- 




## $1$

## Microcontroller Forecast

## 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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## Microcontroller Forecast

## COMPARISON WITH EARLIER FORECASTS

Microcontroller unit shipment projections have increased substantially over the February 1988 forecast. The average seiling 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.

## 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-EEstimated Worldwide MOS Microcontroller Revenue, 1979-1983
- Table 5-Estimated Woridwide 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 Woridwide MOS Microcontroller ASPs, 1979-1983
- Table 9—Estimated Worldwide MOS Microcontroller ASPs, 1984-1987


## $\overline{\text { Microcontroller Forecast }}$

## Table 1 <br> Worldwide MOS Microcontroller Revenue Forecast (Millions of Dollars)

|  | 1988 | 1989 | 1990 | 1991 | 1927 | 1993 | $\begin{gathered} \text { CAGR } \\ 1988-1993 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit MCU Growth | $\begin{array}{r} \$ \quad 944.7 \\ 19.2 \% \end{array}$ | $\begin{array}{r} 991.4 \\ 4.9 \% \end{array}$ | $\begin{array}{ll} \$ \quad 979.0 \\ & (1.28) \end{array}$ | $\begin{array}{r} \$ 1,081.3 \\ 10.4 \% \end{array}$ | $\begin{array}{r} \$ 1,174.6 \\ 8.69 \end{array}$ | $\begin{array}{r} \$ 1,181.8 \\ 0.6 \% \end{array}$ | 4.6\% |
| 8-Bit MCU Growth | $\begin{array}{r} \$ 1,576.3 \\ 21,8 \% \end{array}$ | $\begin{array}{r} \$ 1,654.4 \\ 5.0 \% \end{array}$ | $\begin{gathered} \$ 1,626.0 \\ (1,7 \%) \end{gathered}$ | $\begin{array}{r} \$ 1,911.0 \\ 17.59 \end{array}$ | $\begin{array}{r} \$ 2,219.6 \\ 16.1 \% \end{array}$ | $\begin{array}{r} \$ 2.267 .8 \\ 2.2 \% \end{array}$ | 7.5\% |
| 16-Bit MCU Growth | $\begin{array}{r} 15.0 \\ 19.4 \% \end{array}$ | $\begin{array}{r} 17.9 \\ 19.14 \end{array}$ | $\begin{array}{r} 30.0 \\ 67.5 \% \end{array}$ | $\begin{array}{r} 58.1 \\ 93.3 \% \end{array}$ | $\begin{array}{r} 125.6 \\ 116.4 \% \end{array}$ | $\begin{array}{r} \$ 219.1 \\ 74.4 \% \end{array}$ | 70.9\% |
| Total |  |  |  |  |  |  |  |
| Revenue | \$2.536.0 | \$2,663.7 | \$2,635.0 | \$3,050.3 | \$3,519.8 | \$3,668.7 | 7.7\% |
| Growth | 20.88 | 5.0\% | (1.18) | 15.8\% | 15.4\% | 4.2\% |  |
|  |  |  |  |  | Source: Da |  | Dataquest |

Table 2
Worldwide MOS Microcontroller Unit Shipment Forecast (Millions of Units)

|  | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | $\begin{gathered} \text { CAGR } \\ 1988-1993 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit MCU | 470.0 | 533.0 | 550.0 | 625.0 | 695.0 | 725.0 | $9.1 \%$ |
| Growth | 19.8\% | 13.4\% | 3.2\% | 13.6\% | 11.2\% | 4.3\% |  |
| 8-Bit MCU | 485.0 | 580.5 | 600.0 | 735.0 | 895.0 | 965.0 | 14.8\% |
| Growth | 45.5\% | 19.7\% | 3.4\% | 22.5\% | 21.88 | $7.8 \%$ |  |
| 16-Bit MCU | 1.2 | 1.8 | 3.5 | 7.5 | 18.0 | 35.0 | 96.3\% |
| Growth | 50.0\% | 50.0\% | 94.4\% | 114.34 | 140.0\% | 94.4\% |  |
| Total |  |  |  |  |  |  |  |
| Units | 956.2 | 1,115.3 | 1,153.5 | 1.367.5 | 1,608.0 | 1.725.0 | 12.5\% |
| Growth | 31.6\% | 16.6\% | 3.4\% | 28.6\% | 17.6\% | 7.3\% |  |
|  |  |  |  |  | Source: |  | Dataquest <br> November 1988 |
| SIS Prod., Mkt., \& Tech., Vol. II0001679 |  |  | (c) 1988 Dataquest Incorporated November 3 |  |  |  |  |

## $\overline{\text { Microcontroller Forecast }}$

Table 3
Worldwide MOS Microcontroller ASP Forecast

|  | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | $\begin{gathered} \text { CAGR } \\ 1988-1993 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{array}{r} \text { 4-Bit MCU } \\ \text { Growth } \end{array}$ | $\begin{gathered} \$ 2.01 \\ (0.5 \%) \end{gathered}$ | $\begin{aligned} & \$ 1.86 \\ & (7.5 \%) \end{aligned}$ | $\begin{aligned} & \$ 1.78 \\ & (4.3 \%) \end{aligned}$ | $\begin{aligned} & \$ 1.73 \\ & (2.8 \%) \end{aligned}$ | $\begin{aligned} & \$ 1.69 \\ & (2.38) \end{aligned}$ | $\begin{aligned} & \$ 1.63 \\ & (3.6 \%) \end{aligned}$ | (4.1\%) |
| $\begin{aligned} & \text { 8-Bit MCU } \\ & \text { Growth } \end{aligned}$ | $\begin{aligned} & \$ 3.25 \\ & (16.2 \%) \end{aligned}$ | $\begin{gathered} \$ 2.85 \\ (12.38) \end{gathered}$ | $\begin{aligned} & \$ 2.71 \\ & (4.98) \end{aligned}$ | $\begin{aligned} & \$ 2.60 \\ & (4.18) \end{aligned}$ | $\begin{aligned} & \$ 2.48 \\ & (4.6 \%) \end{aligned}$ | $\begin{aligned} & \$ 2.35 \\ & (5.2 \%) \end{aligned}$ | (5.3\%) |
| 16-Bit MCU Growth | $\begin{aligned} & \$ 12.54 \\ & (20.3 \%) \end{aligned}$ | $\begin{gathered} \$ 9.96 \\ (20.68) \end{gathered}$ | $\begin{gathered} \$ 8.58 \\ (13.9 \%) \end{gathered}$ | $\begin{aligned} & \$ 7.74 \\ & (9.88) \end{aligned}$ | $\begin{aligned} & \$ 6.98 \\ & (9.88) \end{aligned}$ | $\begin{gathered} \$ 6.26 \\ (10.38) \end{gathered}$ | (13.0\%) |
| $\begin{aligned} & \text { Aggregate } \\ & \text { ASP } \\ & \text { Growth } \end{aligned}$ | $\begin{gathered} \$ 2.65 \\ (8.48) \end{gathered}$ | $\begin{aligned} & \$ 2.39 \\ & (9.9 \%) \end{aligned}$ | $\begin{aligned} & \$ 2.28 \\ & (4.4 \%) \end{aligned}$ | $\begin{aligned} & \$ 2.23 \\ & (2.4 \%) \end{aligned}$ | $\begin{aligned} & \$ 2.19 \\ & (1.9 \%) \end{aligned}$ | $\begin{aligned} & \$ 2.13 \\ & (2.8 \%) \end{aligned}$ | (4.3\%) |
|  |  |  |  |  | Source: |  | quest <br> mber 1988 |

## $\overline{\text { Microcontroller Forecast }}$

Table 4
Estimated Worldwide MOS Microcontroller Revenue
1979-1983
(Millions of Dollars)

|  | 1.979 | 1980 | 1981 | 1982 | 1983 | $\begin{gathered} \text { CAGR } \\ 1979-1983 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { 4-Bit MCU } \\ & \text { Growth } \end{aligned}$ | \$110.4 | $\begin{array}{r} \$ 206.6 \\ 87.1 \% \end{array}$ | $\begin{array}{r} \$ 267.1 \\ 29.3 \% \end{array}$ | $\begin{aligned} & \$ 253.0 \\ & (5.3 \%) \end{aligned}$ | $\begin{array}{r} \$ 257.9 \\ 1.9 \% \end{array}$ | 23.6\% |
| $\begin{array}{r} \text { 8-Bit MCU } \\ \text { Growth } \end{array}$ | \$ 75.3 | $\begin{array}{r} \$ 108.7 \\ 44.38 \end{array}$ | $\begin{array}{r} \$ 136.2 \\ 25.3 \% \end{array}$ | $\begin{array}{r} \$ 173.2 \\ 27.18 \end{array}$ | $\begin{array}{r} \$ 267.3 \\ 54.4 \% \end{array}$ | 37.2\% |
| $\begin{gathered} \text { 16-Bit MCU } \\ \text { Growth } \end{gathered}$ | \$ 0.05 | $\begin{aligned} & \$ 0.15 \\ & 200.0 \% \end{aligned}$ | $\begin{aligned} & \$ 0.9 \\ & 500.08 \end{aligned}$ | $\begin{gathered} 0.9 \\ (5.6 \%) \end{gathered}$ | $\begin{array}{r} 1.1 \\ 33.0 \% \end{array}$ | 118.1\% |
| Total |  |  |  |  |  |  |
| Revenue | \$185.8 | \$315.4 | \$404.2 | \$427.0 | \$526.3 | 29.7\% |
| Growth |  | 69.8\% | 28.28 | 5.6\% | 23.3\% |  |

Table 5
Estimated Worldwide MOS Microcontroller Revenue
1984-1987
(Millions of Dollars)

|  | 1984 | 1985 | 1986 | 1987 | $\begin{gathered} \text { CAGR } \\ 1984-1987 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { 4-Bit MCU } \\ & \text { Growth } \end{aligned}$ | $\begin{array}{r} \$ 475.8 \\ 84.5 \% \end{array}$ | $\begin{gathered} 382.3 \\ (19.6 \%) \end{gathered}$ | $\begin{aligned} & \$ 554.7 \\ & \\ & 45.18 \end{aligned}$ | $\begin{array}{r} \$ 92.4 \\ 42.9 \% \end{array}$ | 18.5\% |
| $\begin{array}{r} \text { 8-Bit MCU } \\ \text { Growth } \end{array}$ | 930.3 248.18 | $\begin{gathered} 728.0 \\ (21.7 \%) \end{gathered}$ | $\begin{array}{r} \$ 53.4 \\ 17.2 \% \end{array}$ | $\begin{array}{r} \$ 1,293.6 \\ 51.6 \% \end{array}$ | 11.6\% |
| 16-Bit MCU Growth | $\begin{gathered} 0.7 \\ (41.6 \%) \end{gathered}$ | $\begin{array}{r} 4.0 \\ 506.4 \% \end{array}$ | $\begin{array}{r} 7.0 \\ 74.7 \% \end{array}$ | 12.6 $80.1 \%$ | 167.2\% |
| 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: | quest <br> ember 1988 |

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## Microcontroller Forecast

## Table 6

## Estimated Worldwide MOS Microcontroller Unit Shipments 1979-1983 <br> (Millions of Units)

|  | 1979 | 1980 | 1981 | 1982 | 1983 | $\begin{gathered} \text { CAGR } \\ 1979-1983 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 |  | 400.08 | 700.0\% | 25.0\% | 80.0\% |  |
| Total |  |  |  |  |  |  |
| Units | 62.1 | 117.8 | 168.5 | 212.4 | 262.6 | 43.4\% |
| Growth |  | 89.88 | 43.08 | 26.1\% | 23.7\% |  |

Table 7
Estimated Worldwide MOS Microcontroller Unit Shipments
1984-1987
(Millions of Units)

|  | 1984 | 1985 | 1986 | 1987 | $\begin{gathered} \text { CAGR } \\ 1984-1987 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit MCU | 193.4 | 177.0 | 271.9 | 392.3 | 26.6\% |
| 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: | aquest <br> ember 1988 |

## Microcontroller Forecast

Table 8
Estimated Worldwide MOS Microcontroller ASPs 1979-1983

|  | 1979 | 1980 | 1981 | 1982 | 1983 | $\begin{gathered} \text { CAGR } \\ 1979-1.983 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { 4-Bit MCU } \\ & \text { Growth } \end{aligned}$ | \$ 2.19 | $\begin{gathered} \$ 2.15 \\ (1.68) \end{gathered}$ | $\begin{aligned} & \$ 2.00 \\ & (6.98) \end{aligned}$ | $\begin{aligned} & \$ 2.60 \\ & (20.18) \end{aligned}$ | $\begin{aligned} & \$ 1.50 \\ & (6.28) \end{aligned}$ | (9.0\%) |
| $\begin{array}{r} \text { 8-Bit MCU } \\ \text { Growth } \end{array}$ | \$ 6.50 | $\begin{aligned} & \$ 5.00 \\ & (23.18) \end{aligned}$ | $\begin{aligned} & \$ 3.90 \\ & (22.0 \%) \end{aligned}$ | $\begin{aligned} & \$ 3.20 \\ & (17.9 \%) \end{aligned}$ | $\begin{gathered} \$ 2.95 \\ (7.88) \end{gathered}$ | (17.9\%) |
| 16-Bit MCU Growth | \$50.00 | $\begin{aligned} & \$ 30.00 \\ & (40.08) \end{aligned}$ | $\begin{aligned} & \$ 22.50 \\ & (25.0 \%) \end{aligned}$ | $\begin{aligned} & \$ 17.00 \\ & (24.4 \%) \end{aligned}$ | $\begin{aligned} & \$ 12.56 \\ & (26.1 \%) \end{aligned}$ | (29.2\%) |
| Aggregate ASP Growth | \$ 2.99 | $\begin{aligned} & \$ 2.68 \\ & (10.5 \%) \end{aligned}$ | $\begin{aligned} & \$ 2.40 \\ & (10.4 \%) \end{aligned}$ | $\begin{aligned} & \$ 2.01 \\ & (16.2 \%) \end{aligned}$ | $\begin{gathered} \$ 2.00 \\ (0.38) \end{gathered}$ | (9.5\%) |

Table 9
Estimated Worldwide MOS Microcontroller ASPs 1984-1987

|  | 1984 | 1985 | 1986 | 1987 | $\begin{gathered} \text { CAGR } \\ 1984-1987 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit MCU Growth | $\begin{array}{r} \$ 2.46 \\ 64.0 \% \end{array}$ | $\begin{aligned} & \$ 2.16 \\ & (12.2 \%) \end{aligned}$ | $\begin{gathered} \$ 2.04 \\ (5.68) \end{gathered}$ | $\begin{gathered} \$ 2.02 \\ (1.0 \%) \end{gathered}$ | (6.4\%) |
| $\begin{aligned} & \text { 8-Bit MCU } \\ & \text { - Growth } \end{aligned}$ | $\begin{array}{r} \$ 5.69 \\ 92.9 \% \end{array}$ | $\begin{aligned} & \$ 4.45 \\ & (21.8 \%) \end{aligned}$ | $\begin{aligned} & \$ 3.81 \\ & (14.4 \%) \end{aligned}$ | $\begin{array}{r} \$ 3.88 \\ 1.8 \% \end{array}$ | (12.0\%) |
| 16-Bit MCU Growth | $\begin{aligned} & \$ 11.00 \\ & (12.4 \%) \end{aligned}$ | $\begin{array}{r} \$ 17.40 \\ 58.2 \% \end{array}$ | $\begin{array}{r} \$ 17.48 \\ 0.5 \% \end{array}$ | $\begin{aligned} & \$ 15.74 \\ & (10.08) \end{aligned}$ | 12.7\% |
| Aggregate ASP Growth | $\begin{array}{r} \$ 3.94 \\ 96.6 \% \end{array}$ | $\begin{aligned} & \$ 3.27 \\ & (17.08) \end{aligned}$ | $\begin{aligned} & \$ 2.85 \\ & (12.8 \%) \end{aligned}$ | $\begin{array}{r} \$ 2.89 \\ 1.3 \% \end{array}$ | (9.8\%) |
|  |  |  |  | Source: | $\begin{aligned} & \text { aquest } \\ & \text { ember } 1988 \end{aligned}$ |

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# $\underline{\text { Microcontroller Forecast }}$ 

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## Microcontroller Forecast Summary

## 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


[^0]Source: Dataquest

## Microcontroller Forecast Summary

## 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

## Microcontroller Forecast Summary

Table 1

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

|  | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | $\begin{gathered} \text { CAGR } \\ 1989-1994 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { 4-Bit MCU } \\ & \text { Growth } \end{aligned}$ | $\begin{array}{r} \$ 1,172.2 \\ 15.2 \% \end{array}$ | $\begin{array}{r} \$ 1,183.4 \\ 1.0 \% \end{array}$ | $\begin{array}{r} \$ 1,401.4 \\ 18,4 \% \end{array}$ | $\begin{array}{r} \$ 1,608.8 \\ 14.8 \% \end{array}$ | $\begin{array}{r} \$ 1.823 .3 \\ 13.3 \% \end{array}$ | $\begin{array}{r} \$ 1,910.4 \\ 4.8 \% \end{array}$ | 10.3\% |
| $\begin{aligned} & \text { 8-Bit MCU } \\ & \text { Growth } \end{aligned}$ | $\begin{array}{r} \$ 2,001.0 \\ 18.6 \% \end{array}$ | $\begin{array}{r} \$ 2,023.8 \\ 1.18 \end{array}$ | $\begin{array}{r} \$ 2,521.1 \\ 24.6 \% \end{array}$ | $\begin{array}{r} \$ 3,230.0 \\ 28.18 \end{array}$ | $\begin{array}{r} \$ 4,237.5 \\ 31.2 \% \end{array}$ | $\begin{array}{r} \$ 4.639 .8 \\ 9.5 \% \end{array}$ | 18.3\% |
| 16-Bit MCU Growth | $\begin{array}{r} \$ \quad 50.9 \\ 8.3 \% \end{array}$ | $\begin{array}{r} \$ 2.8 \\ 3.8 \% \end{array}$ | $\begin{aligned} & \$ \quad 61.7 \\ & 16.9 \% \end{aligned}$ | $\begin{array}{r} 134.3 \\ 117.5 \% \end{array}$ | $\begin{array}{r} \$ \quad 244.3 \\ 81.9 \% \end{array}$ | $\begin{array}{r} \$ 300.6 \\ 23.0 \% \end{array}$ | 42.7\% |
| 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\% | 1.18 | 22.2\% | 24.8\% | 26.8\% | 8.7\% |  |

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

| Source: | Dataquest |
| :--- | :--- |
|  | July 1989 |

Table 2
Worldwide MOS Microcontroller Unit Shipment Forecast (Millions of Units)

|  | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | $\begin{gathered} \text { CAGR } \\ 1989-1994 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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\% | 28.68 |  |
| 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 |
| SIS Microcomponents$0004353$ |  | © 1989 Dataquest Incorporated July |  |  |  |  | 3 |

## Microcontroller Forecast Summary

## Table 3

## Worldwide MOS Microcontroller ASP Forecast

|  | 1989 | 1990 | 1991 | 1992 | 2993 | 1994 | $\begin{gathered} \text { CAGR } \\ 1989-1994 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit MCU Growth | $\begin{aligned} & \$ 1.97 \\ & (3.0 \%) \end{aligned}$ | $\begin{aligned} & \$ 1.94 \\ & (1.5 \%) \end{aligned}$ | $\begin{array}{r} \$ 1.96 \\ 1.08 \end{array}$ | $\begin{aligned} & \$ 1.95 \\ & (0.5 \%) \end{aligned}$ | $\begin{array}{r} \$ 1.95 \\ 0 \end{array}$ | $\begin{aligned} & \$ 1.92 \\ & (1.5 \%) \end{aligned}$ | (0.5\%) |
| $\begin{aligned} & \text { 8-Bit MCU } \\ & \text { Growth } \end{aligned}$ | $\begin{aligned} & \$ 3.48 \\ & (6.2 \%) \end{aligned}$ | $\begin{aligned} & \$ 3.39 \\ & (2.6 \%) \end{aligned}$ | $\begin{array}{r} \$ 3.43 \\ 1.2 \% \end{array}$ | $\begin{aligned} & \$ 3.40 \\ & (0.9 \%) \end{aligned}$ | $\begin{aligned} & \$ 3.39 \\ & (0.38) \end{aligned}$ | $\begin{aligned} & \$ 3.35 \\ & (1.2 \%) \end{aligned}$ | (0.88) |
| 16-Bit MCU Growth | $\begin{aligned} & \$ 8.48 \\ & (0.8 \%) \end{aligned}$ | $\begin{aligned} & \$ 8.38 \\ & (1.28) \end{aligned}$ | $\begin{aligned} & \$ 8.23 \\ & (1.8 \%) \end{aligned}$ | $\begin{aligned} & \$ 7.46 \\ & (9.4 \%) \end{aligned}$ | $\begin{aligned} & \$ 6.98 \\ & (6.4 \%) \end{aligned}$ | $\begin{aligned} & \$ 6.68 \\ & (4.3 \%) \end{aligned}$ | (4.7\%) |
| 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

# Microcontroller Forecast Summary 

## Table 4

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

|  | 1979 | 1980 | 1981 | 1982 | 1983 | $\begin{gathered} \text { CAGR } \\ 1979-1983 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { 4-Bit MCU } \\ & \text { Growth } \end{aligned}$ | \$110.4 | $\begin{array}{r} \$ 206.6 \\ 87.18 \end{array}$ | $\begin{array}{r} \$ 267.1 \\ 29.3 \% \end{array}$ | $\begin{gathered} \$ 253.0 \\ (5.3 \%) \end{gathered}$ | $\begin{array}{r} \$ 257.9 \\ 1.9 \% \end{array}$ | 23.6\% |
| $\begin{aligned} & \text { 8-Bit MCU } \\ & \text { Growth } \end{aligned}$ | \$ 75.3 | $\begin{array}{r} \$ 108.7 \\ 44.3 \% \end{array}$ | $\begin{array}{r} \$ 136.2 \\ 25.3 \% \end{array}$ | $\begin{array}{r} \$ 173.2 \\ 27.1 \% \end{array}$ | $\begin{array}{r} \$ 267.3 \\ 54.4 \% \end{array}$ | 37.2\% |
| $\begin{aligned} & \text { 16-Bit MCU } \\ & \text { Growth } \end{aligned}$ | \$ 0.05 | $\begin{aligned} & \$ 0.15 \\ & 200.0 \% \end{aligned}$ | $\begin{array}{r} \$ 0.9 \\ 500.0 \% \end{array}$ | $\begin{gathered} 0.9 \\ (5.6 \%) \end{gathered}$ | $\begin{array}{r} 1.1 \\ 33.0 \% \end{array}$ | 118.1\% |
| 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)

|  | 1984 | 1985 | 1986 | 1987 | 1988 | $\begin{gathered} \text { CAGR } \\ 1984-1988 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{array}{r} \text { 4-Bit MCU } \\ \text { Growth } \end{array}$ | $\begin{array}{r} \$ \quad 475.8 \\ \\ 84.5 \% \end{array}$ | $\begin{gathered} 382.3 \\ (19.6 \%) \end{gathered}$ | $\begin{array}{r} \$ 554.7 \\ 45.1 \% \end{array}$ | $\begin{array}{r} \$ 992.4 \\ 42.9 \% \end{array}$ | $\begin{array}{r} \$ 1,017.2 \\ 28.48 \end{array}$ | 20.9\% |
| $\begin{aligned} & \text { 8-Bit MCU } \\ & \text { Growth } \end{aligned}$ | $\begin{array}{r} 930.3 \\ 248.1 \% \end{array}$ | $\begin{gathered} 728.0 \\ (21.7 \%) \end{gathered}$ | $\begin{array}{r} \$ 853.4 \\ \\ 17.2 \% \end{array}$ | $\begin{array}{r} \$ 1.277 .3 \\ 49.7 \% \end{array}$ | $\begin{array}{r} \$ 1,687.3 \\ 32.18 \end{array}$ | 16.0\% |
| $\begin{gathered} \text { 16-Bit MCU } \\ \text { Growth } \end{gathered}$ | $\begin{gathered} 0.7 \\ (41.6 \%) \end{gathered}$ | $\begin{aligned} & 4.0 \\ & 506.4 \% \end{aligned}$ | $\begin{array}{r} 7.0 \\ \\ 74.7 \% \end{array}$ | $\begin{array}{r} 29.1 \\ 315.8 \% \end{array}$ | $\begin{array}{r} \$ 47.0 \\ 61.8 \% \end{array}$ | 190.5\% |
| Total Revenue Growth | $\begin{array}{r} \$ 1,406.7 \\ 167.3 \% \end{array}$ | $\begin{array}{r} \$ 1,114.3 \\ (20.8 \%) \end{array}$ | $\begin{array}{r} \$ 1,415.1 \\ 27.0 \% \end{array}$ | $\begin{array}{r} \$ 2.098 .8 \\ 48.3 \% \end{array}$ | $\begin{array}{r} \$ 2,751.6 \\ 31.1 \% \end{array}$ | 18.3\% |
|  |  |  |  |  | Source: | Dataquest <br> July 1989 |

## Microcontroller Forecast Summary

Table 6
Estimated Worldwide MOS Microcontroller Unit Shipments 1979-1983
(Millions of Units)

| CAGR |  |  |  |  |  |  |
| :---: | :---: | ---: | ---: | ---: | ---: | ---: |
|  | 1979 | 1980 | 1981 | 1982 | 1983 | 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 | - | $87.6 \%$ | $60.6 \%$ | $55.0 \%$ | $67.4 \%$ | - |
| (B-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)

|  | 1984 | 1985 | 1986 | 1987 | 1988 | $\begin{gathered} \text { CAGR } \\ 1984-1988 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit MCU | 193.4 | 177.0 | 271.9 | 392.3 | 501.1 | 26.98 |
| 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\% | 0.18 | 36.9\% | 48.9\% | 36.4\% |  |
| 16-Bit MCU | 0.06 | 0.23 | 0.4 | 3.4 | 5.5 | 209.4\% |
| Growth | (33.3\%) | 283.38 | 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\% |  |

# Microcontroller Forecast Summary 

Table 8
Estimated Worldwide MOS Microcontroller ASPs 1979-1983

|  | 1979 | 1980 | 1981 | 1982 | 1983 | $\begin{gathered} \text { CAGR } \\ 1979-1983 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{array}{r} \text { 4-Bit MCU } \\ \text { Growth } \end{array}$ | \$ 2.19 | $\begin{gathered} 2.15 \\ (1.6 \%) \end{gathered}$ | $\begin{gathered} \$ 2.00 \\ (6.98) \end{gathered}$ | $\begin{aligned} & \$ 1.60 \\ & (20.1 \%) \end{aligned}$ | $\begin{gathered} \$ 1.50 \\ (6.2 \%) \end{gathered}$ | (9.0\%) |
| $\begin{aligned} & \text { 8-Bit MCU } \\ & \text { Growth } \end{aligned}$ | \$ 6.50 | $\begin{aligned} & \$ 5.00 \\ & (23.1 \%) \end{aligned}$ | $\begin{aligned} & \$ 3.90 \\ & (22.0 \%) \end{aligned}$ | $\begin{aligned} & \$ 3.20 \\ & (17.98) \end{aligned}$ | $\begin{gathered} \$ 2.95 \\ (7.8 \%) \end{gathered}$ | (17.9\%) |
| 16-Bit MCU Growth | \$50.00 | $\begin{aligned} & \$ 30.00 \\ & (40.0 \%) \end{aligned}$ | $\begin{aligned} & \$ 22.50 \\ & (25.0 \%) \end{aligned}$ | $\begin{aligned} & \$ 17.00 \\ & (24.4 \%) \end{aligned}$ | $\begin{aligned} & \$ 12.56 \\ & (26.1 \%) \end{aligned}$ | (29.2\%) |
| Aggregate ASP Growth | \$ 2.99 | $\begin{aligned} & \$ 2.68 \\ & (10.58) \end{aligned}$ | $\begin{aligned} & \$ 2.40 \\ & (10.48) \end{aligned}$ | $\begin{aligned} & \$ 2.01 \\ & (16.2 \%) \end{aligned}$ | $\begin{gathered} \$ 2.00 \\ (0.3 \%) \end{gathered}$ | (9.5\%) |

Table 9
Estimated Worldwide MOS Microcontroller ASPs 1984-1988

| CAGR |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1984 | 1985 | 1986 | 1.987 | 1988 | 1984-1988 |
| 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 | $96.6 \%$ | $(17.0 \%)$ | $(12.8 \%)$ | $0.9 \%$ | $(0.6 \%)$ |  |

## Microcontroller Forecast Summary

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## Microcontroller Forecast Summary

## 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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## Microcontroller Forecast Summary

## 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.

Microcontrolier 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 |

# Microcontroller Forecast Summary 

## Table 1

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

|  | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | $\begin{aligned} & \text { CAGR } \\ & 1989-1994 \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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\% | 14.88 | 13.38 | 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\% | 9.58 |  |
| 16-Bit MCU | \$ 50.9 | \$ 52.8 | \$ 61.7 | \$ 134.3 | \$ 244.3 | \$ 300.6 | 42.7\% |
| Growth | 8.3\% | 3.8\% | 16.98 | 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: | Dataquest |
| ---: | :--- |
|  | July 1989 |

## Table 2

Worldwide MOS Microcontroller Unit Shipment Forecast (Millions of Units)

|  | 1989 | 1990 | 1991 | 1292 | 1993 | 1994 | $\begin{gathered} \text { CAGR } \\ 3.989-1994 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit MCU | 595.0 | 610.0 | 715.0 | 825.0 | 935.0 | 995.0 | 10.88 |
| Growth | 18.78 | 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\% | 29.38 | 31.6\% | 10.8\% |  |
| 16-8it 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 |
| SIS Prod., Mkt., \& Tech. 0004352 |  |  | © 1989 Dataquest Incorporated July |  |  |  | 3 |

## Microcontroller Forecast Summary

Table 3
Worldwide MOS Microcontroller ASP Forecast

|  | 1989 | 1290 | 1991 | 1992 | 1993 | 1994 | $\begin{gathered} \text { CAGR } \\ 1989-1994 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { 4-Bit MCU } \\ & \text { Growth } \end{aligned}$ | $\begin{aligned} & \$ 1.97 \\ & (3.08) \end{aligned}$ | $\begin{aligned} & \$ 1.94 \\ & (1.5 \%) \end{aligned}$ | $\begin{array}{r} \$ 1.96 \\ 1.0 \% \end{array}$ | $\begin{aligned} & \$ 2.95 \\ & (0.5 \%) \end{aligned}$ | $\begin{array}{r} \$ 1.95 \\ 0 \end{array}$ | $\begin{aligned} & \$ 1.92 \\ & (1.5 \%) \end{aligned}$ | (0.58) |
| $\begin{array}{r} \text { 8-Bit MCU } \\ \text { Growth } \end{array}$ | $\begin{aligned} & \$ 3.48 \\ & (6.28) \end{aligned}$ | $\begin{aligned} & \$ 3.39 \\ & (2.68) \end{aligned}$ | $\begin{array}{r} \$ 3.43 \\ 1.2 \$ \end{array}$ | $\begin{aligned} & \$ 3.40 \\ & (0.98) \end{aligned}$ | $\begin{aligned} & \$ 3.39 \\ & (0.39) \end{aligned}$ | $\begin{aligned} & \$ 3.35 \\ & (1.2 \%) \end{aligned}$ | (0.8\%) |
| 16-Bit MCU Growth | $\begin{aligned} & \$ 8.48 \\ & (0.88) \end{aligned}$ | $\begin{aligned} & \$ 8.38 \\ & (1.28) \end{aligned}$ | $\begin{aligned} & \$ 8.23 \\ & (1.8 \%) \end{aligned}$ | $\begin{aligned} & \$ 7.46 \\ & (9.48) \end{aligned}$ | $\begin{aligned} & \$ 6.98 \\ & (6.48) \end{aligned}$ | $\begin{aligned} & \$ 6.68 \\ & (4.3 \%) \end{aligned}$ | (4.7\%) |
| Aggregate |  |  |  |  |  |  |  |
| ASP | \$2.74 | \$2.69 | \$2.73 | \$2.77 | \$2.84 | \$2.83 | 0.6\% |
| Growth | (4.2\%) | (2.0\%) | 2.7\% | 1.5\% | 2.48 | (0.5\%) |  |
|  |  |  |  |  |  | Source: | Dataquest <br> July 1989 |

## Microcontroller Forecast Summary

Table 4
Estimated Worldwide MOS Microcontroller Revenue
1979-1983
(Millions of Dollars)

|  | 1979 | 1980 | 1981 | 1982 | 1983 | $\begin{gathered} \text { CAGR } \\ 1979-1983 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{array}{r} \text { 4-Bit MCU } \\ \text { Growth } \end{array}$ | \$110.4 | $\begin{array}{r} \$ 206.6 \\ 87.1 \% \end{array}$ | $\begin{array}{r} \$ 267.1 \\ 29.3 \% \end{array}$ | $\begin{aligned} & \$ 253.0 \\ & (5.3 \%) \end{aligned}$ | $\begin{array}{r} \$ 257.9 \\ 1.9 \% \end{array}$ | 23.6\% |
| 8-Bit MCU Growth | \$ 75.3 | $\begin{array}{r} \$ 108.7 \\ 44.38 \end{array}$ | $\begin{array}{r} \$ 136.2 \\ 25.38 \end{array}$ | $\begin{array}{r} \$ 173.2 \\ 27.1 \% \end{array}$ | $\begin{array}{r} \$ 267.3 \\ 54.48 \end{array}$ | 37.2\% |
| 16-Bit MCU Growth | $\$ 0.05$ | $\begin{aligned} & \$ 0.15 \\ & 200.0 \% \end{aligned}$ | $\begin{aligned} & \$ 0.9 \\ & 500.0 \% \end{aligned}$ | $\begin{gathered} 0.9 \\ (5.6 \%) \end{gathered}$ | $\begin{array}{r} 1.1 \\ 33.0 \% \end{array}$ | 118.18 |
| 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)


Source: Dataquest July 1989

## Microcontroller Forecast Summary

## Table 6

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

|  | 1979 | 1980 | 1981 | 1.982 | 1983 | $\begin{gathered} \text { CAGR } \\ 1979-1983 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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\% | $55.0 \%$ | 67.48 |  |
| 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 | 43.48 |
| Growth | - | 89.8\% | 43.0\% | 26.1\% | 23.78 |  |

## Table 7

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

|  | 1984 | 1985 | 1986 | 1987 | 1988 | $\begin{gathered} \text { CAGR } \\ 1.984-1.988 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit MCU | 293.4 | 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\% | 36.94 | 48.9\% | 36.4\% |  |
| 16-Bit MCU | 0.06 | 0.23 | 0.4 | 3.4 | 5.5 | 209.4\% |
| Growth | (33.38) | 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 |

# Microcontroller Forecast Summary 

## Table 8

Estimated Worldwide MOS Microcontroller ASPs 1979-1983

|  | 1979 | 1980 | 1.981 | 1982 | 1983 | $\begin{aligned} & \text { CAGR } \\ & 1979-1983 \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { 4-Bit MCU } \\ & \text { Growth } \end{aligned}$ | \$ 2.19 | $\begin{gathered} 2.15 \\ (1.6 \%) \end{gathered}$ | $\begin{gathered} \$ 2.00 \\ (6.9 \%) \end{gathered}$ | $\begin{aligned} & \$ 1.60 \\ & (20.18) \end{aligned}$ | $\begin{aligned} & \$ 1.50 \\ & (6.2 \%) \end{aligned}$ | (9.0\%) |
| $\begin{aligned} & \text { 8-Bit MCU } \\ & \text { Growth } \end{aligned}$ | \$ 6.50 | $\begin{aligned} & \$ 5.00 \\ & (23.18) \end{aligned}$ | $\begin{aligned} & \$ 3.90 \\ & (22.0 \%) \end{aligned}$ | $\begin{aligned} & \$ 3.20 \\ & (17.9 \%) \end{aligned}$ | $\begin{gathered} \$ 2.95 \\ (7.8 \%) \end{gathered}$ | (17.9\%) |
| $\begin{aligned} & \text { 16-Bit MCU } \\ & \text { Growth } \end{aligned}$ | \$50.00 | $\begin{aligned} & \$ 30.00 \\ & (40.0 \%) \end{aligned}$ | $\begin{aligned} & \$ 22.50 \\ & (25.0 \%) \end{aligned}$ | $\begin{aligned} & \$ 17.00 \\ & (24.4 \%) \end{aligned}$ | $\begin{aligned} & \$ 12.56 \\ & (26.1 \%) \end{aligned}$ | (29.2\%) |
| Aggregate ASP Growth | \$ 2.99 | $\begin{aligned} & \$ 2.68 \\ & (10.5 \%) \end{aligned}$ | $\begin{aligned} & \$ 2.40 \\ & (10.48) \end{aligned}$ | $\begin{aligned} & \$ 2.01 \\ & (16.28) \end{aligned}$ | $\begin{gathered} \$ 2.00 \\ (0.3 \%) \end{gathered}$ | (9.5\%) |

Table 9
Estimated Worldwide MOS Microcontroller ASPs
1984-1988

|  | 2984 | 1985 | 1986 | 1987 | 1988 | $\begin{gathered} \text { CAGR } \\ 1984-1988 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit MCU Growth | $\begin{array}{r} \$ 2.46 \\ 64.0 \% \end{array}$ | $\begin{aligned} & \$ 2.16 \\ & (12.28) \end{aligned}$ | $\begin{gathered} \$ 2.04 \\ (5.6 \%) \end{gathered}$ | $\begin{gathered} \$ 2.02 \\ (1.0 \%) \end{gathered}$ | $\begin{array}{r} \$ 2.03 \\ 0.58 \end{array}$ | (4.78) |
| $\begin{aligned} & \text { 8-Bit MCU } \\ & \text { Growth } \end{aligned}$ | $\begin{array}{r} \$ 5.69 \\ 92.98 \end{array}$ | $\begin{aligned} & \$ 4.45 \\ & (21.88) \end{aligned}$ | $\begin{aligned} & \$ 3.81 \\ & (14.4 \%) \end{aligned}$ | $\begin{array}{r} \$ 3.83 \\ 0.5 \% \end{array}$ | $\begin{aligned} & \$ 3.71 \\ & (3.18) \end{aligned}$ | (10.1\%) |
| 16-Bit MCU Growth | $\begin{aligned} & \$ 11.00 \\ & (12.4 \%) \end{aligned}$ | $\begin{array}{r} \$ 17.40 \\ 58.2 \% \end{array}$ | $\begin{array}{r} \$ 17.48 \\ 0.58 \end{array}$ | $\begin{aligned} & \$ 8.55 \\ & (51.18) \end{aligned}$ | $\begin{array}{r} \$ 8.55 \\ 0 \end{array}$ | (6.18) |
| Aggregate ASP Growth | $\begin{array}{r} \$ 3.94 \\ 96.6 \% \end{array}$ | $\begin{aligned} & \$ 3.27 \\ & (17.08) \end{aligned}$ | $\begin{aligned} & \$ 2.85 \\ & (12.8 \%) \end{aligned}$ | $\begin{array}{r} \$ 2.88 \\ 0.98 \end{array}$ | $\begin{aligned} & \$ 2.86 \\ & (0.68) \end{aligned}$ | (7.7\%) |

Source: Dataquest
July 1989

## Worldwide Microcontroller Executive Summary

## MARKET OVERVIEN

Microcontrollers are everywhere. Typically, microcontrollers are used for controlling and monitoring equipment and real-time events. Their data-handing 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

## MARKET FORECAST

During 1986, microcontroller tevenue 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 miliion and 1991 unit shipments of 1.2 billion reflect a 22.9 percent CAGR during this time.


## $\overline{\text { Microcontroller Market Analysis }}$

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, 1985-1988
Figure 4 Estimated Market Share by Word Length for Microcontrollers, 1985-1988
Table 2 Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1985-1988

Figure 5 Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1988

Table 3 Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1985-1988

Figure 6 Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1988

## Microcontroller Market Analysis

## Figure 1

Estimated Market Shares of Leading Manufacturers and Products for 4-Bit Microcontrollers 1988

501.1 Million Units

0004762-1

Source: Dataquest
September 1989

Figure 2
Estimated Market Shares of Leading Manufacturers and Products for 8-Bit Microcontrollers 1988

454.0 Million Units

## Microcontroller Market Analysis

Figure 3
Estimated Market Shares of Leading Manufacturers and Products for 16-Bit Microcontrollers 1988


## Microcontroller Market Analysis

Table 1
Estimated Market Share by Word Length for Microcontrollers

1985-1988
(Thousands of Units)

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

Figure 4
Estimated Market Share by Word Length for Microcontrollers

1985-1988
Billions of Units

*Revised Data 0004762-4

Source: Dataquest
Dataquest
September 1989

## Microcontroller Market Analysis

Table 2
Estimated Market Share by Region
for 4-, 8-, and 16-Bit Microcontrollers
1985-1988
(Thousands of Units)
4-Bit Shipments
U.S. Companies (\%)
Japanese Companies (\%)
European Companies (\%)
8-Bit Shipments
U.S. Companies (\%)
Japanese Companies (\%)
European Companies (\%)
16-Bit Shipments
U.S. Companies (\%)
Japanese Companies (\%)
European Companies (\%)
Total Shipments
U.S. Companies (\%)
Japanese Companies (\%)
European Companies (\%)

| 1985 | $\underline{1986}$ | $\underline{1987}$ | 1988 |
| ---: | ---: | ---: | ---: |
| 177.038 | 271.883 | 392.332 | 501,075 |
| $16.3 \%$ | $17.8 \%$ | $11.8 \%$ | $7.7 \%$ |
| $80.8 \%$ | $79.8 \%$ | $86.3 \%$ | $90.5 \%$ |
| $3.0 \%$ | $2.3 \%$ | $1.9 \%$ | $1.8 \%$ |
|  |  |  |  |
| 163.599 | 224,001 | 333.362 | 454,022 |
| $42.7 \%$ | $34.8 \%$ | $35.3 \%$ | $36.4 \%$ |
| $43.2 \%$ | $50.0 \%$ | $53.1 \%$ | $54,7 \%$ |
| $14.1 \%$ | $15.2 \%$ | $11.6 \%$ | $8.9 \%$ |
|  |  |  |  |
| 232 | 399 | 3.311 | 5,461 |
| $94.8 \%$ | $67.7 \%$ | $96.6 \%$ | $98.7 \%$ |
| 0 | 0 | $0.1 \%$ | $0.2 \%$ |
| $5.2 \%$ | $32.3 \%$ | $3.3 \%$ | $1.2 \%$ |
|  |  |  |  |
| 340.869 | 496.283 | 729.005 | 960.558 |
| $29.0 \%$ | $25.5 \%$ | $22.9 \%$ | $38.4 \%$ |
| $62.7 \%$ | $66.3 \%$ | $70.7 \%$ | $73.1 \%$ |
| $8.3 \%$ | $8.2 \%$ | $6.4 \%$ | $5.1 \%$ |

Source: Dataquest September 1989

## Microcontroller Market Analysis

Figure 5
Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1988


## Microcontroller Market Analysis

Table 3
Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers

1985-1988
(Thousands of Units)

|  | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: |
| 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<br>September 1989

## Microcontroller Market Analysis

Figure 6
Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1988


## Microcontroller Market Analysis

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

## Figure I 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 2 Estimated Market Share by Word Length for Microcontrollers, 1985-1987
Figure 4 Estimated Market Share by Word Length for Microcontrollers, 1980-1987
Table 3 Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1980-1984

Table 4 Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1985-1987

Figure 5 Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1987

Table 5 Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1980-1984

Table 6 Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1985-1987

Figure 6 Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1987

## $\underline{\text { Microcontroller Market Analysis }}$

Figure 1
Estimated Market Shares of Leading Manufacturers and Products for 4-Bit Microcontrollers

1987

392.3 Million Units

Figure 2
Estimated Market Shares of Leading Manufacturers and Products for 8-Bit Microcontrollers 1987

333.4 Million Units

## Microcontroller Market Analysis

Figure 3
Estimated Market Shares of Leading Manufacturers and Products for 16-Bit Microcontrollers 1987

685.000 Units

## Microcontroller Market Analysis

## Table 1

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

|  | 1980 | 1981 | 1982 | 1983 | 1.984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit |  |  |  |  |  |
| Shipments | 96,080 | 133,549 | 158,183 | 171,945 | 193,435 |
| Percent | 81.5\% | 79.3\% | 74.5\% | 65.5\% | 54.28 |
| 8-Bit |  |  |  |  |  |
| Shipments | 21,740 | 34,931 | 54,114 | 90,615 | 163,510 |
| Percent | 18.5\% | 20.78 | 25.58 | 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 |

## Microcontroller Market Analysis

Table 2

## Estimated Market Share by Word Length for Microcontrollers 1985-1987 <br> (Thousands of Units)

|  | $\underline{1985}$ | $\underline{1986}$ | $\underline{1987}$ |
| :---: | :---: | :---: | :---: |
| 4-Bit |  |  |  |
| Shipments | 177,038 | 271,883 | 392,332 |
| Percent | $51.9 \%$ | $54.8 \%$ | $54.0 \%$ |
| 8-Bit |  |  |  |
| Shipments |  |  |  |
| Percent | 163,599 | 224,001 | 333,362 |
| 16-Bit | $48.0 \%$ | $45.1 \%$ | $45.9 \%$ |
| Shipments |  |  |  |
| Percent | 232 | 399 | 685 |
| Total Shipments | 340,869 | 496,283 | 726,379 |
|  |  | Source: | Dataquest. |
|  |  |  | April 1989. |

Figure 4
Estimated Market Share by Word Length for Microcontrollers

1980-1987


## Microcontroller Market Analysis

Table 3

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

|  | 1980 | 1981 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit Shipments | 96,080 | 133,549 | 158,183 | 171,945 | 193,435 |
| U.S. Companies (\%) | 65.2\% | 40.5\% | 28.2\% | $20.3 \%$ | 19.2\% |
| Japanese Companies (\%) | 34.8\% | 59.5\% | 71.78 | 79.28 | 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 (\%) | 73.38 | 68.3\% | 61.0\% | 57.6\% | 51.7\% |
| Japanese Companies (\%) | 15.5\% | 20.1\% | 27.18 | 31.38 | $36.6 \%$ |
| European Companies (\%) | 11.2\% | 11.7\% | 11.8\% | 11.08 | 11.7\% |
| 16-Bit Shipments | 8 | 36 | 50 | 89 | 123 |
| U.S. Companies (\%) | 100.08 | 100.0\% | 100.08 | 100.0\% | 100.08 |
| 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\% | 46.24 | $36.6 \%$ | 33.2\% | 34.18 |
| Japanese Companies (\%) | 31.2\% | 51.3\% | 60.38 | 62.78 | 59.7\% |
| European Companies (\%) | 2.18 | 2.4\% | 3.1\% | 4.18 | 6.2\% |
|  |  |  | Source: D |  | Dataquest |
|  |  |  |  |  | ril 1989 |

## Microcontroller Market Analysis



Table 4
Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers

1985-1987
(Thousands of Units)

|  | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: |
| 4-Bit Shipments | 177,038 | 271,883 | 392,332 |
| U.S. Companies (\%) | 16.3\% | 17.8\% | 11.8\% |
| Japanese Companies (\%) | 80.88 | $79.8 \%$ | 86.3\% |
| European Companies (\%) | 3.08 | 2.38 | 1.9\% |
| 8-Bit Shipments | 163.599 | 224,001 | 333,362 |
| U.S. Companies (8) | 42.7\% | 34.8\% | 35.38 |
| Japanese Companies (\%) | 43.24 | 50.0\% | 53.18 |
| European Companies (\%) | 14.18 | 15.28 | 11.6\% |
| 16-Bit Shipments | 232 | 399 | 685 |
| U.S. Companies (\%) | 94.8\% | 67.78 | 83.68 |
| Japanese Companies (\%) | 0 | 0 | 0.38 |
| European Companies (\%) | 5.2\% | 32.3* | 16.18 |
| Total Shipments | 340.869 | 496.283 | 726,379 |
| U.S. Companies (\%) | 29.04 | 25.5\% | 22.68 |
| Japanese Companies (\%) | 62.7\% | 66.3\% | 71.08 |
| European Companies (\%) | 8.3\% | 8.2\% | 6.4\% |
|  |  | Source: | Dataquest April 1989 |

## Microcontroller Market Analysis

Figure 5

## Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1987



## $\overline{\text { Microcontroller Market Analysis }}$

## Table 5

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

|  | 1980 | 1981 | 2982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit Shipments | 96,080 | 133.549 | 158,183 | 171,945 | 193,435 |
| Percent PMOS | 66.3\% | 52.08 | 35.2\% | 22.08 | 14.94 |
| Percent NMOS | 14.4\% | 19.48 | 23.5\% | 30.58 | 32.2\% |
| Percent CMOS | 19.38 | 28.6\% | 41.39 | 47.5\% | 52.9\% |
| 8-Bit Shipments | 21.740 | 34.931 | 54,114 | 90,615 | 163.510 |
| Percent NMOS | 100.0\% | 99.78 | $96.8 \%$ | 91.4\% | 90.0\% |
| Percent cmos | 0 | 0.3\% | 3.28 | 8.6\% | 10.04 |
| 16-Bit Shipments | 8 | 36 | 50 | 89 | 123 |
| Percent MMOS | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.08 |
| Percent CMOS | 0 | 0 | 0 | 0 | 0 |
| Total Shipments | 117.828 | 168,516 | 212,347 | 262,649 | 357,068 |
| Percent PMOS | 54.18 | 41.28 | 26.2\% | 14.48 | 8.14 |
| Percent mMOS | 30.2\% | 36.18 | $42.2 \%$ | 51.5\% | 58.74 |
| Percent CMOS | 15.8\% | 22.7\% | 31.68 | 34.18 | 33.3\% |
|  |  |  |  | Source: | Dataquest April 1989 |

## Microcontroller Market Analysis

Table 6
Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers

1985-1987
(Thousands of Units)

|  | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: |
| 4-Bit Shipments | 177,038 | 271,883 | 392,332 |
| Percent PMOS | 10.0\% | 4.98 | 2.51 |
| Percent mMOS | $34.8 \%$ | 29.8\% | 24.3\% |
| Percent CMOS | 55.2\% | 65.2\% | 73.28 |
|  |  |  |  |
| 8-Bit Shipments | 163,599 | 224,001 | 333,362 |
| Percent NMOS | $79.5 \%$ | 67.8\% | 59.2\% |
| Percent cmos | 20.5* | 32.28 | 40.8\% |
| 16-Bit Shipments | 232 | 399 | 685 |
| Percent msos | 100.08 | 100.0\% | 96.18 |
| Percent CMOS | 0 | 0 | 3.98 |
| Total Shipments | 340,869 | 496.283 | 726,379 |
| Percent PMOS | 5.2\% | . 2.7\% | 1.38 |
| Percent mmos | 56.38 | 47.08 | 40.4\% |
| Percent CMOS | 38.5\% | 50.3\% | 58.38 |
|  |  | Source: | Dataquest |
|  |  |  | April 1989 |

## Microcontroller Market Analysis

Figure 6
Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1987


Source: Dataquest
April 1989

## Microcontroller Market Analysis

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## Microcontroller Market Analysis

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 3 Estimated Market Share by Word Length for Microcontrollers, 1985-1988
Figure 4 Estimated Market Share by Word Length for Microcontrollers, 1980-1988
Table 4 Estimated Market 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, 1985-1988

Figure 5 Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers, 1988

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, 1985-1988

Figure 6 Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1988

## Microcontroller Market Analysis

Figure 1
Estimated Market Shares of Leading Manufacturers and Products for 4-Bit Microcontrollers

1988

501.1 Million Units

Figure 2
Estimated Market Shares of Leading Manufacturers and Products for 8-Bit Microcontrollers 1988

454.0 Million Units

## Microcontroller Market Analysis

Figure 3
Estimated Market Shares of Leading Manufacturers and Products for 16-Bit Microcontrollers 1988


## $\overline{\text { Microcontroller Market Analysis }}$

Table 1
Estimated Market Share by Word Length for Microcontrollers 1975-1979
(Thousands of Units)

|  | 1.975 | 3976 | 1977 | 1978 | 1.979 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit |  |  |  |  |  |
| Shipments | 500 | 760 | 3,400 | 15,959 | 50,525 |
| Percent | 94.0\% | 75.2\% | 79.38 | 87.8\% | 81.3\% |
| 8-Bit |  |  |  |  |  |
| Shipments | 32 | 251 | 885 | 2,218 | 13,592 |
| Percent | 6.0\% | 24.8\% | 20.7\% | 12.2\% | $18.7 \%$ |
| I6-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

# Microcontroller Market Analysis 

## Table 2

## Estimated Market Share by Word Length for Microcontrollers <br> 1980-1984 <br> (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\% | 74.58 | 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 |

Source: Dataquest
September 1989

## Microcontroller Market Analysis

Table 3
Estimated Market Share by Word Length for Microcontrollers

1985-1988
(Thousands of Units)

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

Source: $\begin{aligned} & \text { Dataquest } \\ & \text { September } 1989\end{aligned}$

Figure 4
Estimated Market Share by Word Length for Microcontrollers

1980-1988


[^1] 0004758-4

## Microcontroller Market Analysis

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

|  | 1975 | 1976 | 1977 | 1978 | 1272 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit Shipments | 500 | 760 | 3.400 | 15.959 | 50,525 |
| U.S. Companies (\%) | 100.0\% | 100.08 | 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\% | 100.08 | 99.3\% | 91.1\% |
| Japanese Companies (\%) | 0 | 0 | 0 | 0.78 | 8.5\% |
| European Companies (\%) | 0 | 0 | 0 | 0 | 0.4\% |
| 16-Bit Shipments | 0 | 0 | 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\% | 100.04 | 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 |  |

## Microcontroller Market Analysis

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 |
| U.S. Companies (\%) | $65.2 \%$. | 40.5\% | 28.2\% | 0.3\% | 19.2\% |
| Japanese Companies (\%) | 34.8\% | 59.58 | 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 (\%) | 73.38 | 68.38 | 61.0\% | 57.6\% | 51.7\% |
| Japanese Companies (\%) | 15.5\% | 20.1\% | 27.18 | 31.38 | 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 (\%) | 66.78 | $46.2 \%$ | 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 | bert 1989 |

## Microcontroller Market Analysis

Table 6
Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1985-1988 (Thousands of Units)

|  | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: |
| 4-Bit Shipments | 177,038 | 271,883 | 392,332 | 501.075 |
| U.S. Companies (\$) | 16.3\% | 17.84 | 11.8\% | 7.7\% |
| Japanese Companies (\%) | 80.8\% | $79.8 \%$ | 86.3\% | 90.5\% |
| European Companies (\%) | 3.0\% | 2.3\% | 1.98 | 1.8\% |
| 8-Bit Shipments | 163,599 | 224,001 | 333,362 | 454,022 |
| U.S. Companies (\%) | 42.74 | 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\% |
| 16-8it 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 (\%) | 62.78 | 66.3\% | 70,7\% | $73.1 \%$ |
| European Companies (\%) | 8.3\% | 8.2\% | 6.4\% | 5.18 |

## Microcontroller Market Analysis

Figure 5
Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1988


## Microcontroller Market Analysis

## Table 7

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

|  | 2975 | 1976 | 1977 | 1278 | 1979 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit | 500 | 760 | 3,400 | 15.959 | 50,525 |
| Percent PMOS | 100.09 | 100.0\% | 100.0\% | 80.48 | 75.3\% |
| Percent NMOS | 0 | 0 | 0 | 14.9\% | 14.9\% |
| - Percent CMOS | 0 | 0 | 0 | 4.79 | $9.8 \%$ |
| 8-Eit | 32 | 251 | 885 | 2.218 | 11,592 |
| Percent mMOS | 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 sMOS | 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\% | 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 |

## Microcontroller Market Analysis

Table 8

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

|  | 1280 | 2981 | 1.982 | 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\% | 14.98 |
| Percent mMOS | 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 | 100.04 | 99.7\% | 96.8\% | 91.4\% | 90.0\% |
| Percent CMOS | 0 | 0.38 | 3.2\% | 8.6\% | 10.0\% |
| 16-Bit Shipments | 8 | 36 | 50 | 89 | 123 |
| Percent NMOS | 100.04 | 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 |

## Microcontroller Market Analysis

Table 9
Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers

1985-1988
(Thousands of Units)

|  | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: |
| 4-Bit Shipments | 177,038 | 271.883 | 392,332 | 501,075 |
| Percent pMOS | 10.0\% | 4.9\% | 2.5\% | 1.2\% |
| Percent smos | 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 | 79.58 | 67.8\% | 59.2\% | 48.4\% |
| Percent CMOS | 20.5\% | 32.28 | 40.8\% | 51.6\% |
| 16-Bit Shipments | 232 | 399 | 3.311 | 5,461 |
| Percent wmos | 100.0\% | 100.0\% | 19.98 | 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\% | 50.38 | 58.4\% | 69.2\% |
|  |  |  | ce: Dataquest |  |

## Microcontroller Market Analysis

Figure 6
Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1988


## Worldwide Microcontroller Analysis

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

# Worldwide Microcontroller Analysis 

## Table 1

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


Source: Dataquest October 1987

## Worldwide Microcontroller Analysis

Figure 1
Estimated Microcontroller Unit Shipments by Word Length 1975-1986


Worldwide Microcontroller Analysis

Table 2
Estimated Market Share by Manufacturer for all Microcontrollers

1975-1980

|  | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 |  |  |  |  | $\cdots$ | . |
| General Instrument |  |  |  | 2.48 | 6.60 | 4.75 |
| Siemens |  |  |  |  |  | 0.02 |
| Others | -90.60 | $\underline{69.34}$ | -31.62 | 19.07 | $\underline{13.70}$ | $\underline{10.17}$ |
| Total | 100.008 | 100.00\% | 100.00\% | 100.00\% | 100.00\% | 100.00\% |

## Worldwide Microcontroller Analysis

Table 2 (Continued)
Estimated Market Share by Manufacturer for all Microcontrollers 1981-1986

|  | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HEC | 26.53\% | 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 | 6.56 | 4.70 |

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

## Worldwide Microcontroller Analysis

Figure 2

## Estimated Market Share by Manufacturer for all Microcontrollers 1985 and 1986



1985


1986

Source: Dataquest October 1987

## Worldwide Microcontroller Analysis

Table 3
Estimated Market Share by Region for all Microcontrollers
1981-1986
(Thousands of Units)

|  | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Europe |  |  |  |  |  |  |
| shipments |  |  |  |  |  |  |
| Percent |  |  |  |  |  |  |

## Worldwide Microcontroller Analysis

Figure 3
Estimated Market Share by Region for all Microcontrollers 1981-1986


## 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


## Microcontroller Application Market Overview

```
* 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
    - Teaçhing toys
- Games
```


## INDUSTRIAL APPLTCATIONS

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.

## Microcontroller Application Market Overview

Typical industrial applications of microcontrollers are listed below:

| $\bullet$ | Motor control | - | Elevators |  |
| :---: | :---: | :---: | :---: | :---: |
| - | Medical instrumentation | - | Power tools |  |
| $\bullet$ | Scales | - | Gas pumps |  |
| - | Liquid and gas chromatographs | * | Timers |  |
| - | Vending machines | - | Machinery control | - |
| - | Oscilloscopes | * | Process control |  |
| - | Beverage dispensers | $\bullet$ | Robot control |  |
|  | Speech recognition | - | Numerical control |  |
|  | Speech synthesis | - | Intelligent transducers |  |

## COMMNICATIONS APPLICATIONS

With the merging of communications and computer technologies in various systems such as videotex and teletext, electronic commnications 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
- Pagers
- Videotex

Modems

## Microcontroller Application Market Overview

## 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
- Oil 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


## Microcontroller Application Market Overview

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


## $\overline{\text { Microcontroller Application Market Overview }}$

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## Microcontroller Shipments--Second Quarter 1987

## 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)

Millions of Units


## Microcontroller Shipments--Second Quarter 1987

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)


## Microcontroller Shipments--Second Quarter 1987

Figure 2
Quarterly Percent Change in 8-Bit Microcontroller Unit Shipments Second Quarter 1986 through Second Quarter 1987 (Percent)


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

| Device | 01/1987 |  | 02/1987 |  | Percent Growth 01 to 02 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Units | Percent of Shipments | Units | Percent of Shipments |  |
| 6805 | 9.450 | 15.29 | 9.593 | 14.84 | 1.5\% |
| 8049 | 8,629 | 13.9 | 8,438 | 13.0 | (2.2\%) |
| 8051 | 6,752 | 10.8 | 7,037 | 10.8 | 4.21 |
| 8048 | 3,515 | 5.6 | 3,643 | 5.6 | 3.64 |
| Others | 33,945 | 54.5 | 36,255 | 55,8 | 6.88 |
| Total | 62,291 | 100.08 | 64,966 | 100.0\% | 4.34 |
|  |  |  |  | Source: | quest uary 1988 |

# Microcontroller Shipments--Second Quarter 1987 

Table 3
Market Share by Technology for 8-bit Microcontrollers
Second Quarter 1986 through Second Quarter 1987

| Device | Tech. | $02 / 8.6$ | $03 / 86$ | $04 / 86$ | $01 / 87$ | $02 / 87$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 8-Bit MCU | CMOS |  | $27.7 \%$ | $28.1 \%$ | $30.0 \%$ | $31.3 \%$ |

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

| Device Type | Region | 02/86 | 03/86 | $04 / 86$ | 01/87 | $02 / 87$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $4 \rightarrow$ Bit | United States | 18.0\% | 18.08 | 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\% | 39.98 | 40.3\% | 39.5\% |
|  | Japan | 46.8 | 46.2 | 43.6 | 44.4 | 44.9 |
|  | Europe | 16.7 | 16.4 | 16.6 | 15.3 | 15.6 |
|  | Total | 100.04 | 100.08 | 100.08 | 100.0\% | 100.0\% |

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

Source: Dataquest January 1988

## Microcontroller Shipments--First Quarter 1987

## 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

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

Millions of Units


## Microcontroller Shipments--First Quarter 1987

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)

| Device | Q4/86 |  | 01/87 |  | $\begin{aligned} & \text { Percent } \\ & \text { Growth } \\ & 04 \text { to } 01 \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Units | Percentage of Shipments | Units | Percentage of Shipments |  |
| 4-Bit | 62,512 | 53.38 | 64,060 | 52.4\% | 2.48\% |
| 8-Bit | 54.721 | 46.6 | 57,989 | 47.5 | 5.97\% |
| 16-Bit | 107 | 0.1 | 118 | 0.1 | 10.28\% |
| Total | 117,340 | 100.0\% | 122,167 | 100.08 | 4.11\% |

## Microcontroller Shipments--First Quarter 1987

Figure 2
Quarterly Percent Change in 8-Bit Microcontroller Unit Shipments First Quarter 1986 through First Quarter 1987
(Percent)


Table 2
Leading 8-Bit Microcontroller Unit Shipments Fourth Quarter 1986 through First Quarter 1987 (Thousands of Units)

| Device | 04/86 |  | 01/87 |  | $\begin{aligned} & \text { Percent } \\ & \text { Growth } \\ & 04 \text { to } 04 \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Units | Percentage of Shipments | Units | Percentage of Shipments |  |
| 6805 | 8,865 | 16.28 | 9,270 | 16.0\% | 4.578 |
| 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 | 28,690 | 52.4 | 30,129 | 52.0 | $5.02 \%$ |
| Total | 54,721 | 100.0\% | 57,989 | 100.0\% | 5.97\% |

Source: Dataquest January 1988

## Microcontroller Shipments--First Quarter 1987

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

| Device | Region | $01 / 86$ | 22/86 | 03/86 | 04/86 | 01/87 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit | United States | 20.18 | 20.78 | 20.2\% | 22.78 | 20.58 |
|  | Japan | 77.2 | 76.7 | 77.1 | 74.4 | 76.7 |
|  | Europe | 2.7 | 2.6 | 2.7 | 2.9 | 2.8 |
|  | Total | 100.0\% | 100.08 | 100.0\% | 100.0\% | 100.08 |
| 8-Bit | United States | 39.28 | 37.84 | 38.08 | 41.6\% | 42.14 |
|  | Japan | 44.1 | 44.7 | 45.4 | 41.2 | 41.6 |
|  | Europe | 16.7 | 17.5 | 16.6 | 17.2 | 16.3 |
|  | Total | 100.0\% | 100.0\% | 100.0\% | 100.08 | 100.08 |

Table 4
Market Share by Technology for 8-Bit MCU Shipments

| Device | Region | 01/86 | 02/86 | 03/86 | 04/86 | 01/87 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 8-Bit MCU | cmos | 23.4\% | 25.24 | 27.38 | 27.5\% | 26.58 |
|  | nmos | 76.6 | 74.8 | 72.7 | 72.5 | 73.5 |
|  | Total | 100.08 | 100.08 | 100.08 | 100.08 | 100.0\% |

## Microcontroller Shipments--Fourth Quarter 1986

## 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
Millions of Units


## Microcontroller Shipments--Fourth Quarter 1986

Table 1
Total Microcontroller Unit Shipments
Third Quarter 1986 through Fourth Quarter 1986
(Thousands of Units)

| MCU | 03/1986 |  | 04/1986 |  | Percent Growth Q3 to 04 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Units | Percent of Shipments | Units | Percent of Shipments |  |
| 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 | 100.08 | 113,743 | 100.0\% | 0.4\% |
|  |  |  |  | Source: | quest <br> ner 1987 |

Figure 2
Quarterly Percent Change in 8-Bit Microcontroller Unit Shipments Fourth Quarter 1985 through Fourth Quarter 1986


## Microcontroller Shipments--Fourth Quarter 1986

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)

| Device | 03/1986 |  | Q4/1986 |  | Percent Growth 03 to 04 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Units | Percent of Shipments | Units | Percent of Shipments |  |
| 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 | 27,638 | 53.9 | 27,385 | 53.6 | (0.9\%) |
| Total | 51,255 | 100.0\% | 51,104 | 100.0\% | (0.3\%) |
|  |  |  |  | Source: | quest <br> meer 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.

# Microcontroller Shipments--Fourth Quarter 1986 

## Table 3

## Market Share by Region for 4- and 8-Bit Microcontrollers

Fourth Quarter 1985 through Fourth Quarter 1986

|  | Region | Q4/85 | 01/86 | 02/86 | Q3/86 | 04/86 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit | United States | 14.3\% | 19.6\% | 20.7\% | 20.2\% | 22.7\% |
|  | Japan | $82.8{ }^{\prime \prime}$ | 77.8 | 76.7 | 77.1 | 74.4 |
|  | Europe | 2.9 | 2.7 | 2.6 | 2.7 | 2.9 |
|  | Total | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |
| 8-Bit | United States | 44.18 | 40.0\% | 38.3\% | 37.18 | 38.6\% |
|  | Japan | 42.4 | 44.4 | 45.4 | 46.8 | 44.1 |
|  | Europe | 13.5 | 15.6 | 16.3 | 16.1 | 17.3 |
|  | Total | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |
|  |  |  |  | Sourc | Dataquest <br> December 1987 |  |

Table 4
Market Share by Technology for Microcontrollers Fourth Quarter 1985 through Fourth Quarter 1986

| Device | Technology | 04/85 | 01/86 | 02/86 | 03/86 | 04/86 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 8-Bit MCU | cmos | 21.6\% | 23.3\% | 25.2\% | $26.6 \%$ | $26.3 \%$ |
| 8-Bit MCU | NMOS | 78.4 | 76.7 | 74.8 | 73.4 | 73.7 |
| Total |  | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |

## Microcontroller Shipments--Third Quarter 1986

## 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)
Millions of Units


## Microcontroller Shipments--Third Quarter 1986

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 microcontrollers 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)

| MCU | 02/1986 |  | 03/1986 |  | $\begin{array}{r} \text { Percent } \\ \text { Growth } \\ 02 \text { to } 03 \end{array}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Units | Percent of Shipments | Units | Percent of Shipments |  |
| 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-Bit | 98 | 0.1 | 117 | 0.1 | 19.4\% |
| Total | 98,824 | 100.0\% | 103,695 | 100.0\% | 4.9\% |
|  |  |  |  | Source: | quest <br> mber 1987 |

## Microcontroller Shipments--Third Quarter 1986

Figure 2

## Quarterly Percent Change in 8-Bit Microcontroller Unit Shipments Third Quarter 1985 through Third Quarter 1986 (Percent)



Table 2
Leading 8-Bit Microcontroller Unit Shipments
Second Quarter 1986 through Third Quarter 1986
(Thousands of Units)

|  | 02/1986 |  | 03/1986 |  | Percent Growth |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Percent of |  | Percent of |  |
| Device | Units | Shipments | 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: | quest <br> mber 1987 |

## Microcontroller Shipments--Third Quarter 1986

Table 3
Market Share by Technology for 8-bit Microcontrollers
Third Quarter 1985 through Third Quarter 1986

| Device | Tech. | 03/85 | 04/85 | 01/86 | 02/86 | 03/86 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 8-Bit MCU | CMOS | 20.4\% | 21.6\% | 21.58 | 22.1\% | 21.6\% |
| 8-Bit MCU | NMOS | 79.6 | 78.4 | 78.5 | 77.9 | 78.4 |
| Total |  | 100.08 | 100.0\% | 100.0\% | 100.0\% | 100.0\% |
|  |  |  |  |  | e: Dataquest <br> December 1987 |  |

## Table 4

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


## Microcontroller Shipments--Second Quarter 1986

## SECOND OUARTER 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)

Millions of Units


## $\overline{\text { Microcontroller Shipments--Second Quarter } 1986}$

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)

| MCU | 01/1986 |  | 02/1986 |  | $\begin{aligned} & \text { Percent } \\ & \text { Growth } \\ & \text { 01 to } 02 \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Units | Percent of Shipments | Units | Percent of Shipments |  |
| 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 | 0.1 | 98 | 0.1 | 21.0\% |
| Total | 92,222 | 100.0\% | 98,824 | 100.0\% | 7.2\% |

## Microcontroller Shipments--Second Quarter 1986

Figure 2

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



Table 2
LEADING 8-BIT MICROCONTROLLER UNIT SHIPMENTS FIRST QUARTER 1986 THROUGH SECOND QUARTER 1986 (Thousands of Units)

| Ranking | Device | 01/1986 |  | 02/1986 |  | Percent Growth Q1 to 02 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Units | Percent of Shipments | Units | Percent of Shipments |  |
| 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 | 21,221 | 51.5 | 23,143 | 51.4 | 9.1\% |
|  | Total | 41,241 | 100.0\% | 45,038 | 100.0\% | 9.2\% |
|  |  |  |  |  | Source: | Dataquest |
|  |  |  |  |  |  | April 1987 |

## $\underline{\text { Microcontroller Shipments--Second Quarter } 1986}$

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 SBCOND QUARTER 1985 THROUGH SECOND QUARTER 1986

| Device Type | Region | 02/85 | 03/85 | 04/85 | 01/86 | 02/86 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | 13.8 | 13.5 | 14.9 | 15.3 |
|  | Total | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |
|  |  |  |  | Source: ${ }^{\text {d }}$ |  | quest |
|  |  |  |  |  |  | 11987 |

## Microcontroller Shipments--First Quarter 1986

## FIRST OUARTER 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 miliion 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)

Millions of Units


Source: Dataquest Pebruaty 1987

## Microcontroller Shipments--First Quarter 1986

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

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

| MCU | 04/1985 |  | 01/1986 |  | Percent Growth Q4 to Q1 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Units | Percent of Shipments | Units | Percent of Shipments |  |
| 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 | 71 | 0.1 | 81 | 0.1 | 14.1\% |
| Total | 84,554 | 100.0\% | 92,548 | 100.0\% | 9.5\% |

Source: Dataquest February 1987

# Microcontroller Shipments--First Quarter 1986 

Figure 2

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



Table 2

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


## Microcontroller Shipments--First Quarter 1986

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

| Device Type | Region | 01/85 | 02/85 | 03/85 | 04/85 | 04/86 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | 3.0 | 3.0 | 2.9 | 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 | 12.9 | 13.8 | 13.8 | 13.6 | 14.7 |
|  | Total | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |
|  |  |  |  | Sourc | Dataquest <br> 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.

## Microcontroller Shipments-Third Quarter 1985

## 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 $8-b i t$ 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

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


[^2]
## Microcontroller Shipments-Third Quarter 1985

Table $l$ 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)

| $\underline{M C U}$ | Q2/1985 |  | Q3/1985 |  | Percent Growth$\text { Q2 to } 03$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Units | Percent of Shipments | Units | Percent of Shipments |  |
| 4-Bit | 43,859 | 52.3\% | 43,699 | 53.48 | (0.48) |
| 8-Bit | 39,854 | 47.6 | 38,123 | 46.5 | (4.38) |
| 16-Bit | 55 | 0.1 | 56 | 0.1 | 1.8\% |
| Total | 83,768 | 100.0\% | 81,878 | 100.0\% | (2.3\%) |

Source: DATAQUEST
April 1986

## Microcontroller Shipments-Third Quarter 1985

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 |  | 03/1985 |  | Percent Growth$\mathrm{Q} 2 \text { to } \mathrm{Q} 3$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Units | Percent of Shipments | Units | Percent of Shipments |  |
|  |  |  |  |  |  |  |
| 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 | 51.7 | (4.4\%) |
|  | Total | 39,854 | 100.0\% | 38,123 | 100.08 | (4.3\%) |

## Microcontroller Shipments-Third Quarter 1985

The key 8-bit microcontrollers in third quarter 1985--the 8049, 6805, 8051, and 8048-had approximately 48.3 percent of the total $8-b i t$ 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 | Region | 93/84 | Q4/84 | Q1/85 | Q2/85 | 93/85 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | 100.08 | 100.08 | 100.08 | 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.

# Microcontroller Shipments-Fourth Quarter 1985 

## FOURTH OUARTER 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)

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)

| MCU | 03/1985 |  | 04/1985 |  | $\begin{aligned} & \text { Percent } \\ & \text { Growth } \\ & 03 \text { to } 04 \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Units | Percent of Shipments | Units | Percent of Shipments |  |
| 4-Bit | 44,187 | 53.7\% | 45,635 | 54.0\% | 3.3\% |
| 8-Bit | 38,060 | 46.2 | 38,726 | 45.9 | 1.8\% |
| 16-Bit | 56 | 0.1 | 71 | 0.1 | 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 |  | Q4/1985 |  | Percent Growth Q3 to Q4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Units | Percent of Shipments | Units | Percent of Shipments |  |
| 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: Dat | $\begin{aligned} & \text { uest } \\ & \text { mber } 1986 \end{aligned}$ |

## 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 | 04/84 | 01/85 | 02/85 | 23/85 | 24/85 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 |  |

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.
-



## 4-Bit Microcontrollers-Product Analysis

The tables and figures in this section are organized as follows:
Table 1 Estimated Market Share by Product Type for 4-Bit Microcontrollers, 1975-1979

Table 2 Estimated Market Share by Product Type for 4-Bit Microcontrollers, 1980-1984

Table 3 Estimated 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 4 Estimated Market Share by Process Technology for 4-Bit Microcontrollers, 1975-1979

Table 5 Estimated Market Share by Process Technology for 4-Bit Microcontrollers, 1980-1984

Table 6 Estimated Market Share by Process Technology for 4-Bit Microcontrollers, 1985-1988

Figure 2 Estimated Market Share by Process Technology for 4-Bit Microcontrollers, 1980-1988

## 4-Bit Microcontrollers--Product Analysis

Table 1
Estimated Market Share* by Product Type for 4-Bit Microcontrollers 1975-1979

|  | 1975 | 1.976 | 1977 | 1978 | 1979 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| TMS 1000 | 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: $\begin{aligned} & \text { Dataquest } \\ & \text { July } 1989\end{aligned}$

## 4-Bit Microcontrollers--Product Analysis

Table 2
Estimated Market Share* by Product Type for 4-Bit Microcontrollers 1980-1984

|  | 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 |
| 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 | 0.1 | 0 |
| Total | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |

*Based on units shipped

| Source: | Dataquest |
| :---: | :---: |
|  | July 198 |

## 4-Bit Microcontrollers--Product Analysis

Table 3
Estimated Market Share* by Product Type for 4-Bit Microcontrollers 1985-1988

|  | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: |
| uPD75XX | 17.8\% | 15.4\% | 12.2\% | 12.7\% |
| MN1500 | 6.4 | 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 |
| uC0M75x | 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 | 3.7 | 11.3 | 17.7 |
| Total | 100.08 | 100.0\% | 100.0\% | 100.0\% |

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

## 4-Bit Microcontrollers--Product Analysis

Figure 1
Estimated Market Share* by Product Type for 4-Bit Microcontrollers

1987 and 1988


1987


1988

Table 4
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 July 1989 |

## 4-Bit Microcontrollers--Product Analysis

## Table 5

## Estimated Market Share by Process Technology for 4-Bit Microcontrollers <br> 1980-1984 <br> (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 |
| :--- |
| July 1989 |

# 4-Bit Microcontrollers--Product Analysis 

Table 6
Estimated Market Share by Process Technology for 4-Bit Microcontrollers

1985-1988
(Thousands of Units)

|  | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: |
| NMOS |  |  |  |  |
| 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 | 10.0\% | 4.9\% | 2.5\% | 1.3\% |
| Total Shipments | 177,038 | 271,883 | 392,332 | 501,075 |
| Note: Columns may not add to totals shown because of rounding. |  |  |  |  |
|  |  |  | Source: | Dataquest July 1989 |

Figure 2
Estimated Market Share by Process Technology for 4-Bit Microcontrollers 1980-1988

Millions of Units


0004373-2

## 4-Bit Microcontrollers--Product Analysis

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## 4-Bit Microcontrollers--Analysis

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

Table 3 Estimated Market Share by Manufacturer for 4-Bit Microcontrollers, 1980-1984

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

Figure 2 Estimated Market Share by Manufacturer for 4-Bit Microcontrollers, 1986 and 1987

Table 5 Estimated Market Share by Region for 4-Bit Microcontrollers, 1980-1984
Table 6 Estimated Market Share by Region for 4-Bit Microcontrollers, 1985-1987
Figure 3 Estimated Market Share by Region for 4-Bit Microcontrollers, 1980-1987
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

## 4-Bit Microcontrollers-Analysis

Table 1
Estimated Market Share by Product Type
for 4-Bit Microcontrollers
1980-1984

| - | 1980 | 1981 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| uPD75XX | 0 | 2.4\% | 5.18 | 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 | 25.4 | 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 |
| S2000 | 1.2 | 0.3 | 0.4 | 0.1 | $\underline{0}$ |
| Total | 100.0\% | 100.08 | 100.0\% | 100.0\% | 100.0\% |

Source: Dataquest<br>September 1988

## 4-Bit Microcontrollers--Analysis

Table 2

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

|  | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: |
| 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 | 0 | 3.3 |
| MS1400 | 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 |
| MP8850X | 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 | 11.3 |
|  | 100.0\% | 100.0\% | 100.0\% |
|  | Source | Dataquest <br> September 1988 |  |

## 4-Bit Microcontrollers--Analysis

Figure 1

## Estimated Market Share by Product Type for 4-Bit Microcontrollers 1986 and 1987



Source: Dataquest

## 4-Bit Microcontrollers-Analysis

Table 3
Estimated Market Share by Manufacturer for 4-Bit Microcontrollers 1980-1984

|  | 1980 | 1981 | 2982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Eurotechnique | 0 | 0 | 0.18 | 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 | 16.4 | 6.9 | 4.3 |
| Toshiba | 0 | 0 | 9.5 | 14.9 | 12.2 |
|  | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |
|  |  |  | Source: Dat |  | r 1988 |

## 4-Bit Microcontrollers--Analysis

Table 4

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

|  | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: |
| 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 | 11.3 |
|  | 100.0\% | 100.0\% | 100.0\% |

Source: Dataquest September 1988

## 4-Bit Microcontrollers--Analysis

Figure 2
Estimated Market Share by Manufacturer for 4-Bit Microcontrollers

1986 and 1987


1986


Source: Dataquest September 1988

## 4-Bit Microcontrollers-Analysis

Table 5
Estimated Market Share by Region
for 4-Bit Microcontrollers
1980-1984
(Thousands of Units)

|  | 1980 | 1981 | 1282 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 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 |

Source: Dataquest September 1988

## 4-Bit Microcontrollers--Analysis

## Table 6

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

|  | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: |
| United States |  |  |  |
| Shipments | 28,804 | 48,458 | 46.160 |
| Percent | 16.3\% | 17.8\% | 11.8\% |
| Japan |  |  |  |
| Shipments | 142.992 | 217.095 | 338.657 |
| Percent | 80.8\% | 79.8\% | 86.3\% |
| Europe |  |  |  |
| Shipments | 5,242 | 6.330 | 7,515 |
| Percent | 3.0\% | 2.3\% | 1.9\% |
| Total Shipments | 177,038 | 271,883 | 392,332 |

Source: Dataquest September 1988

## 4-Bit Microcontrollers--Analysis

Figure 3

## Estimated Market Share by Region <br> for 4-Bit Microcontrollers <br> 1980-1987



## 4-Bit Microcontrollers-Analysis

## Table 7

## Estimated Market Share by Process Technology <br> for 4-Bit Microcontrollers <br> 1980-1984 <br> (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\% | 14.98 |
| Total Shipments | 96,080 | 133,549 | 158.183 | 171,945 | 193.435 |

## 4-Bit Microcontrollers-Analysis

## Table 8

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

|  | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: |
| KMOS |  |  |  |
| 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\% | 4,2\% | 2.5\% |
| Total Shipments | 177,038 | 271,883 | 392,332 |

## 4-Bit Microcontrollers--Analysis

Figure 4

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



$\bullet$

## 4-Bit Microcontrollers--Competitive Analysis

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

| Table 1 | Estimated <br> 1975-1979 | Market Share by Manufacturer for | 4-Bit Microcontrollers, |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Table 2 | Estimated <br> $1980-1984$ | Market Share by Manufacturer for 4-Bit Microcontrollers, |  |
| Table 3 | Estimated <br> $1985-1988$ | Market Share by Manufacturer for 4-Bit Microcontrollers, |  |

Figure 1 Estimated Market Share by Manufacturer for 4-Bit Microcontrollers, 1987 and 1988

Table 4 Estimated Market Share by Region for 4-Bit Microcontrollers, 1975-1979
Table 5 Estimated 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

## 4-Bit Microcontrollers--Competitive Analysis

Table 1

## Estimated Market Share* by Manufacturer for 4-Bit Microcontrollers <br> 1975-1979

| 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 |
| 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 | 51.7 |
| Total | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |

*Based on units shipped

| Source: | Dataquest |
| :--- | :--- |
|  | July 1989 |

## 4-Bit Microcontrollers--Competitive Analysis

## Table 2 <br> Estimated Market Share* by Manufacturer for 4-Bit Microcontrollers 1980-1984

| Mapufacturer | 1980 | 1981 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Eurotechnique | 0 | 0 | 0.18 | $0.5 \%$ | 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 | 9.5 | 14.9 | 12.2 |
| Total | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |

[^3]
## 4-Bit Microcontrollers--Competitive Analysis

Table 3

## Estimated Market Share* by Manufacturer for 4-Bit Microcontrollers <br> 1985-1988

| Manufacturex | 1.985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: |
| Fujitsu | 4.48 | 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 | 17.7 |
| 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

## 4-Bit Microcontrollers--Competitive Analysis

Figure 1
Estimated Market Share by Manufacturer for 4-Bit Microcontrollers

1987 and 1988


0004374-1


Source: Dataquest
Dataquest
July 1989

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: | taquest <br> ly 1989 |

## 4-Bit Microcontrollers--Competitive Analysis

Table 5

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

| Region | 1980 | 1981 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| United States |  |  |  |  |  |
| Shipments |  |  |  |  |  |
| Percent |  |  |  |  |  |


| Source: | Dataquest |
| :--- | :--- |
|  | July 1989 |



Figure 2
Estimated Market Share by Region for 4-Bit Microcontrollers 1980-1988


0004374-2
Source: Dataquest July 1989

## 4-Bit Microcontrollers--Competitive Analysis

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## Microcontroller Historical Shipment Data 1975-1989



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June 1990

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## Chapter 1

## 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:

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## Table 1

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

|  | Product | Process | 1975 | 1976 | 1977 | 1978 | 1979 |
| :--- | :--- | :--- | ---: | ---: | ---: | ---: | ---: |
| Gouid/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 | 50 | 310 | 2,825 | 9,400 | 26,100 |
|  |  |  | 500 | 760 | 3,400 | 15,959 | 50,525 |
| Total 4-Bit MCUs |  |  |  |  |  |  |  |

Table 2
Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer
1980-1984
(Thousands of Units)

|  | Product | Process | 1980 | 1981 | 1982 | 1983 | 1994 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Eurotechnique | COPS | N/C | 0 | 0 | 190 | 840 | 0 |
| Fujitsu | MB884X | N | 0 | 9,200 | 9,900 | 7,500 | 6,100 |
|  | MB885X | C | 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 | C | 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 |
|  | uPD75XXX | C | 0 | 3,200 | 8,000 | 15,100 | 31,500 |
| Oli | Series-40 | C | 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 | C | 1,200 | 1,600 | 1,950 | 1,750 | 1,840 |
|  | SM-5 | C | 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 | T-Series | C | 0 | 0 | 8,300 | 9,800 | 6,000 |
|  | TLCS-43 | N | 0 | 0 | 3,300 | 9,200 | 8,000 |
|  | TLCS-46 | C | 0 | 0 | 2,900 | 3,580 | 3,250 |
|  | TLCS-47 | N | 0 | 0 | 600 | 3,070 | 6,300 |
| Total 4-Bit MCUs |  |  | 96,080 | 133,549 | 158,183 | 171,945 | 193,435 |

Source: Dataquest (bune 1990)

Table 3

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

|  | Product | Process | 1985 | 1986 | 1987 | 1988 | 1989 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | MB882XX | C | 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 | C | 0 | 0 | 485 | 7,680 | 15,700 |
|  | MB885X | C | 2,156 | 3,425 | 3,742 | 6,180 | 10,280 |
|  | MB886XX | C | 0 | 0 | 0 | 0 | 300 |
|  | MB887XX | C | 0 | 0 | 0 | 0 | 700 |
| Hitachi | HMCS-40 | P/N/C | 22,352 | 21,919 | 25,900 | 18,400 | 14,800 |
|  | HMCS-400 | C | NA | NA | 32,100 | 28,700 | 43,000 |
| Matsushita | MN1400 | 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 | C | 0 | 0 | 2,085 | 4,700 | 7,000 |
| Mitsubishi | M5043X/44X | C | 0 | 0 | 13,995 | 13,200 | 18,000 |
|  | M5046X/56X | C | 0 | 0 | 13,105 | 19,800 | 32,500 |
|  | M5072/76 | C | 0 | 0 | 15,054 | 14,100 | 19,000 |
|  | M509X | C | 0 | 0 | 2,056 | 6,430 | 13,000 |
|  | M50XXX | C | 0 | 27,844 | 0 | 0 | 0 |
| Motorola | 141000 | C | 4 | 0 | 0 | 0 | 0 |
| National | COP400 | N/C | 23,500 | 31,273 | 31,970 | 30,450 | 33,400 |
| NBC | 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 | C | 31,590 | 41,920 | 47,670 | 63,600 | 85,500 |
| Oki | Series-40 | C | 6,614 | 7,217 | 6,689 | 7,580 | 9,800 |
| Rockwell | PPS-4 | P | 1,400 | 1,160 | 790 | 325 | 235 |
| Sanyo | LC65/66XX | C | 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 ${ }^{\text {a }}$ | C | 10,370 | 9,140 | 9,510 | 21,750 | 36,100 |
|  | Custom | C | 0 | 0 | 0 | 9,000 | 44,000 |
| Sony | SPC500 | C | 0 | 0 | 0 | 8,500 | 23,000 |
| TI | TMS1000 | P/C | 3,900 | 16,025 | 13,400 | 9,300 | 10,400 |
| Toshiba | T-Series | C | 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 | C | 2,198 | 400 | 202 | 480 | 230 |
|  | TLCS-47 | N | 7,756 | 7,200 | 5,935 | 9,890 | 2,050 |
|  | TLCS-47 | C | 0 | 15,300 | 17,497 | 32,250 | 41,500 |
|  | TLCS-470 | C | 0 | 400 | 1,360 | 100 | 21,400 |
| Total 4- | MCUs |  | 177,038 | 261,883 | 347,812 | 468,445 | 672,860 |

[^4]Table 4
Estimated 4-Bit Microcontroller Unit Shipments by Quarter 1975-1976
(Thousands of Units)

|  | Product | Process | 1975 | Q1/76 | Q2/76 | Q3/76 | Q4/76 | 1976 |
| :--- | :--- | :--- | :---: | ---: | :---: | ---: | :---: | :---: |
| Rockwell | PPS-4 | P | 450 | 100 | 110 | 120 | 120 | 450 |
| TI | TMS1000 | P/C | 50 | 60 | 75 | 75 | 100 | 310 |
|  | Total 4-Bit MCUs |  | 500 | 160 | 185 | 195 | 220 | 760 |
| Scurce: Dataqueat (lane 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 | P | 145 | 145 | 140 | 145 | 575 |
| TI | TMS 1000 | P/C | 225 | 400 | 1,000 | 1,200 | 2,825 |
| Total 4-Bit MCUs |  |  | 370 | 545 | 1,140 | 1,345 | 3,400 |

Table 6

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

|  |  | Product | Process | Q1/78 | Q2/78 | Q3/78 | Q4/78 |
| :--- | :--- | :--- | ---: | ---: | ---: | ---: | ---: | 1978

Table 7

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

|  | Product | Process | Q1/79 | Q2/79 | Q3/79 | Q4/79 | 1979 |
| :--- | :--- | :--- | ---: | ---: | ---: | ---: | ---: |
| 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 | C | 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 | 1 | 1 | 1 | 1 | 360 |
| TI | TMS1000 | P/C | 4,200 | 5,400 | 7,500 | 9,000 | 26,100 |
|  |  |  | 7,510 | 10,225 | 14,740 | 17,690 | 50,525 |

${ }^{1}$ No quarterly data available for Sharp SM-3.
Source: Dataquest (Jume 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 | C | 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 | C | 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 | C | 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 | C | 490 | 800 | 1,550 | 1,960 | 4,800 |
| TI | TMS 1000 | 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 |

[^5]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 | C | 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 | C | 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 | C | 0 | 0 | 1,500 | 1,700 | 3,200 |
| Oki | Series-40 | C | 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 | C | 380 | 400 | 420 | 400 | 1,600 |
|  | SM-5 | C | 2,490 | 2,800 | 2,800 | 2,600 | 10,690 |
| TI | 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 |

$\mathbf{S}=\mathbf{S a m p l e d}$
Sounce: Datacuest (Jume 1990)

Table 10

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

|  | Product | Process | Q1/82 | Q2/82 | Q3/82 | Q4/82 | 1982 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Eurotech. | COP | C/N | S | S | 80 | 110 | 190 |
| Fujitsu | 884X | N | 2,800 | 2,500 | 2,300 | 2,300 | 9,900 |
|  | 8850 | C | 800 | 800 | 750 | 800 | 3,150 |
| Gould | \$2000 | 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 | C | 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 |
|  | uPD75XXX | C | 1,800 | 1,800 | 2,200 | 2,200 | 8,000 |
| Oki | Series-40 | C | 250 | 420 | 830 | 950 | 2,450 |
| Rockwell | PPS-4 | P | 425 | 350 | 500 | 400 | 1,675 |
| Sharp | SM-3 | $\mathbf{P}$ | 250 | 260 | 240 | 240 | 990 |
|  | SM-4 | C | 500 | 550 | 450 | 450 | 1,950 |
|  | SM-5 | C | 2,500 | 2,500 | 2,200 | 2,200 | 9,400 |
| TI | TMS1000 | P/C | 8,000 | 7,000 | 6,000 | 5,000 | 26,000 |
| Toshiba | T-Series | C | 1,200 | 2,000 | 2,500 | 2,600 | 8,300 |
|  | TLCS-43 | N | 500 | 600 | 700 | 1,500 | 3,300 |
|  | TLCS-46 | C | 500 | 600 | 1,100 | 700 | 2,900 |
|  | TLCS-47 | C/N | 50 | 100 | 250 | 200 | 600 |
| Total 4-Bit MCUs |  |  | 38,995 | 40,148 | 40,860 | 38,180 | 158,183 |
| $\begin{aligned} & S=\text { Sampled } \\ & \text { Source: Datiap } \end{aligned}$ | June 1990) |  |  |  |  |  |  |

Table 11
Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1983
(Thoussands 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 | 7,500 |
|  | 8850 | C | 775 | 775 | 780 | 780 | 3,110 |
| Gould | \$2000 | 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 | C | 35 | 36 | 36 | 23 | 130 |
| National | COPS | $\mathrm{C} / \mathrm{N}$ | 4,500 | 5,500 | 5,500 | 5,500 | 21,000 |
| NBC | UCOM-4 | P/C | 5,000 | 5,000 | 5,500 | 5,500 | 21,000 |
|  | uPD75XXX | C | 2,500 | 2,900 | 4,500 | 5,200 | 15,100 |
| Oki | Series-40 | C | 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 | C | 425 | 450 | 425 | 450 | 1,750 |
|  | SM-5 | C | 2,400 | 2,500 | 2,650 | 2,800 | 10,350 |
| TI | TMS1000 | P/C | 4,000 | 3,000 | 2,500 | 2,400 | 11,900 |
| Toshiba | T-Series | c | 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 | C | 800 | 800 | 1,000 | 980 | 3,580 |
|  | TLCS-47 | C/N | 350 | 600 | 800 | 1,320 | 3,070 |
| Total | it MCUs |  | 39,635 | 41,191 | 45,361 | 45,758 | 171,945 |

Source: Dataqsest (June 1990)

Table 12

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

|  | Product | Process | Q1/84 | Q2/84 | Q3/84 | Q4/84 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | 884X | N | 1,600 | 1,500 | 1,500 | 1,500 | 6,100 |
|  | 8850 | 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 | N | 2,100 | 2,300 | 2,100 | 2,100 | 8,600 |
| Motorola | 141000 | C | 40 | 24 | 11 | 5 | 80 |
| National | COPS | $\mathrm{C} / \mathrm{N}$ | 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 |
|  | uPD75XXX | C | 5,510 | 7,570 | 9,210 | 9,210 | 31,500 |
| Oki | Series-40 | C | 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 | C | 460 | 460 | 460 | 460 | 1,840 |
|  | SM-5 | C | 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 | C | 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 | C | 1,000 | 1,000 | 600 | 650 | 3,250 |
|  | TLCS-47 | C/N | 1,400 | 1,400 | 1,700 | 1,800 | 6,300 |
| Total | it MCUs |  | 46,205 | 48,164 | 50,001 | 49,065 | 193,435 |

Source: Dataquest (June 1990)

Table 13

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

|  | Product | Process | Q1/85 | Q2/85 | Q3/85 | Q4/85 | 1985 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pujitsu | 884X | N | 1,450 | 1,392 | 1,392 | 1,400 | 5,634 |
|  | 8850 | C | 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 | N | 2,100 | 2,100 | 2,800 | 4,300 | 11,300 |
| Motorola | 141000 | C | 4 | 0 | 0 | 0 | 4 |
| National | COPS | $\mathrm{C} / \mathrm{N}$ | 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 |
|  | uPD75XXX | C | 7,180 | 8,170 | 8,550 | 7,690 | 31,590 |
| Oki | Series-40 | C | 1,700 | 1,632 | 1,632 | 1,650 | 6,614 |
| Rockwell | PPS-4 | P | 400 | 300 | 360 | 340 | 1,400 |
| Sharp | SM-Series | C | 2,490 | 2,490 | 2,695 | 2,695 | 10,370 |
| TI | TM\$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 | C | 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 | C | 650 | 624 | 624 | 300 | 2,198 |
|  | TLCS-47 | $\mathrm{C} / \mathrm{N}$ | 1,800 | 1,728 | 1,728 | 2,500 | 7.756 |
| Toual | it MCUs |  | 44,124 | 43,092 | 44,187 | 45,635 | 177,038 |

Source: Dataqueat (June 1990)

Table 14

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

|  | 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 | C | 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 |
|  | MNI500 | N | 5,700 | 7,100 | 7,480 | 7.400 | 27,680 |
| Mitsubishi | 50XXX | C | 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 | C | 0 | 0 | 1,750 | 2,150 | 3,900 |
|  | uPD75XXX | C | 8,470 | 10,420 | 11,920 | 11,110 | 41,920 |
| Oki | Series-40 | C | 1,860 | 1,900 | 1,820 | 1,637 | 7,217 |
| Rockwell | PPS-4 | P | 400 | 300 | 210 | 250 | 1,160 |
| Sharp | SM-Series | C | 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 | C | 900 | 1,100 | 1,200 | 1,400 | 4,600 |
|  | TLCS-42 | N/C | 850 | 1,000 | 1,000 | 1,000 | 3,850 |
|  | TLCS-43 | N | 700 | 850 | 650 | 400 | 2,600 |
|  | TLCS 46 | C | 200 | 100 | 50 | 50 | 400 |
|  | TLCS 47 | C/N | 4,400 | 5,200 | 6,700 | 6,200 | 22,500 |
|  | TLCS-470 | C | 0 | 0 | 100 | 300 | 400 |
| Total | it MCUs |  | 57,794 | 63,228 | 69,409 | 71,452 | 261,883 |

Table 15

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 | C | 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 | C | 882 | 905 | 940 | 1,015 | 3,742 |
|  | 885XX | C | 100 | 110 | 125 | 150 | 485 |
| Hitachi | HMCS-40 | P/N/C | 6,300 | 6,405 | 6,520 | 6,675 | 25,900 |
|  | HMCS-400 | C | 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 | C | 0 | 0 | 1,015 | 1,070 | 2,085 |
| Mitsubishi | M5043X/44X | C | 3,393 | 3,294 | 3,767 | 3,541 | 13,995 |
|  | M5046X/56X | C | 2,141 | 3,213 | 3,996 | 3,755 | 13,105 |
|  | M5072/76 | C | 2,701 | 2,908 | 4,337 | 5,108 | 15,054 |
|  | M509X | C | 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 | C | 11,000 | 10,970 | 13,500 | 12,200 | 47,670 |
| Oki | Series-40 | C | 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 | TMS 1000 | 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 | C | 50 | 62 | 48 | 42 | 202 |
|  | TLCS-47 | N | 1,600 | 1,500 | 1,475 | 1,360 | 5,935 |
|  | TLCS-47 | C | 4,300 | 4,220 | 4,405 | 4,572 | 17,497 |
|  | TLCS-470 | C | 300 | 340 | 350 | 370 | 1,360 |
| Total 4 | MCUs |  | 81,113 | 85,223 | 91,712 | 89,764 | 347,812 |

Source: Dataquest (June 1990)

Table 16

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

|  | Product | Process | Q1/88 | Q2/88 | Q3/88 | Q4/88 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | 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 | C | 700 | 900 | 2,880 | 3,200 | 7,680 |
|  | MB885X | C | 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 | C | 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 |
|  | MN1500 | N | 12,180 | 13,370 | 11,730 | 12,300 | 49,580 |
|  | MN1700 | C | 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 | C | 2,900 | 3,300 | 4,100 | 3,800 | 14,100 |
|  | M509X | C | 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 | C | 13,050 | 14,750 | 18,200 | 17,600 | 63,600 |
| Oki | Series-40 | C | 1,600 | 1,680 | 2,000 | 2,300 | 7,580 |
| Rockwell | PPS-4 | P | 150 | 70 | 55 | 50 | 325 |
| Sanyo | LC65/66XX | C | 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 | C | 0 | 0 | 4,000 | 5,000 | 9,000 |
|  | SM-Series | C | 3,750 | 4,300 | 5,100 | 8,600 | 21,750 |
| Sony | SPC500 | C | 0 | 0 | 4,000 | 4,500 | 8,500 |
| TI | TMS 1000 | P/C | 1,700 | 2,300 | 2,100 | 3,200 | 9,300 |
| Toshiba | T-Series | C | 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 | C | 150 | 130 | 100 | 100 | 480 |
|  | TLCS-47 | N | 2,140 | 2,210 | 2,580 | 2,960 | 9,890 |
|  | TLCS-47 | C | 7,200 | 8,190 | 8,410 | 8,450 | 32,250 |
|  | TLCS 470 | C | 0 | 0 | 0 | 100 | 100 |
| Total 4 | MCUs |  | 92,853 | 100,877 | 133,242 | 141,473 | 468,445 |

Scurce: Dataquest (Jube 1990)

Table 17

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 | C | 0 | 0 | 100 | 200 | 300 |
|  | M8887XX | C | 0 | 100 | 200 | 400 | 700 |
|  | MB882XX | C | 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 | C | 3,520 | 3,680 | 4,000 | 4,500 | 15,700 |
|  | MB885X | C | 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 | C | 9,000 | 10,000 | 11,500 | 12,500 | 43,000 |
| Matsushita | MN1400 | P/N/C | 2,000 | 2,100 | 0 | 0 | 4,100 |
|  | MN1500 | N | 10,700 | 12,000 | 14,000 | 12,000 | 48,700 |
|  | MN1700 | C | 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 | C | 6,500 | 8,000 | 9,000 | 9,000 | 32,500 |
|  | M5072/76 | C | 4,500 | 4,000 | 5,500 | 5,000 | 19,000 |
|  | M509X | C | 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 | nCOM-4 | P/C | 1,500 | 1,600 | 1,600 | 1,600 | 6,300 |
|  | uPD75XX | C | 4,800 | 4,900 | 4,900 | 4,900 | 19,500 |
|  | uPD75XXX | N/C | 19,500 | 21,000 | 23,000 | 22,000 | 85,500 |
| Ori | Series-40 | C | 2,300 | 2,400 | 2,400 | 2,700 | 9,800 |
| Rockwell | PPS-4 | P | 90 | 90 | 15 | 40 | 235 |
| Sanyo | LC65/66XX | C | 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 | C | 11,000 | 12,000 | 10,000 | 11,000 | 44,000 |
|  | SM-Series | C | 8,900 | 9,500 | 8,900 | 8,800 | 36,100 |
| Sony | SPC500 | C | 5,300 | 5,800 | 6,000 | 5,900 | 23,000 |
| TI | TMS1000 | P/C | 3,300 | 2,600 | 2,000 | 2,500 | 10,400 |
| Toshiba | T-Series | C | 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 | C | 150 | 30 | 30 | 20 | 230 |
|  | TLCS-47 | N | 650 | 300 | 600 | 500 | 2,050 |
|  | TLCS-47 | C | 9,000 | 10,500 | 11,000 | 11,000 | 41,500 |
|  | TLCS-470 | C | 3,900 | 5,000 | 6,000 | 6,500 | 21,400 |
| Total 4-1 | it MCUs |  | 158,723 | 167,580 | 171,925 | 174,632 | 672,860 |

Source: Datuquest (June 1990)

## Chapter 2

## 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 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, 1985-1989 |
| 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 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 Shipmerts by Quatter 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 |

Table 1

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

|  | Product | Process | 1975 | 1976 | 1977 | 1978 | 1979 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AMD | 8048 | N | 0 | 0 | 0 | 0 | 23 |
| Fairchild | 387 X | N | 0 | 0 | 15 | 23 | 510 |
|  | P8 | 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 | 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 |
| Rockwelt | 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 MCUs |  |  | 32 | 251 | 885 | 2,218 | 11,592 |

Table 2

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 |
|  | P8 | 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 | C | 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 | C | 0 | 0 | 210 | 722 | 1,472 |
|  | 6305 | C | 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 | C | 0 | 0 | 0 | 18 | 10 |
|  | 80C49/39 | C | 0 | 0 | 0 | 140 | 230 |
|  | 80C51/31 | C | 0 | 0 | 0 | 140 | 265 |
|  | 8748 | N | 650 | 775 | 1,530 | 2,065 | 2,500 |
|  | 8749 | N | 0 | 3 | 450 | 960 | 2,030 |
|  | 8751 | N | 0 | 4 | 70 | 320 | 795 |
| Intersil | 80C48/35 | C | 0 | 0 | 0 | 0 | 44 |

Table 2 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer
1980-1984
(Thousands of Units)

|  | Product | Procers | 1980 | 1981 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Matra-Harris | 8048 | N | 0 | 0 | 6 | 48 | 130 |
|  | 8051 | N | 0 | 0 | 0 | 0 | 635 |
|  | $80 \mathrm{C48}$ | C | 0 | 0 | 0 | 0 | 20 |
| Matsustita | MN1800 | C | 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 | C | 0 | 95 | 635 | 1,886 | 4,389 |
|  | 1468705 | C | 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 |
|  | $68 \mathrm{HCl1}$ | 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 | N | 50 | 405 | 880 | 1,270 | 1,940 |
|  | 807X | N | 31 | 70 | 53 | 60 | 35 |
|  | 80C48/35 | C | 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 | C | 0 | 0 | 230 | 940 | 2,020 |
|  | 80C49/39 | C | 0 | 0 | 151 | 650 | 1,770 |
| $:^{\text {a }}$ | 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 |
| cia | 80C48/35 | c | 0 | 0 | 25 | 203 | 450 |
|  | 80C49/39 | C | 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 |

Table 2 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984
(Thousands of Units)

|  | Product | Process | 1980 | 1981 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Philips <br> (Continued) | 8051/31 | N | 0 | 0 | 0 | 40 | 1,160 |
|  | 80C49/39 | C | 0 | 0 | 0 | 0 | 3 |
|  | 84XX | N | 0 | 0 | 80 | 1,940 | 2,500 |
| RCA | 1804A | C | 0 | 0 | 0 | 4 | 23 |
|  | 6805/68HC05 | C | 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 |
| TI | TMS7000 | N | 0 | 22 | 255 | 715 | 990 |
| Thomson (EFCIS) ${ }^{\text {1 }}$ | 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 | C | 0 | 0 | 142 | 850 | 2,170 |
| Zilog | 28 | N | 14 | 344 | 683 | 851 | 2,055 |
| Total 8-Bit MCUs |  |  | 21,740 | 34,931 | 54,114 | 90,615 | 163,510 |

'Thomson sequdred ERCIS in 1984.
Source: Dataquert (June 1990)

Table 3

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

|  | Product | Process | 1985 | 1986 | 1987 | 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 | C | 0 | 0 | 134 | 1,055 | 1,550 |
|  | 80C521/321 | C | 0 | 0 | 0 | 0 | 435 |
|  | 80C5292/3292 | C | 0 | 0 | 0 | 0 | 1,040 |
|  | 8751 | N | 71 | 112 | 133 | 217 | 295 |
|  | 8753 | N | 0 | 0 | 77 | 145 | 155 |
|  | 89 C 51 | C | 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 | C | 0 | 105 | 2,300 | 350 | 585 |
|  | MB897XX | C | 0 | 0 | 0 | 1,631 | 2,200 |
| Gould/AMI ${ }^{1}$ | 6801/03 | N | 576 | 21 | 31 | 7 | 0 |
|  | 6805 | N | 402 | 127 | 39 | 4 | 0 |
| Harris (GE-SS/RCA) ${ }^{2}$ | 6805 | N | 0 | 0 | 0 | 355 | 266 |
|  | $68 \mathrm{HCO5}$ | C | 120 | 359 | 805 | 1,430 | 2,705 |
| Hitachi | 6301 | C | 2,008 | 5,200 | 8,100 | 11,550 | 14,000 |
|  | 6305 | C | 1,386 | 4,242 | 7,250 | 11,150 | 10,600 |
|  | 63701 | C | 0 | 0 | 1,599 | 1,780 | 1,950 |
|  | 63705 | C | 0 | 0 | 1,299 | 1,220 | 770 |
|  | 63 P 01 | C | 0 | 0 | 645 | 1,040 | 1,130 |
|  | 63 P 05 | C | 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 |
|  | 68 P 01 | N | 0 | 0 | 545 | 944 | 1,010 |
|  | 68 P 05 | N | 0 | 0 | 620 | 1,010 | 975 |
|  | H8/532 | C | 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 | C | 112 | 20 | 0 | 0 | 0 |
|  | 80C51/31 | C | 785 | 2,000 | 3,165 | 6,200 | 10,800 |
|  | 8748 | N | 1,310 | 800 | 693 | 800 | 690 |
|  | 8749 | N | 1,445 | 2,247 | 3,625 | 3,500 | 3,085 |

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 | C | 0 | 0 | 30 | 350 | 680 |
|  | $87 \mathrm{C51}$ | C | 0 | 0 | 100 | 500 | 820 |
| Intersil | 80C48/35 | C | 30 | 20 | 0 | 0 | 0 |
|  | 80C49/39 | C | 9 | 10 | 0 | 0 | 0 |
| Matra-Harris | 8051/31 | C | 0 | 0 | 0 | 116 | 290 |
|  | 8052/32 | C | 0 | 0 | 0 | 0 | 45 |
|  | 80C51/31 | N | 20 | 418 | 1,033 | 712 | 310 |
|  | 80C52/32 | C | 10 | 387 | 1,324 | 2,190 | 2,610 |
|  | $80 C 752$ | N | 1,400 | 1,340 | 429 | 98 | 0 |
|  | 83 C 154 | C | 0 | 0 | 83 | 660 | 2,945 |
| Matsushita | MN1800/70/80 | C | 131 | 400 | 1,070 | 4,620 | 11,900 |
| Microchip Technology ${ }^{3}$ | PIC1652/54 | N | 1,515 | 1,700 | 4,063 | 5,242 | 4,065 |
|  | PIC1655/57 | N | 3,295 | 1,400 | 1,073 | 903 | 0 |
|  | PIC1670/72 | N | 2,135 | 1,190 | 460 | 286 | 269 |
|  | PIC16C52/C54 | C | 0 | 0 | 0 | 0 | 1,329 |
|  | PIC16C58 | C | 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 | C | 0 | 0 | 2,614 | 690 | 950 |
|  | M507XX | C | 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 |
| $\text { Mostek }^{4,5}$ | 387X | N | 867 | 969 | 795 | 0 | 0 |
|  | 38P7X | N | 297 | 145 | 90 | 0 | 0 |
|  | F8 | N | 195 | 299 | 136 | 0 | 0 |
| Motorola | 146805 | C | 4,071 | 4,705 | 5,422 | 6,598 | 4,802 |
|  | 1468705 | C | 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 |



Table 3 (Continued)

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

|  | Product | Process | 1985 | 1986 | 1987 | 1988 | 1989 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rockwell | 6500/XX | N | 1,310 | 2,550 | 3,855 | 4,230 | 4,180 |
| Sanyo | LC86XXX | C | 0 | 0 | 0 | 800 | 1,900 |
|  | LM88XX | N | 0 | 0 | 0 | 200 | 400 |
| $\operatorname{SGS}^{5}$ | 387X | N | 2,200 | 4,811 | 3,922 | 0 | 0 |
|  | 28 | N | 244 | 601 | 665 | 0 | 0 |
| $\text { SGS-Thomson }{ }^{\text {s }}$ | 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 | 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 | 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 | 4,945 |
|  | 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 | 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 |
|  | $80 \mathrm{C451}$ | C | 0 | 0 | 0 | 55 | 44 |
|  | 80C51/31 | C | 0 | 60 | 283 | 1,653 | 4,250 |
|  | $83 \mathrm{C451}$ | C | 0 | 0 | 27 | 0 | 0 |
|  | 8400 | N | 0 | 30 | 43 | 10 | 0 |
|  | 8441 | C | 0 | 0 | 128 | 18 | 0 |
|  | $87 \mathrm{C451}$ | C | 0 | 0 | 10 | 15 | 98 |
|  | $87 \mathrm{C51}$ | C | 0 | 0 | 0 | 0 | 316 |
|  | $87 \mathrm{C751}$ | C | 0 | 0 | 0 | 0 | 77 |
| Sony | SPC700 | C | 0 | 0 | 0 | 800 | 5,400 |
| TI | TMS370 | C | 0 | 0 | 0 | 0 | 176 |
|  | TMS7000 | N | 1,396 | 2,555 | 6,600 | 8,800 | 9,800 |
| Thomson ${ }^{5}$ | 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 <br> (Thousands of Units)

|  | Product | Process | 1985 | 1986 | 1987 | 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 | C | 0 | 1,000 | 2,950 | 3,200 | 1,700 |
|  | 80C49/39 | C | 2,925 | 2,280 | 3,600 | 4,200 | 3,250 |
|  | 80C50/40 | C | 0 | 520 | 851 | 820 | 900 |
|  | TLCS-870 | C | 0 | 0 | 0 | 0 | 130 |
|  | TLCS-90 | C | 0 | 0 | 0 | 850 | 2,850 |
| Zilog | Z8 | N | 2,099 | 3,112 | 3,422 | 5,025 | 6,500 |
| Total 8-Bit MCUs |  |  | 163,599 | 212,931 | 299,470 | 377,476 | 458,699 |

Note: Totals for 1986, 1987, and 1988 have been adjusted to remove Dataquest' a previous eatimato for maureyed companics. Totals now refiect actual parvey results. Additionally, because of tho reccipt of now information, 1988 mombers have been restated for many Jepanome companies.
'Gould Semicombintor acquired AMI, 1985.
${ }^{2}$ hinnia mequired GE Solid State and RCA. 1988.
"General Instrument's Microclectronics Divisiocs spisin off a new comypany under the name Mierochip Technology, 1987.
Thomson Components acquired Mostek, forning Thomson Componanto-Mostak Corporation (TCMC), 1985.
sSGS and Tbomson merged, forming SGS-Thomson, 1987. (TCME lost independent identity with the merger.)
Naticnal accusired Fairchild, 1987.
Source: Dalaquest (Iume 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 | Bit MCUs |  | 32 | 13 | 48 | 90 | 100 | 251 |

Source: Dataquest (June 1990)

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 |
|  |  |  | 110 | 160 | 240 | 375 | 885 |
| Total 8-Bit MCUs |  |  |  |  |  |  |  |

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 | 110 | 130 | 190 | 200 | 630 |
|  | 3870 | N | 3 | 5 | 5 | 10 | 23 |
| General | PIC1650 | N | 75 | 95 | 105 | 175 | 450 |
| Instrument |  |  |  |  |  |  |  |
| Intel | 8048 | N | 60 | 100 | 150 | 170 | 480 |
|  | 8748 | N | 0 | 0 | 5 | 25 | 30 |
|  | 8049/39 | 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)

## Table 7

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

|  | 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 | 300 |
|  | 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 | 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 | N | 5 | 10 | 15 | 20 | 50 |
| Signetics | 8048/35 | N | 15 | 30 | 60 | 75 | 180 |
| Total 8-Bit MCUs |  |  | 1,235 | 2,415 | 3,414 | 4,528 | 11,592 |

$s=$ Sampled
Source: Datuquest (June 1990)

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

|  | Product | Process | Q1/80 | Q2/80 | Q3/80 | Q4/80 | 1986 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AMD | 8048 | N | 5 | 38 | 40 | 55 | 138 |
| Fairchild | F8 | N | 170 | 150 | 150 | 150 | 620 |
|  | 3870 | N | 345 | 380 | 550 | 520 | 1,795 |
| Fojitsu | 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 |
| Indist | 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 | 95 |
| Siemens | 802XX | N | 0 | S | 5 | 15 | 20 |
| Signetics | 8048/35 | N | 60 | 60 | 10 | 5 | 135 |
| Zilog | Z8 | N | S | 3 | 5 | 6 | 14 |
| Total 8-Bit MCUs |  |  | 5,285 | 5,566 | 5,035 | 5,854 | 21,740 |

Source: Dataquest (June 1990)

Table 9

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

|  | Product | Process | Q1/81 | Q2/81 | Q3/81 | Q4/81 | 1981 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | N | 100 | 100 | 100 | 100 | 400 |
|  | 8049 | N | 175 | 250 | 250 | 250 | 925 |
| General Instrument | PIC1650 | 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 |
| Mostek | 3870 | N | 755 | 550 | 435 | 745 | 2,485 |
|  | F8 | N | 50 | 30 | 8 | 22 | 110 |
| Motorola | 146805 | C | 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 | N | 60 | 100 | 140 | 160 | 460 |
|  | 8049/39 | N | 90 | 140 | 210 | 270 | 710 |
| NEC | 8021 | N | 20 | 40 | 30 | 50 | 140 |
|  | 8048/35 | - N | 450 | 450 | 400 | 600 | 1,900 |
|  | 8049/39 | N | 325 | 350 | 600 | 850 | 2,125 |
|  | uPD78XX | 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 |

Table 9 (Continued)
Estimated 8-Bit Microcontroler Unit Shipments by Quarter for 1981
(Thousands of Units)

|  | Product | Process | Q1/81 | Q2/81 | Q3/81 | Q4/81 | 1981 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Siemens | 8048/35 | N | S | 10 | 35 | 40 | 85 |
|  | 8021 | N | S | 5 | 20 | 15 | 40 |
|  | 802XX | N | 20 | 50 | 300 | 350 | 720 |
| Synertek | Z8 | N | 0 | 0 | S | 2 | 2 |
| TI | TMS7000 | N | 0 | 2 | 5 | 15 | 22 |
| Toshiba | 8048/35 | N | 25 | 30 | 35 | 40 | 130 |
|  | 8049/39 | N | 39 | 50 | 60 | 70 | 219 |
| Ziiog | Z8 | N | 15 | 24 | 100 | 205 | 344 |
| Total 8-Bit MCUs |  |  | 7,027 | 8,005 | 9,258 | 10,641 | 34,931 |
| $\begin{aligned} & \text { S = Sampled } \\ & \text { Source: Dataquest (June } \end{aligned}$ | 1990) |  |  |  |  |  |  |



Table 10 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1982 (Thousands of Units)

|  | Product | Process | Q1/82 | Q2/82 | Q3/82 | Q4/82 | 1982 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| NEC | 80C48/35 | C | 0 | 10 | 110 | 110 | 230 |
| (Continued) | 80C49/39 | C | 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 | $80 \mathrm{C48}$ | C | 0 | 0 | 5 | 20 | 25 |
|  | $80 C 49$ | C | 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 | Z8 | 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 |
| Symertek | Z8 | N | 5 | 5 | 30 | 50 | 90 |
| TI | 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 | C | 5 | 12 | 50 | 75 | 142 |
| Zilog | Z8 | N | 220 | 180 | 140 | 143 | 683 |
| Total 8-Bit MCUs |  |  | 11,946 | 13,454 | 13,718 | 14,996 | 54,114 |

Source: Drtaquen (June 1990)

|  | Product | Process | Q1/83 | Q2/83 | Q3/83 | Q4/83 | 1983 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AMD | 8048 | N | 60 | 50 | 25 | 55 | 190 |
|  | 8049 | N | 30 | 25 | 25 | 30 | 110 |
|  | 8051 | N | 1 | 70 | 125 | 180 | 376 |
| EFCIS | 6801/03 | N | S | 10 | 20 | 25 | 55 |
|  | 6805 | N | S | 20 | 35 | 45 | 100 |
| Eurotechnique | 8048/35 | N | 7 | 9 | 1 | ${ }^{1}$ | 16 |
|  | 8049/39 | N | 40 | 55 | 1 | 1 | 95 |
|  | 8050/40 | N | 100 | 125 | 1 | 1 | 225 |
| Fairchild | 3870 | N | 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 Instrument | PIC1652/54 | N | 170 | 217 | 220 | 410 | 1,017 |
|  | PIC1655/57 | N | 670 | 603 | 766 | 815 | 2,854 |
|  | PIC1670/72 | N | 530 | 390 | 466 | 725 | 2,111 |
|  | PIC16C58 | N | 130 | 290 | 58 | 160 | 638 |
| Gould | 6801 | N | S | S | S | 220 | 220 |
|  | 6805 | N | 40 | 10 | 5 | 65 | 120 |
| Hitachi | 6301 | C | 150 | 162 | 190 | 220 | 722 |
|  | 6305 | C | 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 | N | 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 | C | 3 | 5 | 5 | 5 | 18 |
|  | 80C49/39 | C | S | 40 | 50 | 50 | 140 |
|  | 80C51/31 | C | S | 40 | 50 | 50 | 140 |
|  | 8748 | N | 470 | 445 | 550 | 600 | 2,065 |
|  | 8749 | N | 180 | 180 | 250 | 350 | 960 |
|  | 8751 | N | 35 | 60 | 75 | 150 | 320 |
| Matra-Harris | 8048 | N | 7 | 9 | 12 | 20 | 48 |
| Matsushita | M ${ }^{\text {c }} 1800$ | N | 7 | 7 | 7 | 7 | 28 |
| Mostek | 3870 | N | 430 | 430 | 400 | 400 | 1,660 |
|  | F8 | N | 50 | 45 | 25 | 70 | 190 |
| Motorola | 146805 | C | 465 | 440 | 387 | 594 | 1,886 |
|  | 1468705 | C | 1 | 1 | 1 | 2 | 5 |


| (19mb) |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| s¢I | 02 | ${ }^{0} \varepsilon$ | sz | 09 | N | 82 | TProuk |
| 9 zI | 08 | $0{ }_{0}$ | $\varepsilon$ | $\varepsilon$ | N | 1E/IS08 |  |
| 000 | 001 | 001 | Ofl | 06 | N | 0¢/0S08 |  |
| Sts | OSI | Ost | ¢¢1 | 011 | N | 6E/6008 |  |
| Ss0't | $06 \tau$ | 082 | 597 | $0 z z$ | N | SE/8408 | sopauts |
| 0co't | $02 \square$ | 00E | osz | 09 | N | 1 $1 / 1508$ |  |
| $0<z$ | 06 | 00 | OS | 06 | N | ¢£/8t08 |  |
| 084! | 00s | $00 \varepsilon$ | $00 \varepsilon$ | 088 | $N$ | xxz08 |  |
| 09 | $s$ | $\boldsymbol{s} \boldsymbol{\tau}$ | $s$ | sz | N | 1208 | sumurs |
| 086 | 0st | 008 | OSI | 08 | N | 8 Z | dreqs |
| 6st't | 098 | 008 | $s t z$ | tsz | N | X $28 \varepsilon$ | salv-Sos |
| 066 | $0 ¢ \tau$ | 0sz | ${ }^{00 \varepsilon}$ | 0si | N | 1/0059 | пәмхооу |
| $\dagger$ | $\tau$ | $\tau$ | $s$ | s | 0 | Vr08I | vis |
| 0064 | 009 | 079 | Oes | 061 | N | XXt8 |  |
| $0{ }^{0}$ | $s \_$ | or | s | 0 | N | 1¢/IS08 |  |
| 0zE | 001 | 001 | 09 | 09 | N | 6¢/6508 |  |
| $0 \times 6$ | O¢Z | 0¢z | 007 | 082 | N | S¢/8t08 |  |
| 098 | 011 | 06 | 06 | 02 | N | zz/Iz08 | sd!t! ${ }^{\text {d }}$ |
| Lz8 | 068 | 002 | LEI | 001 | 0 | 6 b 08 |  |
| $\varepsilon 02$ | 08 | os | Et | 0ع | 0 | $8+008$ | P\% |
| 096' $\downarrow$ | 098'1 | $00 \varepsilon^{\prime} \mathrm{t}$ | Ostit | 0¢9 | N | xx8Lad ${ }^{\text {a }}$ |  |
| ssz | 09 | 09 | 001 | s¢ | N | $60+8$ |  |
| 060'I |  | asz | 000 | 002 | N | $8 \mathrm{c} / 8$ |  |
| 059 | $06 \tau$ | 091 | 001 | 001 | 0 | 68/6t-08 |  |
| 066 | 087 | oiz | s $\mathfrak{1}$ | szı | $\bigcirc$ | ¢ $¢ / 8 \mathrm{f}$ J08 |  |
| 056's | $00 \varepsilon^{4} 1$ | 009't | 009'1 | OSt'I | N | 6E/6t08 |  |
| ${ }^{09 \varepsilon} \varepsilon^{\text {c }}$ \% | 09s'1 | 002 | oss | oss | N | 5¢/8t08 |  |
| Stz | 08 | ${ }_{58}$ | os | OE | N | 1208 | jan |
| siz | 011 | 08 | sz | $s$ | N | 1/00s9 | 4, ${ }^{\text {N }}$ |
| Stz | SL | ¢9 | os | ss | $\bigcirc$ | 6t/8t508 |  |
| 09 | si | si | si | sı | N | X 208 |  |
| 0LZ't | 098 | 0¢£ | S0E | sLz | N | 0t/0S08 |  |
| $06 z^{\prime}$ | ose | 0z¢ | 0z¢ | ${ }_{0} 08$ | N | 6E/6ヶ08 |  |
| OSt'l | Stb | SLE | $00 \varepsilon$ | 0zE | N | 5 $1 / 8708$ | ${ }^{\text {ruouren }}$ |
| t8s | 891 | 9LI | OSI | 06 | N | S0L89 |  |
| t9E | 85 | Itr | 001 | 59 | N | 10L89 |  |
| $\downarrow$ ¢6'9 | 06L'I | 270\% $\tau$ | 0091 | 0zs't | N | 5089 |  |
| s | s | s | 0 | 0 | N | 1089 |  |
| H14\% | ${ }_{508}$ ' 2 | $96 z^{\prime} \tau$ | 001'I | 016 | N | ع0/1089 | (ponupuod) |
| 9 I | 91 | 91 | 02 | SL | N | $0 \angle 8 \varepsilon$ | sporow |
| E861 | c8/b0 | ¢8/E0 | ¢8/ZO | ع8/IO | \$5200.d | ponpord |  |
|  |  | งој ләนе |  | spuesno Иก ม10 II ग | D!! M, | raunss |  |

Table 11 (Continued)

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

raken ower by Thomson
$\mathbf{S}=$ Sampled
Source: Dataquest (Jure 1990)

Table 12

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

|  | Product | Process | Q1/84 | 02/84 | 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 Instroment | 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 | 6301 V | C | 300 | 325 | 367 | 480 | 1,472 |
|  | 6305 | C | 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 | C | 5 | 5 | 0 | 0 | 10 |
|  | 80C49/39 | C | 55 | 55 | 60 | 60 | 230 |
|  | 80C51/31 | C | 50 | 50 | 80 | 85 | 265 |
|  | 8748 | N | 625 | 625 | 625 | 625 | 2,500 |
|  | 8749 | N | 390 | 390 | 600 | 650 | 2,030 |
|  | 8751 | N | 200 | 200 | 200 | 195 | 795 |
| Intersil | 80C48/35 | C | 0 | 0 | 12 | 32 | 44 |
| Matra-Harris | 8048 | N | 30 | 40 | 40 | 20 | 130 |
|  | 8051 | N | 20 | 15 | 250 | 350 | 635 |
|  | $80 \mathrm{C48}$ | C | 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 |


| （poanymos） |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0S6＇I | 00s | 005 | SLt | sLt | N | 82 | dreqs |
| £zI | $\varepsilon!$ | 0 | 011 | 0 | N | 8 Z |  |
| $685^{\prime}$ | OSE | 0zt | セ¢ | SLE | N | x $48 \varepsilon$ | sos |
| Ose＇t | 002 | oss | SLt | 5 $\mathfrak{E}$ | N | 1／0059 | пэмуроу |
| $\iota$ | $s$ | 1 | I | 0 | N | S089 |  |
| $\varepsilon \tau$ | OI | 9 | $s$ | $\tau$ | 0 | Vt08I | vix |
| 00s＇z | 006 | 004 | 000 | 00s | N | XX¢8 |  |
| 091＇t | 00t | 00t | ${ }^{00 E}$ | 09 | N | 18／5508 |  |
| $\varepsilon$ | $\varepsilon$ | 0 | 0 | 0 | 0 | $6+508$ |  |
| 01 | Or | 0 | 0 | 0 | N | 0t／0¢08 |  |
| $06^{6}$＇z | 000＇i | 006 | 059 | 088 | N | 68／6008 |  |
| 01t＇$\varepsilon$ | $000{ }^{\text {c }}$ | 000＇I | 059 | 09＊ | N | se／8＋08 |  |
| OS9 | 0LI | 021 | Osi | 091 | N | zz／1208 | sd！${ }^{\text {dequ }}$ |
| 096＇I | OSt | 095 | oos | OSt | 0 | 68／66008 |  |
| OSt | 06 | 0¢1 | ozi | 001 | 0 | 5 $8 / 8 \mathrm{t} 208$ | Ero |
| 08L＇ı | 0Lて＇ $\mathcal{L}$ | $0<2$＇ | $088{ }^{\prime} \tau$ | 098 $z$ | N | XX8LOdn |  |
| 010＇t | 062 | 062 | 002 | $0 ¢ \tau$ | N | 6 L ¢8 |  |
| 0so＇z | 098 | ass | 029 | ozs | N | $8 t / 8$ |  |
| 0LC＇I | 00s | 00s | 098 | 0it | $\bigcirc$ | 68／6t508 |  |
| 020\％ | 02t | 0zt | 019 | OLS | 0 | ¢ $¢ / 8 t 508$ |  |
| $012 L^{\circ}$ | $006{ }^{4}$ | 006＇t | 096＇t | Oso ${ }^{\text {a }}$ z | $N$ | 68／6108 |  |
| oscic | $0 \not 0 \chi^{\prime}$ | osetz | 061\％ | $0 \mathrm{L6}{ }^{\text {I }}$ | N | ¢ $¢ / 8+08$ |  |
| $08 \varepsilon$ | 061 | 061 | 0 | 0 | $\bigcirc$ | Itc8 |  |
| 0zz＇z | OII＇I | 011\％ | 0 | 0 | 0 | It08 |  |
| 0＜t | 0¢1 | 0¢I | 011 | 001 | N | 2z／1208 | Dan |
| 009 | osi | 0st | 0si | OSI | N | 1／00s9 | บัN |
| $0{ }^{\circ}$ | 0 | 0 | or | $0 \varepsilon$ | 0 | 5 $6 / 8+508$ |  |
| s | $s$ | 01 | OI | or | N | X 208 |  |
| 0061 | oos | cos | SLt | 59\％ | N | 0t／0508 |  |
| 061＇z | $00 \angle$ | 002 | 000 | 068 | N | 68／6008 |  |
| sci＇z | 008 | 008 | 009 | sLs | N | ¢ $¢ / 8708$ | ${ }^{\text {rumopen }}$ |
| $\varepsilon$ | $\varepsilon$ | 0 | 0 | 0 | 0 | пวН89 |  |
| 206＇t | 815 | ¢ $¢$ | E6t | $85 \varepsilon$ | N | 50289 |  |
| 661 | Lع | 9s | 95 | os | N | 10289 |  |
| ze¢＇8 | $88 \mathrm{I}^{\prime} \mathrm{Z}$ | $6 L \varepsilon^{\prime} \tau$ | ILL＇ | E66 $^{\text {＇}}$ | N | 5089 |  |
| $9 \varepsilon$ | 67 | $\iota$ | 0 | 0 | N | ＋089 |  |
| $026{ }^{\circ}$ | S98＇I | 6781 | sso ${ }^{\circ} \mathrm{z}$ | ISİz | $N$ | ع0／1089 |  |
| 09 | $\varepsilon \chi$ | 91 | II | or | N | X $28 \varepsilon$ |  |
| ャع | $\iota$ | 61 | $\stackrel{ }{ }$ | $\stackrel{\square}{ }$ | 0 | s0L89tI |  |
| $68 \varepsilon^{*} \downarrow$ | 2stit | $8 \varepsilon z^{\prime} \mathrm{I}$ | 601＇1 | 062 | 0 | S089］I | Elorovow |
| 1861 | 18／00 | 18／EO | \＄8／20 | 18／10 | 5500041 | papald |  |
|  |  | 1031318 |  | spuesn <br>  <br> a） z | 00．01！W | pajemusg |  |

Table 12 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

|  | Product | Process | Q1/84 | Q2/84 | 03/84 | 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 | Z8 | N | 9 | 9 | 4 | 2 | 24 |
| TI | TMS7000 | N | 240 | 250 | 250 | 250 | 990 |
| Thomson ${ }^{\text { }}$ | 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 | C | 280 | 290 | 750 | 850 | 2,170 |
| Zilog | Z8 | N | 435 | 675 | 450 | 495 | 2,055 |
| Total 8-Bit MCUs |  |  | 33,871 | 38,222 | 46,507 | 44,910 | 163,510 |

Table 13

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

|  | 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 | C | 85 | 77 | 69 | 25 | 256 |
|  | PIC16E57 | N | 5 | 8 | 8 | 45 | 66 |
|  | PIC7000/1 | N | 6 | 5 | 5 | 10 | 26 |
|  | PIC7020/40 | N | 25 | 40 | 45 | 30 | 140 |
|  | PIC7041 | N | 3 | 3 | 3 | 3 | 12 |
| Gould/AMI ${ }^{\text {1 }}$ | 6801/03 | N | 290 | 250 | 16 | 20 | 576 |
|  | 6805 | N | 175 | 158 | 32 | 37 | 402 |
| Hitachi | 6301 V | C | 420 | 425 | 383 | 780 | 2,008 |
|  | 6305 | C | 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 | C | 40 | 30 | 27 | 15 | 112 |
|  | 80C51/31 | C | 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 | C | 8 | 8 | 7 | 7 | 30 |
|  | 80C49/39 | C | 3 | 2 | 2 | 2 | 9 |
| Matra-Harris | 8051 | N | 450 | 300 | 300 | 350 | 1,400 |
|  | 8052 | N | 0 | 0 | 0 | 20 | 20 |
|  | $80 \mathrm{C51}$ | C | 0 | 0 | 0 | 10 | 10 |
| Matsushita | MN1800 | C | 10 | 24 | 32 | 65 | 131 |
| Mitsubishi | MSOXXX | C | 3,200 | 4,050 | 3,900 | 3,975 | 15,125 |



Table 13 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

|  | 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 |
| 11 | TMS7000 | N | 400 | 350 | 316 | 330 | 1,396 |
| Thomson | 6801/03 | N | 65 | 59 | 53 | 160 | 337 |
|  | 6805 | N | 350 | 315 | 284 | 180 | 1,129 |
| TCMC (Mostek) ${ }^{2}$ | 387X | N | 273 | 159 | 211 | 224 | 867 |
|  | 38P7X | N | 112 | 80 | 61 | 44 | 297 |
|  | F8 | N | 62 | 51 | 42 | 40 | 195 |
| Toshiba | 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 | C | 900 | 675 | 650 | 700 | 2,925 |
| Zilog | Z8 | N | 564 | 550 | 495 | 490 | 2,099 |
| Total 8-Bit MCUs |  |  | 45,746 | 39,722 | 38,425 | 39,706 | 163,599 |

'AMI was acquired by Gould Semiconductor.
Thomsan Componens maquired Montek Corpontion from United Technologies, furming Thomson Components-Moatek Corporation (TCMC).
Source: Datocruest (Jume 1990)

Table 14

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

|  | 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 |
|  | P8 | N | 27 | 89 | 98 | 90 | 304 |
| Fujitsu | 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 | C | 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 | C | 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 | C | 950 | 1,265 | 1,175 | 1,810 | 5,200 |
|  | 6305 | C | 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 | N | 150 | 170 | 548 | 732 | 1,600 |
|  | 80C49/39 | C | 0 | 5 | 5 | 10 | 20 |
|  | 80C51/31 | C | 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 | C | 2 | 3 | 5 | 10 | 20 |
|  | 80049/39 | C | 2 | 3 | 4 | 1 | 10 |
| Matra-Harris | 8051 | N | 358 | 362 | 280 | 340 | 1,340 |
|  | 8052 | N | 20 | 105 | 123 | 170 | 418 |
|  | 80 C 51 | C | 10 | 70 | 107 | 200 | 387 |
| Matsushita | MN1800 | C | 70 | 100 | 110 | 120 | 400 |
| Mitsubishi | M50XXX | C | 6,860 | 7,250 | 7,606 | 8,190 | 29,906 |
| Motorola | 146805 | C | 1,002 | 1,050 | 1,030 | 1,623 | 4,705 |

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 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| National | 1468705 | C | 23 | 25 | 22 | 23 | 93 |
|  | 387X | N | 98 | 40 | 20 | 41 | 199 |
|  | 6801/03 | N | 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 |
|  | $68 \mathrm{HCl1}$ | C | 120 | 142 | 180 | 254 | 696 |
|  | 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 | 3,940 |
|  | 8049/39 | N | 1,150 | 1,530 | 1,450 | 1,220 | 5,350 |
|  | 80C48/35 | C | 330 | 580 | 230 | 220 | 1,360 |
|  | 80C49/39 | C | 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 |
| Oki | 80 C 154 | C | 0 | 0 | 12 | 75 | 87 |
|  | 80C48/35 | C | 130 | 135 | 130 | 125 | 520 |
|  | 80C49/39 | C | 590 | 650 | 790 | 690 | 2,720 |
|  | 80C51 | C | 150 | 282 | 520 | 820 | 1,772 |
| 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 | C | 50 | 55 | 65 | 70 | 240 |
|  | 80C51/31 | C | 5 | 15 | 26 | 35 | 81 |
|  | 84CXX | C | 0 | 0 | 0 | 15 | 15 |
|  | 84XX | N | 3,200 | 3,400 | 4,000 | 3,725 | 14,325 |
| RCA | 1804A | C | 4 | 2 | 2 | 3 | 11 |
|  | 6805/68HC05 | C | 55 | 65 | 88 | 151 | 359 |
| Rockwell | 6500/XX | N | 450 | 640 | 510 | 950 | 2,550 |




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 <br> Technology ${ }^{1}$ | PIC1652/54 | N | 758 | 960 | 1,300 | 1,045 | 4,063 |
|  | P1C1655/57 | N | 350 | 347 | 126 | 250 | 1,073 |
|  | PrC1670/72 | 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 | C | 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 | C | 1,859 | 221 | 310 | 224 | 2,614 |
| Motorola | 146805 | C | 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 | C | 714 | 974 | 1,316 | 1,674 | 4,678 |
|  | $68 \mathrm{HCl1}$ | C | 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 | C | 0 | 0 | 0 | 10 | 10 |
| National ${ }^{2}$ | 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 | C | 220 | 320 | 230 | 200 | 970 |
|  | 80C49/39 | C | 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 |
| Oli | 80 C 154 | C | 75 | 95 | 350 | 374 | 894 |
|  | 80C48/35 | C | 125 | 110 | 100 | 93 | 428 |
|  | 80C49/39 | C | 699 | 734 | 890 | 810 | 3,133 |
|  | 80 C 51 | C | 790 | 591 | 660 | 680 | 2,721 |



Table 15 (Continued)
Estimated 8-Bit Microcontroler Unit Shipments by Quarter for 1987 (Thousands of Units)

|  | Product | Process | Q1/87 | Q2/87 | Q3/87 | Q4/87 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Toshiba | 80C49/39 | C | 800 | 850 | 900 | 1,050 | 3,600 |
| (Continued) | 80C50/40 | C | 200 | 225 | 210 | 216 | 851 |
| Zilog | Z8 | N | 863 | 863 | 858 | 838 | 3,422 |
| Total 8-Bit MCUs |  |  | 65,376 | 70,619 | 80,807 | 82,668 | 299,470 |
| 'Genenal Instrument's Microelectrontoz Division sphan off as a expirito comptany under the name Microctip Tochnology. Natioual accuired Eairchild. <br> 'SGS and Thamson Compments merged, forming SOS-Thomsan. TCMC (Mostek) was folded into newly establidred company. Source: Datiquest (Jume 1990) |  |  |  |  |  |  |  |



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 | C | 80 | 150 | 208 | 222 | 660 |
| (Continued) | 83 C 154 | C | 0 | 20 | 41 | 55 | 116 |
| Matsushita | MN1800/70/80 | C | 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 | C | 200 | 140 | 150 | 200 | 690 |
|  | M507XX | C | 5,800 | 6,600 | 5,000 | 5,500 | 22,900 |
|  | M509XX | C | 5,800 | 5,800 | 7,000 | 6,500 | 25,100 |
| Motorola | 146805 | C | 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 |
|  | $68 \mathrm{HC05}$ | C | 2,004 | 2,900 | 4,009 | 3,763 | 12,676 |
|  | 68HC11 | C | 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 | C | 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 | N | 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 | C | 210 | 210 | 160 | 160 | 740 |
|  | 80C49/39 | C | 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 |
|  | V 25 | C | 0 | 0 | 2 | 3 | 5 |

Table 16 (Contimued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter 10 or 1988 (Thousands of Units)

|  | Product | Pracess | Q1/88 | Q2/88 | Q3/88 | Q4/88 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Oni | 00C48/35 | C | 90 | 95 | 90 | 110 | 385 |
|  | 80 Cl 54 | C | 350 | 360 | 420 | 500 | 1,630 |
|  | 80C49/39 | C | 800 | 812 | 890 | 960 | 3,462 |
|  | 80C51/31 | C | 650 | 670 | 950 | 830 | 3,100 |
| Ptilips | 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 | C | 170 | 170 | 160 | 165 | 665 |
|  | 80C51/31 | C | 270 | 250 | 350 | 350 | 1,220 |
|  | 84CXX | C | 350 | 550 | 800 | 820 | 2,520 |
|  | 84XX | N | 2,150 | 2,400 | 2,500 | 2,530 | 9,580 |
| Rockwell | 6500/XX | N | 1,800 | 1,930 | 200 | 300 | 4,230 |
| Sanyo | LC86XXX | C | 0 | 0 | 400 | 400 | 800 |
|  | LM88XX | N | 0 | 0 | 100 | 100 | 200 |
| SGS-Thromson | 387X | N | 1,097 | 848 | 760 | 531 | 3,236 |
|  | 38P7X | N | 18 | 26 | 33 | 33 | 110 |
|  | 6801/03 | N | 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 | CUSTOM | C | 0 | 0 | 80 | 90 | 170 |
|  | SM-Series | C | 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 |
| 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 |
|  | $80 \mathrm{C451}$ | C | 26 | 6 | 13 | 10 | 55 |
|  | 80C51/31 | C | 299 | 415 | 499 | 440 | 1,653 |
|  | 8400 | N | 10 | 0 | 0 | 0 | 10 |
|  | 8441 | C | 16 | 2 | 0 | 0 | 18 |
|  | 87 C 451 | c | 4 | 0 | 5 | 6 | 15 |

Table 16 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1988
(Thousands of Units)

'Harris zequired GE Solid Shte and RCA, 1988.
Source: Dataquest (Jume 1990)

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 |
|  | $80 \mathrm{C} 51 / 3 \mathrm{I}$ | C | 450 | 350 | 360 | 390 | 1,550 |
|  | 80C521/321 | C | 30 | 100 | 130 | 175 | 435 |
|  | 80C5292/3292 | C | 100 | 275 | 310 | 355 | 1,040 |
|  | 8751 | N | 75 | 75 | 75 | 70 | 295 |
|  | 8753 | N | 25 | 45 | 45 | 40 | 155 |
|  | $89 \mathrm{C51}$ | C | 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 | C | 130 | 140 | 150 | 165 | 585 |
|  | MB897XX | C | 522 | 528 | 550 | 600 | 2,200 |
| Harris (GE-SS/RCA) | 6805 | N | 53 | 88 | 65 | 60 | 266 |
|  | 68HC05 | C | 355 | 600 | 750 | 1,000 | 2,705 |
| Hitachi | 6301 | C | 3,200 | 3,300 | 3,500 | 4,000 | 14,000 |
|  | 6305 | C | 2,800 | 2,700 | 2,600 | 2,500 | 10,600 |
|  | 63701 | C | 300 | 400 | 550 | 700 | 1,950 |
|  | 63705 | C | 160 | 180 | 200 | 230 | 770 |
|  | 63 P 01 | C | 275 | 280 | 285 | 290 | 1,130 |
|  | 63 P 05 | C | 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 |
|  | 68 P 01 | N | 245 | 250 | 255 | 260 | 1,010 |
|  | 68 P 05 | N | 265 | 250 | 240 | 220 | 975 |
|  | H8/532 | C | 10 | 40 | 50 | 100 | 200 |
| Incel | 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 | C | 2,100 | 2,800 | 3,000 | 2,900 | 10,800 |
|  | 8748 | N | 200 | 180 | 175 | 135 | 690 |
|  | 8749 | N | 600 | 670 | 1,000 | 815 | 3,085 |
|  | 8751 | N | 200 | 230 | 265 | 210 | 905 |
|  | 8752 | C | 90 | 40 | 210 | 340 | 680 |
|  | 87 C 51 | C | 100 | 260 | 200 | 260 | 820 |

Table 17 (Continued)
Estimated 8-bit Microcontroller Unit Shipment by Quarter for 1989
(Thoussands of Units)

|  | Product | Process | Q189 | Q2/89 | Q3/89 | Q4/89 | 1989 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Matra-Harris | 8052/32 | N | 150 | 100 | 60 | 0 | 310 |
|  | 80C51/31 | C | 625 | 640 | 690 | 655 | 2,610 |
|  | 80C52/32 | C | 370 | 590 | 875 | 1,110 | 2,945 |
|  | 80C752 | C | 0 | 0 | 10 | 35 | 45 |
|  | 83 Cl 54 | C | 55 | 75 | 70 | 90 | 290 |
| Matsushita | MN1800/70/80 | C | 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 | C | 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 | C | 250 | 250 | 250 | 200 | 950 |
|  | M507XX | C | 5,000 | 5,000 | 5,000 | 5,500 | 20,500 |
|  | M509XX | C | 6,000 | 5,500 | 6,000 | 6,500 | 24,000 |
| Motorola | 146805 | C | 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 | C | 5,256 | 7,613 | 14,000 | 17,700 | 44,569 |
|  | $68 \mathrm{HCl1}$ | C | 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 | C | 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 | C | 240 | 270 | 300 | 290 | 1,100 |
|  | 80C49/39 | C | 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 | C | 10 | 30 | 40 | 70 | 150 |

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 | C | 750 | 1,000 | 1,200 | 1,500 | 4,450 |
|  | 80048/35 | C | 100 | 100 | 100 | 100 | 400 |
|  | 80C49/39 | C | 900 | 700 | 500 | 500 | 2,600 |
|  | 80C51/31 | C | 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 | C | 170 | 180 | 190 | 185 | 725 |
|  | 80C51/31 | C | 355 | 415 | 475 | 470 | 1,715 |
|  | 84CXX | C | 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 | C | 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 | C | 220 | 300 | 320 | 360 | 1,200 |
|  | SM-Series | C | 300 | 380 | 400 | 420 | 1,500 |
|  | Z88 | N | 130 | 133 | 137 | 135 | 535 |
| Siemens | 802 XX | 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 |
|  | $80 \mathrm{C451}$ | C | 7 | 8 | 6 | 23 | 44 |
|  | 80C51/31 | C | 912 | 1,256 | 1,303 | 779 | 4,250 |
|  | $87 \mathrm{C451}$ | C | 27 | 16 | 25 | 30 | 98 |
|  | $87 \mathrm{C51}$ | C | 125 | 103 | 43 | 45 | 316 |
|  | 87C751 | C | 10 | 24 | 14 | 29 | 77 |
| Sony | SPC700 | C | 1,000 | 1,300 | 1,500 | 1,600 | 5,400 |
| TI | TMS370 | C | 1 | 25 | 50 | 100 | 176 |
|  | TMS7000 | N | 2,800 | 2,500 | 2,500 | 2,000 | 9,800 |

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 | 170 | 130 | 100 | 100 | 500 |
|  | $8049 / 39$ | N | 250 | 190 | 150 | 150 | 740 |
|  | $80 C 48 / 35$ | C | 700 | 500 | 250 | 250 | 1,700 |
|  | $80 C 49 / 39$ | C | 950 | 800 | 750 | 750 | 3,250 |
|  | $80 C 50 / 40$ | C | 220 | 200 | 240 | 240 | 900 |
|  | TLCS-870 | C | 0 | 0 | 30 | 100 | 130 |
|  | TLCS-90 | C | 500 | 650 | 800 | 900 | 2,850 |
|  | Z8 | N | 1,500 | 1,600 | 1,500 | 1,900 | 6,500 |
|  |  |  | 102,512 | 109,173 | 120,619 | 126,395 | 458,699 |

Source: Dataquen (Jine 1990)

## 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 Unit Stipments by 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-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 12 | Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1989 |

Table I

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

|  | Product | Process | 1980 | 1981 | 1982 | 1983 | 1984 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Intel | 8096 | N | 0 | 0 | 0 | 2 | 1 |
| Texas Instruments | 9940 | N | 8 | 36 | 50 | 89 | 122 |
| Total 16-Bit MCUs |  |  |  |  |  |  |  |

Table 2

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

|  | Product | Process | 1985 | 1986 | 1987 | 1988 | 1989 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Hitachi | H16 | C | 0 | 0 | 0 | 0 | 35 |
| Intel | 8096 | N | 145 | 269 | 548 | 1,670 | 3,105 |
|  | 8098 | N | 0 | 0 | 0 | 80 | 30 |
|  | 80 C 196 | C | 0 | 0 | 0 | 60 | 215 |
| Mitsubishi | M377XX | C | 0 | 0 | 0 | 0 | 180 |
| Mostek ${ }^{1}$ | 68200 | N | 12 | 129 | 110 | 0 | 0 |
| National | HPC | C | 0 | 0 | 25 | 250 | 625 |
| NEC | V35 | C | 0 | 0 | 2 | 9 | 18 |
| SGS-Thomson ${ }^{1}$ | 68200 | N | 0 | 0 | 0 | 64 | 57 |
| TI | 9940 | N | 75 | 1 | 0 | 0 | 0 |
| Various ${ }^{2}$ | 8061 | C | 0 | 0 | 2,626 | 3,328 | 3,173 |
| Total 16-Bit | MCUs |  | 232 | 399 | 3,311 | 5,461 | 7,438 |

${ }^{1}$ Thomson Components acquired Mostek Corporation in 1985. Thomsan and SGS merged in 1987.
${ }^{2}$ The 8061 is a custom-designed 16-bit microcontroller for Pord Motor Company. It is supplied by several semiconductor comparies, including lurel. Ertimated prodoction of the 8061 is based on production of Ford automobiles and trocka. (No attempt to estimate prodaction prior to 1987 has been misde.) 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 MCUs |  |  | 1 | 1 | 2 | 4 | 8 |

Source: Detaquent (Juty 1990)

Table 4
Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

|  | Product | Process | Q1/81 | Q2/81 | Q3/8I | Q4/81 | 1981 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Texas Instroments | 9940 | N | 6 | 10 | 10 | 10 | 36 |
| Total 16-Bit MCUs |  | 6 | 10 | 10 | 10 | 36 |  |
| Soarce: Dataquest (Iume 1990 ) |  |  |  |  |  |  |  |

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 |  |  | 10 | 10 | 15 | 15 | 50 |

Table 6
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 | 9940 | N | 20 | 22 | 22 | 25 | 89 |
| Total 16-Bit |  |  | 20 | 22 | 22 | 25 | 89 |

Source: Dataquest (June 1990)

Table 7

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 |  |  | 30 | 30 | 31 | 32 | 123 |

## 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 | 1985 |
| :--- | :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Intel | 8096 | N | 25 | 40 | 40 | 40 | 145 |
| TCMC (Mostek) | 68200 | N | 0 | 0 | 1 | 11 | 12 |
| Texas Instruments | 9940 | N | 25 | 15 | 15 | 20 | 75 |
| Total 16-Bit MCUs |  |  | 50 | 55 | 56 | $\mathbf{7 1}$ | 232 |

${ }^{1}$ Thomson Componenta socuired Moatek Corporation in 1985, forming Thomeon Composents Mostak Cosporstion (TCMC).
Scurce: Dataquest (June 1990)

Table ;

Estimated 16-Bit Microcontrolier 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 |  |  | 77 | 98 | 117 | 107 | 399 |

Table 10

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


[^6]
## Table 11

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

|  | 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 |
|  | $80 \mathrm{C196}$ | C | 10 | 20 | 10 | 20 | 60 |
| National | HPC | C | 40 | 55 | 80 | 75 | 250 |
| NEC | V35 | C | 2 | 2 | 2 | 3 | 9 |
| SGS-Thomson | 68200 | N | 16 | 19 | 0 | 29 | 64 |
| Various ${ }^{1}$ | 8061 | C | 902 | 940 | 656 | 830 | 3,328 |
| Total 16-Bit MCUs |  |  | 1,270 | 1,456 | 1,148 | 1,587 | 5,461 |

${ }^{1}$ The 8061 is a cugtom-derigned 16-bit microcontroller for Fond Motor Company. It is supplied by servent semicondactor compenies inchuding Intel. Estimated prodoction of the 8061 is based on production of Ford antomobiles and trucks.
Source: Dalaquert (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 |
|  | 80 C 196 | C | 20 | 40 | 55 | 100 | 215 |
| Mitsubishi | M377XX | C | 10 | 20 | 50 | 100 | 180 |
| National | HPC | C | 105 | 90 | 180 | 250 | 625 |
| NEC | V35 | C | 4 | 4 | 5 | 5 | 18 |
| SGS-Thomson | 68200 | N | 19 | 26 | 1 | 11 | 57 |
| Various | 8061 | C | 867 | 909 | 619 | 778 | 3,173 |
| Total 16-Bit MCUs |  |  | 1,660 | 1,874 | 1,745 | 2,159 | 7,438 |

 mated prodrction of the 8061 is based on procuction of Ford automobiles and trucks.
Source: Dataquent (June 1990)

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## 4-Bit Microcontrollers--Historical Shipment Data

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

## 4-Bit Microcontrollers--Historical Shipment Data

## Table 1

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

|  | Product | Process | 1975 | 1976 | 1977 | 1978 | 1.979 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | 50 | 310 | 2.825 | 9.400 | 26,100 |
| Total | CUs |  | 500 | 760 | 3.400 | 15,959 | 50,525 |

## 4-Bit Microcontrollers--Historical Shipment Data

Table 2

## Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 <br> (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 | C | 185 | 2,050 | 3,150 | 3,110 | 2,720 |
| Gould/AMI | S2000 | N | 1,120 | 390 | 566 | 115 | 0 |
| Hitachi | EMCS-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 | c | 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 | C | 0 | 3,200 | 8.000 | 15,100 | 31,500 |
| Oki | Series-40 | C | 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 | C | 1,200 | 1,600 | 1.950 | 1,750 | 1,840 |
|  | SM-5 | C | 4,800 | 10,690 | 9,400 | 10,350 | 12,190 |
| TI | TMS 1000 | P/C | 44,000 | 39,500 | 26,000 | 11,900 | 8,300 |
| Toshiba | T-Series | C | 0 | 0 | 8,300 | 9,800 | 6,000 |
|  | TLCS-43 | N | 0 | 0 | 3,300 | 9,200 | 8,000 |
|  | TLCS-46 | C | 0 | 0 | 2,900 | 3,580 | 3,250 |
|  | TLCS-47 | N | 0 | 0 | 600 | 3.070 | 6.300 |
| Total 4-B | MCUs |  | 96,080 | 133,549 | 158,183 | 171,945 | 193,435 |

# 4-Bit Microcontrollers--Historical Shipment Data 

Table 3
Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988
(Thousands of Units)

|  | Product | Process | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | MB882XX | C | 0 | 0 | 760 | 1,400 |
|  | MB8840X | N | 0 | 0 | 1,843 | 1,910 |
|  | M8884X | N | 5,634 | 6,580 | 7,160 | 6,840 |
|  | MB8850X | C | 0 | 0 | 485 | 3,500 |
|  | MB885X | C | 2,156 | 3,425 | 3,742 | 3,990 |
| Hitachi | HMCS -40 | P/N/C | 22,352 | 21,919 | 25,900 | 21,500 |
|  | HMCS -400 | C | N/A | N/A | 32,100 | 26,500 |
| Matsushita | MN1400 | P/N/C | 20,600 | 27.420 | 11,875 | 8,400 |
|  | MN1500 | N | 11,300 | 27,680 | 42,090 | 49,580 |
|  | MN1700 | C | 0 | 0 | 2,085 | 4.700 |
| Mitsubishi | M5043X/44X | C | 0 | 0 | 13,995 | 13,200 |
|  | M5046X/56X | C | 0 | 0 | 13,105 | 19,800 |
|  | M5072/76 | C | 0 | 0 | 15,054 | 14,100 |
|  | M509X | C | 0 | 0 | 2,056 | 6,430 |
|  | M50xxx | C | 0 | 27,844 | 0 | N/A |
| Motorola | 141000 | C | 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 | C | 31,590 | 41,920 | 47,670 | 63,600 |
| Oki | Series-40 | C | 6,614 | 7,217 | 6,689 | 7.580 |
| Rockwell | PPS-4 | P/N | 1,400 | 1,160 | 790 | 325 |
| SGS-Thomson | COPS | H | 5,242 | 6,330 | 7,515 | 8,850 |
| Sharp | SM-Series* | C | 10,370 | 9,140 | 9,510 | 21,750 |
| II | TMS1000 | P/C | 3,900 | 16,025 | 13,400 | 7,800 |
| Toshiba | T-Series | C | 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 | C | 2,198 | 400 | 202 | 480 |
|  | TLCS-47 | N | 7,756 | 7,200 | 5,935 | 9,890 |
|  | TLCS-47 | C | 0 | 15,300 | 17.497 | 32,250 |
|  | TLCS-470 | C | 0 | 400 | 1,360 | 100 |
| Others** | Unspecified | C | 0 | 10,000 | 44.520 | 88.500 |
| Total | t MCUs |  | 177,038 | 271,883 | 392,332 | 501,075 |

*Sharp SM-Series totaled in 1985.
**Dataquest estimate for companies not surveyed (i.e., Ricoh, Sanyo, Sony). N/A $=$ Not Available

Source: Dataquest July 1989

## 4-Bit Microcontrollers--Historical Shipment Data

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

|  | Product | Process | 1975 | 01/76 | 02/76 | 03/76 | 04/76 | 1976 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rockwell | PPS-4 | P | 450 | 100 | 110 | 120 | 120 | 450 |
| TI | TMS-1000 | P/C | 50 | 60 | 75 | 75 | 100 | 310 |
| Total | -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 | $01 / 77$ | 02/77 | 03/77 | 04/77 | 1977 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rockwell | PPS-4 | P | 145 | 145 | 140 | 145 | 575 |
| TI | TMS-1000 | P/C | 225 | 400 | 1.000 | 1,200 | $\underline{2.825}$ |
| Total | Bit MCUs |  | 370 | 545 | 1,140 | 1,345 | 3,400 |

# 4-Bit Microcontrollers--Historical Shipment Data 

## Table 6

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

|  | Product | Process | 01/78 | 02/78 | 03/78 | 04/78 | 7978 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Gould | S2000 | N | 0 | 9 | 8 | 12 | 29 |
| Hitachi | IMMCS-40 | P/N/C | 85 | 95 | 110 | 120 | 410 |
| Motorola | 141000 | C | 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 | 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: |  | $\begin{aligned} & \text { aquest } \\ & \text { y } 1989 \end{aligned}$ |

Table 7
Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1979 (Thousands of Units)

|  | Product | Process | 01/72 | 02/79 | 03/79 | 04/79 | 1979 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | C | 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 | Bit MCUs |  | 7,510 | 10,225 | 14,740 | 17,690 | 50,525 |

*No quarterly data available for Sharp SM-3.
Source: Dataquest July 1989

## 4-Bit Microcontrollers--Historical Shipment Data

## Table 8

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

|  | Product | Process | 01/80 | 02/80 | 03/80 | 04/80 | 1.980 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | 8850 | C | 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 | C | 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 | C | 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 | C | 490 | 800 | 1,550 | 1,960 | 4,800 |
| II $\quad$ Total | TMS-1000 | P/C | 11.000 | 12.500 | 10.000 | 10,500 | 44,000 |
|  | Bit MCUs |  | 21,955 | 26,550 | 24,555 | 23,020 | 96,080 |

## 4-Bit Microcontrollers--Historical Shipment Data

Table 9
Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

|  | Product | Process | 01/81 | 02/81 | 03/81 | 04/81 | 1981 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Eurotech. | COP | C/N | 0 | 0 | 0 | S | S |
| Fujitsu | 884X | N | 1,600 | 2,300 | 2,500 | 2,800 | 9,200 |
|  | 8850 | C | 200 | 500 | 600 | 750 | 2,050 |
| Goula | 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 | C | 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 | C | 0 | 0 | 1,500 | 1,700 | 3,200 |
| Oki | Series-40 | C | 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 | C | 380 | 400 | 420 | 400 | 1,600 |
|  | SM-5 | C | 2,490 | 2,800 | 2,800 | 2,600 | 10,690 |
| TI $\quad$ Total | TMS-1000 | P/C | 10,000 | 10.000 | 10.500 | 9,000 | 3.500 |
|  | -Bit MCUs |  | 28,085 | 32,230 | 36,835 | 36,399 | 133,549 |

S = Sampled

# 4-Bit Microcontrollers--Historical Shipment Data 

Table 10
Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1982
(Thousands of Units)

|  | Product | Process | 01/82 | 02/82 | 03/82 | 04/82 | 1982 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Eurotech. | COP | C/N | $s$ | S | 80 | 110 | 190 |
| Fujitsu | 884X | N | 2,800 | 2,500 | 2,300 | 2,300 | 9,900 |
|  | 8850 | C | 800 | 800 | 750 | 800 | 3,150 |
| Gould | \$2000 | 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 | C | 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 | C | 1.800 | 1,800 | 2,200 | 2,200 | 8.000 |
| Oki | Series-40 | C | 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 | C | 500 | 550 | 450 | 450 | 1,950 |
|  | SM-5 | C | 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 | T Series | C | 1.200 | 2,000 | 2,500 | 2,600 | 8,300 |
|  | TLCS-43 | N | 500 | 600 | 700 | 1,500 | 3,300 |
|  | TLCS-46 | C | 500 | 600 | 1,100 | 700 | 2,900 |
|  | TLCS-47 | C/N | 50 | 200 | 250 | 200 | -600 |
| Total | -Bit MCUs | , | 38,995 | 40,148 | 40,860 | 38,180 | 158,183 |

Source: Dataquest
JuIy 1989

## 4-Bit Microcontrollers--Historical Shipment Data

## Table 11

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

|  | Product | Process | 02/83 | 02/83 | 03/83 | 04/83 | 1983 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Eurotech. | COP | C/N | 130 | 160 | 250 | 300 | 840 |
| Fujitsu | 884X | N | 2.100 | 1,900 | 1,750 | 1,750 | 7.500 |
|  | 8850 | C | 775 | 775 | 780 | 780 | 3,110 |
| Gould | S2000 | N | 40 | 40 | 30 | 5 | 115 |
| Hitachi. | EMMCS-40 | P/N/C | 4,800 | 4,800 | 5,400 | 5,600 | 20,600 |
| Matsushita | MN1400 | P/W/C | 4,100 | 4,480 | 4,940 | 4,900 | 18,420 |
|  | MN1500 | N | 710 | 1,500 | 2,100 | 2,050 | 6,360 |
| Motorola | 141000 | C | 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 | C | 2.500 | 2,900 | 4,500 | 5,200 | 15,100 |
| Oki | Series-4 | C | 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 | C | 425 | 450 | 425 | 450 | 1,750 |
|  | SM-5 | C | 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 | C | 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 | C | 800 | 800 | 1,000 | 980 | 3,580 |
|  | TLCS-47 | C/N | 350 | 600 | 800 | 1.320 | 3.070 |
| Total | Bit MCUs |  | 39,635 | 41,191 | 45,361 | 45,758 | 171,945 |

## Source: Dataquest July 1989

4-Bit Microcontrollers--Historical Shipment Data

Table 12
Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

|  | Product | Process | 01/84 | 02/84 | 03/84 | 04/84 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | 884X | N | 1,600 | 1,500 | 1,500 | 1,500 | 6,100 |
|  | 8850 | 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/W/C | 5.200 | 5,200 | 5,000 | 5,000 | 20,400 |
|  | MN1500 | \% | 2,100 | 2,300 | 2,100 | 2,100 | 8,600 |
| Motorola | 141000 | C | 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 | C | 5,510 | 7,570 | 9,210 | 9,210 | 31,500 |
| Oki | Series-40 | C | 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 | C | 460 | 460 | 460 | 460 | 1,840 |
|  | SM-5 | C | 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 | COFS | C/N | 300 | 560 | 730 | 1,200 | 2,790 |
| Toshiba | T Series | c | 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 | C | 1,000 | 1,000 | 600 | 650 | 3,250 |
|  | TLCS-47 | C/N | 1.400 | 1.400 | 1.700 | 1.800 | 6.300 |
| Total | -Bit MCUs |  | 46,205 | 48,164 | 50,001 | 49,065 | 193,435 |

## 4-Bit Microcontrollers--Historical Shipment Data

Table 13

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

|  | Product | Process | 01/85 | 02/85 | 03/85 | 04/85 | 1985 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | 884X | N | 1,450 | 1,392 | 1,392 | 1,400 | 5,634 |
|  | 8850 | C | 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 | N | 2,100 | 2,100 | 2,800 | 4,300 | 11,300 |
| Motorola | 141000 | C | 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 | C | 7,180 | 8,170 | 8,550 | 7,690 | 31,590 |
| Oki | Series-40 | C | 1.700 | 1,632 | 1,632 | 1,650 | 6,614 |
| Rockwell | PPS-4 | P | 400 | 300 | 360 | 340 | 1,400 |
| Sharp | SM SERIES | C | 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 | C | 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 | C | 650 | 624 | 624 | 300 | 2,198 |
|  | TLCS-47 | C/N | 1.800 | 1.728 | 1,728 | 2.500 | 7.756 |
| Total | -Bit MCUs |  | 44,124 | 43,092 | 44,187 | 45,635 | 177,038 |

## 4-Bit Microcontrollers--Historical Shipment Data

Table 14
Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

|  | Product | Process | 01/86 | 02/86 | 03/86 | 04/86 | 1986 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | 884X | $N$ | 1,535 | 1,620 | 1,680 | 1,745 | 6,580 |
|  | 885X | C | 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 |
|  | M151500 | N | 5,700 | 7,100 | 7,480 | 7,400 | 27,680 |
| Mitsubishi | 50\%8X | C | 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 |
|  | UCOM-75X | c | 0 | 0 | 1,750 | 2,150 | 3,900 |
|  | uPD-75XX | C | 8,470 | 10.420 | 11,920 | 11,110 | 41.920 |
| Oki | Series-40 | C | 1,860 | 1,900 | 1,820 | 1,637 | 7,217 |
| Rockwell | PPS-4 | P | 400 | 300 | 210 | 250 | 1,160 |
| Sharp | SM SERIES | C | 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 | T Series | C | 900 | 1,100 | 1,200 | 1,400 | 4,600 |
|  | TLCS-42 | N/C | 850 | 1,000 | 1,000 | 1,000 | 3,850 |
|  | TLCS-43 | N | 700 | 850 | 650 | 400 | 2,600 |
|  | TLCS-46 | C | 200 | 100 | 50 | 50 | 400 |
|  | TLCS-47 | C/N | 4,400 | 5,200 | 6,700 | 6,200 | 22,500 |
|  | TLCS-470 | C | 0 | 0 | 100 | 300 | 400 |
| Others* | Unspecified | c | 2,500 | 2.500 | 2.500 | 2,500 | 10.000 |
| Total | -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

# 4-Bit Microcontrollers--Historical Shipment Data 

Table 15
Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1987
(Thousands of Units)

|  | Product | Process | Q1/87 | 02/87 | 03/87 | 04/87 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | 882xx | c | 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 | c | 882 | 905 | 940 | 1,015 | 3,742 |
|  | 885x | c | 100 | 110 | 125 | 150 | 485 |
| Hitachi | hmes-40 | P/N/C | 6,300 | 6,405 | 6,520 | 6,675 | 25,900 |
|  | HMCS-400 | c | 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 | c | 0 | 0 | 1,015 | 1,070 | 2,085 |
| Mitsubishi | M5043X/44X | c | 3,393 | 3,294 | 3,767 | 3,541 | 13,995 |
|  | M5046X/56X | c | 2,141 | 3,213 | 3,996 | 3,755 | 13,105 |
|  | M5072/76 | c | 2,701 | 2,908 | 4,337 | 5,108 | 15,054 |
|  | M509X | c | 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 | 4.510 | 5,000 | 3,700 | 16,810 |
|  | uPD75xx | c | 11,000 | 10,970 | 13,500 | 12,200 | 47,670 |
| Oki | Series-40 | c | 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 | 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 |
|  | ILCS-46 | c | 50 | 62 | 48 | 42 | 202 |
|  | TLCS-47 | N | 1,600 | 1,500 | 1.475 | 1,360 | 5,935 |
|  | TLCS-47 | c | 4,300 | 4,220 | 4,405 | 4,572 | 17,497 |
|  | TLCS-470 | c | 300 | 340 | 350 | 370 | 1,360 |
| Others* | Unspecified | $c$ | 11.130 | 11.130 | 11,130 | .11.130 | -44,520 |
| Total | it 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

## 4-Bit Microcontrollers--Historical Shipment Data

Table 16
Estimated 4-Bit Microcontroller Shipments by Quarter for 1988 (Thousands of Units)

|  | Product | Process | 02/88 | 02/88 | 03/88 | 04/88 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | 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 | C | 700 | 900 | 900 | 1,000 | 3,500 |
|  | MB885X | C | 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 | C | 8,500 | 6,000 | 6,000 | 6,000 | 26,500 |
| Matsushita | Ma1400 | 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 | C | 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 | C | 2,900 | 3.300 | 4,100 | 3,800 | 14,100 |
|  | M509X | C | 530 | 1,600 | 2,100 | 2,200 | 6.430 |
| National | COP400 | N/C | 7,550 | 7,500 | 7,300 | B,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 | c | 13.050 | 14,750 | 18.200 | 17.600 | 63,600 |
| Oki | SERIES-40 | C | 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 | C | 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 | T-SERIES | C | 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 | C | 150 | 130 | 100 | 100 | 480 |
|  | TLCS-47 | N | 2,140 | 2,210 | 2,580 | 2,960 | 9,890 |
|  | TLCS-47 | C | 7,200 | 8,190 | 8.410 | 8,450 | 32,250 |
|  | TLCS-470 | c | 0 | 0 | 0 | 200 | 100 |
| Others* | Unspecified | C | 6,000 | 23,500 | 25,750 | 33.250 | 88,500 |
| Total 4 | it MCUS |  | 102,853 | 124,377 | 131,512 | 142.333 | 501,075 |

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

## 4-Bit Microcontrollers--Data

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, 1985-1987

Table 4 Estimated 4-Bit Microcontroller Unit Shipments by Quarter for 1987

# 4-Bit Microcontrollers--Data 

Table 1

## Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1975-1979 <br> (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 | MNT1400 | 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 | 50 | 310 | 2,825 | 9.400 | 26,100 |
| Total 4-Bit MCUs |  |  | 500 | 760 | 3,400 | 15,959 | 50,525 |
|  |  |  |  |  | Source | Dataquest <br> September 1988 |  |

## 4-Bit Microcontrollers--Data

Table 2

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

|  | Product | Process | 1980 | 1981 | 1.982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Eurotechnique | COPS | N,C | 0 | 0 | 190 | 840 | 0 |
| Fujitsu | MB884X | N | 0 | 9,200 | 9,900 | 7.500 | 6.100 |
|  | MB885X | C | 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 | H | 20 | 1,250 | 1,620 | 6,360 | 8,600 |
| Motorola | 141000 | C | 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 | C | 0 | 3,200 | 8,000 | 15,100 | 31,500 |
| Oki | Series-40 | C | 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 | C | 1,200 | 1,600 | 1.950 | 1,750 | 1,840 |
|  | SM-5 | C | 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 | T-Series | C | 0 | 0 | 8,300 | 9,800 | 6,000 |
|  | TLCS-43 | N | 0 | 0 | 3,300 | 9,200 | 8,000 |
|  | TLCS-46 | C | 0 | 0 | 2,900 | 3,580 | 3,250 |
|  | TLCS-47 | N | 0 | 0 | 600 | 3.070 | 6.300 |
| Total 4-8 | $t$ MCUs |  | 96,080 | 133,549 | 158,183 | 171.945 | 193,435 |

Source: Dataquest

September 1988

## 4-Bit Microcontrollers--Data

Table 3
Estimated 4-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987
(Thousands of Units)

|  | Product | Process | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | MB882XX | C | 0 | 0 | 760 |
|  | MB8840X | N | 0 | 0 | 1,843 |
|  | MB884X | N | 5,634 | 6,580 | 7,160 |
|  | MB8850X | C | 0 | 0 | 485 |
|  | MB885X | C | 2,156 | 3,425 | 3,742 |
| Hitachi | HMCS-40 | P,N,C | 22,352 | 21,919 | 25,900 |
|  | HMCS-400 | C | 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 | c | 0 | 0 | 2,085 |
| Mitsubishi | M5043X/44X | C | 0 | 0 | 13,995 |
|  | M5046X/56X | C | 0 | 0 | 13,105 |
|  | M5072/76 | C | 0 | 0 | 15,054 |
|  | M509X | C | 0 | 0 | 2,056 |
|  | M50xxX | C | 0 | 27,844 | 0 |
| Motorola | 141000 | C | 4 | 0 | 0 |
| National | COPS | N, C | 23,500 | 31,273 | 31,970 |
| NEC | uCOM-4 | P, C | 9,920 | 5,700 | 3,680 |
|  | uCOM75X | N,C | 0 | 3,900 | 16,810 |
|  | uPD75xX | C | 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* | C | 10,370 | 9.140 | 9,510 |
| TI | TMS1000 | P, C | 3,900 | 16,025 | 13.400 |
| Toshiba | T-Series | C | 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 | C | 2,198 | 400 | 202 |
|  | TLCS-47 | N | 7,756 | 7,200 | 5,935 |
|  | TLCS-47 | c | 0 | 15,300 | 17,497 |
|  | TLCS-470 | C | 0 | 400 | 1,360 |
| Others** | Unspecified | C | 0 | 10.000 | 44.520 |
| Total |  |  | 177,038 | 271,883 | 392,332 |

*Sharp SM-Series totaled in 1985.
**Dataquest estimate for companies not surveyed (i.e. Ricoh, Sanyo, Sony).
N/A $=$ Not Available

Source: | Dataquest |
| :--- |
|  |
| September 1988 |

## 4-Bit Microcontrollers--Data

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

|  | Product | Process | 01/87 | 02/87 | 03/87 | 24/87 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fujitsu | 882xx | C | 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 | c | 882 | 905 | 940 | 1,015 | 3,742 |
|  | 885XX | C | 100 | 110 | 125 | 150 | 485 |
| Hitachi | HMCS-40 | P,N,C | 6,300 | 6,405 | 6,520 | 6,675 | 25,900 |
|  | hmCS-400 | c | 7,600 | 8,000 | 8,000 | 8,500 | 32,100 |
| Matsushita | Mal400 | 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 | C | 0 | 0 | 1,015 | 1,070 | 2,085 |
| Mitsubishi | M5043X/44X | c | 3,393 | 3.294 | 3,767 | 3,541 | 13,995 |
|  | M5046X/56X | c | 2,141 | 3.213 | 3,996 | 3,755 | 13,105 |
|  | M5072/76 | c | 2,701 | 2,908 | 4,337 | 5,108 | 15,054 |
|  | M509X | c | 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 | c | 11,000 | 10.970 | 13,500 | 12,200 | 47,670 |
| Oki | Series-40 | c | 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 | TMS 1000 | 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 | c | 50 | 62 | 48 | 42 | 202 |
|  | TLCS-47 | N | 1,600 | 1,500 | 1,475 | 1,360 | 5,935 |
|  | TLCS-47 | C | 4,300 | 4,220 | 4,405 | 4,572 | 17,497 |
|  | TLCS-470 | c | 300 | 340 | 350 | 370 | .1,360 |
| Others* | Unspecified | c | 11,130 | 11,130 | 11,130 | 11,130 | -44.520 |
| Total | it MCUs |  | 92,243 | 96,353 | 102,842 | 100,894 | 392,332 |

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

## 8-Bit Microcontroller Executive Overview

## MARKET ENVIROMMENT

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

The capacity of built-in ROM and RAM has been increased. Currently, 16 KB ROM and 512 KB 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 are losing share every year. Japan manufacturers held more than 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 $\$ 2,354.9 \mathrm{million}$ 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.


## Microcontroller Market Analysis 1975-1989



## Dataquest

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September 1990

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## Chapter 1

## Microcontroller Market Overview

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

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Figure 2 Estimated Market Share of Leading Manufacturers and Procuct Types for 8-Bit Microcontrollers, 1989
Figure 3 Estimated Market Shave of Leading Manufacturers and Product Types for 16-Bit Microcontrollers, 1989
Table 1 Estimated Market Share by Word Length for Mictocontrollers, 1975-1979
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Figure 6 Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers, 1989

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)

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 | $*$ |
| $\quad$ Total Shipments | 532 | 1,011 | 4,285 | 18,177 | 62,122 |
| Calculated value is loss than 0.1 percent |  |  |  |  |  |

Table 2

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

|  | 1990 | 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 | 123 |
| Percent | $*$ | $*$ | $*$ | $*$ | $*$ |
| Total Shipmens | 117,828 | 168,516 | 212,347 | 262,649 | 357,068 |

*Calculated vilue is lese then 0.1 perceat
Source: Drtequen (September 1990)

Table 3
Estimated Market Share by Word Length
for Microcontrollers
1985-1989
(Thousands of Units)

|  | 1985 | 1986 | 1987 | 1988 | 1989 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit |  |  |  |  |  |
| Shipments | 177,038 | 261,883 | 347,812 | 468,445 | 672,860 |
| Percemt | 51.9 | 55.1 | 53.5 | 55.0 | 59.1 |
| 8-Bit |  |  |  |  |  |
| 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 |

Figure 4
Estimated Market Share by Word Length for 4-, 8-, and 16-Bit Microcontrollers 1980-1989


[^7]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 |
| Japarese 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 | 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 | 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 | 1,0il | 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 |

Source: Dataqueat (Sepecmber 1990)

Table 5

## Estimated Market Share by Region for 4-, 8-, and 16-Bit Microcontrollers 1980-1984 <br> (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 Cornpanies (\%) | 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 |
| US Companies (\%) | 73.3 | 68.3 | 61.0 | 57.6 | 51.7 |
| Japanese Companies (\%) | 15.5 | 20.1 | 27.1 | 31.3 | 36.6 |
| Eurupean Cormpanies (\%) | 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 Shipmenks | 117,828 | 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 |
| European Companies (\%) | 2.1 | 2.4 | 3.1 | 4.1 | 6.2 |

Scurce: Daisqueat (Sapthmber 1990)

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 |
| Buropean Companies (\%) | 3.0 | 2.4 | 2.2 | 1.9 | 1.1 |
| 8-Bit Shipments | 163599 | 212,931 | 299,470 | 377,476 | 458,699 |
| US Companies (\%) | 42.7 | 36.6 | 39.3 | 43.9 | 48.1 |
| Japanese Companies (\%) | 43.2 | 47.4 | 47.7 | 45.4 | 41.0 |
| European Companies (\%) | 14.1 | 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 | 98.6 | 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 |

Soure:; Daraguent (September 1990)

Figure 5

## Estimated Market Share by Region

 for 4-, 8-, and 16-Bit Microcontrollers1989


Source: Dataquest (September 1990)

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 | 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: Datequot (Sopmember 19\%)

Table 8

Estimated Market Share by Process Technology
for 4-, 8-, and 16-Bit Microcontroliers
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 |

[^8]Table 9
Estimated Market Share by Process Technology
for 4-, 8-, and 16-Bit Microcontrofiers
1985-1989
(Thousands of Units)

|  | 1985 | 1986 | 1987 | 1988 | 1989 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4-Bit Shiprnents | 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 Shiprnents | 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 | 1,138,997 |
| 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 |

Figure 6
Estimated Market Share by Process Technology for 4-, 8-, and 16-Bit Microcontrollers 1989


Source: Dataquest (September 1990)

## Chapter 2

## 4-Bit Microcontrollers

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

| Table 1 | Estimated Market Share by Manufacturer for 4-Bit Microcontrollers, 1975-1979 |
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| Table 2 | Estimated Market Share by Manufacturer for 4-Bit Microcontrollens, 1980-i984 |
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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 |
| Matsustrita | 0 | 0 | 0 | 0 | 8.7 |
| Motorcla | 0 | 0 | 0 | 0.1 | 0.6 |
| National | 0 | 0 | 0 | 14.6 | 11.1 |
| NBC | 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 |

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 |
| 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 |
| NBC | 15.4 | 17.2 | 21.3 | 21.0 | 25.0 |
| Ori | 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 |
| Toshibs | 0 | 0 | 9.5 | 14.9 | 12.2 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

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 | 16.5 |
| Oki | 3.7 | 2.8 | 1.9 | 1.6 | 1.5 |
| Rockwell | 0.8 | 0.4 | 0.2 | 0.1 | 4 |
| 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 |



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Source: Denapert (Seprember 1990)

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 |  |  |  |  |  |
| $\quad$ Shipments | 500 | 760 | 3,400 | 14,049 | 37,310 |
| Percent | 100.0 | 100.0 | 100.0 | 88.0 | 73.8 |
|  |  |  |  |  |  |
| Japan | 0 | 0 | 0 | 1,910 | 13,215 |
| Shipments | 0 | 0 | 0 | 12.0 | 26.2 |
| Percent |  |  |  |  |  |
| Europe | 0 | 0 | 0 | 0 | 0 |
| Shipments | 0 | 0 | 0 | 0 | 0 |
| Percent | 500 | 760 | 3,400 | 15,959 | 50,525 |
| Total Shipments |  |  |  |  |  |

Table 5
Estimated Market Share by Region
for 4-Bit Microcontrollers
1980-1984
(Thousands of Units)

| Region | 1980 | 1981 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| United States |  |  |  |  |  |
| Shipments | 62,660 | 54,039 | 44,553 | 34,945 | 37,215 |
| Percent | 65.2 | 40.5 | 28.2 | 20.3 | 19.2 |
| Jepan |  |  |  |  |  |
| 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 |

Source: Denciquest (Seppenter 1990)

Table 6

Estimated Market Share by Region
for 4-Bit Microcontrollers
1985.1989
(Thousands of Units)

| Region | 1985 | 1986 | 1987 | 1988 | 19\% |
| :---: | :---: | :---: | :---: | :---: | :---: |
| United States |  |  |  |  |  |
| Shipments | 28,804 | 48,458 | 46,160 | 40,075 | 44,035 |
| Percent | 16.3 | 18.5 | 13.3 | 8.6 | 6.5 |
| Jepan |  |  |  |  |  |
| Shipments | 142,992 | 207,095 | 294,137 | 419,520 | 621,180 |
| Percent | 80.8 | 79.1 | 84.6 | 89.6 | 92.3 |
| Europe |  |  |  |  |  |
| 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 |

Figure 2

## Estimated Market Share by Region

for 4-Bit Microcontrollers
1980-1989


Source: Dataquesi (Seplember 1990)

Table 7

Estimated Market Share* by Product Type for 4-Bit Microcontrollers

1975-1979
(Percentage)

|  | 1975 | $\mathbf{1 9 7 6}$ | $\mathbf{1 9 7 7}$ | 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 |

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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 |
| nCOM-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 |
| \$2000 | 1.2 | 0.3 | 0.4 | 0.1 | 0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

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 |
| SPCS00 | 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 |
| MN1700 | 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 |
| MN1400 | 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 | * |
| 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 | 100.0 | 100.0 |




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 | 0 |  |  |  |  |
| Shipments | 0 | 0 | 0 | 2,375 | 7,530 |
| Percent |  | 0 | 0 | 14.9 | 14.9 |
| CMOS | 0 |  |  |  |  |
| Shipments | 0 | 0 | 0 | 755 | 4,961 |
| Percent |  | 0 | 4.7 | 9.8 |  |
| PMOS | 500 | 760 | 3,400 | 12,829 | 38,034 |
| Shipments | 100 | 100 | 100 | 80.4 | 75.3 |
| Percent | 500 | 760 | 3,400 | 15,959 | 50,525 |
| Total Shipments |  |  |  |  |  |
| Source: Dataquest (September 1990 ) |  |  |  |  |  |

[^9]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 |

Table 12
Estimated Market Sbare by Process Technology
for 4-Bit Microcontrolers
1985-1989
(Thousands of Units)

|  | 1988 | 1986 | 1987 | 1988 | 1989 |
| :--- | ---: | ---: | ---: | ---: | ---: |
| NMOS |  |  |  |  |  |
| Shipments | 61,576 | 81,153 | 95,288 | 68,117 | 75,845 |
| Percent | 34.8 | 31.0 | 27.4 | 14.5 | 11.3 |
| CMOS |  |  |  |  |  |
| Shipments | 97,694 | 167,357 | 242,840 | 394,336 | 589,780 |
| Percent | 55.2 | 63.9 | 69.8 | 84.2 | 87.7 |
| PMOS |  |  |  |  |  |
| Shipments | 17,768 | 13,373 | 9,684 | 5,992 | 7,235 |
| Percent | 10.0 | 5.1 | 2.8 | 1.3 | 1.1 |
| Total Shipments | 177,038 | 261,883 | 347,812 | 468,445 | 672,860 |

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Source: Datequen (Sephember 1990)

Figure 4
Estimated Market Share by Process Technology for 4-Bit Microcontrolers

1980-1989


Source: Dataquest (September 1990)

## Chapter 3

## 8-Bit Microcontrollers

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

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Table 3 Estimated Market Share by Manufacturer for 8-Bit Microconroilers, 1985-1989
Figure 1 Estimated Market Share by Manofacturer for 8-Bit Microcontrollers, 1988 and 1989
Table 4 Estimated Market Share by Region for 8-Bit Microcontrollers, 1975-1979
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Figure 2 Estimated Market Share by Region for 8-Bit Microcontrollers, 1980-1989
Table 7 Estimated Market Share by Product Type for 8-Bit Microcontroliers, 1975-1979
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Table 9 Estimated Market Share by Product Type for 8-Bit Microcontrollers, 1985-1989
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Table 10 Estimated Market Share by Instruction Set for 8-Bit Microcontrollers, 1975-1979
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Table 15 Estimated Market Share by Process Technology for 8-Bit Microcontrollers, 1985-1989
Figure 5 Estimated Market Share by Process Technology for 8-Bit Microcontrollers, 1980-1989
Table 16 Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers, 1975-1979
Table 17 Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers, 1980-1984
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 Microconteollers, 1989

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 |
| NBC | 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-Bir MCUs | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |


Source: Detaquert (Septeraber 1990)

Table 2
Estimated Mariset 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 (G) | 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 |
| Shap | 0 | 0 | 0.3 | 1.1 | 1.2 |
| Siemens | 0.1 | 2.4 | 4.0 | 3.1 | 2.4 |
| Signetics | 0.6 | 0 | 0.3 | 2.3 | 4.7 |
| Symertek | 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 |


Sourct: Datequat (Soptombor 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 ${ }^{1}$ | 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) ${ }^{2}$ | 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 ${ }^{3}$ | 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 |
| Ofi | 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 ${ }^{3}$ | 1.5 | 2.5 | 1.5 | 0 | 0 |
| SGS-Thomson ${ }^{3}$ | 0 | 0 | 0 | 2.2 | 2.5 |
| Shap | 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 ${ }^{3}$ | 0.9 | 1.0 | 1.1 | 0 | 0 |
| Toshiba | 7.7 | 3.4 | 3.5 | 3.0 | 2.2 |
| Zilog | 1.3 | 15 | 1.1 | 1.3 | 1.4 |
|  | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Fuicctild merged with Nationat in 1988.
${ }^{2}$ Heris ecquired GR/RCA during 19tid.

Note: Columas may not add to toctile shown becruse of rounding.
Source: Deaquen (Seppmber 1990)

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 |

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 |
| Westeen 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: Dataqueat (Sepwember 1990)

## Table 6

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

|  | 1985 | 1986 | 1987 | 1988 | 1939 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 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 |
| Westem 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 |

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 |
| :--- | ---: | ---: | ---: | ---: | ---: |
| $802 X$ | 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 |
| $6500 / X X$ | 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 loss than 0.1 percent.
Note: Columns may not add to totenls shown because of rounding. NMOS/CMOS/EPROM versions are included in the market share mumbers for each product type.
Source: Datequest (September 1990)

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 | 2.1 | 8.0 | 12.4 | 12.8 | 11.9 |
| $68 \mathrm{HC11}$ | 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 |
| P1C165X | 25.8 | 11.8 | 7.8 | 4.3 | 3.6 |
| TMS7000 | 0 | 0.1 | 0.5 | 0.8 | 0.7 |
| aPD78XX | 0 | 1.4 | 3.8 | 5.5 | 7.2 |
| Z8 | 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 |

Culcoleted value is lees then 0.1 percent.

product type.
Sroduce: Derequeat (September 1990)

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 |
| $68 \mathrm{HC11}$ | * | 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 | 15 | 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 |
| P1C1655/57 | 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 |
| Z8 | 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 |

*Cakulmed value is less thin 0.1 percent
 product typ.
Source: Ditequeat (Seprember 1990)

Figure 3
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 |

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

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 |
| 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 | 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 |

界
Source: Dataquet (Sepsember 1990)

Table 12
Estimated Market Share by Instruction Set for 8-Bit Microcontroflers

1985-1989
(Percenlage)

|  |  | 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 | $68 \mathrm{HCl1}$ | * | 0.3 | 1.3 | 2.5 | 3.8 |
| Group 6 | $8048 / 35,8049 / 39,8050 / 40,84 \mathrm{XX}$, 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 | 28 | 1.7 | 2.1 | 1.6 | 1.6 | 1.7 |
|  | Others | 1.4 | 0.8 | 5.1 | 9.8 | 13.1 |
|  | Total 8-Bit MCUs | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

 set grocip.
Source: Dataquest (Soptember 1990)

Figure 4
Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1988 and 1989


Source: Dalaquest (September 1990)

Table 13
Estimated Market Share by Process Technology for 8-Bit Microcontrollers

1975-1979

|  | 1975 | 1976 | 1977 | 1978 | 1979 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| NMOS |  |  |  |  |  |
| Shiprnents | 32 | 281 | 885 | 2,218 | 11.592 |
| Percent | 100.0 | 100.0 | 100.0 | 100,0 | 100.0 |

Table 14

Estimated Market Share by Process Technofogy for 8-Bit Microcontrolers

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 | 91.4 | 90.0 |
|  |  |  |  |  |  |
| CMOS | 0 | 95 | 1,745 | 7,836 | 16,375 |
| Shipments | 0 | 0.3 | 3.2 | 8.6 | 10.0 |
| Percent | 21,740 | 34,931 | 54,114 | 90,615 | 163,510 |
| $\quad$ Total Shipments |  |  |  |  |  |

Table 15
Estimated Market Share by Process Technology
for 8-Bit Microcontrollers
1985-1989
(Thousands of Units)

|  | 1985 | 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 |  |  |  |  |  |
| Stipments | 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 | 299,470 | 377,476 | 458,699 |

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 |  |
| Japan | 0 | 0 | 0 | 0.7 | 01.1 |
| Western Europe | 0 | 0 | 0 | 0.5 |  |
| Total NMOS | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Source: Dataquest (September 1990) |  |  |  |  |  |

Table 17

Estimated Market Share by Process Technology by Region for 8-Bit Microcontroflers

1980-1984
(Percentage)

|  | 1980 | 1981 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| NMOS |  |  |  |  |  |
| Usited States | 73.3 | 68.2 | 61.8 | 59.4 | 53.7 |
| Japan | 15.5 | 20.1 | 26.0 | 28.6 | 33.3 |
| Westem 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 | 3980 | 39.3 | 33.7 |
| Japan | 0 | 0 | 62 | 60.7 | 66.1 |
| Western Europe | 0 | 0 | 0 | 0 | 0.1 |
| Total CMOS | 0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 18
Estimated Market Share by Process Techmology by Region for 8-Bit Microcontroliers
1985.1989
(Percentage)

|  | 1985 | 1986 | 1987 | 1988 | 1989 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| NMOS |  |  |  |  |  |
| United States | 49.5 | 46.0 | 50.6 | 56.2 | 55.0 |
| Japan | 32.8 | 32.1 | 31.5 | 28.9 | 28.2 |
| Westem 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 | 18.1 | 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 |

Figure 6
Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers

1989


[^10]
## Chapter 4

## 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 Estimaned Market Share by Manufacturer for 16-Bit Microcoutrollers, 1988 and 1989
Table 2 Estimated Market Share by Region for 16-Bit Mictocontrollers, 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 Mictocontrollers, 1988 and 1989
Table 4 Estimated Market Shate by Process Technology for 16-Bit Microcontrollers, 1985-1989
Figure 4 Estimated Market Share by Process Technology for 16-Bit Mictocontrollers, 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

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 $^{1}$ | 5.2 | 32.3 | 3.3 | 1.2 | 0.8 |
| Texas Instruments | 32.3 | 0.3 | 0 | 0 | 0 |
| Various $^{2}$ | 0 | 0 | 79.2 | 60.9 | 42.7 |
| Total 16-Bit MCUs | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Mostek was acquired by Thomsan Components in 1985. Thomson Components subsequently merged with SGS in 1987.
${ }^{2}$ The 8061 is a custom-designed, 16 -bit microcontroller for Ford Motor Company. It is supplied by several semiconductor comparies, 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 ahown 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)

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 | 98.6 | 96.1 |
| Japan |  |  |  |  |  |
| Shipments | 0 | 0 | 2 | 9 | 233 |
| Percent | 0 | 0 | 0.1 | 0.2 | 3.1 |
| Westem 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: Datequist (September 1990)

Figure 2
Estimated Market Share by Region for 16-Bit Microcontrollers

1985-1989


Source: Dataquest (September 1990)

Table 3

Estimated Market Share by Product Type for 16-Bit Microcontrollers

1985-1989
(Percentage)

|  | 1985 | 1986 | 1987 | 1988 | 1989 |
| :--- | ---: | ---: | ---: | ---: | ---: |
| 8096 | 62.5 | 67.4 | 16.6 | 30.6 | 41.8 |
| 8061 | 0 | 0 | 79.3 | 60.9 | 42.7 |
| HPC | 0 | 0 | 0.8 | 4.6 | 8.4 |
| 68200 | 5.2 | 32.3 | 3.3 | 1.2 | 0.8 |
| Others | 32.3 | 0.3 | 0.1 | 2.7 | 6.4 |
| Total 16-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)

Figure 3

Estimated Market Share by Product Type for 16-Bit Microcontrollers

1988 and 1989


Source: Dataquest (September 1990)

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 | 0 | 0 | 2,653 | 3,647 | 4,246 |
| Shipments | 0 | 0 | 80.1 | 66.8 | 57.1 |
| Percent | 232 | 399 | 3,311 | 5,461 | 7,438 |
| Total Shipments |  |  |  |  |  |

Figure 4

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


Source: Dataquest (September 1990)

Table 5
Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers

1985-1989
(Percentage)

|  | 1985 | 1986 | 1987 | $\mathbf{I 9 8 8}$ | 1989 |
| :--- | ---: | ---: | ---: | ---: | ---: |
| NMOS | 94.8 | 67.7 | 83.3 | 96.5 | 98.2 |
| United States | 0 | 0 | 0 | 0 | 0 |
| Japan | 5.2 | 32.3 | 16.7 | 3.5 | 1.8 |
| Western Europe | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| $\quad$ Total NMOS |  |  |  |  |  |
| CMOS | 0 | 0 | 99.9 | 99.8 | 94.5 |
| United States | 0 | 0 | 0.1 | 0.2 | 5.5 |
| Japan | 0 | 0 | 0 | 0 | 0 |
| Western Earope | 0 | 0 | 100.0 | 100.0 | 100.0 |
| Total CMOS |  |  |  |  |  |

Figure 5
Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers

1989


Source: Dataquest (September 1990)

## Dataquest

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## 8-Bit Microcontrollers--Product Analysis

The tables and figures in this section are organized as follows:
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Table 2 Estimated Market Share by Product Type for 8-Bit Microcontrollers, 1980-1984

Table 3 Estimated Market Share by Product Type for 8-Bit Microcontrollers, 1985-1988

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Figure 48051 Product Life Cycle
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Table 10 Estimated Market Share by Process Technology by Region for 8-Bit Microcontrollers, 1975-1979
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## 8-Bit Microcontrollers-Product Analysis

Table 1
Estimated Market Share by Product Type for 8-Bit Microcontrollers

1975-1979

| Product | $\underline{1975}$ | 1976 | 1977 | 1978 | 1979 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 802X | 0 | 0 | 0 | 0 | 1.48 |
| 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 |
| PICI650 | 0 | O | 0 | 20,3 | 35.4 |
|  | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |
| *Calculated value is less than 0.1\%. <br> 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. |  |  |  |  |  |

## 8-Bit Microcontrollers--Product Analysis

Table 2
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 | 2.1 | 8.0 | 12.4 | 12.8 | 11.9 |
| 68 HCl 11 | 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 | 8.3 | 7.0 | 5.8 |
|  | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |

Source: Dataquest August 1989

## 8-Bit Microcontrollers--Product Analysis

Table 3
Estimated Market Share by Product Type for 8-Bit Microcontrollers 1985-1988

|  | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: |
| 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 |
| 68 HCll | * | 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 | 0 | 7.1 | 5.7 |
| PIC165X | 2.9 | 1.4 | 1.5 | 1.4 |
| TMS7000 | 1.0 | 1.5 | 2.8 | 2.0 |
| uPD788X | 7.0 | 8.2 | 7.2 | 7.1 |
| 28 | 1.7 | 2.0 | 1.4 | 1.3 |
| Others | 5.5 | 7.7 | 12.28 | 12.3 |
|  | 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.

## 8-Bit Microcontrollers--Product Analysis

Figure 1
Estimated Market Share by Product Type for 8-Bit Microcontrollers

1987 and 1988


## 8-Bit Microcontrollers--Product Analysis

Figure 2
8048 Product Life Cycle
Thousands of Units


## 8-Bit Microcontrollers--Product Analysis

Figure 3

## 8049 Product Life Cycle



## 8-Bit Microcontrollers--Product Analysis

Figure 4

## 8051 Product Life Cycle



## 8-Bit Microcontrollers--Product Analysis

Figure 5

## 6801 Product Life Cycle

Thousands of Units


Note: NMOS EPROM versions are included in NMOS data.
CMOS EPROM Versions ars incuded in CMOS data.

## 8-Bit Microcontrollers--Product Analysis

Figure 6
6805 Product Life Cycle


## 8-Bit Microcontrollers--Product Analysis

Table 4

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

|  |  |  | 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 | $\begin{aligned} & 8048 / 35,8049 / 39 \\ & 802 \mathrm{X} \end{aligned}$ | 0 | 0 | 11.9\% | 24.1\% | 32.9 |
| Group | 5 | 387X, 3897X, 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.

## 8-Bit Microcontrollers--Product Analysis

Table 5
Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1980-1984


## 8-Bit Microcontrollers-Product Analysis

Table 6
Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1985-1988

|  |  |  | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Group |  | 6500/1, 6511, 5074X | 10.4\% | 14.9\% | 12.3\% | 6.98 |
| Group |  | 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 | $68 \mathrm{HCl1}$ | * | 0.3 | 1.2 | 2.1 |
| Group | 6 | ```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 | 12 | uPD78XX | 7.0 | 8.2 | 7.2 | 7.1 |
| Group | 12 | 28 | 1.7 | 2.0 | 1.4 | 1.3 |
|  |  | Others | 1.4 | 5.7 | 10.8 | 24.2 |
|  |  | Total 8-Bit MCUs | 100.0\% | 100.0\% | 100.0\% | 100.0\% |
| *Calculated value is less than 0.1\%. <br> Notes: Columns may not add to MMOS/CMOS/EPROM versions are each instruction set group. |  |  | $\begin{gathered} \text { totals } \\ \text { included } \end{gathered}$ | shown because in market share |  | rounding. mates for |

Source: Dataquest August 1989

## 8-Bit Microcontrollers--Product Analysis

Figure 7
Estimated Market Share by Instruction Set for 8-Bit Microcontrollers 1987 and 1988


## 8-Bit Microcontrollers--Product Analysis

Figure 8
8048 Instruction Set Life Cycle


## 8-Bit Microcontrollers--Product Analysis

Figure 9
8051 Instruction Set Life Cycle


Table 7
Estimated Market Share by Process Technology for 8-Bit Microcontrollers

1975-1979
$1975 \quad 1976 \quad 1978 \quad 1979$
NMOS

| Shipments | 32 | 251 | 885 | 2,218 | 11,592 |
| :--- | :---: | :---: | :---: | :---: | ---: |
| Percent | $100.0 \%$ | $100.0 \%$ | $100.0 \%$ | $100.0 \%$ | $100.0 \%$ |

## 8-Bit Microcontrollers--Product Analysis

Table 8
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\% | 91.4\% | 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: | aquest |

Table 9
Estimated Market Share by Process Technology for 8-Bit Microcontrollers

1985-1988
(Thousands of Units)

|  | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: |
| 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 |

## 8-Bit Microcontrollers--Product Analysis

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
$1975 \quad 1976 \quad 1977 \quad 1978 \quad 1979$
nMOS


## 8-Bit Microcontrollers--Product Analysis

## Table 11

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

|  | 1980 | 1982 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| mmos |  |  |  |  |  |
| United States | 73.3* | 69.29 | 61.89 | 59.44 | 53.78 |
| Japan | 15.5 | 20.1 | 26.0 | 28.5 | 33.3 |
| W. Europe | 11.2 | 11.7 | 12.2 | 12.1 | 13.0 |
| Total amos | 100.08 | 100.0V | 100.09 | 100.09 | 100.08 |

cmos

| United states | 0 | 100.08 | 39.88 | 39.34 | 33.74 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Japan | 0 | 0 | 60.2 | 60.7 | 66.1 |
| W. Europe | 0 | 0 | 0 | 0 | 0.1 |
| Total CMOS | 0 | 100.0\% | 100.04 | 100.04 | 100.0\% |

Source: Dataquest August 1989

Table 12

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

198519861987
nMOS

| United States | 49.59 | 46.04 | 50.28 | 56.38 |
| :---: | :---: | :---: | :---: | :---: |
| Japan | 32.8 | 32.1 | 32.1 | 28.7 |
| W. Europe | 17.6 | 22.0 | 17.8 | 15.1 |
| Total mmos | 100.08 | 100 | 100 | 100.0 |

cmos

| United States | 16.4* | 11.28 | 13.74 | 17.78 |
| :---: | :---: | :---: | :---: | :---: |
| Japan | 83.1 | 87.8 | 83.6 | 79.2 |
| W. Europe | 0.3 | 1.0 | 2.7 | 3.1 |
| Total cmos | 100.04 | 100.0才 | 100.04 | 100.04 |

## 8-Bit Microcontrollers--Product Analysis

Figure 11

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



NMOS 219.5 Million Units

234.4 Million Units

# 8-Bit Microcontrollers--Product Analysis 

1
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## 8-Bit Microcontroller Analysis

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

Figure 2 Estimated Market Share by Manufacturer for 8-Bit Microcontrollers, 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

Figure 5 Estimated Market Share by Process Technology and Region for 8-Bit Microcontrollers, 1981-1986

## 8-Bit Microcontroller Analysis

Table 1
Estimated Market Share by Product Type for 8-Bit Microcontrollers 1975-1986
$1975 \quad 1976 \quad 1978 \quad 1979 \quad 1980$

| 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 |  |  |  |  |  |  |
| 8028x |  |  |  |  | 1.38 | 0.09 |
| Others | 100,00\% | 100.00\% | 84.18 | 35,62 | 9.66 | 7.70 |
| Total | 100.00\% | 100.00\% | 100.00\% | 100.00\% | 100.00\% | 100.00\% |

## 8-Bit Microcontroller Analysis

Table 1 (Continued)
Estimated Market Share by Product Type for 8-Bit Microcontrollers 1975-1986

|  | 1981 | 1982 | 1.983 | 1984 | 1985 | 1986 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 |
| UPD78×X | 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 | 3.41 |
| Total | 100.00\% | 100.00\% | 100.00\% | 100.00\% | 100.00\% | 100.00\% |

Source: Dataquest October 1987

## 8-Bit Microcontroller Analysis

Figure 1

## Estimated Market Share by Product Type for 8-Bit Microcontrollers <br> 1985 and 1986




Source: Dataquest
October 1987

## 8-Bit Microcontroller Analysis

Table 2

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

|  | 1981 | 1282 | 1983 | 1984 | 1985 | 1286 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| NEC | 13.889 | 18.134 | 19.26\% | $22.42 \%$ | 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 | 2.63 |
| 2ilog | 0.98 | 1.26 | 0.94 | 1.25 | 1.29 | 1.52 |
| Rockwel1* |  |  |  |  |  | 1.25 |
| Texas Instruments* |  |  |  |  |  | 1.25 |
| Matra-Harris* |  |  |  |  |  | 1.05 |
| N(1) | 0.79 | 0.79 | 0.75 | 1.41 | 1.03 | - |
| Others ${ }^{\text {¢ }}$ | 33.22 | 13.21 | 10.44 | 7,98 | 6.26 | 4.26 |
| Total | 100.008 | 100.004 | 100.004 | 100.008 | 100.002 | 100.00s |

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

# 8-Bit Microcontroller Analysis 

Table 3
$\left.\begin{array}{ccccccc}\text { Estimated Market Share by Region } \\ \text { for } 8 \text {-Bit Microcontrollers } \\ \text { 1981-1986 }\end{array}\right]$

Source: Dataquest
October 1987
Figure 3
Estimated Market Share by Region
for 8-Bit Microcontrollers
1981-1986
Millions of Units


## 8-Bit Microcontroller Analysis

Table 4
Estimated Market Share by Process Technology for 8-Bit Microcontrollers

1981-1986
(Thousands of Units)

|  | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CMOS |  |  |  |  |  |  |
| Shipments | 95 | 1,728 | 7,808 | 16,411 | 42,974 | 77,901 |
| Percent | 0.27\% | 3.19\% | 8.62\% | 10.04\% | 26.35\% | 38.17\% |
| NMOS |  |  |  |  |  |  |
| Shipments | 34,836 | 52,386 | 82,807 | 147,099 | 120,093 | 126,184 |
| Percent | 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 |
|  |  |  |  |  | urce: Dataquest |  |
|  |  |  |  |  | Oc | er 1987 |

Figure 4
Estimated Market Share by Process Technology for 8-Bit Microcontrollers

1981-1986


# 8-Bit Microcontroller Analysis 

Table 5
Estimated Market Share by Process Technology and Region for 8-Bit Microcontrollers

1981-1986
(Thousands of Units)

|  | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | 0.27\% | 1.28\% | 3.39\% | 3.40\% | 3.91\% | 4.09\% |
| Subtotal |  |  |  |  |  |  |
| Shipments | 95 | 1,728 | 7,808 | 16.411 | 42,974 | 77,900.3 |
| Percent of Total | 0.278 | 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\% | 29.978 | 20.41\% | 21.17\% |
| United States |  |  |  |  |  |  |
| Shipments | 26,347 | 34,403 | 51,001 | 80,696 | 65,267 | 63,901 |
| Percent | 75.43\% | 63.57\% | 56.29\% | 49.35\% | 40,02\% | .31,31\% |
| 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: | taquest tober 1987 |

## 8-Bit Microcontroller Analysis

Figure 5

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

Millions of Units


Source: Dataquest
October 1987


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X
$$

## 8-Bit Microcontrollers--Historical Shipment Data

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

## 8-Bit Microcontrollers--Historical Shipment Data

Table 1
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 | 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 | 0 | 0 | 0 | 30 | 300 |
| Mostek | 3878 | 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 | $\underline{0}$ | -0 | 180 |
| Total 8-Bit MCUs |  |  | 32 | 251 | 885 | 2,218 | 11,592 |

Source: Dataquest August 1989
AMD
AMI
Eurotechnique
Fairchild
Fujitsu

| General |
| :--- |
| Instrument |

Hitachi
Intel
Intersil


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## 8-Bit Microcontrollers--Historical Shipment Data

Table 2 (Continued)

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

|  | Product | Process | 1980 | 1981 | 1.982 | 1983 | $\underline{1984}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Matra-Harris | 8048 | N | 0 | 0 | 6 | 48 | 130 |
|  | 8051 | $N$ | 0 | 0 | 0 | 0 | 635 |
|  | $80 \mathrm{C48}$ | C | 0 | 0 | 0 | 0 | 20 |
| Matsushita | MN1800 | C | 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 | C | 0 | 95 | 635 | 1,886 | 4,389 |
|  | 1468705 | C | 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 |
|  | 68 HCl 1 | 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 | N | 50 | 405 | 880 | 1,270 | 1,940 |
|  | 807X | N | 31 | 70 | 53 | 60 | 35 |
|  | 80C48/35 | c | 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 | C | 0 | 0 | 230 | 940 | 2,020 |
|  | 80C49/39 | C | 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 | C | 0 | 0 | 25 | 203 | 450 |
|  | 80C49/39 | C | 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 |

(Continued)

# 8-Bit Microcontrollers--Historical Shipment Data 

Table 2 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1980-1984 (Thousands of Units)

|  | Product | Process | 1980 | 1981 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Philips (Cont.) | 8050/40 | N | 0 | 0 | 0 | 0 | 10 |
|  | 8051/31 | N | 0 | 0 | 0 | 40 | 1,160 |
|  | 80C49/39 | C | 0 | 0 | 0 | 0 | 3 |
|  | 848X | N | 0 | 0 | 80 | 1,940 | 2,500 |
| RCA | 1804A | C | 0 | 0 | 0 | 4 | 23 |
|  | 6805/68HCO5 | C | 0 | 0 | 0 | 0 | 7 |
| Rockwell | 6500/XX | H | 208 | 345 | 315 | 930 | 1.350 |
| SGS | 28 | N | 0 | 0 | 0 | 0 | 123 |
|  | $387 \mathbf{}$ | N | 95 | 260 | 700 | 1,159 | 1,489 |
| Sharp | Z8 | N | 0 | 0 | 165 | 980 | 1,950 |
| Stemens | 8021 | N | 0 | 40 | 95 | 60 | 28 |
|  | 802X8 | 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 |
| 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 | C | 0 | 0 | 142 | 850 | 2,170 |
| zilogTotal 8-Bit | 28 | N | 14 | 344 | 683 | 851 | 2.055 |
|  | Us |  | 21,740 | 34,931 | 54,114 | 90,615 | 163,510 |
|  |  |  |  |  | Sour |  | quest <br> st 1989 |

# 8-Bit Microcontrollers--Historical Shipment Data 

## Table 3

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

|  | Product | Process | 11985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AMD | 8051/31 | N | 1,610 | 1.700 | 2,240 | 2,110 |
|  | 8053 | N | 0 | 0 | 287 | 510 |
|  | 80C51/31 | C | 0 | 0 | 134 | 1,055 |
|  | 8751 | S | 71 | 112 | 133 | 217 |
|  | 8753 | 18 | 0 | 0 | 77 | 145 |
| Fairchild | $387 \times$ | N | 357 | 10 | 0 | 0 |
|  | F8 | N | 287 | 304 | * | * |
| Fujitsu | MBL8048/35 | N | 185 | 328 | 528 | 40 |
|  | MBL8049/39 | N | 707 | 862 | 1,132 | 90 |
|  | MBL8051/31 | N | 0 | 403 | 1,098 | 92 |
|  | MRL80C49/39 | C | 0 | 105 | 2,300 | 220 |
|  | MB897XX | C | 0 | 0 | 0 | 1,471 |
| General | PIC1652/54 | N | 1,515 | 1,700 | * | * |
| Instrument | PIC1655/57 | N | 3,295 | 1,400 | * | * |
|  | PIC1670/72 | N | 2,135 | 1,190 | * | * |
|  | PIC16C58 | C | 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) | 68 HCO 5 | C | 0 | 0 | 0 | 1,430 |
| Hitachi. | 6301 | C | 2,008 | 5,200 | 8,100 | 11,600 |
|  | 6305 | c | 1,386 | 4,242 | 7,250 | 11,200 |
|  | 5801/03 | N | 1,515 | 3,557 | 5,200 | 5,660 |
|  | 6805 | N | 2,902 | 5,275 | 7.160 | 8,490 |
|  | 68201 | C | 0 | 0 | 545 | 944 |
|  | 68205 | C | 0 | 0 | 620 | 1,010 |
|  | 63701 | C | 0 | 0 | 1.599 | 2.780 |
|  | 63705 | C | 0 | 0 | 1,299 | 1,920 |
|  | 63 POL | C | 0 | 0 | 645 | 1,040 |
|  | $63 \mathrm{P05}$ | C | 0 | 0 | 865 | 1.425 |
| Intel | 802X | N | 222 | 93 | 54 | 0 |
|  | 8048/35 | N | 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)

## 8-Bit Microcontrollers--Historical Shipment Data

Table 3 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988
(Thousands of Units)

|  | Product | Process | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Intel (Cont.) | 8051/31 | N | 6,800 | 6.998 | 12,700 | 13,800 |
|  | 8052/32 | N | 269 | 1,600 | 1,885 | 5.800 |
|  | 80C49/39 | C | 112 | 20 | 0 | 0 |
|  | 80C51/31 | C | 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 | C | 0 | 0 | 30 | 350 |
|  | $87 \mathrm{C51}$ | C | 0 | 0 | 100 | 500 |
| Intersil | 80C48/35 | C | 30 | 20 | 0 | 0 |
|  | 80C49/39 | C | 9 | 10 | 0 | 0 |
| Matra-Harris | 8051 | N | 1,400 | 1,340 | 429 | 98 |
|  | 8052 | N | 20 | 418 | 1,033 | 712 |
|  | $80 \mathrm{C51}$ | C | 10 | 387 | 1,324 | 2,190 |
|  | $80 \mathrm{C52}$ | C | 0 | 0 | 83 | 660 |
|  | $83 C 154$ | C | 0 | 0 | 0 | 116 |
| Matsushita | MN1800 | C | 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 | $C$ | 0 | 0 | 0 | 0 |
|  | PIC16E57 | N | 0 | 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 | H | 0 | 0 | 33 | 0 |
| Mitsubishi | M507XX | c | 0 | 0 | 23,706 | 25,800 |
|  | M509XX | C | 0 | 0 | 13,082 | 26,600 |
|  | M50x<x | C | 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 | C | 0 | 0 | 2,614 | 690 |
| Mostek | 387X | N | 867 | * | * | * |
|  | 38P7X | N | 297 | * | * | * |
|  | F8 | N | 195 | * | * | * |
| Motorola | 146805 | C | 4,071 | 4,705 | 5,422 | 6,598 |
|  | 1468705 | C | 48 | 93 | 0 | 0 |

(Continued)

# 8-Bit Microcontrollers--Historical Shipment Data 

Table 3 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988
(Thousands of Units)

|  | Product | Process | 1985 | 1986 | 1287 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Motorola (Cont.) | 387X | N | 174 | 199 | 0 | 0 |
|  | 6801/03 | N | 8,007 | 8,526 | 8,918 | 8,253 |
|  | 6804 | N | 501 | 1,495 | 4,357 | 3,900 |
|  | 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 |
|  | 68 HCO 5 | C | 0 | 0 | 4,678 | 12,676 |
|  | 68HCII | C | 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 | C | 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 |
| WEC | 8021/22 | N | 350 | 100 | 40 | 70 |
|  | 8041 | N | 2,860 | 2,550 | 1,750 | I. 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 | C | 1.800 | 1,360 | 970 | 740 |
|  | 80C49/39 | C | 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 | $80 \mathrm{C154}$ | C | 0 | 87 | 894 | 1,630 |
|  | 80C48/35 | C | 537 | 520 | 428 | 385 |
|  | 80C49/39 | C | 1.950 | 2,720 | 3,133 | 3,462 |
|  | 80C51/31 | C | 0 | 1,772 | 2,721 | 3,100 |
| Philips | 8021/22 | N | 470 | 138 | 172 | 15 |
|  | 8048/35 | N | 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 | C | 145 | 240 | 514 | 665 |

(Continued)

## 8-Bit Microcontrollers--Historical Shipment Data

Table 3 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988
(Thousands of Units)

|  | Product | Process | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Philips (Cont.) | 80C51/31 | C | 0 | 81 | 620 | 1,220 |
|  | 84CXX | C | 0 | 15 | 1,150 | 2,520 |
|  | 84XX | N | 6,200 | 14,325 | 10,810 | 9,580 |
| RCA | 1804 A | C | 13 | 11 | 8 | * |
|  | 6805/68HCO5 | C | 120 | 359 | 805 | * |
| Rockwell | 6500/XX | N | 1,310 | 2.550 | 3,855 | 4,230 |
| SGS-Thomson (M) | 387x | N | 0 | 0 | 795 | 0 |
|  | 38P7X | $\mathbf{N}$ | 0 | 0 | 90 | 110 |
|  | F8 | N | 0 | 0 | 136 | 21 |
|  | 387X | N | 2,200 | 4,811 | 3,922 | 3,236 |
|  | 28 | N | 244 | 601 | 665 | 444 |
|  | 6801/03 | H | 337 | 906 | 1,131 | 1,829 |
|  | 6805 | N | 1,129 | 1.190 | 2,182 | 2,797 |
| Sharp | SM-Series | C | 0 | 0 | 530 | 425 |
|  | 28 | N | 426 | 686 | 590 | 425 |
| Siemens | 8021 | N | 138 | 0 | 0 | 0 |
|  | 802XX | N | 1,538 | 667 | 51 | 66 |
|  | 8048/35 | H | 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 | C | 0 | 60 | 283 | 1,653 |
|  | $80 C 451$ | C | 0 | 0 | 0 | 55 |
|  | $83 \mathrm{C451}$ | c | 0 | 0 | 27 | 0 |
|  | $87 \mathrm{C452}$ | C | 0 | 0 | 10 | 15 |
|  | 8400 | N | 0 | 30 | 43 | 10 |
|  | 8441 | C | 0 | 0 | 128 | 18 |
| TI | TMS7000 | N | 1,396 | 2,555 | 6. 600 | 9,200 |
| TCMC (Mostek) | $387 \times$ | N | 0 | 969 | * | * |
|  | 38P7X | N | 0 | 145 | * | * |
|  | F8 | N | 0 | 299 | * | * |

(Continued)

# 8-Bit Microcontrollers--Historical Shipment Data 

Table 3 (Continued)

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

|  | Product | Process | 1985 | 2986 | 1.987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Toshiba | 8048/35 | N | 4,504 | 1.150 | 1,171 | 890 |
|  | 8049/39 | N | 5,207 | 2.350 | 1,760 | 1,485 |
|  | 80C48/35 | C | 0 | 1,000 | 2,950 | 3,200 |
|  | 80C49/39 | C | 2.925 | 2,280 | 3,600 | 4,200 |
|  | 80C50/40 | c | 0 | 520 | 851 | 820 |
|  | TLCS-90 | c | 0 | 0 | 0 | 850 |
| Zilog | 28 | N | 2,099 | 3,112 | 3,422 | 5.025 |
| Others** | Unspecified | C | 0 | 11,070 | 34,020 | 74.000 |
| Total 8-Bit MCUs |  |  | 163,599 | 224,001 | 333.490 | 454,022 |

*Mergers/Acquisitions:

1. Gould Semiconductor acquired AMI, 1985.
2. 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)

## 8-Bit Microcontrollers--Historical Shipment Data

Table 4
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1975-1976 (Thousands of Units)


Table 5
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1977 (Thousands of Units)

|  | Product | Process | $01 / 77$ | 02/77 | 03/77 | 04/77 | 1977 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fairchild | 3870 | N | 0 | 0 | 0 | 15 | 15 |
|  | F8 | N | 100 | 130 | 180 | 245 | 655 |
| Intel | 8048 | N | 0 | 15 | 30 | 60 | 105 |
| TCMC (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 August 1989

## 8-Bit Microcontrollers--Historical Shipment Data

## Table 6

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

|  | Product | Process | 01/78 | $02 / 78$ | 03/78 | 24/7.8 | 1.978 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | N | 20 | 50 | 75 | 205 | 350 |
|  | F8 | N | 50 | 30 | -35 | 45 | 160 |
| Total 8-Bit MCUs |  |  | 323 | 420 | 580 | 895 | 2,218 |
|  |  |  |  |  | Sou |  | $\begin{aligned} & \text { lest } \\ & =\quad 1989 \end{aligned}$ |

## 8-Bit Microcontrollers--Historical Shipment Data

Table 7
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1979 (Thousands of Units)

|  | Product | Process | 01/79 | 02/79 | 03/79 | 04/79 | 1979 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AMD | 8048 | N | 0 | S | 3 | 20 | 23 |
| Fairchild | 58 | N | 150 | 150 | 180 | 170 | 650 |
|  | 3870 | N | 40 | 50 | 120 | 300 | 510 |
| General |  |  |  |  |  |  |  |
| Instrument | PIC-1650 | N | 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 | N | 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 | 5 | 3 | 5 | 8 |
| SGS-ATES | 387X | N | 5 | 10 | 15 | 20 | 50 |
| Signetics | 8048/35 | N | 15 | 30 | 60 | 75 | 180 |
| TCMC (Mostek) | 3870 | N | 260 | 300 | 425 | 485 | 1,470 |
|  | F8 | N | 90 | 125 | 125 | 130 | 470 |
| Total 8- | MCUs |  | 1,235 | 2,415 | 3,414 | 4,528 | 11,592 |

S = Sampled

## 8-Bit Microcontrollers--Historical Shipment Data

## Table 8

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

|  | Product | Process | 01/80 | 02/80 | 03/80 | Q4/80 | 1980 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AMD | 8048 | N | 5 | 38 | 40 | 55 | 138 |
| Fairchild | F8 | N | 170 | 150 | 150 | 150 | 620 |
|  | 3870 | N | 345 | 380 | 550 | 520 | 1,795 |
| Fujitsu | 8048 | 1 | 0 | 5 | 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 | 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 | 5 | 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 | 5 | 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 |
| 2ilog | 28 | N | S | 3 | 5 | 6 | 14 |
| Total 8- | MCUs |  | 5,285 | 5.566 | 5,035 | 5,854 | 21.740 |

$S=$ Sampled
Source: Dataquest
August 1989

## 8-Bit Microcontrollers--Historical Shipment Data

Table 9
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

|  | Product | Process | 02/81 | 02/81 | 03/81 | 04/81 | 1981 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | S | 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 | 5 | 1 | 2 | 3 |
|  | 8051 | N | 5 | 4 | 9 | 12 | 25 |
|  | 8748 | H | 200 | 200 | 175 | 200 | 775 |
|  | 8048 | N | 1,100 | I. 200 | 1,300 | 1,200 | 4,800 |
|  | 8049/39 | H | 250 | 275 | 325 | 380 | 1,230 |
| Motorola | 146805 | c | 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 | H | 45 | 70 | 120 | 170 | 405 |
|  | 807 X | N | 28 | 12 | 15 | 15 | 70 |
|  | 8048/35 | N | 60 | 100 | 140 | 160 | 460 |
|  | 8049/39 | N | 90 | 140 | 210 | 270 | 710 |
| NEC | 8021 | N | 20 | 40 | 30 | 50 | 140 |
|  | 8048/35 | N | 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 | 387 X | N | 40 | 50 | 80 | 90 | 260 |

# 8-Bit Microcontrollers--Historical Shipment Data 

Table 9 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1981 (Thousands of Units)

|  | Product | Process | 01/81 | 02/81 | 03/81 | 04/81 | 1981 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Siemens | 8048/35 | N | S | 10 | 35 | 40 | 85 |
|  | 8021 | N | S | 5 | 20 | 15 | 40 |
|  | 802XX | N | 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 |
| 2ilog | Z8 | N | 15 | 24 | 100 | 205 | -344 |
| Total 8-Bit | McUs |  | 7,027 | 8,005 | 9,258 | 10,641 | 34,931 |


| Source: | Dataquest |
| :--- | :--- |
|  | August 1989 |

## 8-Bit Microcontrollers--Historical Shipment Data

Table 10
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1982 (Thousands of Units)

|  | Product | Process | 01/82 | 02/82 | 03/82 | 04/82 | 1982 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AMD | 8048 | N | 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 | H | 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 | C | 21 | 42 | 63 | 84 | 210 |
|  | 6305 | C | 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 | H | 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 | NT | 0 | S | 1 | 5 | 6 |
| Matsushita | MN1800 | N | S | 5 | 7 | 10 | 17 |
| Motorola | 146805 | C | 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 | $N$ | 15 | 20 | 8 | 10 | 53 |
|  | 80C48/49 | C | 0 | 0 | 20 | 40 | 60 |

(Continued)

## 8-Bit Microcontrollers-Historical Shipment Data

Table 10 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1982
(Thousands of Units)

|  | Product | Process | 01/82 | 02/82 | 03/82 | 04/82 | 1982 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | C | 0 | 10 | 110 | 110 | 230 |
|  | 80C49/39 | C | 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 | $80 \mathrm{C48}$ | C | 0 | 0 | 5 | 20 | 25 |
|  | 80C49 | C | 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 |
|  | 8487 | N | 0 | 5 | 10 | 70 | 80 |
| Rockwell | 6500/1 | N | 70 | 80 | 80 | 85 | 315 |
| SGS | 387X | N | 130 | 180 | 170 | 220 | 700 |
| Sharp | 28 | 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 | 5 | 2 | 6 | 8 |
| Synertek | 28 | N | 5 | 5 | 30 | 50 | 90 |
| TI | TMS-7000 | N | 35 | 50 | 70 | 100 | 255 |
| TCMC (Mostek) | 3870 | N | 600 | 580 | 450 | 400 | 2,030 |
|  | F8 | N | 15 | 10 | 6 | 2 | 33 |
| Toshiba | 8048/35 | N | 50 | 115 | 220 | 230 | 615 |
|  | 8049/39 | N | 90 | 140 | 160 | 165 | 555 |
|  | 80C49/39 | c | 5 | 12 | 50 | 75 | 142 |
| Zilog | 28 | N | 220 | 180 | 140 | 143 | 683 |
| Total 8-Bit | MCUs |  | 11,946 | 13,454 | 13,718 | 14,996 | 54,114 |


| Source: | Dataquest |
| :--- | :--- |
|  | August 1989 |

## 8-Bit Microcontrollers--Historical Shipment Data

Table 11
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

|  | Preduct | Process | 01/83 | 02/83 | 03/83 | 04/83 | 1983 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AMD | 8048 | N | 60 | 50 | 25 | 55 | 190 |
|  | 8049 | N | 30 | 25 | 25 | 30 | 110 |
|  | 8051 | N | 1 | 70 | 125 | 180 | 376 |
| EFCIS | 6801/03 | N | S | 10 | 20 | 25 | 55 |
|  | 6805 | N | S | 20 | 35 | 45 | 100 |
| Eurotechnique | 8048/35 | N | 7 | 9 | * | * | 16 |
|  | 8049/39 | N | 40 | 55 | * | * | 95 |
|  | 8050/40 | N | 100 | 125 | * | * | 225 |
| Fairchild | 3870 | N | 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 | N | 670 | 603 | 766 | 815 | 2,854 |
|  | PIC-1670-72 | N | 530 | 390 | 466 | 725 | 2,111 |
|  | PIC-16C58 | N | 130 | 290 | 58 | 160 | 638 |
| Gould | 6801 | N | S | 5 | S | 220 | 220 |
|  | 6805 | N | 40 | 10 | 5 | 65 | 120 |
| Hitachi | 6301 | c | 150 | 162 | 190 | 220 | 722 |
|  | 6305 | C | 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 | N | 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 | 5 | 10 | 12 | 15 | 37 |
|  | 80C48/35 | C | 3 | 5 | 5 | 5 | 18 |
|  | 80C49/39 | c | S | 40 | 50 | 50 | 140 |
|  | 80C51/31 | c | 5 | 40 | 50 | 50 | 140 |
|  | 8748 | N | 470 | 445 | 550 | 600 | 2.065 |
|  | 8749 | N | 180 | 180 | 250 | 350 | 960 |
|  | 8751 | N | 35 | 60 | 75 | 150 | 320 |

*Taken over by Thomson
(Continued)

## 8-Bit Microcontrollers--Historical Shipment Data

Table 11 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

|  | Product | Process | 01/83 | 02/83 | 03/83 | 04/83 | 1983 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Matra-Harris | 8048 | N | 7 | 9 | 12 | 20 | 48 |
| Matsushita | MN1800 | N | 7 | 7 | 7 | 7 | 28 |
| Motorola | 146805 | C | 465 | 440 | 387 | 594 | 1,886 |
|  | 1468705 | C | 1 | 1 | 1 | 2 | 5 |
|  | 3870 | H | 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 | H | 275 | 305 | 330 | 350 | 1,270 |
|  | 807X | N | 15 | 15 | 15 | 15 | 60 |
|  | 80C48/49 | C | 55 | 50 | 65 | 75 | 245 |
| NCR | 6500/1 | N | S | 25 | 80 | 110 | 215 |
| NEC | 8021 | N | 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 | C | 125 | 125 | 210 | 480 | 940 |
|  | 80C49/39 | $C$ | 100 | 100 | 160 | 290 | 650 |
|  | 8748 | N | 200 | 400 | 250 | 240 | 1,090 |
|  | 8749 | N | 35 | 100 | 60 | 60 | 255 |
|  | uPD-78XX | N | 650 | 1,150 | 1,300 | 1,860 | 4,960 |
| Oki | 80C48 | C | 30 | 43 | 50 | 80 | 203 |
|  | $80 \mathrm{C4} 9$ | C | 100 | 137 | 200 | 390 | 827 |
| Philips | 8021/22 | N | 70 | 90 | 90 | 110 | 360 |
|  | 8048/35 | N | 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 | H | 150 | 300 | 250 | 230 | 930 |
| SGS-ATES | 387 x | N | 254 | 245 | 300 | 360 | 1,159 |
| Sharp | 28 | N | 80 | 150 | 300 | 450 | 980 |

(Continued)

## 8-Bit Microcontrollers--Historical Shipment Data

Table 11 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1983 (Thousands of Units)

|  | Product | Process | 01/83 | 02/83 | 03/83 | 24/83 | 1983 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | N | 220 | 265 | 280 | 290 | 1.055 |
|  | 8049/39 | N | 110 | 135 | 150 | 150 | 545 |
|  | 8050/40 | $N$ | 90 | 110 | 100 | 100 | 400 |
|  | 8051/31 | N | 3 | 3 | 40 | 80 | 126 |
| Synertek | 28 | N | 60 | 25 | 30 | 20 | 135 |
| TI | TMS-7000 | N | 130 | 175 | 190 | 220 | 715 |
| TCMC (Mostek) | 3870 | N | 430 | 430 | 400 | 400 | 1,660 |
|  | F8 | 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 | 28 | N | 150 | 190 | 211 | 300 | 851 |
| Total 8-8 | it MCUs |  | 17,598 | 20.451 | 23,550 | 29,016 | 90,615 |

Source: Dataquest August 1989

## 8-Bit Microcontrollers--Historical Shipment Data

Table 12
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

|  | Product | Process | 01/84 | 02/84 | 03/84 | 04/84 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AMD | 8048 | k | 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 | 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 | N | 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 |
|  | PrC-16C58 | N | 165 | 110 | 110 | 90 | 475 |
| Hitachi | 6301V | C | 300 | 325 | 367 | 480 | 1,472 |
|  | 6305 | C | 200 | 215 | 215 | 320 | 950 |
|  | 6801/03 | H | 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 | 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 | N | 18 | 50 | 65 | 80 | 213 |
|  | 80C48/35 | C | 5 | 5 | 0 | 0 | 10 |
|  | 80C49/39 | C | 55 | 55 | 60 | 60 | 230 |
|  | 80C51/31 | C | 50 | 50 | 80 | 85 | 265 |
|  | 8748 | N | 625 | 625 | 625 | 625 | 2,500 |
|  | 8749 | N | 390 | 390 | 600 | 650 | 2,030 |
|  | 8751 | N | 200 | 200 | 200 | 195 | 795 |
| Intersil | 80C48/35 | C | 0 | 0 | 12 | 32 | 44 |

(Continued)

## 8-Bit Microcontrollers--Historical Shipment Data

Table 12 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

|  | Product | Process | 01/84 | 02/84 | 03/84 | 04/84 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Matra-Harris | 8048 | N | 30 | 40 | 40 | 20 | 130 |
|  | 8051 | N | 20 | 15 | 250 | 350 | 635 |
|  | $80 \mathrm{C48}$ | C | 0 | 0 | 10 | 10 | 20 |
| Matsushita | WN1800 | N | 10 | 10 | 10 | 10 | 40 |
| Motorola | 146805 | C | 790 | 1,109 | 1.238 | 1,252 | 4,389 |
|  | 1468705 | C | 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 |
|  | 68 HCll | C | 0 | 0 | 0 | 3 | 3 |
| National | 8048/35 | N | 575 | 600 | 800 | 800 | 2,775 |
|  | 8049/39 | N | 390 | 400 | 700 | 700 | 2,190 |
|  | 8050/40 | N | 465 | 475 | 500 | 500 | 1,940 |
|  | 807X | N | 10 | 10 | 10 | 5 | 35 |
|  | 80C48/35 | C | 30 | 10 | 0 | 0 | 40 |
| NCR | 6500/1 | N | 150 | 150 | 150 | 150 | 600 |
| NEC | 8021/22 | N | 100 | 110 | 130 | 130 | 470 |
|  | 8041 | c | 0 | 0 | 1,110 | 1,110 | 2,220 |
|  | 8741 | C | 0 | 0 | 190 | 190 | 380 |
|  | 8048/35 | N | 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 | C | 570 | 610 | 420 | 420 | 2,020 |
|  | 80C49/39 | C | 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 | C | 100 | 120 | 140 | 90 | 450 |
|  | 80C49/39 | C | 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 | N | 380 | 650 | 900 | 1,000 | 2,930 |
|  | 8050/40 | N | 0 | 0 | 0 | 10 | 10 |

(Continued)

# 8-Bit Microcontrollers--Historical Shipment Data 

Table 12 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)

|  | Product | Process | 01/84 | 02/84 | 03/84 | 04/84 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Philips (Continued) | .80C49 | C | 0 | 0 | 0 | 3 | 3 |
|  | 8051/31 | N | 60 | 300 | 400 | 400 | 1,160 |
|  | 848x | N | 500 | 400 | 700 | 900 | 2,500 |
| RCA | 1804A | c | 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 |
|  | 28 | N | 0 | 110 | 0 | 13 | 123 |
| Sharp | 28 | 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 | H | 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 | N | 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 | C | 280 | 290 | 750 | 850 | 2,170 |
| zilogTotal 8- | 28 | N | 435 | 675 | 450 | 495 | 2.055 |
|  | it MCUs |  | 33,871 | 38,222 | 46,507 | 44,910 | 163,510 |
|  |  |  |  |  | Sour |  | quest st 1989 |

# 8-Bit Microcontrollers--Historical Shipment Data 

Table 13
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

|  | Product | Process | 01/85 | 02/85 | 03/85 | 04/85 | 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 | 214 | 287 |
| Fujitsu | MBL8048/35 | N | 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 | N | 975 | 840 | 790 | 690 | 3,295 |
|  | PIC1670/72 | N | 650 | 550 | 510 | 425 | 2,135 |
|  | PIC16C58 | C | 85 | 77 | 69 | 25 | 256 |
|  | PIC16E57 | N | 5 | 8 | 8 | 45 | 66 |
|  | PIC7000/I | N | 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 | 6301 V | C | 420 | 425 | 383 | 780 | 2,008 |
|  | 6305 | C | 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 | c | 40 | 30 | 27 | 15 | 112 |
|  | 80C51/31 | c | 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 | C | 8 | 8 | 7 | 7 | 30 |
|  | 80C49/39 | C | 3 | 2 | 2 | 2 | 9 |

(Continued)

## 8-Bit Microcontrollers--Historical Shipment Data

Table 13 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

|  | Product | Process | 01/85 | 02/85 | 03/85 | 04/85 | 1985 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Matra-Harris | 8051 | 8 | 450 | 300 | 300 | 350 | 1,400 |
|  | 8052 | N | 0 | 0 | 0 | 20 | 20 |
|  | $80 \mathrm{C51}$ | c | 0 | 0 | 0 | 10 | 10 |
| Matsushita | MN1800 | C | 10 | 24 | 32 | 65 | 131 |
| Mitsubishi | M50x<X | C | 3,200 | 4,050 | 3,900 | 3,975 | 15,125 |
| Motorola | 146805 | c | 1,052 | 915 | 1,008 | 1,096 | 4,071 |
|  | 1468705 | $c$ | 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 | N | 37 | 80 | 80 | 81 | 278 |
|  | 68704 | N | 0 | 0 | 4 | 9 | 13 |
|  | 68705 | H | 613 | 532 | 745 | 751 | 2,641 |
|  | 68HC1I | C | 5 | 8 | 10 | 44 | 67 |
| National | 8048/35 | N | 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 | N | 5 | 0 | 0 | 0 | 5 |
| NCR | 6500/1 | N | 160 | 110 | 180 | 190 | 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 |
|  | 8049/39 | N | 1,820 | 1,030 | 1,120 | 1,190 | 5,160 |
|  | 80C48/35 | c | 710 | 470 | 340 | 280 | 1,800 |
|  | 80C49/39 | C | 690 | 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 | c | 150 | 135 | 124 | 128 | 537 |
|  | 80C49/39 | C | 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 | C | 15 | 50 | 50 | 30 | 145 |
|  | 84XX | N | 1,100 | 1,300 | 1,800 | 2.000 | 6.200 |
|  |  |  |  |  | (Continued) |  |  |
| 26 | © 1989 Dataquest Incorporated August |  |  |  | SIS Microcomponents |  |  |
|  |  |  |  |  |  |  | 0004582 |

# 8-Bit Microcontrollers--Historical Shipment Data 

## Table 13 (Continued)

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

|  | Product | Process | 01/85 | 02/85 | 03/85 | 04/85 | 1985 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RCA | 1804A | c | 5 | 3 | 3 | 2 | 13 |
|  | 6805/68HCO5 | C | 20 | 10 | 25 | 65 | 120 |
| Rockwell | 6500/XX | N | 250 | 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 | 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 |
| TI | TMS7000 | N | 400 | 350 | 316 | 330 | 1,396 |
| Thomson | 6801/03 | N | 65 | 59 | 53 | 160 | 337 |
|  | 6805 | N | 350 | 315 | 284 | 180 | 1,129 |
| TCMC (Mostek)* | 387 X | N | 273 | 159 | 211 | 224 | 867 |
|  | 38P7X | N | 112 | 80 | 61 | 44 | 297 |
|  | F8 | N | 62 | 51 | 42 | 40 | 195 |
| Toshiba | 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 | C | 900 | 675 | 650 | 700 | 2,925 |
| zilog | 28 | N | 564 | 550 | 495 | 490 | 2.099 |
| Total 8-B | t MCUs |  | 45,746 | 39,722 | 38,425 | 39,706 | 163,599 |

*Mergers/Acquisitions:

1. AMI was acquired by Gould Semiconductor.
2. Thomson Components acquired Mostek Corporation from United Technologies, forming Thomson Components--Mostek Corporation (TCMC).

Source: Dataquest August 1989

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# 8-Bit Microcontrollers-Historical Shipment Data 

Table 14 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

|  | Product | Process | $01 / 86$ | $02 / 86$ | $03 / 86$ | $04 / 86$ | 1986 |
| :--- | :--- | ---: | ---: | ---: | ---: | ---: | ---: |
|  | RCA | C |  | 4 | 2 | 2 | 3 |$)$

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

## 8-Bit Microcontrollers--Historical Shipment Data

Table 15
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

|  | Product | Process | 01/87 | 02187 | 03/87 | 04/87 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AMD | 8051/31 | \% | 436 | 538 | 626 | 640 | 2,240 |
|  | 8053 | N | 0 | 22 | 115 | 150 | 287 |
|  | 80C51/31 | C | 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 |
|  | MBL8049/39 | N | 252 | 285 | 280 | 315 | 1,132 |
|  | MBL8051/31 | N | 252 | 265 | 276 | 305 | 1,098 |
|  | MRL80C49/39 | C | 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 | C | 1,800 | 1.800 | 2,000 | 2,500 | 8,100 |
|  | 6305 | C | 1,600 | 1,700 | 1,850 | 2,100 | 7,250 |
|  | 63701 | C | 150 | 320 | 449 | 680 | 1,599 |
|  | 63705 | C | 180 | 276 | 385 | 458 | 1.299 |
|  | $63 \mathrm{PO1}$ | C | 100 | 145 | 175 | 225 | 645 |
|  | 63 P 05 | c | 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 |
|  | 68802 | C | 85 | 115 | 165 | 180 | 545 |
|  | 68 PO 5 | C | 100 | 145 | 175 | 200 | 620 |
| Intel | 802 x | 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 | C | 700 | 665 | 1,000 | 800 | 3,165 |
|  | 8748 | N | 200 | 192 | 155 | 146 | 693 |
|  | 8749 | N | 900 | 920 | 880 | 925 | 3,625 |
|  | 8751 | N | 220 | 225 | 266 | 230 | 941 |
|  | 8752 | C | 0 | 0 | 0 | 30 | 30 |
|  | $87 \mathrm{C51}$ | C | 0 | 0 | 0 | 100 | 100 |
| Matra-Harris | 8051 | N | 120 | 126 | 73 | 110 | 429 |
|  | 8052 | N | 199 | 245 | 310 | 279 | 1,033 |
|  | $80 \mathrm{C51}$ | c | 250 | 310 | 360 | 404 | 1,324 |
|  | $80 \mathrm{C52}$ | C | 2 | 12 | 23 | 46 | 83 |

(Continued)

|  |  | Table 15 | ontinu |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Estima | 8-Bit Micro | ontroller <br> (Thousan | nit Ship of Uni | ents by | Quarter | $1987$ |  |
|  | Product | Process | $01 / 87$ | $02 / 87$ | 03/87 | 04/87 | 1987 |
| Matsushita | MN1800 | C | 100 | 320 | 330 | 320 | 1,070 |
| Microchip | PrC1652/54 | N | 758 | 960 | 1,300 | 1.045 | 4,063 |
| Technology* | PIC1655/57 | H | 350 | 347 | 126 | 250 | 1,073 |
|  | PIC1670/72 | N | 80 | 120 | 135 | 125 | 460 |
|  | PLC16E57 | H | 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 | C | 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 | N | 52 | 35 | 83 | 38 | 208 |
|  | M5M80C49/39 | C | 1,859 | 221 | 310 | 224 | 2,614 |
| Motorola | 146805 | C | 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 |
|  | 68 HCO 5 | C | 714 | 974 | 1,316 | 1,674 | 4,678 |
|  | 68\%C11 | $C$ | 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 | C | 0 | 0 | 0 | 10 | 10 |
| National (FCI)* | 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 | $\mathbf{N}$ | 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 | $C$ | 220 | 320 | 230 | 200 | 970 |
|  | 80C49/39 | C | 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 |

## 8-Bit Microcontrollers--Historical Shipment Data

Table 15 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

|  |  | Product | Process | 01/87 | 02/87 | 03/87 | 04/87 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Oki |  | 806154 | c | 75 | 95 | 350 | 374 | 894 |
|  |  | 80C48/35 | C | 125 | 110 | 100 | 93 | 428 |
|  |  | 80C49/39 | c | 699 | 734 | 890 | 810 | 3.133 |
|  |  | $80 \mathrm{C51}$ | C | 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 | N | 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 | C | 74 | 120 | 160 | 160 | 514 |
|  |  | 80C51/31 | c | 60 | 110 | 210 | 240 | 620 |
|  |  | 84CXX | C | 110 | 350 | 380 | 310 | 1,150 |
|  |  | 84XX | N | 2,880 | 3,190 | 2,540 | 2,200 | 10,810 |
| RCA |  | 1804A | C | 5 | 2 | 1 | 0 | 8 |
|  |  | 6805/68HC05 | C | 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 | C | 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 | c | 65 | 69 | 73 | 76 | 283 |
|  |  | $83 \mathrm{C451}$ | C | 1 | 5 | 9 | 12 | 27 |
|  |  | 8400 | N | 10 | 11 | 10 | 12 | 43 |
|  |  | 8441 | c | 0 | 36 | 44 | 48 | 128 |
|  |  | $87 \mathrm{C451}$ | C | 0 | 2 | 3 | 5 | 10 |
|  |  |  |  |  |  |  | (Continued) |  |
| SIS Microcomponents 0004582 |  |  | (c) 1989 Dataquest Incorporated August |  |  |  |  | 33 |

## 8-Bit Microcontrollers--Historical Shipment Data

Table 15 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

|  | Product | Process | 01/87 | 02/87 | 03/87 | 04/87 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | C | 400 | 650 | 800 | 1,100 | 2,950 |
|  | 80C49/39 | C | 800 | 850 | 900 | 1,050 | 3,600 |
|  | 80C50/40 | C | 200 | 225 | 210 | 216 | 851 |
| Zilog | 28 | $N$ | 863 | 863 | 858 | 838 | 3,422 |
| Others** | Unspecified | C | 8.505 | 8,505 | -8.505 | 8.505 | 34,020 |
| Tota | MCUs |  | 73,881 | 79,124 | 89,312 | 91,173 | 333,490 |

*Mergers/Acquistions:
I. 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 companiés not sampled (i.e.. Ricoh, Sanyo, Sony)
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# 8-Bit Microcontrollers--Historical Shipment Data 

## Table 16 (Continued)

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

|  | Product | Process | 01/88 | 22/88 | 03/88 | 04/888 | 1.988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | C | 350 | 360 | 420 | 500 | 1,630 |
|  | 80C48/35 | C | 90 | 95 | 90 | 110 | 385 |
|  | 80C49/39 | c | 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 | C | 170 | 170 | 160 | 165 | 665 |
|  | 80C51/31 | c | 270 | 250 | 350 | 350 | I, 220 |
|  | 84 CXX | c | 350 | 550 | 800 | 820 | 2,520 |
|  | 84XX | N | 2,150 | 2.400 | 2,500 | 2,530 | 9,580 |
| Rockwell | 6500/8x | 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 | N | 362 | 494 | 408 | 565 | 1,829 |
|  | 6805 | N | 754 | 739 | 644 | 660 | 2,797 |
|  | F8 | N | 11 | 10 | 0 | 0 | 21 |
|  | 28 | N | 136 | 148 | 89 | 71 | 444 |
| Sharp | SM (8-Bit) | C | 125 | 100 | 100 | 100 | 425 |
|  | 28 | 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 |

## 8-Bit Microcontrollers--Historical Shipment Data

Table 16 (Continued)

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

|  | Product | Process | 01/88 | 02/88 | 03/88 | 04/88 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | C | 26 | 6 | 13 | 10 | 55 |
|  | 80C51/31 | C | 299 | 415 | 499 | 440 | 1,653 |
|  | 8400 | N | 10 | 0 | 0 | 0 | 10 |
|  | 8441 | C | 16 | 2 | 0 | 0 | 18 |
|  | $87 \mathrm{C451}$ | C | 4 | 0 | - 5 | 6 | 15 |
| TI | TMS7000 | N | 1,600 | 2,200 | 2.600 | 2,800 | 9,200 |
| Toshiba | 8048/35 | N | 220 | 220 | 225 | 225 | 890 |
|  | 8049/39 | H | 370 | 370 | 375 | 370 | 1,485 |
|  | 80C48/35 | C | 800 | 800 | 800 | 800 | 3,200 |
|  | 80C49/39 | C | 1,000 | 1,050 | 1,050 | 1,100 | 4,200 |
|  | 80C50/40 | C | 200 | 200 | 205 | 215 | 820 |
|  | TLCS-90 | C | 50 | 150 | 250 | 400 | 850 |
| Zilog | 28 | $N$ | 925 | 1.300 | 1,500 | 1.300 | 5,025 |
| Others** | Unspecified | C | 18,500 | 18,500 | 18.500 | 18,500 | 74,000 |
| Total 8-Bit MCUs |  |  | 104,450 | 113,296 | 118,422 | 117,854 | 454,022 |

[^11]Source: Dataquest August 1989

## 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.

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, 1985-1987

Table 4 Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985

Table $5 \quad$ Estimated 8-Bit Microcontroller Unit Shipments by Quarter for
Table 6 Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987

# 8-Bit Microcontrollers--Data 

## Table 1

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 | 387 X | N | 0 | 0 | 15 | 23 | 510 |
|  | F8 | N | 27 | 181 | 655 | 630 | 650 |
| General Inst. | PIC1650 | N | 0 | 0 | 0 | 450 | 4.100 |
| Intel | 802X | N | 0 | 0 | 0 | 0 | 160 |
|  | 8048/35 | N | 0 | 0 | 105 | 480 | I,950 |
|  | 8049/39 | N | 0 | 0 | 0 | 10 | 210 |
|  | 8748 | H | 0 | 0 | 0 | 30 | 300 |
| Mostek | 387X | H | 0 | 0 | 20 | 350 | 1,470 |
|  | F8 | H | 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 | $387 \times$ | H | 0 | 0 | 0 | 0 | 50 |
| Signetics | 8048/35 | N | 2 | 0 | - 0 | 0 | 180 |
| Total 8-Bit MCUs |  |  | 32 | 251 | 885 | 2,218 | 11,592 |

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 | Fairchild |
| :--- |
| Fujitsu |
| $\begin{array}{c}\text { General } \\ \text { Instrument }\end{array}$ | －nБтuYpezoxns INY と


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## 8-Bit Microcontrollers--Data

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 |
|  | $80 \mathrm{C48}$ | c | 0 | 0 | 0 | 0 | 20 |
| Matsushita <br> Mostek | M881800 | c | 0 | 0 | 17 | 28 | 40 |
|  | $387 \times$ | N | 2,105 | 2,485 | 2,030 | 1,660 | 1,425 |
|  | 3887X | N | 0 | 0 | 0 | 0 | 148 |
|  | F8 | N | 205 | 110 | 33 | 190 | 195 |
| Motorola | 146805 | c | 0 | 95 | 635 | 1,886 | 4,389 |
|  | 1468705 | c | 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 |
|  | 68 HCl 11 | 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 | H | 50 | 405 | 880 | 1,270 | 1,940 |
|  | 807x | N | 31 | 70 | 53 | 60 | 35 |
|  | 80C48/35 | c | 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 | ${ }^{2}$ | 1,990 | 1,900 | 2,440 | 3,360 | 7,750 |
|  | 8049/39 | N | 920 | 2,125 | 4,200 | 5,950 | 7,210 |
|  | 80C48/35 | C | 0 | 0 | 230 | 940 | 2,020 |
|  | 80C49/39 | c | 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 | c | 0 | 0 | 25 | 203 | 450 |
|  | 80C49/39 | c | 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 |

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## 8-Bit Microcontrollers--Data

Table 2 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer
1980-1984
(Thousands of Units)

|  | Product | Process | 1980 | 1081 | 1982 | 1983 | 1984 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Philips (Cont.) | 8050/40 | N | 0 | 0 | 0 | 0 | 10 |
|  | 8051/31 | N | 0 | 0 | 0 | 40 | 1,160 |
|  | 80C49/39 | C | 0 | 0 | 0 | 0 | 3 |
|  | 84XX | H | 0 | 0 | 80 | 1,940 | 2.500 |
| RCA | 1804A | c | 0 | 0 | 0 | 4 | 23 |
|  | 6805/68EC05 | C | 0 | 0 | 0 | 0 | 7 |
| Rockwell | 6500/8X | 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 | 8 | 0 | 0 | 0 | 126 | 1,792 |
| Synertek | 28 | H | 0 | 2 | 90 | 135 | 24 |
| TI | TMS7000 | N | 0 | 22 | 255 | 715 | 990 |
| Thomson (EFCIS) | 6801/03 | 3 | 0 | 0 | 0 | 55 | 150 |
|  | 6805 | \% | 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 | C | 0 | 0 | 142 | 850 | 2,170 |
| 2ilog | 28 | N | 14 | -344 | 683 | 851 | 2.055 |
| Total 8-8it | cus |  | 21,740 | 34.931 | 54,114 | 90,615 | 163,510 |

## Source: Dataquest

October 1988

| Table 3 |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Estimated 8-Bit Microcontroller Unit Shipm <br> 1985-1987 <br> (Thousands of Units) |  |  |  |  |  |
|  | Product | Process | 1985 | 1986 | 1987 |
| AMD | 8051/31 | N | 1,610 | 1.700 | 2.240 |
|  | 8053 | N | 0 | 0 | 287 |
|  | 80C51/31 | C | 0 | 0 | 134 |
|  | 8751 | N | 71 | 112 | 133 |
|  | 8753 | H | 0 | 0 | - 77 |
| Fairchild | 387X | N | 357 | 10 | 0 |
|  | 58 | N | 287 | 304 | * |
| Fujitsu | MEL8048/35 | N | . 185 | 328 | 528 |
|  | MBL8049/39 | N | 707 | 862 | 1,132 |
|  | MBL8051/31 | H | 0 | 403 | 1,098 |
|  | MBL80C49/39 | C | 0 | 105 | 2,300 |
| General <br> Instrument | PIC1652/54 | N | 1,515 | 1,700 | * |
|  | PIC1655/57 | N | 3,295 | 1.400 | $\cdots$ |
|  | PIC1670/72 | N | 2,135 | 1.190 | $\star$ |
|  | PIC16C58 | C | 256 | 77 | * |
|  | PLC16E57 | H | 66 | 229 | * |
|  | PIC7000/2 | N | 26 | 234 | $\pm$ |
|  | PIC7020/40 | N | 140 | 484 | * |
|  | PIC7041 | N | 12 | 22 | * |
| Gould/AMI | 6801/03 | N | 576 | 21 | 31 |
|  | 6805 | N | 402 | 127 | 39 |
| Hitachi | 6301 | $C$ | 2.008 | 5.200 | 8.100 |
|  | 6305 | C | 1,386 | 4,242 | 7,250 |
|  | 6801/03 | N | 1.515 | 3,557 | 5.200 |
|  | 6805 | N | 2.902 | 5.275 | 7,160 |
|  | 68901 | C | 0 | 0 | 545 |
|  | $68 P 05$ | $C$ | 0 | 0 | 620 |
|  | 63701 | $C$ | 0 | 0 | 1.599 |
|  | 63705 | C | 0 | 0 | 1,299 |
|  | $63 P 01$ | C | 0 | 0 | 645 |
|  | $63 \mathrm{PO5}$ | C | 0 | 0 | 865 |
| Intel | 802X | N | 222 | 93 | 54 |
|  | 8048/35 | N | 1.365 | 595 | 1,067 |
|  | 8049/39 | N | 1.530 | 2.401 | 7,475 |
|  | 8050/40 | N | 240 | 225 | 542 |
|  | 8051/31 | N | 6,800 | 6.998 | 12,700 |
|  | 8052/32 | N | 269 | 1,600 | 1,885 |


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## 8-Bit Microcontrollers--Data

Table 3 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987
(Thousands of Units)

|  | Product | Process | 1285 | 1286 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Intel (Cont.) | 80C49/39 | c | 112 | 20 | 0 |
|  | 80C51/31 | c | 785 | 2,000 | 3,165 |
|  | 8748 | N | 1,310 | 800 | 693 |
|  | 8749 | N | 1,445 | 2,247 | 3,625 |
|  | 8751 | N | 843 | 692 | 94.1 |
|  | 8752 | c | 0 | 0 | 30 |
|  | $87 \mathrm{C51}$ | c | 0 | 0 | 100 |
| Intersil | 80C48/35 | c | 30 | 20 | 0 |
|  | 80C49/39 | c | 9 | 10 | 0 |
| Matra-Harris | 8051 | N | 1,400 | 1,340 | 429 |
|  | 8052 | N | 20 | 418 | 1,033 |
|  | $80 \mathrm{C51}$ | c | 10 | 387 | 1,324 |
|  | $80 \mathrm{C52}$ | c | 0 | 0 | 83 |
| Matsushita | MN1800 | c | 131 | 400 | 1,070 |
| Microchip Tech. | PIC1652/54 | N | 0 | 0 | 4,063 |
|  | PIC1655/57 | \% | 0 | 0 | 1,073 |
|  | PIC1670/72. | N | 0 | 0 | 460 |
|  | PIC16C58 | c | 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 | M5078x | c | 0 | 0 | 23,706 |
|  | M509x | c | 0 | 0 | 13,082 |
|  | M50xCX | c | 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 | C | 0 | 0 | 2,614 |
| Mostek | $387 \times$ | N | 867 | * | * |
|  | 3887X | N | 297 | * | * |
|  | F8 | N | 195 | * | * |
| Motorola | 146805 | c | 4,071 | 4,705 | 5,422 |
|  | 1468705 | c | 48 | 93 | 0 |
|  | 3878 | N | 174 | 199 | 0 |
|  | 6801/03 | N | 8,007 | 8,526 | 8,918 |
|  | 6804 | N | 501 | 1,495 | 4,357 |

# 8-Bit Microcontrollers--Data 

Table 3 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987
(Thousands of Units)

|  | Product | Process | 1985 | 1.286 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Motorola (Cont.) | 6805 | N | 10,777 | 13,559 | 19,716 |
|  | 68701 | N | 278 | 431 | 0 |
|  | 68704 | N | 13 | 82 | 0 |
|  | 68705 | N | 2,641 | 3,861 | 0 |
|  | 68EC05 | c | 0 | 0 | 4,678 |
|  | 68HC11 | C | 67 | 696 | 3,975 |
| National | 8048/35 | H | 2.200 | 390 | 425 |
|  | 8049/39 | N | 1.910 | 1,650 | 2,095 |
|  | 8050/40 | 8 | 1,500 | 2.280 | 1,838 |
|  | COP800 | C | 0 | 0 | 10 |
|  | 807X | N | 5 | 0 | 0 |
| National (FCI) | 58 | N | 0 | 0 | 138 |
| NCR | 6500/1 | 8 | 640 | 1,027 | 397 |
| NEC | 8021/22. | N | 350 | 100 | 40 |
|  | 8041 | \% | 2.860 | 2.550 | 1,750 |
|  | 8048/35 | N | 2,860 ${ }^{\circ}$ | 3.940 | 4,360 |
|  | 8049/39 | N | 5,160 | 5,350 | 4,830 |
|  | 80C48/35 | C | 1,800 | 1,360 | 970 |
|  | 80C49/39 | C | 2,060 | 2,110 | 2,680 |
|  | 8741 | N | 850 | 480 | 330 |
|  | 8748 | N | 1,660 | 1.370 | 590 |
|  | 8749 | $N$ | 2,060 | 1,930 | 3,300 |
|  | uPD788x | N | 11,450 | 18,390 | 24,140 |
| Oki | 80 Cl 54 | C | 0 | 87 | 894 |
|  | 80C48/35 | C | 537 | 520 | 428 |
|  | 80C49/39 | C | 1,950 | 2,720 | 3,133 |
|  | 80 C 51 | C | 0 | 1,772 | 2,721 |
| Philips | 8021/22 | N . | 470 | 138 | 172 |
|  | 8048/35 | H | 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 | C | 0 | 81 | 620 |
|  | 84CXX | c | 0 | 15 | 1.150 |
|  | 848X | $N$ | 6.200 | 14,325 | 10.810 |

(Continued)

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## 8-Bit Microcontrollers--Data

Table 3 (Continued)

## Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987 <br> (Thousands of Units)

|  | Product | Process | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| RCA | 1804A | C | 13 | 11 | 8 |
|  | 6805/68HCO5 | C | 120 | 359 | 805 |
| Rockwell | 6500/XX | N | 1,310 | 2,550 | 3,855 |
| SGS-Thomson* |  |  |  |  |  |
| (M)** | 387X | H | 0 | 0 | 795 |
| (M) | 38P7X | 3 | 0 | 0 | 90 |
| (M) | F8 | 8 | 0 | 0 | 136 |
| (S) | 387\% | H | 2,200 | 4.811 | 3,922 |
| (S) | 28 | N | 244 | 601 | 665 |
| (T) | 6801/03 | N | 337 | 906 | 1,131 |
| (T) | 6805 | H | 1.129 | 1,190 | 2,182 |
| Sharp | SM-Series | C | 0 | 0 | 530 |
|  | 28 | 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 | H | 2,563 | 760 | 111 |
|  | 8049/39 | N | 1,235 | 1,741 | 2,000 |
|  | 8050/40 | N | 277 | 273 | 723 |
|  | 8051/31 | H | 2,362 | 2.687 | 2,731 |
|  | 8052/32 | \% | 5 | 456 | 1,541 |
|  | 80C51/31 | C | 0 | 60 | 283 |
|  | $83 \mathrm{C451}$ | C | 0 | 0 | 27 |
|  | 8400 | N | 0 | 30 | 43 |
|  | $87 \mathrm{C451}$ | C | 0 | 0 | 10 |
| TI | TMS7000 | N | 1.396 | 2.555 | 6,600 |
| ICMC (Mostek) | 387X | N | 0 | 969 | * |
|  | 38P7X | N | 0 | 145 | * |
|  | F8 | N | 0 | 299 | * |

## 8-Bit Microcontrollers--Data

Table 3 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Manufacturer 1985-1987
(Thousands of Units)

|  | Product | Process | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Toshiba | 8048/35 | N | 4,504 | 1,150 | 1,171 |
|  | 8049/39 | 1 | 5,207 | 2,350 | 1,760 |
|  | 80C48/35 | C | 0 | 1,000 | 2,950 |
|  | 80C49/39 | C | 2,925 | 2,280 | 3,600 |
|  | 80C50/40 | C | 0 | 520 | 851 |
| Zilog | 28 | 8 | 2,099 | 3,112 | 3,422 |
| Others\# | Unspecified | C | - | 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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N
controller Unit Shipments by Quarter for 1985

## 8-Bit Microcontrollers--Data

Table 4 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

|  | Product | Process | 01/85 | 02/85 | 03/85 | 04/85 | 1985 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RCA | 1804A | C | 5 | 3 | 3 | 2 | 13 |
|  | 6805/68FCCO5 | C | 20 | 10 | 25 | 65 | 120 |
| Rockwell | 6500/XX | H | 150 | 400 | 360 | 400 | 1,310 |
| SGS | 387X | N | 530 | 550 | 495 | 625 | 2,200 |
|  | 28 | H | 55 | 47 | 42 | 100 | 244 |
| Sharp | 28 | H | 23 | 23 | 190 | 190 | 426 |
| Siemens | 8021 | N | 24 | 54 | 30 | 30 | 138 |
|  | 802XX | H | 295 | 427 | 468 | 348 | 1,538 |
|  | 8048/35 | 88 | 40 | 57 | 57 | 40 | 194 |
|  | 8051/31 | N | 700 | 630 | 567 | 600 | 2.497 |
| Signetics | 8048/35 | $\mathbf{N}$ | 1,400 | 400 | 463 | 300 | 2,563 |
|  | 8049/39 | H | 400 | 200 | 250 | 385 | 1,235 |
|  | 8050/40 | N | 92 | 50 | 60 | 75 | 277 |
|  | 8051/31 | s | 870 | 400 | 417 | 675 | 2,362 |
|  | 8052/32 | H | 0 | 0 | 0 | 5 | 5 |
| TI | TMS7000 | N | 400 | 350 | 316 | 330 | 1,396 |
| Thomson | 6801/03 | N | 65 | 59 | 53 | 160 | 337 |
|  | 6805 | H | 350 | 315 | 284 | 180 | 1,129 |
| TCMC (Mostek)* | 387X | N | 273 | 159 | 211 | 224 | 867 |
|  | 38P7X | N | 112 | 80 | 61 | 44 | 297 |
|  | F8 | N | 62 | 51 | 42 | 40 | 195 |
| Toshiba | 8048/35 | H | 1,600 | 1,404 | 1,000 | 500 | 4,504 |
|  | 8049/39 | N | 1,700 | 1,530 | 1,377 | 600 | 5,207 |
|  | 80C49/39 | $C$ | 900 | 675 | 650 | 700 | 2,925 |
| 2ilog | 28 | N | 564 | 550 | 495 | 490 | 2.099 |
| Total 8-B | MCUs |  | 45,746 | 39,722 | 38,425 | 39,706 | 163,599 |

## *Mergers/Accquisitions:

1. AMI was accquired by Gould Semiconductor.
2. Thomson Components accquired Mostek Corporation from United Technologies, forming Thomson Components-Mostek Corporation (TCMC).

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\begin{aligned}
\text { Source: } & \text { Dataquest } \\
& \text { October } 1988
\end{aligned}
$$

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Estimated 8－Bit Microcontroller Unit Shipments by Quarter for 1986
 Table 5 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986
(Thousands of Units)

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## 8-Bit Microcontrollers--Data

Table 5 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

|  | Product | Process | 01/86 | 02/86 | 03/86 | 04/86 | 1986 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RCA | 1804A | c | 4 | 2 | 2 | 3 | 11 |
|  | 6805/68HC05 | C | 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 |
|  | 28 | N | 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 | 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 | H | 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 | C | 3 | 7 | 10 | 40 | 60 |
|  | 8400 | H | 1 | 6 | 13 | 10 | 30 |
| TI' | TMS7000 | H | 450 | 470 | 785 | 850 | 2,555 |
| Thomson | 6801/03 | N | 200 | 235 | 225. | 246 | 906 |
|  | 6805 | $\mathbf{H}$ | 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 | 8 | 550 | 550 | 650 | 600 | 2,350 |
|  | 80C48/35 | C | 200 | 200 | 300 | 300 | 1,000 |
|  | 80C49/39 | C | 400 | 480 | 800 | 600 | 2,280 |
|  | 80C50/40 | C | 100 | 120 | 200 | 100 | 520 |
| zilog | 28 | N | 710 | 835 | 770 | 797 | 3,112 |
| Others* | Unspecified | C | $\underline{2.767}$ | $\underline{-2.767}$ | 2,768 | 2.768 | 11.070 |
| Total 8-Bit 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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Microchip
Technology*

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## 8-Bit Microcontrollers--Data

## Table 6 (Continued)

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

|  | Product | Erocess | 01/87 | 02/87 | 03/87 | 04/87 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Oki | 80 Cl 54 | c | 75 | 95 | 350 | 374 | 894 |
|  | 80C48/35 | c | 125 | 110 | 100 | 93 | 428 |
|  | 80C49/39 | c | 699 | 734 | 890 | 810 | 3,133 |
|  | $80 \mathrm{C51}$ | c | 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 | N | 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 | C | 74 | 120 | 160 | 160 | 514 |
|  | 80C51/31 | c | 60 | 110 | 210 | 240 | 620 |
|  | 84CXX | c | 110 | 350 | 380 | 310 | 1,150 |
|  | 84XX | N | 2,880 | 3,190 | 2,540 | 2,200 | 10,810 |
| RCA | 1804A | c | 5 | 2 | 1 | 0 | 8 |
|  | 6805/68HC05 | c | 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) | 3887x | N | 30 | 20 | 20 | 20 | 90 |
| (M) | F8 | $N$ | 56 | 50 | 20 | 10 | 136 |
| (S) | 3878 | 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 | c | 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 | s | 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 | 454 | 472 | 1,541 |
|  | 80C51/31 | c | 65 | 69 | 73 | 76 | 283 |
|  | $83 \mathrm{C451}$ | c | 1 | 5 | 9 | 12 | 27 |
|  | 8400 | N | 10 | 11 | 10 | 12 | 43 |
|  | $87 \mathrm{C451}$ | $c$ | 0 | 2 | 3 | 5 | 10 |

(Continued)
SIS Prod., Mkts., \& Tech., Vol. II © 1988 Dataquest Incorporated October

## 8-Bit Microcontrollers--Data

Table 6 (Continued)
Estimated 8-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)


Source: Dataquest October 1988

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## 16-Bit Microcontrollers--Product Analysis

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

## Table 1 Estimated Market Share by Product Type for 16-Bit Microcontrollers, 1985-1987

## Figure 1 Estimated Market Share by Product Type for 16-Bit Microcontrollers, 1986 and 1987

Table $2 \underset{\substack{\text { Estimated Market Share by Process Technology for } \\ \text { 1985-1987 }}}{\text { 16-Bit Microcontrollers, }}$
Figure 2 Estimated Market Share by Process Technology for 16-Bit Microcontrollers, 1985-1987
$\begin{array}{ll}\text { Table } 3 & \begin{array}{l}\text { Estimated Market Share by Process Technology by Region for 16-Bit } \\ \\ \text { Microcontrollers, } 1985-1987\end{array}\end{array}$
Figure 3 Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers, 1987

## 16-Bit Microcontrollers--Product Analysis

Table 1
Estimated Market Share by Product Type for 16-Bit Microcontrollers 1985-1987

|  | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: |
| 8096 | 62.58 | 67.4\% | 80.0\% |
| V35 | 0 | 0 | 0.3 |
| HPC | 0 | 0 | 3.6 |
| 68200 | 5.2 | 32.3 | 16.1 |
| 9940 | 32.3 | 0.3 | 0 |
| Total 16-Bit MCUs | 100.0\% | 100.08 | 100.0\% |

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

| Source: | Dataquest |
| :--- | :--- |
|  | April 1989 |

Figure 1
Estimated Market Share by Product Type for 16-Bit Microcontrollers

1986 and 1987


0003605-1


Source: Dataquest

## 16-Bit Microcontrollers--Product Analysis

Table 2

## Estimated Market Share by Process Technology for 16-Bit Microcontrollers <br> 1985-1987 <br> (Thousands of Units)

|  | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: |
| amos |  |  |  |
| Shipments | 232 | 399 | 658 |
| Percent | 100.0\% | 100.04 | 96.14 |
| CMOS |  |  |  |
| Shipments | 0 | 0 | 27 |
| Percent | 0 | 0 | 3.9\% |
| Total Shipments | 232 | 399 | 685 |
|  |  | Source: | quest $1989$ |

Figure 2

## Estimated Market Share by Process Technology for 16-Bit Microcontrollers <br> 1985-1987

Thousands of Units


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# 16-Bit Microcontrollers--Product Analysis 

Table 3

## Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers <br> 1985-1987

|  | 1985 | 1986 | 1987 |
| :---: | :---: | :---: | :---: |
| MMOS |  |  |  |
| United States | $94.8 \%$ | $67.7 \%$ | $83.3 \%$ |
| Japan | 0 | 0 | 0 |
| Western Europe | 5.2 | 32.3 | 16.7 |
| 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 | $100.0 \%$ |

Figure 3
Estimated Market Share by Process Technology by Region for 16-Bit Microcontrollers

1987


Source: Dataqpezt

## 16-Bit Microcontroller Analysis

## 16-BIT MICROCONTROLLERS

The 16-bit microcontroller offers a high level of system integration on a single chip. With l6-bit CPU performance, high-speed math processing, and high-speed $1 / 0$, the 16 -bit microcontroller will open up applications that previously required many chips. The l6-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 l6-bit MCU applications in various industry segments.

## Evolution

Users of 8 -bit microcontrollers have become increasingly sophisticated, thus placing greater demands on chip suppliers for improved microcontrollers. Before the l6-bit MCU, designers depended on complex multiple-chip solutions to achieve high performance. The l6-bit chip offers a better solution. Even though the 8 -bit and 16 -bit MCUs are used in similar types of applications, the lo-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

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INDUSTRIAL

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INDUSTRIAL
Motor Control
Motor Control
Robotics
Robotics
Discrete and Continuous
Discrete and Continuous
Process Control
Process Control
Numerical Control
Numerical Control
Intelligent Transducers
Intelligent Transducers
INSTRUMENTATION
INSTRUMENTATION
Medical Instrumentation
Medical Instrumentation
Liquid and Gas Chromatographs
Liquid and Gas Chromatographs
Oscilloscopes
Oscilloscopes
CONSUMER
CONSUMER
Video Recorders
Video Recorders
Laser Disk Drives
Laser Disk Drives
High-End Video Games
High-End Video Games
GUIDANCE AND CONTROL
GUIDANCE AND CONTROL
Missile Control
Missile Control
Torpedo Guidance Control
Torpedo Guidance Control
Intelligent Ammunition
Intelligent Ammunition
Aerospace Guidance Systems

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    Aerospace Guidance Systems
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## 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

# 16-Bit Microcontroller Analysis 

Table 2

16-BIT MICROCONTROLLERS AND POTENTIAL APPLICATIONS

| Product | Application |
| :---: | :---: |
| 8096 | Engine Control/High-Speed Peripherals |
| 8796 (EPROM) |  |
| HPC-16040 (CMOS) | Data Communications |
| V25 (CMOS) | Dedicated to Automotive |
| 78312 | General Purpose |
| 68200 | Real-Time Applications Industrial Control <br> Robotics <br> Instrumentation |
|  |  |
|  |  |
|  |  |
| 2800 | General Purpose |
| TMS-9940 | General Purpose |
|  | Source: Dataquest |
|  | December 1986 |

# Competitive Analysis 


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## 16-Bit Microcontrollers--Historical Shipment Data

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

## 16-Bit Microcontrollers-Historical Shipment Data

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 | 0 | 1 |
| mostel | 68200 | N | 0 | 0 | 0 | 0 | 0 |
| NEC | V35 | C | 0 | 0 | 0 | 0 | 0 |
| National | HPC | C | 0 | 0 | 0 | 0 | 0 |
| Texas Instruments | 9940 | N | 8 | 36 | 50 | 89 | 122 |
| Total $16-B i t$ MCUs |  |  | 8 | 36 | 50 | 89 | 123 |
|  |  |  |  | Source: |  | Dataquest <br> September 1989 |  |

Table 2
Estimated 16-Bit Microcontroller Unit Shipments by Manufacturer 1985-1988
(Thousands of Units)

|  | Product | Process | 1985 | 1986 | 1987 | 1988 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Intel | 8096 | N | 145 | 269 | 548 | 1,670 |
|  | 8098 | N |  |  |  | 80 |
|  | 80C196 | $c$ |  |  |  | 60 |
| National | HPC | C | 0 | 0 | 25 | 250 |
| NEC | V35 | C | 0 | 0 | 2 | 9 |
| SGS-Thomson | 68200 | N | 12 | 129 | 110 | 64 |
| Texas Instruments | 9940 | N | 75 | 1 | 0 | 0 |
| Various* | 8061 | C | N/A | W/CA | 2,626 | 3.328 |
| Total 16-Bit MCUs |  |  | 232 | 399 | 3,311 | 5,461 |

$N / A=$ Not Applicable
*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. (No attempt to estimate production prior to 1987 has been made.)

## 16-Bit Microcontrollers--Historical Shipment Data

Table 3
Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1980 (Thousands of Units)


Table 4
Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1981
(Thousands of Units)

|  | Product | Process | $01 / 81$ | $02 / 81$ | $03 / 81$ | $04 / 81$ | I981 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Texas Instruments | 9940 | $N$ | 6 | 10 | 10 | 10 | 36 |
| Total 16-Bit MCUs |  | 6 | 10 | 10 | 10 | 36 |  |.

16-Bit Microcontrollers--Historical Shipment Data

Table 5
Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1982 (Thousands of Units)

|  | Product | Process | $02 / 82$ | $02 / 82$ | $03 / 82$ | $04 / 82$ | 1982 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Texas Instruments | 9940 | $N$ | 10 | 10 | 15 | 15 | 50 |
| Total $16-$ Bit MCJs |  | 10 | 10 | 15 | 15 | 50 |  |

## Table 6

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

|  | Product | Process | $01 / 83$ | $02 / 83$ | $03 / 83$ | $04 / 83$ | 1983 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Texas Instruments | 9940 | $N$ | 20 | 22 | 22 | 25 | 89 |
| Total 16-Bit MCUs |  | 20 | 22 | 22 | 25 | 89 |  |

## 16-Bit Microcontrollers--Historical Shipment Data

Table 7
Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1984 (Thousands of Units)


Table 8
Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1985 (Thousands of Units)

|  | Product | Process | 01/85 | 02/85 | 03/85 | 04/85 | 1985 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Intel | 8096 | N | 25 | 40 | 40 | 40 | 145 |
| TCMC (Mostek)* | 68200 | N | 0 | 0 | 1 | 11 | 12 |
| Texas Instruments | 9940 | N | $\underline{25}$ | 15 | 15 | 20 | 75 |
| Total 16-Bit MCUs |  |  | 50 | 55 | 56 | 71 | 232 |

## 16-Bit Microcontrollers--Historical Shipment Data

Table 9
Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1986 (Thousands of Units)

|  | Product | Process | 01/86 | 22/86 | 03/86 | 04/86 | 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 | - 2 |
| Total 16-Bit MCUs |  |  | 77 | 98 | 117 | 107 | 399 |
|  |  |  |  | Source: |  | Dataques Septembe | 1989 |

Table 10
Estimated 16-Bit Microcontroller Unit Shipments by Quarter for 1987 (Thousands of Units)

|  | Product | Process | $01 / 87$ | 02/87 | 03/87 | 04/87 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Intel | 8096 | N | 86 | 82 | 130 | 250 | 548 |
| NEC | V35 | c | 0 | 0 | 0 | 2 | 2 |
| National | HPC | c | 0 | 0 | 0 | 25 | 25 |
| SGS-Thomson | 68200 | N | 10 | 20 | 55 | 25 | 110 |
| Various* | 8061 | C | 685 | 570 | 645 | 726 | $\underline{2.626}$ |
| Total 1 | Us |  | 781 | 672 | 830 | 1.028 | 3,311 |

*The 8061 is a custom-designed l6-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

# 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 | 03/87 | $04 / 87$ | 2987 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Intel | 8096 | N | 300 | 400 | 370 | 600 | 1,670 |
|  | 8098 | N | 0 | 20 | 30 | 30 | 80 |
|  | $80 \mathrm{C1} 96$ | C | 10 | 20 | 10 | 20 | 60 |
| National | HPC | c | 40 | 55 | 80 | 75 | 250 |
| NEC | V35 | C | 2 | 2 | 2 | 3 | 9 |
| SGS-Thomson | 68200 | N | 16 | 19 | 0 | 29 | 64 |
| various* | 8061 | C | 202 | 940 | 656 | 830 | 3.328 |
| Total 16-Bit MCUs |  |  | 1.270 | 1,456 | 1,148 | 1.587 | 5,461 |
|  |  |  |  | Source: |  | Dataque Septemb | 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.

## 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)

|  | Product | Process | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Intel | 8096 | N |  |  |  |  | s | S | 145 | 269 |
| Mostek | 68200 | N |  |  |  |  |  |  | 12 | 129 |
| TI | 9940 | N | 5 | $\underline{8}$ | 36 | 50 | 89 | 122 | 75 | 1 |
| Total |  |  | 5 | 8 | 36 | 50 | 89 | 122 | 232 | 399 |
|  | $a \leq p$ |  |  |  | 22.50 | 17.0 | 1256 | 11.80 | $17^{40}$ | 17.48 |




## $\overline{\text { PC Graphics Chip Sets--Executive Summary }}$

## 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 decline beginning in 1990, and the CAGR for 1989 through 1993 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, $10-\mathrm{MHz}$ chip sets accounted for more than one-half of all shipments. In 1989, the median is expected to be the $12-\mathrm{MHz}$ 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.

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## $\overline{\text { PC Graphics Chip Sets--Forecast }}$

## 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.

## $\overline{\text { PC Graphics Chip Sets--Forecast }}$

## 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

## Total Low-End Merchant PC Graphics Chip Sets <br> Estimated Worldwide History and Forecast

(Revenue)
Millions of Dollars


## $\overline{\text { PC Graphics Chip Sets--Forecast }}$

Figure 2
Total Low-End Merchant PC Graphics Chip Sets
Estimated Worldwide History and Forecast
(Units)
Millions of Units


# $\overline{\text { PC Graphics Chip Sets--Forecast }}$ 

## Table 1

## Total Low-End Merchant PC Graphics Chip Set Market Estimated Worldwide History and Forecast (Millions of Units)

|  | 1967 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1987-1993 <br> CAGR | $\begin{gathered} 1989-1993 \\ \text { CAGR } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Jotal DOs PC Shapments | 4.6 | 12.3 | 13.8 | 15.4 | 17.1 | 18.7 | 20.6 | 23.61 | 10.5* |
| wrowth Riste |  | 28.14 | 12.24 | 11.6\% | 11.04 | 9.48 | 10.2t |  |  |
| Total Low-Ena Graphics tevicet | 9.2 | 11.1 | 13.7 | 14.3 | 15.8 | 16.4 | 18.3 | 12.1\% | 7.58 |
| wrowth kate |  | 20.54 | 23. 2 * | 4.64 | 10.84 | 3.84 | 11.18 |  |  |
| Low-Eno Graphics thap Sets | 4.3 | 7.5 | 12.0 | 13.0 | 15.0 | 16.1 | 18.2 | 23.23 | 11.5* |
| Saturation | 46.78 | 67.94 | 86,0\% | 91.0 ( | 95.0\% | 98.0\% | 99.68 |  |  |
| Merchant Graphics Chip Sets | 2.1 | 4.5 | 8.1 | 10.2 | 12.5 | 13.7 | 15.7 | 39.88 | 18.08 |
| Growth kate |  | 114.7\% | 79.3\% | 25.14 | 22.71 | 9.98 | 14.9* |  |  |
| Merchant Graphscs Cnip Set ASP Growth Rate | \$26.1 | $\begin{aligned} & 23.9 \\ & (8.62) \end{aligned}$ | $\begin{aligned} & 22.4 \\ & (6.04) \end{aligned}$ | $\begin{gathered} \$ 13.9 \\ (38.08) \end{gathered}$ | $\begin{gathered} 10.2 \\ (27.08) \end{gathered}$ | ${ }_{(23.38)}^{7.8}$ | $\begin{gathered} 6.5 \\ (17.2 t) \end{gathered}$ | (20.84) | (26.86) |
| Merchant Graphacs Chip Set Revenue (Malifions of Dollars) Growth Rate | \$55.0 | $\begin{aligned} & \$ 108.1 \\ & 96.3 \% \end{aligned}$ | $\begin{aligned} & 3182.1 \\ & 68.5 \% \end{aligned}$ | $\begin{aligned} & \$ 141.3 \\ & (22.48) \end{aligned}$ | $\begin{gathered} 126.6 \\ \{10.44\} \end{gathered}$ | $\begin{aligned} & \$ 206.7 \\ & (15.7 t) \end{aligned}$ | $\begin{aligned} & \$ 101.5 \\ & (4.94) \end{aligned}$ | 10.74 | (13.63) |

## PC Graphics Chip Sets--Forecast

## 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.


## $\overline{\text { PC Graphics Chip Sets--Forecast }}$

Figure 3
Total Low-End PC Graphics Solutions-VLSI versus Non-VLSI
Estimated Worldwide History and Forecast


## $\overline{\text { PC Graphics Chip Sets--Forecast }}$

Figure 4

## Total Low-End PC Graphics Solutions by Implementation Estimated Worldwide History and Forecast

Millions of Units


Source: Dataquest November 1989

## $\overline{\text { PC Graphics Chip Sets--Forecast }}$

Table 2

## Total Low-End PC Graphics Solutions by Implementation Estimated Worldwide History and Forecast <br> (Thousands of Units)



## Low-End Graphics Forecast by Graphics Standard

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.


## PC Graphics Chip Sets--Forecast

- 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

Millions of Units


## $\overline{\text { PC Graphics Chip Sets--Forecast }}$

Table 3

Total Low-End PC Graphics Solutions by Standard Type Estimated Worldwide History and Forecast<br>(Thousands of Units)



## 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.


# PC Graphics Chip Sets--Forecast 

Figure 6
Total HGA Implementations
Estimated Worldwide History and Forecast
Millions of Units


Table 4
Total HGA Implementations
Estimated Worldwide History and Forecast (Thousands of Units)

|  | 1987 | 1988 | 1989 | 2990 | 1991 | $\underline{1992}$ | 1993 | $\begin{gathered} 1987-1993 \\ \text { CACA } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Merchant | 0 | 0 | 73.5 | 359.6 | 489.4 | 620.4 | 441.0 | 34.80 |
| Captive | 0 | 0 | 10.5 | 66.3 | 107.2 | 66.0 | 42.0 | 26.03 |
| Proprietary | 199.0 | 197.6 | 273.0 | 262.1 | 208.0 | 186.0 | 140.0 | (5.69) |
| Discrete | 3,102.0 | 2,502.4 | 1,743.0 | 1.262 .0 | 795.4 | 327.6 | 77.0 | (46.06) |
| Total | 3,300.0 | 2,600.0 | 2,100.0 | 1,950.0 | 1,600.0 | 1.200 .0 | 700.0 | (22.84) |
|  |  |  |  |  |  | Source: |  | queat <br> nerer 1989 |

## $\overline{\text { PC Graphics Chip Sets--Forecast }}$

Figure 7

## Total CGA Implementations Estimated Worldwide History and Forecast

Millions of Units


Table 5
Total CGA Implementations Estimated Worldwide History and Forecast (Thousands of Units)

|  | 1987 | 1984 | $\underline{1989}$ | 1990 | 1991 | 1992 | $\underline{1993}$ | $\begin{gathered} \text { 1987-1993 } \\ \text { CAGR } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Merchant | 405.6 | 766.5 | 783.0 | 414.0 | 276.0 | 280.0 | 0 | (25.04) |
| Captsue | 120.0 | 42.0 | 63.0 | 36.0 | 24.0 | 20.0 | 0 | (30.14) |
| Proprietary | 192.0 | 105.0 | 54.0 | 0 | 0 | 0 | 0 |  |
| Discrete | 482.4 | 136.5 | 0 | 0 | 0 | 0 | 0 |  |
| rotal | 1,200.0 | 1,050.0 | 900.0 | 450.0 | 300.0 | 200.0 | 0 | (30.20) |
|  |  |  |  |  |  |  | source: | aguent <br> anbar 1989 |

# PC Graphics Chip Sets--Forecast 

Figure 8
Total EGA Implementations
Estimated Worldwide History and Forecast
Millions of Units


Table 6
Total EGA Implementations Estimated Worldwide History and Forecast (Thousands of Units)

|  | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | $\underline{1993}$ | $\begin{gathered} 1987-1993 \\ \text { CAGR } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Merchant | 1,241.6 | 1,811.5 | 2,269.1 | 1,872.0 | 1,494.0 | 1,006.0 | 606.0 | (11.36) |
| Captive | 217.0 | 580.4 | 416.0 | 240.0 | 144.0 | 75.1 | 34.8 | (26.38) |
| Proprietary | 417.6 | 237.3 | 320.0 | 264.0 | 162.0 | 118.9 | 59.2 | (27.88) |
| 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 | 200.0 | (22.48) |
|  |  |  |  |  |  | Source: |  | aquest <br> mber 1989 |

## $\overline{\text { PC Graphics Chip Sets--Forecast }}$

Figure 9
Total VGA Implementations
Estimated Worldwide History and Forecast
Millions of Units


Table 7
Total VGA Implementations Estimated Worldwide History and Forecast (Thousands of Units)

|  |  |  |  |  |  |  |  | 1987-1993 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1987 | 1988 | $\underline{1989}$ | 1990 | $\underline{1991}$ | 1992 | 1993 | CAGR |
| merchant | 460.1 | 1,946.0 | 4,985.5 | 7.505.0 | 10,197.6 | 11,888.6 | 14,683.4 | 78.14 |
| Captive | 7.6 | 448.4 | 1,214.6 | 959.5 | 823.1 | 773.7 | 832.0 | 119.08 |
| 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 | O | 0 |  |
| Total | 1,510.0 | 3,800.0 | 7,470.0 | 9,500.0 | 12,140.0 | 13,840.0 | 16,860.0 | 49.54 |

## $\overline{\text { PC Graphics Chip Sets--Forecast }}$

## 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 $8514 / \mathrm{A}$ 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 $\$ 149$.


## PC Graphics Chip Sets--Forecast

Figure 10

> High-End PC Graphics-All Applications Estimated Worldwide History and Forecast (Revenue)


Figure 11
High-End PC Graphics-All Applications Estimated Worldwide History and Forecast (Units)
Millions of Units


# $\overline{\text { PC Graphics Chip Sets--Forecast }}$ 

## Table 8

High-End PC Graphics-All Applications Estimated Worldwide History and Forecast

|  | 1987 | 1948 | $\underline{1989}$ | 1990 |  | 1991 |  | 1992 |  | 1993 | $87-1993$ <br> CAGR |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Shipments (K Units) | 111.0 | 194.9 | 410.3 | 933.0 |  | .912.9 |  | 499.7 |  | 002. 2 | 97.4\% |
| ASP | \$1.018 | 3905 | \$ 679 | \$ 492 | \$ | 357 | * | 232 | * | 175 | (25.4\%) |
| Revenue | \$113.0 | \$176.4 | \$274.6 | \$459.0 | * | 682.9 | s | 812.9 | $\leqslant$ | 840.4 | 39.7* |
| (Millions of \$) Growth Rate |  | 56.1* | S7.94 | 64.88 |  | 48.84 |  | 18.94 |  | 3.54 |  |
|  |  |  |  |  |  |  |  |  | r | Datequest Novencer 1989 |  |

Figure 12
High-End PC Graphics-IBM 8514/A and Compatibles Estimated Worldwide History and Forecast (Revenue)

Millions of Dollars


## PC Graphics Chip Sets--Forecast

Figure 13

## High-End PC Graphics-IBM 8514/A and Compatibles Estimated Worldwide History and Forecast (Units)

Millions of Units


Table 9
High-End PC Graphics-IBM 8514/A and Compatibles Estimated Worldwide History and Forecast

|  | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | $1987-1993$ <br> CAGB |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| shipments |  |  |  |  |  |  |  |  |
| (K Units) | 9.0 | 60.0 | 164.2 | 438.5 | 1.052.1 | 2,099.8 | 3.122.4 | 165.1妾 |
| ASP | 8839 | \$723 | \$570 | *39y | \$279 | \$196 | \$137 | (26.28) |
| Revenue <br> (Mililions of 5) | \$7.6 | 342.8 | \$93.5 | \$175.0 | \$293.5 | 8411.6 | \$427.6 | 96.04 |
| Growti Rate |  | 466.5\% | 118.64 | 87.10 | 67.88 | 40.28 | 3.90 |  |
|  |  |  |  |  |  | Bource: D |  | Detaguett |

# $\overline{\text { PC Logic Chip Sets--Forecast }}$ 

## 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.

## $\overline{\text { PC Logic Chip Sets--Forecast }}$

Figure 1

## Worldwide PC Logic Chip Set Forecast (Revenue)



Figure 2
Worldwide PC $\underset{\text { Logic Chip Set Forecast }}{\text { (Units) }}$
Millions of Units


0003950-2
Souree: Detaquest

# $\overline{\text { PC Logic Chip Sets--Forecast }}$ 

Table 1
Worldwide PC Logic Chip Set Forecast
(Millions of Units)

|  | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | $\begin{aligned} & \text { CAGR } \\ & 1987-1993 \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DOS PC Shipments | 9.6 | 12.3 | 13.8 | 15.4 | 17.1 | 18.7 | 20.6 | 13.6\% |
| Chip Set Shipments | 3.1 | 8.0 | 12.7 | 15.1 | 16.9 | 18.5 | 20.4 | 36.88 |
| Saturation | 33\% | 65\% | 92\% | $98 \%$ | $99 \%$ | $99 \%$ | 998 |  |
| Chip Set ASP | \$46.13 | \$49.66 | \$44.09 | \$44.71 | \$43.53 | \$41.89 | \$41.38 | (1.88) |
| Chip Set Revenue (\$M) | \$144 | \$399 | \$561 | \$674 | \$735 | \$774 | \$844 | 34.3\% |
| Chip Set Revenue Growth |  | 177.68 | 40.5\% | 20.38 | $9.0 \%$ | 5.2\% | 9.18 |  |

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.

# $\overline{\text { PC Logic Chip Sets--Forecast }}$ 

Figure 3

## 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.

## $\overline{\text { PC Logic Chip Sets--Forecast }}$

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)

|  | 1987 | 1988 | 1989 |
| :--- | :---: | :---: | :---: |
| 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 <br> Shipments | 3.1 | 8.0 | 15.1 |
|  | Source: |  | Dataquest <br> June |
|  |  |  | 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.


## $\overline{\text { PC Logic Chip Sets--Forecast }}$

Figure 4
Worldwide PC Logic Chip Set Forecast By Bus Architecture


Table 3
Worldwide PC Logic Chip Set Forecast by Bus Architecture (Thousands of Units)

|  | $\underline{1987}$ | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | $\begin{aligned} & \text { CAGR } \\ & \underline{1987-1993} \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | 484 | 572 | 654 | 203.4\% |
| Total | 3,116 | 8,035 | 12,720 | 15,085 | 16,895 | 18,466 | 20,403 | 36.8\% |
|  |  |  |  |  |  |  | Source: | Dataquest <br> June 1989 |

## $\overline{\text { PC Logic Chip Sets--Forecast }}$

## 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 80386 SX 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

Millions of Units


[^13]Source: Dataquest Dataquest
June 1989

## $\overline{\text { PC Logic Chip Sets--Forecast }}$

Table 4
Worldwide PC Logic Chip Set Unit Forecast by Microprocessor Type (Thousands of Units)

|  | $\underline{1987}$ | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | $\begin{gathered} \text { CAGR } \\ \underline{1987-1993} \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 8088 | 787 | 1,507 | 1,767 | 1,114 | 757 | 260 | 137 | (25.3\%) |
| 8086 | 983 | 2.207 | 2,372 | 2,116 | 1.732 | 1.398 | 903 | (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\% |
| 80386 SX | 0 | 55 | 1.017 | 2,569 | 4,408 | 6.191 | 7,896 | 169.6\% |
| Total |  |  |  |  |  |  |  |  |
| 80386 (All) | 78 | 714 | 3.094 | 5,579 | 7,849 | 9,960 | 11,935 | 131.5\% |
| 80486 | 0 | 0 | 0 | 86 | 30.6 | 807 | 1.771 | 1,109.3\% |
| Total | 3,115 | 8,034 | 12,719 | 15,084 | 16,895 | 18,465 | 20,403 | 36.88 |

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 .


## $\overline{\text { PC Logic Chip Sets--Forecast }}$

Figure 6
Worldwide PC Logic Chip Set Forecast by Speed for All Microprocessors
Millions of Units


## $\underline{\text { PC Logic Chip Sets--Forecast }}$

Figure 7
Worldwide 8088/8086 PC Logic Chip Set Forecast By Speed


## $\overline{\text { PC Logic Chip Sets--Forecast }}$

Figure 8
Worldwide 80286 PC Logic Chip Set Forecast By Speed


## $\overline{\text { PC Logic Chip Sets--Forecast }}$

Figure 9
Worldwide 80386SX PC Logic Chip Set Forecast By Speed


## $\overline{\text { PC Logic Chip Sets--Forecast }}$

Figure 10
Worldwide 80386 PC Logic Chip Set Forecast By Speed
Millions of Units


## $\overline{\text { PC Logic Chip Sets--Forecast }}$

Figure 11
Worldwide 80486 PC Logic Chip Set Forecast By Speed


## $\overline{\text { PC Logic Chip Sets--Forecast }}$

Table 5

## Worldwide PC Logic Chip Set Forecast by Speed (Thousands of Units)

| Speeds | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Units by Speed |  |  |  |  |  |  |  |
| 8088/8086 |  |  |  |  |  |  |  |
| 8 MHz | 589 | 754 | 857 | 388 | 124 | 0 | 0 |
| 10 MHz | 1.181 | 2,960 | 3.282 | 2.842 | $\underline{2.357}$ | 1,658 | 1.039 |
| Total | 1,770 | 3,714 | 4,139 | 3,230 | 2.482 | 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 | 137 | 557 | 1.001 | 1.208 | 1.528 |
| 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 | 0 | 0 | 0 | 220 | 1,052 | 1,895 |
| 33 MHz | 0 | 0 | 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 | -0 | 0 | 83 | 302 | 2,204 | 1,696 | 2.221 |
| Total | 78 | 659 | 2,077 | 3,010 | 3,441 | 3.770 | 4,039 |

(Continued)

## $\overline{\text { PC Logic Chip Sets--Forecast }}$

## Table 5 (Continued) <br> Worldwide PC Logic Chip Set Forecast by Speed (Thousands of Units)

| Speeds | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 | 0 | 0 | 0 | 0 | 0 | 16 | -124 |
| Total | 0 | 0 | 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 | 0 | 0 | 16 | 124 |
| Total | 3,115 | 8,034 | 12,719 | 15,084 | 16,895 | 18,465 | 20,402 |



## $\overline{\text { PC Graphics Chip Sets---Product Analysis }}$

## 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 1
Low-End PC Graphics Market Share by Implementation Estimated Worldwide History and Forecast (Millions of Units)

|  | $\underline{1987}$ | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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\% | 82.88 | 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\% | 14.08 | 9.0\% | 5.0\% | $2.0 \%$ | 0.48 |
| Total Low-End Graphics Devices | 9.2 | 11.1 | 13.7 | 14.3 | 15.8 | 16.4 | 18.3 |
|  |  |  |  | Source: |  | Dataquest November 1989 |  |

## PC Graphics Chip Sets--Product Analysis

Figure 1

## Low-End PC Graphics Market Share

 VLSI versus Non-VLSI Implementations

## $\overline{\text { PC Graphics Chip Sets--Product Analysis }}$

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.

Figure 2
Low-End PC Graphics Chip Set Market Share by Implementation


## $\overline{\text { PC Graphics Chip Sets--Product Analysis }}$

## 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)

|  | 1987 | 1988 | 1.989 | 1990 | 1991 | 1992 | 1993 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HGA | 35.8\% | 23.4\% | $15.4 \%$ | 13.6\% | 10.1\% | 7.38 | 3.8\% |
| CGA | 13.08 | 9.5\% | 6.68 | 3.18 | 1.9\% | 1.28 | 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 <br> November 1989 |  |  |

## PC Graphics Chip Sets--Product Analysis

Figure 3
Low-End PC Graphics Market Share by Standard Type


## PC Graphics Chip Sets--Product Analysis

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)

|  | $\underline{1987}$ | $\underline{1988}$ | 1989 | $\underline{1990}$ | 1991 | 1992 | $\underline{1993}$ |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 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 <br> Graphics Devices | 3.3 | 2.6 | 2.1 | 2.0 | 1.6 | 1.2 | 0.7 |

## PC Graphics Chip Sets--Product Analysis

Figure 4
Estimated HGA Market Share by Implementation


## $\overline{\text { PC Graphics Chip Sets--Product Analysis }}$

Table 4
CGA Market Share by Implementation Estimated Worldwide History and Forecast (Thousands of Units)


## PC Graphics Chip Sets--Product Analysis

Figure 5

## Estimated CGA Market Share by Implementation



# PC Graphics Chip Sets--Product Analysis 

Table 5
EGA Market Share by Implementation Estimated Worldwide History and Forecast (Thousands of Units)


## PC Graphics Chip Sets--Product Analysis

Figure 6

## Estimated EGA Market Share by Implementation



## $\overline{\text { PC Graphics Chip Sets--Product Analysis }}$

Table 6
VGA Market Share by Implementation Estimated Worldwide History and Forecast (Thousands of Units)


## $\overline{\text { PC Graphics Chip Sets--Product Analysis }}$

Figure 7
Estimated VGA Market Share by Implementation


## PC Graphics Chip Sets--Product Analysis

## 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

|  | 1987 | 2988 | 1989 | 1990 | 1991 | 1992 | 1993 | $\begin{gathered} \text { CAGR } \\ 1987-1993 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HGA Growth Rate |  |  | 7.50 | $\begin{gathered} 5.70 \\ (24.04) \end{gathered}$ | $\begin{gathered} 4.55 \\ (20.28) \end{gathered}$ | $\begin{gathered} 3.85 \\ (15.48) \end{gathered}$ | $\begin{gathered} 3.25 \\ (15.6 \downarrow) \end{gathered}$ | (18.90) |
| CGA <br> Growth Rate | 12.00 | $\begin{aligned} & 11.10 \\ & (7.58) \end{aligned}$ | $\begin{aligned} & 10.26 \\ & (7.68) \end{aligned}$ | $\begin{gathered} 7.25 \\ (29.38) \end{gathered}$ | $\begin{gathered} 5.45 \\ (24.80) \end{gathered}$ | $\begin{gathered} 4.05 \\ (25.78) \end{gathered}$ | 0 | (17.08) |
| EGA Growth Rate | 27.63 | $\begin{gathered} 20.98 \\ (24.10) \end{gathered}$ | $\begin{gathered} 18.44 \\ (12.18) \end{gathered}$ | $\begin{gathered} 9.25 \\ (49.88) \end{gathered}$ | $\begin{gathered} 6.50 \\ (29.78) \end{gathered}$ | $\begin{gathered} 4.90 \\ (24.68) \end{gathered}$ | $\begin{gathered} 3.95 \\ (19.48) \end{gathered}$ | (27.74) |
| vGA Growth Rate | 34.50 | $\begin{aligned} & 31.63 \\ & (8.30) \end{aligned}$ | $\begin{gathered} 26.41 \\ (16.5 \%) \end{gathered}$ | $\begin{gathered} 15.85 \\ (40.04) \end{gathered}$ | $\begin{gathered} 11.10 \\ (30.08) \end{gathered}$ | $\begin{gathered} 8.30 \\ (25.29) \end{gathered}$ | $\begin{gathered} 6.65 \\ (19.94) \end{gathered}$ | (24.04) |
| Weighted Average | 26.10 | $\begin{aligned} & 23.90 \\ & (8.68) \end{aligned}$ | $\begin{aligned} & 22.40 \\ & (6.02) \end{aligned}$ | $\begin{gathered} 13.90 \\ (38.04) \end{gathered}$ | $\begin{gathered} 10.20 \\ (27.00) \end{gathered}$ | $\begin{gathered} 7.80 \\ (23.36) \end{gathered}$ | $\begin{gathered} 6.50 \\ (17.28) \end{gathered}$ | (20.84) |

## $\overline{\text { PC Graphics Chip Sets--Product Analysis }}$

Figure 8
Low-End Merchant Graphics Chip Set ASP by Standard Type


## $\overline{\text { PC Graphics Chip Sets--Product Analysis }}$

## 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.

## $\overline{\text { PC Graphics Chip Sets--Product Analysis }}$

Memory requirements increase with the square of the resolution (for example, a $1,000-l i n e$ 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 $720 \times 350$ 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 $320 \times 200$ pixels with 4 colors.


## PC Graphics Chip Sets--Product Analysis

- 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 $640 \times 350$ 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 $320 \times 200$ pixels with 256 colors or $640 \times 480$ 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

| Standard | Resolution | Colors |
| :---: | :---: | :---: |
| VGA | $320 \times 200$ | 256 |
|  | $640 \times 480$ | 16 |
|  | $640 \times 480$ | 256 |
|  | $800 \times 600$ | 16 |
|  | $800 \times 600$ | 256 |
|  | $800 \times 600$ | Monochrome |
|  | $960 \times 720$ | 4 |
|  | $960 \times 720$ | 16 |
|  | $960 \times 720$ | Monochrome |
|  | $1024 \times 768$ | 2 |
|  | $1024 \times 768$ | 4 |
|  | $1024 \times 768$ | 16 |
|  | $1024 \times 768$ | Monochrome |
|  | $1280 \times 960$ | 4 |
|  | $1280 \times 960$ | Monochrome |
| EGA | $640 \times 350$ | 16 |
|  | $640 \times 480$ | 16 |
| CGA | $320 \times 200$ | 4 |
|  | $640 \times 200$ | 2 |
|  | $640 \times 400$ | Monochrome |
| HGA | $720 \times 350$ | Monochrome |

## Source: Dataquest

November 1989

## PC Graphics Chip Sets--Product Analysis

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

## PC Logic Chip Sets--Product Analysis

## 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.


## PC Logic Chip Sets--Product Analysis

Figure 1
Estimated PC Logic Chip Set Unit Market Share by Bus Architecture


1987
3.1 Miltion Units


1989
12.7 Million Units

Table 1
Estimated PC Logic Chip Set Unit Market Share by Bus Architecture
(Percent Share)

| PC XT | 58.7\% | 49.6\% | 35.2\% | 21.7\% | 14.78 | 9.08 | 5.18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| PC AT | 41.3 | 49.6 | 63.0 | 64.4 | 67.6 | 71.6 | 74.3 |
| MCA | 0 | 0.8 | 1.7 | 11.4 | 14.9 | 16.3 | 17.4 |
| EISA | 0 | 0 | 0.1 | 2.4 | 2.9 | 3.1 | 3.2 |
| Total | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% |

## PC Logic Chip Sets--Product Analysis

## 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 80386 SX 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


1987
3.1 Million Units


## PC Logic Chip Sets--Product Analysis

Table 2

Estimated PC Logic Chip Set Market Share by Microprocessor Type<br>(Percent Share)

|  | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 8088 | 25.3\% | 18.8\% | 13.98 | 7.4\% | 4.5\% | 1.4\% | 0.7\% |
| 8086 | 31.5 | 27.5 | 18.7 | 14.0 | 10.3 | 7.6 | 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 | 33.5 | 38.7 |
| Total 80386/ 80386 SX | 2.5\% | 8.9\% | 24.3\% | 37.08 | 46.5\% | 53.9\% | 58.5\% |
| 80486 | 0 | 0 | 0 | $0.6 \%$ | 1.8\% | 4.4\% | 8.7\% |
| Total | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.0\% | 100.08 |

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, $10-\mathrm{MHz}$ 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 .


## $\overline{\text { PC Logic Chip Sets--Product Analysis }}$

Figure 3

## Estimated PC Logic Chip Set Unit Market Share by Speed for All Microprocessors



Figure 4
Estimated PC Logic Chip Set Unit Market Share by Speed for 8088/8086 Microprocessors


1987 1.8 Million Units

4.1 Million Units

## PC Logic Chip Sets--Product Analysis

Figure 5

## Estimated PC Logic Chip Set Unit Market Share by Speed for $\mathbf{8 0 2 8 6}$ Microprocessors



1987
1.3 Million Units

0003949-5


1989
5.5 Million Units

Source: Dataquest

Figure 6
Estimated PC Logic Chip Set Unit Market Share by Speed for $\mathbf{8 0 3 8 6}$ Microprocessors


1988
0.7 Million Units


# $\overline{\text { PC Logic Chip Sets--Product Analysis }}$ 

Table 3

## Estimated Worldwide PC Logic Chip Set Unit Market Share by Microprocessor by Speed (Percent Share)

| Speod | 1987 | 1988 | 1989 | 1898 | 1991 | 1992 | 1293 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Units by Speed |  |  |  |  |  |  |  |
| 8088/8086 |  |  |  |  |  |  |  |
| 8 MHz | 33.36 | 20.38 | 20.74 | 12.04 | 5.04 | 0 | 0 |
| 10 MHz | 66.7 | 7.7 | 79.3 | 88.9 | 95.0 | 100.08 | 100.04 |
| Total | 100.02 | 200.08 | 100.08 | 100.04 | 100.0s | 100.0\% | 100.0* |
| 80286 |  |  |  |  |  |  |  |
| 8 MHz | 11.98 | 3.48 | 1.01 | 0 | 0 | 0 | 0 |
| 10 MHz | 37.9 | 18.4 | 10.1 | 5.04 | 0 | 0 | 0 |
| 12 MHz | 43.9 | 62.4 | 58.1 | 50.0 | 41.08 | 36.08 | 32.08 |
| 16 MHz | 6.3 | 15.4 | 28.3 | 36.0 | 43.0 | 44.0 | 41.0 |
| 20 MHz | 0 | 0.4 | 2.5 | 9.0 | 16.0 | 20.0 | 27.0 |
| Total | 100.0\% | 100.0\% | 100.05 | 100.0\% | 100.04 | 100.08 | 100.01 |
| $803865 \times$ |  |  |  |  |  |  |  |
| 16 MHz | 0 | 100.0\% | 100.0\% | 78.04 | 65.04 | 48.04 | 38.08 |
| 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 | 2 | 0 | 0.0 | 0 | 0 | 0 | 0 |
| Totel | 0 | 100.08 | 100.04 | 100.0) | 100.04 | 100.04 | 100.08 |
| 80386 |  |  |  |  |  |  |  |
| $16 \mathrm{NH2}$ | 100.01 | 53.02 | 20.08 | 0 | 0 | 0 | 0 |
| 20 MHz | 0 | 47.0 | 70.0 | 40.04 | 25.0\% | 20.04 | 15.08 |
| 25 MHz | 0 | 0 | 6.0 | 50.0 | 40.0 | 35.0 | 30.0 |
| 33 MHz | 0 | 0 | 4.0 | 10.0 | 35.0 | 45.0 | 55.0 |
| Total | 100.08 | 100.04 | 100.04 | 100.04 | 100.04 | 100.02 | 100.04 |
| 80486 |  |  |  |  |  |  |  |
| 25 MHz | 0 | 0 | 75.04 | 62.08 | 50.08 | 35.01 | 28.09 |
| 33 MHz | 0 | 0 | 25.0 | 34.0 | 40.0 | 47.0 | 44.0 |
| 40 MHz | 0 | 0 | 0 | 4.0 | 10.0 | 16.0 | 21.0 |
| 50 MHz | 0 | 2 | - 0 | 0 | - 0 | 2.09 | 7.0 |
| Total | 0 | 0 | 100.0\% | 100.04 | 100.04 | 100.0\% | 100.08 |
| Speed Totale |  |  |  |  |  |  |  |
| 8 MHz | 23.8》 | 10.90 | 7.26 | 2.68 | 0.78 | 0 | 0 |
| 10 MHz | 53.3 | 45.1 | 30.2 | 20.9 | 14.0 | 9.04 | 5.14 |
| 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 | 14.4 | 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 NHz | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.6 |
| Total | 100.0才 | 100.0\% | 100.0\% | 100.0 | 100.00 | 100.04 | 100.08 |

## PC Logic Chip Sets--Product Analysis

## 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


## $\overline{\text { PC Logic Chip Sets--Product Analysis }}$

Table 4

## Estimated Worldwide PC Logic Chip Set Unit Shipments by Region

(Thousands of Units)


## 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.


## PC Logic Chip Sets--Product Analysis

- 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


## $\overline{\text { PC Logic Chip Sets--Product Analysis }}$

Table 5

## PC Logic Chip Set Average Selling Price Forecast (Dollars)

|  | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | $\begin{gathered} \text { CAGR } \\ 1987 \text { to } 1993 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| PC XT | \$39.84 | \$ 35.07 | \$ 25.87 | \$15.85 | \$12.90 | \$11.92 | \$11.42 | (18.8\%) |
| Change |  | (12.0\%) | (26.2\%) | (38.7\%) | (18.6\%) | (7.6\%) | (4.2\%) |  |
| PC AT | \$55.07 | \$ 62.23 | \$ 52.08 | \$43.12 | \$38.71 | \$35.25 | \$33.76 | (7.88) |
| Change |  | 13.0\% | (16.3\%) | (17.2\%) | (10.2\%) | (8.98) | (4.28) |  |
| MCA |  | \$182.84 | \$124.83 | \$98.80 | \$88.45 | \$81.40 | \$77.35 | (15.8\%) |
| Change |  |  | (31.7\%) | (20.9\%) | (10.5\%) | (8.0\%) | (5.0\%) |  |
| EISA |  |  |  | \$91.29 | \$81.20 | \$74.80 | \$70.80 | (8.1\%) |
| Change |  |  |  |  | (11.18) | (7.9\%) | (5.38) |  |
| Weighted |  |  |  |  |  |  |  |  |
| Average | \$46.13 | \$49.66 | \$ 44.09 | \$44.71 | \$43.53 | \$41.89 | \$41.38 | (1.88) |
| Change |  | 7.7\% | (11.2\%) | 1.4\% | (2.68) | (7.6\%) | (4.28) |  |
|  |  |  |  |  |  |  | Source | e: Dataquest <br> 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.

## $\overline{\text { PC Logic Chip Sets--Product Analysis }}$

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. Sof tware 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 $256 \mathrm{~KB}, 1 \mathrm{MB}$, and 4 MB 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

## PC Logic Chip Sets--Product Analysis

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

| Vendor | $\begin{gathered} \text { PC XT } \\ 8088 / 8086 \end{gathered}$ | PC XI 80286 | PC AT $80286$ | $\begin{gathered} \text { PC AT } \\ \text { B0386SX } \end{gathered}$ | PC AT 80386 | $\begin{gathered} \text { MCA } \\ 80286 \end{gathered}$ | $\begin{gathered} \text { MCA } \\ \text { 80386SX } \end{gathered}$ | $\begin{gathered} \text { MCA } \\ 80386 \\ \hline \end{gathered}$ | Other |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ACC Microelectronics | X |  | X | $\Sigma$ | X | X | X |  |  |
| Acer Labs | X |  | X |  | x |  |  |  |  |
| Chips $\&$ Technology | * | X | X | X | x | X |  | X |  |
| ERSO |  |  | $\mathbf{x}$ |  |  | X |  |  |  |
| G2 | x |  | X | X | $\mathbf{x}$ | X | x | $\mathbf{x}$ |  |
| GS Technology |  |  | x |  |  |  |  |  |  |
| Intel |  |  | X | X | X |  | X | X |  |
| Oak Technology | X |  | X | X |  |  |  |  |  |
| Texas <br> Instruments |  |  | X |  |  |  |  |  |  |
| UMC | X |  | X |  | X |  |  |  |  |
| Vadem |  |  |  |  |  |  |  |  | $\begin{aligned} & \text { PC/XT } \\ & 80 C 186 \end{aligned}$ |
| VIA Technologies |  |  | X | $\mathbf{X}$ | X |  |  |  |  |
| VLSI Technology, Inc. | X |  | X | X | X |  |  |  |  |
| Western Digital/ Faraday | x |  | X | X |  | X | X | X |  |
| zymos | X |  | X | X | X |  |  |  |  |

## PC Logic Chip Sets--Product Analysis

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

## PC Logic Chip Sets--Product Analysis

- 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 5lst 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


## $\overline{\text { PC Graphics Chip Sets--Competitive Analysis }}$

## 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 1 Estimated Low-End PC Graphics Merchant Chip Set Revenue Market Share and Rank (Millions of Dollars)

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)

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 $5 \quad$ Estimated Merchant VGA Chip Set Unit Market Share by Manufacturer
Table 3 Estimated Low-End PC Graphics Chip Set Unit Market Share by Graphics Standard Type (Thousands of Units)

## PC Graphics Chip Sets--Competitive Analysis

Figure 1
Estimated Low-End PC Graphics Merchant Chip Set Revenue Market Share by Manufacturer


1987
\$55.0 Million


1988
$\$ 108.1$ Million

0005191-1

Table 1
Estimated Low-End PC Graphics Merchant Chip Set Revenue Market Share and Rank (Millions of Dollars)

| Rank |  | Vendor |
| :---: | :---: | :---: |
| 1988 | 1987 |  |
| 1 | 2 | Westerm Digital |
| 2 | 1 | Chips and Technologies |
| 3 | 3 | Cirrus Logic |
| 4 | 4 | Tseng Labs |
| 5 | N/A | Headland Technology Other |


| 1988 |  |  | 1987 |  |  |
| ---: | ---: | ---: | ---: | ---: | ---: |
| Share | Revenue |  | Share | Revenue |  |
|  |  |  |  |  |  |
| $29.7 \%$ | 32.1 |  | $12.4 \%$ | 6.8 |  |
| 25.3 | 27.3 |  | 68.5 | 37.7 |  |
| 20.0 | 21.6 |  | 9.2 | 5.1 |  |
| 13.4 | 14.5 |  | 7.9 | 4.3 |  |
| 7.9 | 8.5 |  | N/A | N/A |  |
| 3.7 | 4.0 |  | 2.0 |  | 1.1 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| $100.0 \%$ | $\$ 108.1$ |  | $100.0 \%$ | $\$ 55.0$ |  |

N/A $=$ Not Applicable
Note: Some columns may not add to totals shown because of rounding.
Source: Dataquest
November 1989

## PC Graphics Chip Sets--Competitive Analysis

Figure 2
Estimated Low-End PC Graphics Merchant Chip Set Unit Market Share by Manufacturer



1988
4.5 Million Units

Table 2
Estimated Low-End PC Graphics Merchant Chip Set Unit Market Share and Rank (Millions of Units)

| Rank |  | Vendor | 1988 | 1987 |
| :---: | :---: | :---: | :---: | :---: |
| 1988 | 1987 |  | Share | Share |
| 1 | 2 | Western Digital | 39.88 | 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 |
|  |  | Other | 5.3 | 2.4 |
|  |  | Total | 100.0\% | 100.0\% |
|  |  | Total Units | 4.5 | 2.1 |

N/A $=$ Not Applicable

Source: Dataquest
November 1989

## PC Graphics Chip Sets--Competitive Analysis

Figure 3
Estimated Merchant CGA Chip Set
Unit Market Share by Manufacturer


Figure 4
Estimated Merchant EGA Chip Set Unit Market Share by Manufacturer


## $\overline{\text { PC Graphics Chip Sets--Competitive Analysis }}$

Figure 5
Estimated Merchant VGA Chip Set Unit Market Share by Manufacturer


1987
0.46 Million Units

0005191-5


Source: Dataquest November 1989

## PC Graphics Chip Sets--Competitive Analysis

Table 3
Estimated Low-End PC Graphics Chip Set Unit Market Share by Graphics Standard Type (Thousands of Units)

| Standard | Rank |  | Vendor | 1988 <br> Share | $1987$ <br> Share |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1988 | $\underline{1987}$ |  |  |  |
| CGA | 1 | 1 | Western Digital | 84.5\% | 100.0\% |
|  | 2 | 2 | Acer Laboratories | 11.5 | N/A |
|  |  |  | Other | 4.0 | N/A |
|  |  |  | Total | 100.0\% | 100.0\% |
|  |  |  | Total Units | 767.0 | 405.0 |
| EGA | 1 | 3 | Western Digital | 38.48 | 9.5\% |
|  | 2 | 1 | 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 | 3.9 | 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 | N/A |
|  |  |  | Total | 100.0\% | 100.0\% |
|  |  |  | Total Units | 1,946.0 | 460.0 |

N/A $=$ Not Applicable

Source: | Dataquest |
| :--- |
| November 1989 |

## $\overline{\text { PC Logic Chip Sets--Competitive Analysis }}$

## 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 2 Estimated 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 3 Estimated PC Logic Chip Set Unit Market Share and Rank by Bus Architecture

## $\overline{\text { PC Logic Chip Sets--Competitive Analysis }}$

Figure 1

## Estimated PC Logic Chip Set Revenue Market Share by Manufacturer



1987
Total Revenue $=\$ 144$ Million


## $\overline{\text { PC Logic Chip Sets--Competitive Analysis }}$

Table 1

## Estimated PC Logic Chip Set Revenue, Market Share, and Rank (Millions of Dollars)

| Rank |  | Vendor |
| :---: | :---: | :---: |
| 1988 | 1987 |  |
| 1 | 2 | Chips and Technologies |
| 2 | 3 | Acer Laboratories |
| 3 | 1 | Western Digital |
| 4 | 4 | VLSI Technology |
| 5 | N/A | G2 |
| 6 | 5 | ERSO |
| 7 | 6 | ZYMOS |
|  |  | Other |
|  |  | Total |


| 1988 |  |  | 1987 |  |
| ---: | ---: | ---: | ---: | ---: |
| Revenue | Share |  | Revenue | Share |
|  |  |  |  |  |
| $\$ 112$ | $28.1 \%$ |  | $\$ 37$ | $25.7 \%$ |
| 86 | 21.5 |  | 29 | 20.2 |
| 63 | 15.7 |  | 46 | 31.9 |
| 50 | 12.6 |  | 18 | 12.5 |
| 19 | 4.8 | N/A | 0 |  |
| 19 | 4.7 |  | 5 | 3.5 |
| 18 | 4.5 |  | 4 | 2.8 |
| 32 | 8.0 |  | 5 | 3.5 |
| $\$ 399$ | $100.0 \%$ |  | $\$ 144$ | $100.0 \%$ |

N/A $=$ Not Available

Source: Dataquest June 1989

Figure 2
Estimated PC Logic Chip Set Unit Market Share by Manufacturer


8.0 Million Units

## $\overline{\text { PC Logic Chip Sets--Competitive Analysis }}$

Table 2
Estimated PC Logic Chip Set Unit Market Share and Rank

| Unit Share Rank |  | Vendor | 1988 | 1987 |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Share | Share |
| 1 | 2 |  | Chips and Technologies | 25.28 | 19.18 |
| 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 | 0.8 |
|  |  | Total | 100.0\% | 100.08 |

$N / A=$ Not Available


Figure 3
Estimated PC Logic Chip Set Unit Market Share by Manufacturer for PC XT Bus


1987
1.8 Million Units


## $\overline{\text { PC Logic Chip Sets--Competitive Analysis }}$

Figure 4

## Estimated PC Logic Chip Set Unit Market Share by Manufacturer for PC AT Bus



1987
1.3 Million Units


1988
4.0 Million Units

# PC Logic Chip Sets--Competitive Analysis 

Figure 5
Estimated PC Logic Chip Set Unit Market Share by Manufacturer for MCA Bus


Source: Dataquest

## $\overline{\text { PC Logic Chip Sets--Competitive Analysis }}$

Table 3
Estimated PC Logic Chip Set Unit Market Share and Rank

| Bus | Unit Share Rank |  | Vendor | 1988 | 1987 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1988 | 1987 |  | Share | Share |
| PC XT | 1 | 1 | Acer Laboratories | 66.2\% | 59.7\% |
|  | 2 | 2 | Western Digital | 26.4 | 38.8 |
|  |  |  | Other | 7.4 | 1.5 |
| Total |  |  |  | 100.0\% | 100.0\% |
| PC AT | 1 | 1 | Chips and Technologies | 40.3\% | 41.38 |
|  | 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 | 7.9 | 0.1 |
| Total |  |  |  | 100.0\% | 100.0\% |
| Micro Channel | 1 |  | Western Digital | 74.18 |  |
|  | 2 |  | Intel | 25.9 |  |
| Total |  |  |  | 100.0\% |  |

$$
X
$$

# PC Graphics Chip SetsEmerging Technology and Trends: Standards 

## 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 ( $800 \times 600$ ) 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 $8514 / \mathrm{A}$-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


# PC Graphics Chip Sets- <br> Emerging Technology and Trends: Standards 

- 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 sof tware 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:


## PC Graphics Chip SetsEmerging Technology and Trends: Standards

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 $8514 / \mathrm{A}$ is IBM's $1,024 \times 768$ resolution add-on board, and is based on proprietary VLSI parts. Software writes to the $8514 / \mathrm{A}$ 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 ( $640 \times 480$ resolution, 16 colors) and the next $1,024 \times$ 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


# PC Graphics Chip Sets- <br> Emerging Technology and Trends: Standards 

- 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 of ten 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 Tl 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 Tl 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.

# PC Graphics Chip Sets- <br> Emerging Technology and Trends: Standards 

## 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 $8514 / \mathrm{A}$, 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 ever be as friendly as the Mac?

## Price

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.

# PC Graphics Chip Sets- <br> Emerging Technology and Trends: Standards 

## 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 82 C 480 offers ISA and MCA bus support (no EISA), interlaced display support to $1,600 \times 1,200$ resolution, and noninterlaced display support up to $2,360 \times 1,770$ 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 $1,280 \times 1,024$ resolution. The company will provide register-level interface specifications for sof tware 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.

# PC Graphics Chip SetsEmerging Technology and Trends: Standards 

## 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 Tl 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.

# PC Graphics Chip Sets- <br> Emerging Technology and Trends: Standards 

The Standard after Next: 3-D Graphics Driving the Technology
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.

# PC Logic Chip Sets-- <br> Emerging Technology and Trends 

## 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.

## PC Logic Chip Sets-Emerging Technology and Trends

## 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.

# PC Logic Chip Sets-- <br> Emerging Technology and Trends 

## 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.


# PC Logic Chip Sets-- <br> Emerging Technology and Trends 

## 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.

# PC Logic Chip Sets-Emerging Technology and Trends 

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.

# PC Logic Chip Sets-Emerging Technology and Trends 

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## Display Peripherals- <br> 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


## Display Peripherals- <br> 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 PeripheralsEmerging 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.

# Display PeripheralsEmerging Technology and Trends 

Table 1
Suppliers of Page Printer Control Devices

| Company | Product | Function |
| :--- | :--- | :--- |
| Advanced Micro Devices | An95C75 | N/A |
| Cirrus Logic | CL-GP340/315 | Coprocessor |
| National Semiconductor | NS32CG16 | Processor |
| Teras 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



## $\overline{\text { PC Graphics Chip Sets--Applications and User Issues }}$

## 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


## $\overline{\text { PC Logic Chip Sets--Applications and User Issues }}$

## 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 of ten 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.


## Taiwanese PC Manufacturers

| Manufacturer | Products |
| :---: | :---: |
| Acetek System Inc. <br> Room 502, Fu Hsin S. Rd. <br> Sec., 1, Taipei, 10587 <br> Taiwan | Main boards, add-on cards, peripherals |
| ```A-Dart Technology Inc. F1. 2, No. 9 Kuang Fu N. Road Taipei, Taiwan``` | Add-on cards, power supplies |
| ```Advanced Datum Info. Corp. (ADP) 15/F, 126, Section 4 Nanking East Road Taipei, Taiwan``` | Brain 16, XT-compatible terminals, monitors. add-on cards |
| Alltek Computer Co., Ltd. 3/F-1, No. 63, Lane 122 Jen-ai Road, Section 4 Taipei, Taiwan | IBM PC compatible |
| AMI Computer Mfgr. Inc. P.O. Box 99 Taipei, Taiwan | KC-2, AT compatible |
| Aquarius Systems Inc. 6F, North 394 Keelung Road Section 1 <br> P.O. Box 48-29 <br> Taipei, Taiwan | ASI-2000, AT compatible ASI-100, XT compatible ASI-500, XT compatible |
| Auto Computer Co., Ltd. 3/F-2, No. 271, Section 3 Roosevelt Road Taipei, Taiwan | Autocomputer PC, AT compatible <br> Add-on cards <br> Autocomputer XT, XI compatible |
| Bison Science Technique Co. Ltd. <br> 16, Section 1 <br> Chung Shan North Road <br> Taipei, Taiwan | Bit-Plus, XT compatible |

## Taiwanese PC Manufacturers

## Manufacturer

```
BITCOM International Co.. Ltd.
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.
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
```


## Taiwanese PC Manufacturers

| Manufacturer | Products |
| :---: | :---: |
| Dataven Enterprises Co.. Ltd. 41F, North 25, Alley 12, Lane 91 Section 1, Nei Hu Road Taipei, Taiwan | DVE-1000, XT compatible motherboards |
| Dennison Industrial Co., Ltd. 6th Floor, Fu-Hsing Commercial Building <br> 331 Fu-Hsing North Road Taipei, Taiwan | Amigo 16-M, XT-compatible peripherals, keyboards |
| Digitek Co., Ltd. <br> CANDID International Corp: <br> P.O. Box 4-4, Nankang 4 Taipei, Taiwan | XT turbo, AT, XI compatible |
| Expert Electronic Co., Ltd. <br> Floor 4th, Number 568, Kuang Fu South Road, Taipei, Taiwan R.O.C. | AT, XI main boards, add-on cards, adapters |
| ```First International Computer Inc. (FIC) 201. Tung Hwa North Road Taipei, Taiwan``` | Leo AT, XT compatible |
| Flytech Technology Co.. Ltd. P.O. Box 23-169 Taipei, Taiwan | AT, XT compatibles turbo board multiuser systems |
| Flying Triumph Co.. Ltd. Office: Room 1, 5F, Number 145 Section 1, Keelung Road Taipei, Taiwan | XI compatible add-on card Apple II, IIe cards Fox-16XI, XI compatible |
| Fullink Enterprise Co., Ltd. 5/Floor, Number 145, Section 1 Chung Shan North Road Taipei, Taiwan | AT, XT add-on cards |

## Taiwanese PC Manufacturers



## Manufacturer

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 I, 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 XI, XI compatible
Xetac AT, AT compatible
Xetac IIe, IIe compatible

PC, XI, AT compatibles Add-on cards

AT, XT cards

Dynamic PC, XI, XI compatible Shuttle PC, XI, XI compatible Geniskhan, AT compatible Prince, Jr. compatible Portcom, XT compatible Add-on cards, keyboards AT, XI compatible

## $\overline{\text { Taiwanese PC Manufacturers }}$

| Manufacturex | Products |
| :---: | :---: |
| Joytech Computer Co., Ltd. 10/Floor, North 86 | Excel-Turbo, XT compatible, add-on cards |
| Fuhsing North Road |  |
| Taipei, Taiwan |  |
| K.S. Brotherbox Co.. Led. | AT, XT portable compatible |
| P.O. Box 32-62 |  |
| Taipei, Taiwan |  |
| Kun Ying Enterprise Co., Ltd. | SU-640C, PC, XT compatible |
| Room 1311, North 41, Section 1 | SU-101E, Apple IIe compatible |
| Chung Hsiao West Road | KY-640C, AT compatible |
| Taipei, Taiwan |  |
| Long Redart Co.. Ltd. | PC, AT enhanced, AT compatible |
| P.O. Box 68 | PC, XI enhanced, XI compatible |
| 1257 Taipei, Taiwan | Apple IIe motherboard |
| Lyi-Cheng Enterprise Co., Ltd. | Minta MT-320, AT compatible |
| P.0. Box 78-105 |  |
| Taipei, Taiwan |  |
| Mitac Inc. | Portable Viso, PC compatible |
| 9F1, Number 585 | Mitac 286, AT compatible |
| Ming-Sheng E. Road | MPC-160, XT compatible |
| Taipei, Taiwan | Add-on boards |
| Modern Computer Corp. | PTC-900, AT, XT compatible |
| 41F, North 8, Section 1 | AT-2000, AT compatible |
| Kien Kwo S. Road | Add-on cards |
| Taipei, Taiwan |  |
| Monterey International Corp. | Stafi-2 AT, AT compatible |
| Office: 5/F, Number 40 | XI compatible |
| Deh Hwei Street |  |
| Taipei, Taiwan |  |

## Taiwanese PC Manufacturers

| Manufacturer | Products |
| :---: | :---: |
| Mortec Electronic Ind., Co. Ltd. 2nd Floor, North 10, Lane 575 <br> Tun Hwa South Road <br> Taipei, Taiwan | Tech-5000, XI compatible Tech-1. Apple II compatible Main boards, add-on cards |
| Multitech <br> 15th Floor, 135 Chien-Ku N. Road Section 2, Taipei 10479 Taiwan | Popular 500, PC compatible Plus 700, XT compatible Advance 900, AT compatible |
| Nippon Binary K.R. | COPAM PC-501AT, AT compatible |
| Northern International Inc. Office: 6/F,-5, Number 333 Fu Hsing N. Road Taipei, Taiwan | PC, XT, AT add-on boards |
| ```PGC Shiten Enterprise Co.. Ltd. Room 7, 8th Floor Number 100 Roosevelt Road Section 3 Taipei, Taiwan``` | IP-640, XT compatible Add-on cards, XT, AT |
| ```Peripherals Enterprise Co., Ltd. 7th Floor, Number 349 Min Sheng East Road Taipei, Taiwan``` | AT, XI add-on cards |
| Plus \& Plus Co.. Ltd. <br> 2/F, Number 126 Roosevelt Road <br> Section 3 <br> Taipei, Taiwan | ARC turbo, PC, XT compatible |
| ```POFA Technology Corp. P.O. Box 43-442 432, Keelung Road, Sec. 1, Rm. 703 Taipei, Taiwan``` | Model P, PC compatible <br> Model P+, XT compatible |

## Taiwanese PC Manufacturers

## Manufacturex

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 Neinu 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 Manking E. Road, Section 4 Taipei, Taiwan

Taiwan Hwan Hong Enterprise Co. 6th Floor, Number 163 Han-Sheng East Road Panchiao, Taipei Hsein Taivan

## Products

51-8000 PC AT compatible add-on boards

AT, XT compatible add-on cards, peripherals

Add-on cards, XI 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

TH316XI-M, XT compatible Add-on cards, modems, drives AT compatible
Apple IIe compatible

## Taiwanese PC Manufacturers

Manufacturer
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, TaiwanP.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
Factory: 5th Floor, Number 3
Lane 521, Chung Cheng Road
23138 Hsin Tein
Taipei, Taiwan
Number 16, Lane 134, Section 2
Chung Hsiao East Road
Taipei, TaiwanTaipei, Taiwan
Trun Sole Enterprise Co., Ltd.

AT, XT-compatible boards
Unitron Inc.

## U-2900T, XI compatible

Wugo Co., Ltd.

Phoenix PC II, XT compatible
Winfortune Enterprise Co.. Ltd. 3/F-3, Number 125, Section 3

## Products

Cleveland 186, XI compatible

TCS-7000, AT compatible monitors, terminals
Add-on cards, keyboards,cases, storage

U-3900, AT compatible Add-on cards

## Taiwanese PC Manufacturers

Manufacturer<br>Yih Lung Enterprise Co.. Ltd. Number 112, Chungking N. Road Section 4 Taipei, Taiwan<br>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
```


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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 decline beginning in 1990, and the CAGR for 1989 through 1993 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.

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X
$$


[^0]:    0004353-1

[^1]:    *Revised Data

[^2]:    Source: DATAQUEST
    April 1986

[^3]:    *Based on units shipped

[^4]:     survey resrits. Additionaliy, because of the receipt of new informatign, 1908 mumbert heve been reatated for many Japonese companies.
    ${ }^{1}$ Sharp SM-Series tocesied in 1985.
    NA $=$ Not avaistable
    Source: Dataquest (June 1990)

[^5]:    $\mathbf{S} \oplus$ Sampled
    Source: Dataquest (June 1990)

[^6]:     mated production of the 8061 basd on prodection of Ford antomobiles and trachs. (No atbompt to entimily peoduction prior to 1987 han been ande.) Source: Detugert (Jume 1990)

[^7]:    Source: Dataquest (September 1990)

[^8]:    Sonfot: Deraquan (Soppember 1990)

[^9]:    Source: Dataquest (September 1990)

[^10]:    Source: Dataquest (September 1990)

[^11]:    *Mergers/Acquisitions:

    1. Harris acquired GE Solid State and RCA, 1988.
    **Dataquest estimate for companies not sampled (i.e., Ricoh, Sanyo, Sony)
[^12]:    Source: Dataquest October 1988

[^13]:    0003950-5

