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.
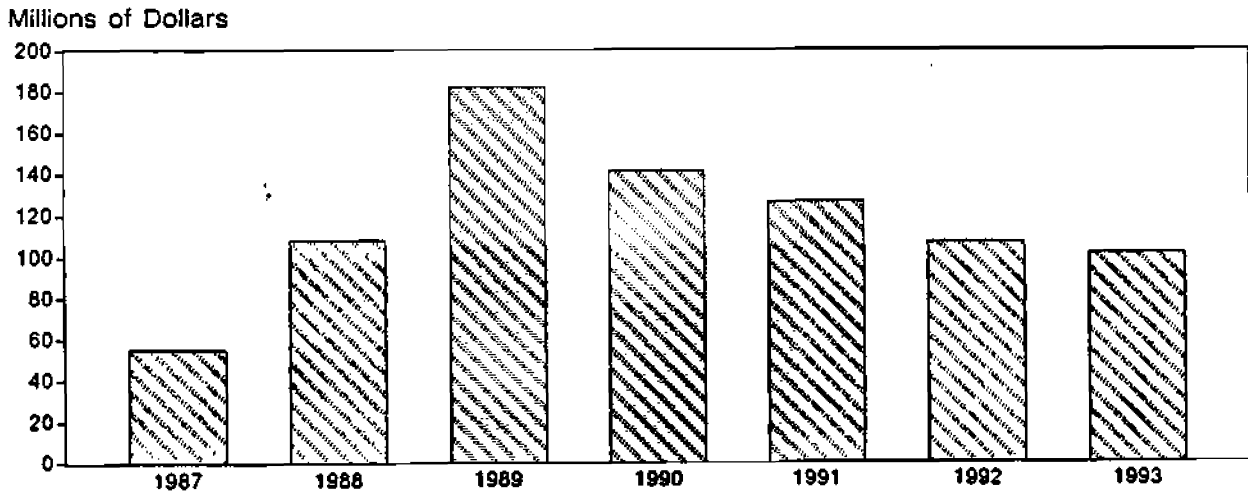
Worldwide Merchant Low-End PC Graphics Chip Set Forecast

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
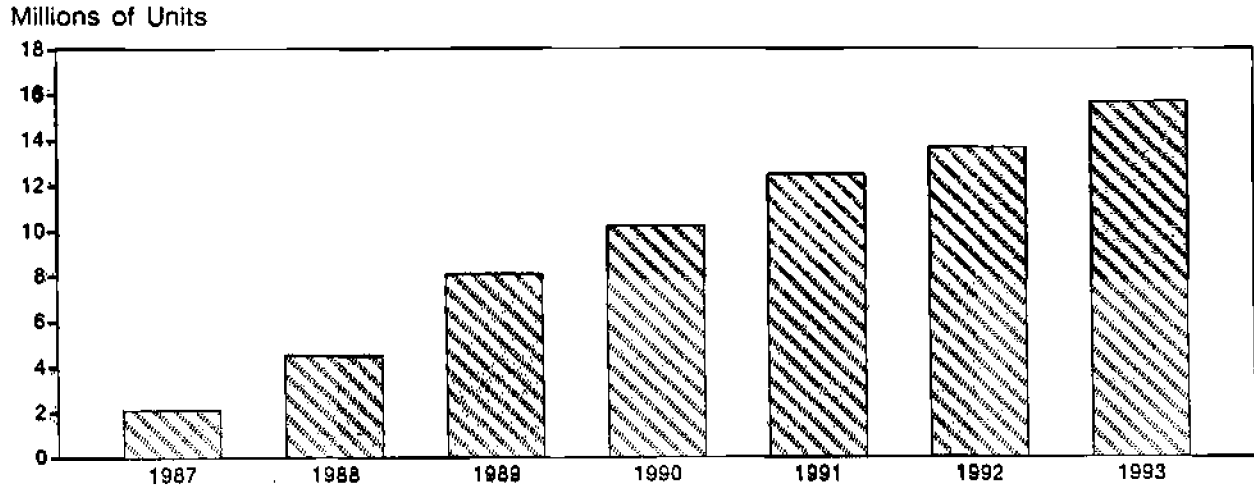Estimated Worldwide History and Forecast
(Revenue)**

Millions of Dollars

0005187-1

Source: Dataquest
November 1989

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Figure 2

**Total Low-End Merchant PC Graphics Chip Sets
Estimated Worldwide History and Forecast
(Units)**

Millions of Units

0005187-2

PC Graphics Chip Sets—Forecast

Table 1

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

	1987	1988	1989	1990	1991	1992	1993	1987-1993 CAGR	1989-1993 CAGR
Total DOS PC Shipments	9.6	12.3	13.8	15.4	17.1	18.7	20.6	13.6%	10.5%
Growth Rate		28.1%	12.2%	11.6%	11.0%	9.4%	10.2%		
Total Low-End Graphics Devices	9.2	11.1	13.7	14.3	15.8	16.4	18.3	12.1%	7.5%
Growth Rate		20.5%	23.2%	4.6%	10.8%	3.8%	11.1%		
Low-End Graphics Chip Sets	4.3	7.5	11.8	13.0	15.0	16.1	18.2	27.2%	11.5%
Saturation	46.7%	67.9%	86.0%	91.0%	95.0%	98.0%	99.6%		
Merchant Graphics Chip Sets	2.1	4.5	8.1	10.2	12.5	13.7	15.7	39.8%	18.0%
Growth Rate		114.7%	79.3%	25.1%	22.7%	9.9%	14.9%		
Merchant Graphics Chip Set ASP	$26.1	$ 23.9	$ 22.4	$ 13.9	$ 10.2	$ 7.8	$ 6.5	(20.8%)	(26.8%)
Growth Rate		(8.6%)	(6.0%)	(38.0%)	(27.0%)	(23.3%)	(17.2%)		
Merchant Graphics Chip Set Revenue (Millions of Dollars)	$55.0	$108.1	$182.1	$141.3	$ 126.6	$106.7	$101.5	10.7%	(13.6%)
Growth Rate		96.3%	68.5%	(22.4%)	(10.4%)	(15.7%)	(4.9%)		

Source: Dataquest
November 1989

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PC Graphics Chip Sets--Forecast

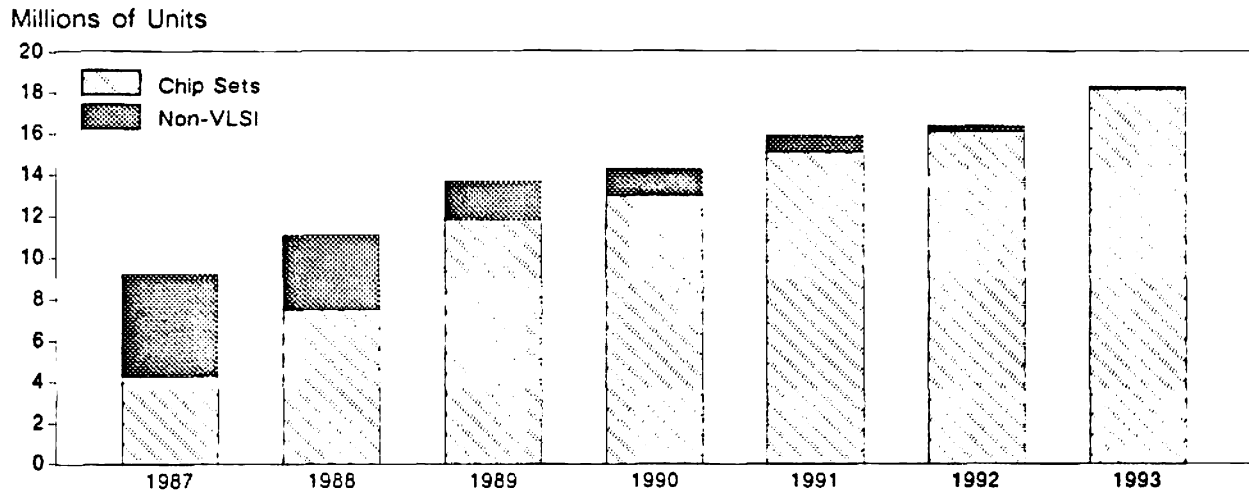**Total Low-End Graphics Forecast by Implementation**

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.

Figure 3

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

Millions of Units
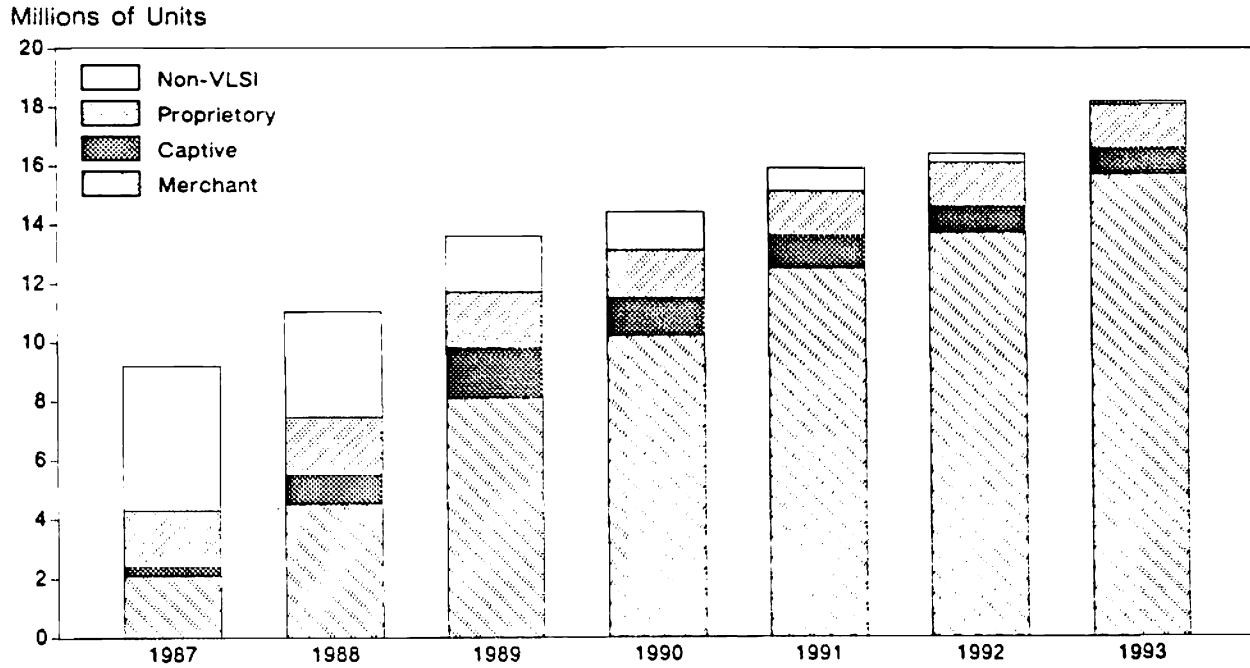

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PC Graphics Chip Sets—Forecast

Figure 4

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

Millions of Units

0005187-4

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Table 2

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

	1987	1988	1989	1990	1991	1992	1993	1987-1993 CAGR
Total Chip Set Implementations	4,301.1	7,541.3	11,756.2	13,013.0	15,048.0	16,111.2	18,177.8	27.2%
Percent of Total	46.7%	67.9%	86.0%	91.0%	95.0%	98.0%	99.6%	
Merchant Chip Sets	2,107.5	4,524.8	8,111.8	10,150.1	12,457.5	13,694.5	15,730.2	39.8%
Growth Rate		114.7%	79.3%	25.1%	22.7%	9.9%	14.9%	
Captive Chip Sets	344.1	1,070.9	1,704.6	1,301.3	1,098.5	934.4	908.9	17.6%
Growth Rate		211.2%	59.2%	(23.7%)	(15.6%)	(14.9%)	(2.7%)	
Proprietary Chip Sets	1,849.5	1,945.7	1,916.3	1,561.6	1,489.8	1,482.2	1,543.3	(3.0%)
Growth Rate		5.2%	(1.5%)	(18.5%)	(4.6%)	(0.5%)	4.1%	
Non-VLSI Implementations	4,908.9	3,558.7	1,913.8	1,287.0	792.0	328.8	82.2	(49.4%)
Percent of Total	53.3%	32.1%	14.0%	9.0%	5.0%	2.0%	0.4%	
Total Low-End Graphics Solutions	9,210.0	11,100.0	13,670.0	14,300.0	1,5840.0	16,440.0	18,260.0	12.1%
Growth Rate		20.5%	23.2%	4.6%	10.8%	3.8%	11.1%	

Source: Dataquest
November 1989

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.

- 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
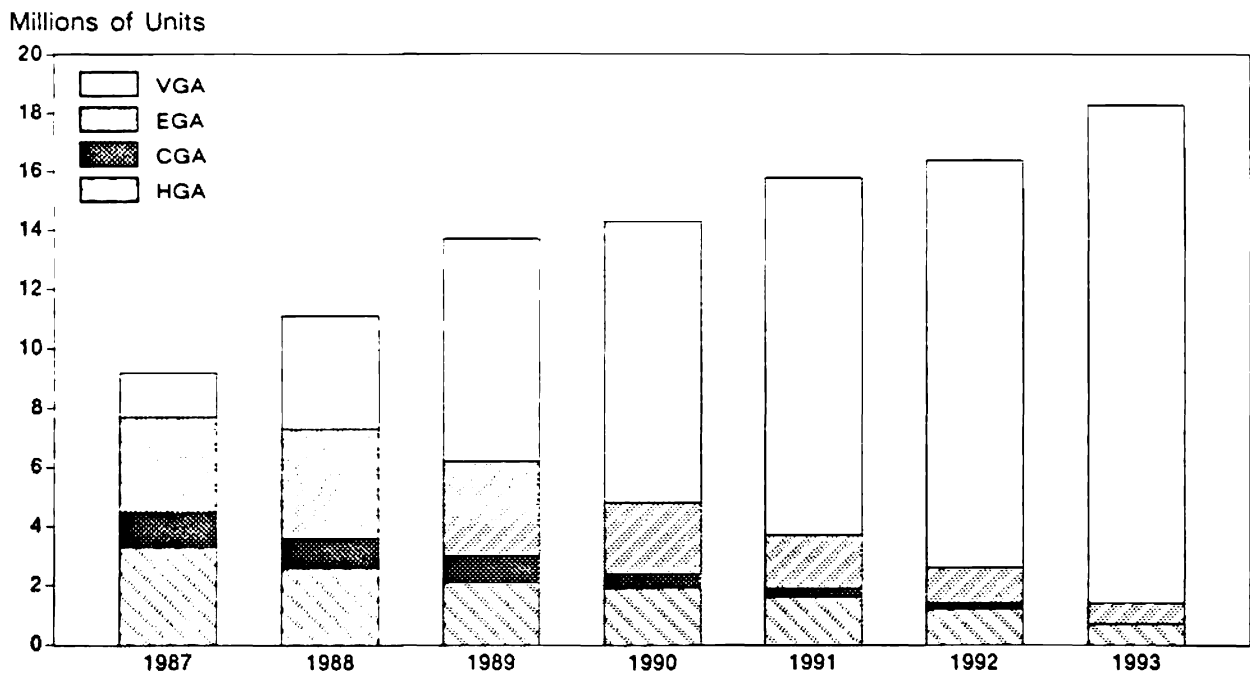
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Source: Dataquest
November 1989

Table 3

Total Low–End PC Graphics Solutions by Standard Type
Estimated Worldwide History and Forecast
(Thousands of Units)

	1987	1988	1989	1990	1991	1992	1993	1987-1993 CAGR
HGA	3,300.0	2,600.0	2,100.0	1,950.0	1,600.0	1,200.0	700.0	(22.8%)
CGA	1,200.0	1,050.0	900.0	450.0	300.0	200.0	0	(25.8%)
EGA	3,200.0	3,650.0	3,200.0	2,400.0	1,800.0	1,200.0	700.0	(22.4%)
VGA	1,510.0	3,800.0	7,470.0	9,500.0	12,140.0	13,840.0	16,860.0	49.5%
Total	9,210.0	11,100.0	13,670.0	14,300.0	15,840.0	16,440.0	18,260.0	12.1%

Source: Dataquest
November 1989

## Low–End Graphics Forecast by Implementation within Standard Type

The Dataquest forecasts by implementation for HGA are presented in Figure 6 and Table 4; for CGA, in Figure 7 and Table 5; for EGA, in Figure 8 and Table 6; and for VGA, in Figure 9 and Table 7. Points worth noting include the following:

- In general, all standards will be implemented increasingly as merchant chip sets as the graphics function is implemented on the motherboard.

- Captive chip sets will begin to consist of motherboard products rather than graphics add–in boards sold by chip set manufacturers. Only a few add–in board makers are currently also in the business of manufacturing motherboards. Becoming a motherboard manufacturer in order to sell graphics chip sets is probably not an option for current add–in board manufacturers. It is not even clear yet that there is any advantage to being a chip set and motherboard manufacturer.

- Proprietary chip sets consist mainly of the IBM PS/2 VGA products. Add–in board manufacturers that are currently using a proprietary chip set will be forced either to sell the chip set to the merchant market as their board business declines or to try to compete as a low–end niche or specialized high–end ugrade vendor.

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Figure 6

Total HGA Implementations
Estimated Worldwide History and Forecast

Millions of Units
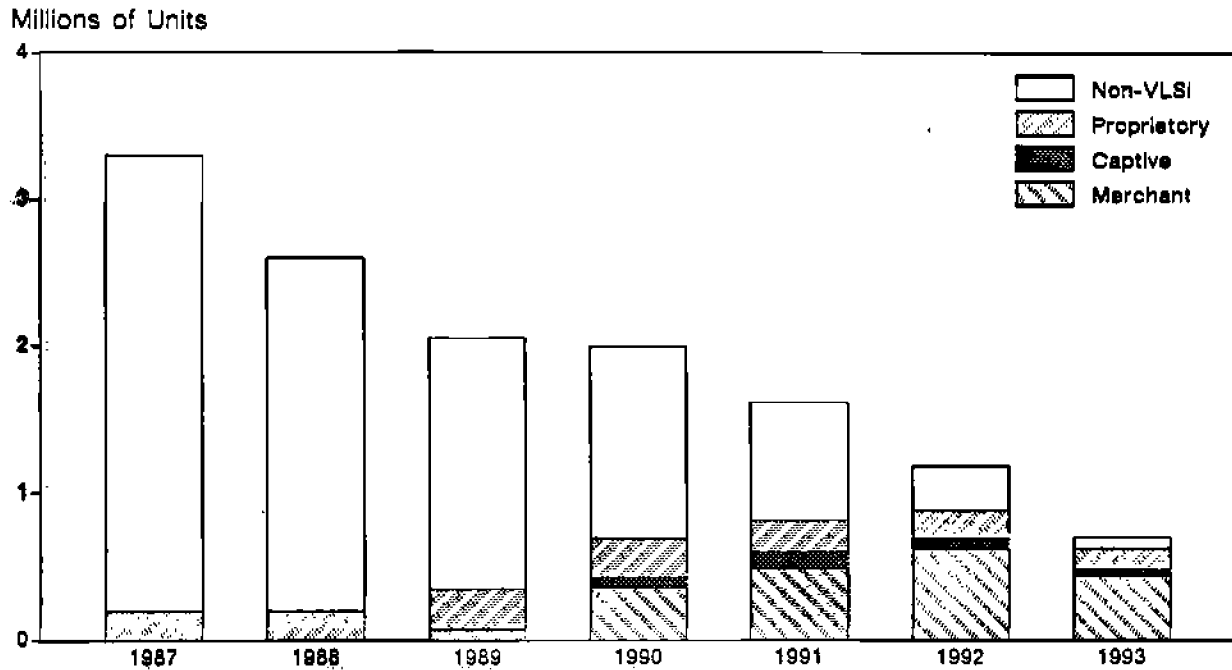
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Source: Dataquest
November 1989

Table 4

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

	1987	1988	1989	1990	1991	1992	1993	1987-1993 CAGR
Merchant	0	0	73.5	359.6	489.4	620.4	441.0	34.8%
Captive	0	0	10.5	66.3	107.2	66.0	42.0	26.0%
Proprietary	198.0	197.6	273.0	262.1	208.0	186.0	140.0	(5.6%)
Discrete	3,102.0	2,402.4	1,743.0	1,262.0	795.4	327.6	77.0	(46.0%)
Total	3,300.0	2,600.0	2,100.0	1,950.0	1,600.0	1,200.0	700.0	(22.8%)

Source: Dataquest
November 1989

Figure 7

Total CGA Implementations
Estimated Worldwide History and Forecast

Millions of Units

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Source: Dataquest
November 1989

Table 5

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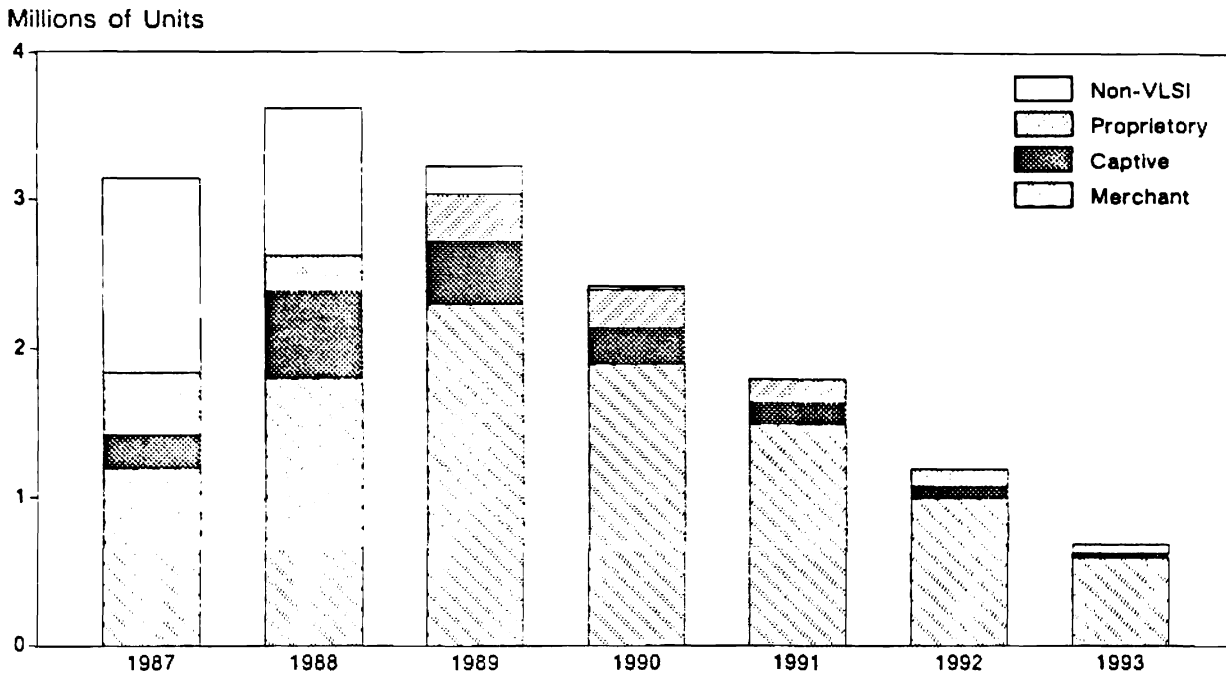### Estimated Worldwide History and Forecast
(Thousands of Units)

	1987	1988	1989	1990	1991	1992	1993	1987-1993 CAGR
Merchant	405.6	766.5	783.0	414.0	276.0	180.0	0	(15.0%)
Captive	120.0	42.0	63.0	36.0	24.0	20.0	0	(30.1%)
Proprietary	192.0	105.0	54.0	0	0	0	0	
Discrete	482.4	136.5	0	0	0	0	0	
Total	1,200.0	1,050.0	900.0	450.0	300.0	200.0	0	(30.1%)

Source: Dataquest
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Figure 8

Total EGA Implementations
Estimated Worldwide History and Forecast

Millions of Units

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Table 6

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

	1987	1988	1989	1990	1991	1992	1993	1987-1993 CAGR
Merchant	1,241.6	1,811.5	2,269.1	1,872.0	1,494.0	1,006.0	606.0	(11.3%)
Captive	217.0	580.4	416.0	240.0	144.0	75.1	34.8	(26.3%)
Proprietary	417.6	237.3	320.0	264.0	162.0	118.9	59.2	(27.8%)
Discrete	1,323.8	1,020.9	194.9	24.0	0	0	0	
Total	3,200.0	3,650.0	3,200.0	2,400.0	1,800.0	1,200.0	700.0	(22.4%)

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Figure 9

Total VGA Implementations
Estimated Worldwide History and Forecast

Millions of Units

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Source: Dataquest
November 1989

Table 7

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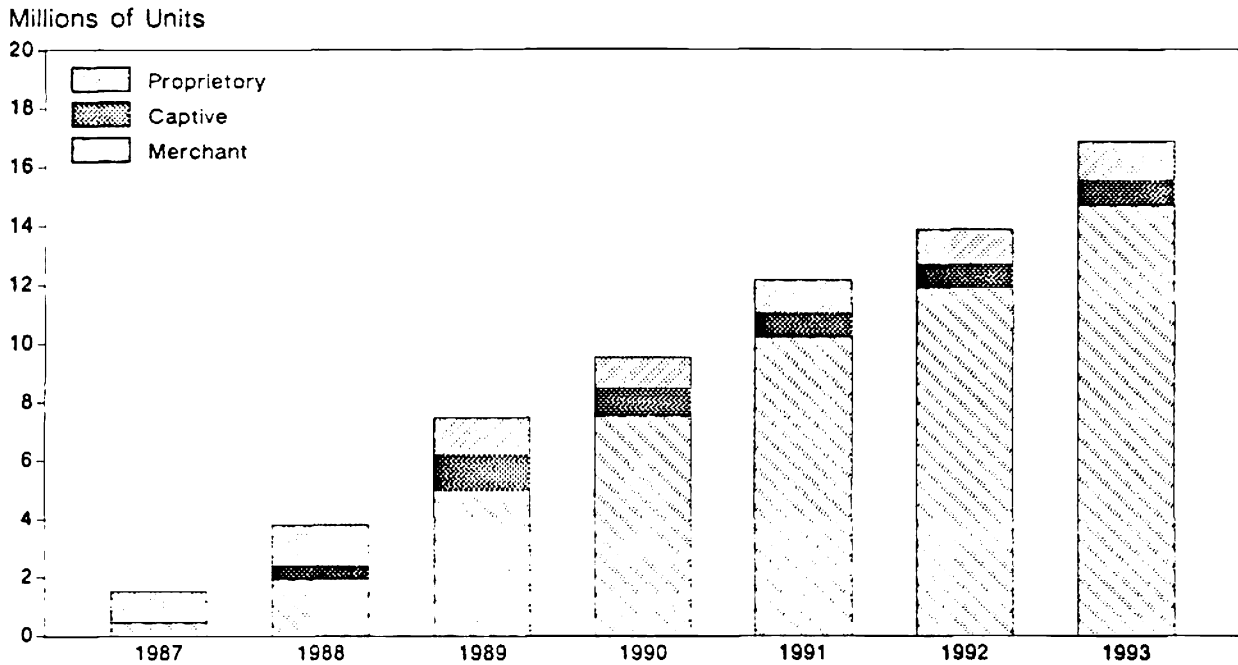### (Thousands of Units)

	1987	1988	1989	1990	1991	1992	1993	1987-1993 CAGR
Merchant	460.1	1,946.0	4,985.5	7,505.0	10,197.6	11,888.6	14,683.4	78.1%
Captive	7.6	448.4	1,214.6	959.5	823.1	773.7	832.0	119.0%
Proprietary	1,042.4	1,405.6	1,269.9	1,035.5	1,119.3	1,177.8	1,344.6	4.3%
Discrete	0	0	0	0	0	0	0	
Total	1,510.0	3,800.0	7,470.0	9,500.0	12,140.0	13,840.0	16,860.0	49.5%

Source: Dataquest
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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/A is expected to be the dominant standard for mainstream high-end PC applications.

- Several chip set vendors have announced plans to introduce 8514/A-compatible chip sets. One vendor has announced a product that will be a combination VGA and 8514/A chip that can be implemented on the motherboard. This opens the possibility for a shift from a board-level market to a chip market in the high end, as is occurring in the low-end market. Dataquest believes that this shift may become significant in the 1992 time frame, but no attempt has been made to forecast high-end chip level prices. Current 8514/A-compatible chip sets are selling in the range of $89 to $149.

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Figure 10

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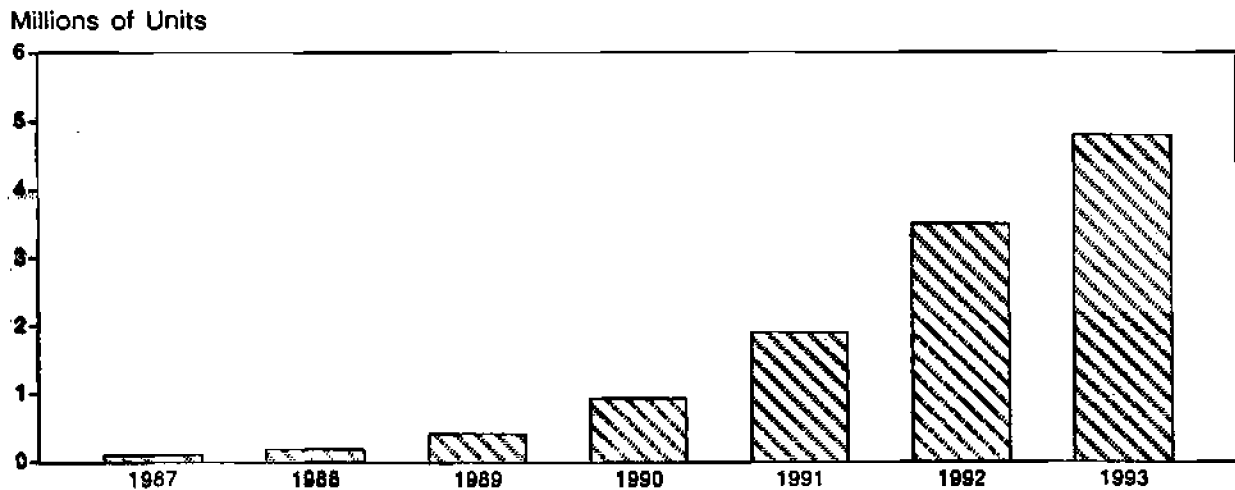Estimated Worldwide History and Forecast
(Revenue)**

Millions of Dollars
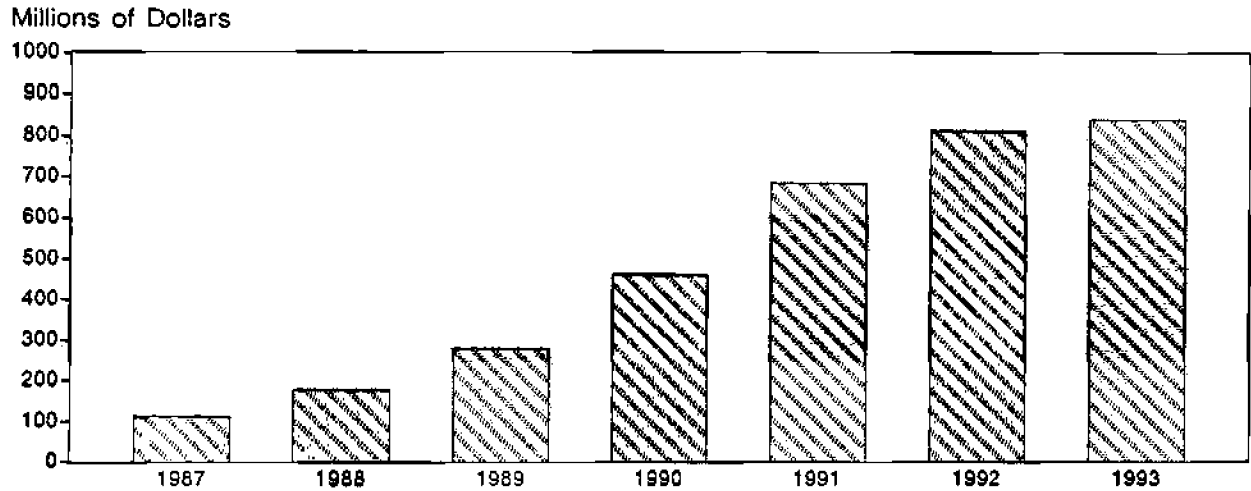
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Source: Dataquest
November 1989

Figure 11

**High-End PC Graphics—All Applications
Estimated Worldwide History and Forecast
(Units)**

Millions of Units

0005187-11

Source: Dataquest
November 1989

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Table 8

High–End PC Graphics—All Applications
Estimated Worldwide History and Forecast

	1987	1988	1989	1990	1991	1992	1993	1987-1993 CAGR
Shipments (K Units)	111.0	194.9	410.3	933.0	1,912.9	3,499.7	4,802.2	87.4%
ASP	$1,018	$ 905	$ 679	$ 492	$ 357	$ 232	$ 175	(25.4%)
Revenue (Millions of $)	$113.0	$176.4	$278.6	$459.0	$ 682.9	$ 811.9	$ 840.4	39.7%
Growth Rate		56.1%	57.9%	64.8%	48.8%	18.9%	3.5%	

Source: Dataquest
November 1989

Figure 12

High–End PC Graphics—IBM 8514/A and Compatibles
Estimated Worldwide History and Forecast
(Revenue)

Millions of Dollars
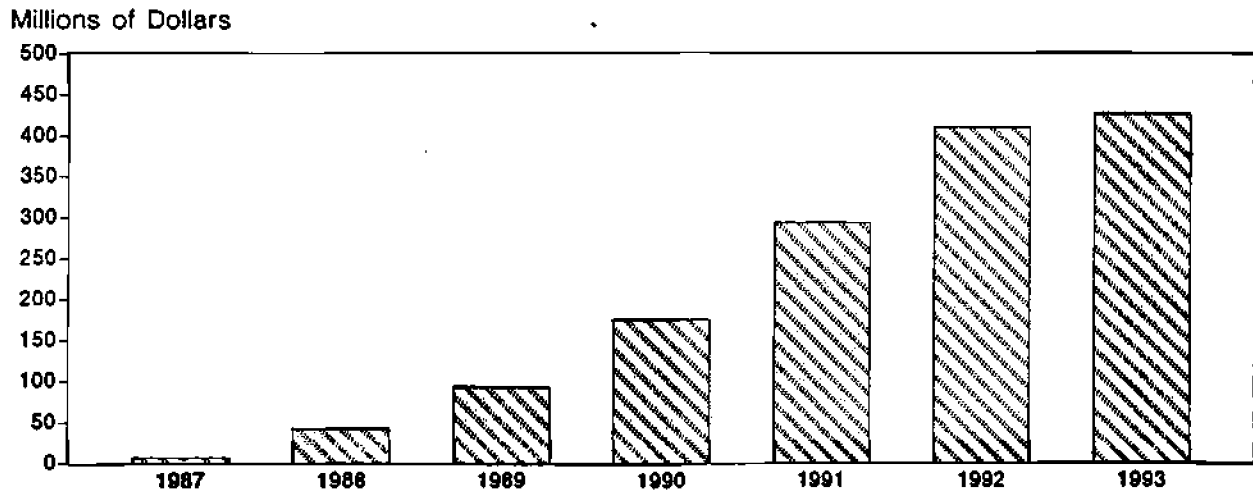
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Source: Dataquest
November 1989

Figure 13

**High-End PC Graphics—IBM 8514/A and Compatibles
Estimated Worldwide History and Forecast
(Units)**
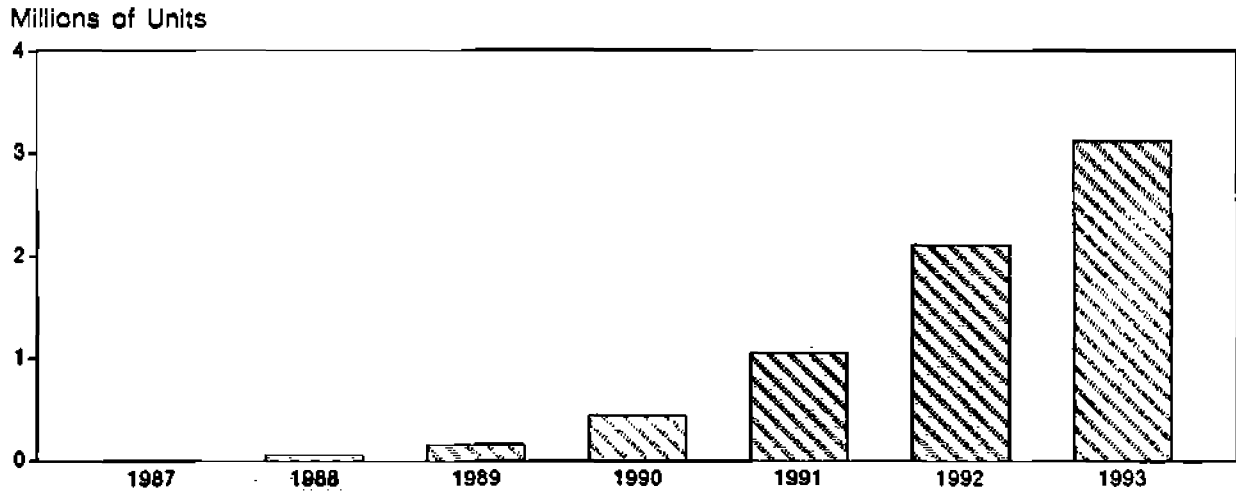
Millions of Units

0005187-13

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 CAGR
Shipments (K Units)	9.0	60.0	164.1	438.5	1,052.1	2,099.8	3,121.4	165.1%
ASP	$839	$713	$570	$399	$279	$196	$137	(26.1%)
Revenue (Millions of $)	$7.6	$42.8	$93.5	$175.0	$293.5	$411.6	$427.6	96.0%
Growth Rate		466.5%	118.6%	87.1%	67.8%	40.2%	3.9%	

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