
	M507XX	С	5,000	5,000	5,000	5,500	20,500
	M509XX	С	6,000	5,500	6,000	6,500	24,000
Motorola	146805	С	1,224	1,120	1,228	1,230	4,802
	6801/03	N	2,101	1,988	1,600	1,500	7,189
	6804	N	1,402	1,578	1,100	900	4,980
	6805	N	7,316	6,825	7,000	7,000	28,141
	68HC05	С	5,256	7,613	14,000	17,700	44,569
	68HC11	С	3,404	4,116	4,500	5,200	17,220
National	8048/35	N	65	40	75	65	245
	8049/39	N	450	800	1,300	1,500	4,050
	8050/40	N	375	350	350	360	1,435
	COP800	С	710	720	1,550	1,950	4,930
NCR	6500/1	N	0	2	71	257	330
	6500/11	N	6	2	0	6	14
NEC	8021/22	N	10	7	5	3	25
	8041	N	270	270	230	230	1,000
	8048/35	N	600	550	500	470	2,120
	8049/39	N	900	910	800	750	3,360
	80C48/35	С	240	270	300	290	1,100
	80C49/39	С	800	850	900	890	3,440
	8741	N	165	170	185	182	702
	8748	N	150	155	160	155	620
	8749	N	440	445	400	350	1,635
	uPD78XX	N	8,800	8,900	9,200	9,200	36,100
	uPD78XXX	N	500	600	700	900	2,700
	V25	<u> </u>	10	30	40	70	150 (Continued)

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#### Table 17 (Continued)

#### Estimated 8-bit Microcontroller Unit Shipment by Quarter for 1989 (Thousands of Units)

	Product	Process	Q1/89	Q2/89	Q3/89	Q4/89	1989
Oki	80C154	С	750	1,000	1,200	1,500	4,450
	80C48/35	С	100	100	100	100	400
	80C49/39	с	900	700	500	500	2,600
	80C51/31	С	700	800	700	760	2,960
Philips	8048/35	N	50	55	65	60	230
	8049/39	N	230	255	275	272	1,032
	8050/40	N	20	25	35	30	110
	8051/31	N	275	295	320	315	1,205
	80C49/39	С	170	180	190	185	725
	80C51/31	С	355	415	475	470	1,715
	84CXX	С	825	830	840	835	3,330
	84XX	N	2,550	2,600	2,650	2,645	10,445
Rockwell	6500/XX	N	980	1,200	850	1,150	4,180
Sanyo	LC86XXX	С	400	400	500	600	1,900
	LM88XX	N	100	100	100	100	400
SGS-Thomson	387X	N	1,047	986	912	816	3,761
	38P7X	N	18	20	13	12	63
	6801/03	N	475	370	268	315	1,428
	6805	N	915	1,248	1,245	1,890	5,298
	Z8	N	202	301	212	140	855
Sharp	CUSTOM	С	220	300	320	360	1,200
	SM-Series	С	300	380	400	420	1,500
	Z8	N	130	133	137	135	535
Siemens	802XX	N	9	4	15	11	39
	8048/35	N	334	409	320	160	1,223
	8051/31	N	1,175	1,010	1,260	1,500	4,945
•	80515/35	N	733	950	900	990	3,573
	8052/32	N	752	739	795	1,234	3,520
Signetics	8049/39	N	526	810	988	1,473	3,797
-	8051/31	N	635	691	830	765	2,921
	8052/32	N	1,000	1,156	1,052	825	4,033
	80C451	С	7	8	6	23	44
	80C51/31	С	912	1,256	1,303	779	4,250
	87C451	С	27	16	25	30	98
	87C51	С	125	103	43	45	316
	87C751	С	10	24	14	29	77
Sony	SPC700	с	1,000	1,300	1,500	1,600	5,400
ті	TMS370	С	1	25	50	100	176
	TMS7000	N	2,800	2,500	2,500	2,000	9,800
							(Continued)

#### 8-Bit Microcontrollers

#### Table 17 (Continued)

#### Estimated 8-bit Microcontroller Unit Shipment by Quarter for 1989 (Thousands of Units)

	Product	Process	Q1/89	Q2/89	Q3/89	Q4/89	1989_
Toshiba	8048/35	N	17 <del>0</del>	130	100	100	500
	8049/39	N	250	190	150	150	740
	80C48/35	с	700	500	250	250	1,700
	80C49/39	С	950	800	750	750	3,250
	80C50/40	с	220	200	240	240	900
	TLCS-870	С	0	0	30	100	130
	TLCS-90	С	500	650	800	900	2,850
Zilog	Z8	N	1,500	1,600	1,500	1,900	6,500
Total 8-B	hit MCUs		102,512	109,173	120,619	126,395	458,699
Source: Dataquest	(June 1990)						

Chapter 2

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Chapter 3

# **16-Bit Microcontrollers**

The following section includes historical 16-bit microcontroller unit shipments by year, manufacturer, product name, and process technology.

The tables are organized as follows:

Table	1	Estimated	16-Bit	Microcontroller	Ųnit	Shipments	bу	Manufacturer, 1980-1984
Table	2	Estimated	16-Bit	Microcontroller	Unit	Shipments	by	Manufacturer, 1985-1989
Table	3	Estimated	16-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1980
Table	4	Estimated	16-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1981
Table	5	Estimated	16- <b>B</b> it	Microcontroller	Unit	Shipments	by	Quarter for 1982
Table	6	Estimated	16-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1983
Table	7	Estimated	16-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1984
Table	8	Estimated	16- <b>B</b> it	Microcontroller	Unit	Shipments	by	Quarter for 1985
Table	9	Estimated	16-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1986
Table	10	Estimated	16-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1987
Table	11	Estimated	16-Bit	Microcontroller	Unit	Shipments	by	Quarter for 1988
Table	12	Estimated	16- <b>B</b> it	Microcontroller	Unit	Shipments	by	Quarter for 1989

#### Microcontroller Historical Shipment Data, 1975-1989

#### Chapter 3

#### Table 1

#### Estimated 16-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

	Product	Process	1980	1981	1982	1983	1984
Intel	8096	N	0	0	0	<u> </u>	1
Texas Instruments	9940	N	8	36	50	89	122
Total 16-Bit N	<b>ACUs</b>		8	36	50	89	123

Source: Dataquest (June 1990)

#### Table 2

#### Estimated 16-Bit Microcontroller Unit Shipments by Manufacturer (Thousands of Units)

	Product	Process	1985	1986	1987	1988	1989
Hitachi	H16	с	0	0	0	0	35
Intel	8096	N	145	269	548	1,670	3,105
	8098	N	0	0	0	80	30
	80C196	С	0	0	0	60	215
Mitsubishi	M377XX	с	0	0	0	0	180
Mostek <sup>1</sup>	68200	N	12	129	110	0	0
National	HPC	С	0	0	25	250	625
NEC	V35	с	0	0	2	9	18
SGS-Thomson <sup>1</sup>	68200	N	0	0	0	64	57
п	9940	N	75	1	O	0	0
Various <sup>2</sup>	8061	С	0	0	2,626	3,328	3,173
Total 16-B	it MCUs		232	399	3,311	5,461	7,438

<sup>1</sup>Thomson Components acquired Mostek Corporation in 1985. Thomson and SGS merged in 1987. <sup>2</sup>The 8061 is a custom-designed 16-bit microcontroller for Pord Motor Company. It is supplied by several semiconductor companies, including Intel. Esti-mated production of the 8061 is based on production of Ford automobiles and trucks. (No attempt to estimate production prior to 1987 has been made.) Source: Dataquest (June 1990)

#### Table 3

#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1980 (Thousands of Units)

	Product	Process	Q1/80	Q2/80	Q3/80	Q4/80	1980
Texas Instruments	9940	N	1	1	2	4	8
Total 16-Bit M	CUs		1	1	2	4	8
Source: Dataquest (June 199	20)						

#### 16-Bit Microcontrollers

#### Table 4

#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

	Product	Process	Q1/81	Q2/81	Q3/81	Q4/81	1981
Texas Instruments	9940	N	6	10	10	10	36
Total 16-Bit M	CUs		6	10	10	10	36
Source: Dataquest (June 19)	90)						

#### Table 5

#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1982 (Thousands of Units)

	Product	Process	Q1/82	Q2/82	Q3/82	Q4/82	1982
Texas Instruments	9940	N	10	10	15	15	50
Total 16-Bit MC	Us		10	10	15	15	50
Source: Dataquest (June 1990)	)						

#### Table 6

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#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

	Product	Process	Q1/83	Q2/83	Q3/83	Q4/83	1983
Texas Instruments	<del>9940</del>	N	20	22	22	25	89
Total 16-Bit M	CUs		20	22	22	25	89
Source: Dataquest (June 199	20)						

#### Table 7

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#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

	Product	Process	Q1/84	Q2/84	Q3/84	Q4/84	1984
Intel	8096	N	0	0	0	1	1
Texas Instruments	9940	N	30	` 30	31	31	122
Total 16-Bit MC	CUs		30	30	31	32	123

Source: Dataquest (June 1990)

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#### Microcontroller Historical Shipment Data, 1975-1989

#### Chapter 3

#### Table 8

#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

	Product	Process	Q1/85	Q2/85	Q3/85	Q4/85	1 <b>985</b>	
Intel	8096	N	25	40	40	40	145	
TCMC (Mostek) <sup>1</sup>	68200	N	0	0	1	11	12	
Texas Instruments	9940	N	25	15	15	20	75	
Total 16-Bit M	CUs		50	55	56	71	232	

<sup>1</sup>Thomson Components acquired Mostek Corporation in 1985, forming Thomson Components Mostek Corporation (TCMC). Source: Dataquest (June 1990)

#### Table 9

#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

	Product	Process	Q1/86	Q2/86	Q3/86	Q4/86	1986
Intel	8096	N	58	66	73	72	269
TCMC (Mostek)	68200	N	18	32	44	35	129
Texas Instruments	9940	N	1	0	0	0	1
Total 16-Bit M	ICUs		77	98	117	107	399
Source: Dataquest (June 19	90)						

#### Table 10

#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

	Product	Process	Q1/87	Q2/87	_Q3/87	Q4/87	1 <b>987</b>	_
Intel	8096	N	86	82	130	250	548	
National	HPC	С	0	0	0	25	25	
NEC	V35	С	0	0	0	2	2	
SGS-Thomson	68200	N	10	20	55	25	110	
Various <sup>1</sup>	8061	С	685	570	645	726	2,626	
Total 16-Bit M	CUs		781	672	830	1,028	3,311	

<sup>1</sup>The 8061 is a custom-designed 16-bit microcontroller for Ford Motor Company. It is supplied by several semiconductor companies, including Intel. Estimated production of the 8061 based on production of Ford sutomobiles and trucks. (No stiempt to estimate production prior to 1987 has been made.) Source: Datageest (June 1990)

#### Chapter 3

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#### **16-Bit Microcontrollers**

#### Table 11

	Product	Process	Q1/88	Q2/88	Q3/88	Q4/88	1988
Intel	8096	N	300	400	370	600	1,670
	8098	N	0	20	30	30	80
	80C196	С	10	20	10	20	60
National	HPC	С	40	55	80	75	250
NEC	V35	С	2	2	2	3	9
SGS-Thomson	68200	N	16	19	0	29	64
Various	8061	с	902	940	656	830	3,328
Total 16-Bit	MCUs		1,270	1,456	1,148	1,587	5,461

#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

<sup>1</sup>The 8061 is a custom-designed 16-bit microcontroller for Ford Motor Company. It is supplied by serveral semiconductor companies including Intel. Estimated production of the 8061 is based on production of Ford automobiles and trucks. Source: Dataquest (June 1990)

#### Table 12

#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1989 (Thousands of Units)

	Product	Process	Q1/89	Q2/89	Q3/89	Q4/89	1989	
Hitachi	H16	C	5	5	10	15	35	
Intel	8096	N	600	780	825	900	3,105	
	8098	N	30	0	0	0	30	
	80C196	С	20	40	55	100	215	
Mitsubishi	M377XX	С	10	20	50	100	180	
National	HPC	с	105	90	180	250	625	
NEC	<b>V</b> 35	С	4	4	5	5	18	
SGS-Thomson	68200	N	19	26	1	11	57	
Various	8061	С	867	90 <del>9</del>	619	778	3,173	
Total 16-Bit MC	Us		1,660	1,874	1,745	2,159	7,438	

<sup>1</sup>The 8061 is a custom-designed 16-bit microcontroller for Ford Motor Company. It is supplied by several semiconductor companies, including Intel. Estimated production of the 8061 is based on production of Ford automobiles and trucks. Source: Dataquest (June 1990)

Estimated 16-Bit

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The following section, 4-Bit Microcontroller Data Tables, includes historical microcontroller unit shipments by year, manufacturer, product name, and process technology.

The tables are organized as follows:

Table 1	Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer, 1975-1979
Table 2	Estimated 4–Bit Microcontroller Unit Shipments by Manufacturer, 1980–1984
Table 3	Estimated 4–Bit Microcontroller Unit Shipments by Manufacturer, 1985–1988
Table 4	Estimated 4-Bit Microcontroller Unit Shipments by Quarter, 1975-1976
Table 5	Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1977
Table 6	Estimated 4–Bit Microcontroller Unit Shipments by Quarter for 1978
Table 7	Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1979
Table 8	Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1980
Table 9	Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1981
Table 10	Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1982
Table 11	Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1983
Table 12	Estimated 4–Bit Microcontroller Unit Shipments by Quarter for 1984
Table 13	Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1985
Table 14	Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1986
Table 15	Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1987
Table 16	Estimated 4–Bit Microcontroller Unit Shipments by Quarter for 1988

#### Table 1

#### Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1975-1979 (Thousands of Units)

	Product	<u>Process</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
Gould/AMI	S2000	N	o	0	0	29	1,425
Hitachi	HMCS-40	P/N/C	0	0	0	410	655
Matsushita	MN1400	P/N/C	0	0	0	0	4,400
Motorola	141000	с	0	0	0	20	285
National	COPS	N/C	0	0	0	2,325	5,600
NEC	uCOM-4	P/C	0	0	0	1,500	7,800
Rockwell	PPS-4	P/N	450	450	575	2,275	3,900
Sharp	SM-3	P	0	0	0	0	360
TI	TMS1000	P/C	<u>    50</u>	<u>310</u>	2,825	9,400	<u>26,100</u>
Total 4-B	it MCUs		500	760	3,400	15,959	50,525

Source: Dataquest July 1989



#### Table 2

#### Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

	Product	Process	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Eurotechnique	COPS	N/C	0	0	190	840	0
Fujitsu	MB884X	N	0	9,200	9,900	7,500	6,100
-	MB885X	С	185	2,050	3,150	3,110	2,720
Gould/AMI	S2000	N	1,120	390	566	115	0
Hitachi	HMCS-40	P/N/C	1,425	19,000	20,600	20,600	22,400
Matsushita	MN1400	P/N/C	10,300	11,250	14,580	18,420	20,400
	MN1500	ท	20	1,250	1,620	6,360	8,600
Motorola	141000	С	240	149	112	130	80
National	COPS	N/C	11,500	11,500	16,200	21,000	26,700
NEC	uCOM-4	P/C	14,800	19,800	25,700	21,000	16,930
	uPD75XX	с	0	3,200	8,000	15,100	31,500
Oki	Series-40	С	90	550	2,450	5,480	6,400
Rockwell	PPS-4	P/N	5,800	2,500	1,675	1,800	2,135
SGS-Thomson	COPS	N	0	0	0	0	2,790
Sharp	SM-3	P	600	920	990	840	800
•	SM-4	С	1,200	1,600	1,950	1,750	1,840
	SM-5	с	4,800	10,690	9,400	10,350	12,190
TI	TM\$1000	P/C	44,000	39,500	26,000	11,900	8,300
Toshiba	<b>T-Series</b>	с	0	0	8,300	9,800	6,000
	TLCS-43	N	0	0	3,300	9,200	8,000
	TLCS-46	С	0	0	2,900	3,580	3,250
	TLCS-47	N	0	0	600	3,070	<u> </u>
Total 4-B	it MCUs		96,080	133,549	158,183	171,945	193,435

Source: Dataquest July 1989

Table 3

#### Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988 (Thousands of Units)

	Product	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Fujitsu	MB882XX	с	0	0	760	1,400
-	MB8840X	ท	0	0	1,843	1,910
	MB884X	N	5,634	6,580	7,160	6,840
	MB8850X	С	0	0	485	3,500
	MB885X	С	2,156	3,425	3,742	3,990
Hitachi	HMCS-40	P/N/C	22,352	21,919	25,900	21,500
	HMCS-400	С	N/A	N/A	32,100	26,500
Matsushita	MN1400	P/N/C	20,600	17,420	11,875	8,400
	MN1500	N	11,300	27,680	42,090	49,580
	MN1700	С	0	0	2,085	4,700
Mitsubishi	M5043X/44X	с	0	0	13,995	13,200
	M5046X/56X	С	0	0	13,105	19,800
	M5072/76	С	0	0	15,054	14,100
	M509X	С	0	0	2,056	6,430
	M50XXX	С	0	27,844	0	N/A
Motorola	141000	С	4	0	0	0
National	COPS	N/C	23,500	31,273	31,970	30,450
NEC	uCOM-4	P/C	9,920	5,700	3,680	6,450
	uCOM75X	N/C	0	3,900	16,810	17,850
	uPD75XX	С	31,590	41,920	47,670	63,600
Oki	Series-40	С	6,614	7,217	6,689	7,580
Rockwell	PPS-4	P/N	1,400	1,160	790	325
SGS-Thomson	COPS	N	5,242	6,330	7,515	8,850
Sharp	SM-Series*	С	10,370	9,140	9,510	21,750
TI	TMS1000	P/C	3,900	16,025	13,400	7,800
Toshiba	<b>T-Series</b>	С	5,580	4,600	6,265	14,050
	TLCS-42	N/C	1,250	3,850	4,060	4,650
	TLCS-43	N	5,672	2,600	2,209	4,650
	TLCS-46	С	2,198	400	202	480
	TLCS-47	N	7,756	7,200	5,935	9,890
	TLCS-47	с	0	15,300	17,497	32,250
	TLCS-470	С	0	400	1,360	100
Others**	Unspecified	с	0	10,000	44,520	<u>88,500</u>
Total 4-	Bit MCUs		177,038	271,883	392,332	501,075
*Sharp SM-Se	ries totaled in	1985.				

\*\*Dataquest estimate for companies not surveyed (i.e., Ricoh, Sanyo, Sony). N/A = Not Available

> Source: Dataquest July 1989

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#### Table 4

#### Estimated 4-Bit Microcontroller Unit Shipments by Quarter 1975-1976 (Thousands of Units)

	<b>Product</b>	Process	<u>1975</u>	<u>01/76</u>	02/76	<u>03/76</u>	04/76	<u>1976</u>
Rockwell	PPS-4	P	450	100	110	120	120	450
TI	TMS-1000	P/C	<u> </u>	_60	<u>75</u>	75	<u>100</u>	<u>310</u>
Total	4-Bit MCUs		500	160	185	195	220	760

Source: Dataquest July 1989

#### Table 5

#### Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1977 (Thousands of Units)

	Product	Process	<u>01/77</u>	<u>02/77</u>	<u>03/77</u>	04/77	<u>1977</u>
Rockwell	PPS-4	P	145	145	140	145	575
TI	TMS-1000	P/C	<u>225</u>	<u>400</u>	<u>1,000</u>	<u>1,200</u>	<u>2,825</u>
Total	4-Bit MCUs		370	545	1,140	1,345	3,400

Source: Dataquest July 1989

#### Table 6

#### Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1978 (Thousands of Units)

	<b>Product</b>	Process	<u>01/78</u>	<u>02/78</u>	<u>03/78</u>	<u>04/78</u>	<u>1978</u>
Gould	S2000	N	0	9	8	12	29
Hitachi	HMCS-40	P/N/C	85	95	110	120	410
Motorola	141000	С	0	0	5	15	20
National	COPS	C/N	300	500	675	850	2,325
NEC	UCOM-4	P/C	150	225	525	600	1,500
Rockwell	PPS-4	P	400	550	675	650	2,275
TI	TMS-1000	P/C	<u>1,400</u>	<u>1,800</u>	3,000	<u>3.200</u>	9,400
Total	4-Bit MCUs		2,335	3,179	4,998	5,447	15,959

Source: Dataquest July 1989

#### Table 7

#### Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1979 (Thousands of Units)

	<u>Product</u>	Process	01/79	02/79	03/79	<u>04/79</u>	<u>1979</u>
Gould	S2000	N	50	300	675	400	1,425
Hitachi	HMCS-40	P/N/C	130	150	175	200	655
Matsushita	MN1400	P/N/C	500	800	1,400	1,700	4,400
Motorola	141000	с	30	75	90	90	285
National	COPS	C/N	900	1,100	1,500	2,100	5,600
NEC	UCOM-4	P/C	1,100	1,300	2,300	3,100	7,800
Rockwell	PPS-4	P	600	1,100	1,100	1,100	3,900
Sharp	SM-3	P	*	*	*	*	360
TI	TMS-1000	P/C	4,200	5,400	7,500	9,000	26,100
Total 4	-Bit MCUs		7,510	10,225	14,740	17,690	50,525

\*No quarterly data available for Sharp SM-3.

Source: Dataquest July 1989

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#### Table 8

#### Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1980 (Thousands of Units)

	Product	Process	<u>01/80</u>	02/80	<u>03/80</u>	<u>04/80</u>	<u>1980</u>
Fujitsu	8850	с	10	25	50	100	185
Gould	S2000	N	180	340	490	110	1,120
Hitachi	HMCS-40	P/N/C	225	300	400	500	1,425
Matsushita	MN1400	P/N/C	2,200	3,000	3,000	2,100	10,300
	MN1500	N	0	0	S	20	20
Motorola	141000	С	70	50	60	60	240
National	COPS	C/N	2,700	3,200	2,800	2,800	11,500
NEC	UCOM-4	P/C	3,300	4,200	4,000	3,300	14,800
Oki	Series-40	С	10	15	25	40	90
Rockwell	PPS-4	P	1,400	1,700	1,700	1,000	5,800
Sharp	SM-3	P	120	140	160	180	600
-	SM-4	C	250	280	320	350	1,200
	SM-5	С	490	800	1,550	1,960	4,800
TI	TMS-1000	P/C	<u>11,000</u>	<u>12,500</u>	<u>10,000</u>	<u>10,500</u>	<u>44,000</u>
Total 4	-Bit MCUs		21,955	26,550	24,555	23,020	96,080

S = Sampled

Source: Dataquest July 1989
### Table 9

# Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

	<b>Product</b>	Process	<u>01/81</u>	<u>02/81</u>	<u>03/81</u>	<u>04/81</u>	<u>1981</u>
Eurotech.	COP	C/N	0	0	0	s	S
Fujitsu	884X	И	1,600	2,300	2,500	2,800	9,200
-	8850	с	200	500	600	750	2,050
Goulđ	S2000	N	100	100	100	90	390
Hitachi	HMCS-40	P/N/C	3,000	4,400	6,000	5,600	19,000
Matsushita	MN1400	P/N/C	2,340	2,610	3,240	3,060	11,250
	MN1500	N	260	290	360	340	1,250
Motorola	141000	с	40	80	10	19	149
National	COPS	C/N	2,500	2,600	3,000	3,400	11,500
NEC	UCOM-4	P/C	4,000	5,100	4,900	5,800	19,800
	uPD-75XX	С	0	0	1,500	1,700	3,200
Oki	Series-40	С	75	120	155	200	550
Rockwell	PPS-4	P	900	700	500	400	2,500
Sharp	SM-3	P	200	230	250	240	920
-	SM-4	с	380	400	420	400	1,600
	SM-5	с	2,490	2,800	2,800	2,600	10,690
TI	TMS-1000	P/C	10,000	<u>10,000</u>	<u>10,500</u>	<u>_9,000</u>	<u>39,500</u>
Total	4-Bit MCUs		28,085	32,230	36,835	36,399	133,549

S = Sampled

Source: Dataquest July 1989

### Table 10

# Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1982 (Thousands of Units)

	<b>Product</b>	Process	<u>01/82</u>	<u>02/82</u>	03/82	04/82	<u>1982</u>
Eurotech.	COP	C/N	S	S	80	110	190
Fujitsu	884X	N	2,800	2,500	2,300	2,300	9,900
-	8850	С	800	800	750	800	3,150
Gould	S2000	N	100	200	185	81	566
Hitachi	HMCS-40	P/N/C	6,000	5,600	4,600	4,400	20,600
Matsushita	MN1400	P/N/C	3,420	3,730	3,830	3,600	14,580
	MN1500	N	380	410	420	410	1,620
Motorola	141000	С	20	28	25	39	112
National	COPS	C/N	3,000	3,500	4,700	5,000	16,200
NEC	UCOM-4	P/C	6,000	7,200	7,000	5,000	25,700
	uPD-75XX	С	1,800	1,800	2,200	2,200	8,000
Oki	Series-40	с	250	420	830	950	2,450
Rockwell	PPS-4	P	, 425	350	500	400	1,675
Sharp	SM-3	P	250	260	240	240	990
-	SM-4	с	500	550	450	450	1,950
	SM-5	с	2,500	2,500	2,200	2,200	9,400
TI	TMS-1000	P/C	8,000	7,000	6,000	5,000	26,000
Toshiba	<b>T</b> Series	с	1,200	2,000	2,500	2,600	8,300
	TLCS-43	N	500	600	700	1,500	3,300
	TLCS-46	С	500	600	1,100	700	2,900
	TLCS-47	C/N	50	<u>_100</u>	250	200	600
Total 4	4-Bit MCUs		38,995	40,148	40,860	38,180	158,183

S = Sampled

Source: Dataquest July 1989

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# Table 11

# Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

	<b>Product</b>	Process	<u>01/83</u>	<u>02/83</u>	<u>03/83</u>	<u>04/83</u>	<u>1983</u>
Eurotech.	COP	C/N	130	160	250	300	840
Fujitsu	884X	N	2,100	1,900	1,750	1,750	7,500
-	8850	С	775	775	780	780	3,110
Gould	S2000	N	40	40	30	5	115
Hitachi	HMCS-40	P/N/C	4,800	4,800	5,400	5,600	20,600
Matsushita	MN1400	P/N/C	4,100	4,480	4,940	4,900	18,420
	MN1500	N	710	1,500	2,100	2,050	6,360
Motorola	141000	С	35	36	36	23	130
National	COPS	C/N	4,500	5,500	5,500	5,500	21,000
NEC	UCOM-4	P/C	5,000	5,000	5,500	5,500	21,000
	uPD-75XX	С	2,500	2,900	4,500	5,200	15,100
Oki	Series-4	Ċ	1,100	1,380	1,500	1,500	5,480
Rockwell	PPS-4	P	350	550	600	300	1,800
Sharp	SM-3	P	220	220	200	200	840
	SM-4	с	425	450	425	450	1,750
	SM-5	С	2,400	2,500	2,650	2,800	10,350
TI	TMS-1000	P/C	4,000	3,000	2,500	2,400	11,900
Toshiba	T Series	С	3,100	2,400	2,500	1,800	9,800
	TLCS-43	N	2,200	2,200	2,400	2,400	9,200
	TLCS-46	С	800	800	1,000	980	3,580
	TLCS-47	C/N	350	600	800	1,320	3,070
Total 4	-Bit MCUs		39,635	41,191	45,361	45,758	171,945

Source: Dataquest July 1989

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# Table 12

# Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

	<b>Product</b>	Process	01/84	02/84	<u>03/84</u>	<u>04/84</u>	<u>1984</u>
Fujitsu	884X	א	1,600	1,500	1,500	1,500	6,100
-	8850	с	770	750	650	550	2,720
Hitachi	HMCS-40	P/N/C	5,600	5,600	5,600	5,600	22,400
Matsushita	MN1400	P/N/C	5,200	5,200	5,000	5,000	20,400
	MN1500	N	2,100	2,300	2,100	2,100	8,600
Motorola	141000	С	40	24	11	5	80
National	COPS	C/N	6,100	6,100	8,000	6,500	26,700
NEC	UCOM-4	P/C	4,910	4,340	3,840	3,840	16,930
	uPD-75XX	с	5,510	7,570	9,210	9,210	31,500
Oki	Series-40	С	1,600	1,600	1,600	1,600	6,400
Rockwell	PPS-4	P	415	370	600	750	2,135
Sharp	SM-3	P	200	200	200	200	800
-	SM-4	с	460	460	460	460	1,840
	SM-5	с	3,000	3,190	3,000	3,000	12,190
TI	TMS-1000	P/C	2,200	2,100	2,000	2,000	8,300
Thomson	COPS	C/N	300	560	730	1,200	2,790
Toshiba	T Series	с	1,400	1,500	1,600	1,500	6,000
	TLCS-43	N	2,400	2,400	1,600	1,600	8,000
	TLCS-46	С	1,000	1,000	600	650	3,250
	TLCS-47	C/N	1,400	1.400	1,700	1,800	6,300
Total	4-Bit MCUs		46,205	48,164	50,001	49,065	193,435

Source: Dataquest July 1989

# Table 13

# Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

	Product	<u>Process</u>	<u>01/85</u>	<u>02/85</u>	<u>03/85</u>	<u>Q4/85</u>	<u>1985</u>
Fujitsu	884X	N	1,450	1,392	1,392	1,400	5,634
	8850	С	550	528	528	550	2,156
Hitachi	HMCS-40	P/N/C	5,600	5,376	5,376	6,000	22,352
Matsushita	MN1400	P/N/C	5,000	4,800	4,800	6,000	20,600
	MN1500	И	2,100	2,100	2,800	4,300	11,300
Motorola	141000	С	4	0	0	0	4
National	COPS	C/N	6,500	6,000	5,800	5,200	23,500
NEC	UCOM-4	P/C	3,250	2,730	2,330	1,610	9,920
	uPD-75XX	С	7,180	8,170	8,550	7,690	31,590
Oki	Series-40	С	1,700	1,632	1,632	1,650	6,614
Rockwell	PPS-4	P	400	300	360	340	1,400
Sharp	SM SERIES	С	2,490	2,490	2,695	2,695	10,370
TI	TMS-1000	P/C	1,000	950	950	1,000	3,900
Thomson	COPS	C/N	1,350	1,296	1,296	1,300	5,242
Toshiba	T Series	С	1,500	1,440	1,440	1,200	5,580
	TLCS-42	N/C	0	0	350	900	1,250
	TLCS-43	N	1,600	1,536	1,536	1,000	5,672
	TLCS-46	с	650	624	624	300	2,198
	TLCS-47	C/N	1,800	1,728	1,728	2,500	7,756
Total	4-Bit MCUs		44,124	43,092	44,187	45,635	177,038

Source: Dataquest July 1989

# Table 14

# Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

	Product	Process	<u>01/86</u>	02/86	<u>03/86</u>	04/86	<u>1986</u>
Fujitsu	884X	N	1,535	1,620	1,680	1,745	6,580
-	885X	С	720	860	900	945	3,425
Hitachi	HMCS-40	P/N/C	6,010	5,500	5,174	5,235	21,919
Matsushita	MN1400	P/N/C	4,500	4,000	4,600	4,320	17,420
	MN1500	N	5,700	7,100	7,480	7,400	27,680
Mitsubishi	50XXX	С	5,994	7,450	6,500	7,900	27,844
National	COPS	с/N	5,950	6,928	8,435	9,960	31,273
NEC	UCOM-4	P/C	1,500	1,250	1,570	1,380	5,700
	UCOM-75X	с	0	0	1,750	2,150	3,900
	uPD-75XX	С	8,470	10,420	11,920	11,110	41,920
Oki	Series-40	с	1,860	1,900	1,820	1,637	7,217
Rockwell	PPS-4	P	400	300	210	250	1,160
Sharp	SM SERIES	с	2,700	2,030	2,150	2,260	9,140
TI	TMS-1000	P/C	4,000	4,170	3,845	4,010	16,025
Thomson	COPS	C/N	1,405	1,450	1,675	1,800	6,330
Toshiba	<b>T</b> Series	С	900	1,100	1,200	1,400	4,600
	TLCS-42	N/C	850	1,000	1,000	1,000	3,850
	TLCS-43	ท	700	850	650	400	2,600
	TLCS~46	с	200	100	50	50	400
	TLCS-47	C/N	4,400	5,200	6,700	6,200	22,500
	TLCS-470	с	0	0	100	300	400
Others*	Unspecified	с	2,500	2,500	2,500	2,500	10,000
Total ·	4-Bit MCUs		60,294	65,728	71,909	73,952	271,883

\*Dataquest estimate for companies not surveyed (i.e., Ricoh, Sanyo, Sony).

Source: Dataquest July 1989

# Table 15

### Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

	Product	<u>Process</u>	<u>01/87</u>	<u>02/87</u>	<u>03/87</u>	<u>04/87</u>	<u>1987</u>
Fujitsu	882XX	с	120	150	225	265	760
-	884X	ท	1,705	1,765	1,800	1,890	7,160
	884XX	N	410	450	478	505	1,843
	885X	С	882	905	940	1,015	3,742
	885XX	с	100	110	125	150	485
Hitachi	HMCS-40	P/N/C	6,300	6,405	6,520	6,675	25,900
	HMCS-400	с	7,600	8,000	8,000	8,500	32,100
Matsushita	MN1400	P/N/C	4,500	3,500	1,885	1,990	11,875
	MN1500	N	7,250	11,000	11,600	12,240	42,090
	MN1700	с	0	0	1,015	1,070	2,085
Mitsubishi	M5043X/44X	с	3,393	3,294	3,767	3,541	13,995
	M5046X/56X	с	2,141	3,213	3,996	3,755	13,105
	M5072/76	С	2,701	2,908	4,337	5,108	15,054
	M509X	С	156	152	727	1,021	2,056
National	COPS	N/C	8,770	8,500	8,200	6,500	31,970
NEC	uCOM-4	P/C	970	110	1,300	1,300	3,680
	uCOM7 5X	N/C	3,500	4,610	5,000	3,700	16,810
	uPD75XX	С	11,000	10,970	13,500	12,200	47,670
Oki	Series-40	С	1,650	1,584	1,740	1,715	6,689
Rockwell	PPS-4	P/N	185	155	150	300	790
Sharp	SM-Series	С	2,170	1,820	2,170	3,350	9,510
TI	TMS1000	P/C	4,400	4,500	2,900	1,600	13,400
SGS-Thomson	COPS	N	1,810	1,880	1,925	1,900	7,515
Toshiba	<b>T-Series</b>	с	1,600	1,460	1,580	1,625	6,265
	TLCS-42	N/C	1,000	1,100	980	980	4,060
	TLCS-43	N	550	560	574	525	2,209
	TLCS-46	с	50	62	48	42	202
	TLCS-47	ท	1,600	1,500	1,475	1,360	5,935
	TLCS-47	С	4,300	4,220	4,405	4,572	17,497
	TLCS-470	C	300	340	350	370	1,360
Others*	Unspecified	C	<u>11,130</u>	<u>11,130</u>	11,130	<u>11,130</u>	44,520
Total 4-	Bit MCUs		92,243	96,353	102,842	100,894	392,332

\*Dataquest estimate for companies not surveyed (i.e., Ricoh, Sanyo, Sony).

Source: Dataquest July 1989

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Table 16

# Estimated 4-Bit Microcontroller Shipments by Quarter for 1988 (Thousands of Units)

	<b>Product</b>	Process	<u>01/88</u>	<u>02/88</u>	<u>03/88</u>	<u>Q4/88</u>	<u>1988</u>
Fujitsu	MB882XX	с	320	350	380	350	1,400
-	MB8840X	<b>N</b> .	400	450	500	560	1,910
	MB884X	N	1,640	1,650	1,750	1,800	6,840
	MB8850X	С	700	900	900	1,000	3,500
	MB885X	С	900	900	1,000	1,190	3,990
Hitachi	HMCS-40	P/N/C	6,500	5,000	5,000	5,000	21,500
	HMCS-400	С	8,500	6,000	6,000	6,000	26,500
Matsushita	MN1400	P/N/C	2,100	2,200	2,000	2,100	8,400
	MN1500	N	12,180	13,370	11,730	12,300	49,580
	MN1700	С	1,100	1,300	1,100	1,200	4,700
Mitsubishi	M5043X/44X	C	3,000	3,500	3,300	3,400	13,200
	M5046X/56X	C	4,900	5,300	5,600	4,000	19,800
	M5072/76	С	2,900	3,300	4,100	3,800	14,100
	M509X	С	530	1,600	2,100	2,200	6,430
National	COP400	N/C	7,550	7,500	7,300	8,100	30,450
NEC	uCOM-4	P/C	2,700	1,350	1,300	1,100	6,450
	uCOM75X	N/C	4,050	4,350	4,750	4,700	17,850
	uPD75XX	с	13,050	14,750	18,200	17,600	63,600
Oki	SERIES-40	С	1,600	1,680	2,000	2,300	7,580
Rockwell	PPS-4	P	150	70	55	50	325
SGS-Thomson	COPS	N	1,743	2,427	2,457	2,223	8,850
Sharp	SM-SERIES	с	3,750	4,300	5,100	8,600	21,750
TI	TMS1000	P/C	1,700	2,300	2,100	1,700	7,800
Toshiba	<b>T-SERIES</b>	С	3,400	3,500	3,550	3,600	14,050
	TLCS-42	N/C	1,000	1,150	1,200	1,300	4,650
	TLCS-43	ท	1,000	1,150	1,200	1,300	4,650
	TLCS-46	С	150	130	100	100	480
	TLCS-47	И	2,140	2,210	2,580	2,960	9,890
	TLCS-47	С	7,200	8,190	8,410	8,450	32,250
	TLCS-470	с	0	0	0	100	100
Others*	Unspecified	c	6,000	23,500	25,750	33,250	88,500
Total 4-	Bit MCUs		102,853	124,377	131,512	142,333	501,075

\*Dataquest estimate for companies not surveyed (i.e., Ricoh, Sanyo, Sony).

Source: Dataquest July 1989

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The following section, 4-Bit Microcontroller Data Tables, includes historical microcontroller unit shipments by year, manufacturer, product name, and process technology.

The tables are organized as follows:

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- Table 1Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer,1975-1979
- Table 2Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer,1980-1984
- Table 3Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer,1985-1987
- Table 4Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1987

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# Table 1

### Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1975–1979 (Thousands of Units)

	Product	Process	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
Gould/AMI	S2000	n .	0	0	0	29	1,425
Hitachi	HMCS-40	P,N,C	0	0	0	410	655
Matsushita	MN1400	P,N,C	0	0	0	0	4,400
Motorola	141000	C	0	0	0	20	285
National	COPS	N,C	0	0	0	2,325	5,600
NEC	uCOM-4	P,C	0	0	0	1,500	7,800
Rockwell	PPS-4	P,N	450	450	575	2,275	3,900
Sharp	SM-3	P	0	0	0	0	360
TI	' TMS1000	P,C	<u>    50</u>	<u>310</u>	2,825	9,400	<u>26,100</u>
Total 4-Bi	t MCUs		500	760	3,400	15,959	50,525

Source: Dataquest September 1988

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### Table 2

# Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1980–1984 (Thousands of Units)

	<b>Product</b>	Process	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Eurotechnique	COPS	N,C	0	0	190	840	0
Fujitsu	MB884X	N	0	9,200	9,900	7,500	6,100
-	MB885X	с	185	2,050	3,150	3,110	2,720
Gould/AMI	S2000	N	1,120	390	566	115	0
Hitachi	HMCS-40	P,N,C	1,425	19,000	20,600	20,600	22,400
Matsushita	MN1400	P,N,C	10,300	11,250	14,580	18,420	20,400
	MN1500	N	20	1,250	1,620	6,360	8,600
Motorola	141000	С	240	149	112	130	80
National	COPS	N,C	11,500	11,500	16,200	21,000	26,700
NEC	uCOM-4	P,C	14,800	19,800	25,700	21,000	16,930
	uPD75XX	С	0	3,200	8,000	15,100	31,500
Oki	Series-40	С	90	550	2,450	5,480	6,400
Rockwell	PPS-4	P,N	5,800	2,500	1,675	1,800	2,135
SGS-Thomson	COPS	N	0	0	0	0	2,790
Sharp	SM-3	P	600	920	990	840	800
-	SM-4	С	1,200	1,600	1,950	1,750	1,840
	SM-5	С	4,800	10,690	9,400	10,350	12,190
TI	TMS1000	P,C	44,000	39,500	26,000	11,900	8,300
Toshiba	<b>T-Series</b>	С	0	0	8,300	9,800	6,000
	TLCS-43	N	0	0	3,300	9,200	8,000
	TLCS-46	С	0	0	2,900	3,580	3,250
	TLCS-47	N	0	0	<u> </u>	3,070	6,300
Total 4-B	it MCUs		96,080	133,549	158,183	171,945	193,435

Source: Dataquest September 1988

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# Table 3

### Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987 (Thousands of Units)

	Product	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>
Fujitsu	MB882XX	с	0	0	760
-	MB8840X	N	0	0	1,843
	MB884X	N	5,634	6,580	7,160
	MB8850X	С	0	0	485
	MB885X	С	2,156	3,425	3,742
Hitachi	HMCS-40	P,N,C	22,352	21,919	25,900
	HMCS-400	с	N/A	N/A	32,100
Matsushita	MN1400	P,N,C	20,600	17,420	11,875
	MN1500	N	11,300	27,680	42,090
	MN1700	С	0	0	2,085
Mitsubishi	M5043X/44X	С	0	0	13,995
	M5046X/56X	С	0	0	13,105
	M5072/76	С	0	0	15,054
	M509X	С	0	0	2,056
	M50XXX	С	0	27,844	0
Motorola	141000	С	4	0	0
National	COPS	N,C	23,500	31,273	31,970
NEC	uCOM-4	P,C	9,920	5,700	3,680
	uCOM7 5X	N,C	0	3,900	16,810
	uPD75XX	С	31,590	41,920	47,670
Oki	Series-40	c	6,614	7,217	6,689
Rockwell	PPS-4	P,N	1,400	1,160	790
SGS-Thomson	COPS	N	5,242	6,330	7,515
Sharp	SM-Series*	с	10,370	9,140	9,510
TI	TMS1000	P,C	3,900	16,025	13,400
Toshiba	<b>T-Series</b>	С	5,580	4,600	6,265
	TLCS-42	N,C	1,250	3,850	4,060
	TLCS-43	N	5,672	2,600	2,209
	TLCS-46	С	2,198	400	202
•	TLCS-47	N	7,756	7,200	5,935
	TLCS-47	С	0	15,300	17,497
	TLCS-470	С	0	400	1,360
Others**	Unspecified	с	0	10,000	44,520
Total 4-Bit	MCUs		177,038	271,883	392,332
*Sharp SM-Series **Dataquest estim N/A = Not Availab	totaled in 1985. ate for companies le	not surveye	d (i.e. Rico	h, Sanyo, S	iony).

Source: Dataquest September 1988

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### Table 4

# Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

	<b>Product</b>	Process	<u>01/87</u>	<u>02/87</u>	<u>03/87</u>	<u>04/87</u>	<u>1987</u>
Fujitsu	882 <b>XX</b>	с	120	150	225	265	760
-	884X	, N	1,705	1,765	1,800	1,890	7,160
•.	884XX	N	410	450	478	505	1,843
Π.	885X	с	882	905	940	1,015	3,742
	885XX	С	100	110	125	150	485
Hitachi	HMCS-40	P,N,C	6,300	6,405	6,520	6,675	25,900
	HMCS-400	С	7,600	8,000	8,000	8,500	32,100
Matsushita	MN1400	P,N,C	4,500	3,500	1,885	1,990	11,875
	MN1500	N	7,250	11,000	11,600	12,240	42,090
	MN1700	С	0	0	1,015	1,070	2,085
Mitsubishi	M5043X/44X	С	3,393	3,294	3,767	3,541	13,995
	M5046X/56X	С	2,141	3,213	3,996	3,755	13,105
	M5072/76	с	2,701	2,908	4,337	5,108	15,054
	M509X	с	156	152	727	1,021	2,056
National	COPS	N,C	8,770	8,500	8,200	6,500	31,970
NEC	uCOM-4	P,C	970	110	1,300	1,300	3,680
	uCOM75X	N,C	3,500	4,610	5,000	3,700	16,810
	uPD75XX	С	11,000	10,970	13,500	12,200	47,670
Oki	Series-40	С	1,650	1,584	1,740	1,715	6,689
Rockwell	PPS-4	P,N	185	155	150	300	790
Sharp	SM-Series	C	2,170	1,820	2,170	3,350	9,510
TI	TMS1000	P,C	4,400	4,500	2,900	1,600	13,400
SGS-Thomson	COPS	N	1,810	1,880	1,925	1,900	7,515
Toshiba	<b>T-Series</b>	с	1,600	1,460	1,580	1,625	6,265
	TLCS-42	N,C	1,000	1,100	980	980	4,060
	TLCS-43	N	550	560	574	525	2,209
	TLCS-46	С	50	62	48	42	202
	TLCS-47	N	1,600	1,500	1,475	1,360	5,935
	TLCS-47	С	4,300	4,220	4,405	4,572	17,497
	TLCS-470	С	300	340	350	370	.1,360
Others*	Unspecified	С	<u>11,130</u>	<u>11,130</u>	11,130	11,130	44,520
Total 4-	Bit MCUs		92,243	96,353	102,842	100,894	392,332

\*Dataquest estimate for companies not surveyed (i.e. Ricoh, Sanyo, Sony).

Source: Dataquest September 1988

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# 8-Bit Microcontroller Executive Overview

#### MARKET ENVIRONMENT

The core architecture of 8-bit microcontrollers is microprocessor-To increase control, bit operation instruction and efficient based. memory use have been improved.

The capacity of built-in ROM and RAM has been increased. Currently, 16KB ROM and 512KB RAM are found in single chips. Some devices contain one-time EPROM and EEPROM. For auxiliary functions, time counters and serial communication interfaces are reinforced, and two or more of them are built in to improve real-time operation and separate processing. Paralleling the expansion of the general consumer market is the development of computers offering special functions such as A/D and D/A converters, fluorescent display tubes, LDC driving circuits, and in some cases, gate arrays. The range of built-in functions on a single chip is widening.

In the future, semiconductor integration technology will include larger memories and more sophisticated built-in functions on a single chip.

#### MARKET SIZE

During 1985, approximately 161 million 8-bit MCUs were shipped worldwide, representing almost 48 percent of total MCU market shipments. Revenue generated from these shipments amounted to \$722 million, representing 65 percent of total 1985 MCU revenue. U.S. manufacturers of 8-bit MCUs held more than 44 percent of market share in 1985, but they Japan manufacturers held more than are losing share every year. 42 percent of MCU market share in 1985, and European manufacturers held approximately 13 percent market share during the same year.

#### MARKET FORECAST

Dataquest expects 8-bit microcontroller revenue to increase by 29.1 percent from 1985 to 1986, to \$932.5 million, with an ASP of \$4.14. Estimated shipment revenue of \$932.5 million in 1986 and \$2,354.9 million in 1991 reflect a 20.4 percent CAGR during this period.

We expect 8-bit microcontroller unit shipments to grow from 161.7 million units in 1985 to 225.2 million units in 1986, increasing approximately 39.3 percent. Estimated unit shipments of 225.2 million units in 1986 and 853.2 million units in 1991 reflect a 30.5 percent CAGR during this period.

# 8-Bit Microcontroller Executive Overview

#### COMPETITIVE ENVIRONMENT

Of the approximately 28 worldwide merchant manufacturers of 8-bit microcontrollers, NEC, Motorola, and Intel, (ranking one, two, and three, respectively) accounted for approximately 45 percent of all 8-bit unit shipments during 1985. The leading products--the 8049, 6805, 8048, and 8051 (ranking one, two, three, and four, respectively)--had more than 50 percent market share during 1985.

Shipments of 8-bit CMOS MCUs reached approximately 20 percent of 8-bit MCU unit shipments during 1985; however, shipments are expected to reach 50 percent of 8-bit MCU unit shipments during 1988. Dataquest expects Japanese manufacturers to gain market share rapidly in the 8-bit MCU segment, as the demand for CMOS increases.

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# Microcontroller Market Analysis 1975–1989

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A Semiconductor Industry Service Report

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This booklet is divided into four major sections.

Chapter 1	Microcontroller Market Overview
Chapter 2	4-Bit Microcontrollers
Chapter 3	8-Bit Microcontrollets
Chapter 4	16-Bit Microcontrollers

Chapter 1

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# **M**icrocontroller Market Overview

The tables and figures in this section are organized as follows:

Figure 1	Estimated Market Share of Leading Manufacturers and Product Types for 4-Bit Microcontrollers, 1989
Figure 2	Estimated Market Share of Leading Manufacturers and Product Types for 8-Bit Microcontrollers, 1989
Figure 3	Estimated Market Share of Leading Manufacturers and Product Types for 16-Bit Microcontrollers, 1989
Table 1	Estimated Market Share by Word Length for Microcontrollers, 1975-1979
Table 2	Estimated Market Share by Word Length for Microcontrollers, 1980-1984
Table 3	Estimated Market Share by Word Length for Microcontrollers, 1985-1989
Figure 4	Estimated Market Share by Word Length for 4-, 8-, and 16-Bit Microcontrollers, 1980-1989
Table 4	Estimated Matket Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1975-1979
Table 5	Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1980-1984
Table 6	Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1985-1989
Figure 5	Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1989
Table 7	Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1975-1979
Table 8	Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1980-1984
Table 9	Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1985-1989
Figure 6	Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1989

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### Figure 1

#### Estimated Market Share of Leading Manufacturers and Product Types for 4-Bit Microcontrollers 1989



### Source: Dataquest (September 1990)

#### Figure 2

#### Estimated Market Share of Leading Manufacturers and Product Types for 8-Bit Microcontrollers 1989



Source: Dataquest (September 1990)

### Figure 3

#### Estimated Market Share of Leading Manufacturers and Product Types for 16-Bit Microcontrollers 1989





Source: Dataquest (September 1990)

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#### Table 1

### Estimated Market Share by Word Length for Microcontrollers 1975-1979 (Thousands of Units)

	1975	1976	1977	1978	1979
4-Bit					
Shipments	500	760	3,400	15,959	50,525
Percent	94.0	75.2	79.3	87.8	81.3
8-Bit					
Shipments	32	251	885	2,218	11,592
Percent	6.0	24.8	20.7	12.2	18.7
16-Bit					
Shipments	0	0	0	0	5
Percent	0	0	0	0	٠
Total Shipments	532	1,011	4,285	18,177	62,122

Source: Dataquest (September 1990)

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### Table 2

### Estimated Market Share by Word Length for Microcontrollers 1980-1984 (Thousands of Units)

	1980	1981	1982	1983	1984
4-Bit					
Shipments	96,080	133,549	158,183	171,945	193,435
Percent	81.5	79.3	74.5	65.5	54.2
8-Bit					
Shipments	21,740	34,931	54,114	90,615	163,510
Percent	18.5	20.7	25.5	34.5	45.8
16-Bit					
Shipments	8	36	50	89	1 <b>23</b>
Percent	*	٠	*		*
Total Shipments	117,828	168,516	212, <b>347</b>	262,649	357,068
Calculated value is less than 0.1 nement.					

Source: Dataguest (September 1990)

#### Table 3

### Estimated Market Share by Word Length for Microcontrollers 1985-1989 (Thousands of Units)

	1985	<b>19</b> 86	1987	1988	1989
4-Bit					
Shipments	177,038	261,883	347,812	468,445	672,860
Percent	51.9	55.1	53.5	55.0	59.1
8-Bi					
Shipments	163,599	212,931	299,470	377,476	458,699
Percent	48.0	44.8	46.0	44.3	40.3
16-Bit					
Shipments	232	399	3,311	5,461	7,438
Percent	0.1	0.1	0.5	0.6	0.7
Total Shipments	340.869	475.213	650.593	851,382	1.138.997

Source: Dataquest (September 1990)

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### Figure 4





Source: Dataquest (September 1990)

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#### Table 4

### Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1975-1979 (Thousands of Units)

	1975	1976	1977	1978	1979
4-Bit Shipments	500	760	3,400	15,959	50,525
US Companies (%)	100.0	100.0	100.0	88.0	73.8
Japanese Companies (%)	0	0	0	12.0	26.2
European Companies (%)	0	0	0	0	0
8-Bit Shipments	32	251	885	2,218	11,592
US Companies (%)	100.0	100.0	100.0	<b>99.3</b>	91.1
Japanese Companies (%)	0	0	0	0.7	8.5
European Companies (%)	0	0	0	0	0.4
16-Bit Shipments	0	0	0	0	5
US Companies (%)	0	0	0	0	100.0
Japanese Companies (%)	0	0	0	0	0
European Companies (%)	0	0	0	0	0
Total Shipments	532	1,011	4,285	18,177	62,122
US Companies (%)	100.0	100.0	100.0	89.4	77.1
Japanese Companies (%)	0	0	0	10.6	22.9
European Companies (%)	0	0	0	0	0.1

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### Table 5

### Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1980-1984 (Thousands of Units)

	1980	1981	1982	1983	1984
4-Bit Shipments	96,080	133,549	158,183	171,945	193,435
US Companies (%)	65.2	40.5	28.2	0.3	19.2
Japanese Companies (%)	34.8	59.5	71.7	79.2	79.3
European Companies (%)	0	0	0.1	0.5	1.4
8-Bit Shipments	21,740	34,931	54,114	90,615	163 <b>,510</b>
US Companies (%)	73.3	68.3	61.0	57.6	51.7
Japanese Companies (%)	15.5	20.1	27.1	31.3	36.6
European Companies (%)	11.2	11.7	11.8	11.0	11.7
16-Bit Shipments	8	36	50	89	123
US Companies (%)	100.0	100.0	100.0	100.0	100.0
Japanese Companies (%)	0	0	0	0	0
European Companies (%)	0	0	0	0	0
Total Shipments	11 <b>7,828</b>	168,516	212,347	262,649	357,068
US Companies (%)	66.7	46.2	36.6	33.2	34.1
Japanese Companies (%)	31.2	51.3	60.3	62.7	59.7
<b>European Companies (%)</b>	2.1	2.4	3.1	4.1	6.2

Source: Dataquett (September 1990)

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### Table 6

### Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1985-1989 (Thousands of Units)

	1985	1986	1987	1988	1989
4-Bit Shipments	177,038	261,883	347,812	468,445	672,860
US Companies (%)	16.3	18.5	13.3	8.6	6.5
Japanese Companies (%)	80.8	79.1	84.6	89.6	92.3
European Companies (%)	3.0	2.4	2.2	1.9	1.1
8-Bit Shipments	163,599	212,931	299,470	377,476	458,699
US Companies (%)	42.7	36.6	39.3	43.9	<b>48</b> .1
Japanese Companies (%)	43.2	47.4	47.7	45.4	41.0
European Companies (%)	<b>14</b> .1	16.0	13.0	10.7	10.8
16-Bit Shipments	232	399	3,311	5,461	7,438
US Companies (%)	94.8	67.7	96.6	<b>98</b> .6	96.1
Japanese Companies (%)	0	0	0.1	0.2	3.1
European Companies (%)	5.2	32.3	3.3	1.2	0.8
Total Shipments	340,869	475,213	650,593	851,382	1,138,997
US Companies (%)	29.0	26.7	25.7	24.8	23.9
Japanese Companies (%)	62.7	64.8	67.2	69.4	71.1
European Companies (%)	8.3	8.5	7.1	5.8	5.0

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Figure 5





Source: Dataquest (September 1990)

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### Table 7

### Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1975-1979 (Thousands of Units)

	1975	1976	1977	1978	1979
4-Bit	500	760	3,400	15,959	50,525
Percent PMOS	100.0	100.0	100.0	80.4	75.3
Percent NMOS	0	0	0	14.9	14.9
Percent CMOS	0	0	0	4.7	9.8
8-Bit	32	251	885	2,218	11,592
Percent NMOS	100.0	100.0	100.0	100.0	100.0
Percent CMOS	0	0	0	0	0
16-Bit	0	0	0	0	5
Percent NMOS	0	0	0	0	100.0
Percent CMOS	0	0	0	0	0
Total Shipments	532	1,011	4,285	18,177	62,122
Percent PMOS	94.0	75.2	<b>79</b> .3	70.6	61.2
Percent NMOS	6.0	24.8	20.7	25.3	30.8
Percent CMOS	0	0	0	4.2	8.0

Source: Dataquest (September 1990)

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#### Table 8

### Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1980-1984 (Thousands of Units)

	1980	1981	1982	1983	1984
4-Bit Shipments	96,080	133,549	158,183	171,945	193,435
Percent PMOS	66.3	52.0	35.2	22.0	14.9
Percent NMOS	14.4	19.4	23.5	30.5	32.2
Percent CMOS	19.3	28.6	41.3	47.5	52.9
8-Bit Shipments	21,740	34,931	54,114	90,615	163,510
Percent NMOS	100.0	99.7	96.8	91.4	90.0
Percent CMOS	0	0.3	3.2	8.6	10.0
16-Bit Shipments	8	36	50	89	123
Percent NMOS	100.0	100.0	100.0	100.0	100.0
Percent CMOS	0	0	0	0	0
Total Shipments	117,828	168,516	212,347	262,649	357,068
Percent PMOS	54.1	41.2	26.2	14.4	8.1
Percent NMOS	30.2	36.1	42.2	51.5	58.7
Percent CMOS	15.8	22.7	31.6	34.1	33.3

Source: Delaquent (September 1990)

#### Table 9

### Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1985-1989 (Thousands of Units)

	1985	1986	1987	1988	1989
4-Bit Shipments	177,038	261,883	347,812	468,445	672,860
Percent PMOS	10.0	5.1	2.8	1.3	1.1
Percent NMOS	34.8	31.0	27.4	14.5	11.3
Percent CMOS	55.2	63.9	69.8	84.2	87.7
8-Bit Shipments	163,599	212,931	299,470	377,476	458,699
Percent NMOS	79.5	71.4	65.4	58.6	49.5
Percent CMOS	20.5	28.6	34.6	41.4	50.5
16-Bit Shipments	232	399	3,311	5,461	7,438
Percent NMOS	100.0	100.0	19.9	33.2	42.9
Percent CMOS	0	0	80.1	66.8	57.1
Total Shipments	340,869	475,213	650,593	851,382	1,138, <b>9</b> 97
Percent PMOS	5.2	2.8	1.5	0.7	0.6
Percent NMOS	56.3	49.1	44.8	34.2	26.9
Percent CMOS	38.5	48.1	53.7	65.1	72.5

Source: Dataquest (September 1989)

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Figure 6





Source: Dataquest (September 1990)

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Microcontroller Market Overview

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Chapter 2

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## **4-Bit Microcontrollers**

The tables and figures in this section are organized as follows:

Table 1	Estimated Market Share by Manufacturer for 4-Bit Microcontrollets, 1975-1979
Table 2	Estimated Market Share by Manufacturer for 4-Bit Microcontrollers, 1980-1984
Table 3	Estimated Market Share by Manufacturer for 4-Bit Microcontrollers, 1985-1989
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Table 5	Estimated Market Share by Region for 4-Bit Microcontrollers, 1980-1984
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Figure 4	Estimated Market Share by Process Technology for 4-Bit Microcontrollers, 1980-1989

#### Table 1

## Estimated Market Share\* by Manufacturer for 4-Bit Microcontrollers 1975-1979 (Percentage)

Manufacturer	1975	1976	1977	1978	1979
Gould/AMI	0	0	0	0.2	2.8
Hitachi	0	0	0	2.6	1.3
Matsushita	0	0	0	0	8.7
Motorela	0	0	0	0.1	0.6
National	0	0	0	14.6	11.1
NEC	0	0	0	9.4	15.4
Rockwell	90.0	59.2	16.9	14.2	7.7
Sharp	0	0	0	0	0.7
Texas Instruments	10.0	40.8	83.1	58.9	51.7
Total	100.0	100.0	100.0	100.0	100.0

\*Based on units shipped Source: Dataquest (September 1990)

#### Table 2

## Estimated Market Share\* by Manufacturer for 4-Bit Microcontrollers 1980-1984 (Percentage)

Manufacturer	1980	1981	1982	1983	1984	
Eurotechnique	0	0	0.1	0.5	0	
Pujitsu	0.2	8.4	8.3	6.2	4.6	
Gould Semiconductor	1.2	0.3	0.4	0.1	0	
Hitachi	1.5	14.2	13.0	12.0	11.6	
Matsushite	10.7	9.4	10.2	14.4	15.0	
Motorola	0.2	0.1	0.1	0.1	0	
National	12.0	8.6	10.2	12.2	13.8	
NBC	15.4	17.2	21.3	21.0	25.0	
Oki	0.1	0.4	1.5	3.2	3.3	
Rockwell	6.0	1.9	1.1	1.0	1.1	
SGS-Thomson	0	0	0	0	1.4	
Sharp	6.9	9.9	7.8	7.5	7.7	
Texas Instruments	45.8	29.6	16.4	6.9	4.3	٠
Toshiba	0	0	9.5	14. <del>9</del>	12.2	
Total	100.0	100.0	100.0	100.0	100.0	

"Based on units shipped Source: Dataquest (September 1990)

#### Table 3

## Estimated Market Share by Manufacturer for 4-Bit Microcontrollers 1985-1989 (Percentage)

	1985	1986	1987	1988	1989
Pujitsu	4.4	3.8	4.0	5.1	5.7
Hitachi	12.6_	8.4	16.7	10.1	8.6
Matsushita	18.0	17.2	16.1	13.4	8.9
Mitsubishi	0	10.6	12.7	11.4	12.3
Motorola	0	0	0	0	0
National	13.3	11.9	9.2	6.5	5.0
NEC	23.4	19.7	19.6	18.8	1 <del>6</del> .5
Oki	3.7	2.8	1.9	1.6	1.5
Rockwell	0.8	0.4	0.2	0.1	•
Sanyo	0	0	0	6.7	10.5
SGS-Thomson	3.0	2.4	2.2	1.9	1.1
Sharp	5.9	3.5	2.7	6.6	11.9
Sony	0	0	0	1.8	3.4
Texas Instruments	2.2	6.1	3.9	2.0	1.5
Toshiba	12.7	13.1	10.8	14.1	13.1
Total	100.0	100.0	100.0	100.0	100.0

\*Calculated value is less than 0.1 percent. Note: Totals for 1986, 1987, and 1988 have been adjusted to remove Dataquest's previous estimate for unsurveyed companies. Totals now reflect actual survey results. Additionally, because of the receipt of new information, 1988 numbers have been restated for many Japanese companies. Columns may not add to totals shown because of runnding. Source: Dataquest (September 1990)

Chapter 2

#### Figure 1

## Estimated Market Share by Manufacturer for 4-Bit Microcontrollers 1988 and 1989



Source: Dataquest (September 1990)

#### Table 4

## Estimated Market Share by Region for 4-Bit Microcontrollers 1975-1979 (Thousands of Units)

Region	1975	1976	1977	1978	1979
United States					
Shipments	500	760	3,400	14,049	37,310
Percent	100.0	100.0	100.0	88.0	73.8
Japan					
Shipments	0	0	0	1,910	13,215
Percent	0	0	0	12.0	26.2
Europe					
Shipments	0	0	0	0	0
Percent	0	0	0	0	0
Total Shipments	500	760	3,400	15,959	50,525

Source: Dataquest (September 1990)

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## Table 5

## Estimated Market Share by Region for 4-Bit Microcontrollers 1980-1984 (Thousands of Units)

Region	1980	1981	1982	1983_	1984
United States				<u> </u>	
Shipments	62,660	54,039	44,553	34,945	37,215
Percent	65.2	40.5	28.2	20.3	19.2
Japan					
Shipments	33,420	79,510	113,440	136,160	153,430
Percent	34.8	59.5	71.7	79.2	79.3
Ешторе					
Shipments	0	0	190	840	2,790
Percent	0	0	0.1	0.5	1.4
Total Shipments	96,080	133,549	158,183	171,945	193,435

Source: Dataquest (September 1990)

## Table 6

## Estimated Market Share by Region for 4-Bit Microcontrollers 1985-1989 (Thousands of Units)

Region	1985	1986	1987	1988	1989
United States					
Shipments	28,804	48,458	46,160	40,075	44,035
Percent	16.3	18.5	13.3	8.6	6.5
Japan					
Shipments	142,992	207,095	294,137	419,520	621,180
Percent	80.8	79.1	84.6	89.6	92.3
Burope					
Shipments	5,242	6,330	7,515	8,850	7,645
Percent	3.0	2.4	2.2	1.9	1.1
Total Shipments	177,038	261,883	347,812	468,445	672,860

Source: Dataquest (September 1990)

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#### Figure 2

## Estimated Market Share by Region for 4-Bit Microcontrollers 1980-1989



Source: Dataquest (September 1990)

#### Table 7

## Estimated Market Share\* by Product Type for 4-Bit Microcontrollers 1975-1979 (Percentage)

	1975	1976	1977	1978	1979
TMS1000	10.0	40.8	83.1	58.9	51.7
uCOM-4	0	0	0	9.4	15.4
COPS	0	0	0	14.6	11.1
MN1400	0	0	0	0	8.7
PPS-4	90.0	59.2	16.9	14.3	7.7
S2000	0	0	0	0.2	2.8
HMCS-40	0	0	0	2.6	1.3
SM-3	0	0	0	0	0.7
14100	0	0	0	0.1	0.6
Total	100.0	100.0	100.0	100.0	100.0

\*Based on units shipped Source: Dataquest (September 1990)

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#### Table 8

## Estimated Market Share\* by Product Type for 4-Bit Microcontrollers 1980-1984 (Percentage)

	1980	1981	1982	1983	1984
uPD75XX	0	2.4	5.1	8.8	16.3
COPS	12.0	8.6	10.4	12.7	15.2
HMCS-40	1.5	14.2	13.0	12.0	11.6
MN1400	10.7	8.4	9.2	10.7	10.5
aCOM-4	15.4	14.8	16.2	12.2	8.8
SM-5	5.0	8.0	5.9	6.0	6.3
MN1500	0	0.9	1.0	3.7	4.4
TMS1000	45.8	29.6	16.4	6.9	4.3
TLCS-43	0	Ð	2.1	5.4	4.i
Series-40	0.1	0.4	1.5	3.2	3.3
TLCS-47	0	0	0.4	1.8	3.3
MB884X	0	6.9	6.3	4.4	3.2
T-Series	0	0	5.2	5.7	3.1
TLCS-46	0	0	1.8	2.1	1.7
B885X	0.2	1.5	2.0	1.8	1.4
PPS-4	6.0	1.9	1.1	1.0	1.1
SM-4 .	1.2	1.2	1.2	1.0	1.0
SM-3	0.6	0.7	0.6	0.5	0.4
141000	0.2	0.1	0.1	0.1	0
S2000	1.2	0.3	0.4	0.1	0
Total	100.0	100.0	100.0	100.0	100.0

\*Based on units shipped Source: Dataquest (September 1990)

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## Table 9

## Estimated Market Share by Product Type for 4-Bit Microcontrollers 1985-1989 (Percentage)

Product	1985	1986	1987	1988	1989
uPD75XXX	17.8	16.0	13.7	13.6	12.7
LC65/66XX	0	0	0	6.6	10.4
MN1500	6.4	10.6	12.1	10.6	7.2
Sharp (Custom)	0	0	0	1.9	6.5
TLCS-47	4.4	8.6	6.7	9.0	6.5
HMCS-400	0	0	9.2	6.1	6.4
COPS	16.2	14.4	11.4	8.4	6.1
SM (4-Bit)	5.9	3.5	2.7	4.6	5.4
M5046X/56X	0	0	3.8	4.2	4.8
SPC500	0	0	0	1.8	3.4
TLCS-470	0	0.2	0.4	*	3.2
uPD75XX	0	1.5	4.8	3.8	2.9
M5072/76	0	0	4.3	3.0	2.8
M5043X/44X	0	0	4.0	2.8	2.7
MB8850X	0	0	0.1	1.6	2.3
T Series	3.2	1.8	1.8	3.0	2.3
HMCS-40	12.6	8.4	7.4	3.9	2.2
M509X	0	0	0.6	1.4	1.9
TMS1000	2.2	6.1	3.9	2.0	1.5
MB885X	1.2	1.3	1.1	1.3	1.5
Series-40	3.7	2.8	1.9	1.6	1.5
MB884X	3.2	2.5	2.1	1.5	1.1
MIN1700	0	0	0.6	1.0	1.0
TLCS-42	0.7	1.5	1.2	1.0	1.0
uCOM-4	5.6	2.2	1.1	1.4	0.9
MIN1400	11.6	6.7	3.4	1.8	0.6
MB8840X	0	0	0.5	0.4	0.4
MB882XX	0	0	0.2	0.3	0.2
TLCS-43	3.2	1.0	0.6	1.0	0.1
MB887XX	0	0	0	0	0.1
LM64XX	0	0	0	0.1	0.1
MB886XX	0	0	0	0	*
PPS-4	0.8	0.4	0.2	0.1	٠
TLCS-46	1.2	0.2	0.1	0.1	•
M50XXX	0	10.6	0	0	0
141000	*	0	0	0	0
Total	100.0	100.0	100.0	0.001	100.0

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\*Calculated value is less than 0.1 percent. Note: Columns may not add to totals shown because of rounding. Source: Dataquest (September 1990)

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Figure 3

Estimated Market Share by Product Type for 4-Bit Microcontrollers 1988 and 1989



Source: Dataquest (September 1990)

#### Table 10

#### Estimated Market Share by Process Technology for 4-Bit Microcontrollers 1975-1979 (Thousands of Units)

	1975	1976	1977	1978	1979
NMOS					
Shipments	0	0	0	2,375	7,530
Percent	0	0	0	14.9	14.9
CMOS					
Shipments	0	0	0	755	4,961
Percent	0	0	0	4.7	9.8
PMOS					
Shipments	500	760	3,400	12,829	38,034
Percent	100	100	100	80.4	75.3
Total Shipments	500	760	3,400	15,959	50,525

Source: Dataquest (September 1990)

## Table 11

#### Estimated Market Share by Process Technology for 4-Bit Microcontrollers 1980-1984 (Thousands of Units)

	1980	1981	1982	1983	1984
NMOS					
Shipments	13,813	25,970	37,167	52,468	62,240
Percent	14.4	19.4	23.5	30.5	32.2
CMOS					
Shipments	18,574	38,129	65,382	81,638	102,358
Percent	19.3	28.6	41.3	47.5	52.9
PMOS					
Shipments	63,693	69,450	55,634	37,839	28,837
Percent	66.3	52.0	35.2	22.0	14.9
Total Shipments	96,080	133,549	158,183	171,945	193,435

Source: Dataquest (September 1990)

## Table 12

#### Estimated Market Share by Process Technology for 4-Bit Microcontrollers 1985-1989 (Thousands of Units)

1985	1986	1987	1988	1989
		-		
61,576	81,153	95,288	68,117	75,845
34.8	31.0	27.4	14.5	<b>i</b> 1.3
97,694	167,357	242,840	394,336	589,780
55.2	63.9	69.8	84.2	87.7
17,768	13,373	9,684	5,992	7,235
10.0	5.1	2.8	1.3	1.1
177,038	261,883	347,812	468,445	672,860
	1985 61,576 34.8 97,694 55.2 17,768 10.0 177,038	1985 1986   61,576 81,153   34.8 31.0   97,694 167,357   55.2 63.9   17,768 13,373   10.0 5.1   177,038 261,883	1985 1986 1987   61,576 81,153 95,288   34.8 31.0 27.4   97,694 167,357 242,840   55.2 63.9 69.8   17,768 13,373 9,684   10.0 5.1 2.8   177,038 261,883 347,812	$\begin{array}{c c c c c c c c c c c c c c c c c c c $

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#### Estimated Market Share by Process Technology for 4-Bit Microcontrollers 1980-1989



Source: Dataquest (September 1990)

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## **8-Bit Microcontrollers**

The tables and figures in this section are organized as follows:

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Table 18	Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers, 1985-1989
Figure 6	Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers, 1989

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#### Table 1

## Estimated Market Share by Manufacturer for 8-Bit Microcontrollers 1975-1979 (Percentage)

				_	
	1975	1976	1977	1978	1979
AMD	0	0	0	0	0.2
Fairchild	84.4	72.1	75.7	29.4	10.0
General Instrument	0	0	0	20.3	35.4
Intel	0	0	11.9	23.4	22.6
Mostek	15.6	27.9	12.4	23.0	16.7
Motorola	0	0	0	3.2	4.5
National	' 0	0	0	0	0.1
NEC	0	0	0	0.7	8.5
Rockwell	0	0	0	0	0.1
SGS	0	0	0	0	0.4
Signetics	0	0	0	0	1.6
Total 8-Bit MCUs	100.0	100.0	100.0	100.0	100.0

Note: Columns may not add to totals abown because of roundin Source: Dataquest (September 1990)

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#### Table 2

## Estimated Market Share by Manufacturer for 8-Bit Microcontrollers 1980-1984 (Percentage)

	1980	1981	1982	1983	1984
AMD	0.6	0.8	0.8	0.7	1.4
Eurotechnique	0	0	0.3	0.4	0
Fairchild	11.1	11.0	4.8	2.3	0.7
Fujitsu	2.1	3.8	2.6	1.8	1.2
Gould Semiconductor	0	0	0.1	0.4	1.0
Hitachi	0	1.4	3.3	4.1	4.3
Intel	27.3	23.9	21.5	17.9	16.7
Matra-Harris	0	0	0	0.1	0.5
Microchip Technology (GI)	25.8	11.8	7.8	7.3	5.8
Mostek (SGS-Thomson)	10.6	7.4	3.8	2.0	1.1
Motorola	5.9	14.0	17.5	18.8	14.0
National	1.4	4.7	5.8	4.8	4.3
NCR	0	0	0	0.2	0.4
NEC	13.4	13.9	18.1	19.3	22.4
Oki	0	0	0.3	1.1	1.5
Philips	0.1	1.1	2.3	4.0	6.3
Rockwell	0.5	1.0	0.6	1.0	0.8
SGS (SGS-Thomson)	0.4	0.7	1.3	1.3	1.0
Sharp	0	0	0.3	1.1	1. <b>2</b>
Siemens	0.1	2.4	4.0	3.1	2.4
Signetics	0.6	0	0.3	2.3	4.7
Synertek	0	0	0.2	0.1	0
Texas Instruments	0	0.1	0.5	0.8	0.6
Thomson (SGS-Thomson)	0	0	0	0.2	0.5
Toshiba	0	1.0	2.4	3.9	6.0
Zilog	0.1	1.0	1.3	0.9	1.3
Total 8-Bit MCUs	100.0	100.0	100.0	100.0	100.0

Note: Columns may not add to totals shown because of rounding. Source: Dataquest (September 1990)

#### Table 3

## Estimated Market Share by Manufacturer for 8-Bit Microcontrollers, 1985-1989 (Percentage)

	1985	1986	1987	1988	1989
AMD	1.0	0.9	1.0	1.1	1.4
Fairchild	0.4	0.1	0	0	0
Fujitsu	0.5	0.8	1.7	0.6	0.7
Gould/AMI	0.6	0.1	0	0	0
Harris (GE-SS/RCA) <sup>2</sup>	0.1	0.2	0.3	0.5	0.6
Hitachi	4.8	8.6	11.1	11.7	9.2
Intel	9.1	8.3	10.8	12.7	11.1
Matra-Harris	0.9	1.0	1.0	1.0	1.4
Matsushita	0.1	0.2	0.4	1.2	2.6
Microchip Tech.	4.6	2.5	2.8	2.2	1.3
Mitsubishi	9.2	14.0	14.0	13.3	10.1
Mostek <sup>3</sup>	0.8	0.7	0.3	0	0
Motorola	16.2	15.8	15.7	18.0	23.3
National	3.4	1.6	1.5	1.6	2.3
NCR	0.4	0.5	0.1	0.3	0.1
NEC	19.0	17.6	14.4	12.5	11.5
Oki	1.5	2.4	2.4	2.3	2.3
Philips	7.3	8.6	6.3	4.5	4.1
Rockwell	0.8	1.2	1.3	1.1	0.9
Sanyo	0	0	0	0.3	0.5
SGS <sup>3</sup>	1.5	2.5	1.5	0	0
SGS-Thomson <sup>3</sup>	0	0	0	2.2	2.5
Sharp	0.3	0.3	0.4	0.3	0.7
Siemens	2.7	2.2	2.7	3.0	2.9
Signetics	3.9	2.8	2.5	2.9	3.4
Sony	0	0	0	0.2	1.2
Texas Instruments	0.9	1.2	2.2	2.3	2.2
Thomson <sup>3</sup>	0.9	1.0	1.1	0	0
Toshiba	7.7	3.4	3.5	3.0	2.2
Zilog	1.3	1.5	1.1	1.3	1.4
	100.0	100.0	100.0	100.0	100.0

<sup>1</sup>Painchild marged with National in 1988. <sup>2</sup>Harris acquired GE/RCA during 1988. <sup>3</sup>Mostek, SOS, and Thomson all marged to become SOS-Thomson in 1988. Note: Columns may not add to totals shown because of rounding. Source: Dataquest (September 1990)

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Figure 1

## Estimated Market Share by Manufacturer for 8-Bit Microcontrollers 1988 and 1989



Source: Dataquest (September 1990)

#### Table 4

#### Estimated Market Share by Region for 8-Bit Microcontrollers 1975-1979 (Thousands of Units)

	1975	1976	1977	1978	1979
United States					
Shipments	32	251	885	2,203	10,557
Percent	100.0	100.0	100.0	100.0	91.1
Japan					
Shipments	0	0	0	15	985
Percent	0	0	0	0.7	8.5
Western Europe					
Shipments	0	0	0	0	50
Percent	0	0	0	0	0.4
Total Shipments	32	251	885	2,218	11,592

Source: Dataquest (September 1990)

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#### Table 5

#### Estimated Market Share by Region for 8-Bit Microcontrollers 1980-1984 (Thousands of Units)

	1980	1981	1982	1983	1984
United States					
Shipments	15,926	23,847	33,035	52,227	84,484
Percent	73.3	68.3	61.0	57.6	51.7
Japan					
Shipments	3,370	7,014	14,689	28,400	59,835
Percent	15.5	20.1	27.1	31.3	36.6
Western Europe					
Shipments	2,444	4,070	6,390	9,988	19,191
Percent	11.2	11.7	11.8	11.0	11.7
Total Shipments	21,740	34,931	54,114	90,615	163,510

Source: Dataquest (September 1990)

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#### Table 6

#### Estimated Market Share by Region for 8-Bit Microcontrollers 1985-1989 (Thousands of Units)

	1985	1986	1987	1988	1989
United States					
Shipments	69,920	77,899	117,816	165,777	220,735
Percent	42.7	36.6	39.3	43.9	48.1
Japan					
Shipments	70,618	100,943	142,845	171,276	188,267
Percent	43.2	47.4	47.7	45.4	41.0
Western Europe					
Shipments	23,061	34,089	38,809	40,423	49,697
Percent	14.1	16.0	13.0	10.7	10.8
Total Shipments	163.599	212.931	299,470	377,476	458,699

Source: Dataquest (September 1990)

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#### Figure 2

#### Estimated Market Share by Region for 8-Bit Microcontrollers 1980-1989



Source: Dataquest (September 1990)

#### Table 7

#### Estimated Market Share by Product Type for 8-Bit Microcontrollers 1975-1979 (Percentage)

Product	1975	1976	1977	1978	1979
802X	0	0	0	0	1.4
8048/35	0	0	11.9	23.7	27.5
8049/39	0	0	0	0.5	4.1
6500/XX	0	0	0	0	0.1
6801/03	0	0	0	0	0.1
6805	0	0	0	0	
F8/387X	100.0	100.0	88.1	55.6	31.5
PIC1650	0	0	0	20.3	35.4
	100.0	100.0	100.0	100.0	100.0

\*Calculated value is less than 0.1 percent.

Note: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in the market share mambers for each product type. Source: Dataquest (September 1990)

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#### Table 8

## Estimated Market Share by Product Type for 8-Bit Microcontrollers 1980-1984

· · · · · · · · · · · · · · · · · · ·	1980	1981	1982	1983	1984
6500/XX	0.5	1.0	0.6	1.3	1.2
6801/03	0.9	5.4	7.8	10.5	7.8
6804	0	0	0	0	*
6805/68HC05	2.t	8.0	12.4	12.8	11.9
68HC11	0	0	0	0	*
8048/35	31.6	26.4	25.0	20.9	20.7
8049/39	9.7	15.0	18.5	18.4	18.9
8050/40	0.2	1.2	1.9	2.4	1.7
8051/31	0	0.1	1.0	6.1	13.6
8052/32	0	0	0	*	0.1
84XX	0	G	0.1	2.1	1.5
F8/387X	25.1	21.2	10.7	5.7	2.7
PIC165X	25.8	t1.8	7.8	4.3	3.6
TM\$7000	0	0.1	0.5	0.8	0.7
aPD78XX	0	1.4	3.8	5.5	7.2
<b>Z8</b>	0.1	1.0	1.7	2.2	2.5
Others	4.0	7.5	8.3	7.0	5.8
	100.0	100.0	100.0	100.0	100.0

\*Calculated value is less than 0.1 percent. Note: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in the market share mumbers for each product type. Source: Dataquest (September 1990)

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## Table 9

## Estimated Market Share by Product Type for 8-Bit Microcontrollers 1985-1989 (Percentage)

	1985	1986	1987	1988	1989
6500/XX	1.2	1.7	1.4	1.4	1.0
6801/03	7.8	8.8	8.7	8.2	6.8
6804	0.3	0.7	1.5	1.0	1.1
6805/68HC05	14.3	15.7	16.7	19.6	23.0
68HC11	•	0.3	1.3	2.5	3.8
8048/35	12.6	6.3	5.3	3.4	2.2
8049/39	17.7	13.2	14.9	11.4	8.5
8050/40	1.3	1.3	2.0	1.4	0.9
8051/31	10.7	9.9	11.5	11.6	10.8
8052/32	0.2	1.5	2.0	3.2	4.8
84XX	3.8	6.7	4.1	3.2	3.0
F8/387X	2.7	3.2	1.7	0.9	0.8
M50XXX	9.2	14.0	0	0	0
M509XX	0	0	4.4	6.6	5.2
M507XX	0	0	7.9	6.1	4.5
PIC1652/54	0.9	0.8	1.4	1.4	1.2
PIC1655/57	2.0	0.7	0.4	0.2	0
TMS7000	1.0	1.5	3.1	2.8	2.2
uPD78XX	7.0	8.6	8.1	8.5	7.9
MN18XX	0.1	0.2	0.4	1.2	2.6
28	1.7	2.1	1.6	1.6	1.7
Others	5.4	2.7	1.8	3.6	8.1
	100.0	100.0	100.0	100.0	100.0

\*Calculated value is less than 0.1 percent. Note: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM varions are included in the market share numbers for each product type. Source: Dataquest (September 1990)

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## Estimated Market Share by Product Type for 8-Bit Microcontrollers 1988 and 1989



Source: Dataquest (September 1990)

#### Table 10

## Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1975-1979 (Percentage)

		1975	1976	1977	1978	1979
Group 1	6500/XX	0	0	0	0	0.1
Group 2	6801/03	0	0	0	0	0.1
Group 3	6805	0	0	0	0	
Group 4	8048/35, 8049/39, 802X	0	0	11.9	24.1	32.9
Group 5	387X, 38P7X, F8	100.0	100.0	88.1	55.6	31.5
Group 6	PIC1650	0	0	0	20.3	35.4
	Total 8-Bit MCU	100.0	100.0	100.0	100.0	100.0

\*Calculated value is less than 0.1 percent. Note: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in market share estimates for each instruction set group. Source: Dataquest (September 1990)

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## Table 11

## Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1980-1984 (Percentage)

		1980	1981	1982	1983	1984
Group 1	6500/1, 6511, 5074X	0.5	1.0	0.6	1.3	1.2
Group 2	6801/03, 6301	0.9	5.4	7.8	10.5	7.8
Group 3	6805, 68HC05, 6305, 146805	2.1	8.0	12.4	12.8	11.9
Group 4	8048/35, 8049/39, 8050/40, 84XX, 8041, 802X	45.4	49.9	53.6	47.7	46.4
<b>Group</b> 5	8051/31, 8052/32, 8053, 80515/35, 80C451, 80C154	0	0.1	1.0	6.2	13.7
Group 6	387X, 38P7X, F8	25.1	21.2	10.7	5.7	2.7
Group 7	PIC165X	25.8	11.8	7.8	5.0	3.9
Стоир 8	TMS7000, PIC70XX	0	0.1	0.5	0.8	0.7
Group 9	uPD78XX	0	1,4	3.8	5.5	7.2
Group 10	Z8	0.1	1.0	1.7	2.2	2.5
	Others	0.1	0.2	0.1	2.4	1.9
	Total 8-Bit MCUs	100.0	100.0	100.0	100.0	100.0

Note: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in market share estimates for each instruction set group. Source: Dataqueet (September 1990)

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#### Table 12

## Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1985-1989 (Percentage)

		1985	1986	1987	1988	1989
Group 1	6500/1, 6511, 5074X	10.4	15.7	9.3	7.5	5.5
Group 2	6801/03, 6301	7.8	8.8	8.7	8.2	6.8
Group 3	6804	0.3	0.7	1.5	1.0	1.1
Group 4	6805, 68HC05, 6305, 146805	14.3	15.7	16.7	19.6	23.0
Group 5	68HC11	*	0.3	1.3	2.5	3.8
Стоир б	8048/35, 8049/39, 8050/40, 84XX, 8041, 802X	39.4	29.5	27.0	20.0	15.0
Group 7	8051/31, 8052/32, 8053, 80515/35, 80C451, 80C154	10.9	11.5	14.2	16.0	18.1
Group 8	387X, 38P7X, F8	2.7	3.2	1.7	0.9	0.8
Group 9	PIC165X	3.1	1.6	1.7	1.6	1.2
Group 10	TMS7000, PIC70XX	1.0	1.5	3.1	2.8	2.2
Group 11	uPD78XX	7.0	8.6	8.1	8.5	7.9
Group 12	<b>Z</b> 8	1.7	2.1	1.6	1.6	1.7
	Others	1.4	0.8	5.1	9.8	13.1
<u> </u>	Total 8-Bit MCUs	100.0	100.0	100.0	100.0	100.0

\*Calculated value is less than 0.1 percent. Note: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in market share estimates for each instruction. set group. Source: Dataquest (September 1990)

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#### **Figure 4**





Source: Dataquest (September 1990)

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#### Table 13

#### Estimated Market Share by Process Technology for 8-Bit Microcontrollers 1975-1979

	1975	1976	1977	1978	1979
MMOS					
Shipments	32	251	885	2,218	11,592
Percent	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (September 1990)

#### Table 14

## Estimated Market Share by Process Technology for 8-Bit Microcontrollers 1980-1984 (Thousands of Units)

	1980	1981	1982	1983	1984
NMOS					
Shipments	21,740	34,836	52,369	82,779	147,135
Percent	100.0	99.7	96.8	<b>9</b> 1. <b>4</b>	90.0
CMOS					
Shipments	0	95	1,745	7,836	16,375
Percent	0	0.3	3.2	8.6	10.0
Total Shipments	21,740	34,931	54,114	90,615	163,510
Source: Dataquest (September 1990)					

## Table 15

## Estimated Market Share by Process Technology for 8-Bit Microcontrollers 1985-1989 (Thousands of Units)

		1986	1987	1988	1989
NMOS					
Shipments	130,011	151,935	195,717	221,138	226,828
Percent	79.5	71.4	65.4	58.6	49.5
CMOS					
Shipments	33,588	60,996	103,753	156,338	231,871
Percent	20,5	28.6	34.6	41.4	50.5
Total Shipments	163,599	212,931	<b>29</b> 9,470	377,476	458,699

Source: Dataquest (September 1990)

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#### Figure 5

#### Estimated Market Share by Process Technology for 8-Bit Microcontrollers 1980-1989



Source: Dataquest (September 1990)

## Table 16

## Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers 1975-1979 (Percentage)

	1975	1976	1977	1978	1979
NMOS					
United States	100.0	100.0	100.0	99.3	91.1
Japan	0	0	0	0.7	8.5
Western Europe	0	0	0	0	0.4
Total NMOS	100.0	100.0	100.0	100.0	100.0
D					

Source: Dataquest (September 1990)

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#### Table 17

## Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers 1980-1984 (Percentage)

	1980	1981	1982	1983	1984
NMOS					
United States	73.3	68.2	61.8	59.4	53.7
Japan	15.5	20.1	26.0	28.6	33.3
Western Europe	11.2	11.7	12.2	12.1	13.0
Total NMOS	100.0	100.0	100.0	100.0	100.0
CMOS					
United States	0	100.0	398	39.3	33.7
Japan	0	0	60.2	60.7	66.1
Western Europe	0	0	Ö	0	0.1
Total CMOS	0	100.0	100.0	100.0	100.0

Source: Dataquart (September 1990)

#### Table 18

## Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers 1985-1989 (Percentage)

	1985	1986	1987	1988	1989
NMOS					
United States	49.5	46.0	50.6	56.2	\$5.0
Japan	32.8	32.1	31.5	28.9	28.2
Western Europe	17.6	22.0	17.9	14.9	16.8
Total NMOS	100.0	100.0	100.0	100.0	100.0
CMOS					
United States	16.4	13.2	<b>18</b> .1	26.5	41.4
Japan	83.1	85.6	78.3	68.7	53.6
Western Europe	0.5	1.2	3.6	4.7	5.0
Total CMOS	100.0	100.0	100.0	100.0	100.0

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## Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers





Source: Dataquest (September 1990)

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# **16-Bit Microcontrollers**

The tables and figures in this section are organized as follows:

Table 1	Estimated Market Share by Manufacturer for 16-Bit Microcontrollers, 1985-1989
Figure 1	Estimated Market Share by Manufacturer for 16-Bit Microcontrollers, 1988 and 1989
Table 2	Estimated Market Share by Region for 16-Bit Microcontrollers, 1985-1989
Figure 2	Estimated Market Share by Region for 16-Bit Microcontrollers, 1985-1989
Table 3	Estimated Market Share by Product Type for 16-Bit Microcontrollers, 1985-1989
Figure 3	Estimated Market Share by Product Type for 16-Bit Microcontrollers, 1988 and 1989
Table 4	Estimated Market Share by Process Technology for 16-Bit Microcontrollers, 1985-1989
Figure 4	Estimated Market Share by Process Technology for 16-Bit Microcontrollers, 1985-1989
Table 5	Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers, 1985-1989
Figure 5	Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers, 1989

Chapter 4

#### Table 1

## Estimated Market Share by Manufacturer for 16-Bit Microcontrollers 1985-1989 (Percentage)

	1985	1986	1987	1988	1989
Hitachi	0	0	0	0	0.5
Intel	62.5	67.4	16.6	33.1	45.0
Mitsubishi	0	0	0	0	2.4
NEC	0	0	0.1	0.2	0.2
National	0	0	0.8	4.6	8.4
SGS-Thomson	5.2	32.3	3.3	1.2	0.8
Texas Instruments	32.3	0.3	0	0	0
Various <sup>2</sup>	0	0	79.2	60.9	42.7
Total 16-Bit MCUs	100.0	100.0	100.0	100.0	100.0

<sup>1</sup>Mostek was acquired by Thomson Components in 1985. Thomson Components subsequently merged with SGS in 1987. <sup>2</sup>The 8061 is a custom-designed, 16-bit microcontroller for Ford Motor Company. It is supplied by several semiconductor companies, including Intel. Estimated production of the 8061 based on production of Ford automobiles and trucks. (No attempt to estimate production prior to 1987 has been made.) Note: Columns may not add to totals shown because of rounding. Source: Dataquest (September 1990)

#### Figure 1

#### Estimated Market Share by Manufacturer for 16-Bit Microcontrollers 1988 and 1989



Source: Dataquest (September 1990)

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#### Table 2

## Estimated Market Share by Region for 16-Bit Microcontrollers 1985-1989

	1985	1986	1987	1988	1989
United States					
Shipments	220	270	3,199	5,388	7,148
Percent	94.8	67.7	96.6	<b>98.</b> 6	96.1
Japan					
Shipments	0	0	2	9	233
Percent	0	0	0.1	0.2	3.1
Western Europe				`	
Shipments	12	129	110	64	57
Percent	5.2	32.3	3.3	1.2	0.8
Total Shipments	232	399	3,311	5,461	7,438

Source: Dataquest (September 1990)

## Figure 2





Source: Dataquest (September 1990)

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Chapter 4

#### Table 3

## Estimated Market Share by Product Type for 16-Bit Microcontrollers 1985-1989 (Percentage)

1986	1987	1988	1989
			1,0,
67.4	16.6	30.6	41.8
0	79.3	60.9	42.7
0	0.8	4.6	8.4
32.3	3.3	1.2	0.8
0.3	0.1	2.7	6.4
100.0	100.0	100.0	100.0
	100.0	100.0 100.0	100.0 100.0 100.0

Note: Columns may not add to totals shown becas Source: Dataquest (September 1990)

Figure 3





Source: Dataquest (September 1990)

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#### Table 4

## Estimated Market Share by Process Technology for 16-Bit Microcontrollers 1985-1989 (Thousands of Units)

	1985	1986	1987	1988	1989
NMOS					
Shipments	232	399	658	1,814	3,192
Percent	100.0	100.0	19.9	33.2	42.9
CMOS					
Shipments	0	0	2,653	3,647	4,246
Percent	0	0	80.1	66.8	57.1
Total Shipments	232	399	3,311	5,461	7,438

Figure 4

#### Estimated Market Share by Process Technology for 16-Bit Microcontrollers 1985-1989





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#### Table 5

#### Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers 1985-1989 (Percentage)

	1985	1986	1987	1988	1989
NMOS					
United States	94.8	67.7	83.3	96.5	98.2
Japan	0	0	0	0	0
Western Europe	5.2	32.3	16.7	3.5	1.8
Total NMOS	100.0	100.0	100.0	100.0	100.0
CMOS					
United States	0	0	99.9	99.8	94.5
Japan	0	0	0.1	0.2	5.5
Western Europe	0	0	0	0	0
Total CMOS	0	0	100.0	100.0	100.0

Source: Dataquest (September 1990)

#### Figure 5

## Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers 1989





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## 8-Bit Microcontrollers--Product Analysis

The tables and figures in this section are organized as follows:

- Table 1Estimated Market Share by Product Type for 8-Bit Microcontrollers,1975-1979
- Table 2Estimated Market Share by Product Type for 8-Bit Microcontrollers,1980-1984
- Table 3Estimated Market Share by Product Type for 8-Bit Microcontrollers,1985-1988
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- Figure 2 8048 Product Life Cycle
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- Figure 5 6801 Product Life Cycle
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- Table 4Estimated Market Share by Instruction Set for 8-Bit Microcontrollers,1975-1979
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- Figure 7 Estimated Market Share by Instruction Set for 8-Bit Microcontrollers, 1987 and 1988
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- Table 7Estimated Market Share by Process Technology for 8-Bit Microcontrollers,1975-1979
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- Figure 10 Estimated Market Share by Process Technology for 8-Bit Microcontrollers, 1980-1988
- Table 10Estimated Market Share by Process Technology by Region for 8-Bit<br/>Microcontrollers, 1975-1979
- Table 11Estimated Market Share by Process Technology by Region for 8-Bit<br/>Microcontrollers, 1980-1984
- Table 12Estimated Market Share by Process Technology by Region for 8-Bit<br/>Microcontrollers, 1985-1988
- Figure 11 Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers, 1988

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### Table 1

#### Estimated Market Share by Product Type for 8-Bit Microcontrollers 1975-1979

<b>Product</b>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
802X	0	0	0	. <b>O</b>	1,4%
8048/35	0	0	11.9%	23.7%	27.5
8049/39	0	0	0	0.5	4.1
6500/XX	0	0	0	0	0.1
6801/03	0	0	0	0	0.1
6805	0	0	0	0	*
F8/387X	100.0%	100.0%	88.1	55.6	31.5
PIC1650	0	0	0	20.3	_35.4
	100.0%	100.0%	100.0%	100.0%	100.0%

\*Calculated value is less than 0.1%.

Notes: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in the market share numbers for each product type.

> Source: Dataquest August 1989

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### Table 2

#### Estimated Market Share by Product Type for 8-Bit Microcontrollers 1980-1984

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
6500/XX	0.5%	1.0%	0.6%	1.3%	1.2%
6801/03	0.9	5.4	7.8	10.5	7.8
6804	0	0	0	0	*
6805/68HC05	2.1	8.0	12.4	12.8	11.9
68HC11	0	0	0	0	*
8048/35	31.6	26.4	25.0	20.9	20.7
8049/39	9.7	15.0	18.5	18.4	18.9
8050/40	0.2	1,2	1.9	2.4	1.7
8051/31	0	0.1	1.0	6.1	13.6
8052/32	0	0	0	*	0.1
84XX	0	0	0.1	2.1	1.5
F8/387X	25.1	21.2	10.7	5.7	2.7
PIC165X	25.8	11.8	7.8	4.3	3.6
TMS7000	0	0.1	0.5	0.8	0,7
uPD78XX	0	1.4	3.8	5.5	7.2
28	0.1	1.0	1.7	2.2	2.5
Others	4.0	7.5	<u> </u>	7.0	<u> </u>
	100.0%	100.0%	100.0%	100.0%	100.0%

\*Calculated value is less than 0.1%.

Notes: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in the market share numbers for each product type.

> Source: Dataquest August 1989

#### Table 3

### Estimated Market Share by Product Type for 8-Bit Microcontrollers 1985-1988

	<u>1985</u>	<u>1986</u>	<u>1987</u>	· <u>1988</u>
6500/XX	1.2%	1.6%	1.3%	1.2%
6801/03	7.8	8.3	7.9	7.1
6804	0.3	0.7	1.3	0.9
6805/68HC05	14.3	14.9	15.0	16.5
68HC11	*	0.3	1.2	2.1
8048/35	12.6	6.0	4.7	2.9
8049/39	17.7	12.6	13.4	9.5
8050/40	1.3	1.2	1.8	1.2
8051/31	10.7	9.4	10.3	9.7
8052/32	0.2	1.4	1.8	2.7
84XX	3.8	6.4	3.6	2.7
F8/387X	2.7	3.0	1.5	0.8
M50XXX	9.2	13.4	0	0
M509XX	0	0	3.9	5.9
M507XX	0	G	7.1	5.7
PIC165X	2.9	1.4	1.5	1.4
TMS7000	1.0	1.5	2.8	2.0
uPD78XX	7.0	8.2	7.2	7.1
28	1.7	2.0	1.4	1.3
Others	5.5	<u>7.7</u>	12.2	<u>19.3</u>
	100.0%	100.0%	100.0%	100.0%

\*Calculated value is less than 0.1%.

Notes: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in the market share numbers for each product type.

> Source: Dataquest August 1989

Figure 1

Estimated Market Share by Product Type for 8-Bit Microcontrollers 1987 and 1988





Source: Dataquest August 1989

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Figure 2

8048 Product Life Cycle



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- 1	011100	
	SULC	-





Figure 4







Figure 5



Thousands of Units



Source: Dataquest August 1989

.

### Figure 6

#### 6805 Product Life Cycle



Source: Dataquest August 1989

### Table 4

#### Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1975-1979

		<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
Group 1	6500/XX	0	o	0	0	0.1%
Group 2	6801/03	0	o	o	0	0.1
Group 3	6805	0	0	0	0	*
Group 4	8048/35, 8049/39 802X	0	0	11.9%	24.1%	32.9
Group 5	387X, 38P7X, F8	100.0%	100.0%	88.1	55.6	31.5
Group 6	PIC1650	0	0	0	20.3	35.4
	Total 8-Bit MCU	100.0%	100.0%	100.0%	100.0%	100.0%

\*Calculated value is less than 0.1%.

Notes: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in market share estimates for each instruction set group.

> Source: Dataquest August 1989

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### Table 5

### Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1980-1984

			<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Group	l	6500/1, 6511, 5074X	0.5%	1.0%	0.6%	1.3%	1.2%
Group	2	6801/03, 6301	0.9	5.4	7.8	10.5	7.8
Group	3	6805, 68HC05 6305, 146805	2.1	8.0	12.4	12.8	11.9
Group	4	8048/35, 8049/39 8050/40, 84XX 8041, 802X	45.4	49.9	53.6	47.7	46.4
Group	5	8051/31, 8052/32 8053, 80515/35 80C451, 80C154	0	0.1	1.0	6.2	13.7
Group	6	387X, 38P7X, F8	25.1	21.2	10.7	5.7	2.7
Group	7	PIC165X	25.8	11.8	7.8	5.0	3.9
Group	8	TMS7000, PIC70XX	0	0.1	0.5	0.8	0.7
Group	9	uPD78XX	0	1.4	3.8	5.5	7.2
Group	10	28	0.1	1.0	1.7	2.2	2.5
		Others	<u>_0,1</u>	<u>0.2</u>	0.1		<u>    1.9</u>
		Total 8-Bit MCUs	100.0%	100.0%	100.0%	100.0%	100.0%

\*Calculated value is less than 0.1%.

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Notes: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in market share estimates for each instruction set group.

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Source: Dataquest August 1989

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### Table 6

#### Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1985-1988

			<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Group	1	6500/1, 6511, 5074X	10.4%	14.9%	12.3%	6.9%
Group	2	6801/03, 6301	7.8	8.3	7.9	7.1
Group	3	6804	0.3	0.7	1.3	0.9
Group	4	6805, 68HC05 6305, 146805	14.3	14.9	15.0	16.4
Group	5	68HC11	*	0.3	1,2	2.1
Group	б	8048/35, 8049/39 8050/40, 84XX 8041, 802X	39.4	28.0	24.2	16.5
Group	7	8051/31, 8052/32 8053, 80515/35 80C451, 80C154	10.9	10.9	12.8	13.3
Group	8	387X, 38P7X, F8	2.7	3.0	1.5	0.8
Group	9	PIC165X	3.1	1.5	1.6	1.4
Group	10	TMS7000, PIC70XX	1.0	1.5	2.8	2.2
Group	11	uPD78XX	7.0	8.2	7.2	7.1
Group	12	Z8	1.7	2.0	1.4	1.3
		Others	_1.4	<u> </u>	10.8	24.2
		Total 8-Bit MCUs	100.0%	100.0%	100.0%	100.0%

\*Calculated value is less than 0.1%. Notes: Columns may not add to totals shown because of rounding. NMOS/CMOS/EPROM versions are included in market share estimates for each instruction set group.

> Source: Dataquest August 1989

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Figure 7



Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1987 and 1988

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### Figure 8

### 8048 Instruction Set Life Cycle









Table 7

#### Estimated Market Share by Process Technology for 8-Bit Microcontrollers 1975-1979

<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
32	251	885	2,218	11,592
100.0%	100.0%	100.0%	100.0%	100.0%
	<u>1975</u> 32 100.0%	<u>1975</u> <u>1976</u> 32 251 100.0% 100.0%	1975     1976     1977       32     251     885       100.0%     100.0%     100.0%	1975     1976     1977     1978       32     251     885     2,218       100.0%     100.0%     100.0%     100.0%

Source: Dataquest August 1989

#### Table 8

#### Estimated Market Share by Process Technology for 8-Bit Microcontrollers 1980-1984 (Thousands of Units)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
NMOS					
Shipments	21,740	34,836	52,369	82,779	147,135
Percent	100.0%	99.7%	96.8%	91.4%	90.0%
CMOS				<u>-</u>	
Shipments	0	95	1,745	7,836	16,375
Percent	0	0.3%	3.2%	8.6%	10.0%
Total Shipments	21,740	34,931	54,114	90,615	163,510

Source: Dataquest August 1989

### Table 9

### Estimated Market Share by Process Technology for 8-Bit Microcontrollers 1985-1988 (Thousands of Units)

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
NMOS				
Shipments	130,011	151,935	197,450	219,549
Percent	79.5%	67.8%	59.2%	48.4%
CMOS				
Shipments	33,588	72,066	135,912	234,473
Percent	20.5%	32.2%	40.8%	51.6%
Total Shipments	163,599	224,001	333,362	454,022

Source: Dataquest August 1989

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### Figure 10

#### Estimated Market Share by Process Technology for 8-Bit Microcontrollers 1980-1988



#### Table 10

#### Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers 1975-1979

	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
NMOS					
United States	100.0%	100.0%	100.0%	99.3%	91.1%
Japan	0	0	0	0.7	8.5
W. Europe	0	0	0	0	4
Total NMOS	100.0%	100.0%	100.0%	100.0%	100.0%
				Source:	Dataquest

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August 1989

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#### Table 11

#### Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers 1980-1984

	<u>1980</u>	<u> 1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
RMOS					
United States	73.3%	68.2%	61.8%	59.4%	53.7%
Japan	15.5	20.1	26.0	28.5	33.3
W. Europe	11.2	11.7	12.2	<u>12.1</u>	<u>13.0</u>
Total NMOS	100.0%	100.0%	100.0%	100.0%	100.0%
CMOS					
United States	0	100.0%	39.8	39.3%	33.7
Japan	0	0	60.2	60.7	66.1
W. Europe	0	<u>0</u>	0	0	0.1
Total CMOS	0	100.0%	100.0%	100.0%	100.0%

Source: Dataquest August 1989

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### Table 12

#### Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers 1985-1988

	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
NMOS				
United States	49.5%	46.0%	50.2%	56.3%
Japan	32.8	32.1	32.1	28.7
W. Europe	17.6	22.0	17.8	15.1
Total NMOS	100.0%	100.0%	100.0%	100.0%
CMOS				
United States	16.4%	11.25	13.75	17.7
Japan	83.1	87.8	83.6	79.2
W. Europe	0_5	1.0	7	
Total CMOS	100.0%	100.0%	100.0%	100.0
			Sources	Dataquest

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Figure 11

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The tables and figures are organized as follows:

Table 1 Estimated Market Share by Product Type for 8-Bit Microcontrollers, 1975-1986 Figure 1 Estimated Market Share by Product Type for 8-Bit Microcontrollers, 1985 and 1986 Table 2 Estimated Market Share by Manufacturer for 8-Bit Microcontrollers, 1981-1986 Estimated Market Share by Manufacturer for 8-Bit Microcontrollers, Figure 2 1985 and 1986 Table 3 Estimated Market Share by Region for 8-Bit Microcontrollers, 1981-1986 Figure 3 Estimated Market Share by Region for 8-Bit Microcontrollers, 1981-1986 Table 4 Estimated Market Share by Process Technology for 8-Bit Microcontrollers, 1981–1986 Figure 4 Estimated Market Share by Process Technology for 8-Bit Microcontrollers, 1981–1986 Table 5 Estimated Market Share by Process Technology and Region for 8-Bit Microcontrollers, 1981–1986 Estimated Market Share by Process Technology and Region for 8-Bit Figure 5 Microcontrollers, 1981–1986

*...* 

Table 1

### Estimated Market Share by Product Type for 8-Bit Microcontrollers 1975-1986

	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
50XXX						
6805/14805/68705/1468705					0.03%	2.12%
8049/80C49/8749					4.05	9.71
8051/80C51/8751						
uPD78XX						
6801/6301/68701					0.11	0.90
84XX/84CXX						
8048/80C48/8748			11.87%	24,12%	27.50	31.86
387X/F8			3.95	19.97	21.83	21.30
PIC-1650				20.29	35.37	25.76
28						0.06
6500					0.07	0.50
8052/80C52						
8041/8741						
8050/80C50						
802XX					1.38	0.09
Others	<u>100.00</u> %	<u>100.00</u> %	<u>_84.18</u>	35.62	9.66	<u> </u>
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

(Continued)

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### Table 1 (Continued)

### Estimated Market Share by Product Type for 8-Bit Microcontrollers 1975-1986

	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
50XXX					9.28%	14.65%
6805/14805/68705/1468705	8.00%	12.12%	12.19%	11.36%	14.40	14.57
8049/80C49/8749	15.02	18.48	18.38	18.86	17.39	13.35
8051/80C51/8751	0.07	0.88	5.78	13.08	10.72	10.30
uPD78XX	1.40	3.79	5.47	7.20	7.02	9.01
6801/6301/68701	5.38	7.84	10.49	7.77	7.80	7.17
84XX/84CXX		0.15	2.14	1.53	3.80	7.04
8048/80C48/8748	26.44	25.00	20.89	20.72	12.54	6.06
387X/F8	18.74	9.06	4.76	2.57	2.68	3.01
PIC-1650	11.81	7.76	7.31	5.75	4.46	2.25
28	0.99	1.73	2,17	2.54	1.70	2.16
6500	0.99	0.58	1.26	1.18	1,20	1.75
8052/80C52					0.18	1.60
8041/8741				1.60	2.28	1.48
8050/80C50	1.16	1.86	2.42	1.70	1.30	1.32
802XX	7.28	8.14	3.90	2.02	1.67	0.87
Others	2.72	2.61	2.84	2.12	1.58	
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Dataquest October 1987

Figure 1







1986

Source: Dataquest October 1987

#### Table 2

#### Estimated Market Share by Manufacturer for 8-Bit Microcontrollers 1981-1986

	1981	1982	1983	1984	1985	1986
NEC	13.88%	18.13	19.26%	22.425	19.08%	18.41
Motorola	13.98	17.55	18.77	13.99	16.30	16.49
Mitsubishi					9.28	14.65
Philips	1.06	2.34	3.97	6.34	7.36	9.00
Intel	23.94	21.49	17.92	16.68	9.15	8.66
Hitachi	1.40	3.34	4.10	4.34	4.79	5.19
Toshiba	1.00	2.42	3.88	5.96	7.75	3.58
Signetics	0.00	0.32	2.35	4.71	3.99	2.94
SGS	0.74	1.29	1.28	0.99	1.50	2.65
General Instrument	11.81	7.76	7.31	5.80	4.57	2.61
Oki		0.30	1.14	1.47	1.53	2.50
Siemens	2.42	4.05	3.13	2.39	2.68	2.36
National	4.71	5.75	4.76	4.27	3.44	1.63
Zilog	0.98	1.26	0.94	1.25	1.29	1.52
Rockwell*						1.25
Texas Instruments*						1.25
Matra-Harris*						1.05
AMD*	0.79	0.79	0.75	1.41	1.03	-
Others*	23.29	13.21	10.44	7.98	6.26	4.26
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

\*Companies combined with Others category in current or prior years, where Others represent companies each with less than 1 percent of total.

> Source: Dataquest October 1987

#### Figure 2

### Estimated Market Share by Manufacturer for 8-Bit Microcontrollers 1985 and 1986





Source: Dataquest October 1987

#### Table 3

### Estimated Market Share by Region for 8-Bit Microcontrollers 1981-1986

	<u>1981</u>	<u>1982</u>	1983	1984	<u>1985</u>	<u>1986</u>
Europe						
Shipments	1,475	4,327	8,138	17,423	21,702	40,262
Percent	4.22%	8.00%	8.98%	11.36%	13.31%	19.73%
Japan						
Shipments	7,014	14,689	28,400	59,835	69,726	91,570
Percent	20.08%	27.14%	31.34%	36.31%	42.76%	44.87%
United States						
Shipments	26,442	35,098	54,077	86,252	71,639	72,252
Percent	75.70%	64.86%	<u>59.68</u> %	<u>52.33</u> %	43.93%	35.40%
Total						
Shipments	34,931	54,114	90,615	163,510	163,067	204,084
Percent	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Dataquest October 1987

### Figure 3

### Estimated Market Share by Region for 8-Bit Microcontrollers 1981-1986



#### Table 4

### Estimated Market Share by Process Technology for 8-Bit Microcontrollers 1981-1986 (Thousands of Units)

	<u>1981</u>	1982	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
oments	95	1,728	7,808	16,411	42,974	77,901
cent	0.27%	3.19%	8.62%	10.04%	26.35%	38.17%
oments	34,836	52,386	82,807	147,099	120,093	126,184
cent	<u>99.73</u> %	<u>96.81</u> %	<u>91.38</u> %	<u>89.96</u> %	<u>73.65</u> %	<u>61.83</u> %
otal						
Shipments	34,931	54,114	90,615	163,510	163,067	204,084
	oments ent ments ent otal Shipments	1981     oments   95     cent   0.27%     oments   34,836     cent   _99.73%     otal	1981   1982     oments   95   1,728     cent   0.27%   3.19%     oments   34,836   52,386     cent   _99.73%   _96.81%     otal	1981   1982   1983     oments   95   1,728   7,808     sent   0.27%   3.19%   8.62%     oments   34,836   52,386   82,807     oment <u>99.73</u> % <u>96.81</u> %   91.38%     otal   34,931   54,114   90,615	1981 1982 1983 1984   oments 95 1,728 7,808 16,411   onets 0.27% 3.19% 8.62% 10.04%   oments 34,836 52,386 82,807 147,099   onet 99.73% 96.81% 91.38% 89.96%   otal 34,931 54,114 90,615 163,510	1981   1982   1983   1984   1985     oments   95   1,728   7,808   16,411   42,974     cent   0.27%   3.19%   8.62%   10.04%   26.35%     oments   34,836   52,386   82,807   147,099   120,093     cent   _99.73%   _96.81%   _91.38%   _89.96%   _73.65%     otal   Shipments   34,931   54,114   90,615   163,510   163,067

Source: Dataquest October 1987



Figure 4

### Table 5

#### Estimated Market Share by Process Technology and Region for 8-Bit Microcontrollers 1981-1986 (Thousands of Units)

	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
CMOS						
Europe						
Shipments				23	155	782.5
Percent				0.01%	0.10%	0.38%
Japan						
Shipments	0	1,033	4,732	10,832	36,447	68,767
Percent	0	1.91%	5.22%	6.62%	22.35%	33.70%
United States						
Shipments	95	695	3,076	5,556	6,372	8,351.8
Percent	<u>0.27</u> %	<u>1.28</u> %	<u>3.39</u> %	<u>3.40</u> %	<u>3.91</u> %	<u>     4.09</u> %
Subtotal						
Shipments	95	1,728	7,808	16,411	42,974	77,900.3
Percent						
of Total	0.27%	3.19%	8.62%	10.04%	26.35%	38.17%
NMOS						
Europe						
Shipments	1,475	4,327	8,138	17,400	21,547	39,479.5
Percent	4.22%	8.00%	8.98%	10.64%	13.21%	19.34%
Japan						
Shipments	7,014	13,656	23,668	49,003	33,279	22,803
Percent	20.08%	25.24%	26,12%	29.97%	20.41%	11.17%
United States						
Shipments	26,347	34,403	51,001	80,696	65,267	63,901
Percent	75.43%	<u>63.57</u> %	<u>56.29</u> %	<u>49.35</u> %	<u>40,02</u> %	<u> </u>
Subtotal						
Shipments	34,836	52,386	82,807	147,099	120,093	126,183.5
Percent						
of Total	99.73%	96.81%	91.38%	89.96%	73.65%	61.83%
Total						
Shipments	34,931	54,114	90,615	163,510	163,067	204,084
Percent	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Dataquest October 1987

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Figure 5

#### Estimated Market Share by Process Technology and Region for 8-Bit Microcontrollers 1981-1986

Millions of Units



Source: Dataquest October 1987





The following section, 8-Bit Microcontroller Data Tables, includes historical microcontroller unit shipments by year, manufacturer, product name, and process technology.

The tables are organized as follows:

Table 1	Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer, 1975–1979
Table 2	Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer, 1980-1984
Table 3	Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer, 1985-1988
Table 4	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1975-1976
Table 5	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1977
Table 6	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1978
Table 7	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1979
Table 8	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1980
Table 9	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1981
Table 10	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1982
Table 11	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1983
Table 12	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984
Table 13	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985
Table 14	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986
Table 15	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987
Table 16	Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1988

### Table 1

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1975-1979 (Thousands of Units)

	<b>Product</b>	<u>Process</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
AMD	8048	N	0	0	o	0	23
Fairchild	387X	N	0	0	15	23	510
	F8	N	27	181	655	630	650
General Instrument	PIC1650	N	0	0	0	450	4,100
Intel	802X	N	0	0	0	0	160
	8048/35	N	0	0	105	480	1,950
	8049/39	N	0	0	Ο	10	210
	8748	N	0	0	0	30	300
Mostek	387X	N	0	0	20	350	1,470
	F8	N	5	70	90	160	470
Motorola	387X	N	0	0	0	70	500
	6801/03	N	0	0	0	0	13
	6805	N	0	0	0	0	3
National	8049/39	N	Ō	Ō	0	0	10
NEC	8048/35	N	Ó	0	0	15	735
	8049/39	N	0	0	0	0	250
Rockwell	6500/XX	ท	0	0	0	0	8
SGS	387X	N	0	Ō	0	0	50
Signetics	8048/35	N	_0	0	0	0	180
Total 8-Bit MC	Us		32	251	885	2,218	11,592

Source: Dataquest August 1989

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tinued)	(Con						
44	0	•	0	0	'n	80C48/35	Intersil
795	320	70	<b>4</b>	•	N	8751	
2,030	960	450	ω	0	N	8749	
2,500	2,065	1,530	775	650	N	8748	
265	140	0	0	0	n	80C51/31	
230	140	0	0	0	n	80C49/39	
10	18	o	0	0	'n	80C48/35	
213	37	0	0	0	И	8052/32	
12,900	3,530	460	25	0	N	8051/31	
490	300	0	0	0	N	8050/40	
2,960	2,085	1,870	1,230	715	N	8049/39	
3,825	5,250	5,200	4,800	3,750	N	8048/35	
1,050	1,395	2,050	1,525	810	N	802X	Intel
2,766	1,420	825	300	0	N	6805	
1,902	1,035	635	190	0	N	6801/03	
950	540	140	0	0	n	6305	
1,472	722	210	0	0	n	6301	Hitachi
13	0	0	0	0	N	PIC7041	
57	0	0	0	0	N	PIC7020/40	
10	0	0	0	Q	N	PIC7000/1	
475	638	0	0	٥	ი	PIC16C58	
2,975	2,111	0	0	0	N	<b>PIC1670/72</b>	
0	¢	4,200	4,125	5,600	N	PIC165X	
4,305	2,854	0	0	Ô	N	PIC1655/57	Instrument
1,650	1,017	0	0	0	N	PIC1652/54	General
1,510	1,325	1,080	925	300	N	MBL8049/39	
425	350	335	400	150	N	MBL8048/35	Fujitsu
74	680	845	745	620	N	F8	
1,075	1,370	1,750	3,100	1,795	N	387X	Fairchild
0	225	121	•	0	N	8050/40	
0	95	36	0	0	N	8049/39	
0	16	9	0	0	N	8048/35	Eurotechnique
540	120	60	0	•	Z	6805	
1,080	220	0	0	0	N	6801/03	AMI ·
2,260	376	0	0	0	¥	8051	
10	110	105	35	0	N	8049	
40	190	320	240	138	N	8048	٩ <del>٢</del>
<u>1984</u>	<u>1983</u>	1982	1981	1980	Process	Product	
		1	1	1		I	
			5		( 1 NOUSAIDU		
			•	-1984	1980		
	turer	Manufac	ments by	Unit Ship	ontroller	8-Bit Microd	Estimated
							•

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Table 2

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### Table 2 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

	<u>Product</u>	Process	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Matra-Harris	8048	N	o	0	6	48	130
	8051	N	0	0	0	0	635
	80C48	C	0	0	0	0	. 20
Matsushita	MN1800	с	0	0	17	28	40
Mostek	387X	N	2,105	2,485	2,030	1,660	1,425
	38P7X	N	0	0	0	0	148
	F8	N	205	110	33	190	195
Motorola	146805	с	0	95	635	1,886	4,389
	1468705	с	0	0	0	5	34
	387 <b>X</b>	N	635	700	425	126	60
	6801/03	N	195	1,655	3,320	7,111	7,920
	6804	N	0	0	0	0	36
	6805	N	460	2,335	4,775	6,934	8,332
	68701	И	0	33	78	364	199
	68705	N	0	64	262	584	1,904
	68HC11	с	0	0	0	0	3
National	8048/35	N	45	460	995	1,450	2,775
	8049/39	N	175	710	1,125	1,290	2,190
	8050/40	N	50	405	880	1,270	1,940
	807X	N	31	70	53	60	35
	80C48/35	С	0	0	60	245	40
NCR	6500/1/11	N	0	0	0	215	600
NEC	8021/22	N	10	140	200	245	470
	8041	ท	0	0	0	0	2,220
	8048/35	N	1,990	1,900	2,440	3,360	7,750
	8049/39	N	920	2,125	4,200	5,950	7,210
	80C48/35	с	0	0	230	940	2,020
	80C49/39	с	0	0	151	650	1,770
	8741	N	0	0	0	0	380
	8748	N	0	195	510	1,090	2,050
	8749	N	0	0	29	255	1,010
	uPD78XX	N	0	490	2,050	4,960	11,780
Oki	80C48/35	С	0	0	25	203	450
	80C49/39	с	0	0	135	827	1,960
Philips	8021/22	N	0	120	280	360	650
-	8048/35	N	19	250	810	940	3,110
	8049/39	И	0	0	95	320	2,930

(Continued)

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# Table 2 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

	Product	Process	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Philips (Cont.)	8050/40	N	0	0	0	0	10
-	8051/31	И	0	0	0	40	1,160
	80C49/39	с	0	0	0	0	3
	84XX	N	0	0	80	1,940	2,500
RCA	1804A	с	0	0	0	4	23
	6805/68HC05	С	0	0	0	0	7
Rockwell	6500/224	N	108	345	315	930	1,350
SGS	Z8	N	0	0	0	0	123
	387X	N	95	260	700	1,159	1,489
Sharp	<b>Z</b> 8	N	0	0	165	980	1,950
Siemens	8021	N	0	40	95	60	28
	802XX	N	20	720	1,780	1,480	1,098
	8048/35	ท	0	85	300	270	405
	8051/31	N	0	0	15	1,030	2,382
Signetics	8048/35	N	135	0	141	1,055	4,609
-	8049/39	N	0	0	25	545	946
	8050/40	N	0	0	8	400	355
	8051/31	ท	0	0	0	126	1,792
Synertek	Z8	N	0	2	90	135	24
TI	TMS7000	N	0	22	255	715	990
Thomson (EFCIS)	6801/03	N	0	0	0	55	150
	6805	N	0	0	0	100	600
Toshiba	8048/35	N	0	130	615	1,440	3,680
	8049/39	N	0	219	555	1,230	3,900
	80C49/39	с	0	0	142	850	2,170
Zilog	Z8	N	14	344	<u>683</u>	<u> </u>	2,055
Total 8-Bit	MCUs		21,740	34,931	54,114	90,615	163,510

Source: Dataquest August 1989

# Table 3

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988 (Thousands of Units)

	Product	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
AMD	8051/31	N	1,610	1,700	2,240	2,110
	8053	N	0	0	287	510
	80C51/31	С	0	0	134	1,055
	8751	N	71	112	133	217
	8753	N	0	0	77	145
Fairchild	387 <b>X</b>	N	357	10	0	0
	F8	X	287	304	*	*
Fujitsu	MBL8048/35	N •	185	328	528	40
-	MBL8049/39	ท	707	862	1,132	90
	MBL8051/31	И	0	403	1,098	92
	MBL80C49/39	С	, <b>Q</b>	105	2,300	220
	MB897XX	С	0	0	0	1,471
General	PIC1652/54	И	1,515	1,700	*	*
Instrument	PIC1655/57	N	3,295	1,400	*	*
	PIC1670/72	N	2,135	1,190	*	*
	PIC16C58	С	256	77	*	*
	PIC16E57	N	66	229	*	*
	PIC7000/1	N	26	234	*	*
	PIC7020/40	N	140	484	*	*
	PIC7041	N	12	22	*	*
Gould/AMI	6801/03	N	576	21	31	0
	6805	N	402	127	39	0
Harris (GE-SS/						
RCA)	68HC05	С	0	0	0	1,430
Hitachi	6301	Ċ	2,008	5,200	8,100	11,600
	6305	с	1,386	4,242	7,250	11,200
	6801/03	N	1,515	3,557	5,200	5,660
	6805	N	2,902	5,275	7,160	8,490
	68P01	с	0	0	545	944
	68P05	С	0	0	620	1,010
	63701	С	0	0	1,599	2,780
	63705	С	0	0	1,299	1,920
	63P01	с	0	0	645	1,040
	63P05	Ç	0	0	865	1,425
Intel	802X	ท	222	93	54	0
	8048/35	ท	1,365	595	1,067	1,500
	8049/39	N	1,530	2,401	7,475	13,100
	8050/40	N	240	225	542	1,200

(Continued)

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# Table 3 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988 (Thousands of Units)

	<b>Product</b>	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Intel (Cont.)	8051/31	ท	6,800	6,998	12,700	13,800
	8052/32	n	269	1,600	1,885	5,800
	80C49/39	С	112	20	0	0
	80C51/31	С	785	2,000	3,165	6,200
	8748	N	1,310	800	693	800
	8749	N	1,445	2,247	3,625	3,500
	8751	N	843	692	941	1,000
	8752	с	0	0	30	350
	87C51	· c	0	0	100	500
Intersil	80C48/35	с	30	20	0	0
	80C49/39	с	9	· 10	0	0
Matra-Harris	8051	N	1,400	1,340	429	98
	8052	N	20	418	1,033	712
	80C51	с	10	387	1,324	2,190
	80C52	C	0	0	83	660
	83C154	с	0	0	0	116
Matsushita	MN1800	с	131	400	1,070	4,620
Microchip Tech.	PIC1652/54	N	0	0	4,063	5,242
-	PIC1655/57	N	0	0	1,073	903
	PIC1670/72	N	0	0	460	286
	PIC16C58	С	0	0	0	0
	PIC16E57	N	O	0	32	0
	PIC70XX	N	0	0	0	990
	PIC7000/1	N	0	0	696	0
	PIC7020/40	N	0	0	1,985	0
	PIC7041	N	0	0	33	0
Mitsubishi	M507XX	С	0	0	23,706	25,800
	M509XX	C	0	0	13,082	26,600
	M50XXXX	С	15,125	29,906	0	0
	M5L8048/35	N	0	0	515	185
	M5L8049/39	N	0	0	1,691	1,130
	M5M8050/40	N	0	0	208	154
	M5M80C49/39	С	0	0	2,614	690
Mostek	387 <b>X</b>	N	867	*	*	*
	38P7X	N	297	*	*	*
	F8	И	195	*	*	*
Motorola	146805	C	4,071	4,705	5,422	6,598
	1468705	С	48	93	0	0

(Continued)

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# Table 3 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988 (Thousands of Units)

		<b>Product</b>	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Motorola (	(Cont.)	387 <b>X</b>	N	174	199	0	o
		6801/03	N	8,007	8,526	8,918	8,253
National National (FCI) NCR NEC	6804	N	501	1,495	4,357	3,900	
	ational ational (FCI) CR EC	6805	N	10,777	13,559	19,716	27,042
		68701	N	278	431	0	0
		68704	N	13	82	0	0
		68705	N	2,641	3,861	0	0
		68HC05	С	0	0	4,678	12,676
		68HC11	С	67	696	3,975	9,389
National		8048/35	N	2,200	390	425	315
		8049/39	N	1,910	1,650	2,095	1,950
		8050/40	N	1,500	1,280	1,838	2,210
		COP800	С	0	0	10	1,555
		807X	N	5	0	0	0
National (	(FCI)	F8	N	0	0	138	45
NCR		6500/1	N	640	1,027	397	747
		6500/11	N	0	0	0	371
NEC		8021/22	N	350	100	40	70
		8041	N	2,860	2,550	1,750	1,290
		8048/35	N	2,860	_3,940	4,360	2,570
		8049/39	N	5,160	5,350	4,830	3,360
		80C48/35	С	1,800	1,360	970	740
		80C49/39	С	2,060	2,110	2,680	3,430
		8741	N	850	480	330	370
		8748	N	1,660	1,370	590	650
		8749	N	2,060	1,930	3,300	1,820
		uPD78XX	N	11,450	18,390	24,140	32,210
Oki		80C154	С	.0	87	894	1,630
		80C48/35	с	537	520	428	385
		80C49/39	С	1,950	2,720	3,133	3,462
		80C51/31	С	0	1,772	2,721	3,100
Philips		8021/22	N	470	138	172	15
		8048/35	ท	1,430	289	285	215
		8049/39	N	2,550	2,186	1,810	1,230
		8050/40	N	100	393	1,780	215
		8051/31	N	1,100	700	1,840	1,400
		80C49/39	с	145	240	514	665

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# Table 3 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988 (Thousands of Units)

		Product	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Philips (Cor	it.)	80C51/31	с	0	81	620	1,220
-		84CXX	С	0	15	1,150	2,520
		84XX	И	6,200	14,325	10,810	9,580
RCA		1804A	C	13	11	8	*
		6805/68HC05	С	120	359	805	*
Rockwell		6500/XX	ท	1,310	2,550	3,855	4,230
SGS-Thomson	(M)	387X	N	0	0	795	0
	(M)	38P7X	N	0	0	90	110
	(M)	F8	N	0	0	136	21
	(S)	387X	N	2,200	4,811	3,922	3,236
	(S)	<b>Z8</b>	N	244	601	665	444
	(T)	6801/03	N	337	906	1,131	1,829
	(T)	6805	N	1,129	1,190	2,182	2,797
Sharp		SM-Series	с	0	0	530	425
-		Z8	N	426	686	590	425
Siemens		8021	N	138	0	0	0
		802XX	N	1,538	667	51	66
		8048/35	N	194	956	1,733	1,345
		8051/31	N	2,497	2,194	4,055	5,123
		80515/35	N	0	126	768	1,974
		8052/32	N	0	713	1,431	2,642
Signetics		8048/35	N	2,563	760	111	18
-		8049/39	N	1,235	1,741	2,000	2,449
		8050/40	N	277	273	723	698
		8051/31	N	2,362	2,687	2,731	4,038
		8052/32	N	5	456	1,541	1,958
		80C51/31	с	0	60	283	1,653
		80C451	С	0	0	0	55
		83C451	С	0	0	27	0
		87C451	С	0	0	10	15
		8400	N	0	30	43	10
		8441	С	0	0	128	18
TI		TMS7000	N	1,396	2,555	6,600	9,200
TCMC (Mostel	c)	387X	ท	0	969	*	*
		38P7X	N	0	145	*	*
		F8	N	0	299	*	*

(Continued)

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### Table 3 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988 (Thousands of Units)

	<b>Product</b>	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Toshiba	8048/35	N	4,504	1,150	1,171	890
	8049/39	N	5,207	2,350	1,760	1,485
	80C48/35	с	0	1,000	2,950	3,200
	80C49/39	с	2,925	2,280	3,600	4,200
	80C50/40	с	0	520	851	820
	TLCS-90	Ċ	0	0	0	850
Zilog	28	И	2,099	3,112	3,422	5,025
Others**	Unspecified	С	0	11,070	34,020	74,000
Total 8-H	lit MCUs		163,599	224,001	333,490	454,022

### \*Mergers/Acquisitions:

- 1. Gould Semiconductor acquired AMI, 1985.
- Thomson Components acquired Mostek, forming Thomson Components---Mostek Corporation (TCMC), 1985.
- 3. National acquired Fairchild, 1987.
- 4. General Instrument's Microelectronics Division spun off as a new company under the name Microchip Technology, 1987.
- 5. SGS and Thomson merged, forming SGS-Thomson, 1987. (TCMC lost independent identity with the merger.)
- 6. Harris acquired GE Solid State and RCA, 1988.

\*\*Dataquest estimate for companies not sampled (i.e., Rohm, Sanyo, Sony)

Source: Dataquest August 1989

# Table 4

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1975-1976 (Thousands of Units)

	<b>Product</b>	Process	<u>1975</u>	01/76	02/76	<u>03/76</u>	04/76	<u>1976</u>
Fairchild	FS	N	27	8	33	70	70	181
TCMC (Mostek)	F8	N	_5	_5	<u>15</u>	<u>20</u>	<u>_30</u>	<u>_70</u>
Total 8-E	it MCUs		32	13	48	90	100	251

Source: Dataquest August 1989

# Table 5

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1977 (Thousands of Units)

	<u>Product</u>	Process	<u>01/77</u>	<u>02/77</u>	<u>03/77</u>	<u>04/77</u>	<u>1977</u>
Fairchild	3870	N	0	0	о	15	15
	F8	N	100	130	180	245	655
Intel	8048	N	0	15	30	60	105
TCMC (Mostek)	F8	N	10	15	25	40	90
	3870	N	0	0	5	<u>15</u>	_20
Total 8-Bi	t MCUs		110	160	240	375	885

Source: Dataquest August 1989



# Table 6

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1978 (Thousands of Units)

	Product	Process	<u>01/78</u>	<u>02/78</u>	<u>03/78</u>	<u>Q4/78</u>	<u>1978</u>
Fairchild	F8	N	110	130	190	200	630
	3870	N	3	5	5	10	23
General							
Instrument	PIC-1650	N	75	95	105	175	450
Intel	8048	N	60	100	150	170	480
	8748	N	0	0	5	25	30
	8049/39	N	0	0	0	10	10
Motorola	3870	N	5	10	15	40	70
NEC	8048/35	N	0	0	0	15	15
TCMC (Mostek)	3870	ท	20	50	75	205	350
	F8	N	_50	_30	_35	<u>45</u>	<u>160</u>
Total 8-Bi	t MCUs		323	420	580	895	2,218

Source: Dataquest August 1989



# Table 7

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1979 (Thousands of Units)

	<b>Product</b>	Process	01/79	02/79	03/79	<u>04/79</u>	<u>1979</u>
AMD	8048	N	0	S	3	20	23
Fairchild	F8	N	150	150	180	170	650
	3870	И	40	50	120	300	510
General							
Instrument	PIC-1650	ท	300	950	1,250	1,600	4,100
Intel	8048	N	190	390	570	800	1,950
	8748	N	50	75	75	100	300
	8049/39	N	20	30	60	100	210
	8021/22	N	10	20	50	80	160
Motorola	6801/03	N	0	S	3	10	13
	6805	И	0	0	S	3	3
	3870	N	80	125	125	170	500
National	8049/39	N	0	0	S	10	10
NEC	8048/35	N	25	160	250	300	735
	8049/39	N	0	S	100	150	250
Rockwell	6500/1	N	0	S	3	5	8
SGS-ATES	387X	И	5	10	15	20	50
Signetics	8048/35	N	15	30	60	75	180
TCMC (Mostek)	3870	ท	260	300	425	485	1,470
	F8	N	90	<u>    125</u>	<u>    125</u>	<u>130</u>	470
Total 8-Bit	. MCUs		1,235	2,415	3,414	4,528	11,592

S = Sampled

Source: Dataquest August 1989



# Table 8

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1980 (Thousands of Units)

	<b>Product</b>	Process	<u>01/80</u>	02/80	<u>03/80</u>	<u>04/80</u>	<u>1980</u>
MD	8048	N	, <b>5</b>	38	40	55	138
Fairchild	F8	พ	170	150	150	150	620
	3870	ท	345	380	550	520	1,795
Fujitsu	8048	N	0	S	50	100	150
-	8049	N	0	S	100	200	300
General							
Instrument	PIC-1650	N	1,700	1,700	1,100	1,100	5,600
Intel	8048	N	1,000	1,000	750	1,000	3,750
	8049/39	N	140	175	175	225	715
	8021/22	N	110	200	200	300	810
	8748	N	125	160	140	225	650
Motorola	6801/03	И	15	35	70	75	195
	6805	N	10	50	250	150	460
	3870	И	150	150	160	175	635
National	807X	N	S	5	10	16	31
	8050/40	ท	5	10	15	20	50
	8048/35	N	S	5	15	25	45
	8049/39	N	25	40	50	60	175
NEC	8048/35	N	610	470	450	460	1,990
	8021	N	0	S	S	10	10
	8049/39	N	200	250	170	300	920
Philips	8048/35	N	2	5	5	7	19
Rockwell	6500/1	N	8	15	35	50	108
SGS-ATES	387X	N	20	25	30	20	95
Siemens	802XX	N	0	S	5	15	20
Signetics	8048/35	n	60	60	10	5	135
TCMC (Mostek)	3870	N	530	570	455	550	2,105
	F8	N	55	70	45	35	205
Zilog	Z8	ท	S	3	5	6	14
Total 8-Bi	t MCUs		5,285	5,566	5,035	5,854	21,740

S = Sampled

Source: Dataquest August 1989

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# Table 9

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

	Product	Process	<u>01/81</u>	02/81	<u>03/81</u>	04/81	<u>1981</u>
AMD	8048	N	50	50	65	75	240
	8049	N	0	10	10	15	35
Fairchild	F8	N	175	200	210	160	745
	3870	N	900	850	700	650	3,100
Fujitsu	8048	ы	100	100	100	100	400
	8049	N	175	250	250	250	925
General							
Instrument	PIC-1650	N	1,000	1,100	1,025	1,000	4,125
Hitachi	6801/03	N	20	30	60	80	190
	6805	N	45	45	90	120	300
Intel	8751	N	0	0	3	1	4
	8021/22	N	325	350	400	450	1,525
	8749	N	S	S	1	2	3
	8051	N	S	4	9	12	25
	8748	N	200	200	175	200	775
	8048	N	1,100	1,200	1,300	1,200	4,800
	8049/39	N	250	275	325	380	1,230
Motorola	146805	с	4	6	40	45	95
	68701	N	4	5	12	12	33
	6805	N	210	610	755	760	2,335
	6801/03	N	130	210	555	760	1,655
	68705	N	2	12	20	30	64
	3870	N	190	210	200	100	700
National	8050/40	N	45	70	120	170	405
	807X	N	28	12	15	15	70
	8048/35	ท	60	100	140	160	460
	8049/39	И	90	140	210	270	710
NEC	8021	N	20	40	30	50	140
	8048/35	ท	450	450	400	600	1,900
	8049/39	N	325	350	600	850	2,125
	uPD-78XX	N	40	90	110	250	490
	8748	N	20	50	65	60	195
Philips	8048/35	N	10	60	80	100	250
-	8021/22	N	15	25	30	50	120
Rockwell	6500/1	N	100	100	75	70	345
SGS-ATES	387X	N	40	50	80	90	260

(Continued)



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# Table 9 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

	<b>Product</b>	Process	<u>01/81</u>	02/81	<u>03/81</u>	<u>04/81</u>	<u>1981</u>
Siemens	8048/35	N	S	10	35	40	85
	8021	N	S	5	20	15	40
	802XX	й	20	50	300	350	720
Synertek	28	N	0	0	S	2	2
TI	TMS-7000	N	0	2	5	15	22
TCMC (Mostek)	3870	N	755	550	435	745	2,485
	F8	N	50	30	8	22	110
Toshiba	8048/35	N	25	30	35	40	130
	8049/39	N	39	50	60	70	219
Zilog	Z8	И	15	24	_100	205	344
Total 8-Bi	t MCUs		7,027	8,005	9,258	10,641	34,931

S = Sampled

Source: Dataquest August 1989

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# Table 10

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1982 (Thousands of Units)

	<u>Product</u>	Process	<u>01/82</u>	02/82	<u>03/82</u>	04/82	<u>1982</u>
AMD	8048	ы	75	80	80	85	320
	8049	N	15	25	30	35	105
	6805	N	0	S	S	60	60
Eurotechnique	8048/35	N	S	1	3	5	9
-	8049/39	N	S	1	10	25	36
	8050/40	N	S	1	50	70	121
Fairchild	3870	N	600	600	250	300	1,750
	F8	N	175	250	220	200	845
Fujitsu	8048	N	90	80	80	85	335
-	8049	N	260	260	270	290	1,080
General							
Instrument	PIC-1650	N	1,100	1,100	1,000	1,000	4,200
Hitachi	6301	С	21	42	63	84	210
	6305	с	14	28	42	56	140
	6801/03	N	125	150	170	190	635
	6805	N	150	195	225	255	825
Intel	8021/22	N	500	600	500	450	2,050
	8048	N	1,300	1,350	1,300	1,250	5,200
	8049/39	N	450	500	450	470	1,870
	8051	N	30	50	80	300	460
	8748	N	230	400	450	450	1,530
	8749	N	30	100	150	170	450
	8751	N	10	10	20	30	70
Matra-Harris	8048	N	0	S	1	5	6
Matsushita	MN1800	N	S	S	7	10	17
Motorola	146805	с	60	65	160	350	635
	3870	N	75	100	130	120	425
	6801/03	N	875	770	775	900	3,320
	6805	N	875	930	1,450	1,520	4,775
	68701	N	18	20	20	20	78
	68705	N	42	40	95	85	262
National	8048/35	N	170	225	300	300	995
	8049/39	N	300	375	200	250	1,125
	8050/40	N	200	260	200	220	880
	807X	И	15	20	8	10	53
	80048/49	с	0	0	20	40	60

(Continued)



### Table 10 (Continued)

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1982 (Thousands of Units)

	<u>Product</u>	Process	<u>01/82</u>	<u>02/82</u>	<u>03/82</u>	<u>04/82</u>	<u>1982</u>
NEC	8021	N	50	50	50	50	200
	9048/35	N	700	700	590	450	2,400
	8049/39	N	1,000	1,200	1,000	1,000	4,200
	80C48/35	С	0	10	110	110	230
	80C49/39	с	0	5	46	100	151
	8748	N	100	160	50	200	510
	8749	N	1	3	5	20	29
	uPD-78XX	N	350	500	600	600	2,050
Oki	80C48	С	0	0	5	20	25
	80C49	С	0	10	40	85	135
Philips	8021/22	N	60	70	70	80	280
•	8048/35	N	150	175	225	260	810
	8049/39	ท	10	15	30	40	95
	84XX	N	0	S	10	70	80
Rockwell	6500/1	N	70	80	80	85	315
SGS	387X	N	130	180	170	220	700
Sharp	<b>Z</b> 8	N	20	25	50	70	165
Siemens	8021	N	20	25	25	25	95
	802XX	N	410	450	470	450	1,780
	8048/35	N	50	70	90	90	300
	8051/31	N	0	S	S	15	15
Signetics	8048/35	N	0	6	55	80	141
-	8049/39	N	0	S	10	15	25
	8050/40	N	0	S	2	6	8
Synertek	<b>Z</b> 8	N	5	5	30	50	90
TĪ	TMS-7000	N	35	50	70	100	255
TCMC (Mostek)	3870	N	600	580	450	400	2,030
	F8	N	15	10	б	2	33
Toshiba	8048/35	N	50	115	220	230	615
	8049/39	N	90	140	160	165	555
	80C49/39	с	5	12	50	75	142
Zilog	Z8	Ŋ	220	180	140	143	<u>    683 </u>
Total 8-Bit	. MCUs		11,946	13,454	13,718	14,996	54,114

S = Sampled

Source: Dataquest August 1989

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# Table 11

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

	Product	Process	<u>01/83</u>	<u>02/83</u>	03/83	04/83	<u>1983</u>
AMD	8048	N	60	50	25	55	190
•	8049	N	30	25	25	30	110
	8051	N	1	70	125	180	376
RECIS	6801/03	N	S	10	20	25	55
21000	6805	N	S	20	35	45	100
Eurotechnique	8048/35	N	7	9	*	*	16
	8049/39	N	40	55	*	*	95
	8050/40	11	100	125	*	*	225
Fairchild	3870	ท	300	350	340	380	1,370
	F8	N	210	220	150	100	680
Fujitsu	8048	N	90	90	85	85	350
	8049	N	320	325	340	340	1,325
General	PIC-1652/54	N	170	217	220	410	1,017
Instrument	PIC-1655/57	ท	670	603	766	815	2,854
	PIC-1670-72	ท	530	390	466	725	2,111
	PIC-16C58	N	130	290	58	160	638
Gould	6801	ท	S	S	S	220	220
	6805	N	40	10	5	65	120
Hitachi	6301	Ċ	150	162	190	220	722
	6305	с	100	120	150	170	540
	6801/03	N	210	235	275	315	1,035
	6805	N	300	335	375	410	1,420
Intel	8021/22	N	425	370	320	280	1,395
	8048	И	1,300	1,300	1,300	1,350	5,250
	8049/39	N	500	510	525	550	2,085
	8050/40	N	S	70	110	120	300
	8051	N	320	610	800	1,800	3,530
	8052/32	N	S	10	12	15	37
	80C48/35	с	3	5	5	5	18
	80C49/39	с	S	40	50	50	140
	80C51/31	с	S	40	50	50	140
	8748	N	470	445	550	600	2,065
	8749	N	180	180	250	350	960
	8751	ห	35	60	75	150	320

\*Taken over by Thomson

(Continued)

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# Table 11 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

	Product	Process	<u>01/83</u>	<u>02/83</u>	<u>03/83</u>	<u>04/83</u>	<u>1983</u>
Matra-Harris	8048	N	7	9	12	20	48
Matsushita	MN1800	N	7	7	7	7	28
Motorola	146805	С	465	440	387	594	1,886
	1468705	С	1	1	1	2	5
	3870	Я	75	20	16	15	126
	6801/03	N	910	1,100	2,296	2,805	7,111
	6804	N	0	0	S	S	S
	6805	N	1,520	1,600	2,024	1,790	6,934
	68701	N	65	100	141	58	364
	68705	N	90	150	176	168	584
National	8048/35	N	320	340	375	415	1,450
	8049/39	N	300	320	320	350	1,290
	8050/40	N	275	305	330	360	1,270
	807X	ท	15	15	15	15	60
	80C48/49	C	55	50	65	75	245
NCR	6500/1	И	S	25	80	110	215
NEC	8021	ท	30	50	85	80	245
	8048/35	N	550	550	700	1,560	3,360
	8049/39	N	1,450	1,600	1,600	1,300	5,950
	80C48/35	С	125	125	210	480	940
	80C49/39	С	100	100	160	290	650
	8748	N	200	400	250	240	1,090
	8749	N	35	100	60	60	255
	uPD-78XX	ท	650	1,150	1,300	1,860	4,960
Oki	80C48	С	30	43	50	80	203
	80C49	С	100	137	200	390	827
Philips	8021/22	N	70	90	90	110	360
	8048/35	ท	280	200	230	230	940
	8049/39	N	60	60	100	100	320
	8051/31	N	0	5	10	25	40
	84XX	N	190	530	620	600	1,940
RCA	1804A	C	S	S	2	2	4
Rockwell	6500/1	N	150	300	250	230	930
SGS-ATES	387X	N	254	245	300	360	1,159
Sharp	Z8	N	80	150	300	450	980

(Continued)

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# Table 11 (Continued)

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

	<b>Product</b>	Process	<u>01/83</u>	<u>02/83</u>	<u>03/83</u>	04/83	<u>1983</u>
Siemens	8021	N	25	5	25	5	60
	802XX	N	380	300	300	500	1,480
	8048/35	N	90	50	40	90	270
	8051/31	N	60	250	300	420	1,030
Signetics	8048/35	И	220	265	280	290	1,055
•	8049/39	ы	110	135	150	150	545
	8050/40	ম	90	110	100	100	400
	8051/31	N	3	3	40	80	126
Synertek	<b>Z</b> 8	И	60	25	30	20	135
TI	TMS-7000	N	130	175	190	220	715
TCMC (Mostek)	3870	N	430	430	400	400	1,660
	<b>F</b> 8	N	50	45	25	70	190
Toshiba	8048/35	N	280	340	400	420	1,440
	8049/39	N	250	270	300	410	1,230
	80C49/39	C	120	190	300	240	850
Zilog	Z8	N	<u> </u>	<u>    190</u>	<u>211</u>	300	<u> </u>
Total 8-B	lit MCUs		17,598	20,451	23,550	29,016	90,615

S = Sampled

Source: Dataquest August 1989



# Table 12

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

	Product	Process	<u>Q1/84</u>	02/84	<u>03/84</u>	04/84	<u>1984</u>
AMD	8048	N	35	5	0	0	40
	8049	N	5	5	0	0	10
	8051	N	385	575	900	400	2,260
AMI	6801	N	240	260	280	300	1,080
	6805	м	105	105	150	180	540
Fairchild	387X	N	346	282	285	162	1,075
	F8	N	26	19	20	9	74
Fujitsu	8048	N	90	95	120	120	425
-	8049	N	350	360	400	400	1,510
General	7000/1	N	0	1	5	4	10
Instrument	7020/40	N	0	15	20	22	57
	7041	N	0	5	5	3	13
	PIC-1652/54	ท	425	435	435	355	1,650
	PIC-1655/57	N	975	1,150	1,200	980	4,305
	PIC-1670-72	N	775	780	780	640	2,975
	PIC-16C58	N	165	110	110	90	475
Hitachi	6301V	С	300	325	367	480	1,472
	6305	С	200	215	215	320	950
	6801/03	м	360	400	572	570	1,902
	6805	N	490	570	856	850	2,766
Intel	802X	ы	250	250	300	250	1,050
	8048/35	ท	1325	1,000	800	700	3,825
	8049/39	N	560	900	800	700	2,960
	8050/40	N	130	130	130	100	490
	8051/31	N	2300	3,800	3,600	3,200	12,900
	8052/32	ท	18	50	65	80	213
	80C48/35	С	5	5	0	0	10
	80C49/39	С	55	55	60	60	230
	80C51/31	с	50	50	80	85	265
	8748	N	625	625	625	625	2,500
	8749	N	390	390	600	650	2,030
	8751	И	200	200	200	195	795
Intersil	80C48/35	с	0	0	12	32	44

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# Table 12 (Continued)

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

	Product	Process	<u>01/84</u>	02/84	<u>03/84</u>	04/84	<u>1984</u>
Matra-Harris	8048	N	30	40	40	20	130
	8051	N	20	15	250	350	635
	80C48	с	0	0	10	10	20
Matsushita	MN1800	N	10	10	10	10	40
Motorola	146805	С	790	1,109	1,238	1,252	4,389
	1468705	С	4	4	19	7	34
	387X	N	10	11	16	23	60
	6801/03	N	2,151	2,055	1,849	1,865	7,920
	6804	N	0	0	7	29	36
	6805	N	1,993	1,772	2,379	2,188	8,332
	68701	N	50	56	56	37	199
	68705	N	358	493	535	518	1,904
	68HC11	С	0	0	0	3	3
National	8048/35	N	575	600	800	800	2,775
	8049/39	ท	390	400	700	700	2,190
	8050/40	ท	465	475	500	500	1,940
	807X	N	10	10	10	5	35
	80C48/35	с	30	10	0	0	40
NCR	6500/1	N	150	150	150	150	600
NEC	8021/22	ท	100	110	130	130	470
	8041	с	0	0	1,110	1,110	2,220
	8741	С	0	0	190	190	380
	8048/35	ท	1,970	2,190	2,350	1,240	7,750
	8049/39	N	2,050	1,360	1,900	1,900	7,210
	80C48/35	С	570	610	420	420	2,020
	80C49/39	с	410	360	500	500	1,770
	8748	N	520	620	550	360	2,050
	8749	N	230	200	290	290	1,010
	uPD-78XX	N	2,360	2,880	3,270	3,270	11,780
Oki	80C48/35	с	100	120	140	90	450
	80C49/39	с	450	500	560	450	1,960
Philips	8021/22	N	160	150	170	170	650
<b>~</b> <sup>−</sup>	8048/35	N	460	650	1,000	1,000	3,110
	8049/39	N	380	650	900	1,000	2,930
	8050/40	N	0	Ŭ	0	10	10

(Continued)

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# Table 12 (Continued)

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

	Product	Process	01/84	02/84	<u>03/84</u>	<u>04/84</u>	<u>1984</u>
Philips	•80C49	с	0	Q	0	3	3
(Continued)	8051/31	N	60	300	400	400	1,160
	84XX	N	500	400	700	900	2,500
RCA	1804A	с	2	5	6	10	23
	6805	N	0	1	1	5	7
Rockwell	6500/1	N	325	475	350	200	1,350
SGS	387X	N	375	344	420	350	1,489
	Z8	N	0	110	0	13	123
Sharp	Z8	N	475	475	500	500	1,950
Siemens	8021	N	5	6	9	8	28
	802XX	N	306	221	306	265	1,098
	8048/35	N	91	141	108	65	405
	8051/31	N	522	533	662	665	2,382
Signetics	8048/35	N	540	1,263	1,386	1,420	4,609
	8049/39	N	150	162	244	390	946
	8050/40	n	100	90	85	80	355
	8051/31	N	85	125	692	890	1,792
Synertek	28	N	9	9	4	2	24
TI	TMS-7000	N	240	250	250	250	990
Thomson	6801/03	N	30	30	15	75	150
	6805	N	50	120	130	300	600
TCMC (Mostek)	387X	N	375	400	300	350	1,425
	38P7X	И	0	0	58	90	148
	F8	N	40	40	40	75	195
Toshiba	8048/35	N	400	480	1,300	1,500	3,680
	8049/39	N	500	500	1,300	1,600	3,900
	80C49/39	С	280	290	750	850	2,170
Zilog	Z8	N	<u> </u>	<u> </u>	<u>    450                                </u>	495	2,055

Total 8-Bit MCUs

33,871 38,222 46,507 44,910 163,510

Source: Dataquest August 1989

### Table 13

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# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

	Product	Process	<u>01/85</u>	02/85	<u>03/85</u>	<u>04/85</u>	<u>1985</u>
AMD	8051/31	N	250	400	360	600	1,610
	8751	N	2	15	14	40	71
Fairchild	387X	N	148	90	52	67	357
	F8	N	33	60	80	114	287
Fujitsu	MBL8048/35	И	60	40	40	45	185
-	MBL8049/39	N	200	180	162	165	707
General	PIC1652/54	N	350	400	425	340	1,515
Instrument	PIC1655/57	ท	975	840	790	690	3,295
	PIC1670/72	N	650	550	510	425	2,135
	PIC16C58	С	85	77	69	25	256
	PIC16E57	N	5	8	8	45	66
	PIC7000/1	ท	6	5	5	10	26
	PIC7020/40	N	25	40	45	30	140
	PIC7041	N	3	3	3	3	12
Gould/AMI*	6801/03	N	290	250	16	20	576
	6805	N	175	158	32	37	402
Hitachi	6301V	с	420	425	383	780	2,008
	6305	C	280	290	261	555	1,386
	6801/03	N	385	400	360	370	1,515
	6805	ท	552	560	625	1,165	2,902
Intel	802X	ท	125	35	32	30	222
	8048/35	N	400	350	315	300	1,365
	8049/39	N	420	400	360	350	1,530
	8050/40	N	100	50	45	45	240
	8051/31	N	2,500	1,500	1,500	1,300	δ,800
	8052/32	N	80	68	61	60	269
	80C49/39	с	40	30	27	15	112
	80C51/31	с	100	150	275	260	785
	8748	N	525	250	275	260	1,310
	8749	N	410	300	275	460	1,445
	8751	N	275	200	248	120	843
Intersil	80C48/35	С	8	8	7	7	30
	80C49/39	с	3	2	2	2	9

(Continued)



# Table 13 (Continued)

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

	<b>Product</b>	Process	<u>01/85</u>	<u>02/85</u>	<u>03/85</u>	<u>04/85</u>	<u>1985</u>
Matra-Harris	8051	Я	450	300	300	350	1,400
	8052	N	0	0	0	20	20
	80C51	С	0	0	0	10	10
Matsushita	MN1800	С	10	24	32	65	131
Mitsubishi	M50XXX	c	3,200	4,050	3,900	3,975	15,125
Motorola	146805	c	1,052	915	1,008	1,096	4,071
	1468705	С	8	7	7	26	48
	387X	N	14	63	65	32	174
	6801/03	N	1,840	2,246	2,265	1,656	8,007
	6804	N	33	116	158	194	501
	6805	N	2,284	2,258	2,779	3,456	10,777
	68701	И	37	80	80	81	278
	68704	N	0	0	4	9	13
	68705	И	613	532	745	751	2,641
	68HC11	С	5	8	10	44	67
National	8048/35	N	800	690	480	230	2,200
	8049/39	ท	700	500	370	340	1,910
	8050/40	N	500	380	320	300	1,500
	807X	ท	5	0	0	0	5
NCR	6500/1	N	160	110	180	190	640
NEC	8021/22	ท	130	120	60	40	350
	8041	N	1,130	450	600	680	2,860
	8048/35	N	1,090	570	600	600	2,860
	8049/39	N	1,820	1,030	1,120	1,190	5,160
	80C48/35	с	710	470	340	280	1,800
	80C49/39	С	690	550	360	460	2,060
	8741	N	270	270	170	140	850
	8748	N	480	550	340	290	1,660
	8749	N	460	540	550	410	2,060
	uPD78XX	N	2,680	2,740	2,510	3,520	11,450
Oki	80C48/35	с	150	135	124	128	537
	80C49/39	С	560	440	440	510	1,950
Philips	8021/22	N	170	150	110	40	470
-	8048/35	N	700	400	200	130	1,430
	8049/39	N	1,000	700	500	350	2,550
	8050/40	N	20	20	20	40	100
	8051/31	N	350	300	250	200	1,100
	80C49/39	с	15	50	50	30	145
	84XX	N	1,100	1,300	1,800	2,000	6,200

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(Continued)

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### Table 13 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

	Product /	Process	<u>01/85</u>	02/85	<u>03/85</u>	04/85	<u>1985</u>
RCA	1804A	с	5	3	з	2	13
	6805/68HC05	с	20	10	25	65	120
Rockwell	6500/XX	И	150	400	360	400	1,310
SGS	387X	N	530	550	495	625	2,200
	28	N	55	47	42	100	244
Sharp	28	N	23	23	190	190	426
Siemens	8021	N	24	54	30	30	138
	802XX	ท	295	427	468	348	1,538
	8048/35	N	40	57	57	40	194
	8051/31	N	700	630	567	600	2,497
Signetics	8048/35	N	1,400	400	463	300	2,563
-	8049/39	N	400	200	250	385	1,235
	8050/40	N	92	50	60	75	277
	8051/31	N	870	400	417	675	2,362
	8052/32	N	0	0	0	5	5
TI	TMS7000	N	400	350	316	330	1,396
Thomson	6801/03	N	65	59	53	160	337
	6805	ท	350	315	284	180	1,129
TCMC (Mostek)*	387X	N	273	159	211	224	867
	38 <b>P7X</b>	N	112	80	61	44	297
	F8	ท	62	51	42	40	195
Toshiba	8048/35	N	1,600	1,404	1,000	500	4,504
	8049/39	ท	1,700	1,530	1,377	600	5,207
	80C49/39	с	900	675	650	700	2,925
Zilog	28	N	<u> </u>	550	<u>     495</u>	490	2,099
Total 8-Bi	t MCUs		45,746	39,722	38,425	39,706	163,599

### \*Mergers/Acquisitions:

1. AMI was acquired by Gould Semiconductor.

 Thomson Components acquired Mostek Corporation from United Technologies, forming Thomson Components--Mostek Corporation (TCMC).

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Source: Dataquest August 1989

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itinued)	(Cor						
387	200	107	70	10	Q	80C51	
418	170	123	105	20	A	8052	
1,340	340	280	362	358	N	8051	Matra-Harris
10	щ	4	ω	2	ŋ	80C49/39	•
20	10	Ű	ω	2	n	80C48/35	Intersil
692	212	175	155	150	N	8751	
2,247	700	535	512	500	N	8749	
800	200	200	200	200	N	8748	
2,000	802	588	310	300	G	80C51/31	
20	10	رب رب	C)1	0	n	80C49/39	
1,600	732	548	170	150	ч	8052/32	
6,998	1,985	1,965	1,626	1,422	И	8051/31	
225	58	65	52	50	N	8050/40	
2,401	790	746	450	415	N	8049/39	
595	165	160	140	130	N	8048/35	
56	18	20	25	30	N	802X	
5,275	1,310	1,425	1,360	1,180	N	6805	Intel
3,557	1,135	1,062	840	520	N	6801/03	
4,242	1,375	1,152	955	760	n	6305	
5,200	1,810	1,175	1,265	950	G	6301	Hitachi
127	27	01	48	42	N	6805	
21	1	0	4	16	N	6801/03	Gould Semi.
22	œ	0	(JI	ω	¥	PIC7041	
484	100	100	150	134	N	PIC7020/40	
234	100	100	20	14	N	PIC7000/1	
229	60	52	60	57	N	PIC16E57	
77	•	0	45	32	n	PIC16C58	
1,190	250	250	490	200	N	PIC1670/72	
1,400	400	400	300	300	Ņ	PIC1655/57	Instrument
1,700	400	400	500	400	N	<b>PIC1652/54</b>	General
105	36	34	20	15	ი	MBL80C49/39	
403	134	116	88	65	N	MBL8051/31	
862	238	224	208	192	N	MBL8049/39	
328	108	92	73	55	N	MBL8048/35	Pujitsu
304	06	86	68	27	N	178	
10	0	0	ч	6	N	387X	Fairchild
112	25	22	35	30	N	8751	
1,700	550	450	350	350	N	8051/31	AMD
<u>1986</u>	04/86	03/86	02/86	01/86	<b>Process</b>	Product	
		,	<u>ی</u>	ts of Unit	(Thousand		
	for 1986	Ouarter	ments by	Unit Ship	controller	ated 8-Bit Micro	Estin

Table 14

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tinued)	(Con						
14,325	3,725	4,000	3,400	3,200	N	84XX	
15	15	0	0	0	Q	84CXX	
81	35	26	15	U,	G	80C51/31	
240	70	65	55	50	G	80C49/39	
700	210	180	160	· 150	N	8051/31	
393	108	100	95	06	N	8050/40	
2,186	536	550	550	550	N	8049/39	
289	75	70	69	75	Ч	8048/35	
138	25	40	38	35	N	8021/22	Philips
1,772	820	520	282	150	a	80C51	•
2,720	069	790	650	590	â	80C49/39	
520	125	130	135	130	Q	80C48/35	
87	75	12	0	0	G	80C154	Oki
18,390	4,760	5,200	4,580	3,850	N	uPD78XX	•
1,930	450	520	430	530	N	8749	
1,370	200	460	300	410	N	8748	
480	06	50	60	280	N	8741	
2,110	069	470	540	410	G	80C49/39	
1,360	220	230	580	330	n	_ 80C48/35	-
5,350	1,220	1,450	1,530	1,150	N	8049/39	
3,940	1,100	066	950	006	N	8048/35	
2,550	510	580	730	730	ч	8041	
100	30	20	10	40	N	8021/22	NEC
1,027	277	265	230	255	N	6500/1	NCR
1,280	300	330	320	330	N	8050/40	
1,650	500	550	250	350	ч	8049/39	
390	110	130	50	001	N	8048/35	National
696	254	180	142	120	G	68HC11	
3,861	1,117	1,004	196	779	И	68705	
82	29	33	10	10	N	68704	
431	62	125	152	92	ч	68701	
13,559	3,739	3,290	3,399	3,131	X	6805	
1,495	516	541	254	184	N	6804	
8,526	2,256	2,101	2,053	2,116	N	6801/03	
199	41	20	40	86	N	387X	
E6	23	22	25	23	G	1468705	
4,705	1,623	1,030	1,050	1,002	n	146805	Motorola
29,906	8,190	7,606	7,250	6,860	G	MSOXXX	Mitsubishi
400	120	110	100	70	n	MAN1800	Matsushita
1986	04/8 <b>6</b>	03/86	02/86	01/86	Process	Product	
				ı		-	

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8-Bit Microcontrollers--Historical Shipment Data

Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

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Table 14 (Continued)

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# Table 14 (Continued)

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

	Product	Process	01/86	<u>02/86</u>	<u>Q3/86</u>	<u>04/86</u>	<u>1986</u>
RCA	1804A	с	4	2	2	3	11
	6805/68HC05	с	55	65	88	151	359
Rockwell	6500/XX	N	450	640	510	950	2,550
SGS	387X	N	852	1,301	1,030	1,628	4,811
	<b>Z</b> 8	И	194	153	147	107	601
Sharp	28	N	230	160	142	154	686
Siemens	802XX	N	340	304	15	8	667
	8048/35	N	26	68	431	431	956
	8051/31	ท	321	573	733	567	2,194
	80515/35	N	0	0	13	113	126
	8052/32	N	81	117	219	296	713
Signetics	8048/35	ท	225	215	230	90	760
	8049/39	И	440	450	465	386	1,741
	8050/40	N	68	70	73	62	273
	8051/31	ท	650	665	712	660	2,687
	8052/32	N	87	102	126	141	456
	80C51/31	с	3	7	10	40	60
	8400	ห	1	6	13	10	30
TI	TMS7000	N	450	470	785	850	2,555
Thomson	6801/03	ท	200	235	225	246	906
	6805	N	260	290	310	330	1,190
TCMC (Mostek)	387X	N	255	239	225	250	969
	38P7X	N	56	38	28	23	145
	F8	N	23	151	70	55	299
Toshiba	8048/35	N	250	250	350	300	1,150
	8049/39	N	550	550	650	600	2,350
	80C48/35	с	200	200	300	300	1,000
	80C49/39	С	400	480	800	600	2,280
	80C50/40	с	100	120	200	100	520
Zilog	Z8	N	710	835	770	797	3,112
Others*	Unspecified	С	2.767	2,767	2,768	2,768	11,070
Total 8-B	it MCUs		48,513	54,062	58,924	62,502	224,001

\*Dataquest estimate for companies not surveyed (i.e., Ricoh, Sanyo, Sony)

Source: Dataquest August 1989

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# Table 15

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

	Product	Process	<u>01/87</u>	<u>02/87</u>	<u>03/87</u>	<u>04/87</u>	<u>1987</u>
AMD	8051/31	N	436	538	626	640	2,240
	8053	И	0	22	115	150	287
	80C51/31	с	15	5	24	90	134
	8751	N	26	30	35	42	133
	8753	N	10	20	22	25	77
Fujitsu	MBL8048/35	N	112	126	135	155	528
- <b>-</b>	MBL8049/39	N	252	285	280	315	1,132
	MBL8051/31	N	252	265	276	305	1,098
	MBL80C49/39	С	350	500	650	800	2,300
Gould Semi.	6801/03	N	8	2	6	15	31
	6805	N	8	22	3	6	39
Hitachi	6301	с	1,800	1,800	2,000	2,500	8,100
	6305	С	1,600	1,700	1,850	2,100	7,250
	63701	С	150	320	449	680	1,599
	63705	с	180	276	385	458	1,299
	63P01	С	100	145	175	225	645
	63P05	С	125	190	250	300	865
	6801/03	N	1,250	1,300	1,300	1,350	5,200
	6805	N	1,565	1,685	1,790	2,120	7,160
	68P01	с	85	115	165	180	545
	68P05	С	100	145	175	200	620
Intel	802 <b>X</b>	N	18	16	11	9	54
	8048/35	N	285	265	255	262	1,067
	8049/39	N	1,315	1,360	2,700	2,100	7,475
	8050/40	N	70	72	200	200	542
	8051/31	N	2,000	2,500	3,800	4,400	12,700
	8052/32	N	400	435	500	550	1,885
	80C51/31	С	700	665	1,000	800	3,165
	8748	N	200	192	155	146	693
	8749	N	900	920	880	925	3,625
	8751	ห	220	225	266	230	941
	8752	С	0	0	0	30	30
	87C51	с	0	0	0	100	100
Matra-Harris	8051	N	120	126	73	110	429
	8052	N	199	245	310	279	1,033
	80C51	с	250	310	360	404	1,324
	80C52	с	2	12	23	46	83

(Continued)



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itinued)	(Cor						
24,140	6,600	6,140	5,420	5,980	N	uPD78XX	
3.300 065	1.050	730	089 08T	1.3U 840	4 2	8749	
330	90	70	. 90	. 80	4 4	8741	
2,680	830	069	450	710	i 0	80C49/39	
970	200	230	320	220	n	80C48/35	
4,830	1,050	1,430	1,350	1,000	N	8049/39	
4,360	1,100	1,170	1,070	1,020	N	8048/35	
1,750	350	480	540	380	N	8041	
40	01	10	20	0	N	8021/22	NEC
397	2	60	170	165	N	6500/1	NCR
138	30	20	40	48	N	F8	National (FCI)*
10	10	0	0	0	a	COP800	
1,838	570	550	368	350	N	8050/40	
2,095	500	650	480	465	N	8049/39	
425	100	120	103	102	N	8048/35	National
3,975	1,587	1,290	969	402	n	68HC11	
4,678	1,674	1,316	974	714	ი	68HC05	
19,716	5,090	4,923	4,785	4,918	N	6805	
4,357	1,385	970	1,149	853	N	6804	
8,918	2,163	2,232	2,267	2,256	N	6801/03	
5,422	1,450	1,428	1,381	1,163	n	146805	Motorola
2,614	224	310	221	1,859	n	M5M80C49/39	
208	38	83	35	52	N	M5M8050/40	
1,691	524	375	344	448	N	M5L8049/39	
515	286	28	61	140	N	M5L8048/35	
13,082	4,733	4,978	2,295	1,076	ი	M509XX	
23,706	5,976	6,174	5,783	5,773	n	M507XX	Mitsubishi
33	0	15	6	σ	N	PIC7041	
1,985	480	505	525	475	N	<b>PIC7020/40</b>	
<b>6</b> 96	216	175	160	145	ч	<b>PIC7000/1</b>	
32	0	7	5	15	N	PIC16E57	
460	125	135	120	80	N	PIC1670/72	
1,073	250	126	347	350	N	PIC1655/57	Technology*
4,063	1,045	1,300	960	758	N	PIC1652/54	Microchip
1,070	320	330	320	100	n	MN1800	Matsushita
1987	04/87	03/87	02/87	01/87	<u>Process</u>	Product	
			s)	ls of Unit	(Thousand		
	or 1987	Quarter f	nents by	Unit Ship	controller l	ed 8-Bit Micro	Estimat
			Ð	(Continue	Table 15 (		
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# Table 15 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

		Product	Process	<u>01/87</u>	<u>02/87</u>	<u>03/87</u>	<u>04/87</u>	<u>1987</u>
Oki		80C154	с	75	95	350	374	894
		80C48/35	С	125	110	100	93	428
		80C49/39	С	699	734	890	810	3,133
		80C51	С	790	591	660	680	2,721
Philips		8021/22	N	35	60	45	32	172
-		8048/35	N	75	70	95	45	285
		8049/39	ท	430	450	500	430	1,810
		8050/40	N	90	754	856	80	1,780
		8051/31	N	320	460	550	510	1,840
		80C49/39	С	74	120	160	160	514
		80C51/31	C	60	110	210	240	620
		84CXX	С	110	350	380	310	1,150
		84XX	N	2,880	3,190	2,540	2,200	10,810
RCA		1804 <b>a</b>	С	5	2	1	0	8
		6805/68HC05	С	190	170	155	290	805
Rockwell		6500/XX	N	980	925	900	1,050	3,855
SGS-Thomson*	(M)	387X	N	230	175	200	190	795
	(M)	38P7X	N	30	20	20	20	90
	(M)	F8	N	56	50	20	10	136
	(S)	387X	N	1,254	1,222	958	488	3,922
	(S)	28	N	131	163	233	138	665
	(T)	6801/03	N	295	280	276	280	1,131
	(T)	6805	N	530	585	502	565	2,182
Sharp		SM-Series	С	110	185	110	125	530
		28	N	120	225	120	125	590
Siemens		802XX	N	17	12	9	13	51
		8048/35	N	507	541	372	313	1,733
		8051/31	N	812	987	1,147	1,109	4,055
		80515/35	N	164	164	202	238	768
		8052/32	N	316	362	406	347	1,431
Signetics		8048/35	N	48	25	22	16	111
		8049/39	N	488	502	514	496	2,000
		8050/40	N	80	220	218	205	723
		8051/31	N	680	685	700	666	2,731
		8052/32	N	155	450	464	472	1,541
		80C51/31	С	65	69	73	76	283
		83C451	с	1	5	9	12	27
		8400	N	10	11	10	12	43
		8441	с	0	36	44	48	128
		87C451	С	0	2	3	5	10



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### Table 15 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

	Product	Process	<u>01/87</u>	<u>02/87</u>	<u>03/87</u>	<u>04/87</u>	<u>1987</u>
TI	TMS7000	N	1,100	1,600	1,800	2,100	6,600
Toshiba	8048/35	N	300	310	286	275	1,171
	8049/39	N	500	400	435	425	1,760
	80C48/35	С	400	650	800	1,100	2,950
	80C49/39	С	800	850	900	1,050	3,600
	80C50/40	С	200	225	210	216	851
Zilog	<b>Z</b> 8	ท	863	863	858	838	3,422
Others**	Unspecified	С	8,505	8,505	8,505	<u>    8,505</u>	34,020
Total 8-1	Bit MCUs		73,881	79,124	89,312	91,173	333,490

### \*Mergers/Acquistions:

- 1. General Instrument's Microelectronics Division spun off as a separate company under the name Microchip Technology.
- 2. National acquired Fairchild.
- 3. SGS and Thomson Components merged, forming SGS-Thomson. TCMC (Mostek) was folded into the newly established company.

\*\*Dataquest estimate for companies not sampled (i.e., Ricoh, Sanyo, Sony)

Source: Dataquest August 1989

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# Table 16

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

Intel		Fujitsu Farris(GE- SS/RCA) Hitachi	AND D
8048/35 8049/39 8050/40 8051/31 8052/32 80C51/31 8749 8749 8751 8751 8751 8751	6305 63701 63705 63P01 6801/03 6805 68P01 68P05	8751 8753 8048/35 8049/39 8051/31 80C49/39 MB897XX 68HC05 6301	Product 8051/31 8053 8053
<b>つ 0 ズ X Z 0 X X Z X Z</b>	<b>z z z z c c c c c</b>	OO OOZXXXX	Process N N
3,300 3,300 1,200 200 200 200 200 100	2,500 685 240 2,100 2,100 2,230	45 20 20 20 20 20 20 20 20 20 20 20 20 20	01/88 600 120 180
3,400 3,400 1,300 1,400 1,400 1,400 1,400 1,00 100	2,800 695 260 260 1,410 2,110 2,110 2,50	52 2,900	<u>02/88</u> 570 110 220
3,100 3,100 1,500 1,600 1,000 1,000 100	2,950 700 485 270 1,450 2,140 242 265	3 3 3 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	<u>03/88</u> 540 140 230
2,000 2,000 2,000 2,000 2,000 200 200 20	2,950 700 485 270 1,450 2,140 2,140 242	3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	04/88 400 140 425
13,100 13,100 5,800 1,000 1,000 500	11,200 2,780 1,920 1,040 5,660 8,490 1,010	217 145 90 220 1,471 1,430 11,600	<u>1938</u> 2,110 510 1,055

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# Table 16 (Continued)

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

	Product	Process	01/88	02/88	88/60	04/88	<u>1988</u>
Matra-Harris	8051/31	N	48	24	16	01	86
	8052/32	N	246	200	105	161	712
	80C51/31	n	419	540	620	611	2,190
	80C52/32	n	80	150	208	222	660
	83C154	Q	0	20	41	55	116
Matsushita	MN1800	n	460	730	1,030	2,400	4,620
Microchip	PIC1652/54	N	1,000	1,285	1,472	1,485	5,242
Technology	PIC1655/57	N	250	202	221	230	903
	PIC1670/72	N	100	76	60	50	286
	PIC70XX	N	410	276	304	0	066
Mitsubishi	8048/35	N	30	70	50	35	185
	8049/39	N	430	370	230	100	1,130
	8050/40	N	25	49	50	30	154
	80C49/39	ი	200	140	00T	250	069
	M507XX	Q	5,800	6,600	6,700	6,700	25,800
	M509XX	n	5,800	5,800	7,500	7,500	26,600
Motorola	146805	n	1,587	1,694	1,942	1,375	6,598
	6801/03	N	2,045	1,960	2,134	2,114	8,253
	6804	N	1,012	828	1,040	1,020	3,900
	6805	N	5,859	7,032	7,226	6,925	27,042
	68HC05	a	2,004	2,900	4,009	3,763	12,676
	68HC11	ი	1,870	2,077	2,513	2,929	9,389
National	8048/35	N	80	100	50	85	315
	8049/39	N	430	500	550	470	1,950
	8050/40	N	650	725	625	210	2,210
	COP800	n	300	300	650	305	1,555
	F8	N	20	10	10	UI	45
NCR	6500/1	N	150	250	285	62	747
	6500/11	N	N	200	136	33	371
NEC	8021/22	N	10	10	25	25	70
	8041	N	420	350	260	260	1,290
	8048/35	N	880	400	790	500	2,570
	8049/39	Ņ	730	850	950	830	3,360
	80C48/35	'n	210	210	160	160	740
	80C49/39	Q	750	950	930	800	3,430

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# Table 16 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

	<u>Product</u>	<u>Process</u>	<u>01/88</u>	<u>02/88</u>	<u>03/88</u>	<u>04/88</u>	<u>1988</u>
NEC (Cont.)	8741	N	120	90	80	80	370
	8748	N	120	170	180	180	650
	8749	N	320	510	500	490	1,820
	uPD78XX	N	7,050	8,300	8,430	8,430	32,210
Oki	80C154	С	350	360	420	500	1,630
	80C48/35	С	90	95	90	110	385
	80C49/39	С	800	812	890	960	3,462
	80C51/31	C	650	670	950	830	3,100
Philips	8021/22	N	10	5	0	0	15
	8048/35	N	60	60	45	50	215
	8049/39	N	420	370	220	220	1,230
	8050/40	N	95	60	30	30	215
	8051/31	N	450	350	300	300	1,400
	80C49/39	с	170	170	160	165	665
	80C51/31	с	270	250	350	350	1,220
	84CXX	С	350	550	800	820	2,520
	84XX	и	2,150	2,400	2,500	2,530	9,580
Rockwell	6500/XX	N	1,800	1,930	200	300	4,230
SGS-Thomson	387X	N	1,097	848	760	531	3,236
	38P7X	N	18	26	33	33	110
	6801/03	ท	362	494	408	565	1,829
	6805	N	754	739	644	660	2,797
	F8	N	11	10	0	0	21
	Z8	N	136	148	89	71	444
Sharp	SM (8-Bit)	С	125	100	100	100	425
	Z8	N	125	100	100	100	425
Siemens	802XX	N	24	11	12	19	66
	8048/35	N	325	387	308	325	1,345
	8051/31	N	1,176	1,477	1,231	1,239	5,123
	80515/35	N	304	411	536	723	1,974
	8052/32	N	643	722	565	712	2,642

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### Table 16 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

	Product	Process	<u>01/88</u>	<u>02/88</u>	<u>03/88</u>	<u>04/88</u>	<u>1988</u>
Signetics	8048/35	N	8	0	0	10	18
	8049/39	N	497	634	718	600	2,449
	8050/40	N	273	126	149	150	698
	8051/31	N	950	1,057	1,081	950	4,038
	8052/32	N	220	468	790	480	1,958
	80C451	с	26	6	13	10	55
	80C51/31	с	299	415	499	440	1,653
	8400	N	10	0	0	0	10
	8441	с	16	2	0	0	18
	87C451	с	4	0	· 5	6	15
TI	TMS7000	ท	1,600	2,200	2,600	2,800	9,200
Toshiba	8048/35	N	220	220	225	225	890
	8049/39	N	370	370	375	370	1,485
	80C48/35	с	800	800	800	800	3,200
	80C49/39	С	1,000	1,050	1,050	1,100	4,200
	80C50/40	с	200	200	205	215	820
	TLCS-90	С	50	150	250	400	850
Zilog	28	ท	925	1,300	1,500	1,300	5,025
Others**	Unspecified	С	18,500	<u>18,500</u>	18,500	<u>18,500</u>	74,000
Total 8-Bit MCUs			104,450	113,296	118,422	117,854	454,022

\*Mergers/Acquisitions:
 1. Harris acquired GE Solid State and RCA, 1988.
\*\*Dataquest estimate for companies not sampled (i.e., Ricoh, Sanyo, Sony)

Source: Dataquest August 1989

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# 8-Bit Microcontrollers-Data

The following section, 8-Bit Microcontroller Data Tables, includes historical microcontroller unit shipments by year, manufacturer, product name, and process technology.

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The tables are organized as follows:

- Table 1Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer,<br/>1975-1979
- Table 2Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer,1980-1984
- Table 3Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer,<br/>1985-1987
- Table 4Estimated 8-Bit Microcontroller Unit Shipments by Quarter for1985
- Table 5Estimated 8-Bit Microcontroller Unit Shipments by Quarter for1986
- Table 6Estimated 8-Bit Microcontroller Unit Shipments by Quarter for<br/>1987

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# 8-Bit Microcontrollers--Data

### Table 1

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1975-1979 (Thousands of Units)

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	<b>Product</b>	Process	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
amd	8048	n	0	o	0	0	23
Fairchild	387X	N	0	0	15	23	510
	F8	N	27	181	655	630	650
General Inst.	PIC1650	ท	0	0	0	450	4,100
Intel	802X	N	0	0	0	0	160
	8048/35	N	0	0	105	480	1,950
	8049/39	N	0	0	0	10	210
	8748	N	Ó	0	0	30	300
Mostek	387X	N	Ó	0	20	350	1,470
	F8	N	5	70	90	160	470
Motorola	387X	N	Ō	0	Ó	70	500
	6801/03	N	Ō	Ō	Ō	0	13
	6805	N	Ō	Ō	Ō	Ō	3
National	8049/39	ท	Ō	Ō	Ō	0	10
NEC	8048/35	N	Ó	Ó	Ō	15	735
-	8049/39	ท	Ó	Ō	Ō	0	250
Rockwell	6500/XX	ท	Ō	Ō	Ō	Ō	8
SGS	387X	N	0	Ő	Ō	0	50
Signetics	8048/35	N		0	0	0	180
Total 8-Bit MCUs			32	251	885	2,218	11,592

Source: Dataquest October 1988

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•-*	Product	Process	1980	1981	1982	1983	1984
	8048	R.	138	240	320	190	40
	8049	N	0	35	105	110	ĸ
	8051	N	0	0	o	376	2,260
AMI	6801/03	N	0	0	0	220	1,080
	6805	N	0	0	60	120	540
Eurotechnique	8048/35	И	0	ç	Q	16	_
I	8049/39	И	0	0	36	95	_
	8050/40	N	0	0	121	225	~
Fairchild	387X	N	1,795	3,100	1,750	1,370	1,075
	P8	N	620	745	845	089	74
Fujitsu	MBL8048/35	N	150	400	335	350	425
	MBL8049/39	N	300	925	1,080	1,325	1,510
General	PIC1652/54	ч	0	0	0	1,017	1,650
Instrument	PIC1655/57	¥,	0	0	0	2,854	4,305
	PIC165X	N	5,600	4,125	4,200	0	~
	PIC1670/72	¥	0	0	0	2,111	2,975
	PIC16C58	n	0	0	0	638	- 47!
	<b>PIC7000/1</b>	N	0	0	0	0	1
	<b>PIC7020/40</b>	¥	0	0	0	0	5
	PIC7041	¥	0	0	0	0	H
Hitachi	6301	n	, O	0	210	722	1,472
	6305	a	0	0	140	540	950
	6801/03	N	•	190	635	1,035	1,902
	6805	N	0	300	825	1,420	2,766
Intel	802X	H	810	1,525	2,050	1,395	1,050
	8048/35	N	3,750	4,800	5,200	5,250	3,825
	8049/39	N	715	1,230	1,870	2,085	2,960
	8050/40	N	0	0	0	300	490
	8051/31	N	•	25	460	3,530	12,900
	8052/32	N	0	0	0	37	213
	80C48/35	Q	0	0	0	18	10
	80C49/39	a	0	0	0	140	230
	80C51/31	n	0	•	0	140	265
	8748	N	650	775	1,530	2,065	2,500
	8749	N	0	ω	450	960	2,030
	8751	N	0	4	70	320	795
	80C48/35	n	0	•	•	0	44

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8-Bit Microcontrollers-Data

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Table 2

# Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1980--1984 (Thousands of Units)

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### Table 2 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

	Product	<u>Process</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Matra-Harris	8048	N	0	. 0	6	48	130
	8051	N	0	0	0	0	635
	80C48	с	0	0	0	0	20
Matsushita	MN1800	С	0	0	17	28	40
Mostek	387X	N	2,105	2,485	2,030	1,660	1,425
	38P7X	n	0	0	0	0	148
	F8	N	205	110	33	190	195
Motorola	146805	С	0	95	635	1,886	4,389
	1468705	с	0	0	0	5	34
	387X	N	635	700	425	126	60
	6801/03	N	195	1,655	3,320	7,111	7,920
	6804	N	0	0	0	0	36
	6805	ห	460	2,335	4,775	6,934	8,332
	68701	ห	0	33	78	364	199
•	68705	N	0	64	262	584	1,904
	68HC11	C ·	0	0	0	0	3
National	8048/35	N	45	460	995	1,450	2,775
	8049/39	N	175	710	1,125	1,290	2,190
	8050/40	И	50	405	880	1,270	1,940
	807X	n	31	70	53	60	35
	80C48/35	¢	0	0	60	245	40
NCR	6500/1/11	N	0	0	0	215	600
NEC	8021/22	N	10	140	200	245	470
	8041	N	0	0	0	0	2,220
	8048/35	N	1,990	1,900	2,440	3,360	7,750
	8049/39	N	920	2,125	4,200	5,950	7,210
	80C48/35	С	0	0	230	940	2,020
	80C49/39	с	0	0	151	650	1,770
	8741	N	0	0	0	0	380
	8748	N	0	195	510	1,090	2,050
	8749	N	0	0	29	255	1,010
	uPD78XX	N	0	490	2,050	4,960	11,780
Oki	80C48/35	С	0	0	25	203	450
	80C49/39	С	0	0	135	827	1,960
Philips	8021/22	N	0	120	280	360	650
-	8048/35	N	19	250	810	940	3,110
	8049/39	ท	0	0	95	320	2,930

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### Table 2 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

.

	Product	Process	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Philips (Cont.)	8050/40	N	0	0	0	0	10
-	8051/31	N	0	0	0	40	1,160
	80C49/39	с	0	0	0	0	3
	84XX	N	0	0	80	1,940	2,500
RCA	1804A	с	0	0	0	4	23
	6805/68HC05	С	0	0	0	0	7
Rockwell	6500/XX	N	108	345	315	930	1,350
SGS	28	N	0	0	0	0	123
	387X .	n	95	260	700	1,159	1,489
Sharp	28	N	0	0	165	980	1,950
Siemens	8021	N	0	40	95	60	28
	802XX	N	20	720	1,780	1,480	1,098
	8048/35	N	0	85	300	270	405
	8051/31	N	0	0	15	1,030	2,382
Signetics	8048/35	N	135	0	141	1,055	4,609
-	8049/39	N	0	0	25	545	946
	8050/40	N	0	0	8	400	355
	8051/31	N	0	0	0	126	1,792
Synertek	28	N	0	2	90	135	24
TĪ	TMS7000	И	0	22	255	715	990
Thomson (EFCIS)	6801/03	N	0	0	0	55	150
	6805	N	0	0	0	100	600
Toshiba	8048/35	N	0	130	615	1,440	3,680
	8049/39	N	0	219	555	1,230	3,900
	80C49/39	с	0	0	142	850	2,170
Zilog	<b>Z8</b>	ท	14	344	<u>    683</u>	<u> </u>	2,055
Total 8-Bit	MCUs		21,740	34,931	54,114	90,615	163,510

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# Table 3

# Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987 (Thousands of Units)

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### Table 3 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987 (Thousands of Units)

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	<b>Product</b>	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>
Intel (Cont.)	80C49/39	с	112	- 20	0
• - · ·	80C51/31	С	785	2,000	3,165
	8748	N	1,310	800	693
	8749	И	1,445	2,247	3,625
	8751	N	843	692	941
	8752	С	0	0	30
	87C51	С	0	0	100
Intersil	80C48/35	С	30	20	0
	80C49/39	с	9	10	0
Matra-Harris	8051	N	1,400	1,340	429
	8052	N	20	418	1,033
	80C51	с	10	387	1,324
	80C52	С	0	0	83
Matsushita	MN1800	с	131	400	1,070
Microchip Tech.	PIC1652/54	N	0	0	4,063
•	PIC1655/57	N	0	0	1,073
	PIC1670/72 ·	N	0	· O	460
	PIC16C58	С	0	0	0
	PIC16E57	N	0	0	32
	PIC7000/1	N	0	0	696
	PIC7020/40	N	0	0	1,985
	PIC7041	N •	0	0	33
Mitsubishi	M507XX	С	0	. 0	23,706
	M509XX	С	0	0	13,082
	M50XXXX	С	15,125	29,906	0
	M5L8048/35	N	0	0	515
	M5L8049/39	N	0	0	1,691
	M5M8050/40	N	. 0	0	208
	M5M80C49/39	С	` 0	0	2,614
Mostek	387 <b>X</b>	ท	867	*	*
	38P7X	N	297	*	*
	F8	N	195	*	*
Motorola	146805	С	4,071	4,705	5,422
	1468705	с	48	93	0
	387X	N	174	199	0
	6801/03	N	8,007	8,526	8,918
	6804	N	501	1,495	4,357

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### Table 3 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987 (Thousands of Units)

	<b>Product</b>	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>
Motorola (Cont.)	6805	N	10,777	13,559	19,716
	68701	N	278	431	0
	68704	N	13	82	0
	68705	И	2,641	3,861	0
	68HC05	С	0	0.	4,678
	68HC11	С	67	696	3,975
National	8048/35	N	2,200	390	425
	8049/39	N	1,910	1,650	2,095
	8050/40	N	1,500	1,280	1,838
	COP800	С	0	0	10
	807X	พ่	5	0	0
National (FCI)	F8	N	0	0	138
NCR	6500/1	N	640	1,027	397
NEC	8021/22	N	350	100	40
	8041	N	2,860	2,550	1,750
	8048/35	N	2,860	3,940	4,360
	8049/39	N	5,160	5,350	4,830
	80C48/35	С	1,800	1,360	970
	80C49/39	С	2,050	2,110	2,680
	8741	N	850	480	330
	8748	N	1,660	1,370	590
	8749	* N	2,060	1,930	3,300
	uPD78XX	N	11,450	18,390	24,140
Oki	80C154	С	0	87	894
	80C48/35	С	537	520	428
	80C49/39	С	1,950	2,720	3,133
	80C51	С	0	1,772	2,721
Philips	8021/22	N	470	138	172
	8048/35	ที่	1,430	289	285
	8049/39	N	2,550	2,186	1,810
	8050/40	N -	100	393	1,780
	8051/31	N	1,100	700	1,840
	80C49/39	C	145	240	514
	80C51/31	Ċ	0	81	620
	84CXX	с	0	15	1,150
	84XX	N	6,200	14,325	10,810

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### Table 3 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987 (Thousands of Units)

.

	Product	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>
RCA	1804 <b>a</b>	с	13	11	8
	6805/68HC05	с	120	359	805
Rockwell	6500/XX	N	1,310	2,550	3,855
SGS-Thomson*					
(M)**	387X	N	0	0	795
(M)	38P7X	N	0	0	90
(M)	F8	И	0	0	136
(S) .	387X	n	2,200	4,811	3,922
(S)	Z8	N	244	601	665
(T)	6801/03	И	337	906	1,131
(T)	6805	N	1,129	1,190	2,182
Sharp	SM-Series	С	0	0	530
-	<b>Z</b> 8	N	426	686	590
Siemens	8021	N	138	0	0
	802XX	N	1,538	667	51
	8048/35	N	194	956	1,733
Siemens	8051/31	N	2,497	2,194	4,055
	80515/35	· N	0	126	768
	8052/32	N	0	713	1,431
Signetics	8048/35	N	2,563	760	111
-	8049/39	N	1,235	1,741	2,000
*	8050/40	N	277	273	723
	8051/31	N	2,362	2,687	2,731
	8052/32	· N	5	456	1,541
	80C51/31	C	0	60	283
	83C451	C	0	0	27
	8400	N	0	30	43
	87C451	с	0	0	10
TI	TMS7000	N	1,396	2,555	6,600
TCMC (Mostek)	387X	. N	0	969	*
- /	38P7X	N	0	145	*
	F8	N	Ö	299	*

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### Table 3 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987 (Thousands of Units)

	Product	Process	<u>1985</u>	<u>1986</u>	<u>1987</u>
Toshiba	8048/35	И	4,504	1,150	1,171
	8049/39	N	5,207	2,350	1,760
	80C48/35	С	0	1,000	2,950
	80C49/39	С	2,925	2,280	3,600
	80C50/40	С	0	520	851
Zilog	28	N	2,099	3,112	3,422
Others#	Unspecified	с	0	11,070	34,020
Total 8	-Bit MCUs		163,599	224,001	333,362

### \*Mergers/Accquisitions:

- 1. Gould Semiconductor accquired AMI, 1985.
- 2. Thomson Components accquired Mostek, forming Thomson Components---Mostek Corporation (TCMC), 1985.
- 3. National accquired Fairchild, 1987.
- 4. General Instrument's Microelectronics Division spun off as a new company under the name Microchip Technology, 1987.
- 5. SGS and Thomson merged, forming SGS-Thomson, 1987. (TCMC lost independent identity with the merger.)
- \*\*(M) = Mostek
  - (S) = SGS
  - (T) = Thompson

#Dataquest estimate for companies not sampled (i.e., Rohm, Sanyo, Sony)

Source: Dataquest October 1988

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# Table 4

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

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80C49/39 C 3 2	Intersil 80C48/35 C 8 8	8751 N 275 200	8749 N 410 300	. 8748 N. 525 250	80C51/31 C 100 150	80C49/39 C 40 30	8052/32 N 80 68	8051/31 N 2,500 1,500	8050/40 N 100 50	· 8049/39 X 420 400	8048/35 N 400 350	Intel 802X N 125 35	6805 N 552 560	6801/03 N 385 400	. 6305 C 280 290	Hitachi 6301 C 420 425	6805 N 175 158	Gould/AMI* 6801/03 N 290 250	PIC7041 N 3 3	PIC7020/40 N 25 40	PIC7000/1 N 6 5	PIC16E57 N 5 8	PIC16C58 C 85 77	PIC1670/72 N 650 550	Instrument PIC1655/57 N 975 840	General PIC1652/54 N 350 400	MBL8049/39 N 200 180	Fujitsu MBL8048/35 N 60 40	F8 N 33 60	Fairchild 387X N 148 90	·8751 N 2· 15	AMD 8051/31 N 250 400	
																				ō	•			N		*	Ö	ίπ					
<u>ი</u> (	'n	N	N	N	n	n	M	N	N	X	N	N	м	N	n	n	N	N	¥	N	24	N	n	N	N	N	Ņ	N	N	N	N	N	
<b>د</b> ی ا	8	275	410	525	100	40	80	2,500	100	420	400	125	552	385	280	420	175	290	ω	25	0	<b>0</b> 7	85	650	975	350	200	60	33	148	Ņ	250	
2	\$	200	300	250	150	30	68	1,500	50	400	350	35	560	400	290	425	158	250	ω	40	υ,	80	77	550	840	400	180	40	60	06	15	400	
2	7	248	275	275	275	27	61	1,500	45	360	315	32	625	360	261	383	32	16	ω	40	(JI	8	69	510	790	425	162	40	08	52	14	360	
2	7	120	460	260	260	15	60	1,300	45	350	300	30	1,165	370	555	780	37	20	ω	30	10	45	25	425	069	340	165	45	114	67	40	600	

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	Product	Process	<u>58/TO</u>	02/85	03/85	04/85	1985
Matra-Harris	8051	4	450	300	300	350	1,400
	8052	N	0	0	0	20	20
	80C51	n	0	0	0	10	01
Matsushita	MN1800	n	10	24	32	65	131
Mitsubishi	MSOXCC	n	3,200	4,050	3,900	3,975	15,125
Motorola	146805 .	n	1,052	915	1,008	1,096	4,071
	1468705	ი	8	1	7	26	48
	387X	N	14	63	65	32	174
	6801/03	N	1,840	2,246	2,265	1,656	8,007
	6804	N	33	116	158	194	501
	6805	N	2,284	2,258	2,779	3,456	10,777
	68701	N	37	80	80	81	278
	58704	N	0	0	4	9	13
	68705	N	613	. 532	745	751	2,641
	68HC11	n	ن س	8	10	44	67
National	8048/35	N	800	069	480	230	2,200
	8049/39	N	700	500	370	340	1,910
	8050/40	N	500	380	320	300	1,500
	807X	N	UT	0	0	0	IJ
NCR	6500/1	N	160	110	180	06T	640
NEC	8021/22	N	130	120	60	40	350
	8041	N	1,130	450	600	680	2,860
	8048/35	N	1,090	570	600	600	2,860
٠	8049/39	N	1,820	1,030	1,120	1,190	5,160
-	80C48/35	n	710	470	340	280	1,800
-	80C49/39	n	069	550	360	460	2,060
	8741	N	270	270	170	140	850
	8748	N	480	550	340	290	1,660
	8749	N	460	640	550	410	2,060
	uPD78XX	N	2,680	2,740	2,510	3,520	11,450
Oki	80C48/35	ი	150	135	124	128	537
	80C49/39	ი	560	440	440	510	1,950
Philips	8021/22	N	170	150	110	40	470
	8048/35	N	700	400	200	130	1,430
	8049/39	N	1,000	700	500	350	2,550
	8050/40	N	20	20	20	40	100
	8051/31	N	350	300	250	200	1,100
	80C49/39	ი	15	50	50	30	145
	84XX	N	1,100	1,300	1,800	2,000	6,200

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Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

Table 4 (Continued)

8-Bit Microcontrollers-Data

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### Table 4 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

	Product	Process	<u>01/85</u>	02/85	03/85	<u>04/85</u>	<u>1985</u>
RCA	1804A	с	5	3	3	2	13
	6805/68HC05	С	20	10	25	65	120
Rockwell	6500/XX	n	150	400	360	400	1,310
SGS	387X	ท	530	550	495	625	2,200
	Z8	n	55	47	42	100	244
Sharp	<b>Z</b> 8	И	23	23	190	190	426
Siemens	8021	N	24	54	30	30	138
	802XX	Ŋ	295	427	468	348	1,538
	8048/35	N	40	57	57	40	194
	8051/31	N -	700	630	567	600	2,497
Signetics	8048/35	N	1,400	400	463	300	2,563
•	8049/39	N	400	200	250	385	1,235
	8050/40	N	92	50	60	75	277
	8051/31	И	870	400	417	675	2,362
	8052/32	N	0	0	0	5	5
TI	TMS7000	N	400	350	316	330	1,396
Thomson	6801/03	ы	65	59	53	160	337
	6805	N	350	315	284	180	1,129
TCMC (Mostek)*	387X	И	273	159	211	224	867
	38P7X	N	112	80	61	44	297
	<b>F</b> 8	N	62	51	42	40	195
Toshiba	8048/35	И	1,600	1,404	1,000	500	4,504
	8049/39	И	1,700	1,530	1,377	600	5,207
-	80C49/39	с	900	675	650	700	2,925
Zilog	Z8	N	564	550	<u> </u>	490	2,099
Total 8-Bi	t MCUs		45,746	39,722	38,425	39,706	163,599

### \*Mergers/Accquisitions;

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1. AMI was accquired by Gould Semiconductor.

2. Thomson Components accquired Mostek Corporation from United Technologies, forming Thomson Components--Mostek Corporation (TCMC).

> Source: Dataquest October 1988

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		Matra-Harris		Intersil									•			Intel	·		Hitachi		Gould Semi.							Instrument	General				Fujitsu		Fairchild		AMD	
80C51	8052	8051	80C49/39	80C48/35	8751	8749	8748	80C51/31	80C49/39	8052/32	8051/31	8050/40	8049/39	8048/35	802X	6805	6801/03	6305	6301	6805	6801/03	PIC7041	<b>PIC7020/40</b>	PIC7000/1	PIC16257	PIC16C58	<b>PIC1670/72</b>	PIC1655/57	PIC1652/54	MBL80C49/39	MBL8051/31	MBL8049/39	MBL8048/35	F8	387X	8751	8051/31	Product
03	Z '	M	ი	a	N	¥	И	ი	n	N	N	N	X	N	¥	N	¥	ი	ŋ	*	N	N	N	N	N	Q	N	N	N	n	N	N	N	N	N	N	N	Process
10	20	358	2	2	150	500	200	300	0	150	1,422	50	415	130	30	1,180	520	760	950	42	16	ω	134	14	57	32	200	300	400	15	65	192	Ω Ω	27	ŵ	30	350	01/86
103 70	105	362	ω	ω	155	512	200	310	UI	170	1,626	52	450	140	25	1,360	840	955	1,265	48	•	C)	150	20	60	45	490	300	500	20	38	208	73	<b>6</b> 8	4	35	350	02/86
107	123	280	4	сл	175	535	200	588	C1	548	1,965	65	746	160	20	1,425	1,06Ź	1,152	1,175	10	0	σ	100	100	52	0	250	400	400	34	116	224	92	98	0	22	450	03/86
200	170	340	ч	10	212	700	200	802	10	732	1,985	58	790	165	18	1,310	1,135	1,375	1,810	27	ч	60	100	100	60	0	250	400	400	36	134	238	108	06	•	25	550	04/86
387 387	418	1,340	01	20	692	2,247	800	2,000	20	1,600	6,998	225	2,401	595	56	5,275	3,557	4,242	5,200	127	21	22	484	234	229	77	1,190	1,400	1,700	105	403	862	328	304	01	112	1,700	1986

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8-Bit Microcontrollers-Data

# Table 5

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

MAILBOOL         C         70         100         110         120           MSDXXXX         C         6,860         7,250         7,666         8,190           1468005         C         1,002         1,050         1,030         1,10           387X         C         1,002         1,050         1,030         1,10           6801/03         N         2,116         2,050         1,030         1,623           68701         N         134         2,54         541         516           68705         N         131         3,399         3,290         3,739           68705         N         134         254         541         516           68705         N         130         320         320         330         320           8048/35         N         130         320         330         300         300           8044/35         N         130         1,004         1,117         30         300         300         300         300         300         300         300         300         300         300         300         1,117         300         300         1,100         300         300	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 280 3,300 1,250 280 590 590 130 150 150 150 20 20 3,200 3	<b>ぶつつひれれれよよつつつちがれまつ</b> し	8048/35 8049/39 8050/40 8051/31 80C49/39 80C51/31 80C51/31 84CXX 84CXX	
MAILBOO         C         70         100         110         110           MSDXXXX         C         6,860         7,250         7,610         8,190           146805         C         1,062         1,050         1,030         1,101           146805         C         1,022         1,050         1,030         1,101           587X         N         2,116         2,050         1,030         1,623           587X         N         2,116         2,050         1,030         1,623           68705         N         2,116         2,053         2,111         5,22         2,23           68701         N         184         254         541         5,101         2,125         62           68701         N         100         10         10         3,133         3,399         3,290         3,739           68701         N         100         10         10         2,255         62           68041/35         N         100         10         100         110         2,112           8044/35         N         1,150         1,530         1,450         1,120           80044/35         N         <	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 3,250 130 130 130 150 150 150 150 150 150 4 150 4 150 150 150 150 150 150 150 150 150 150	<b>ここれまれままっこころまずままつこ</b>	8042/35 8048/35 8049/39 8050/40 8051/31 80C49/39 80C51/31 80C51/31 80C51/31	
MNILLOO         C         70         100         110         110           MSOXXXX         C         6.860         7.250         7.666         8.199           146805         C         1.002         1.050         1.030         1.10           146805         C         1.002         1.050         1.030         1.02           146805         C         1.002         1.050         1.030         1.622           146805         N         2.115         2.050         2.030         2.125           6801/03         N         1.11         3.131         3.399         3.290         3.231           68704         N         1.11         1.12         1.25         2.2         2.2           68805         N         1.12         1.25         2.30         3.290         3.733           68101         N         1.00         1.00         1.00         1.110         3.733           68101         N         1.00         1.00         1.00         1.00         1.00         1.125         1.00         1.125         1.00         1.110         1.125         1.00         1.00         1.00         1.00         1.00         1.00	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 3,210 3,250 130 130 150 150 150 150 4 150 4 150 4 150 150 150 150 150 150 150 150 150 150	<b>いいれまれれよいこうのまずれまつ</b> い	8042/35 8049/39 8050/40 8051/31 80C49/39 80C49/39 80C51/31	
MN1800         C         70         100         110         110           MS0XXXX         C         6,860         7,250         7,666         8,199           146805         C         1,002         1,050         7,250         7,666         8,199           146805         C         1,002         1,050         1,030         1,12           387X         N         2,116         2,053         2,110         20         4           6801/03         N         1,110         N         21         254         541         2,125         3         3,131         3,399         3,290         3,733         6	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 3,250 3,250 3,250 3,250 130 150 150 150 150 150 150 150 150 150 15	<b>い                                    </b>	8042/35 8048/35 8049/39 8050/40 8051/31 8051/31 80C49/39	
MN11800         C         70         100         110         121           NMSD2XXX         C         6,8605         C         1,002         1,050         1,10         1,10           1468705         C         1,002         1,050         1,030         1,12           1468705         C         23         25         22         2           1468705         C         1,002         1,050         1,030         1,62           6801/03         N         2,116         2,053         2,101         2,25           68705         N         3,131         3,399         3,290         3,731           68705         N         3,131         3,399         3,290         3,131           8048/35         N         1,220         130         142         1,112           8048/35         N         1,150         1,530         1,450         1,221           80448	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 3,210 410 530 150 150 410 150 150 4 150 4 150 4	<b>ਸ਼ # # # # # 0 0 0 0 # # # # 0 0</b>	8042/22 8048/35 8049/39 8050/40 8051/31	
MN1800         C         6,860         7,250         7,606         8,199           146805         C         1,002         1,052         1,050 <td><math display="block">\begin{array}{cccccccccccccccccccccccccccccccccccc</math></td> <td>1,150 3,250 410 530 130 150 150 410 150 150 4 150 4 150 4 150 4</td> <td><b>ヸヸヸヸヮぃぃぃヸヸ゙ヸヸ</b>ぃぃ</td> <td>8042/22 8048/35 8049/39 8050/40</td> <td></td>	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 3,250 410 530 130 150 150 410 150 150 4 150 4 150 4 150 4	<b>ヸヸヸヸヮぃぃぃヸヸ゙ヸヸ</b> ぃぃ	8042/22 8048/35 8049/39 8050/40	
MN1800         C         70         100         110         12           MN1800         C         6,860         7,250         7,606         8,119           MS0XXX         C         1,002         1,050         1,030         1,622           1468705         C         23         25         22         2         2           387X         98         40         20         42         2         1         2         1         5         2         <	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 3,300 1,250 410 130 130 150 150 4 150 4 150 4	<b>ギ</b> ポ ぷ こ こ こ こ こ こ こ こ こ	8042/22 8048/35 8049/39	
MN1800         C         70         100         100         110         121           MS02XXX         C         6,860         7,250         7,606         8,119           1468705         C         1,002         1,050         1,030         1,622           1468705         C         1,002         1,050         1,030         1,622           1468705         C         23         25         22         2           6804         N         2,116         2,053         2,101         2,254           6804         N         3,131         3,393         3,290         3,291         3,213           68705         N         10         10         33         2         162         2           68705         N         110         12         12         2	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 410 3,850 130 130 150 410 130 130 410 130 130 410 130 130 410 130 130 150 150 150 150 150 150 150 15	<b>オ                                    </b>	8048/35	
MN1800         C         70         100         110         12           MS0XXX         C         6,860         7,250         7,666         8,110           1468705         C         1,002         1,050         1,050         1,052           387X         N         23         25         222         2         2           6801/03         N         2,116         2,053         2,101         2,25         3,290         3,290         3,73           6805         N         3,131         3,399         3,290         3,73         541         51           68704         N         110         12         350         2,50         3,73           68705         N         3,50         2,50         3,73         2         3,73           68704         N         100         130         3,13         3,39         3,290         3,73           80448/35         N         100         142         140         25         330         110           80441/35         N         1,30         320         330         300         311           80448/35         C         310         230         230         30<	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 330 410 3,850 130 130 150 150	<b>ざいいりょず</b> れまつり	97 / T 9 0 0	
MANLBOO         C         70         100         110         12           M450XXX         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,030           1468705         C         2,250         1,030         1,030         1,030         1,030           387X         N         98         40         20         2         2         2           387X         N         98         40         20         4         20         4           6801/03         N         2,116         2,053         2,101         2,254         541         511           68701         N         10         10         3         3,131         3,399         3,290         3,73           68701/1         N         100         12         142         1,004         1,25           686701/1         N         100         10         3,73         2         6           68701/1         N         100         10         2         50         130         1,110           100         10         10         10         10         2	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 3,150 410 3,850 130 130 410 130 130 4	0000 <b>4</b> # # # 00	CC/ LCV0	Philips
MANLBOO         C         70         100         110         12           M450XXX         C         6,860         7,250         7,606         8,12           146875         C         1,002         1,050         1,002         1,250         7,606         8,12           387X         R         98         40         20         2 <td< td=""><td><math display="block">\begin{array}{cccccccccccccccccccccccccccccccccccc</math></td><td>1,150 330 410 530 130 410 130 410 130 4</td><td>о<b>о</b>вёяяо<b>о</b></td><td>80C51</td><td></td></td<>	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 330 410 530 130 410 130 410 130 4	о <b>о</b> вёяяо <b>о</b>	80C51	
MAILBOO         C         TO         IOO         IOO         IIO         IIIO         IIIO         IIIIO         IIIIO         IIIIIO         IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	,053 2,101 2,25 254 541 51 152 125 6 10 33 25 961 1,004 1,11 142 180 25 250 550 50 230 265 27 10 265 27 10 265 27 10 265 27 580 1,450 1,22 580 1,450 1,22 580 230 2,0 69 60 5,200 4,76 135 130 12	1,150 330 410 3,850 130 410 130 410	о <b>ט</b> яйяяо <b>0</b>	80C49/39	
MAILBOO         C         TO         IOO         IOO         IIO         IIIO         IIII         IIII         IIIIII         IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	,053 2,101 2,251 2,101 2,251 1,290 3,290 3,290 3,131 1,004 1,111 1,004 1,111 1,004 1,111 1,004 1,111 1,004 1,111 1,004 1,101 2,50 5,50 5,50 5,50 5,50 5,50 5,50 5,50	1,150 330 410 530 3,850 4	<u>о я й я я о о</u>	80C48/35	
MN1800         C         70         100         110         12           MN1800         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,62           1468705         C         1,002         1,050         1,030         1,62           387X         N         2,116         2,050         2,030         1,62           6801/03         N         2,116         2,053         2,102         2,22           68704         N         131         3,399         3,290         3,73           68705         N         120         152         125         6           68705         N         10         10         33         2           68705         N         100         10         33         2           68705         N         100         50         130         111           68705         N         350         250         50         50         10         25           8048/35         N         330         320         300         10         20         30           80448/35         N	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1,150 330 410 530 3,850 4	ま 茶 末 ま ひ つ	80C154	Oki
MN1800         C         70         100         110         12           MN1800         C         6,860         7,250         7,666         8,19           146805         C         1,002         1,050         1,030         1,62           1468705         C         23         25         22         2           387X         N         2,116         2,053         2,101         2,52           6801/03         N         2,116         2,053         2,101         2,25           6804         N         3,131         3,399         3,290         3,73           68705         N         10         10         3         12         125           688701         N         10         110         3,399         3,290         3,73           688701         N         100         152         132         152         152           8048/35         N         100         100         10         11         11           8050/40         N         330         320         330         11           8041         N         150         1,530         1,450         1,530         1,450         1,22	,053 2,101 2,25 254 541 51 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 265 27 10 265 27 10 265 27 10 265 27 580 2,0 580 51 950 1,450 1,22 580 1,450 1,22 580 230 69 60 50 99 60 50 99	1,150 330 410 280 410 530	茶杯丼ひつ	uPD78XX	
MN1800         C         70         100         110         12           MS0XXXX         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,62           1468705         C         23         25         22         2           387X         N         2,116         2,053         2,101         2,25           6804         N         3,131         3,399         3,290         3,73           68705         N         311         3,399         3,290         3,73           68705         N         10         10         13         3,399         3,290         3,73           68705         N         3131         3,399         3,290         3,73         6         1,004         1,11           68705         N         100         10         133         2         1	,053 2,101 2,25 254 541 51 399 3,290 3,73 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 265 27 10 265 27 10 20 330 30 250 580 1,10 580 1,450 1,22 580 1,450 1,22 580 230 470 69 300 460 20	1,150 330 410 280 410	<b>440</b> 0	8749	
MN1800         C         70         100         110         12           MS0XXX         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,62           1468705         C         23         25         22         2           6801/03         N         2,116         2,053         2,101         2,25           6804         N         3,131         3,399         3,290         3,73           68704         N         184         254         541         51           68705         N         3,131         3,399         3,290         3,73           68705         N         10         10         33         2           68705         N         10         10         33         2           688701         N         10         13         2         10         33         2           688705         N         10         10         33         2         1           8048/35         N         100         50         130         11           8048/35         N         20         2	,053 2,101 2,25 254 541 51 152 3,290 3,73 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 550 50 320 265 27 10 265 27 10 265 27 10 20 30 950 990 1,10 580 1,450 1,22 580 230 20 99 60 50 99	1,150 1 330 410 280	ឌ០ព	8748	
MAN1800         C         70         100         110         12           MS0XXXX         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,62           1468705         C         23         25         22         2           6801/03         N         2,116         2,053         2,101         2,25           68701         N         184         254         541         51           68701         N         184         254         541         51           68705         N         10         10         3,73         6           68705         N         10         10         3,73         6           68705         N         10         10         3,73         2           688701         N         10         13         2,90         3,73         2           688705         N         10         13         3,290         3,73         2           6884211         N         10         10         33         25         5           8021/22         N         330         320	,053 2,101 2,25 254 541 51 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 265 27 10 20 30 730 580 51 950 990 1,10 580 1,450 1,22 580 470 69	1,150 1 330 410	იი	8741	
MN1800         C         70         100         110         12           M50XXXX         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,62           146805         C         1,002         1,050         1,030         1,62           146805         N         98         40         20         1,62           6801/03         N         2,116         2,053         2,101         2,25           6805         N         3,131         3,399         3,290         3,73           68704         N         10         10         3,73         2           68705         N         10         10         3,73         2           68705         N         10         10         3,73         2           68705         N         10         10         3,73         2           688051         N         10         10         3,73         2           6841C11         C         120         142         180         130         11           10         10         330         320         330	,053 2,101 2,25 254 541 51 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 265 27 10 265 27 10 265 27 10 260 51 950 990 1,10 230 1,450 1,22	1,150 1 330	n	80C49/39	
MN1800         C         70         100         110         12           M50XXX         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,62           146805         C         1,002         1,050         1,030         1,62           146805         C         2,3         25         22         2           5801/03         N         2,116         2,053         2,101         2,25           6804         N         3,131         3,399         3,290         3,73           68704         N         10         10         3,73         2           68705         N         10         10         3,73         2           6880511         C         120         130         11         11           68041/35         N         100         250         50         50	,053 2,101 2,25 254 541 51 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 330 30 230 265 27 10 265 27 10 26 33 730 580 51 950 1,450 1,22	1,150 1	,	80C48/35	
MN1800         C         70         100         110         12           M50XXX         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,62           146805         C         1,002         1,050         1,030         1,62           1468705         C         1,002         1,050         1,030         1,62           387X         N         98         40         20         4           6801/03         N         2,116         2,053         2,101         2,25           6805         N         3,131         3,399         3,290         3,73           68705         N         10         10         33         2           68705         N         10         10         3,73         2           68705         N         10         10         3,73         2           6880701         N         10         10         3,73         2           6880711         C         120         142         180         25         6           68050/40         N         330         320         33	,053 2,101 2,25 254 541 51 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 330 30 230 265 27 10 265 27 10 580 51 950 990 1,10		N	8049/39	
MN1800         C         70         100         110         12           M50XXX         C         6,860         7,250         7,666         8,19           146805         C         1,002         1,050         1,030         1,62           146805         C         1,002         1,050         1,030         1,62           146805         C         1,002         1,050         1,030         1,62           1468705         C         1,032         1,030         1,62           6801/03         N         2,116         2,053         2,101         2,25           6805         N         3,131         3,399         3,290         3,73           68704         N         10         10         33         2           68705         N         10         10         3,73           68705         N         10         10         3,73           68704         N         10         10         3,73           68705         N         10         10         33         2           68705         N         10         10         33         2           68705         N	,053 2,101 2,25 254 541 51 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 330 30 230 265 27 10 20 31	900	ų	8048/35	
MAN1800         C         70         100         110         12           MSOXXXX         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,62           1468705         C         1,002         1,050         1,030         1,62           1468705         C         1,002         1,050         1,030         1,62           146805         C         23         25         22         2           146805         N         2,116         2,053         2,101         2,25           6804         N         3,131         3,399         3,290         3,73           68701         N         12         152         125         6           68705         N         10         10         3         2           68705         N         10         10         3         2           68705         N         10         10         3         2           68705         N         100         10         33         2           68705         N         100         10         30         1 <td>,053 2,101 2,25 254 541 51 ,399 3,290 3,73 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 330 30 20 265 27 10 20 3</td> <td>730</td> <td>R</td> <td>8041</td> <td></td>	,053 2,101 2,25 254 541 51 ,399 3,290 3,73 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 330 30 20 265 27 10 20 3	730	R	8041	
MN1800         C         70         100         110         12           M50XXX         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,62           146805         C         23         25         22         2           387X         N         98         40         20         1,62           6801/03         N         2,116         2,053         2,101         2,25           6805         N         3,131         3,399         3,290         3,73           68701         N         184         254         541         51           68705         N         10         10         3         2           68705         N         10         10         3         2           68705         N         10         13         2         6           68705         N         10         13         2         6           68705         N         10         13         2         6           68705         N         10         3         2         1           8048/35<	,053 2,101 2,25 254 541 51 ,399 3,290 3,73 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 265 27	40	N	8021/22	NEC
MAN1800         C         70         100         110         12           M50XXXX         C         6,860         7,250         7,606         8,19           146805         C         1,002         1,050         1,030         1,62           146805         C         1,002         1,050         1,030         1,62           146805         C         23         25         22         2           387X         N         98         40         20         1,62           6801/03         N         2,116         2,053         2,101         2,25           6805         N         3,131         3,399         3,290         3,73           68701         N         10         10         33         2           68705         N         10         13         250         125         6           68705         N         10         10         33         2	,053 2,101 2,25 254 541 51 ,399 3,290 3,73 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11 250 550 50 320 330 30	255	N	6500/1	NCR
MN1800       C       70       100       110       12         M50XXX       C       6,860       7,250       7,606       8,19         146805       C       1,002       1,050       1,030       1,62         146805       C       1,002       1,050       1,030       1,62         146805       C       23       25       22       2         387X       N       98       40       20       1,62         6801/03       N       2,116       2,053       2,101       2,25         6804       N       2,116       2,053       2,101       2,25       4         6805       N       3,131       3,399       3,290       3,73       51         68701       N       92       152       125       6         68705       N       10       10       33       2         68705       N       100       10       33       2         68704       N       100       10       33       2         8048/35       N       100       10       33       2         8049/39       N       350       250       550       50	,053 2,101 2,25 254 541 51 ,399 3,290 3,73 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11	330	N	8050/40	
MN1800       C       70       100       110       12         M50XXX       C       6,860       7,250       7,606       8,19         146805       C       1,002       1,050       1,030       1,62         1468705       C       1,002       1,050       1,030       1,62         1468705       C       23       25       22       2         387X       N       98       40       20       1,62         6801/03       N       2,116       2,053       2,101       2,25         6804       N       2,116       2,053       2,101       2,25         6805       N       3,131       3,399       3,290       3,73         68701       N       92       152       125       6         68705       N       10       10       33       2         6880511       N       100       10       33       2         68805       N       10       130       11       104       1,11         68705       N       100       50       130       11	,053 2,101 2,25 254 541 51 ,399 3,290 3,73 152 125 6 10 33 2 961 1,004 1,11 142 180 25 50 130 11	350	N	8049/39	
MN1800       C       70       100       110       12         M50XXX       C       6,860       7,250       7,606       8,19         146805       C       1,002       1,050       1,030       1,62         146805       C       1,002       1,050       1,030       1,62         146805       C       23       25       22       2         387X       N       98       40       20       1,62         6801/03       N       2,116       2,053       2,101       2,25         6804       N       3,131       3,399       3,290       3,73         68701       N       3,131       3,399       3,290       3,73         68704       N       10       10       33       2         68705       N       10       10       33       2         68705       N       779       961       1,004       1,11         688C11       C       120       142       180       25	,053 2,101 2,25 254 541 51 ,399 3,290 3,73 152 125 6 10 33 2 961 1,004 1,11 142 180 25	100	N	8048/35	National
MN1800       C       70       100       110       12         M50XXX       C       6,860       7,250       7,606       8,19         146805       C       1,002       1,050       1,030       1,62         146805       C       1,002       1,050       1,030       1,62         146805       C       23       25       22       2         387X       N       98       40       20       4         6801/03       N       2,116       2,053       2,101       2,25         6804       N       1,131       3,399       3,290       3,73         68701       N       92       152       125       6         68704       N       92       152       125       6         68704       N       92       152       125       6         68705       N       779       961       1,004       1,11	,053 Z,101 Z,25 254 541 51 ,399 3,290 3,73 152 125 6 10 33 2 961 1,004 1,11	120	ŋ	68HC11	
MN1800       C       70       100       110       12         M50XXX       C       6,860       7,250       7,606       8,19         146805       C       1,002       1,050       1,030       1,62         1468705       C       1,002       1,050       1,030       1,62         387X       N       98       40       20       4         6801/03       N       2,116       2,053       2,101       2,25         6804       N       184       254       541       51         68701       N       3,131       3,399       3,290       3,73         68704       N       10       10       33       2	,053 2,101 2,25 254 541 51 ,399 3,290 3,73 152 125 6 10 33 2	779	N	68705	
MAN1800       C       70       100       110       12         M50XXX       C       6,860       7,250       7,606       8,19         146805       C       1,002       1,050       1,030       1,62         146805       C       1,002       1,050       1,030       1,62         1468705       C       23       25       22       2         387X       N       98       40       20       4         6801/03       N       2,116       2,053       2,101       2,25         6805       N       3,131       3,399       3,290       3,73         68701       N       92       152       125       6	,053 2,101 2,25 254 541 51 ,399 3,290 3,73 152 125 6	10	И	68704	
MAN1800       C       70       100       110       12         M50XXX       C       6,860       7,250       7,606       8,19         146805       C       1,002       1,050       1,030       1,62         1468705       C       1,002       1,050       1,030       1,62         387X       N       98       40       20       4         6801/03       N       2,116       2,053       2,101       2,25         6804       N       184       254       541       51         6805       N       3,131       3,399       3,290       3,73	,053 Z,101 Z,25 254 541 51 ,399 3,290 3,73	92	N	68701	
MAN1800       C       70       100       110       12         M50XXX       C       6,860       7,250       7,606       8,19         146805       C       1,002       1,050       1,030       1,62         1468705       C       1,002       1,050       1,030       1,62         387X       N       98       40       20       4         6801/03       N       2,116       2,053       2,101       2,25         6804       N       184       254       541       51	,053 2,101 2,25 254 541 51	3,131 3	벽	6805	
MN1800       C       70       100       110       12         M50XXX       C       6,860       7,250       7,606       8,19         146805       C       1,002       1,050       1,030       1,62         1468705       C       23       25       22       2         387X       N       98       40       20       4         3801/03       N       2,116       2,053       2,101       2,25	,053 2,101 2,25	184	N	6804	
MN1800       C       70       100       110       12         M50XXX       C       6,860       7,250       7,606       8,19         146805       C       1,002       1,050       1,030       1,62         1468705       C       1,002       1,050       1,030       1,62         387X       N       98       40       20       4		2,116 2	N	6801/03	
MN1800 C 70 100 110 12 M50XXX C 6,860 7,250 7,606 8,19 146805 C 1,002 1,050 1,030 1,62 1468705 C 23 25 22 2	40 20 4	86	¥	387X	
MAN1800 C 70 100 110 12 M50XXX C 6,860 7,250 7,606 8,19 146805 C 1,002 1,050 1,030 1,62	25 22 2	23	G	1468705	
MN1800 C 70 100 110 12 M50XXX C 6,860 7,250 7,606 8,19	,050 1,030 1,62	1,002 1	Q	146805	Motorola
MN1800 C 70 100 110 12	,250 7,606 8,19	6,860 7	n	M50XXX	Mitsubishi
	100 110 12	70	n	MN1800	Matsushita
<u>00/50 00/57 00/77 00/77 5550125</u>	<u>00/40 00/60 00/2</u>	A 48/10	Frocess	Fronter	

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Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

Table 5 (Continued)

8-Bit Microcontrollers-Data

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### Table 5 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

	Product	Process	<u>01/86</u>	<u>02/86</u>	03/86	<u>04/86</u>	<u>1986</u>
RCA	1804 <b>a</b>	с	4	2	2	3	11
	6805/68HC05	С	55	65	88	151	359
Rockwell	6500/XX	N	450	640	510	950	2,550
SGS	387X	И	852	1,301	1,030	1,628	4,811
	Z8	N	194	153	147	107	601
Sharp	<b>Z</b> 8	ท	230	160	142	154	686
Siemens	802XX	N	340	304	15	8	667
	8048/35	N	26	68	431	431	956
	8051/31	N	321	573	733	567	2,194
	80515/35	N	0	0	13	113	126
	8052/32	N	81	117	219	296	713
Signetics	8048/35	N	225	215	230	90	760
-	8049/39	N	440	450	465	386	1,741
	8050/40	N	68	70	73	62	273
	8051/31	N	650	665	712	660	2,687
	8052/32	N	87	102	126	141	456
	80C51/31	с	3	7	10	40	60
	8400	N	1	6	13	10	30
TI	TMS7000	N	450	470	785	850	2,555
Thomson	6801/03	N	200	235	225	246	906
	6805	N	260	290	310	330	1,190
TCMC (Mostek)	387X	N	255	239	225	250	969
	38P7X	N	56	38	28	23	145
	F8	N	23	151	70	55	299
Toshiba	8048/35	N	250	250	350	300	1,150
	8049/39	N	550	550	650	600	2,350
	80C48/35	С	200	200	300	300	1,000
	80C49/39	С	400	480	800	600	2,280
	80C50/40	С	100	120	200	100	520
Zilog	Z8	ท	710	835	770	797	3,112
Others*	Unspecified	C ·	2.767	2,767	2,768	2,768	11,070
Total 8-B	it MCUs		48,513	54,062	58,924	62,502	224,001

\*Dataquest estimate for companies not surveyed (i.e., Ricoh, Sanyo, Sony)

Source: Dataquest October 1988

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Matra-Harris		Gould Semi Hitachi	AMD Fujitsu
8751 8752 87551 8051 8052 80651 80652 80652	6801/03 6805 68P01 68P05 802X 8048/35 8048/35 8049/39 8050/40 8051/31 8052/32 8052/32 8052/31 8052/32 8052/31 8748	MBL8051/31 MBL8051/31 6801/03 6805 6301 6305 63701 63705 63705 63705 63705	<b>Product</b> 8051/31 8053 80C51/31 8751 8753 MBL8048/35 MBL8048/35
00XX00X	<b>ೱ</b>	0000044045	л 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
220 0 120 199 250 2	1,250 1,565 1,565 100 2,000 2,000 2,000 200 200	252 252 1,800 1,600 180 180 125	01/87 436 15 26 10 112
225 0 126 310 12	1,300 1,685 1,685 145 2,500 1,360 2,500 2,500 435 665 192	265 265 1,800 1,700 276 145 190	02/87 538 22 30 126
266 0 310 23	1,300 1,790 165 2,700 2,700 3,800 1,000 1,000 1,000	2,000 1,850 175 2,200 1,850 175 250	03/87 626 115 24 25 280
230 100 110 279 404 46	1,350 2,120 200 200 262 2,100 4,400 800 146 925	2,500 2,500 458 300 458	04/87 640 150 90 42 25 155
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8-Bit Microcontrollers-Data

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Table 6

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

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# Table 6 (Continued)

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

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	Product	Process	01/87	02/87	03/87	04/87	1987
Matsushita	008 LIUW	υ	100	320	330	320	1,070
Microchip	PIC1652/54	<b>为</b>	758	960	1,300	1,045	4,063
Technology*	PIC1655/57	N	350	347	126	250	1,073
	PIC1670/72	N	80	120	135	125	460
	PIC16E57	N	15	ទ	7	•	32
	PIC7000/1	ų	145	160	175	216	969
	PIC7020/40	Z	475	525	505	480	1,985
	PIC7041	N	9	9	15	9	33
Mitsubishi	M507XX	U	5,773	5,783	6,174	5,976	23,706
	M509XX	U	1,076	2,295	4,978	4,733	13,082
	M5L8048/35	N	140	61	28	286	515
	M5L8049/39	N	448	344	375	524	1,691
	M5M8050/40	Z	52	35	83	38	208
	M5M80C49/39	U	<b>1,859</b>	221	310	224	2,614
Motorola	146805	U	1,163	1,381	1,428	1,450	5,422
	6801/03	N	2,256	2,267	2,232	<b>2,16</b> 3	8,918
	6804	N	853	1,149	970	1,385	4,357
	6805	N	4,918	4,785	4,923	5,090	19,716
	68HC05	U	714	974	1,316	1,674	4,678
	68HC11	υ	402	696	1,290	1,587	3,975
National	8048/35	N	102	103	120	100	425
	8049/39	N	465	480	650	500	2,095
	8050/40	N	350	368	550	570	1,838
	COP800	υ	•	0	0	10	10
National (FCI)*	F.8	N	48	40	20	30	138
NCR	6500/1	N	165	170	60	7	397
NEC	8021/22	Z	•	20	9	10	40
	8041	N	380	540	480	350	1,750
	8048/35	N	1,020	1,070	1,170	1,100	4,360
	8049/39	N	1,000	1,350	I,430	1,050	4,830
	80C48/35	υ	220	320	230	200	970
	80C49/39	υ	710	450	. 690	830	2,680
	8741	N	80	<b>06</b>	70	06	330
	8748	N	130	180	200	80	590
	8749	N	840	680	730	1,050	3,300
	uPD78XX	N	5,980	5,420	6,140	6,600	24,140

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### Table 6 (Continued)

# Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

	Product	Process	<u>01/87</u>	02/87	<u>03/87</u>	<u>04/87</u>	<u>1987</u>
Oki	80C154	с	75	95	350	374	894
	80C48/35	С	125	110	100	93	428
	80C49/39	с	699	734	890	810	3,133
	80C51	С	790	591	660	680	2,721
Philips	8021/22	И	35	60	45	32	172
	8048/35	n	75	70	95	45	285
•	8049/39	N	430	450	500	430	1,810
	8050/40	ุท	90	754	856	80	1,780
	8051/31	N	320	460	550	510	1,840
	80C49/39	С	74	120	160	160	514
	80C51/31	С	60	110	210	240	620
	84CXX	С	110	350	380	310	1,150
	84XX	N	2,880	3,190	2,540	2,200	10,810
RCA	1804A	С	5	2	1	0	8
+	6805/68HC05	С	190	170	155	290	805
Rockwell	6500/XX	N	980	925	900	1,050	3,855
SGS-Thomson*							
(M)**	387X	N	230	175	200	190	795
(M)	38P7X	N	30	20	20	20	90
(M)	F8	N	56	50	20	10	136
(S) .	387X	N	1,254	1,222	958	488	3,922
(S)	<b>Z8</b>	N	131	163	233	138	665
(T)	6801/03	N	295	280	276	280	1,131
(T)	6805	n	530	585	502	565	2,182
Sharp	SM-Series	С	110	185	110	125	530
	28	n	120	225	120	125	590
Siemens	802XX	n	17	12	9	13	51
	8048/35	N	507	541	372	313	1,733
	8051/31	n	812	987	1,147	1,109	4,055
	80515/35	N	164	164	202	238	768
	8052/32	N	316	362	405	347	1,431
Signetics	8048/35	N	48	25	22	16	111
	8049/39	N	488	502	514	496	2,000
	8050/40	n	80	220	218	205	723
	8051/31	N	680	685	700	666	2,731
	8052/32	N	155	450	464	472	1,541
	80C51/31	С	65	69	73	76	283
	83C451	с	1	5	9	12	27
	8400	N	10	11	10	12	43
	87C451	C	0	2	3	5	10

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### Table 6 (Continued)

### Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

		Product	Process	<u>01/87</u>	<u>02/87</u>	<u>03/87</u>	<u>04/87</u>	<u>1987</u>
TI		TM\$7000	N	1,100	1,600	1,800	2,100	6,600
Toshiba		8048/35	Ħ	300	310	286	275	1,171
		8049/39	N	500	400	435	425	1,760
		80C48/35	с	400	650	800	1,100	2,950
		80C49/39	С	800	850	900	1,050	3,600
		80C50/40	С	200	225	210	216	851
Zilog		28	N	863	863	858	838	3,422
Others#		Unspecified	С	8,505	8,505	8,505	8,505	<u>34,020</u>
Total	8-Bit	MCUs		73,881	79,088	89,268	91,125	333,362

### \*Mergers/Accquistions:

- 1. General Instrument's Microelectronics Division spun off as a separate company under the name Microchip Technology.
- 2. National accquired Fairchild.
- 3. SGS and Thomson Components merged, forming SGS-Thomson. TCMC (Mostek) was folded into the newly established company.
- \*\*(M) = Mostek
  - (S) = SGS
  - (T) = Thompson

#Dataquest estimate for companies not sampled (i.e., Ricoh, Sanyo, Sony)

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Source: Dataquest October 1988







The tables and figures in this section are organized as follows:

- Table 1Estimated Market Share by Product Type for 16-Bit Microcontrollers,<br/>1985-1987
- Figure 1 Estimated Market Share by Product Type for 16-Bit Microcontrollers, 1986 and 1987
- Table 2Estimated Market Share by Process Technology for 16-Bit Microcontrollers,<br/>1985-1987
- Figure 2 Estimated Market Share by Process Technology for 16-Bit Microcontrollers, 1985-1987
- Table 3Estimated Market Share by Process Technology by Region for 16-Bit<br/>Microcontrollers, 1985-1987
- Figure 3 Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers, 1987

### Table 1

### Estimated Market Share by Product Type for 16-Bit Microcontrollers 1985-1987

	1985	1986	<u>1987</u>
8096	62.5%	67.4%	80.0%
V35	0	0	0.3
HPC	0	0	3.6
68200	5.2	32.3	16.1
9940	32.3		0
Total 16-Bit MCUs	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source:	Dataqu	est
	April	1989

Figure 1

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### Estimated Market Share by Product Type for 16-Bit Microcontrollers 1986 and 1987



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### Table 2

### Estimated Market Share by Process Technology for 16-Bit Microcontrollers 1985-1987 (Thousands of Units)

	<u>1985</u>	<u>1986</u>	<u>1987</u>
NMOS			
Shipments	232	399	658
Percent	100.0%	100.0	96.1
CMOS			
Shipments	0	0	27
Percent	0	0	3.9%
Total Shipments	232	399	685
		Source:	Dataquest April 1989

### Figure 2

### Estimated Market Share by Process Technology for 16-Bit Microcontrollers 1985-1987



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Source: Dataquest April 1989

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### Table 3

### Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers 1985-1987

	<u>1985</u>	<u>1986</u>	<u>1987</u>
NMOS			
United States	94.8%	67.7%	83.3%
Japan	0	0	0
Western Europe	5.2	<u>32,3</u>	<u>16.7</u>
Total NMOS	100.0%	100.0%	100.0%
CMOS			
United States	0	0	92.6%
Japan	0	0	7.4
Western Europe	0	0	0
Total CMOS	0	0	100.0%
		Source:	Dataquest April 1989

Figure 3

Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers 1987



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## **16-Bit Microcontroller Analysis**

### 16-BIT MICROCONTROLLERS

The 16-bit microcontroller offers a high level of system integration on a single chip. With 16-bit CPU performance, high-speed math processing, and high-speed I/O, the 16-bit microcontroller will open up applications that previously required many chips. The 16-bit microcontrollers on the market today are designed to fit the needs of a wide variety of control applications that require high-performance operation such as industrial control, instrumentation, and intelligent computer peripherals. Table 1 shows 16-bit MCU applications in various industry segments.

### <u>Evolution</u>

Users of 8-bit microcontrollers have become increasingly sophisticated, thus placing greater demands on chip suppliers for improved microcontrollers. Before the 16-bit MCU, designers depended on complex multiple-chip solutions to achieve high performance. The 16-bit chip offers a better solution. Even though the 8-bit and 16-bit MCUs are used in similar types of applications, the 16-bit MCU chips can also be used in higher-performance applications.

Approximately 232,000 16-bit microcontroller units were shipped in 1985, less than 1 percent of all microcontrollers shipped. We expect the unit shipments of these devices to grow at about 150 percent CAGR, during the next six years.

Table 2 shows 16-bit microcontrollers and potential applications.

## **16-Bit Microcontroller Analysis**

### Table 1

### 16-BIT MICROCONTROLLER APPLICATIONS

INDUSTRIAL . Motor Control Robotics Discrete and Continuous Process Control Numerical Control Intelligent Transducers INSTRUMENTATION Medical Instrumentation Liquid and Gas Chromatographs Oscilloscopes

CONSUMER Video Recorders Laser Disk Drives High-End Video Games

GUIDANCE AND CONTROL Missile Control Torpedo Guidance Control Intelligent Ammunition Aerospace Guidance Systems DATA PROCESSING Plotters Copiers Disk Drives Tape Drives High-Range Printers TELECOMMUNICATIONS

Modems Intelligent Line Card Control

AUTOMOTIVE Ignition Control Transmission Control Antiskid Braking Emission Control

> Source: Dataquest December 1986

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# **16-Bit Microcontroller Analysis**

### Table 2

### 16-BIT MICROCONTROLLERS AND POTENTIAL APPLICATIONS

Product	Application
8096 8796 (EPROM)	Engine Control/High-Speed Peripherals
HPC-16040 (CMOS)	Data Communications
V25 (CMOS)	Dedicated to Automotive
78312	General Purpose
68200	Real-Time Applications Industrial Control Robotics Instrumentation
<b>2</b> 800	General Purpose
TMS-9940	General Purpose

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Source: Dataquest December 1986

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The following section includes historical microcontroller unit shipments by year, manufacturer, product name, and process technology.

The tables are organized as follows:

Table 1	Estimated 16-Bit Microcontroller Unit Shipments by Manufacturer, 1980-1984
Table 2	Estimated 16-Bit Microcontroller Unit Shipments by Manufacturer, 1985-1988
Table 3	Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1980
Table 4	Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1981
Table 5	Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1982
Table 6	Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1983
Table 7	Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1984
Table 8	Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1985
Table 9	Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1986
Table 10	Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1987
Table 11	Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1988

### Table 1

### Estimated 16-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

	<b>Product</b>	Process	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Intel	8096	N	0	0	0	0	1
Mostek	68200	N	0	0	0	0	0
NEC	V35	с	0	0	0	0	0
National	HPC	с	0	0	0	0	0
Texas Instruments	9940	N	8	<u>36</u>	<u>50</u>	89	122
Total 16-Bit MCUs			8	36	50	89	123

Source: Dataquest September 1989

### Table 2

### Estimated 16-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988 (Thousands of Units)

	Product	<u>Process</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Intel	8096	N	145	269	548	1,670
	8098	N				80
	80C196	С				60
National	HPC	С	0	0	25	250
NEC	V35	С	0	0	2	9
SGS-Thomson	68200	И	12	129	110	64
Texas Instruments	9940	N	75	1	0	0
Various*	8061	с	<u>N/A</u>	<u>N/A</u>	2,626	3,328
Total 16-Bit MC	CUs		232	399	3,311	5,461

N/A = Not Applicable

\*The 8051 is a custom-designed 16-bit microcontroller for Ford Motor Company. It is supplied by several semiconductor companies including Intel. Estimated production of the 8061 is based on production of Ford automobiles and trucks. (No attempt to estimate production prior to 1987 has been made.)

> Source: Dataquest September 1989



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### Table 3

### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1980 (Thousands of Units)

	Product	Process	01/80	02/80	03/80	04/80	<u>1980</u>
Texas Instruments	9940	N	1	1	2	4	8
Total 16-Bit MC	Us		1	1	2	4	8

Source: Dataquest September 1989

### Table 4

### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

,	<u>Product</u>	Process	<u>01/81</u>	02/81	03/81	<u>04/81</u>	<u>1981</u>
Texas Instruments	9940	N	6	10	10	10	36
Total 16-Bit MC	Ųs		6	10	10	10	36

Source: Dataquest September 1989

### Table 5

### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1982 (Thousands of Units)

	Product	Process	01/82	02/82	<u>03/82</u>	04/82	<u>1982</u>
Texas Instruments	9940	N	10	10	15	15	50
Total 16-Bit MC	Us		10	10	15	15	50

Source: Dataquest September 1989

### Table 6

### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

	<b>Product</b>	Process	01/83	02/83	<u>03/83</u>	<u>04/83</u>	<u>1983</u>
Texas Instruments	9940	N	20	22	22	25	89
Total 16-Bit MC	CUs		20	22	22	25	89

Source: Dataquest September 1989

### Table 7

### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

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	<b>Product</b>	Process	01/84	02/84	<u>03/84</u>	04/84	<u>1984</u>
Intel Texas Instruments	8096 9940	n N	0 30	0 <u>30</u>	0 <u>31</u>	1 <u>31</u>	1 <u>122</u>
Total 16-Bit MC	IUs		30	30	31	32	123

Source: Dataquest September 1989

### Table 8

### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

	<b>Product</b>	Process	<u>01/85</u>	<u>02/85</u>	<u>03/85</u>	<u>04/85</u>	<u>1985</u>
Intel	8096	ท	25	40 '	40	40	145
TCMC (Mostek)*	68200	N	0	0	1	11	12
Texas Instruments	9940	N	<u>25</u>	<u>15</u>	<u>15</u>	<u>20</u>	<u>.75</u>
Total 16-Bit MC	Us		50	55	56	71	232

\*Thomson Components acquired Mostek Corporation in 1985, forming Thomson Components Mostek Corporation (TCMC).

> Source: Dataquest September 1989

### Table 9

### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

	<b>Product</b>	Process	<u>01/86</u>	<u>02/86</u>	<u>03/86</u>	<u>04/86</u>	<u>1986</u>
Intel	8096	N	58	66	73	72	269
TCMC (Mostek)	68200	N	18	32	44	35	129
Texas Instruments	9940	N	_1	_0	_0	_0	l
Total 16-Bit MCUs			77	98	117	107	399

Source: Dataquest September 1989

### Table 10

### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

	Product	Process	<u>01/87</u>	<u>02/87</u>	<u>03/87</u>	<u>04/87</u>	<u>1987</u>
Intel	8096	N	86	82	130	250	548
NEC	V35	с	0	0	0	2	2
National	HPC	с	0	0	0	25	25
SGS-Thomson	68200	N	10	20	55	25	110
Various*	8061	с	<u>685</u>	<u>570</u>	<u>645</u>	726	2,626
Total 16-Bit MCUs			781	672	830	1,028	3,311

\*The 8061 is a custom-designed 16-bit microcontroller for Ford Motor Company. It is supplied by several semiconductor companies including Intel. Estimated production of the 8061 based on production of Ford automobiles and trucks. (No attempt to estimate production prior to 1987 has been made.)

> Source: Dataquest September 1989

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## 16-Bit Microcontrollers--Historical Shipment Data

#### Table 11

#### Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1988 (Thousands of Units)

	Product	Process	01/87	02/87	<u>03/87</u>	<u>04/87</u>	<u>1987</u>
Intel	8096	N	300	400	370	600	1,670
	8098	N	0	20	30	30	80
	80C196	с	10	20	10	20	60
National	HPC	с	40	55	80	75	250
NEC	V35	с	2	2	2	3	9
SGS-Thomson	68200	N	16	19	0	29	64
Various*	8061	C	902	<u>    940</u>	<u>    656</u>	830	<u>3,328</u>
Total 16-B	it MCUs		1,270	1,456	1,148	1,587	5,461

Source: Dataquest September 1989

\*The 8061 is a custom designed 16-bit microcontroller for Ford Motor Company. It is supplied by several semiconductor companies including Intel. Estimated production of the 8061 is based on production of Ford automobiles and trucks.

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# 16-Bit Microcontrollers-Historical Shipment Data

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## 16-Bit Microcontroller Data

The following table lists historical unit shipments of 16-bit MCUs by manufacturer, by product name, and technology for 1979 through 1986.

#### Table 1

#### 16-Bit Microcontroller Shipment Estimates 1979-1986 (Thousands of Units)

	<b>Product</b>	<u>Process</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Intel	8096 68200	N N					S	S	145	269 129
TI	9940	n	<u>5</u>	<u>8</u>	<u>36</u>	<u>50</u>	<u>89</u>	<u>122</u>	<u>75</u>	<u> </u>
Total			5	8	36	50	89	122	232	399
*S = Sample	asp ed				22.50	17.00	12.56	11.00	17.40	17.48

Source: Dataquest October 1987

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### PC Graphics Chip Sets--Executive Summary

#### EXECUTIVE SUMMARY

#### PC Graphics Chip Set Market Overview

Total worldwide merchant PC graphics chip set revenue was \$108 million in 1988, representing an increase of 96.4 percent over 1987 revenue of \$55 million. Dataquest is forecasting 1989 revenue at \$182 million, for an annual growth rate of 68.5 percent. The saturation of chip set solutions into the graphics market signals the end of the rapid growth phase for the industry. Compound annual growth rate (CAGR) for 1989 through 1993 is expected to be 11.5 percent and is closely tied to growth in the PC market, which is expected to have a CAGR of 10.5 percent for that period. However, because of severe pricing pressure, average selling prices (ASPs) are forecast to decline by a negative 26.8 percent CAGR in the period. Consequently, revenue is expected to be a negative 13.6 percent.

#### Trends and Issues

A summary of important competitive trends in this industry includes the following:

- The three largest merchant vendors of low-end PC graphics chip sets are Western Digital, Chips and Technologies, and Cirrus Logic. These companies accounted for 90 percent of merchant revenue in 1987 and 75 percent in 1988.
- In 1987, there were five merchant chip set vendors. In 1988 nine vendors offered merchant products. Currently, 12 vendors participate in the market. As the business shifts from add-in boards to motherboard implementations, some vendors who now offer boards with proprietary chip sets will begin to offer those chip sets on the merchant market. Dataquest estimates that by the end of 1990, there will be between 16 and 20 merchant graphics chip set vendors.
- The increase in the number of competitors combined with expected slower growth in unit shipments is expected to lead to aggressive pricing strategies. These strategies result in lower revenue overall for the industry and continued margin pressure for individual vendors.
- VGA is expected to become the dominant low-end PC graphics standard beginning in 1989. The older standards (HGA, CGA, EGA) are expected to decline rapidly in use as VGA prices decline.
- What the next PC graphics standard will be is currently under debate. Although the shift to a new standard will not occur as rapidly as it has in the past, Dataquest believes that the IBM 8514/A will be the eventual successor to VGA in the mainstream PC market.

### PC Logic Chip Sets--Executive Summary

#### EXECUTIVE SUMMARY

#### PC Logic Chip Set Market Overview

Total worldwide PC logic chip set revenue was approximately \$399 million in 1988, representing an increase of 177 percent over 1987 revenue of \$144 million. Total chip set revenue is expected to grow at a compound annual growth rate (CAGR) of 12.6 percent for the period from 1989 through 1993, as compared with a CAGR of 70 percent for the period from 1987 through 1990, the emerging period for the industry. Dataquest believes that in 1990, the penetration of chip sets into PCs will be likely to approach saturation and, at that point, the growth rate of chip sets will be tied directly to the growth rate of the PC industry.

#### Competition

The following points should be noted about competition in this market:

- The two largest vendors of PC logic chip sets are Chips and Technologies, a U.S. company, and Acer Laboratories, a Taiwanese company. Acer controls the major share (66 percent) of the PC XT market while Chips and Technologies controls the largest share (40 percent) of the PC AT market.
- Ranked by 1988 revenue, the top five chip set vendors have 82.7 percent of the market. The top seven vendors have 91.9 percent of the market.
- The rapid growth of the chip set market, as chip sets displace discreet logic in PCs, has attracted many new entrants to this industry. Dataquest believes that the industry capacity is currently above the expected demand and that this will cause vendors to compete aggressively on price.
- Large semiconductor companies that perceive the displacement of discreet logic products with chip sets as a direct threat to their business have turned their attention to this market and will be leveraging their resources to compete with the many start-ups and smaller participants.
- The critical success factors for vendors in this industry are listed below:
  - Systems expertise
  - Access to design tools
  - Access to high-volume/low-cost manufacturing
  - Excellent customer service and support capabilities
  - The ability to demonstrate a product growth or upgrade path for the customer

### PC Logic Chip Sets--Executive Summary

#### Trends and Issues

- The PC XT bus segment is expected to lose 24 points of market share between 1987 and 1989, going from 59 percent to 35 percent of all chip set shipments. This is a result of the displacement of the PC XT with low-end PC AT products as prices on these products come down.
- The PC AT bus segment currently composes about 50 percent of all chip set shipments. Dataquest believes that the PC AT segment will continue to make up the bulk of the market, with its share going to about 74 percent by 1993 because the PC AT bus will cover both the low end of the market when implemented with the 80286 microprocessor and the middle range of the market when implemented with the 80386SX or 80386.
- Dataquest believes that the EISA bus architecture will not be successful in competing for the high end of the PC market against the MCA bus, mostly as a result of the late introduction of the EISA bus. The MCA bus currently composes about 2 percent of the chip set market and is expected to account for 17 percent of the market by 1993.
- As the market shifts away from the PC XT segment, the 8088/8086 microprocessor segment is losing ground also. The 8088/8086 segment is expected to go from 56 to 33 percent of chip set shipments between 1987 and 1989 and to fall to about 5 percent of the market by 1993.
- The 80286 segment has lost market share at the high end to both the 80386SX and the 80386, but it has made up for this by gaining at the low end. The 80286 segment is expected to go from 41 percent to 43 percent of the market between 1987 and 1989, and to 28 percent by 1993, as it continues to lose at the high end.
- As new microprocessors are introduced, the average speed grade for the market has shifted upward. In 1987, 10-MHz chip sets accounted for more than one-half of all shipments. In 1989, the median is expected to be the 12-MHz segment. Dataquest expects the median to step up one speed grade every two years, reaching 20 MHz by 1993.
- Average selling prices (ASPs) will fall in 1989 as a result of price competition. They will rise in 1990 as the introduction of EISA chip sets and increased penetration of the MCA chip sets shifts the product mix toward the high end. ASPs will then come down slowly through the rest of the period as price decreases are offset by the continued move in product mix toward the high end.



#### FORECAST METHODOLOGY AND ASSUMPTIONS

The PC graphics device forecast is derived from the Dataquest Personal Computer Industry Service (PCIS) PC forecast, the Dataquest Graphics and Imaging graphics device forecast, and a survey of worldwide chip set vendors. Dataquest's new graphics forecast for 1989 through 1993 is derived as a function of saturation of the DOS PC market. The estimates for 1987 and 1988 are based on the chip set vendor survey and Dataquest analysis. The following is a summary of the significant assumptions made in these forecasts:

- The worldwide DOS PC market will continue to grow through the period at a compound annual growth rate (CAGR) of approximately 13 percent.
- As a general trend, very large-scale integration (VLSI) ICs are displacing discrete chips (non-VLSI). Because of the advantages chip set usage offers systems and add-in board manufacturers—lower cost, better performance, and faster time to market, this displacement has happened very rapidly.
- Average selling prices (ASPs) for low-end graphics chip sets will fall very sharply in 1990 due to oversupply and severe price competition. Dataquest expects low-end graphics chip prices to continue to decline through the forecast period, approaching the prices of other high-volume, standard commodity chips. ASPs for high-end graphics devices will decline by about a 25 percent CAGR through the period as volumes increase.
- Total low-end graphics solutions comprise all low-end PC graphics devices and implementations. Total graphics chip sets are a subset of all graphics solutions and comprises only VLSI implementations. VLSI (chip set) implementations are defined as follows:
  - Merchant—Chip sets that are sold into the merchant market to be implemented on a board by an OEM
  - Captive—Chip sets that are consumed internally as part of a board-level product that is offered for sale by a merchant chip set vendor
  - Proprietary—Chip sets that are sold only as part of a board-level product and not as a merchant product

#### HIGHLIGHTS OF THE PC GRAPHICS CHIP SET AND DEVICE FORECASTS

Dataquest forecasts the PC graphics markets by low-end and high-end devices. Devices are implemented in either VLSI or non-VLSI, as an add-in board product, or as a chip set on a motherboard. Low-end solutions are forecast by graphics standard type, by implementation (merchant, captive, or proprietary) within this standard type, and by non-VLSI or VLSI. High-end devices are forecast simply as IBM- and non-IBM-compatible.

#### Worldwide Merchant Low-End PC Graphics Chip Set Forecast

Dataquest estimates 1988 worldwide merchant low-end PC graphics chip set revenue to be \$108 million compared with the 1987 estimate of \$55 million. The forecast for 1989 is \$182 million. Dataquest's merchant low-end PC graphics chip set revenue forecast is presented in Figure 1. The unit forecast is shown in Figure 2. The data for these figures is given in Table 1.



#### Figure 1

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Source: Dataquest November 1989

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Figure 2





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Source: Dataquest November 1989

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#### Table 1

#### Total Low-End Merchant PC Graphics Chip Set Market Estimated Worldwide History and Forecast (Millions of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	1987-1993 <u>Cagr</u>	1989-1993 <u>CAGR</u>
Total DOS PC Shipments Growth Rate	9.6	12.3 28.1%	13.8 12.2%	15.4 11.6%	17.1 11.0%	18.7 9.41	20.6 10.2%	13.64	10.54
Total Low-End Graphics Devices Growth Rate	9.2	11.1 20.5%	13.7 23.2¥	14.3 4.6%	15.8 10.8%	16.4 3.8%	18.3 11.1%	12.1%	7.50
Low-End Graphics Chip Sets Saturation	4.3 46.7%	7.5 67.9%	11.8 86.0%	13.0 91.0%	15.0 95.0%	16.1 98.0%	18.2 99.6%	27.28	11.5%
Merchant Graphics Chip Sets Growth Rate	2.1	4.5 114.7%	8.1 79.3%	10.2 25.14	12.5 22.7	13.7 9.98	15.7 14.9%	39.8%	18.04
Merchant Graphics Chip Set ASP Growth Rate	\$26.1	\$ 23.9 (8.6%)	\$ 22.4 (6.0%)	\$ 13.9 (38.0%)	\$ 10.2 (27.0%)	\$ 7.8 (23.3%)	\$ 6.5 (17.2%)	(20.8%)	(26.8%)
Merchant Graphics Chip Set Revenue (Millions of Dollars) Growth Rate	\$55.0	\$108.1 96.3%	\$182.1 68.5%	\$141.3 (22.4%)	\$ 126.6 (10.4%)	\$106.7 (15.7%)	\$101.5 {4.9%}	10.7%	(13.68)

Source: Dataguest November 1989

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#### Total Low-End Graphics Forecast by Implementation

The Dataquest low-end graphics forecasts by implementation are presented in Figures 3 and 4 and in Table 2. Points worth noting include the following:

- VLSI (chip set) implementations rose from 4.3 million units (46.7 percent of devices) in 1987 to 7.5 million units (67.9 percent of devices) in 1988. The projection for 1989 is for 11.7 million units or 86 percent of all devices being implemented in VLSI. By 1992, 98 percent of all implementations are expected to be done in VLSI.
- Merchant chip sets are expected to grow at a CAGR of about 40 percent from 1987 through 1993. The shift to motherboard implementations of the graphics function is contributing to this growth.
- Captive chip sets are expected to peak in 1989, then decline and level off. The decline is due to the shift toward motherboard implementations and away from add-in boards. Some vendors are also motherboard manufacturers, which will account for the captive units in the later years of the period.
- Proprietary chip sets consist mostly of IBM PS/2 systems. Current add-in board vendors using proprietary devices will be forced to become merchant chip set vendors as the board business goes away.



Figure 3

Total Low-End PC Graphics Solutions-VLSI versus Non-VLSI Estimated Worldwide History and Forecast

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Total Low-End PC Graphics Solutions by Implementation Estimated Worldwide History and Forecast



Source: Dataquest November 1989



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#### Table 2

#### Total Low-End PC Graphics Solutions by Implementation Estimated Worldwide History and Forecast (Thousands of Units)

	<u>1987</u>	1986	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	1987-1993 <u>CAGR</u>
Total Chip Set Implementations Percent of Total	4,301.1 46.7%	7,541.3 67.9%	11,756.2 86.0%	13,013.0 91.0%	15,048.0 95.0%	16,111.2 98.0%	18,177.8 99.6%	27.20
Merchant Chip Sets Growth Nate	2,107.5	4,524.8 114.7%	0,111.8 79.3%	10,150.1 25.1%	12,457.5 22.78	13,694.5 9.9%	15,730.2 14.9%	39.8%
Captive Chip Sets Growth Rate	344.1	1,070.9 211.2%	1,704.6 59.20	1,301.3 (23.7%)	1,098.5 (15.6%)	934.4 (14.9%)	908.9 (2.7%)	17.6% )
Proprietary Chip Sets Growth Rate	1,849.5	1,945.7 5.28	1,916.3 (1.5%)	1,561.6 (18.5%)	1,489.8 (4.61)	1,482.2 {0.5%}	1,543.3 4.1%	(3.0%)
Non-VLS1 Implementations Percent of Total	4,908.9 53.3%	3,558.7 32.11	1,913.8 14.0%	1,287.0 9.01	792.0 5.0%	328.8	82.2 0.4%	(49.41)
Total Low-End Graphics Solutions Growth Rate	9,210.0	11,100.0 20.5%	13,670.0 23.2%	14,300.0 4.6%	1,5840.0 10.8%	16,440.0 3.8%	18,260.0 11.1%	12.14

Source: Dataquest November 1989

#### Low-End Graphics Forecast by Graphics Standard

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The Dataquest forecast of low-end PC graphics solutions by standard type is presented in Figure 5 and Table 3. Points worth noting include the following:

• Video Graphics Array (VGA) is expected to be the dominant standard beginning in 1989. Growing at a CAGR of almost 50 percent for the period, VGA appears to be a satisfactory solution for the majority of applications. As prices of VGA chips continue to decline, the other standards will lose share to VGA and become obsolete.

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- Although it is not reflected in these forecasts, we expect the next PC graphics standard or standards to begin to erode VGA growth during the 1991 to 1993 time frame. The shift toward a new standard will depend on pricing of chips, monitors, and memory, and will be slower than previous shifts to newer standards.
- The older standards—Hercules Graphics Adapter (HGA) and Color Graphics Adapter (CGA)—are expected to decline rapidly in use. They are still used on low-cost systems, but the price premium to move up to Enhanced Graphics Adapter (EGA) or VGA is shrinking rapidly. HGA and CGA are seeing some use in recent notebook and pocket PC products because these designs were done before the recent price declines in EGA and VGA chip sets. New versions of these products are expected to incorporate EGA and VGA.

#### Figure 5

#### Total Low-End PC Graphics Solutions by Standard Type Estimated Worldwide History and Forecast



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Table 3

#### Total Low-End PC Graphics Solutions by Standard Type Estimated Worldwide History and Forecast (Thousands of Units)

	<u>198</u> 7	7988	1989	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	1987-1993 <u>Cagr</u>
HGA	3.300.0	2.600.0	2.100.0	1,950.0	1,600.0	1,200.0	700.0	(22.8%)
CGA	1,200.0	1.050.0	900.0	450.0	300.0	200.0	0	(25.8%)
EGA	3.200.0	3.650.0	3,200.0	2,400.0	1,800.0	1,200.0	700.0	(22.4%)
VGA	1,510.0	3,800.0	7,470.0	9,500.0	12,140.0	<u>13,640.0</u>	<u>16,860.0</u>	49.5%
Total	9,210.0	11,100.0	13,670.0	14,300.0	15,840.0	16,440.0	18,260.0	12.18

Source: Dataguest November 1989

#### Low-End Graphics Forecast by Implementation within Standard Type

The Dataquest forecasts by implementation for HGA are presented in Figure 6 and Table 4; for CGA, in Figure 7 and Table 5; for EGA, in Figure 8 and Table 6; and for VGA, in Figure 9 and Table 7. Points worth noting include the following:

- In general, all standards will be implemented increasingly as merchant chip sets as the graphics function is implemented on the motherboard.
- Captive chip sets will begin to consist of motherboard products rather than graphics add-in boards sold by chip set manufacturers. Only a few add-in board makers are currently also in the business of manufacturing motherboards. Becoming a motherboard manufacturer in order to sell graphics chip sets is probably not an option for current add-in board manufacturers. It is not even clear yet that there is any advantage to being a chip set and motherboard manufacturer.
- Proprietary chip sets consist mainly of the IBM PS/2 VGA products. Add-in board manufacturers that are currently using a proprietary chip set will be forced either to sell the chip set to the merchant market as their board business declines or to try to compete as a low-end niche or specialized high-end ugrade vendor.

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Total HGA Implementations Estimated Worldwide History and Forecast



Table 4

#### Total HGA Implementations Estimated Worldwide History and Forecast (Thousands of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	1987-1993 <u>CAGR</u>
Merchant	¢	0	73.5	359.6	489.4	620.4	441.0	34.8%
Captive	0	0	10.5	66.3	107.2	66.0	42.0	26.04
Proprietary	198.0	197.6	273.0	262.1	208.0	186.0	140.0	(5.69)
Discrete	3,102.0	2,402.4	1,743.0	1,262.0	795.4	327.6	77.0	(46.0%)
Total	3,300.0	2,600.0	2,100.0	1,950.0	1,600.0	1,200.0	700.0	(22.8%)

Source: Dataquest November 1989

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Millions of Units



Source: Dataquest November 1989

Table 5

#### **Total CGA Implementations** Estimated Worldwide History and Forecast (Thousands of Units)

	<u>1987</u>	<u>7998</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	1987-1993 <u>Cagr</u>
Merchant	405.6	766.5	783.0	414.0	276.0	180.0	0	(15.04)
Captive	120.0	42.0	63.0	36.0	24.0	20.0	0	(30.1%)
Proprietary	192.0	105.0	54.0	0	0	0	0	
Discrete	482.4	136.5	0	0	0	0	0	-
Total	1,200.0	1,050.0	900.0	450.0	300.0	200.0	0	(30,14)

Source: Dataguest November 1989

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Millions of Units



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Source: Dataquest November 1989 -

#### Table 6

#### **Total EGA Implementations** Estimated Worldwide History and Forecast (Thousands of Units)

	<u>1987</u>	<u>1988</u>	1989	<u>1990</u>	1991	1992	1993	1987-1993 <u>CAGR</u>
Merchant	1,241.6	1,811.5	2,269.1	1,872.0	1,494.0	1,006.0	606.0	(11.3%)
Captive	217.0	580.4	416.0	240.0	144.0	75.1	34.8	(26.3%)
Proprietary	417.6	237.3	320.0	264.0	162.0	118.9	59.2	(27.8%)
Discrete	1,323.8	1,020.9	194.9	24.0	0	0	0	
Total	3,200.0	3,650.0	3,200.0	2,400.0	1,800.0	1,200.0	700.0	(22.4%)

Source: Dataguest November 1989

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Figure 9





Table 7

#### Total VGA Implementations Estimated Worldwide History and Forecast (Thousands of Units)

								1987-1993
	1987	1988	1989	1990	1991	1992	<u>1993</u>	CAGR
Merchant	460.1	1,946.0	4,985.5	7,505.0	10,197.6	11,888.6	14,683.4	78.18
Captive	7.6	448.4	1,214.6	959.5	823.1	773.7	832.0	119.00
Proprietary	1,042.4	1,405.6	1,269.9	1,035.5	1,119.3	1,177.8	1,344.6	4.38
Discrete	0	0	0	0	0	0	0	
Total	1,510.0	3,800.0	7,470.0	9,500.0	12,140.0	13,840.0	16,860.0	49.5%
							Source: D	taquest

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#### High-End PC Graphics Forecast-All Applications

The Dataquest forecast for high-end PC graphics for all applications is presented in Figures 10 and 11 and Table 8. Points worth noting include the following:

- Unit shipments are growing at a CAGR of approximately 87 percent; ASPs are declining by about a 25 percent CAGR for the period 1987 through 1993. This allows revenue to grow at a CAGR of 96 percent. ASPs shown in Table 8 are for board-level products.
- The high-end market is not as mature as the low-end market. Volumes are still very low, and the cost to implement is complicated by the cost of monitors and is less influenced by chip prices.

#### High-End PC Graphics Forecast-IBM 8514/A and Compatibles

The Dataquest forecast for IBM 8514/A and compatible PC graphics is presented in Figures 12 and 13 and Table 9. ASPs shown in Table 9 are for board-level products. Points worth noting include the following:

- The 8514/A is expected to be the dominant standard for mainstream high-end PC applications.
- Several chip set vendors have announced plans to introduce 8514/Acompatible chip sets. One vendor has announced a product that will be a combination VGA and 8514/A chip that can be implemented on the motherboard. This opens the possibility for a shift from a board-level market to a chip market in the high end, as is occurring in the low-end market. Dataquest believes that this shift may become significant in the 1992 time frame, but no attempt has been made to forecast high-end chip level prices. Current 8514/A-compatible chip sets are selling in the range of \$89 to \$149.

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Figure 10





Figure 11





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#### Table 8

#### High-End PC Graphics—All Applications Estimated Worldwide History and Forecast

	<u>1987</u>	<u>1986</u>	<u>1989</u>	<u>1990</u>	L	<u>1991</u>		<u>1992</u>		<u>1993</u>	1987-1993 <u>Cagr</u>
Shipments (K Units)	111.0	194.9	410.3	933.0	1	,912.9	3	,499.7	4	,802.2	87.48
ASP	\$1,018	\$ 905	\$ 679	\$ 492	5	357	\$	232	\$	175	(25.4%)
Revenue (Millions of \$)	\$113.0	\$176.4	\$278.6	\$459.0	\$	682.9	\$	811.9	\$	840.4	39.74
Growth Rate		56.1%	57.94	64.8%		48.8%		18.91		3.54	

Source: Dataquest November 1989

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#### Figure 12

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Figure 13







#### High-End PC Graphics-IBM 8514/A and Compatibles Estimated Worldwide History and Forecast

	<u>1987</u>	1988	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	1987-1993 <u>Cagr</u>
Shipments								
(K Units)	9.0	60.0	164.1	438.5	1,052.1	2,099.8	3,121.4	165.1%
ASP	\$839	\$713	\$570	\$399	\$279	\$196	\$137	(26.18)
Revenue								
(Millions of \$)	\$7.6	\$42.8	\$93.5	\$175.0	\$293.5	\$411.6	\$427.6	96.0%
Growth Rate		466.5%	118.6%	87.14	67.84	40.2%	3,91	

Source: Dataquest November 1989

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#### FORECAST METHODOLOGY AND ASSUMPTIONS

The PC logic chip set forecast is derived from the Dataquest Personal Computer Industry Service (PCIS) PC forecast and from a survey of worldwide chip set vendors. Dataquest's new chip set forecast for 1989 through 1993 is derived as a function of saturation of the DOS PC market. The estimates for 1987 and 1988 are based on the chip set vendor survey and Dataquest analysis. The following is a summary of the significant assumptions made in these forecasts:

- The worldwide DOS PC market will continue to grow from 1989 through 1993 at a compound annual growth rate (CAGR) of approximately 13 percent.
- As a general trend, discrete chips are being displaced by very large scale integration (VLSI) ICs. In personal computers specifically, discrete logic chips are being replaced by logic chip sets. Because of the advantages that chip set use offers systems manufacturers—lower cost, better performance, faster time to market—this displacement has happened very rapidly.
- Average selling prices (ASPs) will fall in 1989 as a result of price competition. They will rise in 1990 as the introduction of EISA chip sets and increased penetration of the MCA chip sets shifts the product mix toward the high end. ASPs will then come down slowly through the rest of the period as price decreases are offset by the continued move in product mix toward the high end.

#### WORLDWIDE PC LOGIC CHIP SET FORECAST

Dataquest estimates 1988 worldwide PC logic chip set revenue to be \$399 million compared with the 1987 estimate of \$144 million. The forecast for 1989 is \$561 million. Dataquest's PC logic chip set revenue forecast is presented in Figure 1. The chip set unit forecast is shown in Figure 2. The data for these figures are given in Table 1.









Figure 2





Source: Dataquest June 1989

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#### Table 1

#### Worldwide PC Logic Chip Set Forecast (Millions of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	CAGR 1987-1993
DOS PC Shipments	9.6	12.3	13.8	15.4	17.1	18.7	20.6	13.6%
Chip Set Shipments Saturation	3.1 33%	8.0 65∿	12.7 92%	15.1 98%	16.9 99%	18.5 99%	20.4 99%	36.8%
Chip Set ASP	\$46.13	\$49.66	\$44.09	\$44.71	\$43.53	\$41.89	\$41.38	(1.8%)
Chip Set Revenue (\$M)	\$144	\$399	\$561	\$674	\$735	\$774	\$844	34.3%
Chip Set Revenue Growth		177.6%	40.5%	20.3%	9.0%	5.2%	9.1%	

Source: Dataquest June 1989

#### MARKET DYNAMICS

The CAGR for chip set unit shipments from 1987 to 1993 is approximately 37 percent, an attractive rate of growth to investors, which should entice them to seek ways to participate in this industry. However, because of the nature of the relationship between PC consumption and chip set consumption, it is important to look at the development of this market in terms of the product life cycle.

Figure 3 graphs shipments of chip sets against the shipments of DOS PCs. This shows the rapid growth of chip set shipments as they approach the level of PC shipments. Between 1987 and 1988, chip set shipments increased 158 percent. The CAGR for 1987 to 1990 is still almost 70 percent. In this same period, Dataquest estimates that the number of chip set vendors will increase from 6 to 23.

Dataquest believes that in 1990, the penetration of chip sets into PCs will likely approach saturation. By the end of 1989, the penetration is expected to be approximately 92 percent. At this point, the growth rate of chip set shipments will be tied directly to the growth rate of PC shipments. In fact, the CAGR for chip set shipments from 1989 to 1993 is only 12.6 percent. This level of growth should attract fewer new entrants and will cause some participants to exit the industry.

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Worldwide PC Logic Chip Set Forecast as Compared with the DOS PC Forecast



#### A CASE OF OVERCAPACITY

According to a Dataquest survey, worldwide logic chip set vendors expect to ship more than 15 million units in 1989. Table 2 lists the results of this survey along with Dataquest's estimated actual and forecast numbers for chip set and PC unit consumption for the period from 1987 through 1989. The vendors expect to ship 19 percent more than the forecast for chip sets in 1989 and 9 percent more than the forecast PC consumption.

The difference between the vendor's expectations and the Dataquest forecast might be explained by aggressive goal setting on the part of the vendors. One could argue also that some units will be shipped into inventory. It is clear, however, that more than enough capacity exists to satisfy the demand for chip sets, and new entrants to the industry are expected to aggravate this situation.

This analysis implies that the competition for market share in this industry is likely to lead to aggressive, if not predatory, pricing policies on the part of participants. Given the degree of standardization of these products, they will take on more of the attributes of a commodity, where pricing and service are the keys to success.

#### Table 2

#### Worldwide PC Logic Chip Set Vendor Survey Results (Millions of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>
DOS PC Consumption Forecast	9.5	12.3	13.8
DOS Chip Set Consumption Forecast	3.1	8.0	12.7
Vendor Estimated Chip Set Shipments	3.1	8.0	15.1
	So	urce: Da	ataquest
		J	une 1989

#### HIGHLIGHTS OF THE PC LOGIC CHIP SET FORECASTS

Dataquest forecasts the PC logic chip set market by bus architecture, microprocessor type, and speed grade by microprocessor type.

#### Forecast by Bus Architecture

The Dataquest chip set forecast by bus architecture is presented in Figure 4 and Table 3. Points worth noting about the bus architecture forecast include:

- The PC XT bus unit shipments are expected to peak in 1989 at about 4.5 million units, and then decline as the bus is phased out and displaced by low-end PC AT products. PC XT chip set unit shipments are expected to decline approximately 9 percent annually for the period of 1987 through 1993.
- The PC AT bus will remain the dominant architecture through the period, with a CAGR of 50.9 percent.
- The Micro Channel bus chip sets began shipping in 1988. The EISA bus chip sets are expected to be available in the second half of 1989. This gives the MCA bus a head start in the marketplace and will allow it to gain and hold a larger share of the high-end market.



Worldwide PC Logic Chip Set Forecast By Bus Architecture



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Worldwide PC Logic Chip Set Forecast by Bus Architecture (Thousands of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	CAGR 1987-1993
PC XT	1,829	3,988	4,476	3,279	2,481	1,658	1,039	(9.0%)
PC AT	1,287	3,986	8,015	9,720	11,419	13,230	15,165	50.9%
MCA	0	61	221	1,716	2,511	3,006	3,545	125.5%
EISA	0	0	8	370		572	654	203.4%
Total	3,116	8,035	12,720	15,085	16,895	18,466	20,403	36.8%

Source: Dataquest June 1989

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#### Forecast by Microprocessor Type

The Dataquest chip set forecast by microprocessor type is presented in Figure 5 and Table 4. Points worth noting about the microprocessor forecast include:

- The 8088/8086 segment parallels the PC XT bus decline, forecast to peak in 1989 and then gradually to be displaced by the 80286.
- The 80286 unit shipments are expected to peak in 1991 and then begin to decline. The 80386SX is expected to take share from the 80286, with the 80286 becoming the dominant low-end product, and the 80386SX moving into the dominant position as the midrange product by 1993.
- The 80386 shares the high-end segment with the 80486, which was introduced in April of this year. Dataquest believes that this will dampen the growth of the 80386 product, as the 80486 displaces the 80386 at the very high end of the market.

Figure 5

#### Worldwide PC Logic Chip Set Forecast By Microprocessor Type



Source: Dataquest June 1989

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#### Table 4

#### Worldwide PC Logic Chip Set Unit Forecast by Microprocessor Type (Thousands of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	CAGR <u>1987-1993</u>
8088	787	1,507	1,767	1,114	757	260	137	(25.3%)
8086	<u>983</u>	2,207	2,372	2,116	<u>1,732</u>	<u>1,398</u>	<u> </u>	(1,4%)
Total								
8088/8086	1,770	3,714	4,139	3,230	2,489	1,658	1,039	(8.5%)
80286	1,267	3,606	5,486	6,189	6,258	6,040	5,658	28.3%
80386	78	659	2,077	3,010	3,441	3,770	4,039	93.2%
80386SX	0	55	1,017	2,569	4,408	<u>6,191</u>	7,896	169.6%
Total								
80386 (All)	78	714	3,094	5,579	7,849	9,960	11,935	131.5%
80486	0	Q	0	86	<u> </u>	<u> </u>	1.771	1,109.3%
Total	3,115	8,034	12,719	15,084	16,895	18,465	20,403	36.8%

Source: Dataquest June 1989

#### Forecast by Speed Grade

The Dataquest PC logic chip set forecast of speed grades for all microprocessors is presented in Figure 6. The forecast for speed grades of individual microprocessors is presented in Figures 7 through 11. Data for these figures are presented in Table 5. Points worth noting about the speed forecast include:

- In general, the lower speed grades (8, 10 and 12 MHz) are only available on the older microprocessors (the 8088, 8086 and 80286). These older products are being displaced in the market by the newer designs, which will continue to cause a secular shift in the market mix away from the slower speed grades.
- As each microprocessor product approaches maturity, the speed grade profile approaches a more normal distribution. This is also true of the profile for the total of all microprocessors.
- In 1987, the median speed was 10 MHz. Dataquest believes that the median speed for all microprocessors currently is 12 MHz. By 1993, the median speed is expected to be 20 MHz.



Worldwide PC Logic Chip Set Forecast by Speed for All Microprocessors








#### Worldwide 8088/8086 PC Logic Chip Set Forecast By Speed





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Figure 8

Worldwide 80286 PC Logic Chip Set Forecast By Speed



#### Worldwide 80386SX PC Logic Chip Set Forecast By Speed





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#### Worldwide 80386 PC Logic Chip Set Forecast By Speed







Worldwide 80486 PC Logic Chip Set Forecast By Speed



#### Table 5

#### Worldwide PC Logic Chip Set Forecast by Speed (Thousands of Units)

<u>Speeds</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Units by Speed							
8088/8086							
8 MHz	589	754	857	388	124	0	0
10 MHz	<u>1,181</u>	<u>2,960</u>	3,282	2,842	<u>2,357</u>	1,658	<u>1,039</u>
Total	1,770	3,714	4,139	3,230	2,481	1,658	1,039
80286							
8 MHz	151	123	55	. 0	0	0	0
10 MHz	480	664	554	309	0	0	0
12 MHz	556	2,250	3,187	3,094	2,566	2,175	1,811
16 MHz	80	555	1,552	2,228	2,691	2,658	2,320
20 MHz	0	14	<u>137</u>	<u> </u>	<u>1,001</u>	1,208	<u>1,528</u>
Total	1,267	3,606	5,486	6,189	6,258	6,040	5,658
80386SX							
16 MHz	0	55	1,017	2,004	2,865	2,971	3,000
20 MHz	0	0	0	565	1,322	2,167	3,000
25 MHz	0	Ó	Ó	Ô	220	1,052	1,895
33 MHz	Q	_Q	0	0	0	0	0
Total	0°	55	1,017	2,569	4,408	6,191	7,896
80386						•	
16 MHz	78	349	415	0	0	0	0
20 MHz	0	310	1,454	1,204	860	754	606
25 MHz	0	0	125	1,505	1,376	1,319	1,212
33 MHz	_\$	<u></u> Q	83	301	<u>1,204</u>	1,696	<u>2,221</u>
Total	78	659	2,077	3,010	3,441	3,770	4,039

(Continued)

-



#### Table 5 (Continued)

#### Worldwide PC Logic Chip Set Forecast by Speed (Thousands of Units)

<u>Speeds</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
80486							
25 MHz	0	0	0	53	153	282	496
33 MHz	0	0	0	29	122	379	779
40 MHz	0	0	0	3	31	129	372
50 MHz	<u>0</u>	<u>0</u>	<u>0</u>	_0	0	<u>    16  </u>	124
Total	0	o	0	86	306	807	1,771
Speed Totals							
8 MHz	740	877	912	388	124	0	0
10 MHz	1,661	3,623	3,836	3,152	2,357	1,658	1,039
12 MHz	556	2,250	3,187	3,094	2,566	2,175	1,811
16 MHz	158	960	2,985	4,232	5,556	5,629	5,320
20 MHz	0	324	1,591	2,326	3,184	4,129	5,134
25 MHz	0	0	125	1,558	1,750	2,654	3,602
33 MHz	0	0	83	330	1,327	2,076	3,000
40 MHz	0	0	0	3	31	129	372
50 MHz	0	0	0	<u> </u>	0	16	124
Total	3,115	8,034	12,719	15,084	16,895	18,465	20,402

Source: Dataquest June 1989





#### **PRODUCT MARKET SHARE ANALYSIS**

The low-end PC graphics market is broken down into four implementations of the graphics solution: merchant chip sets, captive chip sets, proprietary chip sets, and non-VLSI implementations. Data in this section is presented in figure form to compare 1987 and 1988 actual with 1993 forecast data.

#### Low-End PC Graphics Market Shares by Implementation

The Dataquest estimates for the share of implementations, broken down by VLSI and non-VLSI, are presented in Table 1 and Figure 1. VLSI (chip set) implementations are expected to be used in about 86 percent of solutions by the end of 1989. The shift toward VLSI is expected to approach saturation in the 1992 time frame.

# Table 1Low-End PC Graphics Market Share by ImplementationEstimated Worldwide History and Forecast(Millions of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Total Chip Sets	46.7%	67.9%	86.0%	91.0%	95.0%	98.0%	99.6%
Merchant Chip Sets	49.0%	60.0%	69.0%	78.0%	82.8%	85.0%	86.5%
Captive Chip Sets	8.0%	14.2%	14.5%	10.0%	7.3%	5.8%	5.0%
Proprietary Chip Sets	43.0%	25.8%	16.3%	12.0%	9.9%	9.2%	8.5%
Non-VLSI Implementations	53.3%	32.1%	14.0%	9.0%	5.0%	2.0%	0.4%
Total Low-End Graphics Devices	9,2	11.1	13.7	14.3	15.8	16.4	18.3

Source: Dataquest November 1989



Low-End PC Graphics Market Share

Figure 1

VLSI versus Non-VLSI Implementations

Source: Dataquest November 1989

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The further breakdown of VLSI implementations into merchant, captive, and proprietary is presented in Figure 2. Merchant implementations are expected to account for 69 percent of all chip sets by the end of 1989 and 86.5 percent by 1993.



Low-End PC Graphics Chip Set Market Share by Implementation



#### Low-End PC Graphics Market Shares by Standard Type

The Dataquest estimates for market share by standard type are presented in Table 2 and Figure 3. VGA accounted for only 16.4 percent of the market in 1987 but is expected to rise to almost 55 percent by the end of 1989. By 1993, the low-end graphics market is expected to be about 92 percent VGA, with the older standards becoming obsolete.

#### Table 2

#### Low-End PC Graphics Market Share by Standard Type Estimated Worldwide History and Forecast (Millions of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
HGA	35.8%	23.4%	15.4%	13.6%	10.1%	7.3%	3.8%
CGA	13.0%	9.5%	6.6%	3.1%	1.9%	1.2%	0
EGA	34.8%	32.9%	23.4%	16.8%	11.4%	7.3%	3.8%
VGA	16.4%	34.2%	54.6%	66.4%	76.6%	84.2%	92.4%
Total Low-End Graphics Devices	9.2	11.1	13.7	14.3	15.8	16.4	18.3

Source: Dataquest November 1989











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#### Low-End PC Graphics Market Shares by Implementation within Standard Types

The Dataquest estimates for the different implementations for HGA are presented in Table 3 and Figures 4; for CGA, in Table 4 and Figure 5; for EGA in Table 5 and Figure 6; and for VGA, in Table 6 and Figure 7. This information reflects the same shift toward merchant chip set implementations within each type as is seen in the data for total implementations (Table 1).

#### Table 3

#### HGA Market Share by Implementation Estimated Worldwide History and Forecast (Thousands of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Merchant	0	0	3.5%	18.4%	30.6%	51.7%	63.0%
Captive	0	0	0.5%	3.4%	6.7%	5.5%	6.0%
Proprietary	6.0%	7.6%	13.0%	13.4%	13.0%	15.5%	20.0%
Discrete	94.0%	92.4%	83.0%	64.7%	49.7%	27.3%	11.0%
Total HGA Graphics Devices	3.3	2.6	2.1	2.0	1.6	1.2	0.7

Source: Dataquest November 1989



Figure 4

Estimated HGA Market Share by Implementation

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November 1989



#### Table 4

#### CGA Market Share by Implementation Estimated Worldwide History and Forecast (Thousands of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Merchant	33.8%	73.0%	87.0%	92.0%	92.0%	90.0%	0
Captive	10.0%	4.0%	7.0%	8.0%	8.0%	10.0%	0
Proprietary	16.0%	10.0%	6.0%	0	0	0	0
Discrete	40.2%	13.0%	0	0	0	0	0
Total CGA Graphics Devices	1.2	1.1	0.9	0.5	0.3	0.2	)¢

Source: Dataquest November 1989

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Estimated CGA Market Share by Implementation





#### Table 5

#### EGA Market Share by Implementation Estimated Worldwide History and Forecast (Thousands of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Merchant	38.8%	49.6%	70.9%	78.0%	83.0%	83.8%	86.6%
Captive	6.8%	15.9%	13.0%	10.0%	8.0%	6.3%	4.9%
Proprietary	13.1%	6.5%	10.0%	11.0%	9.0%	9.9%	8.5%
Discrete	41.3%	28.0%	6.1%	1.0%	0	0	0
Total EGA Graphics Devices	3.2	3.7	3.2	2.4	1.8	1.2	0.7
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Source: Dataquest November 1989

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Estimated EGA Market Share by Implementation



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Source: Dataquest November 1989



Table 6

#### VGA Market Share by Implementation Estimated Worldwide History and Forecast (Thousands of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Merchant	30.5%	51.2%	66.7%	79.0%	84.0%	85.9%	87.1%
Captive	0.5%	11.8%	16.3%	10.1%	6.8%	5.6%	4.9%
Proprietary	69.0%	37.0%	17.0%	10.9%	9.2%	8.5%	8.0%
Discrete	0	0	0	0	0	0	0
Total VGA Graphics Devices	1.5	3.8	7.5	9.5	12.1	13.8	16.9

Source: Dataquest November 1989

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Estimated VGA Market Share by Implementation





#### MERCHANT CHIP SET PRICING

The Dataquest estimates for average selling prices (ASPs) for merchant chip sets by standard type are presented in Table 7 and Figure 8. Points worth noting include the following:

- Prices are expected to drop sharply between 1989 and 1990. This is due to new vendors coming into the market and creating a situation of oversupply. Competition for VGA market share has driven prices for VGA chip sets down to the level of EGA prices, causing severe price erosion in EGA.
- The weighted average ASP for all merchant graphics chip sets is expected to continue to decline rapidly through 1993, approaching the prices of other commodity VLSI devices. As more high-volume, low-cost producers enter the market, pricing will be cost-based rather than market-based, as it has been until now.
- The ASP forecast was prepared by making assumptions about VGA manufacturing costs, expected premiums required to move up from one standard to the next, and by making comparisons to price trends in similar devices. As VGA becomes the dominant standard, the weighted average ASP begins to reflect VGA pricing.

#### Table 7

#### Low-End Merchant PC Graphics Chip Sets ASPs by Type Estimated Worldwide History and Forecast

	<u>1987</u>	1988	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	CAGR <u>1987–1993</u>
HGA			7.50	5.70	4.55	3.85	3.25	(18.9%)
Growth Rate				(24.0%)	(20.2%)	(15.4%)	(15.6%)	
CGA	12.00	11.10	10.26	7.25	5.45	4.05		(17.0%)
Growth Rate		(7.5%)	(7.6%)	(29.3%)	(24.8%)	(25.7%)	0	
FGA	27.63	20.98	18.44	9.25	6.50	4.90	3.95	(27.7%)
Growth Rate		(24.1%)	(12.1%)	(49.8%)	(29.7%)	(24.6%)	(19.4%)	
VGA	34.50	31.63	26.41	15.85	11.10	8.30	6.65	(24.0%)
Growth Rate		(8.3\)	(16.5%)	(40.0%)	(30.0%)	(25.2%)	(19.9%)	
Weighted Average	26.10	23.90	22.40	13.90	10.20	7.80	6.50	(20.8%)
ngigaves nierbyc		(8.6%)	(6.0%)	(38.0%)	(27.0%)	(23.3%)	(17.2%)	

Source: Dataquest November 1989

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Dollars 40-HGA • CGA 35 X EGA VGA + Weighted Average 30 25 20 15-10-5. 0 1992 1993 1988 1989 1990 1991 1987 Source: Dataquest November 1989 0005190-8

Figure 8

Low-End Merchant Graphics Chip Set ASP by Standard Type

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#### PRODUCT CHARACTERISTICS AND SEGMENTATION

Currently, PC graphics can be divided into two basic types of products: high end and low end. Essentially, the high-end product is an intelligent graphics controller, whereas the low-end product is a simple bit map or collection of memory.

The characteristics of the high-end graphics controller are as follows:

- It has a sophisticated (and high-level) command set for drawing while off-loading the system CPU.
- It may or may not allow direct access to the bit map--i.e., it may or may not allow the system CPU to go around the command set.
- It is capable of higher resolutions and performance.
- It is medium- to high-priced, and it is implemented on a separate add-on board or on the main CPU motherboard.

The high-end graphics segment contains products at the chip level that are sophisticated VLSI graphics coprocessors. These are devices such as the IBM 8514/A, TI TMS34010, Hitachi ACRTC, and Intel i82786. This segment also contains the board-level products that use these coprocessors.

Off-loading the host CPU from the drawing and font creation tedium directly results in an increase in graphics and overall system performance. However, along with the additional computing power comes the requirement for larger memory arrays due to the higher display resolution.

The characteristics of the low-end frame buffer are as follows:

- The system CPU does all graphics drawing; it is not equipped with a high-level command set.
- Essentially, it is a bit map with an addressing scheme.
- Performance at higher resolutions depends on the host CPU.
- It is low- to medium-priced, and it is implemented on a separate add-on board or on the main CPU motherboard.

Graphics systems have two characteristics that are reflected in hardware requirements: Large memories are required to support high-resolution displays, and a lot of computing power is required to generate complex graphic images.

Memory requirements increase with the square of the resolution (for example, a 1,000-line monochrome display without gray scale would require 1 million bits of memory storage, whereas a 2,000-line display would require 4 million bits of memory). A further complication is that for high-resolution displays, more bits must be read from memory in a shorter time. As the number of lines increases, the time available to display each line decreases, since all lines must be displayed within 1/60 of a second. In addition, as the number of lines increases, the number of bits per line also increases. The problem of reading more bits from memory in a shorter time can be solved by faster memories, or by reading more bits at a time, or both. The main point is that graphics displays are memory-intensive and are directly tied to advances in memory technology.

Rapid computation is the other critical factor in graphics applications. Vector information has to be converted to bit patterns and written into the display memory. This process requires a lot of computer power. For example, plotting a straight diagonal line given the end-point coordinates requires a multiplication for each pixel. Circles require a square-root computation for each point, and other shapes can require more complex computations. Special processor chips designed to execute such operations directly in hardware can greatly speed up the plotting process.

#### PC GRAPHICS STANDARDS: AN EVOLUTION IN RESOLUTION

The evolution of graphics adapters has lead us from the original Hercules Graphics Adapter (HGA) to the Video Graphics Array (VGA), which is now the standard on the IBM PS/2 line of computers. Between these two products have been several other graphics iterations such as the Color Graphics Adapter (CGA), the Multi-Color Graphics Adapter (MCGA), and the Enhanced Graphics Adapter (EGA). All of these display products are originations by IBM. Also, as they were improvements on one another, only a few are relevant to today's market requirements, as follows:

- HGA—The Hercules Graphics Adapter was conceived by Hercules Corporation as one of the first third-party add-on boards for the IBM PC. It is monochrome but offers a higher display resolution than the monochrome display adapter (MDA) introduced with the PC. The HGA card was first introduced in 1982. Technically, it fits near the bottom of the display resolution ranks. Though it is a long way from today's VGA products, the Hercules specification is upheld in backward compatibility within existing graphics products. The resolution for the HGA is 720 x 350 pixels.
- CGA—The Color Graphics Adapter was the first color specification after the monochrome Hercules adapter. CGA is very limited in its color offering but began life as an alternative to monochrome display solutions. The resolution for CGA is 320 x 200 pixels with 4 colors.

- EGA--The Enhanced Graphics Adapter builds on the CGA and increases the number of colors available at the same and higher resolutions. The resolution for EGA is 640 x 350 pixels with 16 colors.
- VGA--The Video Graphics Array is the first graphics standard to be included on the system board as an integral feature. VGA offers still higher resolution and more colors than EGA. The resolution for VGA is 320 x 200 pixels with 256 colors or 640 x 480 with 16 colors.

Table 8 presents the PC graphics standards and their various specifications, including enhancements.

#### Table 8

PC Graphics Standards and Specifications Including Common Enhancement Modes

Resolution	Colors
320 x 200	256
640 x 480	16
640 x 480	256
800 x 600	16
800 x 600	256
800 x 600	Monochrome
960 X 720	4
960 X 720	16
960 X 720	Monochrome
1024 x 768	2
1024 x 768	4
$1024 \times 768$	16
1024 x 768	Monochrome
1280 x 960	4
1280 x 960	Monochrome
640 x 350	16
640 x 480	16
320 x 200	4
640 x 200	2
640 x 400	Monochrome
720 x 350	Monochrome
	Resolution 320 x 200 640 x 480 640 x 480 800 x 600 800 x 600 960 X 720 960 X 720 960 X 720 960 X 720 1024 x 768 1024 x 768 1026 x 960 1280 x 960 1280 x 960 320 x 200 640 x 400 720 x 350

Source: Dataquest November 1989

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The following is a list of PC graphics chip set vendors:

- Acer Laboratories, Inc., USA 926 Thompson Place Sunnyvale, CA 94086 Phone: 408-733-3174 Fax: 408-733-2569
- Chips and Technologies, Inc. 3050 Zanker Rd. San Jose, CA 95134 Phone: 408-343-0600 Fax: 408-434-9315
- Cirrus Logic, Inc. 1463 Centre Pointe Dr. Milpitas, CA 95035 Phone: 408-945-8300
- Genoa Systems Corp.
  75 East Trimble Rd.
  San Jose, CA 95131
  Phone: 408-432-9090
  Fax: 408-434-0997
- Headland Technology, Inc. (formerly Video-7)
   46335 Landing Parkway
   Fremont, CA 94538
   Phone: 415-656-7800
   Fax: 415-656-0397
- Intel Corp.
  3065 Bowers Ave.
  Santa Clara, CA 95051
  Phone: 408-987-8080
- NSI Logic, Inc.
  259 Cedar Hill Rd.
  Marlboro, MA 01752
  Phone: 508-460-0717
  Fax: 508-460-0847
- Oak Technology, Inc. 139 Kifer Ct. Sunnyvale, CA 94086 Phone: 408-737-0888 Fax: 408-737-3838

- Trident Microsystems, Inc. 321 Soquel Way Sunnyvale, CA 94086 Phone: 408-738-3194 Fax: 408-738-0905
- Tseng Laboratories, Inc. 10 Pheasant Run Newtown, PA 18940 Phone: 215-968-0502 Fax: 215-860-7713
- United Microelectronics Corp. (UMC) 13th Floor, No. 687 Min-Sheng East Road Taipei, Taiwan, R.O.C. Phone: (02) 715-2455 Fax: (02) 716-6291
- Western Digital Imaging 800 East Middlefield Rd. Mountain View, CA 94043 Phone: 415–960–3353 Fax: 415–968–1974

#### **PRODUCT MARKET SHARE ANALYSIS**

The PC logic chip set product market share analysis is broken down by bus architecture, microprocessor type, speed, and region. In each case the data are presented in figure form for the comparison of 1987 actual with 1989 forecast, and in tabular form for 1987 through 1993.

#### Market Share by Bus Architecture

The Dataquest estimates for PC logic chip set unit market share by bus architecture are presented in Figure 1 and Table 1. Points worth noting include the following:

- The PC XT bus is expected to lose 24 points of market share from 1987 through 1989, going from 59 percent to 35 percent of all chip set shipments. By 1993, the PC XT bus is expected to slip to approximately 5 percent market share, being virtually displaced by the PC AT bus.
- The PC XT bus is losing market share to the PC AT bus, which is expected to gain 22 points of market share between 1987 and 1989, going from 41 percent to 63 percent of all chip set shipments. By 1993, the PC AT bus is expected to make up the bulk of the market, with about 74 percent of the chip set shipments.
- Dataquest believes that the EISA bus will not be successful in competing against MCA for the high-end PC market. No EISA products are available at this time, and when they do become available, they will be forever in a catch-up mode with MCA. The MCA bus currently has about 2 percent market share and is expected to make up about 17 percent of all chip set shipments by 1993.





Source: Dataquest June 1989

#### Market Share by Microprocessor Type

The Dataquest estimates for PC logic chip set unit market share by microprocessor type are presented in Figure 2 and Table 2. Points worth noting include the following:

- The 8088/8086 segment is expected to lose 23 points of market share between 1987 and 1989, going from 56 percent to 33 percent of all chip set shipments.
- The 80286 segment should grow slightly, from 41 percent to 43 percent of all chip set shipments. The 80286 will be losing share at the high end but will make up for it by displacing the 8088/8086 at the low end.
- The 80386 and 80386SX are the fastest-growing segments, displacing the 80286 segment at the high end. The 80386 is expected to go from 3 percent of all chip set shipments in 1987 to 16 percent in 1989.



#### Figure 2

Estimated PC Logic Chip Set Unit Market Share by Microprocessor Type

> Source: Dataquest June 1989

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#### Table 2

#### Estimated PC Logic Chip Set Market Share by Microprocessor Type (Percent Share)

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
8088	25.3%	18.8%	13.9%	7.4%	4.5%	1.4%	0.7%
8086	<u>31.5</u>	<u>27.5</u>	<u>18.7</u>	<u>14.0</u>	<u>10.3</u>	<u>7.6</u>	4.4
Total 8088/8086	56.8%	46.3%	32.6%	21.4%	14.8%	9.0%	5.1%
80286	40.7%	44.9%	43.1%	41.0%	37.0%	32.7%	27.7%
80386	2.5%	8.2%	16.3%	20.0%	20.4%	20.4%	19.8%
80386SX	0	0.7	8.0	17.0	26.1	<u>33.5</u>	<u>38.7</u>
Total 80386/							
80386SX	2.5%	8.9%	24.3%	37.0%	46.5%	53.9%	58.5%
80486	0	0	0	<u>0.6</u> %	<u>1.8</u> %	<u>4.4</u> %	<u>8.7</u> %
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest June 1989

#### Market Share By Speed Grade

The Dataquest estimates for PC logic chip set unit market share by speed grade for all chip sets are presented in Figure 3. The estimates for speed grades by individual microprocessor are presented in Figures 4 through 6. Data for these figures are presented in Table 3. Points worth noting include the following:

- In general, we expect lower speed grades in each segment to be phased out as higher speed grades are introduced. This will cause a secular shift in the speed profile for all microprocessors toward higher speeds.
- In 1987, 10-MHz chip sets accounted for more than half of all chip set shipments. By 1989, the median is expected to be 12 MHz. Dataquest estimates that the median will step up approximately one speed grade every two years, reaching 20 MHz by 1993.

Figure 3



Estimated PC Logic Chip Set Unit Market Share by Speed for All Microprocessors



#### Estimated PC Logic Chip Set Unit Market Share by Speed for 8088/8086 Microprocessors



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Figure 5

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#### Table 3

#### Estimated Worldwide PC Logic Chip Set Unit Market Share by Microprocessor by Speed (Percent Share)

Speed	<u>1987</u>	<u>1988</u>	<u>1989</u>	1990	<u>1991</u>	<u>1992</u>	<u>1993</u>
Units by Speed							
8088/8086 .							
8 MHz	33.3	20.3	20.7%	12.0%	5.0%	0	0
10 MHz	66.7	<u>_79.7</u>	79.3	88.0	95.0	<u>100.0</u> %	<u>100.0</u> %
Total	100.0%	100.0	100.0	100.0%	100.0%	100.0%	100.0%
80286							
8 MHz	11.9%	3.4%	1.0%	0	0	0	0
10 MHz	37.9	18.4	10,1	5.0%	Ō	0	Ó
12 MHz	43.9	62.4	58.1	50.0	41.0%	36.0%	32.0%
16 MHz	6.3	15.4	28.3	36.0	43.0	44.0	41.0
20 MHz	<u>، مار</u>	0.4	2.5	_9.0	16.0	20.0	27.0
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0
80386SX							
16 MHz	0	100.0%	100.0%	78.0%	65.0%	48.0%	38.0%
20 MHz	0	0	0.0	22.0	30.0	35.0	38.0
25 MHz	0	0	0.0	0	5.0	17.0	24.0
33 MHz	Q	0	0.0	0	0	0	0
Total	0	100.0%	100.0%	100.0	100.0	100.0%	100.0%
80386							
16 MHz	100.0	53.0%	20.0	0	0	0	0
20 MHz	0	47.0	70.0	40.0%	25.0%	20.0	15.0%
25 MHz	ò	0	6.0	50.0	40.0	35.0	30.0
33 MHs		0	4.0	10.0	35.0	45.0	<u>_\$5.0</u>
Total	100.0%	100.0%	100.0%	100.0	100.0%	100.0	100.0%
80486							
25 MHz	0	0	75.0	62.0%	50.0%	35.0%	28.0%
33 MHz	Ó	0	25.0	34.0	40.0	47.0	44.0
40 MHz	0	0	0	4.0	10.0	16.0	21.0
SO MH2	Q	Q	0	0	<u>0</u>		
Total	a	0	100.0	100.0%	100.0	100.0%	100.0%
Speed Totals							
8 MHs	23.8	10.95	7.2%	2.6%	0.7%	0	0
10 MHz	53.3	45.1	30.2	20.9	14.0	9.0%	5.1%
12 MHz	17.9	28.0	25.1	20.5	15.2	11.8	8.9
16 MHz	5.1	11.9	23.5	28.1	32.9	30.5	26.1
20 MHz	0	4.0	12.5	15.4	18.8	22.4	25.2
25 MHz	0	0	1.0	10.3	10.4	24.4	17.7
33 MHz	0	0	0.7	2.2	7.9	11.2	14.7
40 MHz	0	0	0	0	0.2	0.7	1.8
50 MHz	<u> </u>	0	0	0	0	<u>0.1</u>	6
Total	100.0%	100.0%	100.0%	100.0	100.0	100.0%	100.0N

Source: Dataquest June 1989

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#### Market Share By Region of Consumption

The Dataquest estimates for PC logic chip set unit market share by region of consumption for all chip sets are presented in Figure 7 and Table 4. Points worth noting include the following:

- The Asia/Pacific region accounted for 62 percent of all chip set consumption in 1987 and is expected to account for 49 percent in 1989. The high Asian consumption should be no surprise and simply reflects the high concentration of clone PC manufacturers in Asia. The decrease in Asian consumption is reflected in an increase in consumption by the North America and Japan regions.
- North America consumed 21 percent of all chip sets in 1987. Dataquest expects North American market share to rise to 29 percent in 1989. This increase is believed to be caused partly by U.S. manufacturers gradually shifting the onshore and offshore production mix toward increased domestic manufacturing. Also, evidence indicates that some non-U.S. PC manufacturers are shifting a portion of their production to the United States.
- Japan's consumption is expected to increase from 4.2 percent share to 9.4 percent between 1987 and 1989. We believe that this reflects wider penetration and acceptance of PC use in Japan, and we expect to see a continuation of this trend.



Figure 7

#### Estimated Worldwide PC Logic Chip Set Unit Consumption by Region

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#### Table 4

#### Estimated Worldwide PC Logic Chip Set Unit Shipments by Region (Thousands of Units)

	<u>1987</u>	<u>1988</u>	<u>1989</u>
North America	648	2,041	3,663
Share	20.8%	25.4%	28.8%
Japan	131	450	1,196
Share ·	4.2%	5.6%	9.4%
Western Europe	361	667	1,297
Share	11.6%	8.3%	10.2%
Asia Pacific	1,919	4,636	6,270
Share	61.6%	57.7%	49.3%
Rest of World	. 56	241	293
Share	1.8%	3.0%	2.3%
Total	3,115	8,034	12,719

Source: Dataquest June 1989

#### PRICING

#### Average Selling Price Analysis and Forecast

The Dataquest estimates for average selling prices (ASPs) for all chip sets and for chip sets by bus architecture are presented in Figure 8 and Table 5. Points worth noting include the following:

- ASPs rose by 7.7 percent between 1987 and 1988, as a result of the increased share of the higher-priced PC AT products and the fact that the PC AT ASPs rose as the mix moved toward higher-priced, higher-speed chip sets.
- Dataquest believes that ASPs will fall by about 11 percent from 1988 to 1989, as a result of new vendors entering the market, creating pricing pressure as they compete for market share.
Dataquest expects ASPs to rise slightly in 1990 as the introduction of EISA chip sets and increased penetration of the MCA chip sets shifts the product mix toward the high end. ASPs will then come down slowly through the rest of the period as price decreases are partially offset by the continued move in product mix toward the higher-priced high-end products.



Figure 8

#### PC Logic Chip Set Average Selling Price Forecast

Source: Dataquest June 1989

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Table	5
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#### PC Logic Chip Set Average Selling Price Forecast (Dollars)

							CAGR
<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1987 to 1993</u>
\$39.84	\$ 35.07	\$ 25.87	\$15.85	\$12.90	\$11.92	\$11.42	(18.8%)
	(12.0%)	(26.2%)	(38.7%)	(18.6%)	(7.6%)	(4.2%)	
\$55.07	\$ 62.23	\$ 52.08	\$43.12	\$38.71	\$35.25	\$33.76	(7.8%)
	13.0%	(16.3%)	(17.2%)	(10.2%)	(8.9%)	(4.2%)	
	\$182.84	\$124.83	\$98.80	\$88.45	\$81.40	\$77.35	(15.8%)
		(31.7%)	(20.9%)	(10.5%)	(8.0%)	(5.0%)	•
			\$91.29	\$81.20	\$74.80	\$70.80	(8.1%)
				(11.1%)	(7.9%)	(5.3%)	
\$46.13	\$ 49.66	\$ 44.09	\$44.71	\$43.53	\$41.89	\$41.38	(1.8%)
	7.7%	(11.2%)	1.4%	(2.6%)	(7.6%)	(4.2%)	
	<u>1987</u> \$39.84 \$55.07 \$46.13	1987       1988         \$39.84       \$35.07         \$12.0%       \$62.23         \$55.07       \$62.23         \$182.84         \$46.13       \$49.66         7.7%	1987       1988       1989         \$39.84       \$35.07       \$25.87         (12.0%)       (26.2%)         \$55.07       \$62.23       \$52.08         13.0%       (16.3%)         \$182.84       \$124.83         (31.7%)         \$46.13       \$49.66       \$44.09         7.7%       (11.2%)	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$

Source: Dataquest June 1989

#### **Product Characteristics**

#### **Technical Areas of Product Competition**

For the most part, the configuration and technical aspects of these products is transparent to the end-user because a great deal of standardization in both form factor and function exists at the systems level. To a large degree, this also is true at the OEM level. The performance and functionality of a given chip set family are highly specified, which means that it becomes difficult for vendors to differentiate their products. Dataquest believes that these products will become standardized to the point where they may be considered commodities. The competition for these products will then be based more on pricing and support than on technical differentiation.

The general product characteristics for PC logic chip sets are integration, compatibility, memory support, and performance. Descriptions of these characteristics are as follows:

- Integration—Products will vary both in the level of integration and in the design or layout of the integrated functions.
  - The number of chips in the chip set is one aspect of integration. Vendors have been working toward higher integration and have been lowering the number of chips per set. Newer designs have fewer chips, but many older designs with less integration still are available. Currently, PC XT chip sets are available with from one to four chips. PC AT chip sets have from two to seven chips and MCA chip sets range from three to seven.
  - The number of nonmemory chips required to implement the system, other than those in the chip set, also is an aspect of the integration level. The amount of nonmemory chips required in newer designs has come down too, but a wide range still exists. PC XT designs are available that require from 12 to 58 nonmemory chips for implementation. The range for PC AT designs is 5 to 40, and the range for MCA is 29 to 98.
- Compatibility--Chip sets must be compatible with various hardware and software. Hardware compatibility means accepting both peripheral devices and add-in cards. Software compatibility is required for the operating systems and applications.
- Memory Support—The chip set must support some board level memory, with the typical configurations being 256KB, 1MB, and 4MB memory modules. Extended memory support through Paged Interleave or EMS is a typical feature. The design of the chip set also will determine the performance of the system, given a certain DRAM speed. Better implementations will require slower and less expensive DRAMs to achieve higher performance.
- Performance—Within a product family it is the technology of manufacture, the design and efficiency of integration, the compatibility of the chip set, and the system implementation that will determine the overall level of performance of a product.

#### PRODUCT FAMILIES AND SUPPLIER MATRIX

The chip set product families break down along bus types. The PC XT is at the low end of the market. This product, being the older technology and perhaps the easier to implement, was used as an entry point by some vendors entering the market in 1986 and

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1987. All of these vendors have since gone on to introduce products in the PC AT family. Anticipating the decline of the PC XT segment, some entrants to the market in 1988 and 1989 did not offer an XT product; instead, they entered in the midrange of the market using the PC AT as an entry point. Only six vendors offer products on the MCA family, which is at the high end of the market. No EISA products are available at this time, but Dataquest expects several vendors to offer EISA chip sets by the fourth quarter of 1989 or the first quarter of 1990. Table 6 is a product family vendor matrix.

#### Table 6

#### PC Logic Chip Set Product Family Vendor Matrix

	PC XT	PC XT	PC AT	PC AT	PC AT	MCA	MCA	MCA	
<u>Vendor</u>	8088/8086	<u>80286</u>	<u>80286</u>	<u>80386SX</u>	<u>80386</u>	<u>80286</u>	<u>80386SX</u>	<u>80386</u>	<u>Other</u>
ACC Micro- electronics	x		x	X	x	x	x		
Acer Labs	x		х		x				
Chips & Technology	×	x	x	x	x	x		x	
ERSO			x			x			
G2	x		x	х	x	x	x	x	
GS Technology			x						
Intel			x	x	x		x	x	
Oak Technology	x		x	x					
Texas Instruments			x						
UMC	x		x		x				
Vadem									PC/XT 80C186
VIA Technologie:	5		x	х	x				
VLSI Technology. Inc.	, x		x	x	x				
Western Digital. Faraday	′ <b>x</b>		x	x		x	x	x	
Zymos	x		x	x	x				

Source: Dataquest June 1989

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PC logic chip set vendors include the following:

- ACC Microelectronics Corp. 3295 Scott Blvd., Suite 400 Santa Clara, CA 95954 Phone: 408–980–0622 Fax: 408–980–0626
- Acer Laboratories, Inc., USA 926 Thompson Place Sunnyvale, CA 94086 Phone: 408-733-3174 Fax: 408-733-2569
- Chips and Technologies, Inc. 3050 Zanker Road San Jose, CA 95134 Phone: 408-434-0600 Fax: 408-434-9315
- Electronic Research and Service Organization (ERSO) 315 Song Chiang Rd., 8th Floor Taipei 10477, Taiwan, R.O.C. Phone: (02) 502-8212 Fax: (02) 502-8795
- Faraday Electronics, Inc. Division of Western Digital 2801 Southeast Main Street Irvine, CA 92714 Phone: 714-757-4250 Fax: 714-553-1904
- GS Technology 201 Ravendale Ave. Mountain View, CA 94043 Phone: 415-968-6081 Fax: 415-964-9747
- Headland Technology, Inc. (formerly G2) 46335 Landing Parkway Fremont, CA 94538 Phone: 415-656-7800 Fax: 415-656-0397
- Intel Corp.
   3065 Bowers Ave.
   Santa Clara, CA 95051
   Phone: 408-987-8080

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- Oak Technology, Inc. 139 Kifer Court Sunnyvale, CA 94086 Phone: 408-737-0888 Fax: 408-737-3838
- United Microelectronics Corp. (UMC) 13th Floor, No. 687 Min-Sheng East Road Taipei, Taiwan, R.O.C. Phone: (02) 715-2455 Fax: (02) 716-6291
- Vadem

   1885 Lundy Ave.
   San Jose, CA 95131
   Phone: 408-943-9301
   Fax: 408-943-9735
- VIA Technologies, Inc. 4160B Technology Drive Fremont, CA 94538 Phone: 415-651-2796 Fax: 415-659-9057
- VLSI Technology, Inc. 10220 South 51st Street Phoenix, AZ 85044 Phone: 602–893–8574 Fax: 602–893–0807
- Zymos Corp. 477 N. Mathilda Ave. Sunnyvale, CA 94086 Phone: 408-730-5400 Fax: 408-730-5456

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#### MARKET SHARE ANALYSIS

The market share data figures and tables for merchant PC graphics chip set vendors for 1987 and 1988 are organized as follows:

- Figure 1 Estimated Low-End PC Graphics Merchant Chip Set Revenue Market Share by Manufacturer
- Table 1Estimated Low-End PC Graphics Merchant Chip Set Revenue Market<br/>Share and Rank (Millions of Dollars)
- Figure 2 Estimated Low-End PC Graphics Merchant Chip Set Unit Market Share by Manufacturer
- Table 2Estimated Low-End PC Graphics Merchant Chip Set Unit Market Share<br/>and Rank (Millions of Units)
- Figure 3 Estimated Merchant CGA Chip Set Unit Market Share by Manufacturer
- Figure 4 Estimated Merchant EGA Chip Set Unit Market Share by Manufacturer
- Figure 5 Estimated Merchant VGA Chip Set Unit Market Share by Manufacturer
- Table 3Estimated Low-End PC Graphics Chip Set Unit Market Share by<br/>Graphics Standard Type (Thousands of Units)

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Figure 1

Estimated Low-End PC Graphics Merchant Chip Set Revenue Market Share by Manufacturer

Table 1

#### Estimated Low-End PC Graphics Merchant Chip Set Revenue Market Share and Rank (Millions of Dollars)

Rank			19	88	1987	
1988	1987	Vendor	Share	Revenue	Share	Revenue
1	2	Westerm Digital	29.7%	32.1	12.4%	6.8
2	l	Chips and Technologies	25.3	27.3	68.5	37.7
3	3	Cirrus Logic	20.0	21.6	9.2	5.1
4	4	Tseng Labs	13.4	14.5	7.9	4.3
5	N/A	Headland Technology	7.9	8.5	N/A	N/A
•		Other	3.7	4.0	2.0	<u>    1.1</u>
		Total	100.0%	\$108.1	100.0%	\$55.0

N/A = Not Applicable

Note: Some columns may not add to totals shown because of rounding.

Source: Dataquest November 1989

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Figure 2

Estimated Low-End PC Graphics Merchant Chip Set Unit Market Share by Manufacturer

#### Table 2

#### Estimated Low-End PC Graphics Merchant Chip Set Unit Market Share and Rank (Millions of Units)

R	ank		1988	1987
1988	1987	Vendor	Share	<u>Share</u>
1	2	Western Digital	39.8%	26.9%
2	1	Chips and Technologies	22.3	53.7
3	3	Tseng Labs	15.1	9.7
4	4	Cirrus Logic	11.2	7.3
5	N/A	Headland Technology	6.3	N/A
3.70		Other	5.3	2.4
		Total	100.0%	100.0%
		Total Units	4.5	2.1

N/A = Not Applicable

Source: Dataquest November 1989

0005191

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SIS Microcomponents 0005191

**Estimated Merchant VGA Chip Set** Unit Market Share by Manufacturer Western Digitai Headland 11.5% -+ 18.7% 7.3% Tseng Labs Teeng Labs 5.3% Others 2.0% Chips and Technologies 28.2% Cirrus Logic 94.7% Cirrus Logic 32.3% 1988 1987 1.9 Million Units 0.46 Million Units Source: Dataquest November 1989 0005191-6

Figure 5

SIS Microcomponents 0005191 5

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#### Table 3

#### Estimated Low-End PC Graphics Chip Set Unit Market Share by Graphics Standard Type (Thousands of Units)

	R;	ank 📃		1988	1987
<u>Standard</u>	<u>1988</u>	<u>198</u> 7	<u>Vendor</u>	<u>Share</u>	<u>Share</u>
CGA	1	1	Western Digital	84.5%	100.0%
	2	2	Acer Laboratories	11.5	N/A
			Other	4.0	<u>N/A</u>
			Total	100.0%	100.0%
			Total Units	767.0	405.0
EGA	1	3	Western Digital	38.4%	9.5%
	2	l	Chips and Technologies	26.4	74.3
	2	2	Tseng Labs	26.4	12.8
	3	N/A	Headland Technology	4.9	N/A
			Other	<u>    3.9</u>	3.4
			Total	100.0%	100.0%
			Total Units	1,812.0	1,242.0
VGA	1	1	Cirrus Logic	32.3%	94.7%
	2	N/A	Chips and Technologies	28.2	N/A
	3	N/A	Western Digital	18.7	N/A
	4	N/A.	Headland Technology	11.5	N/A
	5 '	2	Tseng Labs	7.3	5.3
			Other	2.0	<u>N/A</u>
			Total	100.0%	100.0%
			Total Units	1,946.0	460.0

N/A = Not Applicable

Source: Dataquest November 1989

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#### MARKET SHARE ANALYSIS

The market share data tables and figures for PC logic chip set vendors for 1987 and 1988 are organized as follows:

- Figure 1 Estimated PC Logic Chip Set Revenue Market Share by Manufacturer
- Table 1
   Estimated PC Logic Chip Set Revenue, Market Share, and Rank
- Figure 2 Estimated PC Logic Chip Set Unit Market Share by Manufacturer
- Table 2Estimated PC Logic Chip Set Unit Market Share and Rank
- Figure 3 Estimated PC Logic Chip Set Unit Market Share by Manufacturer for PC XT Bus
- Figure 4 Estimated PC Logic Chip Set Unit Market Share by Manufacturer for PC AT Bus
- Figure 5 Estimated PC Logic Chip Set Unit Market Share by Manufacturer for MCA Bus
- Table 3Estimated PC Logic Chip Set Unit Market Share and Rank by Bus<br/>Architecture

#### Figure 1

Estimated PC Logic Chip Set Revenue Market Share by Manufacturer



1987 Total Revenue = \$144 Million



Total Revenue = \$399 Million

0003948-1

Source: Dataquest June 1989

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#### Table 1

#### Estimated PC Logic Chip Set Revenue, Market Share, and Rank (Millions of Dollars)

Ra	ank		198	8	198	7
<u>1988</u>	1987	Vendor	Revenue	Share	Revenue	Share
1	2	Chips and Technologies	\$112	28.1%	\$ 37	25.7%
2	3	Acer Laboratories	86	21.5	29	20.2
3	1	Western Digital	63	15.7	46	31.9
4	4	VLSI Technology	50	12.6	18	12.5
5	N/A	G2	19	4.8	N/A	0
6	5	ERSO	19	4.7	5	3.5
7	6	ZyMOS	18	4.5	4	2.8
		Other	32	8.0	5	3.5
		Total	\$399	100.0%	\$144	100.0%
N/A =	Not Ava	ilable				

Source: Dataquest June 1989

Figure 2

#### Estimated PC Logic Chip Set Unit Market Share by Manufacturer



3.1 Million Units

0003948-2

Source: Dataquest June 1989

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Table	2
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Estimated PC Logic Chip Set Unit Market Share and Rank

Unit Sha	are <u>Rank</u>		1988	1987
<u>1988</u>	<u>1987</u>	<u>Vendor</u>	<u>Share</u>	<u>Share</u>
1	2	Chips and Technologies	25.2%	19.1%
2	1	Acer Laboratories	24.7	32.1
3	1	Western Digital	14.8	32.1
4	3	VLSI Technology	9.9	9.6
5	5	ZyMOS	6.3	3.1
6	4	ERSO	4.9	3.2
7	N/A	G2	3.8	N/A
		Other	10.4	<u>    0,8</u>
		Total	100.0%	100.0%

N/A = Not Available

Source: Dataquest June 1989

Figure 3

Estimated PC Logic Chip Set Unit Market Share by Manufacturer for PC XT Bus



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Source: Dataquest June 1989

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Figure 4

Estimated PC Logic Chip Set Unit Market Share by Manufacturer for PC AT Bus





1987 1.3 Million Units

4

0003948-4

Source: Dataquest June 1989

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Figure 5

Estimated PC Logic Chip Set Unit Market Share by Manufacturer for MCA Bus

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#### Table 3

#### Estimated PC Logic Chip Set Unit Market Share and Rank by Bus Architecture

	<u>Unit Sha</u>	<u>are Rank</u>		1988	1987
<u>Bus</u>	<u>1988</u>	<u>1987</u>	Vendor	<u>Share</u>	<u>Share</u>
PC XT	1	1	Acer Laboratories	66.2%	59.7%
	2	2	Western Digital	26.4	38.8
			Other	<u>7.4</u>	<u>1.5</u>
Total		•		100.0%	100.0%
PC AT	1	1	Chips and Technologies	40.3%	41.3%
	2	3	VLSI Technology	15.1	20.8
	3	5	Zymos	10.1	6.6
	4	4	ERSO	7.9	6.9
	5	2	Western Digital	7.1	24.3
	6	N/A	GS Technology	5.9	N/A
	7	N/A	G2	5.7	N/A
			Other	<u>    7.9</u>	<u>0.1</u>
Total				100.0%	100.0%
Micro Channel	1		Western Digital	74.1%	
	2		Intel	25.9	
Total				100.0%	

N/A = Not Available

Source: Dataquest June 1989

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#### WHAT'S THE NEXT PC GRAPHICS STANDARD?

It is a tradition in the IBM environment that a new-and-improved graphics hardware standard comes into vogue every two years. Though the video graphics array (VGA) is the current fashion, the next style is being readied, and the stakes are high for the winner. The main contenders are IBM and third-party IBM-compatible vendors, third-party Texas Instruments-compatible vendors, and, to a lesser extent, vendors of enhanced VGA products.

Texas Instruments (TI) contends that boards based on its 34010 chip are the best choice because it offers the best performance at a low price and has good software support. Although it does offer good price, performance, and compatibility, it is unclear why the market needs something other than the de facto IBM standard. Dataquest believes that, even though TI may serve a high-performance niche in specialized PC graphics markets, its push into the mass market may further confuse the user.

There is a coalition called VESA (for Video Electronics Standards Association) that wants to market standardized medium-resolution (800 x 600) products. Basically, this is a VGA-type market, with enhancements, and should have moderate success, distinct from the TI or IBM standards.

The IBM standard is based on its 8514/A graphics board, which was introduced in 1987, but is only now beginning to show impressive results. It is clearly the de facto standard for high resolution on IBM's PS/2 machines. Chip vendors are already offering 8514/A-compatible products. TI is competing with third-party 8514/A vendors for this market. Dataquest believes that the 8514/A-type products are most suited for the next-generation mainstream graphics market.

#### STANDARDS IN THE IBM ENVIRONMENT

A graphics hardware standard allows a world of software to run on a family of machines from various vendors. The need for consistent display standards is acute in the IBM environment, where improvements in special resolution and number of colors is a constant but problematic process (unlike the Macintosh environment, where resolution density is fixed and the QuickDraw standard has been unwavering).

Under IBM, there have been two standards: the enhanced graphics adapter (EGA) standard was introduced in 1984 and was superseded in 1987 by the introduction of the VGA. The EGA was the best-selling product until 1988; now the VGA is the dominant standard. But there is considerable lag between when a standard is first introduced and its widespread availability and use. This lag is a result of the following requirements:

- Widespread software support
- Availability of third-party graphics chips, boards, and monitors

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- Readiness of the distribution channel
- Acceptance by the user community

We expect the VGA to continue to be the best-selling product for the foreseeable future, although the next standard after VGA will build up momentum over the next 18 months.

There is a historical trend worth noting that follows the introduction of a new graphics standard by IBM. The steps are as follows:

- Phase I—IBM introduces a new graphics standard.
- Phase IIA—Third-party vendors introduce a semicompatible product.
- Phase IIB——Third—party vendors introduce a fully compatible product.
- Phase IIC--Third-party vendors introduce a fully compatible, but enhanced, version.
- Phase III—The original standard becomes a full commodity product.
- Phase IV--A new graphics standard is introduced.

This cycle can take about three years. In terms of current standards, the industry is at about Phase III with the VGA and Phase IIB with the 8514/A. However, there is still considerable argument with regard to the acceptance of the 8514/A as the next standard after VGA, from certain camps that have alternative products to sell.

#### **Current Situation of Standards**

According to the trade press and third-party vendors, there are arguments among various camps regarding the next standard after VGA. Discussions of the camps follow.

#### The TI 34010/34020 TIGA

The Texas Instruments Graphics Architecture, or TIGA, is a new software interface from TI that will run on its 34010/34020 graphics processors. It will allow software written to the TIGA standard to run on any TI 34010/20-based graphics board that has been made TIGA compatible. This works as follows:



TI is promoting the above scheme as the next-generation mainstream graphics standard, as opposed to IBM's 8514/A standard.

#### IBM's 8514/A

The 8514/A is IBM's  $1,024 \times 768$  resolution add-on board, and is based on proprietary VLSI parts. Software writes to the 8514/A as follows:



#### Third-Party Consortium's VESA

VESA is a screen-addressing scheme from a consortium of third-party graphics vendors. The scheme is an extension of IBM's VGA standard for offering resolution higher than that offered on VGA, at 16 or 256 colors. It is intended as an interim step between the basic VGA (640 x 480 resolution, 16 colors) and the next 1,024 x 768 resolution standard. The consortium consists of graphics board, chip, and monitor vendors.

Each of these standards can support interlaced or noninterlaced screens, which is irrelevant to the applications software or graphics standard.

#### THE STANDARDS BATTLE: 8514A, TIGA, AND VESA

Which one of the above standards or proposals is going to be the mainstream standard of the next few years?

To begin with, the VESA proposal is only an interim scheme that is to be used mainly with the current generation of  $800 \times 600$  resolution-type multisynch monitors, and, in our view, it is not a long-term solution for  $1,024 \times 768$  screens. The VESA proposal is acceptable for allowing enhanced VGA boards (which are mainly nonintelligent in nature) to come under one standards umbrella. The real battle is for an intelligent or processor-based  $1,024 \times 768$  graphics standard, the two contenders for which are TI and IBM.

#### TI versus IBM

In Dataquest's view, there are four important fronts in the battle over the next graphics standard:

- Performance
- Compatibility

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- User frustration
- Price

#### Performance

Historically, performance has been the most misused and abused area of comparison in all categories of graphics hardware before PC graphics—and this is again true in the current PC graphics battleground. Graphics performance numbers tend to be used like many statistics; that is, they are creatively selected and tailored to support any cause. So PC graphics performance numbers must be taken with a grain of salt. In general, however, several points can be safely observed:

- TI 34010 (and the resulting board) is a midrange to high-performance part. But being software-programmable as a general-purpose processor, it does not have the very high performance of a special-purpose processor hardwired to perform a specific function. The 34020 will be significantly faster--as will be the second iterations of competing parts.
- The IBM 8514/A chip set is a midrange part, specifically optimized for high performance in the IBM PC environment. It offers at least comparable, and often better, performance in the three important areas of BITBLT, line drawing, and character support.

The fundamental difference between the two competing parts is that, although the IBM part is hardwired to perform a limited set of functions quickly, it pays for this by not being as flexible as a general-purpose processor.

On the other hand, the TI part is a general-purpose, software-programmable microprocessor, which is why it is also usable in print controllers and fax machines. But it pays for this flexibility in raw drawing speed. (The old "no free lunch" principle—even the ill-fated, hardwired Intel 80786 was faster in some areas.)

The raging debate and hype (particularly from the TI camp) is that one part guarantees better performance than the other. We believe that the two parts are more similar in performance than dissimilar. Each is faster in some areas (TI does not own performance, although that is the message in the media), and each is expected to enhance its performance in the future. Furthermore, it would be naive to assume that third-party 8514/A parts will not be able to offer comparable performance in many cases and better performance in others.

Performance improvement is an ongoing process, provided one starts with a reasonable architecture, which is true for TI and IBM.

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#### Compatibility

The fundamental mandate is to be compatible with all software written for the MS-DOS and OS/2 market at  $1,024 \times 768$  resolution. This can be achieved in a number of ways:

- Be TI/TIGA compatible, and hope that most future software will support TIGA either directly or under Windows and Presentation Manager (PM). This is a reasonable assumption.
- Be IBM 8514/A compatible, either directly or through Windows/PM. This is a good bet because we expect the 8514/A to become a de facto standard.

#### The User Frustration Factor

Although TI is doing a very good job of eliciting software support for TIGA, there can be little doubt about the support IBM will continue to command. It would appear that the question is which product is expected to have the most support. But even if the answer is IBM's 8514/A, there is a larger question with regard to what we call the UFF, or the user frustration factor.

Dataquest believes that the aggravating incompatibilities in the PC environment make the PC less friendly to the average user than the Macintosh environment. Do users really need yet another standard? If vendors continue to muddy the waters with competing standards—in order to sell hardware at the expense of user friendliness—will the IBM platform <u>ever</u> be as friendly as the Mac?

#### Ргісе

The TI 34010 costs approximately \$20 to \$40. The 8514/A parts from clone vendors are expected to be priced in the same range, although it will be higher at first. (This price is a small premium over VGA prices). Although the prices are similar for the graphics engine, what is different is the glue logic required for the finished board and its associated cost--which is expected to be lower for the more highly integrated 8514/A solutions. Another important issue is the expected economies of scale. If the 8514/A catches on as is forecast, there should be significant cost reductions. The competitive environment will also heavily impact prices: more than five vendors are expected to sell 8514/A parts, versus the sole-sourced TI part. Of course, such a highly competitive environment affects more than just pricing.



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#### **VENDOR ACTIVITY**

#### **Texas Instruments**

TI continues to promote its TI 34010 very aggressively and recently announced its standard graphics interface, called TIGA. Future graphics boards based on the TI part will be TIGA compatible, and software support is expected to be good. A number of vendors, including Compaq, Dell, Hewlett-Packard, and Wyse, have announced products based on the TI part. (Compaq is having its board done by Renaissance GRX of Bellevue, Washington.)

#### Tseng

Tseng initially had aggressive plans to target the 8514/A with its own VLSI, as it did in the VGA market. However, how soon the company gets in the running is currently not known.

#### Chips and Technologies

Chips announced its 8514/A compatible single-chip solution, the 82C480, on June 27, 1989. The company is providing an interface driver, the Adapter Interface (AI), and will also release a register specification document, giving software developers the option of bypassing the AI. The 82C480 offers ISA and MCA bus support (no EISA), interlaced display support to 1,600 x 1,200 resolution, and noninterlaced display support up to 2,360 x 1,770 resolution.

#### Western Digital Imaging

Western Digital Imaging (WDI) was the first vendor to announce an 8514/A-compatible chip set. On June 7 WDI announced a two-chip set, called the Personal Workstation Graphics Array 1 (PWGA1). The PWGA1 offers ISA, MCA, and EISA bus support and supports both interlaced and noninterlaced monitors at up to 1,280 x 1,024 resolution. The company will provide register-level interface specifications for software vendors.

#### Headland Technology

Headland Technology (formerly Video 7) reportedly is developing its own 8514/A-compatible chip set. The company is not expected to finish development in 1989, but it is planning to have 8514/A compatibles for 1990. In the past, it has offered boards based on another vendor's chip sets, and it may do so again.

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#### Integrated Information Technology (IIT)

IIT is a new Santa Clara, California-based semiconductor company, the first products of which were math coprocessors. It plans to sell a register-level compatible 8514/A and VGA on a single chip product this year, with plans to sample in August 1989. The full-custom single chip will be offered as a 144-pin package. It uses a common memory space for both 8514/A and VGA screens. The part is initially to be sold for less than \$100, and the company plans to come down the price curve aggressively. IIT intends to be in the chip business only; board sales are not anticipated.

#### **IBM**

IBM, the inventor of the 8514/A, has been shipping the product since third quarter 1987, although shipments initially were very slow in ramping up. Since then, a significant body of software has been created that supports the device. IBM has shipped more than 100,000 of its 8514/A products and is expected to ship up to 150,000 in 1989 alone. Its backlog is considerable, and there is a wait of several weeks for products. So far, this activity has been without much of a marketing effort. IBM is now aggressively promoting the product for its PS/2 machines; it has no intention of offering it for the PC AT market. Furthermore, IBM is expected to implement it as a chip set on the motherboard of its higher-end PS/2s, starting early next year.

#### DATAQUEST ANALYSIS

In the battle between TI and 8514/A vendors, the question is not really about which is the better part. In Dataquest's opinion, TI has the more versatile part in general, while the IBM standard is specific to the PC and PS/2 environment. And all claims to the contrary, we believe that the IBM part does quite well—even better in many cases—against the TI part. Because the two choices are at least comparable in performance, we do not believe that performance should be the centerpiece of the argument when discussing the mainstream power-user market. (The TI 34010/34020, we believe, is well suited for certain line-drawing performance demanding markets such as CAD.)

For the mainstream market, the question is, if IBM compatibility is important, what is the more suitable part for IBM compatibility? The answer is the 8514/A.

But why is IBM compatibility important? Certainly, users will gain the peace of mind that any future software that supports high resolution will run on IBM and compatible hardware. That being the case, why do we need another standard? Dataquest contends that we do not. Establishing yet another standard is tedious and confuses a market that has had enough confusion (particularly with regard to bus structures--MCA versus EISA). With graphics standards aggravating an already tenuous situation, if the industry does not tread carefully, customers could migrate to Apple, Sun, and even IBM itself, at the expense of the IBM-compatible community.

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#### The Standard after Next: 3-D Graphics Driving the Technology

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As the battle for the next PC graphics standard is being played out at the high end of the market, new applications and technology are beginning to hint at what we might expect from PC graphics in the future. The advent of 3-D graphics and a virtual reality interface, applications that are extremely computational-intensive, drives the need for faster and more powerful graphics-optimized computing engines. Reduced instruction-set computing (RISC) microprocessors are a logical choice for these applications.

One example of a product that may end up competing for the very high-end PC graphics market is Intel's recently introduced i860 microprocessor. The i860 includes specialized hardware graphics support and provides 10 to 100 times the computational power of the Intel 80386 microprocessor, which is capable of producing usable 3-D graphics. One PC vendor has already announced a high-end PC that will include an i860 socket on the motherboard, anticipating and facilitating the use of the device in graphics applications.



#### EMERGING TECHNOLOGY AND TRENDS

#### Impact and Importance of Standards: EISA versus MCA

An alternative to IBM's Micro Channel Architecture (MCA) bus structure was announced by a group of PC competitors on September 13, 1988. Support for the extended industry standard architecture (EISA) bus has been widely endorsed by PC vendors, hardware manufacturers, and software vendors. This announcement has caused a strong reaction in the marketplace, with uncertainty as to which architecture to support. Businesses need to plan for the future and the issue of whether to purchase MCA systems now or wait for EISA systems to become available is an important one.

#### Background

EISA was started by several PC manufacturers, led by Compaq, that did not want to pay the royalties IBM demanded for using its Micro Channel Architecture. They argued that IBM developed MCA as a strategy to increase market share and to limit the number of PC manufacturers by increasing the barriers to entry for low-cost manufacturers. IBM has denied this, stating that the MCA bus was developed because of its technical superiority and its ability to meet future computing demands. Technically, both EISA and MCA can support the same applications. Although proponents of each group claim advantages in their own design, the real question is: Which bus structure will win, or will they coexist? Dataquest believes that the answer to this question will depend on the third-party, add-in board manufacturers because it is the availability of add-in products that will influence the decision of the systems buyer.

#### EISA

#### EISA Delivery Time

No EISA bus machines are currently available. The finished specification has been published and work is under way to design and build the first machines, which Dataquest expects will be introduced in the second half of 1989. EISA's success will depend greatly on the perceived need when an extended bus is required and on the ability of IBM to demonstrate real applications for MCA. Dataquest believes that, perhaps as early as the 1989 Fall Comdex, high-speed graphics cards, communications boards, and improved disk and I/O management products will be introduced. These products will use the MCA bus, as it is the only extended bus architecture at present. This will place the proponents of EISA in a catch-up mode immediately.



#### **EISA Backward Compatibility**

According to its advocates, EISA's main advantage is its backward compatibility. Customers have large investments in LAN cards, communication boards, and peripheral products that can be moved to newly purchased systems. Dataquest does not agree that this issue is strong enough to dissuade businesses from purchasing a different bus architecture for the following reasons:

- Because older systems are passed down intact to areas that were previously devoid of PCs, businesses do not have surplus boards available.
- The new systems probably contain standard features that were options on older systems.
- The third-party board manufacturers have added new features and functions to their products, which makes upgrading attractive.

Although backward compatibility is feasible with EISA, Dataquest believes that, in a business environment, the bus layout will not significantly alter sales—provided support products, third-party boards, and peripherals are competitively priced and readily available. The total system price and the support product availability ultimately will determine which product will sell.

#### EISA Second Sources

Many companies selecting PCs prefer to have multiple sources for the same product. The number of PC manufacturers supporting the EISA bus make the EISA PC attractive for this reason. Dataquest believes this to be an especially critical area to watch to ensure that the EISA bus is identical from one PC to another. The potential exists for one manufacturer to "improve" on features to leverage market share.

#### MCA

#### MCA Delivery Time

IBM has been shipping MCA PCs since April 1987. Dataquest estimates that there was an installed base of 1.8 million MCA-based systems by the end of 1988. Companies anticipating the arrival of new applications do not have to wait for a PC with the MCA bus to be developed. Dataquest believes that third-party manufacturers of application hardware will concentrate their resources on MCA-based PCs initially, simply due to the large marketplace into which they can sell their products. The delay in shipping EISA third-party boards can only boost MCA credibility.

#### MCA Backward Compatibility

MCA's disadvantage is that it is not compatible with the nearly 33 million MS-DOS PCs shipped since 1983. Dataquest does not view this as a strong justification for not purchasing the MCA PC.

#### MCA Second Sources

Several companies have announced plans to ship MCA PCs or they are already shipping them. These companies, which are members of the EISA consortium, have stated that they will satisfy the customer, one way or another. The argument that there is only one vendor for MCA has therefore been eliminated.

#### MARKET PARTICIPANTS

#### IBM

Dataquest believes that IBM holds the winning hand in this card game. It is in a good position to influence the outcome of the EISA/MCA challenge and can sway the business community to embrace MCA. Our analysis is based on the following factors:

- The delay in introducing EISA gives IBM time to introduce products that can take advantage of MCA and time to establish a user base. The sooner useful MCA applications hit the market, the greater the market share that MCA will capture.
- Although it has stated that the royalty structure will remain in place, IBM always has the option of changing its mind if this becomes beneficial.
- Companies that have a universal cross-licensing agreement in place with IBM may not be required to pay the same royalty fees as companies that do not. This makes it more attractive for those companies to manufacture MCA-based PCs.
- It is being debated whether EISA or MCA, in the current configurations and environment, is technically superior. We believe that the issue is really which architecture will perform better in the future, with an expected requirement being the ability to expand to a 64-bit data path and handle processing speeds above 40 MHz. EISA may have problems with both the physical accommodation of a 64-bit bus and the electrical noise associated with high-speed processors. In addition, IBM has the time and the option to redesign the current MCA to eliminate the debate and to clearly differentiate performance before the first EISA machine is even shipped.
- Most important, although MCA exists now, EISA is, at present, vaporware.

#### Compaq

Compaq Computer held an estimated 5.9 percent worldwide market share of all personal computers shipped in 1988. Compaq is also the leader of the EISA consortium, and we believe that it holds enough market share and following to make EISA a viable product. Dataquest believes that Compaq will follow through and introduce EISA regardless of how the rest of the PC industry reacts to extended bus architectures.

#### EISA Consortium

Dataquest believes that the EISA consortium is very serious. It is well organized and well supported by members. Nevertheless, it faces an uphill battle against MCA with obstacles that IBM will exploit at every opportunity.

The first obstacle is that the EISA standard is being formed by a group of competitors anxious to increase their own market shares in an extremely competitive market. Even with the common interest of EISA, it is hard to believe that any group of competitors with a common goal will stay together. Any fragmentation in the ranks will be noted quickly by IBM.

A second obstacle is that members of the EISA consortium will hedge their bets and develop, or already have developed, MCA PCs, and they will actively market them. This is partially a result of the effort they have already put into cloning MCA systems and partially due to the fear of being caught without an extended architecture product if EISA stalls.

#### THE WINNERS AND THE LOSERS

#### The Winners

Dataquest believes that if Apple Computer can capitalize on its stable NuBus platform, it will be a clear winner as a result of the chaos caused by multiple PC bus standards. Certainly, Microsoft will win because it is hardware independent and will sell products to both MCA- and EISA-based PCs.

#### The Losers

The losers will be the public, which ultimately will pay the price for this confusion, and the PC manufacturers, which must invest limited funds in both standards. Designing two products is costly because of development time, distribution and revision changes, service, and repair.

#### Third-Party Add-In Boards: The Deciding Factor

The determination of the winners and the losers may well lie in the hands of the third-party add-in board designers. These vendors also have limited resources to develop and market products. How they allocate these resources will heavily influence the EISA/MCA struggle.

Today, the question is moot. The current MCA-installed base is estimated at 1.8 million units, and it is expected to increase to 4.9 million units by the end of 1990. In order to tap this rapidly expanding market, new add-in boards must be designed because existing ISA boards are not compatible.

On the other hand, EISA bus shipments are expected to be minimal during 1989 because EISA chip sets are not expected to be available until late second quarter of 1989. Specific EISA add-in boards also will be delayed waiting for chips. However, backward ISA compatibility allows board manufacturers to service this market with existing products. Also, many board vendors may further delay EISA product development investments until the size of the EISA-installed base becomes attractive.

But, the use of existing 8- and 16-bit ISA boards will likely impair the performance of 32-bit EISA machines. That, combined with the lack of a sufficient variety of full 32-bit EISA add-in boards, will tend to favor the MCA standard. Ultimately, backward compatibility, touted as one of the main advantages of the EISA architecture, may prove the undoing of this nascent standard.

#### CONCLUSION

In the near term, Dataquest expects sales of MCA-based PCs to increase as a result of the creditability given to a new bus structure by the PC-clone manufacturers. In Dataquest's opinion, IBM's influence, EISA's late entry, and fragmentation within the EISA ranks will hinder the acceptance of EISA systems. Compaq's strong influence and determination ensure that MCA and EISA systems will coexist in the market, at least in the intermediate term, with MCA products gaining market share as other vendors offer MCA systems. EISA will survive as a bridge, to extend the use of the current installed base of XT and AT machines. In the long term, however, Dataquest believes that EISA will not meet the challenge of future performance and expandability requirements and that this market will become a shrinking niche market, serviced by only a few surviving vendors.



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### Display Peripherals— Emerging Technology and Trends

#### INTRODUCTION

Display peripherals is an expanding category that now includes devices for a variety of display mediums. These are visual mediums such as video displays, panel displays, and, more recently, typeset-quality page printers. Although video control devices are not especially new, the concept of dedicated processing engines for page-oriented printing systems and related tasks is only now emerging.

This service section will discuss the semiconductor technology and trends surfacing in the applications segment of raster printer processing engines/controllers and associated devices.

#### A BIT OF HISTORY

Over the last five years, the business computing market has experienced an influx of higher-speed, typeset-quality page-oriented printers. These are systems based on ink-jet, laser engines, ion-deposition, and other print technologies.

As an example, laser systems are capable of generating a text-only page image in 2 to 10 seconds. However, speed is only one aspect of page printers; they are also very flexible in terms of mixing complex graphics and multiple type fonts. Their versatility has helped create an expanding market poised for rapid growth. Figure 1 displays the market potential for these printers and, therefore, the control processors.

#### Figure 1



#### North American Page Printer Shipment Forecast

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## Display Peripherals— Emerging Technology and Trends

The accelerated market growth will remain predicated on the technical abilities of the printers to image various graphics with text and to do so at the rated page-per-minute speed. The necessity of quality and quantity prompted semiconductor suppliers, in conjunction with printer engine manufacturers, to develop tailored integrated circuit controllers for this task.

### **DEFINITION OF A RASTER PRINTER CONTROLLER**

A raster printer controller is a type of computing engine, be it a processor or controller, resolved for a given class of task or, in other words, a task solution engine. Dataquest believes that the boundary between microprocessors and microcontrollers is disintegrating as applications evolve. As this phenomenon occurs, more of the powerful processor architectures will infiltrate dedicated control applications. In this case, the processing device is resolved for control of a high-speed printing system. Prior designs have used general-purpose microprocessors or other alternatives.

#### The Technical Rationale: Clear-Cut Speed

Regardless of the printing technology used, there is a distinct need to keep the page output in unison with the data output of the image processor. Electronic printer engines—such as a laser—can lay down thousands of characters, or millions of dots for graphics, per second. The controlling processor must be able to decode incoming data for print, execute the page layout program in memory, and then feed the printing engine quickly enough to create an unbroken page image.

Page printers (especially laser printers) contain two primary functional sections, as depicted in Figure 2.

Laser print engines have been optimized for high-speed throughput and relatively low cost for desktop publishing. For this reason, the cost of the electronics must be kept at a minimum to avoid a high printer average selling price.



## Display Peripherals— Emerging Technology and Trends

### Figure 2

### An Example Laser Printer



PAGE PRINTER DEVICE SUPPLIERS

Table 1 lists the current announced set of products and vendors in the page printer device market.

As indicated in Table 1, these devices function in a variety of ways. Many are self-contained microprocessors tailored for graphics operations. Others, such as Cirrus Logic's Raster Printer Accelerator (RPX) device is a coprocessor compatible with a variety of low-cost microprocessors. Western Digital's WD65C10 is an interface controller designed to work as a slave to a local MPU in the printer controller. It performs the contiguous bit transfer to the printing engine, thus off-loading the data formatting task and the direct memory access function from the MPU.



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# Display Peripherals— Emerging Technology and Trends

### Table 1

### Suppliers of Page Printer Control Devices

Company	Product	Function
Advanced Micro Devices	Am95C75	N/A
Cirrus Logic	CL-GP340/315	Coprocessor
National Semiconductor	NS32CG16	Processor
Texas Instruments	TMS34010	Processor
Weitek Corp.	XL-8200	Processor
Western Digital	WD65C10	Interface

N/A = Not available

Source: Dataquest October 1988

### **TECHNICAL ARCHITECTURAL ASPECTS**

The application of page printers requires a unique combination of technical resources to manage the efficient translation of incoming text and graphics data into a complete page image. Specifically, the most salient features are as follows:

- Arithmetic computational speed
- Dot-per-inch resolution for graphics and complex character sets
- Slower, low-cost DRAMs
- BITBLT operation (bit-aligned block level transfer)
- Page memory address capacity
- Dedicated graphics functions/instructions
- Appropriate pricing for class (speed range) of printer

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# PC Graphics Chip Sets---Applications and User Issues

### THE USER'S PERSPECTIVE

The important points to evaluate when considering the risks and rewards of graphics chip sets are identical to those for PC logic chip sets, which are discussed in the "Applications and User Issues" segment of the PC logic chip set analysis. These points are summarized here:

- Optimum performance and chip count
  - Reduced number of components needed
  - Optimized performance and reliability
  - Higher functionality with lower power consumption
- Time to market
  - Off-the-shelf parts and designs
- Cost savings
  - Improved manufacturability
  - Simplified debugging
  - Easier field repair
- Differentiation difficult
  - Differentiating products difficult with use of commodity parts

### CRITICAL SUCCESS FACTORS FOR SUPPLIERS

Critical success factors for suppliers are also identical to those for PC logic chip sets, which are also discussed in the "Applications and User Issues" segment of the PC logic chip set analysis. These points are summarized here:

- Systems expertise
- Access to design tools
- Access to high-volume, low-cost manufacturing
- Strong customer service and support
- Ability to demonstrate a product growth path

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# PC Logic Chip Sets--Applications and User Issues

### APPLICATIONS AND USER ISSUES

### The User's Perspective

The following are points that should be considered when evaluating the risks and rewards of chip sets:

- Optimum performance and chip count--Chip sets can provide an overall optimum solution for many new system designs.
  - In terms of integration, well-engineered chip sets offer a significant reduction in the number of components needed for a given system.
  - Along with integration comes benefits of optimized performance and system reliability.
  - Higher functionality and lower power consumption are typical by-products of chip-count reduction.
  - Fewer devices on a board and, hence, fewer solder joints and package connections can offer greatly enhanced reliability.
- Time to market—Chip sets are available immediately, almost as off-the-shelf commodity parts; thus, they can speed time to market. This is particularly important to OEMs building products with short product life cycles. Personal computer manufacturers must often cycle new designs every 6 to 18 months to remain competitive.
- Only alternative—For many OEMs lacking their own IC design and manufacturing capabilities, chip sets may provide the only viable path to entry into a given market. With the cost of chip sets near that of the discrete components they are replacing, and with their inherent advantages, chip sets may be the commodity of choice.
- Cost savings—Other benefits of reducing the chip count in a given system that could result in further cost savings to users include improved manufacturability, lower inventory, simplified debugging, and easier field repair.
- Hard to differentiate—Product differentiation is often more difficult with chip sets because every OEM using the same off-the-shelf parts ends up with basically the same system. Although many chip sets are designed using ASIC methodologies and CAD tools enabling modification of parts for a given buyer, adding proprietary features to a chip set can have an impact on time to market as well as component cost.

# PC Logic Chip Sets--Applications and User Issues

• Sourcing—Most chip sets are single-sourced products, although each supplier usually has several manufacturing foundries available for use. Potential users should be interested in the overall strength of a vendor both in terms of track record on timely delivery and quality and in terms of economic health and commitment to the industry.

### Critical Success Factors for Suppliers

In order to compete effectively in this industry, participants will require certain capabilities and resources, including the following:

- Systems expertise--Systems designers are looking for vendors able to work with them from the beginning of the board design to integrate and sometimes customize the chip set in the system. Chip set vendors with board design and systems expertise will be able to provide this capability. The ultimate goal of the chip set vendor is to become the technology driver of the systems market.
- Design tools—Fast chip design turnaround will be required because of short product life cycles. Access to design tools will allow the vendor to offer the product as a core, which can be modified to allow the customer some degree of differentiation.
- High-volume/low-cost manufacturing--As a result of the increasing commoditization of these products, access to a high-volume/low-cost foundry will be essential. Many chip set vendors do not own their own foundries. As long as there are no capacity shortages in the industry, these vendors have the benefit of shopping around for the best prices. However, vendors must consider the risk of being shut out in the event of capacity shortages.
- Customer service/support—Because of the lack of major differentiation in these products, service and customer support are as important as pricing. A user might not switch vendors for either better pricing or better service but, if offered both, will find it difficult to resist. Support—including technical assistance, extensive documentation, and the availability of evaluation and development boards—is demanded by users. Users also demand service, in the form of rapid turnaround in both design and manufacture, in order to meet ever-shorter time-to-market requirements.
- Growth path--Each new generation of microprocessor or major performance upgrade requires a new chip set design. Suppliers must be able to commit resources to fulfill product migration needs of the systems designers.

#### <u>Manufacturer</u>

Acetek System Inc. Room 502, Fu Hsin S. Rd. Sec., 1, Taipei, 10587 Taiwan

A-Dart Technology Inc. Fl. 2, No. 9 Kuang Fu N. Road Taipei, Taiwan

Advanced Datum Info. Corp. (ADP) 15/F, 126, Section 4 Nanking East Road Taipei, Taiwan

Alltek Computer Co., Ltd. 3/F-1, No. 63, Lane 122 Jen-ai Road, Section 4 Taipei, Taiwan

AMI Computer Mfgr. Inc. P.O. Box 99 Taipei, Taiwan

Aquarius Systems Inc. 6F, North 394 Keelung Road Section 1 P.O. Box 48-29 Taipei, Taiwan

Auto Computer Co., Ltd. 3/F-2, No. 271, Section 3 Roosevelt Road Taipei, Taiwan

Bison Science Technique Co. Ltd. 16, Section 1 Chung Shan North Road Taipei, Taiwan peripherals Add-on cards, power supplies

Products

Main boards, add-on cards,

Brain 16, XT-compatible terminals, monitors, add-on cards

IBM PC compatible

KC-2, AT compatible

ASI-2000, AT compatible ASI-100, XT compatible ASI-500, XT compatible

Autocomputer PC, AT compatible Add-on cards Autocomputer XT, XT compatible

Bit-Plus, XT compatible

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#### <u>Manufacturer</u>

BITCOM International Co., Ltd. AT, XT add-on cards 9th Floor, Number 56 Nanking East Road, Section 4 Taipei, Taiwan

Bright Up Industries Co., Ltd. 12-F, Number 142, Section 4 Chung Hsiao East Road Taipei, Taiwan

BURDA Enterprises Inc. 5/F, 26, Section 3 Jen-ai Road Taipei, Taiwan

Cartolia Computer Co., Ltd. 2/F, Number 567, Chung Hsiai East Road, Section 7 Taipei, Taiwan

C & D Technology, Inc. P.O. Box 5-250 Taipei, Taiwan U.S.-Britronics Inc. 14730 E. Firestone Boulevard Suite 302 La Mirada, CA 90638

Central Pillar Co., (Taiwan) Ltd. CPC-1000, PC compatible, Room 4-3, 4/F., Number 2 Fu Hsing N. Road Taipei (104), Taiwan

Chung Yu Electronics, Ltd. P.O. Box 30-535 Taipei, Taiwan

SPC 8816, XT-compatible monitors

Products

AT, XT compatible Apple II, IIe

AT, XT compatible Apple II, IIe

Mandax Multi PC AT Add-on cards, peripherals

add-on cards

AT, XT-compatible power supplies

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#### <u>Manufacturer</u>

Dataven Enterprises Co., Ltd. 41F, North 25, Alley 12, Lane 91 Section 1, Nei Hu Road Taipei, Taiwan

Dennison Industrial Co., Ltd. 6th Floor, Fu-Hsing Commercial Building 331 Fu-Hsing North Road Taipei, Taiwan

Digitek Co., Ltd. CANDID International Corp. P.O. Box 4-4, Nankang 4 Taipei, Taiwan

Expert Electronic Co., Ltd. Floor 4th, Number 568, Kuang Fu South Road, Taipei, Taiwan R.O.C.

First International Computer Inc. (FIC) 201, Tung Hwa North Road Taipei, Taiwan

Flytech Technology Co., Ltd. P.O. Box 23-169 Taipei, Taiwan

Flying Triumph Co., Ltd. Office: Room 1, 5F, Number 145 Section 1, Keelung Road Taipei, Taiwan

Fullink Enterprise Co., Ltd. 5/Floor, Number 145, Section 1 Chung Shan North Road Taipei, Taiwan

#### <u>Products</u>

DVE-1000, XT compatible motherboards

Amigo 16-M, XT-compatible peripherals, keyboards

XT turbo, AT, XT compatible

AT, XT main boards, add-on cards, adapters

Leo AT, XT compatible

AT, XT compatibles turbo board multiuser systems

XT compatible add-on card Apple II, IIe cards Fox-16XT, XT compatible

AT, XT add-on cards

#### <u>Manufacturer</u>

Galaxy Microcraft Systems Co., Ltd. P.O. Box 24-543 Taipei, Taiwan

GIT Co., Ltd. Hou & Hou Co., Ltd. P.O. Box 47-157 Taipei, Taiwan

Goodworld Industrial Co., Ltd. Third Floor 122-2 Section 1 Shin-Sheng S. Road Taipei 10622, Taiwan

Horn Computer Electronic Co., Ltd. 6/Floor, Number 1-4, Section 5 Chung Hsiao East Road Taipei, Taiwan

Hwa Hsin Electronic Co., Ltd. 1/Floor, Number 1, Alley 29 Lane 283, Roosevelt Road Section 3, Taipei Taiwan

Inter-Orient & World Corp. P.O. Box 48 243 Taipei, Taiwan R.O.C.

Jepssen Enterprise Co., Ltd. Room 1105, North 415 Hsin-Yi Road, Section 4 Taipei, Taiwan

#### **Products**

GX-2000, XT compatible add-on cards, modems

AT-1200, AT compatible DM-3600, XT compatible Motherboards, cards, keyboards

Xetac XT, XT compatible Xetac AT, AT compatible Xetac IIe, IIe compatible

PC, XT, AT compatibles Add-on cards

AT, XT cards

Dynamic PC, XT, XT compatible Shuttle PC, XT, XT compatible Geniskhan, AT compatible Prince, Jr. compatible Portcom, XT compatible Add-on cards, keyboards

AT, XT compatible

#### Manufacturer

Joytech Computer Co., Ltd. 10/Floor, North 86 Fuhsing North Road Taipei, Taiwan

K.S. Brotherbox Co., Ltd. P.O. Box 32-62 Taipei, Taiwan

Kun Ying Enterprise Co., Ltd. Room 1311, North 41, Section 1 Chung Hsiao West Road Taipei, Taiwan

Long Redart Co., Ltd. P.O. Box 68 1257 Taipei, Taiwan

Lyi-Cheng Enterprise Co., Ltd. P.O. Box 78-105 Taipei, Taiwan

Mitac Inc. 9F1, Number 585 Ming-Sheng E. Road Taipei, Taiwan

Modern Computer Corp. 41F, North 8, Section 1 Kien Kwo S. Road Taipei, Taiwan

Monterey International Corp. Office: 5/F, Number 40 Deh Hwei Street Taipei, Taiwan

#### **Products**

Excel-Turbo, XT compatible, add-on cards

K.S. Brotherbox Co., Ltd. AT, XT portable compatible

SU-640C, PC, XT compatible SU-101E, Apple IIe compatible KY-640C, AT compatible

PC, AT enhanced, AT compatible PC, XT enhanced, XT compatible Apple IIe motherboard

Minta MT-320, AT compatible

Portable Viso, PC compatible Mitac 286, AT compatible MPC-160, XT compatible Add-on boards

PTC-900, AT, XT compatible AT-2000, AT compatible Add-on cards

Staff-2 AT, AT compatible XT compatible



#### Manufacturer

Mortec Electronic Ind., Co. Ltd. 2nd Floor, North 10, Lane 575 Tun Hwa South Road Taipei, Taiwan

Multitech 15th Floor, 135 Chien-Ku N. Road Section 2, Taipei 10479 Taiwan

Nippon Binary K.K.

Northern International Inc. Office: 6/F.-5, Number 333 Fu Hsing N. Road Taipei, Taiwan

P&C Shiten Enterprise Co., Ltd. Room 7, 8th Floor Number 100 Roosevelt Road Section 3 Taipei, Taiwan

Peripherals Enterprise Co., Ltd. 7th Floor, Number 349 Min Sheng East Road Taipei, Taiwan

Plus & Plus Co., Ltd. 2/F, Number 126 Roosevelt Road Section 3 Taipei, Taiwan

POFA Technology Corp. P.O. Box 43-442 432, Keelung Road, Sec. 1, Rm. 703 Taipei, Taiwan

### Products

Tech-5000, XT compatible Tech-1, Apple II compatible Main boards, add-on cards

Popular 500, PC compatible Plus 700, XT compatible Advance 900, AT compatible

COPAM PC-501AT, AT compatible

PC, XT, AT add-on boards

IP-640, XT compatible Add-on cards, XT, AT

AT, XT add-on cards

ARC turbo, PC, XT compatible

Model P, PC compatible Model P+, XT compatible

#### <u>Manufacturer</u>

8000 BC 10 comp

Sailing Strong Intern Co., Ltd. Number 179, Fu-Shing N. Road Taipei, Taiwan

SPL Taiwan Ltd. 2/F, Morrison Plaza 25-4, Jen-ai Road, Section 4 Taipei, Taiwan

Spring Circle Computer Inc. Office: 3/F., Number 126 Roosevelt, Section 3 Taipei, Taiwan

Starrise Computer Co., Ltd. Office: Number 63, Hsin Ming Road Neihu Zone Taipei, Taiwan

Supertron Electronic Co., Ltd. Office: 7/F, Chung San Building Number 486, Fu-Hsin North Road Taipei, Taiwan

Surwave Electronic Ltd. Office: Number 187, Section 1 Ta-An Road Taipei, Taiwan

Taiwan Hannox International Inc. Office: 4/F, Number 100 Nanking E. Road, Section 4 Taipei, Taiwan

Taiwan Hwan Hong Enterprise Co. 6th Floor, Number 163 Han-Sheng East Road Panchiao, Taipei Hsein Taiwan 51-8000 PC AT compatible add-on boards

Products

AT, XT compatible add-on cards, peripherals

Add-on cards, XT AT

PC XT final assembly cases and keyboards

AT, XT compatible, add-on boards

Amigo-MX5, Apple IIe compatible Amigo-16/PT, PC compatible

AT, XT add-on card compatible

TH316XT-M, XT compatible Add-on cards, modems, drives AT compatible Apple IIe compatible

#### Manufacturer

Products

Cleveland 186, XT compatible

Taiwan Tomorrowland Inc. 2F-1, North 13, Lane 190 Fu Hsing North Road Taipei, Taiwan

Tatung Co. 22, Chungshan North Road 3rd Section Taipei, Taiwan

Tralite Enterprise Co., Ltd. 11 Floor 185 Section 2 Chung Shan North Road Taipei, Taiwan

Trun Sole Enterprise Co., Ltd. AT, XT-compatible boards P.O. Box 55-506 Taipei, Taiwan

Turn-Point Science Tech. Co., Ltd. 11 Floor-5, Number 80, Section 1 Ho Ping West Road Taipei, Taiwan

Unitron Inc. Factory: 5th Floor, Number 3 Lane 521, Chung Cheng Road 23138 Hsin Tein Taipei, Taiwan

Wugo Co., Ltd. Number 16, Lane 134, Section 2 Chung Hsiao East Road Taipei, Taiwan

Winfortune Enterprise Co., Ltd. 3/F-3, Number 125, Section 3 Taipei, Taiwan

TCS-7000, AT compatible monitors, terminals

Add-on cards, keyboards, cases, storage

U-2900T, XT compatible U-3900, AT compatible Add-on cards

Phoenix PC II, XT compatible

Winton turbo, XT compatible add-on boards

#### <u>Manufacturer</u>

Yih Lung Enterprise Co., Ltd. Number 112, Chungking N. Road Section 4 Taipei, Taiwan

Youth Keep Enterprise Co., Ltd. Office: 1/F, Number 7, Lane 92 Section 2, Jen-ai Road Taipei, Taiwan

Yutional Enterprise Co., Ltd. 3 Floor, Number 337, Section 4 Shin I Road Taipei, Taiwan <u>Products</u>

AT, XT-compatible add-on cards

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AT compatible boards

Apple IIe compatible add-on cards









# PC Graphics Chip Sets--Executive Summary

### EXECUTIVE SUMMARY

### PC Graphics Chip Set Market Overview

Total worldwide merchant PC graphics chip set revenue was \$108 million in 1988, representing an increase of 96.4 percent over 1987 revenue of \$55 million. Dataquest is forecasting 1989 revenue at \$182 million, for an annual growth rate of 68.5 percent. The saturation of chip set solutions into the graphics market signals the end of the rapid growth phase for the industry. Compound annual growth rate (CAGR) for 1989 through 1993 is expected to be 11.5 percent and is closely tied to growth in the PC market, which is expected to have a CAGR of 10.5 percent for that period. However, because of severe pricing pressure, average selling prices (ASPs) are forecast to decline by a negative 26.8 percent CAGR in the period. Consequently, revenue is expected to be a negative 13.6 percent.

#### Trends and Issues

A summary of important competitive trends in this industry includes the following:

- The three largest merchant vendors of low-end PC graphics chip sets are Western Digital, Chips and Technologies, and Cirrus Logic. These companies accounted for 90 percent of merchant revenue in 1987 and 75 percent in 1988.
- In 1987, there were five merchant chip set vendors. In 1988 nine vendors offered merchant products. Currently, 12 vendors participate in the market. As the business shifts from add-in boards to motherboard implementations, some vendors who now offer boards with proprietary chip sets will begin to offer those chip sets on the merchant market. Dataquest estimates that by the end of 1990, there will be between 16 and 20 merchant graphics chip set vendors.
- The increase in the number of competitors combined with expected slower growth in unit shipments is expected to lead to aggressive pricing strategies. These strategies result in lower revenue overall for the industry and continued margin pressure for individual vendors.
- VGA is expected to become the dominant low-end PC graphics standard beginning in 1989. The older standards (HGA, CGA, EGA) are expected to decline rapidly in use as VGA prices decline.
- What the next PC graphics standard will be is currently under debate. Although the shift to a new standard will not occur as rapidly as it has in the past, Dataquest believes that the IBM 8514/A will be the eventual successor to VGA in the mainstream PC market.

