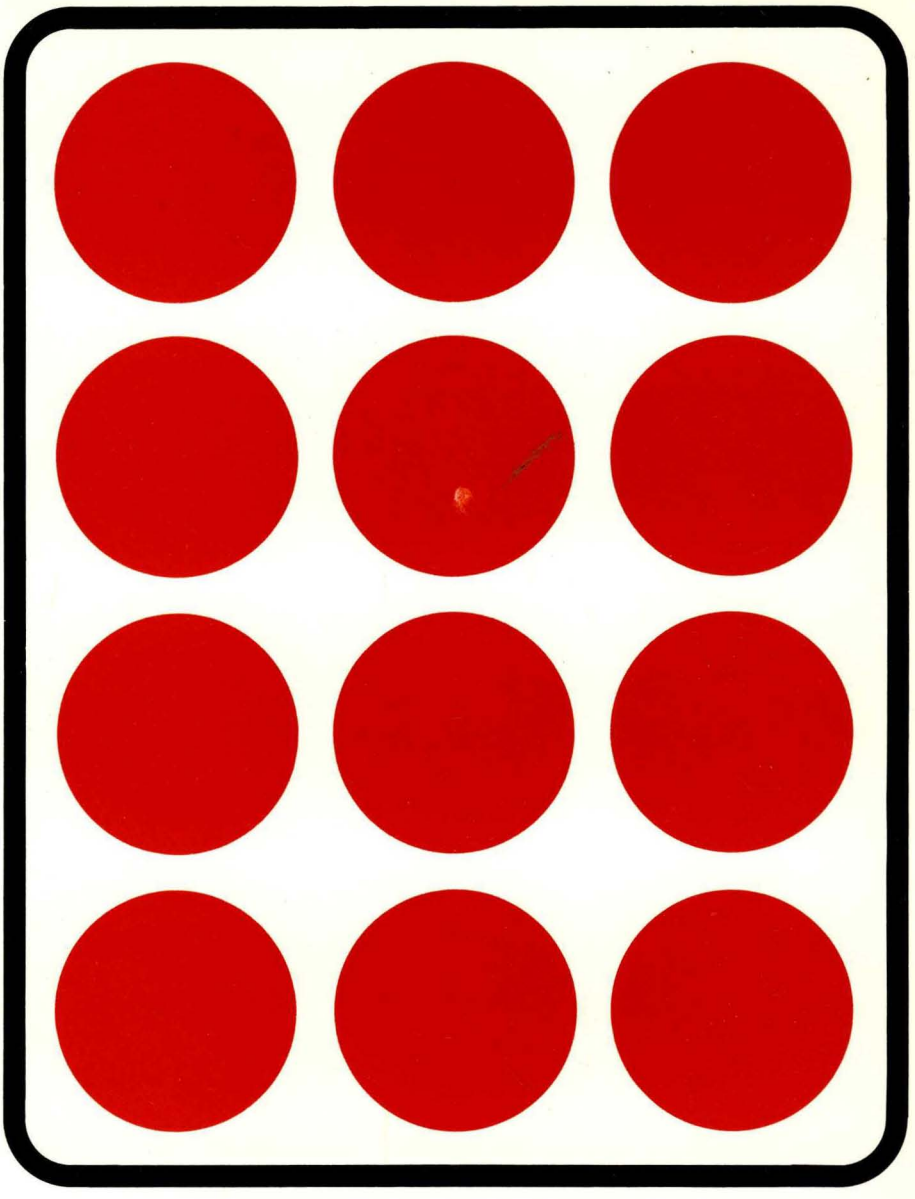
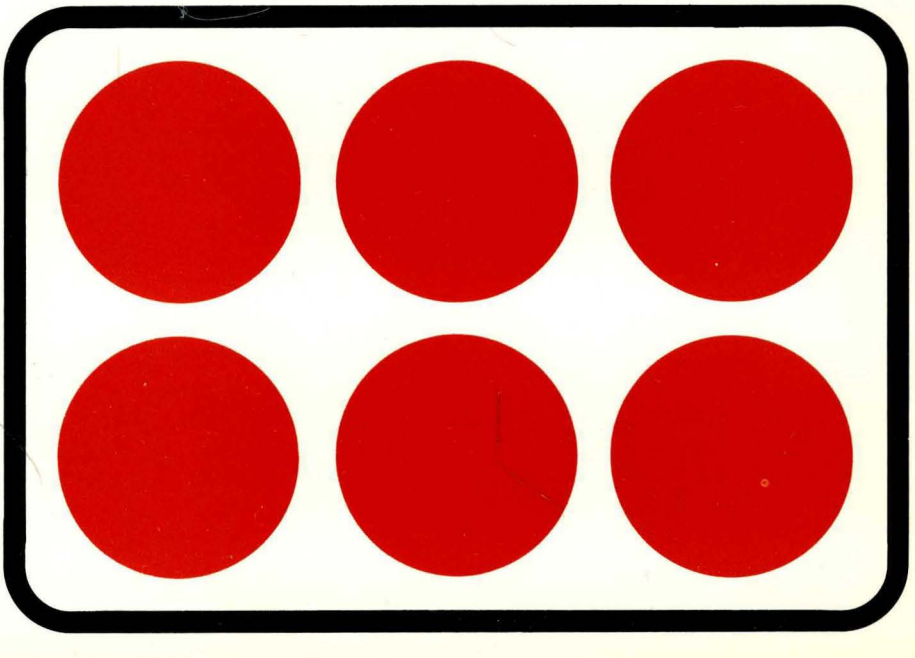


1986 DISK/TREND® REPORT



FLEXIBLE DISK DRIVES

1986 DISK/TREND® REPORT

FLEXIBLE DISK DRIVES

November, 1986

DISK/TREND, Inc.
5150 El Camino Real, Suite B-20
Los Altos, California 94022

Telephone: 415/961-6209
Facsimile: 415/969-2560
Telex: 171914

FOREWORD

1985 was the first year in which shipments of flexible disk drives didn't experience excellent growth. In fact, shipments and revenues declined -- a symptom of the broad slowdown affecting much of the computer industry.

But a 25% boost in floppy drive shipments is underway in 1986, and those manufacturers in a position to ship the newer configurations in quantity are enjoying revenue increases. However, it is doubtful that many of the leading floppy drive producers, now mostly Japanese companies, will find profit in 1986's sales surge, given the changes which have occured in the dollar/yen exchange rate. Fortunately, the computer industry is populated with optimists, so most of these firms are redoubling their cost reduction efforts and praying for a strong dollar.

The DISK/TREND Report is now ten years old, and has grown to three volumes, including the first report on optical disk drives, which was published in July. A separate report on rigid disk drives was published in October.

We are always willing to help you at any time by providing additional information on the industry which we may have available. And, as always, we welcome and appreciate your suggestions for improvements in the DISK/TREND Report.

James N. Porter

Robert H. Katzive

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INTRODUCTION

Some improvements in DISK/TREND Report data organization

Regular users tell us that it makes the DISK/TREND Report much easier to use when we keep the format as consistent as possible from year to year, so we make every effort to do so. However, we do try to improve clarity of the information presented, and to add new material whenever it is appropriate. Here are the changes in this report for 1986:

* The data on drive applications has been reorganized into new groups, in recognition of continuing changes in the industry, and the same groups are now used in this report on flexible disk drives and the separate DISK/TREND Report on rigid disk drives. In addition to the consolidated application table in the summary section of the report, separate application tables have been added for each product group, showing worldwide unit shipments broken down into seven categories, with estimates for 1985 and projections for 1989.

* As a convenience to readers, year-to-year growth rates, expressed as percentage change notations, have been added to the disk diameter breakdown tables in the microfloppy drive section, the track density and drive height analysis tables in the other product sections, as well as to Table 2 in the summary section.

Same time next year, but...

We do not revise the main groups into which data for this report is organized very frequently, recognizing that many DISK/TREND users employ the same groups in their internal plans, but we have concluded that next year will be one of those occasions. Here are tentative changes planned for the 1987 DISK/TREND Report on flexible disk drives:

* Both of the existing 8 inch floppy drive groups for one side and two sided drives will be combined, due to declining shipment levels.

* The section on special flexible disk drives will be changed into two separate sections on (1) high end flexible disk drives over 5 megabytes, which will also include several high end drives now covered in the 5.25 inch, two sided drive section, and (2) spiral track flexible disk drives.

SUMMARY

Industry size

In 1985, worldwide flexible disk drive revenues declined 21.9% and unit shipments were down 8.7%. These declines were caused mostly by weak markets for personal computers, the largest application for floppy drives, combined with difficult conditions throughout the computer industry. Revenues were also impacted by an intense fight for market share during the first half of 1985 by many new Japanese drive manufacturers.

Growth in unit shipments has resumed in 1986, fueled by renewed growth in the personal computer market, which is expected to continue, but at more modest levels than previously. The 25.8% increase in worldwide unit shipments expected in 1986 will bring the total for the year to 21,757,100 floppy drives of all types, a new record for the industry. Average annual increases of 9% are expected during 1987-89, boosting the 1989 total to over 28 million drives.

However, total revenues for all types of floppy drives are expected to remain basically flat through 1989. The forecasted revenue increases generated by microfloppy drives, the flexible disk drive industry's major growth product, will just barely offset the revenue declines for older product configurations.

As expected, participation in floppy drive manufacturing by U.S. manufacturers has dropped sharply, with only 14.6% of 1986 worldwide revenues generated by U.S. companies. IBM, Digital Equipment, Tandon and Iomega are currently the main revenue producers, but some of their captive programs will soon be phased out.

TABLE 1

CONSOLIDATED WORLDWIDE REVENUES

ALL EXISTING FLEXIBLE DISK DRIVE GROUPS

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1985		Forecast							
	Revenues		1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	209.9	311.3	80.5	122.1	33.8	51.2	--	--	--	--
Other U.S. Captive	149.3	192.3	75.1	93.4	54.8	66.9	25.5	31.9	8.8	11.6
TOTAL U.S. CAPTIVE	359.2	503.6	155.6	215.5	88.6	118.1	25.5	31.9	8.8	11.6
PCM	85.5	87.7	77.0	83.5	52.1	57.6	50.7	56.4	61.9	72.8
OEM	175.2	195.1	70.2	86.6	116.0	133.4	152.7	176.8	177.1	213.6
TOTAL U.S. NON-CAPTIVE	260.7	282.8	147.2	170.1	168.1	191.0	203.4	233.2	239.0	286.4
TOTAL U.S. REVENUES	619.9	786.4	302.8	385.6	256.7	309.1	228.9	265.1	247.8	298.0
Non-U.S. Manufacturers										
Captive	112.6	905.0	56.3	818.9	83.0	858.4	105.1	868.7	120.1	797.1
OEM	412.7	962.7	609.0	1,400.3	700.3	1,569.0	766.2	1,631.4	812.3	1,643.0
TOTAL NON-U.S. REVENUES	525.3	1,867.7	665.3	2,219.2	783.3	2,427.4	871.3	2,500.1	932.4	2,440.1
Worldwide Recap										
TOTAL WORLDWIDE REVENUES	1,145.2	2,654.1	968.1	2,604.8	1,040.0	2,736.5	1,100.2	2,765.2	1,180.2	2,738.1

Marketing channels

Despite the elimination of six flexible disk drive manufacturers listed in last year's DISK/TREND Report, the total has increased by ten this year, up to 63 organizations.

13 of the new names this year represent companies not previously listed from Korea, Hong Kong, Taiwan and Brazil -- all are actual manufacturers of floppy drives, but most are still shipping at modest levels. There are still 12 U.S. companies listed, but a few of those are expected to depart soon. At the peak of U.S. floppy drive manufacturing activity in 1981, 26 firms were listed. 41 Asian companies are now included, 25 from Japan.

The phase-out of captive floppy drive production by IBM and certain other U.S. manufacturers has shifted the majority of worldwide revenues to OEM drives. U.S. captive revenues are forecasted to drop from 25.1% of the worldwide total for all floppy drives in 1984 to a mere .4% in 1989. Worldwide revenues from OEM drives are forecasted at 67.8% of the total for 1989.

Many system manufacturers which might previously have made their own floppy drives now prefer to buy OEM drives at low prices and avoid the product development scramble to keep up with the continuing parade of new drive configurations. Most of this business will go to non-U.S. manufacturers of OEM drives, whose share of worldwide floppy drive revenues will climb from 1984's 29.3% to 1989's 60%. It should be noted that the increase in unit shipments will be much greater than is reflected by these numbers, given the movement from older captive drives sold at end user price levels to newer OEM drives sold at continually declining prices.

TABLE 2

CONSOLIDATED WORLDWIDE REVENUES
ALL EXISTING FLEXIBLE DISK DRIVE GROUPS

MARKET CLASS REVIEW
REVENUE SUMMARY

WORLDWIDE REVENUES BY MANUFACTURER TYPE	1985 Revenues $M	1985 Revenues %	1986 Forecast $M	1986 Forecast %	1987 Forecast $M	1987 Forecast %	1988 Forecast $M	1988 Forecast %	1989 Forecast $M	1989 Forecast %
U.S. Manufacturers										
IBM Captive	311.3	11.7%	122.1	4.6%	51.2	1.8%	--	--	--	--
	-39.4%		-60.8%		-58.1%		--		--	
Other U.S. Captive	192.3	7.2%	93.4	3.5%	66.9	2.4%	31.9	1.1%	11.6	.4%
	-24.3%		-51.4%		-28.4%		-52.3%		-63.6%	
PCM	87.7	3.3%	83.5	3.2%	57.6	2.1%	56.4	2.0%	72.8	2.7%
	+71.6%		-4.8%		-31.0%		-2.1%		+29.1%	
OEM	195.1	7.3%	86.6	3.3%	133.4	4.8%	176.8	6.3%	213.6	7.8%
	-72.5%		-55.6%		+54.0%		+32.5%		+20.8%	
Total U.S. Manufacturers	786.4	29.5%	385.6	14.6%	309.1	11.1%	265.1	9.4%	298.0	10.9%
	-48.6%		-51.0%		-19.8%		-14.2%		+12.4%	
Non-U.S. Manufacturers										
Captive	905.0	34.0%	818.9	31.4%	858.4	31.3%	868.7	31.4%	797.1	29.1%
	+6.3%		-9.5%		+4.8%		+1.2%		-8.2%	
OEM	962.7	36.5%	1,400.3	54.0%	1,569.0	57.6%	1,631.4	59.2%	1,643.0	60.0%
	-5.6%		+45.5%		+12.0%		+4.0%		+0.7%	
Total Non-U.S. Manufacturers	1,867.7	70.5%	2,219.2	85.4%	2,427.4	88.9%	2,500.1	90.6%	2,440.1	89.1%
	-.2%		+18.8%		+9.4%		+3.0%		-2.4%	
Worldwide Recap										
Captive	1,408.6	53.1%	1,034.4	39.7%	976.5	35.7%	900.6	32.6%	808.7	29.5%
	-13.0%		-26.6%		-5.6%		-7.8%		-10.2%	
PCM	87.7	3.3%	83.5	3.2%	57.6	2.1%	56.4	2.0%	72.8	2.7%
	+71.6%		-4.8%		-31.0%		-2.1%		+29.1%	
OEM	1,157.8	43.6%	1,486.9	57.1%	1,702.4	62.2%	1,808.2	65.4%	1,856.6	67.8%
	-33.1%		+28.4%		+14.5%		+6.2%		+2.7%	
Total All Manufacturers	2,654.1	100.0%	2,604.8	100.0%	2,736.5	100.0%	2,765.2	100.0%	2,738.1	100.0%
	-21.9%		-1.9%		+5.1%		+1.0%		-1.0%	

Note: Percentage figures with plus/minus signs refer to year-to-year growth rates.

Product mix

Although two sided 5.25 inch drives have been the leading floppy drive configuration since 1983 and will provide 65% of the industry's 1986 worldwide shipments, the end of their dominance is in sight. 5.25 inch, two sided drives are forecasted to grow only 4.6% in worldwide unit shipments in 1987, peaking at 12,765,000 drives in that year.

IBM's personal computers were a key factor in the ascendancy of two sided 5.25 inch drives, and IBM's expected introduction of a compact desktop personal computer using 3.5 inch rigid and floppy drives during the first half of 1987 will be a key factor in the industry's movement from 5.25 inch to 3.5 inch drive formats. 1987 worldwide shipments of 3.5 inch drives are forecasted to jump 52% in 1987, to 8,515,000 units worldwide. By 1989, 3.5 inch drives are expected to be the industry's leading floppy drive configuration, with 14,290,000 units shipped that year, 51% of the total for all floppy drives.

Except for the "special drives" product group, which is now benefiting from strong shipments of Bernoulli principle drives in the IBM compatible PC market and a shipment spurt of spiral track drives in the Japanese domestic home computer market, all other floppy product groups are now in decline.

When using the DISK/TREND Report, comparative total revenue figures can provide a misleading impression of unit shipments when the proportion of captive drives for a product group is higher than the industry average, as it is with 8 inch drives. When using revenue figures, note the large spread between selling prices for low cost drives, such as 5.25 inch drives, and higher price products, such as 8 inch drives.

Figure 1
CHANGING PRODUCT MIX
WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
CONSOLIDATED REVENUE

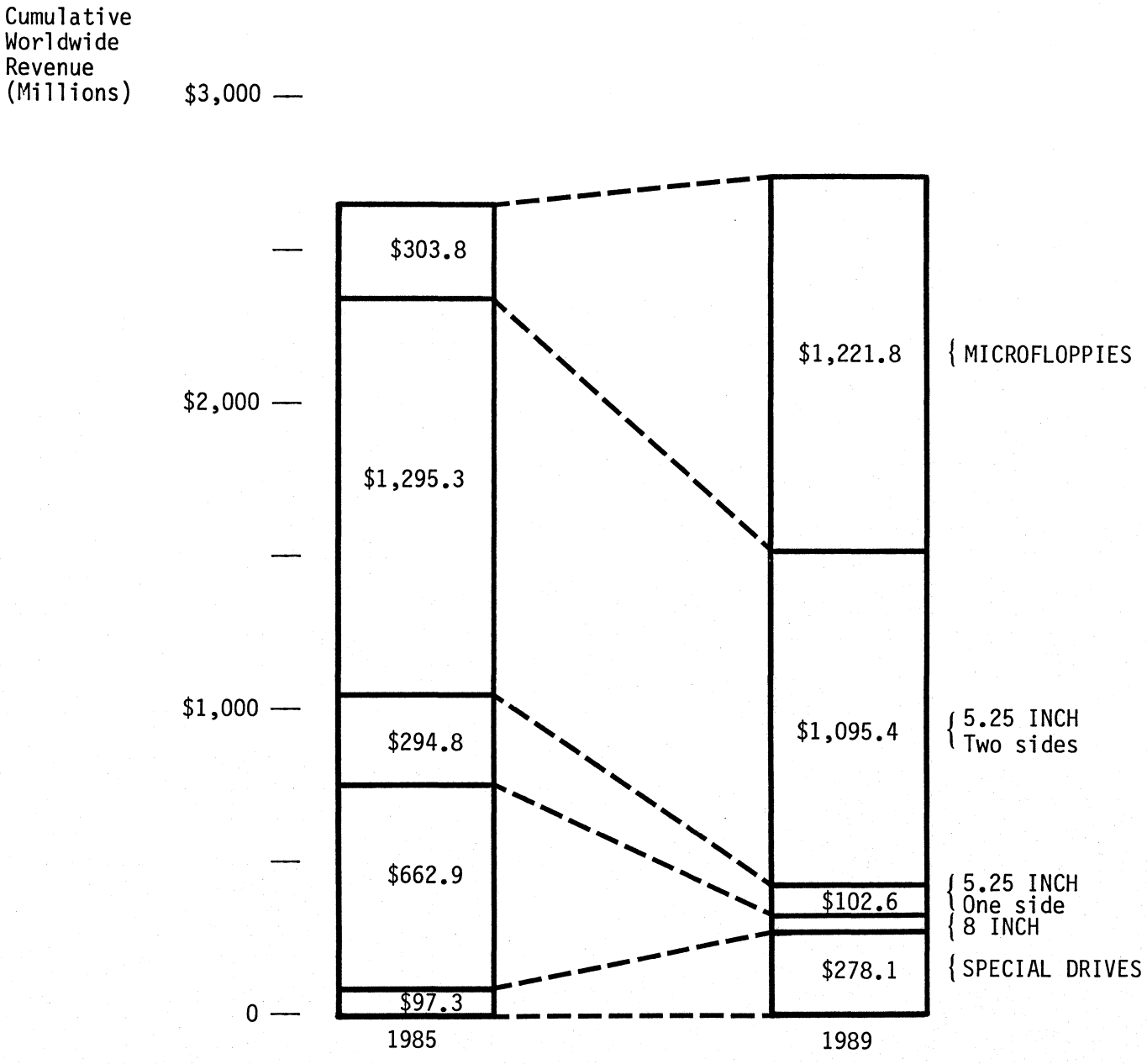

TABLE 3

WORLDWIDE SHIPMENTS

PRODUCT CATEGORY SUMMARY

ALL MANUFACTURERS

Units: Thousands / Dollars: $ Million		1985 Ship	1985 %	1986 Ship	1986 %	1987 Ship	1987 %	1988 Ship	1988 %	1989 Ship	1989 %
		Shipments		Forecast							
8 INCH DRIVES											
One Side	Units	118.3	-39.8	86.0	-27.3	69.0	-19.7	47.0	-31.8	31.0	-34.0
	$M	62.5	-44.1	41.2	-34.0	32.0	-22.3	21.2	-33.7	13.5	-36.3
Two Sides	Units	786.3	-34.8	606.1	-22.9	418.2	-31.0	223.0	-46.6	91.0	-59.1
	$M	600.4	-40.0	389.5	-35.1	211.7	-45.6	78.5	-62.9	26.7	-65.9
8 INCH TOTAL	Units	904.6	-35.5	692.1	-23.4	487.2	-29.6	270.0	-44.5	122.0	-54.8
	$M	662.9	-40.4	430.7	-35.0	243.7	-43.4	99.7	-59.0	40.2	-59.6
5.25 INCH DRIVES											
One Side	Units	2,902.2	-38.6	1,947.0	-32.9	1,236.0	-36.5	778.0	-37.0	465.0	-40.2
	$M	294.8	-35.1	202.5	-31.3	172.8	-14.6	139.0	-19.5	102.6	-26.1
Two Sides	Units	10,092.7	-5.2	12,197.9	+20.8	12,765.0	+4.6	12,093.0	-5.2	10,820.0	-10.5
	$M	1,295.3	-17.5	1,300.5	+.4	1,358.4	+4.4	1,278.6	-5.8	1,095.4	-14.3
5.25 INCH TOTAL	Units	12,994.9	-15.4	14,144.9	+8.8	14,001.0	-1.0	12,871.0	-8.0	11,285.0	-12.3
	$M	1,590.1	-21.5	1,503.0	-5.4	1,531.2	+1.8	1,417.6	-7.4	1,198.0	-15.4
MICROFLOPPY DRIVES											
	Units	3,268.1	+65.7	5,600.0	+71.3	8,515.0	+52.0	11,705.0	+37.4	14,290.0	+22.0
	$M	303.8	+50.6	535.9	+76.3	780.3	+45.6	1,025.2	+31.3	1,221.8	+19.1
SPECIAL DRIVES											
	Units	124.6	-34.4	1,320.1	+959.4	1,682.0	+27.4	2,088.0	+24.1	2,448.0	+17.2
	$M	97.3	+62.9	135.2	+38.9	181.3	+34.0	222.7	+22.8	278.1	+24.8
TOTAL ALL DRIVES											
	Units	17,292.2	-8.7	21,757.1	+25.8	24,685.2	+13.4	26,934.0	+9.1	28,145.0	+4.4
	$M	2,654.1	-21.9	2,604.8	-1.8	2,736.5	+5.0	2,765.2	+1.0	2,738.1	-.9

Figure 2

CHANGING PRODUCT MIX

WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
ALL MANUFACTURERS

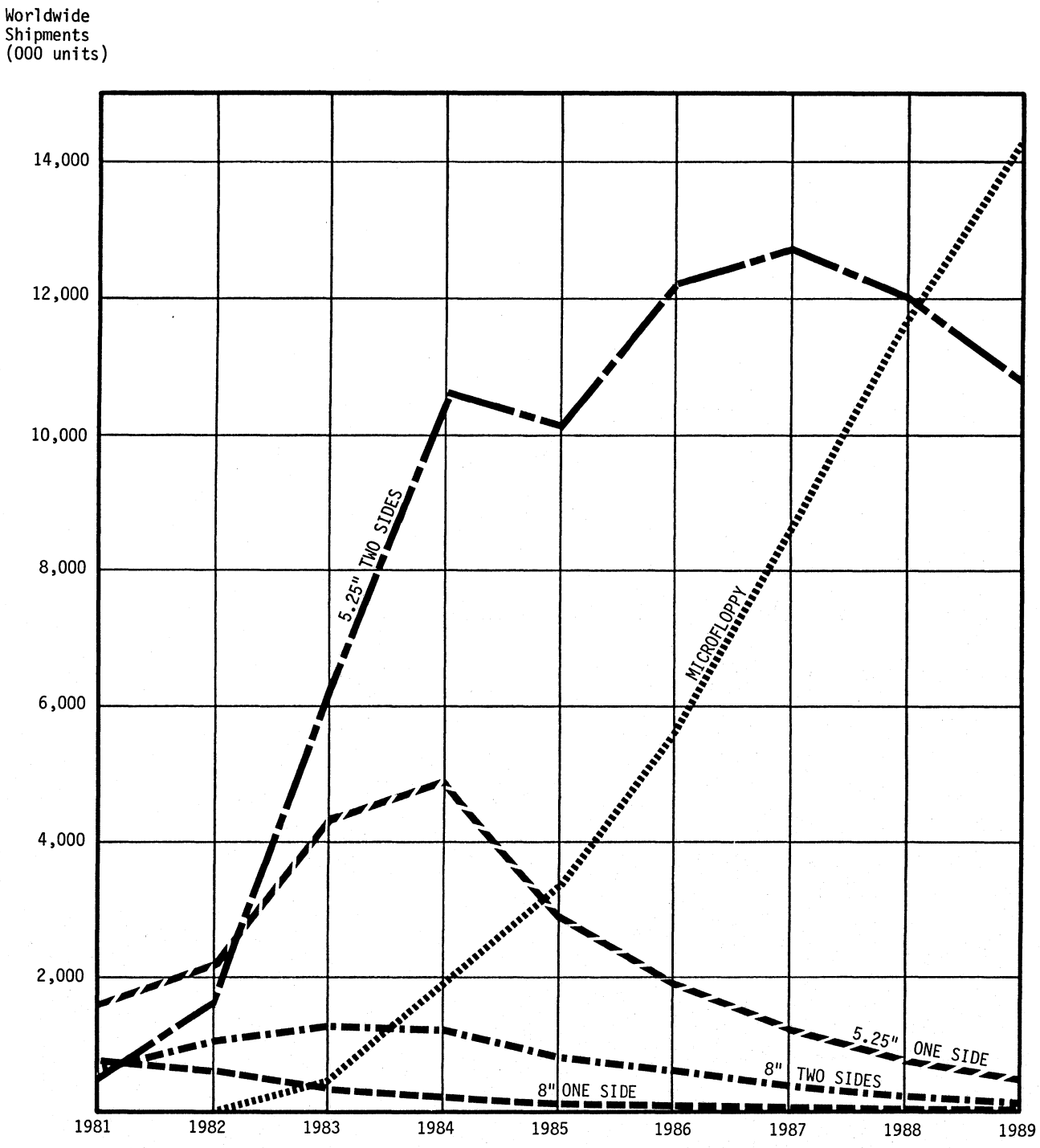

TABLE 4

WORLDWIDE SHIPMENTS

PRODUCT CATEGORY SUMMARY

MANUFACTURERS OF OEM DRIVES

Units: Thousands / Dollars: $ Million		1985 Ship	1985 %	1986 Ship	1986 %	1987 Ship	1987 %	Forecast 1988 Ship	Forecast 1988 %	Forecast 1989 Ship	Forecast 1989 %
8 INCH DRIVES											
One Side	Units	95.2	-33.9	74.0	-22.2	60.0	-18.9	41.0	-31.6	28.0	-31.7
	$M	39.3	-22.4	30.6	-22.1	24.4	-20.2	16.4	-32.7	11.2	-31.7
Two Sides	Units	375.8	-38.4	323.8	-13.8	267.0	-17.5	167.0	-37.4	73.0	-56.2
	$M	84.9	-45.9	82.6	-2.7	64.7	-21.6	37.6	-41.8	14.8	-60.6
8 INCH TOTAL	Units	471.0	-37.6	397.8	-15.5	327.0	-17.7	208.0	-36.3	101.0	-51.4
	$M	124.2	-40.2	113.2	-8.8	89.1	-21.2	54.0	-39.3	26.0	-51.8
5.25 INCH DRIVES											
One Side	Units	2,529.7	-42.0	1,722.5	-31.9	1,008.0	-41.4	575.0	-42.9	292.0	-49.2
	$M	123.9	-56.9	93.6	-24.4	62.6	-33.1	45.2	-27.7	27.3	-39.6
Two Sides	Units	8,538.6	-9.2	11,115.3	+30.1	11,653.0	+4.8	11,016.0	-5.4	9,967.0	-9.5
	$M	685.8	-35.9	892.1	+30.0	943.7	+5.7	888.9	-5.8	806.5	-9.2
5.25 INCH TOTAL	Units	11,068.3	-19.6	12,837.8	+15.9	12,661.0	-1.3	11,591.0	-8.4	10,259.0	-11.4
	$M	809.7	-40.3	985.7	+21.7	1,006.3	+2.0	934.1	-7.1	833.8	-10.7
MICROFLOPPY DRIVES											
	Units	2,965.1	+60.6	4,957.0	+67.1	7,498.0	+51.2	10,340.0	+37.9	12,638.0	+22.2
	$M	210.4	+33.7	336.3	+59.8	483.3	+43.7	653.8	+35.2	791.5	+21.0
SPECIAL DRIVES											
	Units	40.5	-73.6	1,239.0	+2959.2	1,618.0	+30.5	1,981.0	+22.4	2,266.0	+14.3
	$M	13.5	-16.6	51.7	+282.9	123.7	+139.2	166.3	+34.4	205.3	+23.4
TOTAL ALL DRIVES											
	Units	14,544.9	-12.0	19,431.6	+33.5	22,104.0	+13.7	24,120.0	+9.1	25,264.0	+4.7
	$M	1,157.8	-33.4	1,486.9	+28.4	1,702.4	+14.4	1,808.2	+6.2	1,856.6	+2.6

Figure 3

CHANGING PRODUCT MIX

WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
MANUFACTURERS OF OEM DRIVES

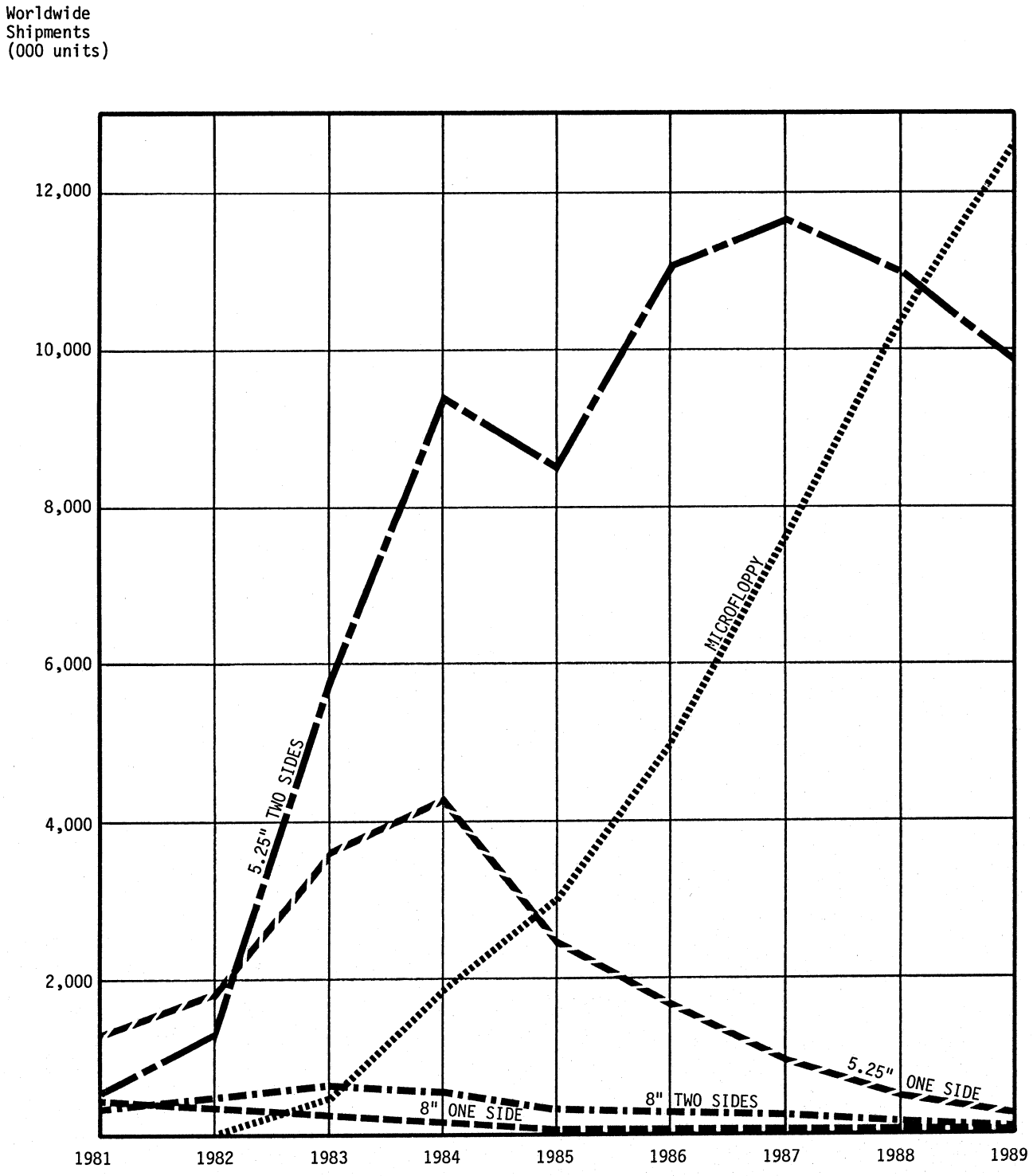

TABLE 5

1985 ESTIMATED MARKET SHARES

WORLDWIDE REVENUES OF ALL FLEXIBLE DISK DRIVES
(Value of non-U.S. currencies estimated at average 1985 rates)

	CAPTIVE		NON-CAPTIVE*		TOTAL INDUSTRY	
	$M	%	$M	%	$M	%
U.S. MANUFACTURERS						
Control Data	7.8	.6	32.4	2.6	40.2	1.5
Digital Equipment	81.6	5.8	--	--	81.6	3.1
IBM	311.2	22.1	--	--	311.2	11.7
Iomega	--	--	95.8	7.7	95.8	3.6
Qume	17.5	1.2	5.0	.4	22.5	.9
Shugart	30.7	2.2	23.6	1.9	54.3	2.0
Tandon	12.5	.9	116.1	9.3	128.6	4.8
Tandy	42.0	3.0	--	--	42.0	1.6
Other U.S.	.3	--	9.9	.8	10.2	.4
U.S. Total	503.6	35.8	282.8	22.7	786.4	29.6
NON-U.S. MANUFACTURERS						
Alps Electric	--	--	80.7	6.5	80.7	3.0
Canon	33.0	2.3	23.8	1.9	56.8	2.1
Epson	20.8	1.5	53.8	4.3	74.6	2.8
Hitachi	38.0	2.7	12.4	1.0	50.4	1.9
Isot	9.2	.6	15.3	1.2	24.5	.9
Matsushita Communication Ind.	--	--	80.4	6.5	80.4	3.0
Matsushita Electric Ind.	--	--	27.3	2.2	27.3	1.0
Mitsubishi	59.1	4.2	105.0	8.4	164.1	6.2
Mitsumi	--	--	25.2	2.0	25.2	1.0
NEC	434.6	30.9	23.0	1.9	457.6	17.3
Olivetti	176.8	12.5	1.5	0.1	178.3	6.7
Sony	20.7	1.5	76.1	6.1	96.8	3.7
Teac	--	--	139.4	11.2	139.4	5.3
Toshiba	59.3	4.2	61.5	5.0	120.8	4.6
YE data	--	--	133.6	10.7	133.6	5.0
Other Non-U.S.	53.5	3.8	103.7	8.3	157.2	5.9
Non-U.S. Total	905.0	64.2	962.7	77.3	1,867.7	70.4
WORLDWIDE TOTAL	1,408.6	100.0	1,245.5	100.0	2,654.1	100.0

*Includes PCM drives.

TABLE 6

Codes: C = Captive
P = PCM
O = OEM
Numbers in table indicate TPI

CURRENT PRODUCT LINES
MANUFACTURERS OF FLEXIBLE DISK DRIVES

U.S. MANUFACTURERS	TYPE	13 8 INCH ONE SIDE	14 8 INCH TWO SIDES	15 5.25 INCH ONE SIDE	16 5.25 INCH TWO SIDES	17 MICRO FLOPPIES	18 SPECIAL
Caldisk	O	48	48				
Data Technology	O				333		
Digital Equipment	C	48		96			
Eastman Kodak	C,O				192,333,384		
Genisco	O					135	
Hi-Tech Peripherals	O			48	48,96		
IBM	C		48				
Iomega	P,O						300,394,570,641
Miltope	O	48	48				
Omek	O				48,96		
Shugart	O	48	48				
Tandon	O				48,96		
ASIAN MANUFACTURERS							
Alps Electric	O			48	48,96	135	
Asia Commercial	O			48	48,96		
Brother	C,O					67.5,135	
Canon	C,O				48,96	67.5,135	
Chinon	P,O			48	48,96	67.5,135	
Citizen	C,O				480	135	
Copal	O				48,96	135	
Epson	C,P,O				48,96	135	
Ergo	O				48		
Fujitsu	O				48,96	135	
Gold Star	C,O			48	48,96		
Hitachi	C,O		48,96		96,125	100,135	
Ho Shin	O			48,96	48,96		
Hyundai Magnetics	C,O				48,96		
Inventa	O			48	48,96		
Janome Sewing Machine	O					67.5,100,135	
Konica	O				480		
Lung Hwa	O				48		
Matsushita Com. Ind.	O		48		48,96,192	67.5,135	
Matsushita Elect. Ind.	O					50,100,200	
Mitac	P,O			48			
Mitsubishi	C,O		48		48,96	135	
Mitsumi	O			48	48	67.5,135	Spiral
NEC	C,O		48		48,96	135	
Oceanic	P,O			48	48		
Oki Electric	C,O				48,96		
Oriental Precision	C,P,O			48	48,96		
Ricoh	C,O		48		48,96		Spiral
Samsung	C,O				48,96		
Sankyo Seiki	O					67.5,135	Spiral
Sony	C,O					135	
TEAC	O			48,96	48,96	135	
Tecmate	O			48	48,96	135	
Teco	O					135	
Tokyo Electric Company	O			48	96	67.5,135	Spiral
Toshiba	C,O		48		48,96	135	
Victor Co. of Japan	O				48,96	67.5,135	
Video Technology	P,O			48	48,96		
Weltec Digital	P,O				48,96		
Wong's Electronics	C				48		
YE Data	O		48		48,96	67.5,135	
SOUTH AMERICAN MANUFACTURERS							
Cobra	C	48					
Elebra Informatica	O			48,96	48,96		
Flexdisc	O			48	48,96		
Multidigit	O			48	48,96		
EUROPEAN MANUFACTURERS							
Elcomatic	O	48	48,96				
Instrumentation & Automation	C,O			48	48		
ISOT	C,O	48	48	48	48,96		
Magyar Optikai Muvek	O	48		48			
Olivetti	C,O		48		48,96	135	
Robotron	C,O			48,96			

Application mix

A change has been made this year in the list of application areas used in this report. The application breakdowns have been revised to reflect changes in disk drive markets, and also to make it possible to use a common system to define the applications for rigid and optical disk drives, as well as flexible disk drives. The new breakdowns will be used in each of the sections of the DISK/TREND Report. Separate application summaries are included in each product section of this report, with the data summarized on Table 7, on the facing page.

Single user microcomputers for business and professional applications used 68.3% of worldwide shipments for all types of floppy drives in 1985, and this application's use of two sided 5.25 inch drives amounted to 76% of the worldwide total. By 1989 the two sided 5.25 inch share will drop off to 68%, as microfloppies assume leadership.

Consumer and hobby markets declined to 11.6% of total floppy drive markets in 1985, due to weak market conditions, but are expected to rise in 1989 to 20.1% of the combined total of all types of floppy drives. Over 80% of the remaining 1989 shipments of one side 5.25 inch drives will be destined for consumer and hobby computers, but those shipments will be dwarfed by the 4.5 million 3.5 inch drives expected to be used in the same market.

Dedicated application office systems and workstations, including the traditional word processing market, used 11% of all floppy drives in 1985, predominantly two sided 5.25 inch drives. The 1989 requirement is expected to be down to 9.9% of the total, with 5.25 inch, two sided drives still in the lead.

TABLE 7

FLEXIBLE DISK DRIVE APPLICATIONS SUMMARY

CONSOLIDATED WORLDWIDE SHIPMENTS

	1985 Estimate						1989 Projection					
	All FDD*	8" One Side	8" Two Sides	5.25" One Side	5.25" Two Sides	Micro Floppies	All FDD*	8" One Side	8" Two Sides	5.25" One Side	5.25" Two Sides	Micro Floppies
MAINFRAME/SUPERMINI General purpose												
Units (000)	214.4	6.8	134.6	--	62.6	10.5	199.4	.6	19.1	--	108.2	71.5
Share %	1.2%	5.8%	17.1%	--	.6%	.4%	.7%	2.0%	21.0%	--	1.0%	.5%
MINICOMPUTERS AND MULTIPLE USER MICROS Including networks												
Units (000)	754.9	14.8	254.2	20.3	432.0	33.7	645.4	2.8	30.1	--	541.0	71.5
Share %	4.4%	12.5%	32.3%	.7%	4.3%	1.0%	2.5%	9.0%	33.0%	--	5.0%	.5%
MICROCOMPUTERS Single user												
Units (000)	11,723.6	30.5	194.4	1,948.5	7,666.4	1,883.7	16,167.2	3.7	10.0	79.1	7,357.6	8,716.8
Share %	68.3%	25.8%	24.7%	67.1%	76.0%	57.6%	62.9%	12.0%	11.0%	17.0%	68.0%	61.0%
OFFICE SYSTEMS AND WORKSTATIONS Dedicated application												
Units (000)	1,894.8	62.1	128.5	68.5	1,307.0	328.8	2,532.9	22.7	16.4	9.3	2,055.8	428.7
Share %	11.0%	52.5%	16.3%	2.4%	13.0%	10.1%	9.9%	73.0%	18.0%	2.0%	19.0%	3.0%
NON-OFFICE SYSTEMS AND WORKSTATIONS Dedicated application												
Units (000)	447.0	4.1	58.4	17.4	264.4	102.6	732.6	1.2	12.7	--	432.8	285.8
Share %	2.6%	3.4%	7.4%	.6%	2.6%	3.1%	2.9%	4.0%	14.0%	--	4.0%	2.0%
CONSUMER AND HOBBY COMPUTERS												
Units (000)	1,990.9	--	--	847.4	307.8	835.7	5,165.8	--	--	376.6	216.4	4,572.8
Share %	11.6%	--	--	29.2%	3.1%	25.6%	20.1%	--	--	81.0%	2.0%	32.0%
OTHER APPLICATIONS												
Units (000)	141.9	--	16.2	--	52.5	73.2	253.8	--	2.7	--	108.2	142.9
Share %	.9%	--	2.2%	--	.4%	2.2%	1.0%	--	3.0%	--	1.0%	1.0%
TOTAL, ALL APPLICATIONS*												
Units (000)	17,167.6	118.3	786.3	2,902.2	10,092.7	3,268.1	25,697.0	31.0	91.0	465.0	10,820.0	14,290.0
Share %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

*Does not include special floppy drives

TECHNICAL REVIEW

Competing technologies

No competing technology has yet provided effective competition to flexible disk drives in their existing mainstream markets. The only significant competition for the principal floppy drive configurations has come from newer floppy drives offering more capacity, smaller size or lower price.

Flexible disk drives continue to evolve rapidly. New sizes and capacities, new designs and new manufacturing methods are continually making floppy drives more cost effective against competitive data storage technologies. Consequently, alternate technologies have had limited success in breaking into floppies' established markets. The rate of innovation currently enjoyed by floppy drives is not going to slow down soon -- new technologies and capabilities will be introduced annually through the remainder of this decade.

The unique combination of low cost, random access and media removability provided by flexible disk drives is the reason for their growth. To have an impact on floppy drives, any competing technology must offer a significant improvement at a competitive price.

These products are the ones with the most potential to challenge flexible disk drives in selected markets:

* Small rigid disk drives: Rapid growth of small Winchester disks has displaced large quantities of floppy drives which otherwise would have been sold, but availability of these rigid disk drives has probably also served to increase the size of the total market for small computer systems, and therefore boost the market for floppy drives. For almost all small fixed disk drives installed, a

companion removable media recording device is necessary to provide for software distribution, save/restore of programs and files, and backup to protect against hardware, software or operator error. Most of the time that removable device is a floppy disk drive.

The rigid disk challenge to flexible disk drives is most effectively presented by 5.25 inch and smaller rigid disk cartridge drives. Small disk cartridge drives are one of the best ways to accomplish fast save and restore of files in the 5-10 megabyte range, and offer access times fast enough to be satisfactory as a basic system disk, in lieu of a fixed Winchester drive. Availability has been the limiting factor in growth of the disk cartridge share of this market, with only a few manufacturers in production. If floppy disk drives having capacities of 5 megabytes or more are successful, then rigid disk drives will be less attractive as a floppy disk replacement. Such high capacity floppy drives have been introduced by several companies. Specialized products, such as the Iomega Bernoulli disk drives also help floppy drives withstand rigid disk competition.

* Stretched surface recording: Another candidate is the stretched surface recording (SSR) technology developed by 3M. SSR is now the subject of drive development programs by other manufacturers for both removable cartridge and fixed drive formats. In either implementation, a magnetic recording layer is placed upon a plastic film which is then stretched across concentric cylindrical rings. The chief characteristic of this technology is that it allows a head to fly on an air cushion backed by a deformable surface that bulges slightly in the region under the head. This provides the close head-media separation needed for high capacity, but also makes the product head-crash proof. The capacity of such a product will be similar to that of a Winchester disk drive of matching diameter, but the cost may eventually be substantially less because the SSR disk has the potential of being fabricated at only one quarter of the cost of an aluminum substrate disk. If adequately supported and promoted by 3M, SSR has the potential to become a major commercial technology.

* Read-only optical disks: The read-only optical disk category is dominated by the CD-ROM. Storage capacities of 550 to 600 megabytes are typical of these products. CD-ROM technology borrows heavily from the designs of the 4.72" CD audio players now in volume production. CD-ROM acceptance benefits from industry agreement on the CD standards developed jointly by Sony and Philips. In addition to the 4.72" CD-ROM, which is limited in performance, high performance 12" read-only drives are being shipped by Reference Technology.

  Most read-only optical drives will be used with small systems to provide personal access to large amounts of information. They are expected to have no impact on the floppy drive's role of providing backup capabilities for small systems and in distribution of software for personal computers.

* Non-reversible optical disks: The first optical disk recording systems to enter the market are "non-reversible" or "write-once" systems. After many years of costly development programs undertaken by several European, American and Japanese manufacturers, such devices are beginning to be introduced as shippable products.

  Because they have track densities approaching 16,000 tracks per inch, write-once drives are capable of higher areal densities than magnetic recording techniques now in use. Some planned systems provide several gigabytes on a single removable disk. Other drives are being used in mass storage systems which access large numbers of optical disks under system control.

  Although not yet demonstrated, advocates of the various types of optical disk media technologies believe that their disks will provide archival lives which equal or exceed those of magnetic media, with 10 years being a commonly encountered specification for archival life of the media. Lifetime is limited by the gradual appearance of defects on the recording layer due to the corrosive effects of water and oxygen on the metal films used in the recording layers of the media. The termination point of media lifetime occurs when the error correction capability of the drive is no longer capable of coping with the gradually increasing media defect density. Some recently introduced media based on dye-polymer designs have no metallic films and may offer improved stability.

  In broad terms, two kinds of systems will be offered: Document storage and data storage systems. Systems intended to store images of documents were early entries to the market in Japan, offered by Toshiba, Matsushita Electric, and others. The early emphasis on optical document storage systems in the Japanese market is explained by the extremely complicated character of the written Japanese language. Since most business communication and records are in handwritten characters, the Japanese emphasis first on copying machines, then facsimile transmission, and now optical document storage systems is understandable. At this time, it does not appear that optical document storage systems will be able to compete on a price per image basis with microfilm for bulk storage of images. However, the fast and convenient access to stored images provided by optical disk systems will probably create a major place for them in the emerging office automation market for large-scale specialized applications.

  Data storage systems have been later to develop, partly because of more stringent demands upon the media and the difficulty of developing a drive with performance suitable for data processing applications. Optical data storage systems and disk drives from a variety of firms, including Optical Storage International, Optotech, Optimem, ISI, Alcatel Thomson Gigadisc, Hitachi, Toshiba, NEC and Sony are now being shipped in modest numbers. These firms have identified a number of target applications involving databases which are infrequently or never updated, and for which a write-once system would not be at a disadvantage -- such as stock market

history, legal files, seismic data, banking transaction logs and law enforcement records. Replacement of magnetic tape for general archival storage is also high on the target list. While Storage Technology Corporation was unsuccessful in bringing its high performance 7640 product to market, it did succeed in setting expectations for the functionality of a high-end, DP-oriented optical storage product. The STC project has been cancelled and is now up for sale.

The write-once systems now available or entering the market use comparable, but differing technologies, with capacities per disk in the range of one hundred megabytes to three gigabytes. The smaller capacity products are being marketed initially as OEM drives for use in small systems; larger capacity drives are being used in captive systems and by a few OEM purchasers.

High cost, high capacity, and write-once related system complexities mean that there will be no impact by write-once disks on floppy drives used in their traditional roles. Even the highest capacity floppy drives using conventional technologies will not compete with write-once drives -- the product classes and applications are mutually exclusive.

* Erasable optical disks: The possibility for real inroads into the market for magnetic disk drives, including high capacity floppy disk drives, exists with reversible optical disk systems. This will occur when either of the principal proposed technologies reaches the status of a reliable production product. Magneto-optical recording has seen development activity for more than twenty years, and "phase change" optical recording has attracted considerable attention during the past few years. Low-end erasable optical drives offer the promise of higher capacities and average access times equivalent to those offered by many of today's small magnetic rigid disk drives. The first commercial products on the market will appear in late 1987 and 1988 and will offer removable media.

Most current magneto-optical development programs involve using a low power laser to change the magnetic state of the active layer on a disk. The laser raises the temperature of the active layer into the range of the Curie point while a magnetic field is present, causing individual magnetic domains on the disk to align with the direction of the external field. Changes in magnetic orientation are detected during reading, as the affected spot on the disk causes a small rotation in the polarized light reflected from the surface or transmitted through the disk. However, magneto-optical disks have not yet shown the ability to overwrite in place. Each individual sector must be erased before the sector can be rewritten again.

Phase change optical recording involves a different type of amorphous coating, in which individual spots on the disk are changed by polarized light from a crystalline state, during which light is

reflected, to a noncrystalline state, during which light is absorbed. Fujitsu has revealed a comparable process in which different crystalline states are used to vary reflectivity.

A third technology, potentially the least expensive to manufacture, is erasable dye/polymer. As of yet, only limited success has been obtained with this technique because developers have not been able to demonstrate an adequately large number of write/erase cycles. Individual firms are also working on other proposed reversible optical recording technologies, but none of these are known to have overcome all of the problems, which have included: Slow completion of the reversal cycle, limitations on the number of reversals before degradation, poor shelf life, and low recording density.

Magneto-optical storage is close to being in a manufacturable status, although some additional work needs to be done to insure that the media is adequately resistant to corrosion caused by exposure to air, water and atmospheric pollutants. Most of the technical problems have been overcome by some of the U.S., Japanese or European companies working in the area, and a few of these firms have committed to the heavy investment required to establish volume production capability. Technology announcements of products in 3.5" and 5.25" formats have been made by Verbatim, 3M, and several Japanese firms, and several firms are preparing to manufacture magneto-optical drives and media in volume by 1988. Phase change media production could follow in a few years if acceptable stability and producibility are feasible.

Drive and media costs for erasable optical storage are far above the costs of conventional floppy technology, and it is unlikely that floppy drives below 5 megabytes will be impacted. However, it is likely that conflicts will come into being between the very low end optical drives and very high end floppy drives expected in a few years. The capacity range of such products (none yet in production) is likely to lie in the range of 40-50 megabytes. Prices will be comparable, although the floppy media will probably remain less expensive than optical media. Both products will compete against tape drives for save/restore applications in small systems and personal computers.

* Magnetic bubbles: If regarded as a specialized data storage product, magnetic bubbles still look like a product with a future, despite a serious loss of credibility after the 1981 departure of National Semiconductor, Texas Instruments and Rockwell International from the field. Intel announced its exit from the market in 1986. The rate at which the market for magnetic bubbles developed was clearly not acceptable for the drop-outs, which had plans for much more immediate returns on their investments.

Bubbles' markets were obviously not the mainstream data storage applications dominated by magnetic disk and tape drives. As expected by disk and tape manufacturers, but not by many bubble manufacturers, the older products were well established, mostly multiple

sourced, and getting better all the time. But there are many practical limitations for disk and tape, and applications where they are unsuitable or marginal because of environmental limitations or minimum practical size thresholds.

Bubbles started to find suitable applications, once they were actually in production and support chips became available. The highest manufacturing levels are still maintained by Hitachi, with most production used by Nippon Telephone and Telegraph for a variety of telecommunication applications. AT&T, with manufacturing by Western Electric, is believed to be much further behind in developing internal bubble applications, despite the fact that the basic technology was invented at Bell Labs.

The bubble program of Intel Magnetics was instrumental in developing a wide variety of applications. Intel led the market with 1 Mbit chips, the introduction of support circuits and a guaranteed future price reduction policy. The company attracted a variety of customers in specialized and harsh environment applications -- at least sufficient to establish quantity production and start down the learning curve-- but in 1986 announced it would exit the bubble memory business. Nevertheless, the non-volatility of magnetic bubbles and their suitability for capacities too small to be cost effective for magnetic disk drives remain attractive to system manufacturers for applications such as industrial control systems, robots, point of sale terminals, portable computers, medical instrumentation, avionic systems and militarized systems.

The future market available to magnetic bubbles will be directly proportional to their price level as compared to magnetic disk for equivalent capacities. During the rest of the 1980's, it still seems probable that bubbles' prices will not approach disks' prices -- and bubbles' main markets will be smaller and more specialized.

In the 1990's, content addressable, high density bubble memories based upon Vertical Bloch Line (VBL) domains and bubble logic might be able to challenge disk memory in some applications. R&D efforts at Carnegie-Mellon University have shown promise, but much remains to be done to make VBL a practical technology.

* Tape drives: When disk drive capacities used with small computer systems rise above 20-30 megabytes, the functional requirements for a removable media backup device frequently cannot be met by a flexible disk drive. Floppies' comparatively limited capacity is usually adequate for systems on which the typical file is also small, such as with word processing systems, many small business systems, and most personal computers. But if files are typically large, if a data base management system is used, or if it is necessary to back up an entire rigid disk for protection at the end of each day, most of today's floppies are usually not the best answer. However, the new high capacity floppies being developed by Eastman Kodak, Hitachi, Toshiba and others may improve the position of the floppy drive as a backup vehicle.

Digital cassette and tape cartridge drives were available before most of today's floppy drives, but production of these drives has never approached that for floppies. The reasons lie in the inability of tape drives to offer fast direct access to individual records, generally higher prices for the tape drives, and until recently, a lack of industry-wide standards for interfaces and media interchange. Today, however, the pressing demand for backup devices capable of handling the higher capacities offered by the newest small Winchester drives has created a new opportunity for small tape drives.

The streaming tape cartridge drives now offered by several manufacturers are achieving a major penetration of this market. Streamers have been available from a few suppliers during the past few years, but with different interfaces and recording formats from each manufacturer -- a situation which discouraged many system manufacturers from investing in the controller and software development needed to use these drives. However, the advent of the high capacity 5.25 inch Winchester has provided the stimulus for most of the tape cartridge drive manufacturers to quickly agree on common standards for interfaces and recording formats.

These standards, plus new tape cartridge drives designed to the same form factor as 3.5 inch and 5.25 inch Winchesters, is resulting in major penetration by tape cartridge streamers of the back up market with Winchesters in the 20-30 megabyte range and above. Will this development displace flexible disk drives? No, not significantly, since floppies never had a logical market opportunity with higher capacity 3.5 inch and 5.25 inch Winchesters, except for applications using files usually small enough to fit a floppy. The new generation of high capacity floppy drives is extending the rigid disk capacity range over which floppies can compete for a role as a backup device to the 30-40 megabyte range. Anything larger probably will create a demand for tape streamers or removable rigid disk drives. In any event, floppy drives will undoubtedly continue to be used on many small systems with large capacity Winchester drives. Their role will include software distribution, and remaining a convenient backup method for the small files which usually accompany the large ones.

* Integrated circuit cards: Small plastic cards containing IC memories ranging in size from 8 kilobytes to over 250 kilobytes may challenge floppy disk drives in selected applications such as games, medical history storage, programming for electronic musical instruments, and type font storage for printers. Typically about the size of a credit card, the cards may contain a PROM, EPROM, or EEPROM depending upon whether the application requires read-only, write-once or rewritable storage. While more expensive than floppy disk media, the cards are less vulnerable, though not immune, to handling damage. The IC card has been promoted more widely in Europe and Japan than in the U.S.

Flexible disk drive enhancements

IBM developed most of the basic technology used in flexible disk drives, but has failed to introduce a successful new floppy drive since the two sided 8 inch drive in 1976. In 1985, IBM announced that it would phase out production of floppy disk drives. In the late 1970s, Shugart Associates shrunk IBM's original technology down to the 5.25 inch format, pulling off one of the most influential repackaging jobs of all time.

In the meantime, the floppy formats which have created the most impact in recent years are the Sony 3.5 inch microfloppy and the Nippon Telephone & Telegraph 1.6 megabyte version of the 5.25 inch drive. Without IBM's heavy handed leadership, the industry has taken years to find its way to a consensus on these formats, while passing others by. And after all the confusion, IBM finally endorsed both the 3.5 inch and 1.6 megabyte 5.25 inch formats through product introductions. It is expected that IBM will do the same for the 2.0 megabyte 3.5 inch format in 1987.

The lesson of recent years is that there are many potential technical improvements in flexible disk drive recording technology, each waiting for the backing of an influential firm in the industry. It is expected that by using improved head positioning systems or very high capacity media, manufacturers of floppy disk drives will be able to expand capacity to the 40 megabyte range. Here are some of the leading areas of potential advancements in flexible disk recording technology:

* Media: The polyester substrate used with flexible disks suffers from limitations in its dimensional stability which derive from the manufacturing process used. As a result, today's mainstream floppy drive products using open loop head positioning systems for low cost are limited to 48 TPI with 8 inch drives, 96/100 TPI with 5.25 inch drives, and 135 TPI with microfloppy drives. The relatively small tonnage of polyester required for diskettes did not inspire plastics manufacturers to invest heavily in research targeted at dimensional stability improvements until the last few years, when

the quantities became too large to ignore. However, the magnetic recording industry has been actively developing several methods of increasing linear and track recording density.

Longitudinal particulate coatings: The conventional 8 inch and 5.25 inch diskettes used for the last 10 years, with 300 Oersted oxide coatings, have generally been recorded at 5,000 to 6,000 flux reversals per inch. The 600 Oersted cobalt modified oxide coatings now used in high density 5.25 inch and microfloppy diskettes from several manufacturers are used in numerous production drives at 8,000 to 10,000 FCI, and special types are available for use at even higher densities. New 2 megabyte 3.5 inch drives from several manufacturers use diskettes at 17,434 FCI, and Hitachi is offering an 8 inch Hitachi drive with 9.6 megabyte capacity recording at about 13,700 FCI, plus a new 5.25 inch drive with 6.5 megabytes achieved with 125 TPI and 19,560 BPI. The new Iomega Bernoulli effect 5.25 inch drives record data at over 17,000 FCI, using a diskette with similar coercivity but a thinner coating. In 1985, Eastman Kodak introduced a 12 megabyte floppy drive recording at 21,925 BPI. A 10 megabyte drive announced by Konica in 1986 has extended track density to 480 TPI -- the highest yet for floppy drives using conventional floppy media packaging -- but uses standard 600 Oersted magnetic media.

Several manufacturers of flexible media and magnetic particles have promising programs underway to improve the density of longitudinal particulate recording. Based on the information available, it appears that conventional recording methods are being stretched at least to 20,000 FCI now and can be extended to at least 40,000 FCI within a year or two. Longitudinal particulate recording has many good years left, with the full exploitation of its potential recording density probably to be paced primarily by market forces.

Isotropic coatings: It is theoretically possible, by reducing the length of magnetic particles, which are normally very long and thin, to resolve magnetic flux changes at much higher densities. It has been demonstrated that such diskettes could be recorded at up to 50,000 BPI. Since diskettes suitable for isotropic recording may be produced in great quantities on coating equipment widely used by media manufacturers today, this technology could be of great interest to the industry if certain thermal instability problems associated with cobalt modification of very small particles can be resolved.

Perpendicular recording: Perpendicular recording offers great potential for increased recording densities on flexible disks, and may have a better short-term outlook with flexible disk drives than with rigid disk drives because of floppies' slow spin rate. Several Japanese firms have announced systems to record video images on small diameter floppies. The flying head technology used with rigid disks requires a high revolution

rate, which will result in very high data transfer rates with perpendicular recording -- faster than most systems and controllers are now ready to handle. However, the contact recording method used with flexible disk drives and the slower rates of revolution encountered, combined with the very high densities of perpendicular recording, produce transfer rates comparable to the small Winchester disk drives now in wide use.

Several firms have announced tentative specifications for small flexible disk drives using perpendicular recording. Sony's experimental 3.5 inch drive provides 4 megabytes using 65,500 FCI. Matsushita Electric has claimed the capability to record at 70,000 FCI. Toshiba has made a preliminary announcement of a 4 megabyte 3.5 inch drive using barium ferrite particulate media.

Most planned flexible disk drives using perpendicular recording employ disks with sputtered chromium-cobalt magnetic surfaces. Sputtering technology is highly developed, but throughput is relatively slow, because it is usually a batch process. If the millions of low cost diskettes necessary to support any significant penetration of the flexible disk market by perpendicular recording are to be produced by sputtering, major improvements in production rates are probably necessary. Continuous sputtering production processes have been announced by the Japanese firms which have active drive/media programs in the field.

Track density: As discussed above, media dimensional stability limitations effectively hold track densities to the ranges now employed, if low cost open loop head positioning systems are to be used. It is possible to increase track densities through the use of prerecorded servo information on disks combined with a closed loop head positioning system, but the industry has been slow to move in that direction because of the general desire to hold costs as low as possible and the lack of an industry standard.

Initially, two manufacturers of high capacity 5.25 inch drives attempted to develop the high capacity market using different methods of achieving higher track density. However, Amlyn's late production start spoiled its chance for acceptance of the reference track technology employed in its 3.2 megabyte drive, and the firm closed down operations.

Drivetec was more successful in getting started, however, and began shipping its 3.3 megabyte two sided drive in mid 1983. Drivetec used embedded servo information on each diskette to provide tracking information and insure media interchange. Drivetec has since ceased operations, but licensed its technology to Eastman Kodak. Eastman Kodak started production of the 3.3 megabyte drive in 1984, and, in 1985, introduced 6.6 and 12 megabyte drives operating at 384 and 333 TPI, respectively. The 12 megabyte unit offers 75 millisecond average access time using a voice coil positioner.

Iomega developed a unique design, widely known as the Bernoulli box, that reaches 641 tracks per inch in a media cartridge of unconventional design. Production began in 1983. The Iomega design uses the hydraulic effects of the rapidly spinning disk to properly position the media relative to the head.

Konica's drive achieves a track density of 480 TPI using a two-stage servo system. An optical sensor is used for coarse positioning and an embedded closed-loop servo provides fine positioning using prewritten servo information. Other firms have examined the possibility of increasing track density using techniques borrowed from optical drive designs.

Companies offering high capacity drives will find an interesting market with specialized system manufacturers needing floppies with more capacity. In addition, there will be a significant add-on market associated with personal computers that will fill the need of many users for removable media with more capacity. The long term outlook for these products, however, will probably be determined by the position IBM will eventually have to take on high capacity floppies.

DEFINITIONS

Many basic terms have varying meanings within the computer industry, depending upon the role of the person speaking. In this report, such terms are used in the way most disk drive manufacturers use them.

MARKET CLASSIFICATION

Market class is used here, arbitrarily, to differentiate captive, PCM and OEM disk drive marketing activities.

Captive: Disk drives manufactured internally or by a subsidiary of a computer manufacturer or system OEM, and sold or leased primarily for use with systems offered by the manufacturer. Note that the term is used to describe the products, not the manufacturer; drives sold to PCM or OEM market classes are classified accordingly. Most DISK/TREND statistics separate data between IBM captive and "other captive", but the term still pertains to the disk drives involved, not the manufacturer.
Examples:

* Drives sold by DEC or IBM are considered captive, if internally manufactured or made by a subsidiary.

Non-captive: Any public sale or lease by any disk drive manufacturer, except sales or leases of internally manufactured drives by computer manufacturers or system OEMs primarily for use with their own systems. Both OEM and PCM shipments are included in the non-captive category.

Example:

* Shipments by Epson are non-captive, except for drives sold with systems by the parent company or other subsidiaries.

PCM: Disk drives sold or leased by "plug compatible manufacturers" directly to end users; shipments of internally manufactured drives by computer manufacturers or system OEMs are not included unless supplied in plug compatible configurations for installation with systems supplied by other manufacturers. This category is not limited to plug compatible drives installed on IBM systems. It includes any drives which are suitably equipped to be connected without additional hardware to systems of all types, including minicomputers and small business systems.

Examples:

* Disk drives sold by Iomega to end users of IBM systems.

* Disk drives sold by Chinon through distribution to end users of Apple systems.

OEM: Disk drives sold through any non-captive distribution channel except PCM. (See also the definition of "Distribution channel"). Drives are normally sold to OEMs to be included in complete systems or subsystems; such drives are included in OEM totals whether or not the OEM actually manufactures the remainder of the system or subsystem, or merely assembles components and adds software. Sales by a disk drive manufacturer to a second drive manufacturer for resale are included only in shipment totals for the originating drive manufacturer, except when drives are produced on a contract manufacturing basis with a design supplied by the disk drive manufacturer which finally sells the drive to a third party. Distributors and dealers are arbitrarily defined to be included in OEM totals.

Examples:

* Standard OEM drives sold by independent drive manufacturers to IBM for use with personal computers are considered to be OEM drives.

* Floppy drives designed by IBM and manufactured for IBM by an outside contract manufacturing firm are considered captive drives.

GEOGRAPHIC CLASSIFICATION

Geographic analysis is based upon two regions: The U.S. and non-U.S. Together, these two regions comprise the worldwide market.

U.S. vs. Worldwide SHIPMENTS: Shipments are classified U.S. or worldwide depending on the shipment destination of a drive's first public sale. Examples:

* An OEM shipment by a U.S. drive manufacturer to a European system manufacturer is included in worldwide totals.

* An OEM shipment by a Japanese drive manufacturer to a U.S. system manufacturer is included in U.S. totals.

U.S. vs. Non-U.S. MANUFACTURERS: Manufacturers are classified U.S. or non-U.S., depending on the location of the firm's headquarters, regardless of the location of individual manufacturing plants.

Examples:

* IBM and Tandon are considered U.S. manufacturers, even though each firm manufactures some of its disk drives in non-U.S. locations.

UNITS OF MEASUREMENT

Spindles: The basic unit in counting disk drives. One spindle or spindle disk assembly consists of the disk drive mechanism required to utilize a single disk or disk stack. All DISK/TREND unit totals are counted in spindles, even though some drive configurations include more than one spindle.

Revenue: Based on sales of disk drives alone, as normally sold by individual manufacturers. Controllers sold as separate units are not included, nor are spare parts or service. When individual disk drive models include integral control functions, such as may be required for the first drive on a string of drives, the actual value of the complete unit is used. Sale prices are estimated public sale transaction prices, whether at captive end user, PCM or OEM levels. All prices are in 1986 constant dollars.

Forecasts: Expected shipments and revenues for current or announced products in new production. Evolutionary improvements within existing formats are included, but completely new configurations or technologies are not included. Examples:

* Enhancements such as double density versions of existing configurations and revised encoding schemes are anticipated in DISK/TREND forecasts.

* Innovations such as non-standard size disks or new physical configurations may require establishment of new DISK/TREND product groups.

DISTRIBUTION CHANNEL CLASSIFICATION

Shipments of non-captive drives (OEM and PCM market classes) are analyzed by each of the following distribution channels:

Mainframe computer manufacturers: Any manufacturer which derives the largest share of its revenues from selling mainframes, even though other types of products may also be sold. Examples: IBM, NCR.

Mini/micro computer manufacturers: Any manufacturer which derives the largest part of its revenues from the manufacture of minicomputers, plus semiconductor manufacturers which produce computer systems as part of their product lines. Examples of this class include: Digital Equipment, Data General, Intel, Motorola, Hewlett-Packard, Prime Computer.

System OEMs/systems houses: (1) OEMs which manufacture a system requiring disk drives, such as Apple, Wang or Compaq. (2) System houses, of any size, which combine finished components and software to offer users complete systems.

Independent peripherals suppliers: Specialized manufacturers which add controllers, interfaces and other equipment or software, and offer plug compatible subsystems to end users, system OEMs and systems houses. Examples are Qualogy, Mountain Computer, and Tecmar.

Distributors, dealers, end users: This category includes: (1) Sales of plug compatible (PCM) disk drives with any other necessary hardware by disk drive manufacturers directly to end users. (2) Distribution through wholesalers, such as Hamilton Avnet, Arrow, or dealers of any type.

APPLICATIONS

Disk drive applications are associated with a specific class of system, regardless of the manufacturer or method of distribution. The categories used in this report are given below.

Mainframe/supermini: Disk drives attached to the processor or to a terminal associated with a general purpose mainframe or supermini-computer.

Minicomputers and multiple-user microcomputers: Disk drives associated with small general purpose processors typically serving multiple users. This category also includes network file servers. Examples include: IBM System/36, AT&T 3B2, DEC PDP-11.

Microcomputers: Includes disk drives attached to a general purpose microcomputer typically used by a single user in a professional or business environment. Examples: Compaq Plus, IBM PC/XT, IBM PC/AT, Apple Macintosh.

Office systems and workstations: Disk drives attached to office systems designed for dedicated use in specific applications, such as word processing, electronic mail, or document storage. Specialized hardware is normally used. Examples: Wang OIS series, NBI and CPT office systems.

Non-office systems and workstations: Includes disk drives used with systems in non-office dedicated applications, such as order processing or shipping, point of sale, medical, factory production control, law enforcement, CAD/CAM/CAE, military, etc.

Consumer and hobby computers: Used in equipment sold primarily to consumers for non-business applications.

Other applications: Any application not included above.

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

1986 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

Coverage

Examples of flexible disk drives in this group include:

Caldisk	142M
Digital Equipment	RX02
Elcomatic	ACP 500
IBM	3770 series, 3540
ISOT	ES 5074
Miltope	DD 400
Shugart	801, 848-1

All drives designed to use single sided flexible disks of nominal 8 inch diameter are included in this group. "Soft sector" drives use IBM compatible media, with a single index hole. "Hard sector" drives use additional holes to identify sectors. OEM drives in this group were generally designed to the same physical dimensions as the Shugart 801. Most of the OEM 8 inch drives introduced during the 1980's were "half high" models, but only a single one side version remains in production -- the Shugart 848-1, a Tandon product until the company's 8 inch product line was sold in mid-1986.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1985	1986	1987	1988	1989
U.S. manufacturers	27.9	7.9	3.5	--	--
All manufacturers	62.5	41.2	32.0	21.2	13.5

After shipments peaked in 1981, production for this product group has dropped steadily, down to 118,300 drives worldwide in 1985, with no letup expected in the continuing decline.

Most newer systems use smaller floppies, but older systems will generate business for 8 inch one side floppy drives as long as the system shipments hold up. Half high 8 inch drives arrived too late to change the market, and in 1986 constitute only about 1% of worldwide shipments.

Small business systems, terminals and word processing used to be the main application areas for 8 inch, one side drives, but only word processing remains a major market in Western countries. Drives in this group are still generally used with many types of computer systems in Eastern Bloc countries, and production for this requirement in several countries currently provides most of the non-U.S. shipments.

Shugart built its early leadership in the OEM floppy drive market with 8 inch, one side models, and under Xerox ownership maintained its lead in this group. In early 1986, Xerox sold the 8 inch floppy drive product line and the Shugart name to the Narlinger Group, which now operates as Shugart Corporation and manufactures the 8 inch floppy drive product lines acquired from Shugart/Xerox, Tandon and Control Data.

While still under Xerox ownership, Shugart shipped 33,200 drives in 1985, for 34.9% of worldwide unit shipments of non-captive drives. Magyar Optikai Muvek (known as MOM), a Hungarian manufacturing organization, shipped 31.5%, and ISOT, the Bulgarian enterprise which makes disk drives for many of the Eastern Bloc countries, was third with 27.3%. Only a few other manufacturers still produce OEM floppy drives in this group, and the number is reduced each year.

Marketing trends

DISK/TREND forecasts indicate that all production in Western countries will cease by 1987, with only Eastern Bloc shipments continuing

after that time. The forecasted decline will affect all market classes. It now appears that IBM's continued reliance on its original floppy format for many word processing and terminal applications will end, in favor of smaller floppy drive configurations. The few other remaining captive programs will suffer the same fate. The customer base for OEM drives is much larger, but many OEM's are quick to adopt new disk drive formats, so shipments of OEM drives will also continue to slide.

Technical trends

Nothing new is expected in this product group. Drive manufacturers are unwilling to invest in the format, since they recognize that system OEMs wishing similar capacities will turn to 5.25 inch and smaller floppy formats and those wishing larger capacities will use two sided drives of various sizes.

Half high 8 inch, one side drives were introduced by several manufacturers, but they were not developed especially for this product group. The main interest of most drive manufacturers in half high 8 inch drives was in two sided drives, and since the additional cost in offering one sided versions is low, several manufacturers offered them -- but too late to turn the tide.

Forecasting assumptions

1. 8 inch, one side drives will be displaced in most new system designs by smaller diameter drives.

TABLE 8

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1985		Forecast							
	Revenues		1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	8.8	12.6	--	--	--	--	--	--	--	--
Other U.S. Captive	1.9	2.6	1.0	1.6	.5	.8	--	--	--	--
TOTAL U.S. CAPTIVE	10.7	15.2	1.0	1.6	.5	.8	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	11.1	12.7	4.5	6.3	1.8	2.7	--	--	--	--
TOTAL U.S. NON-CAPTIVE	11.1	12.7	4.5	6.3	1.8	2.7	--	--	--	--
TOTAL U.S. REVENUES	21.8	27.9	5.5	7.9	2.3	3.5	--	--	--	--
Non-U.S. Manufacturers										
Captive	--	8.0	--	9.0	--	6.8	--	4.8	--	2.3
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	26.6	--	24.3	--	21.7	--	16.4	--	11.2
TOTAL NON-U.S. REVENUES	--	34.6	--	33.3	--	28.5	--	21.2	--	13.5
Worldwide Recap										
TOTAL WORLDWIDE REVENUES	21.8	62.5	5.5	41.2	2.3	32.0	--	21.2	--	13.5
OEM Average Price ($000)	.331	.413	.328	.414	.295	.407	--	.400	--	.400

TABLE 9

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1985		Forecast							
	Shipments		1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	8.4	12.0	--	--	--	--	--	--	--	--
Other U.S. Captive	2.3	3.1	1.2	2.0	.6	1.0	--	--	--	--
TOTAL U.S. CAPTIVE	10.7	15.1	1.2	2.0	.6	1.0	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	33.5	39.2	13.7	20.0	6.1	9.0	--	--	--	--
TOTAL U.S. NON-CAPTIVE	33.5	39.2	13.7	20.0	6.1	9.0	--	--	--	--
TOTAL U.S. SHIPMENTS	44.2	54.3	14.9	22.0	6.7	10.0	--	--	--	--
Non-U.S. Manufacturers										
Captive	--	8.0	--	10.0	--	8.0	--	6.0	--	3.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	56.0	--	54.0	--	51.0	--	41.0	--	28.0
TOTAL NON-U.S. SHIPMENTS	--	64.0	--	64.0	--	59.0	--	47.0	--	31.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	44.2	118.3	14.9	86.0	6.7	69.0	--	47.0	--	31.0
Cumulative Shipments										
IBM	360.8	502.8	360.8	502.8	360.8	502.8	360.8	502.8	360.8	502.8
Non-IBM	2,579.6	4,102.3	2,594.5	4,188.3	2,601.2	4,257.3	2,601.2	4,304.3	2,601.2	4,335.3
WORLDWIDE TOTAL	2,940.4	4,605.1	2,955.3	4,691.1	2,962.0	4,760.1	2,962.0	4,807.1	2,962.0	4,838.1

TABLE 10

FLEXIBLE DISK DRIVES, 8 Inch, One Side

WORLDWIDE SHIPMENTS (000)

DRIVE HEIGHT ANALYSIS

	1985		Forecast							
	--Shipments--		-----1986----		-----1987----		-----1988----		-----1989----	
	Units	%	Units	%	Units	%	Units	%	Units	%
U.S. MANUFACTURERS										
Captive Total	15.1		2.0		1.0		--		--	
Full Size	15.1	100.0	2.0	100.0	1.0	100.0	--	--	--	--
OEM Total	39.2		20.0		9.0		--		--	
Full Size	33.7	86.1	19.0	95.1	8.3	92.3	--	--	--	--
Half High	5.5	13.9	1.0	4.9	.7	7.7	--	--	--	--
Total U.S.	54.3		22.0		10.0		--		--	
Full Size	48.8	90.0	21.0	95.6	9.3	93.1	--	--	--	--
Half High	5.5	10.0	1.0	4.4	.7	6.9	--	--	--	--
NON-U.S. MANUFACTURERS										
Captive Total	8.0		10.0		8.0		6.0		3.0	
Full Size	8.0	100.0	10.0	100.0	8.0	100.0	6.0	100.0	3.0	100.0
OEM Total	56.0		54.0		51.0		41.0		28.0	
Full Size	56.0	100.0	54.0	100.0	51.0	100.0	41.0	100.0	28.0	100.0
Total Non-U.S.	64.0		64.0		59.0		47.0		31.0	
Full Size	64.0	100.0	64.0	100.0	59.0	100.0	47.0	100.0	31.0	100.0
WORLDWIDE RECAP										
Total Shipments	118.3		86.0		69.0		47.0		31.0	
	-39.8%		-27.3%		-19.7%		-31.8%		-34.0%	
Full Size	112.8	95.5	85.0	98.9	68.3	99.1	47.0	100.0	31.0	100.0
	-39.8%		-24.6%		-19.6%		-31.1%		-34.0%	
Half High	5.5	4.5	1.0	1.1	.7	.9	--	--	--	--
	-40.2%		-81.8%		-30.0%		--		--	

Note: Percentage figures with plus/minus signs refer to year-to-year growth rates.

TABLE 11

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

APPLICATIONS SUMMARY
Percentage of Worldwide Shipments

APPLICATION	1985 Estimate Units (000)	1985 Estimate %	1989 Projection Units (000)	1989 Projection %
MAINFRAME/SUPERMINI General purpose	6.8	5.8	.6	2.0
MINICOMPUTERS AND MULTI-USER MICROS Business and professional, including networks	14.8	12.5	2.8	9.0
MICROCOMPUTERS Business and professional, single user	30.5	25.8	3.7	12.0
OFFICE SYSTEMS AND WORKSTATIONS Dedicated application	62.1	52.5	22.7	73.0
NON-OFFICE SYSTEMS AND WORKSTATIONS Technical, distribution, medical, other specialized	4.1	3.4	1.2	4.0
CONSUMER AND HOBBY COMPUTERS	--	--	--	--
OTHER APPLICATIONS	--	--	--	--
Total	118.3	100.0	31.0	100.0

TABLE 12

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE
DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

Distribution channel	1985 U.S. Net Shipments Units (000)	%	FORECAST 1986 %	1987 %	1988 %	1989 %
Mainframe computer manufacturers	2.4	7.2	4.9	--	--	--
Mini/micro computer manufacturers	1.6	4.8	3.6	2.2	--	--
System OEMs/systems houses	23.4	69.9	82.4	96.2	--	--
Independent peripherals suppliers	3.7	11.1	5.0	--	--	--
Distributors, dealers, end users	2.4	7.0	4.1	1.6	--	--
TOTAL	33.5					

TABLE 13

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1985 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Shugart	29.1	86.9	33.2	34.9
Magyar Optikai Muvek	--	--	30.0	31.5
Isot	--	--	26.0	27.3
Tandon	4.0	11.9	5.5	5.8
Other U.S.	.4	1.2	.5	.5
Other Non-U.S.	--	--	--	--
TOTAL	33.5	100.0	95.2	100.0

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

1986 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

Coverage

Examples of flexible disk drives in this group include:

Caldisk	143M
Elcomatic	ACP 700
Hitachi	FDD-412, FDD-441
IBM	4964, 4966
ISOT	ES 5083
Matsushita Communication Ind.	JA-751
Miltope	DD 450, DD 550
Mitsubishi Electric	M2896-63
NEC	FD 1165
Ricoh	RF8160
Shugart	851, 848-2
Toshiba	ND-40D
YE Data	YD-180

Most of the flexible disk drives in this group are intended to use IBM's recording formats for two sided flexible disks, either "Diskette 2" for standard density or "Diskette 2D" for double density. IBM's diskette magazine drive is included in the group, since it uses standard media in a conventional drive, fed by a diskette-changing mechanism. Most OEM drives introduced in the last few years are half-high versions.

Drives using special recording formats are offered by two manufacturers. In 1983, Hitachi announced a half high drive with 9.6 megabytes capacity, achieved with 96 TPI and 20,560 BPI, using a run length limited code, with cobalt modified oxide coated media. Elcomatic's ACP 1500 provides 3.2 megabytes by using 96 TPI and normal recording densities. Burroughs' high capacity floppy drives, which pioneered the use of a reference track for head positioning, are no longer in production.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1985	1986	1987	1988	1989
U.S. manufacturers	305.2	141.6	63.1	4.7	1.6
All manufacturers	600.4	389.5	211.7	78.5	26.7

8 inch, two sided drives reached their worldwide shipment peak in 1983, at 1,275,900 units, and have declined steadily to 1985's 786,300 units. The rate of fall will slow in 1986, buoyed somewhat by strong markets for mid-range systems, but the 1986 estimated worldwide shipment total is down to 606,100 drives.

U.S. manufacturers' shipments of 8 inch, two sided drives peaked in 1982. In recent years, the largest factor in maintaining shipments of drives in this product group at a high level has been heavy use of the two sided 8 inch format in the Japanese domestic market. But the tide has turned, as 1.6 megabyte 5.25 inch drives have been designed into more of the newer Japanese office computers. The advent of 1.6 and 2.0 megabyte 3.5 inch drives will further impact the market for 8 inch drives.

In 1986, an estimated 463,000 half high two sided 8 inch drives will be shipped by non-U.S. drive manufacturers, contrasting sharply with only 28,900 by U.S. manufacturers. The low U.S. total is attributed to the fact that more than half of U.S. total shipments are by IBM, which never progressed to a half high model. Also contributing was Shugart's previous role as the dominant U.S. manufacturer of OEM 8 inch drives -- considering the fact that the firm never produced a successful half high 8 inch drive.

In the U.S., production of drives in this group is now drying up quickly. IBM continues to reduce its reliance on 8 inch, two sided drives, as older systems are replaced by personal computers, specialized

workstations and terminals using smaller floppies. And the old Shugart organization, after years of decline under inept Xerox ownership, was sold in early 1986. The Narlinger Group acquired the 8 inch floppy product line, now down to modest production levels, and the Shugart company name. It now operates as Shugart Corporation and manufactures the 8 inch floppy drive product lines purchased from Xerox, Tandon and Control Data.

Japanese companies now dominate OEM shipments in this group. YE Data continues to lead in worldwide non-captive shipments with 133,000 drives in 1985, 35.4% of the total. Hitachi held 13.3% and NEC 11.4%.

Marketing trends

Continued decline for this product group is inevitable. 1989 worldwide shipments are forecasted at a mere 91,000 drives, and a total even this large is a tribute to the production longevity of some of the systems in which two sided 8 inch drives are used.

It is believed that this product group's current lack of vigor is traceable to a combination of factors: (1) Rapid development of the 5.25 and 3.5 inch formats, offering capacities equalling those of 8 inch drives at much lower prices. (2) The reliability problems most manufacturers experienced with 8 inch, two sided drives in the late 1970's, which kept many OEMs from committing to the format, and (3) Lack of further development of the 8 inch drive format by IBM, which inhibited manufacturers of OEM drives from investing in higher density versions.

In addition, certain specific developments will further change the future outlook. In Japan's domestic market, most manufacturers of small office computer systems have already felt the pressure to move to desktop versions of their older systems, and the 1.6 megabyte 5.25 inch floppy

drive developed under the sponsorship of Nippon Telephone & Telegraph has made it possible to do so with a half high 5.25 inch drive. Shipments of these drives are increasing rapidly in Japan, and they are displacing most of the growth which would have otherwise gone to 8 inch, two sided drives. More recent availability of 3.5 inch drives in this capacity range have intensified the problem for 8 inch drives.

But the knockout punch for 8 inch, two sided drives has been delivered by IBM, their originator. IBM is using 1.6 megabyte 5.25 inch drives in its high end personal computer, the PC AT, and is broadening usage of these drives to additional new PC models and other small systems, with a resulting drop in production of 8 inch, two sided drives. IBM is now de-emphasizing internal production of all types of flexible disk drives, in view of the ready availability of all types of floppy drives at depressed OEM price levels, and the final internal IBM production of 8 inch drives in this group is now forecasted for 1987.

Technical trends

With the exception of limited programs by Burroughs, PerSci, and Elcomatic, there have been few serious attempts to introduce higher capacity drives in this group.

The key reason that development of 8 inch drives has been stuck at 1.6 megabytes since 1976 is IBM's lack of innovation in the area. Since the existing 8 inch diskette's physical design and recording format were defined by IBM, and because of IBM's dominant leadership in the applications for 8 inch, two sided floppies, most manufacturers of OEM drives hesitated to attempt the introduction of their own improvements, even though some had undertaken development programs.

Several manufacturers of OEM drives were ready to introduce new drives for years, with most planning various track following methods, to make possible doubling the track density. These plans were generally set back by the reliability problems which were experienced by two sided 8 inch floppy drives until the end of the 1970's, and by the hope of most manufacturers that IBM would take the lead in establishing a new high capacity format, preferably with an improved, higher density media standard.

In October, 1983, Hitachi announced a 9.6 megabyte drive which uses a special Maxell cobalt modified oxide coated diskette. The Hitachi drive uses 96 TPI and triples the effective linear density to 20,560 BPI, by roughly doubling the actual recording density and using a run length limited code. This drive has been sold mostly in the Japanese domestic market, as a backup device for fixed Winchester disk drives.

After all the waiting, the momentum has passed to the smaller diameter floppy formats. After observing the high growth of desktop and portable systems, most manufacturers remaining in the flexible disk drive business are now putting their development resources into smaller drives.

Forecasting assumptions

1. IBM will continue the transition to smaller floppy drives for new versions of its personal computer and other small systems, and will end internal production of 8 inch, two sided drives by 1987.

2. The Japanese domestic market will continue to move away from 8 inch, two sided floppy drives, in favor of high capacity 5.25 inch and 3.5 inch drives.

3. U.S. system manufacturers competing with IBM will follow IBM's move to 5.25 inch and smaller drives, causing a continuing reduction in OEM shipments of 8 inch, two sided drives.

TABLE 14

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1985 Revenues		Forecast 1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	166.4	260.1	80.5	122.1	33.8	51.2	--	--	--	--
Other U.S. Captive	14.0	20.9	.3	3.0	--	--	--	--	--	--
TOTAL U.S. CAPTIVE	180.4	281.0	80.8	125.1	33.8	51.2	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	15.3	24.2	8.0	16.5	5.4	11.9	1.4	4.7	.4	1.6
TOTAL U.S. NON-CAPTIVE	15.3	24.2	8.0	16.5	5.4	11.9	1.4	4.7	.4	1.6
TOTAL U.S. REVENUES	195.7	305.2	88.8	141.6	39.2	63.1	1.4	4.7	.4	1.6
Non-U.S. Manufacturers										
Captive	--	234.5	--	181.8	--	95.8	--	40.9	--	11.9
PCM	--	--	--	--	--	--	--	--	--	--
OEM	5.8	60.7	10.2	66.1	7.5	52.8	3.7	32.9	1.2	13.2
TOTAL NON-U.S. REVENUES	5.8	295.2	10.2	247.9	7.5	148.6	3.7	73.8	1.2	25.1
Worldwide Recap										
TOTAL WORLDWIDE REVENUES	201.5	600.4	99.0	389.5	46.7	211.7	5.1	78.5	1.6	26.7
OEM Average Price ($000)	.312	.226	.337	.255	.253	.242	.219	.225	.200	.203

TABLE 15

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1985		Forecast							
	Shipments		1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	97.9	153.0	48.8	74.0	21.1	32.0	--	--	--	--
Other U.S. Captive	9.3	13.9	.2	2.0	--	--	--	--	--	--
TOTAL U.S. CAPTIVE	107.2	166.9	49.0	76.0	21.1	32.0	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	45.6	69.0	22.5	49.9	18.3	43.0	6.3	21.0	2.0	8.0
TOTAL U.S. NON-CAPTIVE	45.6	69.0	22.5	49.9	18.3	43.0	6.3	21.0	2.0	8.0
TOTAL U.S. SHIPMENTS	152.8	235.9	71.5	125.9	39.4	75.0	6.3	21.0	2.0	8.0
Non-U.S. Manufacturers										
Captive	--	243.6	--	206.3	--	119.2	--	56.0	--	18.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	22.0	306.8	31.5	273.9	32.7	224.0	17.0	146.0	6.0	65.0
TOTAL NON-U.S. SHIPMENTS	22.0	550.4	31.5	480.2	32.7	343.2	17.0	202.0	6.0	83.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	174.8	786.3	103.0	606.1	72.1	418.2	23.3	223.0	8.0	91.0
Cumulative Shipments										
IBM	776.0	1,166.6	824.8	1,240.6	845.9	1,272.6	845.9	1,272.6	845.9	1,272.6
Non-IBM	1,301.7	4,552.4	1,355.9	5,084.5	1,406.9	5,470.7	1,430.2	5,693.7	1,438.2	5,784.7
WORLDWIDE TOTAL	2,077.7	5,719.0	2,180.7	6,325.1	2,252.8	6,743.3	2,276.1	6,966.3	2,284.1	7,057.3

TABLE 16

FLEXIBLE DISK DRIVES, 8 Inch, Two Sides

WORLDWIDE SHIPMENTS (000)

DRIVE HEIGHT ANALYSIS

	1985 --Shipments--		Forecast							
			1986		1987		1988		1989	
	Units	%	Units	%	Units	%	Units	%	Units	%
U.S. MANUFACTURERS										
Captive Total	166.9		76.0		32.0		--		--	
Full Size	166.9	100.0	76.0	100.0	32.0	100.0	--	--	--	--
OEM Total	69.0		49.9		43.0		21.0		8.0	
Full Size	38.9	56.5	21.0	42.1	8.0	18.6	--	--	--	--
Half High	30.1	43.5	28.9	57.9	35.0	81.4	21.0	100.0	8.0	100.0
Total U.S.	235.9		125.9		75.0		21.0		8.0	
Full Size	205.8	87.3	97.0	77.1	40.0	53.4	--	--	--	--
Half High	30.1	12.7	28.9	22.9	35.0	46.6	21.0	100.0	8.0	100.0
NON-U.S. MANUFACTURERS										
Captive Total	243.6		206.3		119.2		56.0		18.0	
Full Size	14.0	5.7	6.3	3.1	1.2	1.0	--	--	--	--
Half High	229.6	94.3	200.0	96.9	118.0	99.0	56.0	100.0	18.0	100.0
OEM Total	306.8		273.9		224.0		146.0		65.0	
Full Size	31.0	10.1	10.9	4.0	6.0	2.7	4.0	2.7	1.0	1.5
Half High	275.8	89.9	263.0	96.0	218.0	97.3	142.0	97.3	64.0	98.5
Total Non-U.S.	550.4		480.2		343.2		202.0		83.0	
Full Size	45.0	8.2	17.2	3.6	7.2	2.1	4.0	2.0	1.0	1.2
Half High	505.4	91.8	463.0	96.4	336.0	97.9	198.0	98.0	82.0	98.8
WORLDWIDE RECAP										
Total Shipments	786.3		606.1		418.2		223.0		91.0	
	-34.8%		-22.9%		-31.0%		-46.6%		-59.1%	
Full Size	250.8	31.9	114.2	18.8	47.2	11.3	4.0	1.8	1.0	1.1
	-44.5%		-54.4%		-58.6%		-91.5%		-75.0%	
Half High	535.5	68.1	491.9	81.2	371.0	88.7	219.0	98.2	90.0	98.9
	-28.9%		-8.1%		-24.5%		-40.9%		-58.9%	

Note: Percentage figures with plus/minus signs refer to year-to-year growth rates.

TABLE 17

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

APPLICATIONS SUMMARY
Percentage of Worldwide Shipments

APPLICATION	1985 Estimate Units (000)	1985 Estimate %	1989 Projection Units (000)	1989 Projection %
MAINFRAME/SUPERMINI General purpose	134.6	17.1	19.1	21.0
MINICOMPUTERS AND MULTI-USER MICROS Business and professional, including networks	254.2	32.3	30.1	33.0
MICROCOMPUTERS Business and professional, single user	194.4	24.7	10.0	11.0
OFFICE SYSTEMS AND WORKSTATIONS Dedicated application	128.5	16.3	16.4	18.0
NON-OFFICE SYSTEMS AND WORKSTATIONS Technical, distribution, medical, other specialized	58.4	7.4	12.7	14.0
CONSUMER AND HOBBY COMPUTERS	--	--	--	--
OTHER APPLICATIONS	16.2	2.2	2.7	3.0
Total	786.3	100.0	91.0	100.0

TABLE 18

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES
DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

Distribution channel	1985 U.S. Net Shipments Units (000)	%	FORECAST 1986 %	1987 %	1988 %	1989 %
Mainframe computer manufacturers	19.3	28.5	25.6	23.1	20.8	18.7
Mini/micro computer manufacturers	1.9	2.8	3.0	3.2	3.3	3.4
System OEMs/systems houses	32.8	48.5	53.9	60.1	65.4	70.4
Independent peripherals suppliers	2.9	4.2	2.9	1.9	1.1	--
Distributors, dealers, end users	10.7	16.0	14.6	11.7	9.4	7.5
TOTAL	67.6					

TABLE 19

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1985 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
YE Data	--	--	133.0	35.4
Hitachi	--	--	49.8	13.3
NEC	7.0	10.4	43.0	11.4
Tandon	24.1	35.7	30.1	8.0
Mitsubishi Electric	13.0	19.2	26.0	6.9
Shugart	14.7	21.7	23.7	6.3
Matsushita Com. Ind.	--	--	22.0	5.9
BASF	--	--	20.0	5.3
Control Data	5.3	7.8	13.6	3.6
Other U.S.	1.5	2.2	1.6	.4
Other Non-U.S.	2.0	3.0	13.0	3.5
TOTAL	67.6	100.0	375.8	100.0

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

1986 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

Coverage

Examples of flexible disk drives in this group include:

48 tracks per inch

Alps Electric	DFC 122
Asia Commercial	FD-103
Chinon	F-051D
Flexdisc	FF450
Goldstar Tele-Electric	GSF 48S
Hi-Tech Peripherals	H548-25
Ho Shin	HD-55A
Instrumentation & Automation	MFDD-110
Inventa	FD-541
ISOT	ES 5088
Magyar Optikai Muvek	MF 2000
Mitac	AD-3
Mitsumi Electric	D 501
Multidigit	DF0211
Oceanic	OC-116, OH-2
Oriental Precision	OFD-543
Robotron	K 5600.10
TEAC	FD-55AV
Tecmate	NPH-501A
Video Technology	FDM 110

96/100 tracks per inch

Digital Equipment	RX50
Ho Shin	HD-55C
Robotron	K 5600.20
TEAC	FD-55EV

The basic standards for physical size and recording format for this product group were created by the introduction of the Shugart SA 400, the original minifloppy, in 1976. The early growth in small microcomputer systems inspired several innovative one sided 5.25 inch drives, some of which achieved success until the industry's movement to two sided versions.

An early pioneer was Micropolis, which introduced 100 TPI 5.25 inch drives in 1977, matching the 77 track standard recording format of 8 inch

floppy drives. In 1980 Tandon and Micro Peripherals joined Micropolis in setting a 96 TPI standard, which established the 80 tracks/per side format now widely used with both one and two sided drives.

Because of the continued shrinkage in the physical size of computer systems, reduced drive height became an extremely active area of innovation. BASF introduced drives in 1978 which were two thirds the height of the SA 400's 3.25 inches, but sales of two thirds high drives by BASF and others were modest. However, half high drives, pioneered by Tandon and Alps Electric, are now offered by most drive manufacturers, and have become the dominant physical size standard for floppy drives using 5.25 inch diskettes.

Other innovative one side 5.25 inch drives have been introduced, with varying levels of success. Early in 1982, Amlyn started shipping a drive using a special cartridge of five diskettes, each recorded on one side at 170 TPI and 9500 BPI. This drive had limited success, and Amlyn has discontinued operations. With first shipments also in 1982, Digital Equipment Corporation offers a one sided drive which uses a single head positioning system for two diskettes, for use with DEC personal computers.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1985	1986	1987	1988	1989
U.S. manufacturers	140.9	60.4	34.3	7.4	--
All manufacturers	294.8	202.5	172.8	139.0	102.6

After peaking in 1984 with almost 5 million units shipped worldwide, 5.25 inch, one side drives have experienced a sharp drop in production

rates caused by weak demand in 1985 and a continuing transition to other types of floppy drives. 2,902,200 drives were shipped worldwide in 1985, and 1986 shipments are forecasted at 1,947,000.

1984 was also the last year of significant shipments of OEM drives in this product group by U.S. manufacturers. 1985 shipments by U.S. firms were only 1% of the worldwide OEM total, with 1986 expected to be the final year.

Shipments of OEM drives by non-U.S. manufacturers have constituted the bulk of shipments in this group in recent years, but these are also in rapid decline. Worldwide OEM shipments by non-U.S. companies were down 27.7% in 1985, to 2,497,700 units, and will fall an estimated additional 31.2% in 1986, to 1,719,000.

Even though the totals are lower, OEM shipments in 1985 continued to be dominated by Alps Electric's large sales to Apple and other personal computer manufacturers. Alps held 55.3% of worldwide unit shipments in 1985, with 1,400,000 drives. Mitsumi Electric's late entry into the market has generated business with selected major accounts, and the firm secured 23.7% of 1985's total shipments.

Most captive production of 5.25 inch, one side drives in Western countries has been discontinued, with the 1985 end of captive programs by Tandy, Shugart, Philips and Olivetti -- leaving Digital Equipment's RX50 as the only major captive drive still in production, along with limited production in Korea and Hong Kong for low end personal computers. Eastern Bloc captive shipments are starting to grow, however, as several countries start to place emphasis on development of personal computer industries.

Marketing trends

Usage of 5.25 inch, one side drives in Western countries will continue to drop rapidly. DISK/TREND forecasts indicate an average annual decline of 37.9% for 1987 through 1989, with the 1989 worldwide unit shipment total down to 465,000 drives.

In the U.S., the remaining captive shipments by Digital Equipment are expected to decline, as newer types of drives are substituted. Newer drives will also displace the majority of OEM flexible disk drive production by non-U.S. manufacturers, with their 1989 shipments projected to be down to 292,000 drives.

By 1989, it is expected that all production of drives in this group will be concentrated in the Eastern Bloc. Eastern Bloc countries have concentrated on establishing production of full size 5.25 inch, one side drives for their emerging personal computer industry, but it is expected that a gradual transition to half high drives will occur, as it already has in Western countries.

The most significant reason for the abandonment of 5.25 inch, one side drives in Western countries was IBM's action in offering two sided 5.25 inch drives with its personal computers. The outstanding success of IBM's personal computer family has made the industry hungry for compatibility. And, while 5.25 inch one side drives were offered with the original personal computer model, two sided drives have dominated shipments on that and subsequent models.

Microfloppy drives will directly displace 5.25 inch, one side drives which otherwise would have been used in portable and desktop computers. While the widespread use of 5.25 inch diskette media provides considerable momentum for the format, it is expected that microfloppies will gradually

build up shipment momentum in the portable and "small-footprint" desktop computer markets, at the expense of 5.25 inch drives.

Technical trends

The industry has not invested heavily in development programs for this product group, and most of the work undertaken has been intended to result in smaller, cheaper floppy drives. Well publicized programs by Alps Electric, Tandon and Shugart resulted in mechanism-only versions of 5.25 inch, one side drives priced as low as $40 for very large quantities.

More significant to the entire industry, however, were the half high drives, just 1.625 inches (41 millimeters) in height. Although designed for both one sided and two sided models, the one sided versions have kept this product group going longer than would otherwise have been likely.

Significant changes in technology for this group during the next few years are not expected. 5.25 inch, one side drives offer neither the capacity potential of two sided 5.25 inch drives nor the smaller physical volume potential of 3.5 inch drives -- and will probably not see any further development.

Forecasting assumptions

1. Shipments of 5.25 inch, one side drives will decline, except in Eastern Bloc countries, due to competition from microfloppies and 5.25 inch, two sided drives.

TABLE 20

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1985 Revenues		Forecast 1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	110.4	138.8	45.0	60.0	25.7	34.3	5.9	7.4	--	--
TOTAL U.S. CAPTIVE	110.4	138.8	45.0	60.0	25.7	34.3	5.9	7.4	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	2.1	2.1	.4	.4	--	--	--	--	--	--
TOTAL U.S. NON-CAPTIVE	2.1	2.1	.4	.4	--	--	--	--	--	--
TOTAL U.S. REVENUES	112.5	140.9	45.4	60.4	25.7	34.3	5.9	7.4	--	--
Non-U.S. Manufacturers										
Captive	10.8	32.1	.9	48.9	1.4	75.9	--	86.4	--	75.3
PCM	--	--	--	--	--	--	--	--	--	--
OEM	76.6	121.8	45.4	93.2	22.2	62.6	9.5	45.2	2.5	27.3
TOTAL NON-U.S. REVENUES	87.4	153.9	46.3	142.1	23.6	138.5	9.5	131.6	2.5	102.6
Worldwide Recap										
TOTAL WORLDWIDE REVENUES	199.9	294.8	91.7	202.5	49.3	172.8	15.4	139.0	2.5	102.6
OEM Average Price ($000)	.050	.049	.050	.054	.055	.062	.070	.079	.089	.093

TABLE 21

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1985 Shipments		Forecast 1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	246.0	307.0	90.0	120.0	52.5	70.0	12.0	15.0	--	--
TOTAL U.S. CAPTIVE	246.0	307.0	90.0	120.0	52.5	70.0	12.0	15.0	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	31.8	32.0	3.5	3.5	--	--	--	--	--	--
TOTAL U.S. NON-CAPTIVE	31.8	32.0	3.5	3.5	--	--	--	--	--	--
TOTAL U.S. SHIPMENTS	277.8	339.0	93.5	123.5	52.5	70.0	12.0	15.0	--	--
Non-U.S. Manufacturers										
Captive	19.0	65.5	3.0	104.5	3.0	158.0	--	188.0	--	173.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	1,551.9	2,497.7	920.0	1,719.0	404.0	1,008.0	135.0	575.0	28.0	292.0
TOTAL NON-U.S. SHIPMENTS	1,570.9	2,563.2	923.0	1,823.5	407.0	1,166.0	135.0	763.0	28.0	465.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	1,848.7	2,902.2	1,016.5	1,947.0	459.5	1,236.0	147.0	778.0	28.0	465.0
Cumulative Shipments										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	13,194.9	17,152.6	14,211.4	19,099.6	14,670.9	20,335.6	14,817.9	21,113.6	14,845.9	21,578.6
WORLDWIDE TOTAL	13,194.9	17,152.6	14,211.4	19,099.6	14,670.9	20,335.6	14,817.9	21,113.6	14,845.9	21,578.6

TABLE 22

FLEXIBLE DISK DRIVES, 5.25 Inch, One Side

WORLDWIDE SHIPMENTS (000)

DRIVE HEIGHT ANALYSIS

	1985		Forecast							
	--Shipments--		-----1986----		-----1987----		-----1988----		-----1989----	
	Units	%	Units	%	Units	%	Units	%	Units	%
U.S. MANUFACTURERS										
Captive Total	307.0		120.0		70.0		15.0		--	
Full Size	205.0	66.9	120.0	100.0	70.0	100.0	15.0	100.0	--	--
Half High	102.0	33.1	--	--	--	--	--	--	--	--
OEM Total	32.0		3.5		--		--		--	
Full Size	11.0	34.4	--	--	--	--	--	--	--	--
Half High	21.0	65.6	3.5	100.0	--	--	--	--	--	--
Total U.S.	339.0		123.5		70.0		15.0		--	
Full Size	216.0	63.8	120.0	97.3	70.0	100.0	15.0	100.0	--	--
Half High	123.0	36.2	3.5	2.7	--	--	--	--	--	--
NON-U.S. MANUFACTURERS										
Captive Total	65.5		104.5		158.0		188.0		173.0	
Full Size	28.5	43.5	73.0	70.0	118.0	74.8	130.0	69.2	74.0	42.8
Half High	37.0	56.5	31.5	30.0	40.0	25.2	58.0	30.8	99.0	57.2
OEM Total	2,497.7		1,719.0		1,008.0		575.0		292.0	
Full Size	121.7	4.9	91.0	5.3	110.0	10.9	123.0	21.4	104.0	35.6
Half High	2,376.0	95.1	1,628.0	94.7	898.0	89.1	452.0	78.6	188.0	64.4
Total Non-U.S.	2,563.2		1,823.5		1,166.0		763.0		465.0	
Full Size	150.2	5.9	164.0	9.0	228.0	19.6	253.0	33.2	178.0	38.3
Half High	2,413.0	94.1	1,659.5	91.0	938.0	80.4	510.0	66.8	287.0	61.7
WORLDWIDE RECAP										
Total Shipments	2,902.2		1,947.0		1,236.0		778.0		465.0	
	-38.6%		-32.9%		-36.5%		-37.0%		-40.2%	
Full Size	366.2	12.6	284.0	14.6	298.0	24.1	268.0	34.4	178.0	38.3
	-81.9%		-22.4%		+4.9%		-10.0%		-33.5%	
Half High	2,536.0	87.4	1,663.0	85.4	938.0	75.9	510.0	65.6	287.0	61.7
	-6.2%		-34.4%		-43.5%		-45.6%		-43.7%	

Note: Percentage figures with plus/minus signs refer to year-to-year growth rates.

TABLE 23

FLEXIBLE DISK DRIVES, 5.25 Inch, One Side

WORLDWIDE SHIPMENTS (000)

TRACK DENSITY ANALYSIS

	1985 --Shipments--		Forecast 1986		1987		1988		1989	
	Units	%	Units	%	Units	%	Units	%	Units	%
U.S. MANUFACTURERS										
Captive Total	307.0		120.0		70.0		15.0		--	
48 TPI	147.0	48.0	--	--	--	--	--	--	--	--
96 TPI	160.0	52.0	120.0	100.0	70.0	100.0	15.0	100.0	--	--
OEM Total	32.0		3.5		--		--		--	
48 TPI	31.0	97.0	3.5	100.0	--	--	--	--	--	--
96 TPI	1.0	3.0	--	--	--	--	--	--	--	--
Total U.S.	339.0		123.5		70.0		15.0		--	
48 TPI	178.0	52.6	3.5	2.8	--	--	--	--	--	--
96 TPI	161.0	47.4	120.0	97.2	70.0	100.0	15.0	100.0	--	--
NON-U.S. MANUFACTURERS										
Captive Total	65.5		104.5		158.0		188.0		173.0	
48 TPI	47.5	72.6	101.5	97.2	152.0	96.3	178.0	94.8	159.0	92.0
96 TPI	18.0	27.4	3.0	2.8	6.0	3.7	10.0	5.2	14.0	8.0
OEM Total	2,497.7		1,719.0		1,008.0		575.0		292.0	
48 TPI	2,494.7	100.0	1,719.0	100.0	1,008.0	100.0	575.0	100.0	292.0	100.0
96 TPI	3.0	--	--	--	--	--	--	--	--	--
Total Non-U.S.	2,563.2		1,823.5		1,166.0		763.0		465.0	
48 TPI	2,542.2	99.3	1,820.5	99.9	1,160.0	99.6	753.0	98.8	451.0	97.1
96 TPI	21.0	.7	3.0	.1	6.0	.4	10.0	1.2	14.0	2.9
WORLDWIDE RECAP										
48 TPI	2,720.2	93.8	1,824.0	93.8	1,160.0	94.0	753.0	96.9	451.0	97.1
	-41.2%		-32.9%		-36.4%		-35.0%		-40.1%	
96 TPI	182.0	6.2	123.0	6.2	76.0	6.0	25.0	3.1	14.0	2.9
	+89.1%		-32.4%		-38.2%		-67.1%		-44.0%	
Total Shipments	2,902.2		1,947.0		1,236.0		778.0		465.0	
	-38.6%		-32.9%		-36.5%		-37.0%		-40.2%	

Note: Percentage figures with plus/minus signs refer to year-to-year growth rates.

TABLE 24

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

APPLICATIONS SUMMARY
Percentage of Worldwide Shipments

	1985 Estimate		1989 Projection	
APPLICATION	Units (000)	%	Units (000)	%
MAINFRAME/SUPERMINI General purpose	--	--	--	--
MINICOMPUTERS AND MULTI-USER MICROS Business and professional, including networks	20.3	.7	--	--
MICROCOMPUTERS Business and professional, single user	1,948.6	67.1	79.1	17.0
OFFICE SYSTEMS AND WORKSTATIONS Dedicated application	68.5	2.4	9.3	2.0
NON-OFFICE SYSTEMS AND WORKSTATIONS Technical, distribution, medical, other specialized	17.4	.6	--	--
CONSUMER AND HOBBY COMPUTERS	847.4	29.2	376.6	81.0
OTHER APPLICATIONS	--	--	--	--
Total	2,902.2	100.0	465.0	100.0

TABLE 25

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE
DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

Distribution channel	1985 U.S. Net Shipments Units (000)	%	FORECAST 1986 %	1987 %	1988 %	1989 %
Mainframe computer manufacturers	12.3	.8	.6	.3	--	--
Mini/micro computer manufacturers	10.0	.6	.5	.3	--	--
System OEMs/systems houses	1,411.8	89.2	88.8	88.5	87.4	85.5
Independent peripherals suppliers	18.2	1.1	.6	--	--	--
Distributors, dealers, end users	131.4	8.3	9.5	10.9	12.6	14.5
TOTAL	1,583.7					

TABLE 26

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1985 Net Shipments: To United States Destinations Units (000)	%	Worldwide Units (000)	%
Alps Electric	1,270.0	80.2	1,400.0	55.3
Mitsumi Electric	--	--	600.0	23.7
Tokyo Electric	80.0	5.1	100.0	3.9
Teac	--	--	90.0	3.6
Wong's Technology	60.9	3.9	62.5	2.5
Tecmate	33.7	2.1	45.0	1.8
Tandon	30.8	1.9	31.0	1.2
Other U.S.	1.0	.1	1.0	--
Other Non-U.S.	107.3	6.7	200.2	8.0
TOTAL	1,583.7	100.0	2,529.7	100.0

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

1986 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

Coverage

Examples of flexible disk drives in this group include:

48 tracks per inch

Alps Electric	DFC 222
Asia Commercial	FD-104
Canon	211, 413
Chinon	F-502II
Copal	F-5002
Epson	SD-521
Ergo	DS-5
Flexdisc	FF 650
Fujitsu	M2551A
Goldstar Tele-Electric	GSF 48D
Hi-Tech Peripherals	H548-50AT
Ho Shin	HD-55AX
Hyundai Magnetics	FFD HM 65-22
Instrumentation & Automation	BD-120
Inventa	FD 561
ISOT	ES 5321
Lung Hwa	LDD-106DDS
Matsushita Communication Ind.	JA-551
Mitsubishi Electric	MF501A
Mitsumi	D 503
Multidigit	DF0511
NEC	FD 1053
Oceanic	OB-1
Oki Electric	GM 3315BU
Omek	OM55
Oriental Precision	OFD 546
Ricoh	RF5050
Samsung Electronics	SFD-500K
Tandon	TM-100-2, TM-75-2
TEAC	FD-55BV
Tecmate	NPH-502
Toshiba	ND-04D
Victor Company of Japan	MDP-200, MDP-2
Video Technology	FDM 145
Weltec Digital	M 48D
Wong's Electronics	WST 212-5
YE Data	YD-580

96 tracks per inch, 1.0 megabyte

Asia Commercial	FD-106
Alps Electric	DFC 422

96 tracks per inch, 1.0 megabyte (continued)

Canon	MDD-221
Copal	F-5004
Epson	SD-540
Fujitsu	M2552A
Goldstar Tele-Electric	GSF 96D
Hi-Tech Peripherals	H596-10
Hitachi	HFD 510C
Ho Shin	HD-55CX
Hyundai Magnetics	FDD HM 65-4
Inventa	FD 565
ISOT	ES 5323
Matsushita Communication Ind.	JA-561
Mitsubishi Electric	MF503A
Multidigit	DF1011
NEC	FD 1055
Omek	OM56
Oriental Precision	OFD 596
Samsung Electronics	SFD-510K
Tandon	TM-65-4
TEAC	FD-55FV
Toshiba	ND-06D
Victor Company of Japan	MDP-100, MDP-300
Video Technology	FDM 160
Weltec Digital	M 96D
YE Data	YD-480

96 tracks per inch, 1.6 megabytes

Alps Electric	DFC 642, DFC 682
Canon	MD-5501
Chinon	F-506
Copal	F-5006, F-5008
Epson	SD-560, SD-580
Flexdisc	FF 950
Fujitsu	M2553A, M2554A
Goldstar Tele-Electric	GSF 96C
Hi-Tech Peripherals	H596-16AT
Hitachi	HFD 516C, HFD 516DA
Ho Shin	HD-55DH
Hyundai Magnetics	FDD HM 65-8
Matsushita Com. Ind.	JU-581, JU-595
Mitsubishi Electric	MF504A
Multidigit	DF1611
NEC	FD 1155C
Oki Electric	GM3505BU
Omek	OM57
Ricoh	RF5160
Samsung Electronics	SFD-560K
Tandon	TM-75-8
TEAC	FD-55GV, FD-55GFV
Tecmate	NPH-504

96 tracks per inch, 1.6 megabytes (continued)

Toshiba	ND-08D, ND-08DE
Victor Company of Japan	MDP-1000, MFD-5162Z
Weltec Digital	M 16-A
YE Data	YD-380, YD-380B

96 tracks per inch, 2.0 megabytes

Multidigit	DF 2011

Over 96 tracks per inch

Citizen	AFDD
Data Technology	DTC 12
Eastman Kodak	Kodak 3.3, 6.6, 12
Hitachi	FDD 541
Konica	KT-510
Matsushita Communication Ind.	JU-521

Two sided 5.25 inch floppy drives became a reality in 1978. The size of these drives was the same as the one sided SA 400 introduced in 1976 -- 3.25 inches high, 5.75 inches wide, and 8.0 inches deep.

The first two thirds high drives were offered by BASF, also in 1978, followed by a handful of others, with sales mostly in Europe. However, during the last four years most manufacturers of 5.25 inch drives have introduced half high models (1.625 inches high), with an enthusiastic reaction from system manufacturers.

The original 48 TPI drives were joined by 96 TPI drives from Tandon, Micro Peripherals and Micropolis in 1980, and a major trend was started, with most manufacturers now also offering 96 TPI models.

In 1982, 1.6 megabyte 5.25 inch drives were first shipped by YE Data, designed to a standard coordinated by Nippon Telephone and Telegraph. These drives match the capacity and file organization of two sided 8 inch drives by using a minimum of 77 tracks (at 96 TPI) per side at 9600 BPI. Initial shipments were used mostly on systems sold in the Japanese domestic market. IBM's 1984 introduction of the PC AT, using YE Data's 1.6

megabyte drive, has stampeded the market into rapid worldwide usage of the 1.6 megabyte 5.25 inch format. The 2.0 megabyte drive using slightly higher linear densities has so far generated only small sales.

Drivetec's half high drive using an embedded servo technique -- with 192 TPI, and capacity of 3.3 megabytes -- was a technical success and a commercial failure. The company closed down in early 1985 after spending all of its money, but in 1983 had licensed Eastman Kodak to make the drive. Eastman started production of a drive compatible with Drivetec's unit in 1984, and in 1985 announced 6.6 and 12 megabyte models. The 12 megabyte model will be second sourced by Data Technology.

Another type of high capacity drive is offered by Hitachi, with 6.5 megabyte capacity achieved by using 125 TPI and 29,560 BPI. The drive uses cobalt modified particulate media, and was initially produced in the first quarter of 1985. The latest high capacity drive in this group is Konica's 10.97 megabyte drive, using embedded servo techniques to attain 480 TPI, with the capability to read lower capacity standard diskettes.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1985	1986	1987	1988	1989
U.S. manufacturers	216.4	75.1	75.1	85.9	83.8
All manufacturers	1,295.3	1,300.5	1,358.4	1,278.6	1,095.4

Worldwide shipments of two sided 5.25 inch floppy drives suffered their first decline in 1985, dropping 5.2%, to 10,092,700 drives. However, a more vigorous market in 1986 is creating renewed growth for the product group, with worldwide 1986 shipments expected to reach 12,197,900 units, up 20.8%.

1985's decline was caused by slow growth in the personal computer market and other parts of the computer industry. Also contributing to the problem was the increasing usage of small Winchester disks, which reduce user demand of extra floppy drives on personal computers. It is also likely that some large manufacturers of personal computers started 1985 with excess inventories of floppy drives, prompting them to cut back purchases of additional drives in the first half of 1985.

During 1986, however, the character of the market has been completely different. The trend to more personal computers with Winchester disk drives has continued, but renewed growth has been sufficient to enlarge the 1986 market for two sided 5.25 inch floppy drives by an estimated 2.1 million drives.

Included in this total are almost two million one half megabyte 48 TPI drives, which are forecasted to increase 30.3% in worldwide shipments. It's a mixed picture for 96 TPI drives: 1.0 megabyte drives are expected to continue their decline, down 36.7% in 1986; 1.6 megabyte drives will continue their growth, up 22.3% in 1986. IBM's selection of 1.6 megabyte drives for the PC AT has provided the key stimulus for expansion of the 1.6 megabyte drive market, and the firm's continued usage of 48 TPI models as the key drives with most PC XT variations (at least through 1986) has concentrated 1986's growth in 5.25 inch drives in these models.

IBM's movement to half high drives for all of its major personal computers has also helped to depress shipments of older full size drives. 97% of 1986 worldwide shipments are expected to be half high drives.

Shipments by U.S. companies of 5.25 inch, two sided drives are declining even more rapidly than expected. After a 1984 peak of 4.5 million drives, worldwide shipments by U.S. manufacturers collapsed to

1,971,500 units in 1985 and are estimated at 723,100 units for 1986. Tandon remains the only major producer still in the business, making both captive and OEM drives. The other U.S. firms which previously held major shares of the OEM market -- Control Data, Qume, Micro Peripherals and Shugart -- have withdrawn.

Non-U.S. manufacturers increased their shipments of drives in this group by 2 million units in 1985, with growth of more than 3 million drives forecasted for 1986. OEM drives are leading the growth, up an estimated 54.4% in 1986, to 10,482,200 drives. Captive shipments by non-U.S. producers peaked in 1985, with 1,331,100 drives. The outlook for 1986 is a reduction to 992,600 units, as low industry price levels discourage new captive manufacturing programs and as some large captive producers move on to microfloppies.

1985 saw a dramatic collapse in OEM price levels, with almost 20 Japanese manufacturers competing intensely for market share. However, with the drop in the value of the U.S. dollar versus the yen, prices have stabilized in 1986, with some manufacturers actually increasing prices.

Single user business and professional microcomputers, mostly personal computers, generated 76% of the worldwide unit shipments for this product group in 1985, followed by dedicated application office systems with 13%. IBM has been the largest influence in concentrating applications for two sided 5.25 inch drives in the personal computer area, through usage on most of its personal computers except briefcase portables.

In 1985 Tandon failed for the first time in several years to maintain shipment leadership in this product group, as the firm's shipments to IBM declined. Teac held 20% of worldwide unit shipments for 1985, with 1,710,000 drives, followed by YE Data and Tandon, each with 14.7%.

Marketing trends

DISK/TREND forecasts now project 1987 as the last year of growth in total shipments for this product group. 1987 worldwide unit shipments are expected to be up 4.6%, followed by declines of 5.2% in 1988 and 10.5% in 1989 -- as the competitive impact of 3.5 inch drives starts to displace the market for 5.25 inch, two sided drives.

Critical to this forecast is the assumption that IBM will soon start the movement to 3.5 inch flexible disk drives for its major office personal computer product lines. The first product expected is a compact desktop PC using 3.5 inch rigid and floppy disks during the first half of 1987. It is likely that IBM also will continue to offer the PC XT with 5.25 inch floppies for the next few years, but that it will be gradually replaced by the new system.

The impact of such actions by IBM will be to stimulate a rapid transition to 3.5 inch floppy drives for new systems by all participants in the existing PC clone market. 1987 should continue to see growth for two sided 5.25 inch floppy drives, but the rate of growth will be stunted, as system manufacturers divert new programs to utilization of 3.5 inch drives. After 1987, 5.25 inch shipment declines are inevitable -- but the 10.5% drop forecasted for 1989 is relatively small, in consideration of the great momentum the two sided 5.25 inch format has developed.

It is probable that IBM will continue to rely on 5.25 inch floppy drives for systems in the PC AT class for at least a few years longer, providing continuing support for the growth in shipments of 1.6 megabyte 5.25 inch drives. 1.6 megabyte drives are expected to achieve 31% average annual growth in worldwide shipments during 1987-89, and by 1989 will account for over 60% of unit shipments in this product group.

There is increasing activity among manufacturers offering high capacity flexible disk drives, above 1.6 megabytes. It is clear that there is a significant latent market for removable media drives in the capacity range of 5, 10, 20, or more megabytes, as backup devices to the millions of small rigid disk drives now being sold. Current floppy drives with up to 2 megabytes capacity do not provide the convenience most users would like, and tape cartridge drives add system integration complexity many system manufacturers would like to avoid.

The current situation in the 5.25 inch high capacity floppy field is unfortunately a typical one for the industry: Several products, from creditable companies, all technically sound, all producible in quantity, but no industry standard. There has been informal activity among several Japanese companies to agree on standards for 3.3 and 6.6 megabyte drives, but the real market opportunity probably lies with higher capacity drives, which have the opportunity to secure a major part of the backup market now being exploited by tape drive manufacturers.

The half high 20 megabyte (formatted) drive from Iomega, covered in the section on special floppy drives due to the Bernoulli effect technology employed, is a major contender. Also significant are the 12 megabyte (unformatted) drives from Eastman Kodak and Data Technology, plus the Konica 10 megabyte (formatted) drive, which has promises of second source support from Citizen and Omron.

Shipments of these drives are not broken out in current DISK/TREND tables, but projections included in the totals are summarized below:

Worldwide OEM and PCM unit shipments (000)	1986	1987	1988	1989
Drives with capacities greater than 1.6 MB	14.0	75.0	197.0	325.0

Technical trends

The remaining technical questions for this product group involve the methods used to achieve higher capacities. Linear densities approaching 30,000 bits per inch are already in use with the Hitachi 6.5 megabyte drive, and it is reasonable to expect that media with the potential for much higher densities will be available during the next few years.

However, most of the high capacity floppy drives now entering the market achieve their high capacities by utilizing embedded servo head positioning systems, and by increasing track densities to higher levels than can be achieved by the conventional "open loop" head positioning systems used with today's floppy drives. Iomega offers Bernoulli effect drives with track densities over 600 TPI, for example, and the recently announced Konica 5.25 inch drive operates at 480 TPI.

The technology is available to offer capacities even higher than those so far announced, but reaching an industry consensus on the method and interchange standards will be, as usual, the key problem. Will the industry wait for IBM to finally enter the field and select the winner? Probably.

Forecasting assumptions

1. IBM will initiate worldwide usage of 3.5 inch floppy drives in the first half of 1987, but will continue the PC XT and PC AT product lines for at least two more years, utilizing 5.25 inch floppy drives.

2. The growth rate for personal computers which resumed in 1986 will be maintained.

3. The dollar/yen exchange rate will stay in the current range, and the major Japanese floppy disk drive producers will maintain prices at approximately the current levels.

TABLE 27

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1985 Revenues		Forecast 1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	34.7	38.6	--	--	--	--	--	--	--	--
Other U.S. Captive	23.0	30.0	28.8	28.8	28.6	31.8	19.6	24.5	8.8	11.6
TOTAL U.S. CAPTIVE	57.7	68.6	28.8	28.8	28.6	31.8	19.6	24.5	8.8	11.6
PCM	3.4	3.9	--	--	--	--	--	--	--	--
OEM	134.5	143.9	40.2	46.3	36.7	43.3	51.3	61.4	57.9	72.2
TOTAL U.S. NON-CAPTIVE	137.9	147.8	40.2	46.3	36.7	43.3	51.3	61.4	57.9	72.2
TOTAL U.S. REVENUES	195.6	216.4	69.0	75.1	65.3	75.1	70.9	85.9	66.7	83.8
Non-U.S. Manufacturers										
Captive	84.4	537.0	26.0	379.6	22.1	382.9	25.2	365.2	24.5	277.3
PCM	--	--	--	--	--	--	--	--	--	--
OEM	243.7	541.9	423.9	845.8	453.0	900.4	430.5	827.5	394.6	734.3
TOTAL NON-U.S. REVENUES	328.1	1,078.9	449.9	1,225.4	475.1	1,283.3	455.7	1,192.7	419.1	1,011.6
Worldwide Recap										
TOTAL WORLDWIDE REVENUES	523.7	1,295.3	518.9	1,300.5	540.4	1,358.4	526.6	1,278.6	485.8	1,095.4
OEM Average Price ($000)	.081	.080	.083	.080	.081	.081	.081	.081	.081	.081

TABLE 28

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1985		Forecast							
	---Shipments---		------1986-----		------1987-----		------1988-----		------1989-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	99.0	110.0	--	--	--	--	--	--	--	--
Other U.S. Captive	70.0	90.0	90.0	90.0	99.0	110.0	68.0	85.0	32.0	42.0
TOTAL U.S. CAPTIVE	169.0	200.0	90.0	90.0	99.0	110.0	68.0	85.0	32.0	42.0
PCM	20.0	23.0	--	--	--	--	--	--	--	--
OEM	1,628.4	1,748.5	547.1	633.1	284.3	350.0	296.0	365.0	321.0	400.0
TOTAL U.S. NON-CAPTIVE	1,648.4	1,771.5	547.1	633.1	284.3	350.0	296.0	365.0	321.0	400.0
TOTAL U.S. SHIPMENTS	1,817.4	1,971.5	637.1	723.1	383.3	460.0	364.0	450.0	353.0	442.0
Non-U.S. Manufacturers										
Captive	211.6	1,331.1	86.6	992.6	63.0	1,002.0	69.0	992.0	70.0	811.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	3,067.0	6,790.1	5,072.7	10,482.2	5,755.0	11,303.0	5,639.0	10,651.0	5,254.0	9,567.0
TOTAL NON-U.S. SHIPMENTS	3,278.6	8,121.2	5,159.3	11,474.8	5,818.0	12,305.0	5,708.0	11,643.0	5,324.0	10,378.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	5,096.0	10,092.7	5,796.4	12,197.9	6,201.3	12,765.0	6,072.0	12,093.0	5,677.0	10,820.0
Cumulative Shipments										
IBM	414.0	460.0	414.0	460.0	414.0	460.0	414.0	460.0	414.0	460.0
Non-IBM	15,932.9	28,779.6	21,729.3	40,977.5	27,930.6	53,742.5	34,002.6	65,835.5	39,679.6	76,655.5
WORLDWIDE TOTAL	16,346.9	29,239.6	22,143.3	41,437.5	28,344.6	54,202.5	34,416.6	66,295.5	40,093.6	77,115.5

TABLE 29

FLEXIBLE DISK DRIVES, 5.25 Inch, Two Sides

WORLDWIDE SHIPMENTS (000)

DRIVE HEIGHT ANALYSIS

	1985 --Shipments--		Forecast -----1986----		-----1987----		-----1988----		-----1989----	
	Units	%	Units	%	Units	%	Units	%	Units	%
U.S. MANUFACTURERS										
Captive Total	200.0		90.0		110.0		85.0		42.0	
Full Size	140.0	70.1	35.0	38.9	--	--	--	--	--	--
Half High	60.0	29.9	55.0	61.1	110.0	100.0	85.0	100.0	42.0	100.0
OEM Total	1,771.5		633.1		350.0		365.0		400.0	
Full Size	1,373.8	77.7	310.0	49.0	35.0	10.0	--	--	--	--
Half High	397.7	22.3	323.1	51.0	315.0	90.0	365.0	100.0	400.0	100.0
Total U.S.	1,971.5		723.1		460.0		450.0		442.0	
Full Size	1,513.8	76.9	345.0	47.7	35.0	7.6	--	--	--	--
Half High	457.7	23.1	378.1	52.3	425.0	92.4	450.0	100.0	442.0	100.0
NON-U.S. MANUFACTURERS										
Captive Total	1,331.1		992.6		1,002.0		992.0		811.0	
Full Size	16.2	1.2	15.8	1.6	33.0	3.3	78.0	7.9	22.0	2.7
Half High	1,314.9	98.8	976.8	98.4	969.0	96.7	914.0	92.1	789.0	97.3
OEM Total	6,790.1		10,482.2		11,303.0		10,651.0		9,567.0	
Full Size	5.8	.1	6.2	.1	17.0	.2	32.0	.3	45.0	.5
Half High	6,784.3	99.9	10,476.0	99.9	11,286.0	99.8	10,619.0	99.7	9,522.0	99.5
Total Non-U.S.	8,121.2		11,474.8		12,305.0		11,643.0		10,378.0	
Full Size	22.0	.3	22.0	.2	50.0	.4	110.0	.9	67.0	.6
Half High	8,099.2	99.7	11,452.8	99.8	12,255.0	99.6	11,533.0	99.1	10,311.0	99.4
WORLDWIDE RECAP										
Total Shipments	10,092.7		12,197.9		12,765.0		12,093.0		10,820.0	
	-5.2%		+20.8%		+4.6%		-5.2%		-10.5%	
Full Size	1,535.8	15.2	367.0	3.0	85.0	.7	110.0	.9	67.0	.6
	-52.2%		-76.1%		-76.8%		+29.4%		-39.0%	
Half High	8,556.9	84.8	11,830.9	97.0	12,680.0	99.3	11,983.0	99.1	10,753.0	99.4
	+15.2%		+38.2%		+7.1%		-5.4%		-10.2%	

Note: Percentage figures with plus/minus signs refer to year-to-year growth rates.

TABLE 30

FLEXIBLE DISK DRIVES, 5.25 Inch, Two Sides

WORLDWIDE SHIPMENTS (000)

TRACK DENSITY ANALYSIS

	1985		Forecast							
	--Shipments--		-----1986----		-----1987----		-----1988----		-----1989----	
	Units	%	Units	%	Units	%	Units	%	Units	%
U.S. MANUFACTURERS										
Captive Total	200.0		90.0		110.0		85.0		42.0	
48 TPI	190.0	95.1	55.0	61.2	80.0	72.8	25.0	29.4	--	--
96 TPI 1.6 MB	10.0	4.9	35.0	38.8	30.0	27.2	60.0	70.6	42.0	100.0
OEM Total	1,771.5		633.1		350.0		365.0		400.0	
48 TPI	1,682.2	94.9	605.0	95.6	270.0	77.1	178.0	48.8	120.0	30.0
96 TPI 1.0 MB	75.8	4.3	11.6	1.8	--	--	--	--	--	--
96 TPI 1.6 MB	13.5	.8	16.5	2.6	80.0	22.9	187.0	51.2	280.0	70.0
Total U.S.	1,971.5		723.1		460.0		450.0		442.0	
48 TPI	1,872.2	95.0	660.0	91.3	350.0	76.1	203.0	45.1	120.0	27.2
96 TPI 1.0 MB	75.8	3.8	11.6	1.6	--	--	--	--	--	--
96 TPI 1.6 MB	23.5	1.2	51.5	7.1	110.0	23.9	247.0	54.9	322.0	72.8
NON-U.S. MANUFACTURERS										
Captive Total	1,331.1		992.6		1,002.0		992.0		811.0	
48 TPI	609.6	45.9	285.3	28.7	198.0	19.8	188.0	19.0	107.0	13.2
96 TPI 1.0 MB	110.0	8.3	51.5	5.2	28.0	2.8	14.0	1.4	8.0	1.0
96 TPI 1.6 MB	611.5	45.8	655.8	66.1	776.0	77.4	790.0	79.6	696.0	85.8
OEM Total	6,790.1		10,482.2		11,303.0		10,651.0		9,567.0	
48 TPI	3,971.3	58.5	7,465.7	71.2	7,121.0	63.0	5,427.0	51.0	3,633.0	38.0
96 TPI 1.0 MB	931.5	13.7	637.0	6.1	446.0	4.0	245.0	2.3	76.0	.8
96 TPI 1.6 MB	1,887.3	27.8	2,379.5	22.7	3,736.0	33.0	4,979.0	46.7	5,858.0	61.2
Total Non-U.S.	8,121.2		11,474.8		12,305.0		11,643.0		10,378.0	
48 TPI	4,580.9	56.4	7,751.0	67.6	7,319.0	59.5	5,615.0	48.3	3,740.0	36.0
96 TPI 1.0 MB	1,041.5	12.8	688.5	6.0	474.0	3.9	259.0	2.6	84.0	.8
96 TPI 1.6 MB	2,498.8	30.8	3,035.3	26.4	4,512.0	36.6	5,769.0	49.1	6,554.0	63.2
WORLDWIDE RECAP										
48 TPI	6,453.1	63.9	8,411.0	69.0	7,669.0	60.1	5,818.0	48.2	3,860.0	35.7
	-21.4%		+30.3%		-8.8%		-24.1%		-33.6%	
96 TPI 1.0 MB	1,117.3	11.1	700.1	5.7	474.0	3.7	259.0	2.1	84.0	.8
	-37.4%		-37.3%		-32.3%		-45.4%		-67.6%	
96 TPI 1.6 MB	2,522.3	25.0	3,086.8	25.3	4,622.0	36.2	6,016.0	49.7	6,876.0	63.5
	+287.4%		+22.4%		+49.7%		+30.2%		+14.3%	
Total Shipments	10,092.7		12,197.9		12,765.0		12,093.0		10,820.0	
	-5.2%		+20.9%		+4.7%		-5.3%		-10.5%	

Notes: 1. Percentage figures with plus/minus signs refer to year-to-year growth rates.
2. Track densities greater than 96 TPI are grouped with 96 TPI 1.6 MB totals in this table.

TABLE 31

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

APPLICATIONS SUMMARY
Percentage of Worldwide Shipments

APPLICATION	1985 Estimate Units (000)	1985 Estimate %	1989 Projection Units (000)	1989 Projection %
MAINFRAME/SUPERMINI General purpose	62.6	.6	108.2	1.0
MINICOMPUTERS AND MULTI-USER MICROS Business and professional, including networks	432.0	4.3	541.0	5.0
MICROCOMPUTERS Business and professional, single user	7,666.4	76.0	7,357.6	68.0
OFFICE SYSTEMS AND WORKSTATIONS Dedicated application	1,307.0	13.0	2,055.8	19.0
NON-OFFICE SYSTEMS AND WORKSTATIONS Technical, distribution, medical, other specialized	264.4	2.6	432.8	4.0
CONSUMER AND HOBBY COMPUTERS	307.8	3.1	216.4	2.0
OTHER APPLICATIONS	52.5	.4	108.2	1.0
Total	10,092.7	100.0	10,820.0	100.0

TABLE 32

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES
DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

Distribution channel	1985 U.S. Net Shipments Units (000)	%	FORECAST 1986 %	1987 %	1988 %	1989 %
Mainframe computer manufacturers	1,999.6	42.4	39.9	35.5	35.2	33.1
Mini/micro computer manufacturers	373.4	7.9	7.5	7.1	6.7	6.4
System OEMs/systems houses	1,147.6	24.3	23.6	27.5	36.5	42.9
Independent peripherals suppliers	215.9	4.6	4.1	3.7	3.3	3.0
Distributors, dealers, end users	978.9	20.8	24.9	26.2	18.3	14.6
TOTAL	4,715.4					

TABLE 33

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1985 Net Shipments: To United States Destinations Units (000)	%	Worldwide Units (000)	%
Teac	571.0	12.1	1,710.0	20.0
Tandon	1,203.1	25.5	1,260.9	14.7
YE Data	850.0	18.0	1,260.0	14.7
Mitsubishi Electric	611.0	13.0	945.0	11.0
Matsushita Com. Ind.	376.0	8.0	861.0	10.1
Toshiba	149.0	3.2	621.0	7.3
Control Data	274.6	5.8	294.9	3.4
Epson	97.8	2.1	292.8	3.4
Canon	--	--	240.0	2.8
Alps Electric	165.0	3.5	205.0	2.4
Tokyo Electric	120.0	2.5	150.0	1.8
BASF	--	--	126.0	1.5
Qume	105.0	2.2	110.0	1.3
Other U.S.	65.7	1.4	105.7	1.2
Other Non-U.S.	127.2	2.7	379.3	4.4
TOTAL	4,715.4	100.0	8,561.6	100.0

FLEXIBLE DISK DRIVES, MICROFLOPPIES

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Coverage

Examples of flexible disk drives in this group include:

3.5" disk diameter, one side, 67.5 TPI

Brother	FB 200
Canon	MD 3101
Janome Sewing Machine	MFD-90
Matsushita Communication Ind.	JU-314
Mitsumi Electric	D 351
Sankyo Seiki	FDU-350-SB
Victor Company of Japan	MDP-30F

3.5" disk diameter, one side, 135 TPI

Alps Electric	DFL 313, DFM 313
Canon	MD 351, MD3301
Chinon	F-353C
Copal	F-3503
Epson	SMD-170B, SMD-270
Fujitsu	M2531A
Janome Sewing Machine	MFD-91
Matsushita Communication Ind.	JU-323
Mitsumi Electric	D 355
Sankyo Seiki	FDU-355-SB, FDU-365-S
Sony	OA-D31V, MP-F53V
Teac	FD-35EN, FD-135
Tecmate	NPH-301
Toshiba	ND-353A/S, ND-351S/T
Victor Company of Japan	MDP-10, MFD-3503Z

3.5" disk diameter, two sides, 67.5 TPI

Canon	MD 352, MD 3202
Sankyo Seiki	FDU-350-DB
YE Data	YD-625B

3.5" disk diameter, two sides, 135 TPI, 1.0 megabyte

Alps Electric	DFL 413, DFM 413
Brother	FB 600V
Canon	MD 350, MD 3402
Chinon	F-354C
Citizen	OMDT-20A, OPDA-00A
Copal	F-3504
Epson	SMD-180B, SMD-280H
Fujitsu	M2532A

3.5" disk diameter, two sides,1 35 TPI, 1.0 megabytes (continued)

Genisco Memory Products	EDR-350
Janome Sewing Machine	MFD-91D
Matsushita Communication Ind.	JU-363
Mitsubishi Electric	MF353AF
Mitsumi Electric	D357
NEC	FD 1035, FD 1036A
Sankyo Seiki	FDU-355-DB, FDU-365-D
Sony	OA-D32W, MP-F53W, MP-F63W-OOD
Teac	FD-35FN, FD-135FN
Tecmate	MT-302
Teco	VF 3540
Toshiba	ND-354A/S, ND-352S/T
Victor Company of Japan	MDP-20, MFD-3103Z
YE Data	YD-645B, YD-645C

3.5" disk diameter, two sides, 135 TPI, 1.6 megabytes

Brother	FB 700
Chinon	F-356
Citizen	ORDA-OOA
Copal	F-3516
Fujitsu	M2533A
Hitachi	HFD 716A
Matsushita Communication Ind.	JU-386
Mitsubishi Electric	MF354, MF355B
NEC	FD 1135C, FD 1136C
Sankyo Seiki	FDH-350-D
Sony	MP-F83W-OOD
Teac	FD-35GN
Toshiba	ND-355S
YE Data	YD-665B, YD-700

3.5" disk diameter, two sides, 135 TPI, 2.0 megabytes

Alps Electric	DFM-713, DFL-713
Brother	FB 800
Chinon	F-357C
Citizen	OSDA
Fujitsu	M2536A
Matsushita Communication Ind.	JU-394
Mitsubishi Electric	MF355
Sony	MP-F73W-OOD
Teac	FD-35HFN
Toshiba	ND-356S

3.0" disk diameter, one side

Hitachi	HFD 305SX
Matsushita Electronic Comp.	EME-155, EME-131

3.0 disk diameter, two sides

Hitachi	HFD 305D
Matsushita Electronic Comp.	EME-231, EME-160

This year's DISK/TREND Report continues to treat one and two sided microfloppy drives as a single product group. There are now only two principal microfloppy media standards: (1) The 3.5 inch Sony-type diskette, for which over 20 manufacturers now offer drives, and (2) the 3.0 inch Matsushita Electric/Hitachi diskette, which is currently supported only by the two original drive manufacturers which introduced the format.

The basic drives (with capacities of one megabyte or less) in each of these groups use 6,250 bytes per track, the same track capacity as "double density" 5.25 inch diskettes, and also use 40 or 80 tracks per side to maintain file compatibility with 5.25 inch diskettes.

1.6 and 2.0 megabyte 3.5 inch drives were announced for the first time in 1985 by a few manufacturers. These drives are intended for use with the high density media originally proposed by Sony, and will operate at up to 17,400 BPI, using the 135 TPI standard of today's production drives. Most of these drives claim "backward compatibility," the ability to read and write on lower capacity diskettes. It is expected that most major manufacturers of microfloppy drives will soon announce similar drives, in anticipation of a 1987 adoption of the 2.0 megabyte standard by IBM, for worldwide usage.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1985	1986	1987	1988	1989
U.S. manufacturers	--	--	--	--	--
All manufacturers	303.8	535.9	780.3	1,025.2	1,221.8

Growth in worldwide unit shipments for microfloppy drives is averaging 63.5% annually during 1985-86, with the DISK/TREND forecast for 1986 set at 5.6 million drives. The last U.S. production of drives in this group occured in 1984. With the exception of limited production of 3.5 inch drives in Taiwan, all microfloppy drives are now manufactured by Japanese companies.

The 3.5 inch diskette introduced by Sony has become the industry standard. OEM shipments of the Matsushita/Hitachi 3.0 inch drives have increased during 1985-86, driven by strong demand in the European home computer market, but the 1986 total will be below 16% of worldwide microfloppy drive shipments. 3.0 inch drives have never significantly penetrated the U.S. market, and after an early lead have been passed up in Japan by 3.5 inch drives, now used by many leading system manufacturers, including Fujitsu, NEC and IBM.

Within the 3.5 inch format, a striking reversal in the rankings of one side and two sided drives has occurred in the last two years. In 1984, one side 3.5 inch drives held 64.9% of all microfloppy unit shipments, but in 1986 two sided drives now account for 69.5% of shipments. Almost all new systems introduced in the last two years using microfloppies have adopted two sided 3.5 inch models. Most 3.5 inch drives shipped in the last year have used the standard 135 TPI, with 80 tracks per side. 67.5 TPI drives, with 40 tracks per side, have a minor role, with less than 61,000 units shipped in 1986.

Microfloppy drives remain primarily an OEM business. Non-captive shipments of 3.5 inch drives by Sony were 991,000 units in 1985, 33.5% of the worldwide total. Matsushita Electric shipped 510,000 drives all 3.0 inch, for 17.2%. Captive drives were only 11.5% of the microfloppy total.

Marketing trends

By 1989, microfloppy drives are expected to become the leading floppy drive format. Microfloppy drives will constitute 25.7% of all 1986 floppy drive unit shipments, but are forecasted to account for more than half of the 1989 total. Growth is expected to average 32% annually during 1987-89, with 14,290,000 microfloppy drives to be shipped in 1989.

The rise to prominence by microfloppy drives has occured with limited participation so far by IBM. IBM has used 3.5 inch two sided drives since 1984 in the JX system offered in several Pacific Basin countries, and in early 1986 introduced the Convertible briefcase portable, using similar drives.

Most of the microfloppy shipments so far have been generated without IBM's help. Hewlett-Packard started the process with its adoption of the original Sony 3.5 inch drive in 1982. Apple Computer provided a major boost by using a special version of the Sony 3.5" drive on the Macintosh, and 3.5 inch drives have since been widely adopted for portable computers and for consumer computer systems.

But major changes are expected for 1987 in IBM's usage of microfloppy drives. The current DISK/TREND forecasts are based on the assumption that IBM will soon start to use 3.5 inch flexible disk drives for its major office personal computer product lines.

The first product expected is a compact desktop IBM PC using 3.5 inch rigid and floppy disks during the first half of 1987. It is likely that IBM also will continue to offer the PC XT with 5.25 inch floppies for the next few years, but that it will be gradually replaced by the new system.

The impact of such actions by IBM will be to stimulate a rapid transition to 3.5 inch floppy drives for new systems by all participants

in the existing PC clone market. Another milestone associated with IBM's expected new "small footprint" system will be usage of the 2 megabyte microfloppy drive now offered by several leading Japanese floppy drive manufacturers. This action, of course, will also create another worldwide standard for all those concerned with maintaining IBM compatibility.

57.6% of all microfloppy drives were used with single user business and professional microcomputers, mostly personal computers in 1985, and 25.6% of the balance were used with consumer and hobby computers. Considering the rapid movement to microfloppies expected during the next few years for personal computers of all types, the share for each of these applications is expected to rise further by 1989 -- to 61% for office personal computers and 32% for consumer and hobby computers.

Technical trends

Until early 1985, the Nippon Telephone and Telegraph program to establish a 1.6 megabyte standard for 3.5 inch drives seemed to have the support of the Japanese computer industry. But the NTT 1.6 megabyte consensus collapsed after Sony proposed a new 2 megabyte media standard using a thinner coating and higher coercivity -- and IBM expressed interest.

14 Japanese companies now offer 1.6 megabyte 3.5 inch drives, while only 9 offer 2 megabyte versions. However, most of those manufacturers which have announced only 1.6 megabyte drives are prepared to quickly offer 2 megabyte drives, and probably will do so when IBM acts.

Several Japanese firms have revealed work on perpendicular recording for microfloppy drives, but the impact on existing microfloppies will probably be slight, due to lack of agreement on a common media standard.

One of the more promising programs is Toshiba's 4 megabyte 3.5 inch drive using barium ferrite media, because of the media's potential advantages in producibility using existing coating methods and durability in normal contact recording. Toshiba's product announcements, although presented in detail, have so far been labeled "preliminary". The company has indicated that it hopes to begin shipments in 1987.

Forecasting assumptions

1. Two sided 3.5 inch drives will become the dominant microfloppy standard for portable, personal and home computers.

2. IBM will initiate worldwide usage of 3.5 inch floppy drives in the first half of 1987, but will continue the PC XT and PC AT product lines for at least two more years, utilizing 5.25 inch floppy drives.

3. The growth rate for personal computers which resumed in 1986 will be maintained.

4. The dollar/yen exchange rate will stay in the current range, and the major Japanese floppy disk drive producers will maintain prices at approximately the current levels.

TABLE 34

FLEXIBLE DISK DRIVES, MICROFLOPPIES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1985 Revenues		Forecast 1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. CAPTIVE	--	--	--	--	--	--	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. NON-CAPTIVE	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. REVENUES	--	--	--	--	--	--	--	--	--	--
Non-U.S. Manufacturers										
Captive	17.4	93.4	29.4	199.6	59.5	297.0	79.9	371.4	95.6	430.3
PCM	--	--	--	--	--	--	--	--	--	--
OEM	86.6	210.4	129.5	336.3	217.6	483.3	321.3	653.8	412.0	791.5
TOTAL NON-U.S. REVENUES	104.0	303.8	158.9	535.9	277.1	780.3	401.2	1,025.2	507.6	1,221.8
Worldwide Recap										
TOTAL WORLDWIDE REVENUES	104.0	303.8	158.9	535.9	277.1	780.3	401.2	1,025.2	507.6	1,221.8
OEM Average Price ($000)	.077	.071	.071	.068	.067	.064	.065	.063	.064	.063

TABLE 35

FLEXIBLE DISK DRIVES, MICROFLOPPIES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1985		Forecast							
	Shipments		1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. CAPTIVE	--	--	--	--	--	--	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. NON-CAPTIVE	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. SHIPMENTS	--	--	--	--	--	--	--	--	--	--
Non-U.S. Manufacturers										
Captive	59.0	303.0	105.0	643.0	204.4	1,017.0	293.0	1,365.0	366.4	1,652.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	1,119.0	2,965.1	1,816.5	4,957.0	3,234.0	7,498.0	4,908.0	10,340.0	6,393.0	12,638.0
TOTAL NON-U.S. SHIPMENTS	1,178.0	3,268.1	1,921.5	5,600.0	3,438.4	8,515.0	5,201.0	11,705.0	6,759.4	14,290.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	1,178.0	3,268.1	1,921.5	5,600.0	3,438.4	8,515.0	5,201.0	11,705.0	6,759.4	14,290.0
Cumulative Shipments										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	2,558.2	5,706.9	4,479.7	11,306.9	7,918.1	19,821.9	13,119.1	31,526.9	19,878.5	45,816.9
WORLDWIDE TOTAL	2,558.2	5,706.9	4,479.7	11,306.9	7,918.1	19,821.9	13,119.1	31,526.9	19,878.5	45,816.9

TABLE 36

FLEXIBLE DISK DRIVES, MICROFLOPPIES

WORLDWIDE REVENUES ($M)

BREAKDOWN BY DISK DIAMETER

	1985 Revenues			Forecast											
	1986			1987			1988			1989		
	3.0"	3.5" SS	3.5" DS	3.0"	3.5" SS	3.5" DS	3.0"	3.5" SS	3.5" DS	3.0"	3.5" SS	3.5" DS	3.0"	3.5" SS	3.5" DS
U.S. MANUFACTURERS															
IBM Captive	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. REVENUES	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NON-U.S. MANUFACTURERS															
Captive	--	34.2	59.2	--	36.7	162.9	--	43.7	253.3	--	39.2	332.2	--	20.8	409.5
OEM	28.8	75.6	106.0	44.5	42.6	249.2	55.6	24.8	402.9	63.2	9.7	580.9	61.6	3.2	726.7
TOTAL NON-U.S. REVENUES	28.8	109.8	165.2	44.5	79.3	412.1	55.6	68.5	656.2	63.2	48.9	913.1	61.6	24.0	1,136.2
WORLDWIDE RECAP															
Captive	--	34.2	59.2	--	36.7	162.9	--	43.7	253.3	--	39.2	332.2	--	20.8	409.5
	--	+77.2%	+160.8%	--	+7.3%	+175.2%	--	+19.1%	+55.5%	--	-10.3%	+31.1%	--	-46.9%	+23.3%
OEM	28.8	75.6	106.0	44.5	42.6	249.2	55.6	24.8	402.9	63.2	9.7	580.9	61.6	3.2	726.7
	+77.8%	-26.5%	+176.8%	+54.5%	-43.7%	+135.1%	+24.9%	-41.8%	+61.7%	+13.7%	-60.9%	+44.2%	-2.5%	-67.0%	+25.1%
Total Revenues	28.8	109.8	165.2	44.5	79.3	412.1	55.6	68.5	656.2	63.2	48.9	913.1	61.6	24.0	1,136.2
	+55.7%	-10.1%	+170.8%	+54.5%	-27.8%	+149.5%	+24.9%	-13.6%	+59.2%	+13.7%	-28.6%	+39.1%	-2.5%	-50.9%	+24.4%
ANNUAL SHARE, BY DIAMETER	9.5%	36.2%	54.3%	8.3%	14.8%	76.9%	7.1%	8.8%	84.1%	6.2%	4.8%	89.0%	5.0%	2.0%	93.0%

Note: Percentage figures with plus/minus signs refer to year-to-year growth rates.

TABLE 37

FLEXIBLE DISK DRIVES, MICROFLOPPIES

WORLDWIDE SHIPMENTS (000)

BREAKDOWN BY DISK DIAMETER

	1985 Shipments			Forecast											
				1986			1987			1988			1989		
	3.0"	3.5" SS	3.5" DS	3.0"	3.5" SS	3.5" DS	3.0"	3.5" SS	3.5" DS	3.0"	3.5" SS	3.5" DS	3.0"	3.5" SS	3.5" DS
U.S. MANUFACTURERS															
IBM Captive	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. SHIPMENTS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NON-U.S. MANUFACTURERS															
Captive	--	121.0	182.0	--	146.0	497.0	--	181.0	836.0	--	170.0	1,195.0	--	93.0	1,559.0
OEM	532.0	1,075.0	1,358.1	878.0	685.0	3,394.0	1,161.0	417.0	5,920.0	1,379.0	168.0	8,793.0	1,382.0	58.0	11,198.0
TOTAL NON-U.S. SHIPMENTS	532.0	1,196.0	1,540.1	878.0	831.0	3,891.0	1,161.0	598.0	6,756.0	1,379.0	338.0	9,988.0	1,382.0	151.0	12,757.0
WORLDWIDE RECAP															
Captive	--	121.0	182.0	--	146.0	497.0	--	181.0	836.0	--	170.0	1,195.0	--	93.0	1,559.0
	--	+116.1%	+180.0%	--	+20.7%	+173.1%	--	+24.0%	+68.2%	--	-6.1%	+42.9%	--	-45.3%	+30.5%
OEM	532.0	1,075.0	1,358.1	878.0	685.0	3,394.0	1,161.0	417.0	5,920.0	1,379.0	168.0	8,793.0	1,382.0	58.0	11,198.0
	+117.7%	-12.1%	+258.2%	+65.0%	-36.3%	+149.9%	+32.2%	-39.1%	+74.4%	+18.8%	-59.7%	+48.5%	+.2%	-65.5%	+27.4%
Total Shipments	532.0	1,196.0	1,540.1	878.0	831.0	3,891.0	1,161.0	598.0	6,756.0	1,379.0	338.0	9,988.0	1,382.0	151.0	12,757.0
	+113.3%	-6.5%	+246.8%	+65.0%	-30.5%	+152.6%	+32.2%	-28.0%	+73.6%	+18.8%	-43.5%	+47.8%	+.2%	-55.3%	+27.7%
ANNUAL SHARE, BY DIAMETER	16.3%	36.7%	47.0%	15.7%	14.8%	69.5%	13.6%	7.0%	79.4%	11.8%	2.9%	85.3%	9.7%	1.1%	89.2%

Note: Percentage figures with plus/minus signs refer to year-to-year growth rates.

TABLE 38

FLEXIBLE DISK DRIVES, MICROFLOPPIES

APPLICATIONS SUMMARY
Percentage of Worldwide Shipments

	1985 Estimate		1989 Projection	
APPLICATION	Units (000)	%	Units (000)	%
MAINFRAME/SUPERMINI General purpose	10.5	.4	71.5	.5
MINICOMPUTERS AND MULTI-USER MICROS Business and professional, including networks	33.7	1.0	71.5	.5
MICROCOMPUTERS Business and professional, single user	1,883.6	57.6	8,716.8	61.0
OFFICE SYSTEMS AND WORKSTATIONS Dedicated application	328.8	10.1	428.7	3.0
NON-OFFICE SYSTEMS AND WORKSTATIONS Technical, distribution, medical, other specialized	102.6	3.1	285.8	2.0
CONSUMER AND HOBBY COMPUTERS	835.7	25.6	4,572.8	32.0
OTHER APPLICATIONS	73.2	2.2	142.9	1.0
Total	3,268.1	100.0	14,290.0	100.0

TABLE 39

FLEXIBLE DISK DRIVES, MICROFLOPPIES
DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

Distribution channel	1985 U.S. Net Shipments Units (000)	%	FORECAST 1986 %	1987 %	1988 %	1989 %
Mainframe computer manufacturers	16.2	1.4	8.8	31.5	37.1	34.2
Mini/micro computer manufacturers	266.9	23.8	19.2	12.1	9.4	8.6
System OEMs/systems houses	733.2	65.5	61.3	44.0	39.2	40.6
Independent peripherals suppliers	13.5	1.3	1.5	1.8	2.2	2.6
Distributors, dealers, end users	89.2	8.0	9.2	10.6	12.1	14.0
TOTAL	1,119.0					

TABLE 40

FLEXIBLE DISK DRIVES, MICROFLOPPIES
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1985 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Sony	854.0	76.3	991.0	33.5
Matsushita Elect. Ind.	--	--	510.0	17.2
Epson	13.0	1.2	422.0	14.2
Matsushita Com. Ind.	11.0	1.0	184.0	6.2
YE Data	--	--	110.0	3.7
Teac	20.0	1.8	110.0	3.7
NEC	69.0	6.2	102.1	3.5
Alps Electric	18.0	1.6	80.0	2.7
Mitsubishi Electric	22.0	2.0	69.0	2.3
Toshiba	62.0	5.5	68.0	2.3
Canon	10.0	.9	60.0	2.0
Other U.S.	--	--	--	--
Other Non-U.S.	40.0	3.5	259.0	8.7
TOTAL	1,119.0	100.0	2,965.1	100.0

FLEXIBLE DISK DRIVES, SPECIAL

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Coverage

Examples of flexible disk drives included in this group are:

8 inch Bernoulli principle drives

Iomega	Alpha-10H, Alpha-20A

5.25 inch Bernoulli principle drives

Iomega	Beta-20, B105-MAC

Spiral track drives

Mitsumi Electric	QDM-01 Quick Disk, D 281
Ricoh	SDU8E00
Sankyo Seiki	FMC-250, FMC-270
Tokyo Electric Company	MC-116, MC-132

The flexible disk drives in this group are analyzed separately, because the drives included are significantly different from those in other DISK/TREND product groups. The functional and physical characteristics of these products are varied, and will be individually discussed below. Specific shipment and revenue forecasts for products in this group were included in the DISK/TREND Report for the first time in the 1985 edition.

Special flexible disk drive market status and trends

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1985	1986	1987	1988	1989
U.S. manufacturers	96.0	100.6	133.1	167.1	212.6
All manufacturers	97.3	135.2	181.3	222.7	278.1

Iomega's Bernoulli principle drives

Product background: Iomega's drives use the Bernoulli effect to control head/disk spacing. These are high performance drives, using flexible disks in a removable rigid cartridge, and a sophisticated internal air flow system to maintain the proper position of the disk relative to the recording head. A voice coil rotary head positioning system, in conjunction with an embedded servo, provides average seek times of about 35-40 milliseconds.

Iomega announced the 8 inch Alpha-10 in May, 1981, and deliveries of production drives, with 10 megabytes formatted capacity, started in September, 1982. The original drive was replaced by a half high 8 inch model in 1984, also with 10 megabyte capacity, and a 21 megabyte version was added in 1985. A 5 megabyte full size 5.25 inch drive was introduced in 1983, followed by a 21 megabyte half high version in 1986.

The 10 megabyte 8 inch drive operates at 300 TPI and 18,000 FCI (24,000 BPI), and spins at 1,500 RPM, while the new 21 megabyte version increases track density to 641 TPI. Iomega's first 5.25 inch drives offered 5.25 megabyte capacity, with 394 TPI at 17,200 BPI, and maintained the 625 kilobyte/second transfer rate standard with most 5.25 Winchester drives, by using a rotational speed of 1,964 RPM.

The newly introduced 21 megabyte 5.25 inch drive increases recording density to 570 TPI at 23511 BPI (17633 FCI), and increases the transfer rate to 666 kilobyte/second. The drive is offered only in an OEM version so far, using a SCSI interface.

Market position: The capacity, performance, and pricing of Iomega's drives place them in competition with small Winchester disks and removable

rigid disk cartridge drives, rather than with most existing flexible disk drives. The only announced flexible disk drives with the potential to challenge Iomega in its key markets are the new 5.25 inch high capacity floppies in the 10 megabyte range which have been promised for delivery by the end of 1986 by Eastman Kodak/Data Technology, and the recently announced drives to be jointly offered by Konica/Citizen/Omron and promised for delivery in 1987.

Iomega has attracted great interest in the industry, but orders for OEM drives from system manufacturers were initially slow in coming. The firm achieved much better success through its program to sell subsystems in the personal computer add-on market.

During 1983-85, an 8 inch subsystem sold through dealers to IBM PC users was the key to the firm's growth to over $100 million in annual sales. During 1986, however, sales have been flat and profits down, due to IBM's April, 1986, personal computer price changes and probably also to approaching saturation of the PC end user market for the 8 inch Bernoulli subsystem. When IBM cut the upcharge for the Winchester drive options on its personal computers, Iomega sales were hurt badly, and Bernoulli box prices had to come down.

A 5.25 inch subsystem for the Apple Macintosh market was added in fourth quarter of 1984, but has not made a major contribution to sales. However, the 1986 introduction of a 21 megabyte half high 5.25 inch drive is expected to make a major contribution to Iomega's growth.

The company is currently following a policy of offering this drive only in the OEM market, in an attempt to diversify its distribution channels and cut back on almost complete reliance on its end user marketing program. It is still an open question, however, as to whether the current

strong interest in the new 5.25 inch drive will be adequate to attract enough conventional system manufacturers as customers, or whether the program will merely result in distribution to the personal computer aftermarket through PC system and subsystem makers, in competition with Iomega's existing PC product lines.

Iomega's main difficulty in selling to system manufacturers on an OEM basis lies in lack of credible alternate sources for the company's drives. The products are unique, and system manufacturers, as always, are reluctant to take a chance on a sole-source product, even from a company as prosperous as Iomega.

The first step was taken with a license to SCI Systems to manufacture Iomega's drives, but no specific plans to enter the OEM market as a second source have been announced. In 1984 a license was granted to Nippon Chemi-Con, a major Japanese manufacturer of electrolytic capacitors, to manufacture and market Iomega drives in Japan. Also, Verbatim has a license to make and sell Iomega media. Further development of alternate sources for drives and media would provide a major boost in establishing shipments of Iomega's drives to conventional system manufacturers.

Sales outlook: Following a no-growth year in 1986, DISK/TREND forecasts expect further declines in shipments of plug compatible Bernoulli box drives in 1987, as 8 inch drive shipments drop and Iomega steers available 5.25 inch drive production to the OEM market. It is expected that Iomega will have to enter the PC aftermarket directly, however, by the end of 1987 -- and the forecast is for strong growth in PCM unit shipments after 1987, although revenues will stay lower due to a drop in average unit prices. Total unit shipments by Iomega and any potential similar

competitive drives, in both PCM and OEM distribution channels, are forecasted to grow from 1986's 105,100 units to 648,000 drives in 1989.

These forecasts assume, of course, a market environment benign to Bernoulli drives, with no significant rearguard action by IBM in connection with its personal computer aftermarket. IBM could greatly reduce Iomega's market by changing the PC attachment opportunity for these drives or by offering its own data storage product to serve the same function. However, there is no indication of any IBM plans to do so, for the moment.

Spiral track drives:

Mitsumi Quick Disk
Ricoh SDU8E00
Sankyo Seiki FMC-170, FMC-270
Tokyo Electric Company MC-108, MC-116

Product background: All of these drives record in a single spiral track on a flexible disk ranging from 2.6 to 2.8 inches in diameter. The drives' physical size, interfaces and media are not compatible between drives from different manufacturers. Olivetti offered a similar drive, starting in 1977, but phased it out a few years ago. Olivetti's drive was used as a program loader and data storage medium on a variety of word processing and data processing equipment, but has been replaced with 5.25 inch floppy drives. The drive was unsuccessful as an OEM product.

Sankyo Seiki's first spiral track drive was introduced in 1980, and Tokyo Electric drives were introduced in 1982. The Mitsumi "Quick Disk", became available in early 1984, and Ricoh's drive was introduced in the Spring of 1986.

Market position: All of these drives are, like Olivetti's, intended to develop the market for very small, low priced serial recording devices in applications such as electronic typewriters, POS terminals, personal computers, and for other specialized systems. Most early shipments were in connection with Japanese produced electronic typewriters.

Mitsumi's Quick Disk may be the most ambitious product in this group. The target market is low cost home computers, where the intent is to provide a very low cost serial recording device which will be usable in quickly loading programs and user files into main system memory. Current drives have 64 kilobytes capacity, but higher capacity versions are expected. The drive is designed to sell for less than $30 to system manufacturers, and several successful home computers intended for the Japanese market have already appeared with Quick Disk drives. Maxell offers the media, providing a credible source.

Sales outlook: The three companies participating so far in the spiral track flexible disk drive market shipped a total of only 25,000 units in 1985, but the huge success in the Japan domestic market of certain game-oriented home computers has driven the 1986 shipment level to over 1.2 million drives, mostly the Mitsumi Quick Disk. The current popularity of the system market underlying this quick rise may turn out to be a short-lived fad, and the DISK/TREND forecasts through 1989 indicate more modest increases. Because of the very low average unit price for drives of this type, the total revenues produced remain comparatively small.

Forecasting assumptions

1. IBM will not take any actions which would significantly reduce the Iomega market opportunity in attaching drives to IBM personal computers.

2. The market for home computers will enjoy continued growth in the Japanese domestic market for home computers, with heavy use of spiral track floppy drives, but will have little penetration of other markets.

TABLE 41

FLEXIBLE DISK DRIVES, SPECIAL TYPES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1985 Revenues		Forecast							
	1986		1987		1988		1989			
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. CAPTIVE	--	--	--	--	--	--	--	--	--	--
PCM	82.1	83.8	77.0	83.5	52.1	57.6	50.7	56.4	61.9	72.8
OEM	12.2	12.2	17.1	17.1	72.1	75.5	100.0	110.7	118.8	139.8
TOTAL U.S. NON-CAPTIVE	94.3	96.0	94.1	100.6	124.2	133.1	150.7	167.1	180.7	212.6
TOTAL U.S. REVENUES	94.3	96.0	94.1	100.6	124.2	133.1	150.7	167.1	180.7	212.6
Non-U.S. Manufacturers										
Captive	--	--	--	--	--	--	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	1.3	--	34.6	--	48.2	1.2	55.6	2.0	65.5
TOTAL NON-U.S. REVENUES	--	1.3	--	34.6	--	48.2	1.2	55.6	2.0	65.5
Worldwide Recap										
TOTAL WORLDWIDE REVENUES	94.3	97.3	94.1	135.2	124.2	181.3	151.9	222.7	182.7	278.1

TABLE 42

FLEXIBLE DISK DRIVES, SPECIAL TYPES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1985 Shipments		Forecast 1986		1987		1988		1989	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM Captive	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. CAPTIVE	--	--	--	--	--	--	--	--	--	--
PCM	82.4	84.1	74.8	81.1	58.0	64.0	96.3	107.0	154.7	182.0
OEM	15.5	15.5	24.0	24.0	160.1	168.0	280.3	311.0	396.0	466.0
TOTAL U.S. NON-CAPTIVE	97.9	99.6	98.8	105.1	218.1	232.0	376.6	418.0	550.7	648.0
TOTAL U.S. SHIPMENTS	97.9	99.6	98.8	105.1	218.1	232.0	376.6	418.0	550.7	648.0
Non-U.S. Manufacturers										
Captive	--	--	--	--	--	--	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	25.0	--	1,215.0	--	1,450.0	49.0	1,670.0	86.0	1,800.0
TOTAL NON-U.S. SHIPMENTS	--	25.0	--	1,215.0	--	1,450.0	49.0	1,670.0	86.0	1,800.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	97.9	124.6	98.8	1,320.1	218.1	1,682.0	425.6	2,088.0	636.7	2,448.0
Cumulative Shipments										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	142.8	217.2	241.6	1,537.3	459.7	3,219.3	885.3	5,307.3	1,522.0	7,755.3
WORLDWIDE TOTAL	142.8	217.2	241.6	1,537.3	459.7	3,219.3	885.3	5,307.3	1,522.0	7,755.3

FLEXIBLE DISK DRIVE SPECIFICATIONS

FLEXIBLE DISK DRIVE SPECIFICATIONS

Coverage

The product specification section of this report includes most flexible disk drives intended for computer data storage which are now in production or announced, arranged alphabetically by manufacturer. Most of the listed drives are still in production.

Specifications on drive models sold by computer system manufacturers but purchased on an OEM basis from others have been included in only a few cases. Also not listed in most cases are captive drives which are similar to OEM models made by the same manufacturer. In some cases, drives made by one drive manufacturer and resold by another drive manufacturer have been included for identification purposes.

Generic type

Media intended for use with individual drives is identified by recording format -- for example, 5.25"--2/80 means 5.25 inch media suitable for two sided 80 track recording. For 5.25 inch and 3.5 inch drives which require media intended for higher than normal recording densities, the identification HD has been added to the media listing. Individual drives may require media with a variety of special characteristics.

Capacities

Capacities are listed as "U" for unformatted or "F" for formatted. All capacities are per spindle. For DISK/TREND purposes, one spindle consists of the disk drive mechanism required to utilize a single

flexible disk. Drives which use a single head positioning mechanism with two diskettes are considered to be two spindles.

OEM prices

The 500 unit price is usually given for most OEM flexible disk drives sold in the United States, except where larger quantity prices are indicated. Since these prices may be changed by manufacturers without notice, please use them with the appropriate caution.

Accuracy

All information has been cross checked for accuracy. However, it is anticipated that some errors may be included, since many manufacturers' published specifications do not cover all of the items listed, and numerous verbal inquiries were necessary. Your corrections will be most welcome and will be included in the next edition.

DISK/TREND product groups

In most cases the product groups used for individual drives are clear, but a few arbitrary decisions have been made. The IBM magazine drive has been included in the 8 inch, two sided group, since the magazine mechanism uses a single drive.

DISK/TREND PRODUCT GROUPS FOR FLEXIBLE DISK DRIVES

13. 8 inch, one side
14. 8 inch, two sides
15. 5.25 inch, one side
16. 5.25 inch, two sides
17. Microfloppies, one and two sides
18. Special flexible disk drives

MANUFACTURER	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC
DRIVE	DFC 122	DFC 222	DFC 422	DFC 642	DFC 682
DISK/TREND GROUP	15	16	16	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 1/40	5.25" -- 2/40	5.25" -- 2/80	5.25" - 2/80 HD	5.25" - 2/80 HD
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250	U: .5	U: 1.0	U: 1.6	U: 1.0/1.6
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 10,416	U: 6,250/10,416
Data surfaces per spindle	1	2	2	2	2
Tracks per surface	40	40	80	77	80/77
Track density (TPI)	48	48	96	96	96
Maximum linear density (BPI)	5536	5876	5922	9646	5922/9646
Rotational speed (RPM)	300	300	300	360	300/360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	6	3	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	35	35	35	35	35
Average rotational delay (msec)	100	100	100	83.3	100/83.3
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1985	1984	1984	8/85	8/85
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC
DRIVE	DFL 313 FDV 213A	DFL 413 FDV 223A	DFL 713	DFM 313	DFM 413
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 1/80	3.5" -- 2/80	3.5" -- 2/80 HD	3.5" -- 1/80	3.5" -- 2/80
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .5	U: 1.0	U: 2.0	U: .5	U: 1.0
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 12,500	U: 6,250	U: 6,250
Data surfaces per spindle	1	2	2	1	2
Tracks per surface	80	80	80	80	80
Track density (TPI)	135	135	135	135	135
Maximum linear density (BPI)	8190	8717	17434	8187	8717
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	6	6	6	6	6
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25	62.5	31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 4.0 x 5.5	1.625 x 4.0 x 5.5	1.625 x 4.0 x 5.5	1.18 x 4.0 x 6.0	1.18 x 4.0 x 6.0
FIRST CUSTOMER SHIPMENT	5/84	4/85	1986	1986	1986
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	ALPS ELECTRIC	ASIA COMMERCIAL	ASIA COMMERCIAL	ASIA COMMERCIAL	BROTHER
DRIVE	DFM 713	FD-103	FD-104	FD-106	FB 100
DISK/TREND GROUP	17	15	16	16	17
MARKET	OEM	OEM	OEM	OEM	OEM, Captive
MEDIA: Generic type	3.5" -- 2/80 HD	5.25" -- 1/40	5.25" -- 2/40	5.25" -- 2/80	3.5" -- 1/40
Nominal disk diameter	3.5"	5.25"	5.25"	5.25"	3.5"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated
Sectoring	Soft/Hard	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 2.0	U: .125/.250	U: .250/.5	U: .5/1.0	F: 102.4
Capacity per track (Bytes)	U: 12,500	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	F: 2,560
Data surfaces per spindle	2	1	2	2	1
Tracks per surface	80	40	40	80	40
Track density (TPI)	135	48	48	96	67.5
Maximum linear density (BPI)	17434	2768/5536	2938/5876	2961/5922	4064
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	6	6	6	60
Settling time (msec)	15	16	16	16	20
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	62.5	15.63/31.25	15.63/31.25	15.63/31.25	15.63
SIZE (Inches: H x W x D)	1.18 x 4.0 x 6.0	1.625 x 5.75 x 8.25	1.625 x 5.75 x 8.25	1.625 x 5.75 x 8.25	2.16 x 5.1 x 6.5
FIRST CUSTOMER SHIPMENT	1986	2Q85	1Q86	3Q86	1984
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	BROTHER	BROTHER	BROTHER	BROTHER	BROTHER
DRIVE	FB 200	FB 600V	FB 620V	FB 700	FB 710
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Generic type	3.5" -- 1/40	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	F: 184.3	U: 1.0	U: 1.0	U: 1.0/1.67	U: 1.0/1.67
Capacity per track (Bytes)	F: 4,608	U: 6,250	U: 6,250	U: 6,250/10,416	U: 6,250/10,416
Data surfaces per spindle	1	2	2	2	2
Tracks per surface	40	80	80	80	80
Track density (TPI)	67.5	135	135	135	135
Maximum linear density (BPI)	8128	8717	8717	8717/14528	8717/14528
Rotational speed (RPM)	300	300	300	360	300/360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	24	6	3	3	3
Settling time (msec)	24	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	83	100/83
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	37.5/62.5	31.25/62.5
SIZE (Inches: H x W x D)	2.5 x 5.2 x 8.1	1.0 x 4.0 x 5.9	1.0 x 4.0 x 5.9	1.0 x 4.0 x 5.9	1.0 x 4.0 x 5.9
FIRST CUSTOMER SHIPMENT	1985	2Q86	2Q86	2Q86	2Q86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	BROTHER	CALDISK	CALDISK	CALDISK	CANON
DRIVE	FB 800	142M	143M1	143M	MD 5201
DISK/TREND GROUP	17	13	13	14	16
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive	OEM
MEDIA: Generic type	3.5" -- 2/80	8" -- 1/77	8" -- 1/77	8" -- 2/77	5.25" -- 2/80
Nominal disk diameter	3.5"	8"	8"	8"	5.25"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft/Hard	Soft/Hard	Soft/Hard	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/2.0	U: .401/.802	U: .401/.802	U: .8/1.6	U: .250/.5
Capacity per track (Bytes)	U: 6,250/12,500	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250
Data surfaces per spindle	2	1	1	2	2
Tracks per surface	80	77	77	77	40
Track density (TPI)	135	48	48	48	48
Maximum linear density (BPI)	8717/17434	3268/6536	3268/6536	3408/6816	2938/5876
Rotational speed (RPM)	300	360	360	360	300
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	3	6	6	6	6
Settling time (msec)	15	10	10	10	15
Head load time(msec)	Continuous Contact	30	30	30	Continuous Contact
Average rotational delay (msec)	100	83.3	83.3	83.3	100
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25/62.5	31.25/62.5	15.63/31.25
SIZE (Inches: H x W x D)	1.0 x 4.0 x 5.9	4.9 x 8.4 x 15.0	4.9 x 8.4 x 15.0	4.9 x 8.4 x 15.0	1.06 x 5.75 x 7.8
FIRST CUSTOMER SHIPMENT	2Q86	1/77	1/77	8/77	7/86
U.S. OEM PRICE FOR 500 UNITS	--	$420	$427	$505	--
COMMENTS					

MANUFACTURER	CANON	CANON	CANON	CANON	CANON
DRIVE	MD 5501	MDD 211	MDD 221	MDD 413	MDD 530
DISK/TREND GROUP	16	16	16	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/80	5.25" -- 2/40	5.25" -- 2/80	5.25" -- 2/40	5.25" -- 2/80
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/1.6	U: .250/.5	U: .5/1.0	U: .250/.5	U: 1.0
Capacity per track (Bytes)	U: 6,250/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 6,250
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	80/77	40	80	40	80
Track density (TPI)	96	48	96	48	96
Maximum linear density (BPI)	5922/9646	2938/5876	2961/5922	2938/5876	5922
Rotational speed (RPM)	300/360	300	300	300	300
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	6	3	6	3
Settling time (msec)	15	20	15	20	20
Head load time(msec)	Continuous Contact	25	25	25	Continuous Contact
Average rotational delay (msec)	100/83.3	100	100	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	15.63/31.25	15.63/31.25	15.63/31.25	31.25
SIZE (Inches: H x W x D)	1.06 x 5.75 x 7.8	1.28 x 5.75 x 8.5	1.28 x 5.75 x 8.5	2.26 x 5.75 x 8.5	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	7/86	5/83	4/83	2/84	4/85
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS				Dual drive	

MANUFACTURER	CANON	CANON	CANON	CANON	CANON
DRIVE	MDD 531	MD 3101 MD 3102	MD 3201 MD 3202	MD 3301 MD 3302	MD 3401 MD 3402
DISK/TREND GROUP	16	17	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/40	3.5" -- 1/40	3.5" -- 2/40	3.5" -- 1/80	3.5" -- 2/80
Nominal disk diameter	5.25"	3.5"	3.5"	3.5"	3.5"
Recording medium	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .5	U: .250	U: .5	U: .5	U: 1.0
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	1	2	1	2
Tracks per surface	40	40	40	80	80
Track density (TPI)	48	67.5	67.5	135	135
Maximum linear density (BPI)	5876	8126	8647	8187	8717
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	6	6	6	3	3
Settling time (msec)	20	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.0 x 4.0 x 5.8	1.0 x 4.0 x 5.8	1.0 x 4.0 x 5.8	1.0 x 4.0 x 5.8
FIRST CUSTOMER SHIPMENT	4/85	7/86	7/86	7/86	7/86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS		MD 3101 is low power version	MD 3201 is low power version	MD 3301 is low power version	MD 3401 is low power version

MANUFACTURER	CANON	CANON	CANON	CANON	CHINON
DRIVE	MD 350	MD 351	MD 352	MD 353	Enhancer 2000
DISK/TREND GROUP	17	17	17	17	15
MARKET	OEM	OEM	OEM	OEM	OEM, PCM
MEDIA: Generic type	3.5" -- 2/80	3.5" -- 1/80	3.5" -- 2/40	3.5" -- 1/40	5.25" -- 1/40
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	5.25"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .5/1.0	U: .250/.5	U: .250/.5	U: .125/.250	U: .174
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125,6,250	U: 3,125/6,250	Varies
Data surfaces per spindle	2	1	2	1	1
Tracks per surface	80	80	40	40	35
Track density (TPI)	135	135	67.5	67.5	48
Maximum linear density (BPI)	4359/8717	4094/8187	4324/8647	4063/8126	2768
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	6	6	12
Settling time (msec)	20	20	20	20	20
Head load time(msec)	25	25	25	25	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	Varies
SIZE (Inches: H x W x D)	1.18 x 4.0 x 5.9	1.18 x 4.0 x 5.9	1.18 x 4.0 x 5.9	1.18 x 4.0 x 5.9	2.7 x 7.3 x 10.0
FIRST CUSTOMER SHIPMENT	11/84	11/84	11/84	11/84	1986
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					Subsystem compatible with Commodore 1541

MANUFACTURER	CHINON	CHINON	CHINON	CHINON	CHINON
DRIVE	F-051D F-051M F-051AII	F-502II F-502LII	F-506 F-506L	F-351	F-353C F-353E
DISK/TREND GROUP	15	16	16	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 1/40	5.25" -- 2/40	5.25" - 2/80 HD	3.5" -- 1/40	3.5" -- 1/80
Nominal disk diameter	5.25"	5.25"	5.25"	3.5	3.5
Recording medium	Oxide Coated	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .125/.250	U: .250/.5	U: 1.0/1.6	U: .125/.250	U: .250/.5
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 6,250/10,416	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	2	2	1	1
Tracks per surface	40	40	80/77	40	80
Track density (TPI)	48	48	96	67.5	135
Maximum linear density (BPI)	2768/5536	2938/5876	5922/9646	4062/8125	4093/8187
Rotational speed (RPM)	300	300	300/360	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	5	3	6	3
Settling time (msec)	20	20	15	20	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100/83.3	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	31.25/62.5	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.1	1.625 x 5.75 x 8.1	1.625 x 5.75 x 8.1	1.26 x 4.0 x 6.1	1.26 x 4.0 x 6.1
FIRST CUSTOMER SHIPMENT	8/83	4/84	7/85	11/83	6/84
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	F-051M is mechanism - only version F-051AII is Apple version				F-353 CAE is auto eject model

MANUFACTURER	CHINON	CHINON	CHINON	CHINON	CHINON
DRIVE	F-354C F-354E	F-354L	F-354MC F-354MCU	F-356	F-357C F-357L
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM	OEM	OEM, PCM	OEM	OEM
MEDIA: Generic type	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80 HD	3.5" -- 2/80 HD
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .5/1.0	U: .5	U: .8	U: .8/1.6	U: 2.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	Varies	U: 5,208/10,416	U: 12,500
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	80	80	80	77	80
Track density (TPI)	135	135	135	135	135
Maximum linear density (BPI)	4359/8717	4359/8717	8850	7092/14184	17434
Rotational speed (RPM)	300	300	390-605	360	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	12	3	3
Settling time (msec)	15	15	30	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	76.9/49.6	83.3	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	61.2	31.25/62.5	62.5
SIZE (Inches: H x W x D)	1.26 x 4.0 x 6.1	1.0 x 4.0 x 5.75	1.7 x 4.1 x 7.0	1.26 x 4.0 x 6.1	1.26 x 4.0 x 6.1
FIRST CUSTOMER SHIPMENT	11/84	7/86	1985	7/85	7/86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	F-354 CAE is auto eject model		Subsystem for Apple MacIntosh		

MANUFACTURER	CITIZEN	CITIZEN	CITIZEN	CITIZEN	CITIZEN
DRIVE	AFDD	OMDT-20A	OPDA-00A	OPDB-00A	ORDA-00A
DISK/TREND GROUP	16	17	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" - 2/357	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80 HD
Nominal disk diameter	5.25"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	F: 10.97	U: .5/1.0	U: .5/1.0	U: .5/1.0	U: .8/1.6
Capacity per track (Bytes)	F: 15,360	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	357	80	80	80	77
Track density (TPI)	480	135	135	135	135
Maximum linear density (BPI)	18000	4359/8717	4359/8717	4359/8717	7092/14184
Rotational speed (RPM)	600	300	300	300	360
PERFORMANCE					
Actuator type	Linear, Voice Coil	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	20	6	3	6	3
Settling time (msec)	--	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	50	100	100	100	83.3
Data transfer rate (KBytes/sec)	200	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.0 x 3.9 x 5.2	1.0 x 4.0 x 5.9	1.0 x 4.0 x 5.9	1.0 x 4.0 x 5.9
FIRST CUSTOMER SHIPMENT	2Q87	10/84	11/86	11/86	11/86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	Embedded Servo SCSI interface 75 msec. aver. positioning	Top Loading	Front Loading	Front Loading	Front Loading

MANUFACTURER	CITIZEN	COPAL	COPAL	COPAL	COPAL
DRIVE	OSDA	F-5002	F-5004	F-5006	F-5008
DISK/TREND GROUP	17	16	16	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 2/80 HD	5.25" -- 2/40	5.25" -- 2/80	5.25" - 2/80 HD	5.25" - 2/80 HD
Nominal disk diameter	3.5"	5.25"	5.25"	5.25"	5.25"
Recording medium	High Density, Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/2.0	U: .250/.5	U: .5/1.0	U: .8/1.6	U: .5/1.0 or U: .8/1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416	U: 6,250/10,416
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	80	40	80	77	80/77
Track density (TPI)	135	48	96	96	96
Maximum linear density (BPI)	8717/17434	2938/5876	2961/5922	4823/9646	5922/9646
Rotational speed (RPM)	300	300	300	360	300/360
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING: Track to track (msec)	3	6	3	3	3
Settling time (msec)	15	15	15	15	15
Head load time (msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	83.3	100/83.3
Data transfer rate (KBytes/sec)	31.25/62.5	15.63/31.25	15.63/31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.0 x 4.0 x 5.9	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	2Q87	9/85	6/85	6/85	6/85
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	Front Loading				

MANUFACTURER	COPAL	COPAL	COPAL	COPAL	DATA TECHNOLOGY
DRIVE	F-3503	F-3504	F-3514	F-3516	DTC 12
DISK/TREND GROUP	17	17	17	17	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 1/80	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80 HD	5.25" Cartridge
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	5.25"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.500	U: .500/1.0	U: 1.0	U: 1.6	U: 12.76
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 6,250	U: 10,416	U: 23,868
Data surfaces per spindle	1	2	2	2	2
Tracks per surface	80	80	80	80	301
Track density (TPI)	135	135	135	135	333
Maximum linear density (BPI)	4094/8187	4359/8717	8717	14184	21640
Rotational speed (RPM)	300	300	300	360	600
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Linear, Voice Coil
POSITIONING:Track to track(msec)	3	3	3	3	25
Settling time (msec)	15	15	15	15	--
Head load time(msec)	Continuous Contact	Continuous Contact	50	50	Continuous Contact
Average rotational delay (msec)	100	100	100	83.3	50
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	31.25	62.5	275
SIZE (Inches: H x W x D)	1.26 x 4.0 x 6.063	1.26 x 4.0 x 6.063	1.18 x 4.0 x 5.9	1.18 x 4.0 x 5.9	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	4/85	4/85	8/86	8/86	10/86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	$495
COMMENTS					Embedded Servo SCSI interface 65 msec average positioning

MANUFACTURER	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	EASTMAN KODAK	EASTMAN KODAK	EASTMAN KODAK
DRIVE	RX02	RX50	KODAK 3.3	KODAK 6.6	KODAK 12
DISK/TREND GROUP	13	15	16	16	16
MARKET	Captive	Captive	Captive, OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	8" -- 1/77	5.25" -- 1/80	5.25" - Special	5.25" - Special	5.25" Cartridge
Nominal disk diameter	8"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	F: .256/.512	Per Diskette: F: .409 Per Drive: F: .818	U: 3.33	U: 6.6	U: 12.76
Capacity per track (Bytes)	F: 3,328/6,656	F: 5,120	U: 10,416	U: 10,416	U: 23,868
Data surfaces per spindle	1	1 per diskette 2 per drive	2	2	2
Tracks per surface	77	80	160	320	301
Track density (TPI)	48	96	192	384	333
Maximum linear density (BPI)	3268/6536	5536	9908	9908	21925
Rotational speed (RPM)	360	300	360	360	600
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Cam, Stepping Motor	Lead Screw/Dual Stepping Motors	Lead Screw/Dual Stepping Motors	Linear, Voice Coil
POSITIONING: Track to track(msec)	6	6	3	3	25
Settling time (msec)	20		15	15	--
Head load time(msec)	16		Continuous contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	83.3	100	83.3	83.3	50
Data transfer rate (KBytes/sec)	31.25	31.25	62.5	62.5	250
SIZE (Inches: H x W x D)	17 x 10.5 x 19	3.25 x 5.75 x 8.5	1.625 x 5.75 x 8.5	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	4Q78	4Q82	1Q84	3Q86	4Q86
U.S. OEM PRICE FOR 500 UNITS	--	--	$220 (1000)	$240	--
COMMENTS	Dual drive	Dual drive with single head positioning system	Embedded Servo	Embedded Servo	Embedded Servo SCSI Interface 75 msec aver. positioning

MANUFACTURER	ELCOMATIC	ELCOMATIC	ELCOMATIC	EPSON	EPSON
DRIVE	ACP 500 ACP 550	ACP 700 ACP 750	ACP 1500	SD-521	SD-540
DISK/TREND GROUP	13	14	14	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	8" -- 1/77	8" -- 2/77	8" -- Special	5.25" -- 2/40	5.25" -- 2/80
Nominal disk diameter	8"	8"	8"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .401/.802	U: .8/1.6	U: 1.6/3.2	U: .250/.5	U: .5/1.0
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208/10,416	U: 10,416	U: 3,125/6250	U: 3,125/6250
Data surfaces per spindle	1	2	2	2	2
Tracks per surface	77	77	154	40	80
Track density (TPI)	48	48	96	48	96
Maximum linear density (BPI)	3268/6536	3408/6816	3408/6816	2938/5876	2938/5876
Rotational speed (RPM)	360	360	360	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	1.5	6	3
Settling time (msec)	15	15	32	15	15
Head load time(msec)	35	35	35	Continuous Contact	35
Average rotational delay (msec)	83.3	83.3	83.3	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	4.35 x 8.55 x 12.0	4.35 x 8.55 x 12.0	4.35 x 8.55 x 12.0	1.625 x 5.75 x 7.7	1.625 x 5.75 x 7.7
FIRST CUSTOMER SHIPMENT	4Q81	4Q81	1983	10/83	10/83
U.S. OEM PRICE FOR 500 UNITS	--	--	--	$70 (1000)	$90 (1000)
COMMENTS	ACP 500: AC ACP 550: DC	ACP 700: AC ACP 750: DC			

MANUFACTURER	EPSON	EPSON	EPSON	EPSON	EPSON
DRIVE	SD-560	SD-580	TF-20	SMD-170B	SMD-180B
DISK/TREND GROUP	16	16	16	17	17
MARKET	OEM	OEM	Captive, PCM	OEM	OEM
MEDIA: Generic type	5.25" - 2/80 HD	5.25" - 2/80 HD	5.25" -- 2/40	3.5" -- 1/80	3.5" -- 2/80
Nominal disk diameter	5.25"	5.25"	5.25"	3.5"	3.5"
Recording medium	High Density, Oxide Coated	High Density, Oxide Coated	Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated
Sectoring	Soft	Soft	Soft/Hard	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .8/1.6	U: 1.0/1.6	U: .250/.5 F: .164/.328	U: .250/.5	U: .5/1.0
Capacity per track (Bytes)	U: 5,208/10,416	U: 6,250/10,416	F: 4,100	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	2	2	1	2
Tracks per surface	77	80/77	40	80	80
Track density (TPI)	96	96	48	135	135
Maximum linear density (BPI)	4823/9646	5922/9646	2990/5980	4095/8190	4360/8720
Rotational speed (RPM)	360	300/360	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	15	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	35	50	20	Continuous Contact	Continuous Contact
Average rotational delay (msec)	83.3	100/83.3	100	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 7.7	1.625 x 5.75 x 7.7	3.15 x 6.5 x 13.78*	1.57 x 4 x 5.8	1.57 x 4 x 5.8
FIRST CUSTOMER SHIPMENT	10/83	4/85	9/82	5/85	10/83
U.S. OEM PRICE FOR 500 UNITS	$95 (1000)	$95 (1000)	--	$90 (1000)	$90 (1000)
COMMENTS			*Dual drive subsystem	SMD-170B is low power model (2.5 watts, operating, uses + 5vdc only)	SMD-180B is low power model (2.5 watts, operating, uses +5vdc only)

MANUFACTURER	EPSON	EPSON	EPSON	ERGO	FLEXDISC
DRIVE	SMD-270	SMD-280H	SMD-280L	DS-5	FF 450
DISK/TREND GROUP	17	17	17	16	15
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 1/80	3.5" -- 2/80	3.5" -- 2/80	5.25" -- 2/40	5.25" -- 1/40
Nominal disk diameter	3.5"	3.5"	3.5"	5.25"	5.25"
Recording medium	High Density, Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft/Hard	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: 1.0	U: 1.0	U: .250/.5	U: .125/.250
Capacity per track (Bytes)	U: 3,125/6,250	U: 6,250	U: 6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	2	2	2	1
Tracks per surface	80	80	80	40	40
Track density (TPI)	135	135	135	48	48
Maximum linear density (BPI)	4095/8196	8717	8717	2938/5876	2768/5536
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	6	6
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	31.25	31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.1 x 4.0 x 5.87	1.1 x 4.0 x 5.87	1.0 x 4.0 x 5.87	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1986	1986	9/85	1985	--
U.S. OEM PRICE FOR 500 UNITS	--	$75 (1000)	$80 (1000)	$60	--
COMMENTS		SMD-280H is low power model (1.6 watts, operating, uses +5vdc only)	SMD-280L is low power model (1.6 watts, operating, uses +5vdc only)		

MANUFACTURER	FLEXDISC	FLEXDISC	FUJITSU	FUJITSU	FUJITSU
DRIVE	FF 650	FF 950	M2551A	M2552A	M2553A
DISK/TREND GROUP	16	16	16	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/40	5.25" - 2/80 HD	5.25" -- 2/40	5.25" -- 2/80	5.25" - 2/80 HD
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .8/1.6	U: .250/.5	U: .5/1.0	U: .8/1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 5,208/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	40	77	40	80	77
Track density (TPI)	48	96	48	96	96
Maximum linear density (BPI)	2938/5876	4823/9646	2938/5876	2961/5922	4823/9646
Rotational speed (RPM)	300	360	300	300	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	3	6	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	83.3	100	100	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	31.25/62.5	15.63/31.25	15.63/31.25	31.25/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	--	--	1/86	1/86	1/86
U.S. OEM PRICE FOR 500 UNITS	--	--	$83	$121	$125
COMMENTS					

MANUFACTURER	FUJITSU	FUJITSU	FUJITSU	FUJITSU	FUJITSU
DRIVE	M2554A	M2531A	M2532A	M2533A	M2534A
DISK/TREND GROUP	16	17	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" - 2/80 HD	3.5" -- 1/80	3.5" -- 2/80	3.5" -- 2/80 HD	3.5" -- 2/80 HD
Nominal disk diameter	5.25"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/1.6	U: .250/.5	U: .5/1.0	U: 1.6	U: 1.0/1.6
Capacity per track (Bytes)	U: 6,250/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416	U: 6,250/10,416
Data surfaces per spindle	2	1	2	2	2
Tracks per surface	80/77	80	80	77	80/77
Track density (TPI)	96	135	135	135	135
Maximum linear density (BPI)	5922/9646	4094/8187	4359/8717	7264/14528	8717/14528
Rotational speed (RPM)	300/360	300	300	360	300/360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100/83.3	100	100	83.3	100/83.3
Data transfer rate (KBytes/sec)	31.25/62.5	15.63/31.25	15.63/31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.26 x 4.0 x 6.0	1.26 x 4.0 x 6.0	1.625 x 4.0 x 6.0	1.625 x 4.0 x 6.0
FIRST CUSTOMER SHIPMENT	1/86	1/86	1/86	2/86	2/86
U.S. OEM PRICE FOR 500 UNITS	$132	$96	$112	$124	$134
COMMENTS					

MANUFACTURER	FUJITSU	GENISCO MEMORY PRODUCTS	GOLDSTAR TELE-ELECTRIC	GOLDSTAR TELE-ELECTRIC	GOLDSTAR TELE-ELECTRIC
DRIVE	M2536A	EDR-350	GSF 48S	GSF 48D	GSF 96C
DISK/TREND GROUP	17	17	15	16	16
MARKET	OEM	OEM	OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	3.5" -- 2/80 HD	3.5" -- 2/80	5.25" -- 1/40	5.25" -- 2/40	5.25" -- 2/80
Nominal disk diameter	3.5"	3.5"	5.25"	5.25"	5.25"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft/Hard	Soft/Hard
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 2.0	U: 1.0	U: .125	U: .5	U: 1.6
Capacity per track (Bytes)	U: 6,250/12,500	U: 6,250	U: 3,125	U: 6,250	U: 10,416
Data surfaces per spindle	2	2	1	2	2
Tracks per surface	80	80	40	40	77
Track density (TPI)	135	135	48	48	96
Maximum linear density (BPI)	8717/17434	8717	2768	5870	9600
Rotational speed (RPM)	300	300	300	300	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING: Track to track(msec)	3	6	5	5	3
Settling time (msec)	15	15	10	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	31.25	31.25	31.25	62.5
SIZE (Inches: H x W x D)	1.625 x 4.0 x 6.0	3.75 x 5.75 x 7.37	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	2/86	1987	1983	1983	3Q86
U.S. OEM PRICE FOR 500 UNITS	$145	--	--	--	--
COMMENTS		Sold as militarized subsystem	Apple compatible		

MANUFACTURER	GOLDSTAR TELE-ELECTRIC	HI-TECH PERIPHERALS	HI-TECH PERIPHERALS	HI-TECH PERIPHERALS	HI-TECH PERIPHERALS
DRIVE	GSF 96D	H548-25 H548-25FE,HE,HC	H548-50AT H548-50HS H548-50FS	H596-10	H596-16 H596-16AT
DISK/TREND GROUP	16	15	16	16	16
MARKET	Captive, OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/80	5.25" -- 1/40	5.25" -- 2/40	5.25" -- 2/80	5.25" - 2/80 HD
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	High Density, Oxide Coated
Sectoring	Soft/Hard	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	U: .125/.250	U: .250/.5	U: .5/1.0	U: .8/1.6
Capacity per track (Bytes)	U: 6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416
Data surfaces per spindle	2	1	2	2	2
Tracks per surface	80	40	40	80	77
Track density (TPI)	96	48	48	96	96
Maximum linear density (BPI)	5870	2938/5876	2938/5876	2961/5922	4823/9646
Rotational speed (RPM)	300	300	300	300	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	6	6	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	83.3
Data transfer rate (KBytes/sec)	31.25	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	2Q86	8/83	8/83	8/83	8/83
U.S. OEM PRICE FOR 500 UNITS	--	$120	$120	$140	$195
COMMENTS		H548-25FE,HE,HC are Apple compatible models			

MANUFACTURER	HITACHI	HITACHI	HITACHI	HITACHI	HITACHI
DRIVE	FDD-412 FDD-413B	FDD-441	FDD 541	HFD 516C	HFD 516DA
DISK/TREND GROUP	14	14	16	16	16
MARKET	Captive, OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	8" -- 2/77	Maxell FD2-HD	Maxell MD2-EH	5.25" - 2/80 HD	5.25" - 2/80 HD
Nominal disk diameter	8"	8"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	High Density Oxide Coated	High Density, Oxide Coated	High Density Oxide Coated	High Density, Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .8/1.6	U: 9.6	U: 6.5	U: .8/1.6	U: 1.0/1.6
Capacity per track (Bytes)	U: 5,208/10,416	U: 31,250	U: 31,250	U: 5,208/10,416	U: 6,250/10,416
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	77	154	104	77	80/77
Track density (TPI)	48	96	125	96	96
Maximum linear density (BPI)	3408/6816	20560*	29560	4823/9646	5876/9646
Rotational speed (RPM)	360	360	720	360	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	2	2	3	3
Settling time (msec)	35	15	37	15	15
Head load time(msec)	50	Continuous Contact	Continuous Contact	50	50
Average rotational delay (msec)	83.3	83.3	41.7	83.3	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	187.5	375	31.25/62.5	37.5/62.5
SIZE (Inches: H x W x D)	2.24 x 8.54 x 13.0	2.24 x 8.54 x 12.9	1.625 X 5.75 X 8.6	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	2/82	2/84	1Q85	4/83	5/85
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS		*Uses 2,7 RLL Code			

MANUFACTURER	HITACHI	HITACHI	HITACHI	HO SHIN	HO SHIN
DRIVE	HFD 305SX	HFD 305D	HFD 716A	HD-55A	HD-55C
DISK/TREND GROUP	17	17	17	15	15
MARKET	OEM	OEM	Captive, OEM	OEM	OEM
MEDIA: Generic type	3.0" -- 1/40	3.0" -- 2/40	3.5" -- 2/80 HD	5.25" -- 1/40	5.25" -- 1/80
Nominal disk diameter	3"	3"	3.5"	5.25"	5.25"
Recording medium	High Density, Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .125/.250	U: .250/.5	U: 1.6	U: .125/.250	U: .250/.5
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 10,416	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	2	2	1	1
Tracks per surface	40	40	77	40	80
Track density (TPI)	100	100	135	48	96
Maximum linear density (BPI)	4473/8946	4915/9830	14183	2768/5536	2788/5578
Rotational speed (RPM)	300	300	360	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	4	2
Settling time (msec)	15	15	32	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	83.3	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	62.5	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.57 x 3.54 x 5.83	1.57 x 3.54 x 5.83	1.5 x 4.0 x 5.4	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	10/82	4Q83	2/86	5/84	5/84
U.S. OEM PRICE FOR 500 UNITS	--	--	--	$50	$55
COMMENTS					

MANUFACTURER	HO SHIN	HO SHIN	HO SHIN	HO SHIN	HO SHIN
DRIVE	HD-55AX	HD-55CX	HD-55D	HD-55DH	HD-55DX
DISK/TREND GROUP	16	16	16	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/40	5.25" -- 2/80	5.25" -- 2/40	5.25" - 2/80 HD	5.25" -- 2/80
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: .250/.5	U: .8/1.6	U: .5/1.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416	U: 3,125/6,250
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	40	80	40	77	80
Track density (TPI)	48	96	48	96	96
Maximum linear density (BPI)	2768/5536	2788/5578	2938/5876	4823/9646	2961/5922
Rotational speed (RPM)	300	300	300	360	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	4	2	4	2	2
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	83.3	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	3/85	3/85	3/85	12/85	3/85
U.S. OEM PRICE FOR 500 UNITS	$60	$65	$60	$70	$65
COMMENTS					

MANUFACTURER	HYUNDAI MAGNETICS	HYUNDAI MAGNETICS	HYUNDAI MAGNETICS	IBM	IBM
DRIVE	FDD HM 65-22	FDD HM 65-4	FDD HM 65-8	3540	3770 Series 3602
DISK/TREND GROUP	16	16	16	13	13
MARKET	Captive, OEM	Captive, OEM	Captive, OEM	Captive	Captive
MEDIA: Generic type	5.25" -- 2/40	5.25" -- 2/80	5.25" - 2/80 HD	8" -- 1/77	8" -- 1/77
Nominal disk diameter	5.25"	5.25"	5.25"	8"	8"
Recording medium	Oxide Coated	Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: 1.0/1.6	F: .242944	F: .242944
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250/10,416	F: 3,328	F: 3,328
Data surfaces per spindle	2	2	2	1	1
Tracks per surface	40	80	80/77	74/3	74/3
Track density (TPI)	48	96	96	48	48
Maximum linear density (BPI)	2938/5877	2961/5922	4823/9646	3268	3268
Rotational speed (RPM)	300	300	300/360	360	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	6	3	3	50	50
Settling time (msec)	15	15	15	20	20
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	80	80
Average rotational delay (msec)	100	100	100/83.3	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	37.5/62.5	360	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	--	--
FIRST CUSTOMER SHIPMENT	1986	1986	1986	--	1/75
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS				Input/output device for S/370 and 4300 systems	

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5231	5265-A1X 5265-A2X 5265-B1X 5265-B2X	6670	3684	3694
DISK/TREND GROUP	13	13	13	14	14
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Generic type	8" -- 1/77	8" -- 1/77	8" -- 1/77	8" -- 2/77	8" -- 2/77
Nominal disk diameter	8"	8"	8"	8"	8"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	F: .242944	F: .246272	F: .242944	F: .985088	F: .568320
Capacity per track (Bytes)	F: 3,328	F: 3,328	F: 3,328	F: 6,656	F: 3,840
Data surfaces per spindle	1	1	1	2	2
Tracks per surface	74/3	74/3	74/3	74/3	74/3
Track density (TPI)	48	48	48	48	48
Maximum linear density (BPI)	3268	3268	3268	6816	3408
Rotational speed (RPM)	360	360	360	360	360
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	50	50	50	5	5
Settling time (msec)	20	20	20	35	35
Head load time(msec)	80	80	80	--	
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	360	31.25
SIZE (Inches: H x W x D)	--	--	--	--	--
FIRST CUSTOMER SHIPMENT	--	--	--	--	--
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	5230 Data collection system	5265 point of sale terminal	Information Distributor	Point of sale terminal	3600 finance communication controller

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	4701-1	4701-2	4956 4965	4964	4966 (Magazine Drive)
DISK/TREND GROUP	14	14	14	14	14
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Generic type	8" -- 2/77	8" -- 2/77	8" -- 2/77	8" -- 2/77	8" -- 2/77
Nominal disk diameter	8"	8"	8"	8"	8"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	F: .568320	F: .985088	F: .985088 or F: 1.136640 or F: 1.212416	F: .492544 or F: .568320 or F: .606208	F: .985088 or F: 1.136640 or F: 1.212416
Capacity per track (Bytes)	F: 3,840	F: 6,656	F: 6,656/7,680/ 8,192	F: 3,328/3,840/ 4,096	F: 6,656/7,680/ 8,192
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	74/3	74/3	74/3	74/3	74/3
Track density (TPI)	48	48	48	48	48
Maximum linear density (BPI)	3408	6816	3408/6816	3408	3408/6816
Rotational speed (RPM)	360	360	360	360	720
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	5	5	5	5	5
Settling time (msec)	35	35	35	35	35
Head load time(msec)					
Average rotational delay (msec)	83.3	83.3	83.3	83.3	41.7
Data transfer rate (KBytes/sec)	31.25	62.5	31.25/62.5	31.25	62.5/125
SIZE (Inches: H x W x D)	--	--	--	--	--
FIRST CUSTOMER SHIPMENT	1982	1982	8/81	11/76	2/79
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	4701 finance communication controller	4701 finance communication controller	Similar drive included with 4952 and 4954 models C and XXD Series 1	Similar drive included with some 4962 models Series/1	Capacity is 2 10-diskette magazines and 3 diskettes Series 1

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	~~5265-X3X~~ 5265-X4X 5265-X5X 5265-X6X 5265-X7X 55265-X8X	5360-A1X 5360-BXX 5360-DXX 5362-XXX	5360-X2X 5381-XXX 5832-XXX (Magazine Drive)	5525-02X 5525-03X 5525-04X	5525-05X (Magazine Drive)
DISK/TREND GROUP	14	14	14	14	14
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Generic type	8" -- 2/77	8" -- 2/77	8" -- 2/77	8" -- 2/77	8" -- 2/77
Nominal disk diameter	8"	8"	8"	8"	8"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	F: .985088	F: 1.212416	F: .985088 or F: 1.212416	F: 1.212416	F: 1.212416
Capacity per track (Bytes)	F: 6,656	F: 8192	F: 6,656/8,192	F: 8,192	F: 8,192
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	74/3	74/3	74/3	74/3	74/3
Track density (TPI)	48	48	48	48	48
Maximum linear density (BPI)	3408/6816	6816	3408/6816	6816	6816
Rotational speed (RPM)	360	360	360	360	720
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	5	5	5	5	5
Settling time (msec)	35	35	35	35	35
Head load time(msec)		--			
Average rotational delay (msec)	83.3	83.3	41.7	83.3	41.7
Data transfer rate (KBytes/sec)	62.5	62.5	31.25/62.5	62.5	125
SIZE (Inches: H x W x D)	--	--	--	--	--
FIRST CUSTOMER SHIPMENT	--	--	1/79 (S/34)	2/80	11/80
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	5265 point of sale terminal	System 36	Capacity is 2 10-diskette magazines and 3 diskettes System 36 & 38	5520 administrative system	5520 administrative system

MANUFACTURER	IBM	IBM	IBM	INSTRUMENTATION AND AUTOMATION	INSTRUMENTATION AND AUTOMATION
DRIVE	8101-A20 8101-A23/25	8130-All Models 8140-All Models 8150-All Models	Displaywriter 6360-20 Single 6360-22 Dual	MFDD-100	MFDD-110
DISK/TREND GROUP	14	14	14	15	15
MARKET	Captive	Captive	Captive	Captive, OEM	Captive, OEM
MEDIA: Generic type	8" -- 2/77	8" -- 2/77	8" -- 2/77	5.25" -- 1/40	5.25" -- 1/40
Nominal disk diameter	8"	8"	8"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	F: .492544 or F: .985088	F: .492544 or F: .985088	F: .284160 or F: 1.136640	U: .109/.218	U: .125/.250
Capacity per track (Bytes)	F: 3,328/6,656	F: 3,328/6,656	F: 3,840/7,680	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	2	2	1	1
Tracks per surface	74/3	74/3	74/3	35	40
Track density (TPI)	48	48	48	48	48
Maximum linear density (BPI)	3408/6816	3408/6816	3408/6816	2581/5162	2788/5576
Rotational speed (RPM)	360	360	360	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Cam, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	5	5	5	18	5
Settling time (msec)	35	35	35	15	15
Head load time(msec)				Continuous Contact	Continuous Contact
Average rotational delay (msec)	83.3	83.3	83.3	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	--	--	--	3.93 x 6.1 x 8.62	2.2 x 5.86 x 9.68
FIRST CUSTOMER SHIPMENT	1980	1980	6/81	1984	4Q86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	8100 system	8100 system	Models 6360-10 and 6360-11 are single and dual drives for one-sided diskettes	Subsystem for Apple II system	Subsystem for Apple II system

MANUFACTURER	INSTRUMENTATION AND AUTOMATION	INSTRUMENTATION AND AUTOMATION	INVENTA	INVENTA	INVENTA
DRIVE	BD-101	BD-120	FD 541	FD 561	FD 565
DISK/TREND GROUP	16	16	15	16	16
MARKET	Captive, OEM	Captive, OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/40	5.25" -- 2/40	5.25" -- 1/40	5.25" -- 2/40	5.25" -- 2/80
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .250/.5	U: .250	U: .5	U: 1.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	2	1	2	2
Tracks per surface	40	40	40	40	80
Track density (TPI)	48	48	48	48	96
Maximum linear density (BPI)	2938/5876	2938/5876	5536	5576	5922
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	5	5	8	6	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 X 5.75 x 8.1	1.625 X 5.75 x 8.1	1.625 X 5.75 x 8.1
FIRST CUSTOMER SHIPMENT	1986	4Q86	1986	1986	1986
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS				F 561M is mechanism only	F 565M is mechanism only

MANUFACTURER	IOMEGA	IOMEGA	IOMEGA	IOMEGA	IOMEGA
DRIVE	A110H Bernoulli Box	A120H Bernoulli Box	A210H-APL Bernoulli Box	Alpha-10H	Alpha-20H
DISK/TREND GROUP	18	18	18	18	18
MARKET	PCM	PCM	PCM	OEM	OEM
MEDIA: Generic type	Alpha-10 Cartridge	Alpha-20 Cartridge	Alpha-10 Cartridge	Alpha-10 Cartridge	Alpha-20 Cartridge
Nominal disk diameter	8"	8"	8"	8"	8"
Recording medium	High Density, Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	F: 10.0	F: 21.4	(Two Spindles) F: 20.0	F: 10.027 or 10.497	F: 21.4
Capacity per track (Bytes)	F: 32,768	F: 32,768	F: 32,768	F: 32,768 or 34,304	F: 32,768
Data surfaces per spindle	1	1	1	1	1
Tracks per surface	306	654	306	306	654
Track density (TPI)	300	641	300	300	641
Maximum linear density (BPI)	24000 BPI 18000 FCI	24000 BPI 18000 FCI	24000 BPI 18000 FCI	24000 BPI 18000 FCI	24000 BPI 18000 FCI
Rotational speed (RPM)	1500	1500	1500	1500	1500
PERFORMANCE					
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
POSITIONING:Track to track(msec)	10 (including settling)	10 (including settling)	10 (including settling)	10 (including settling)	10 (including settling)
Settling time (msec)	--	--	--	--	--
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	20	20	20	20	20
Data transfer rate (KBytes/sec)	1130	1130	Variable	1130	1130
SIZE (Inches: H x W x D)	6.32 x 12.5 x 15.25	6.32 x 12.5 x 15.25	6.32 x 12.5 x 15.25	2.32 x 8.54 x 12.0	2.32 x 8.54 x 12.0
FIRST CUSTOMER SHIPMENT	8/85	10/85	3Q85	4Q84	3Q85
U.S. OEM PRICE FOR 500 UNITS	$1795 (List)	$2395 (List)	$2495 (List)	see below	See below
COMMENTS	Subsystem for IBM PC A210H is 2 drive version priced at $2695	Subsystem for IBM PC A220H is 2 drive version priced at $3495	Dual drive subsystem for Appletalk Net.	1st drive $840 2nd drive $464	1st drive $900 2nd drive $550

MANUFACTURER	IOMEGA	IOMEGA	ISOT	ISOT	ISOT
DRIVE	B105-MAC	Beta-20	ES 5074	ES 5082	ES 5083
DISK/TREND GROUP	18	18	13	13	14
MARKET	PCM	OEM	Captive, OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	Alpha-5 Cartridge	Beta-20 Cartridge	8" -- 1/77	8" -- 1/77	8" -- 2/77
Nominal disk diameter	5.25"	5.25"	8"	8"	8"
Recording medium	High Density, Oxide Coated	High Density, Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft/Hard	Soft/Hard
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	F: 5.25	F: 21.4	U: .401	U: .4/.8	U: .8/1.6
Capacity per track (Bytes)	F: 13,312	F: 16,128	U: 5,208	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	2	1	1	2
Tracks per surface	394	677	77	77	77
Track density (TPI)	394	570	48	48	48
Maximum linear density (BPI)	17200 MFM	23511 BPI 17633 FCI	3268	3268/6536	3408/6816
Rotational speed (RPM)	1964	1845.7	360	360	360
PERFORMANCE					
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	10 (including settling)	6.2 (including settling)	10	10	10
Settling time (msec)	--	--	10	25	20
Head load time(msec)	Continuous Contact	Continuous Contact	40	40	35
Average rotational delay (msec)	15.3	16.25	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	625	666	31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	5.1 x 10.7 x 12.5	1.625 x 5.75 x 8	5.2 x 10.3 x 16.1	5.2 x 10.3 x 16.1	5.2 x 10.3 x 16.1
FIRST CUSTOMER SHIPMENT	4Q84	3Q86	1978	1983	1983
U.S. OEM PRICE FOR 500 UNITS	$1495 (List)	See Below	--	--	--
COMMENTS	Subsystem for Apple MacIntosh	1000 Quantity: 1st Drive $995 2nd Drive $723 40 ms average positioning time SCSI interface 1,8 RLL Code			

MANUFACTURER	ISOT	ISOT	ISOT	ISOT	ISOT
DRIVE	ES 5088	ES 5088M	ISOT 5050E	ES 5321	ES 5323
DISK/TREND GROUP	15	15	15	16	16
MARKET	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	5.25" -- 1/40	5.25" -- 1/40	5.25" -- 1/40	5.25" -- 2/40	5.25" -- 2/80
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .125	U: .125/.250	U: .250	U: .250/.5	U: .5/1.0
Capacity per track (Bytes)	U: 3,125	U: 3,125/6,250	U: 6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	1	1	2	2
Tracks per surface	40	40	40	40	80
Track density (TPI)	48	48	48	48	96
Maximum linear density (BPI)	2768	2768/5536	5536	2938/5876	2961/5922
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Cam, Stepping Motor	Cam, Stepping Motor	Cam, Stepping Motor	Cam, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	40	40	40	25	5
Settling time (msec)	10	10	10	15	15
Head load time(msec)	50	50	50	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63	15.63/31.25	31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1979	1982	1984	1984	1985
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS		Apple II compatible			

MANUFACTURER	JANOME SEWING MACHINE CO.	JANOME SEWING MACHINE CO.	JANOME SEWING MACHINE CO.	JANOME SEWING MACHINE CO.	KONICA
DRIVE	MFD-80	MFD-90	MFD-91	MFD-91D	KT-510
DISK/TREND GROUP	17	17	17	17	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.0" -- 1/40	3.5" -- 1/40	3.5" -- 1/80	3.5" -- 2/80	5.25" - 2/357
Nominal disk diameter	3"	3.5"	3.5"	3.5"	5.25"
Recording medium	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .125/.250	U: .250/.5	U: .5/1.0	F: 10.97
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	F: 15,360
Data surfaces per spindle	1	1	1	2	2
Tracks per surface	40	40	80	80	357
Track density (TPI)	100	67.5	135	135	480
Maximum linear density (BPI)	4473/8946	4065/8130	4094/8187	4359/8718	18000
Rotational speed (RPM)	300	300	300	300	600
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil
POSITIONING:Track to track(msec)	10	6	3	3	20
Settling time (msec)	15	15	15	15	--
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	50
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	200
SIZE (Inches: H x W x D)	1.57 x 3.54 x 5.9	1.57 x 4.0 x 5.3	1.57 x 4.0 x 5.3	1.57 x 4.0 x 5.3	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	2Q84	4Q84	4Q84	4Q84	4/87
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	Capable of using 48 tracks per surface. Mechanism-only version is 3.25" wide.				Embedded Servo SCSI interface 75 msec. aver. positioning

MANUFACTURER	LUNG HWA	MAGYAR OPTIKAI MUVEK	MAGYAR OPTIKAI MUVEK	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL
DRIVE	LDD-106DDS	Momflex 6400	MF 2000	JA-751	JA-561
DISK/TREND GROUP	16	13	15	14	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/40	8" -- 1/77	5.25" -- 1/40	8" -- 2/77	5.25" -- 2/80
Nominal disk diameter	5.25"	8"	5.25"	8"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .5	U: .4/.8	U: .125	U: .8/1.6	U: 1.0
Capacity per track (Bytes)	U: 6,250	U: 5,208/10,416	U: 3,125	U: 5,208/10,416	U: 6,250
Data surfaces per spindle	2	1	1	2	2
Tracks per surface	40	77	40	77	80
Track density (TPI)	48	48	48	48	96
Maximum linear density (BPI)	5876	3268/6536	2768	3408/6816	5876
Rotational speed (RPM)	300	360	300	360	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Cam, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	4	30	3	3
Settling time (msec)	15	15	0	25	15
Head load time(msec)	Continuous Contact	35	40	50	50
Average rotational delay (msec)	100	83.3	100	83.3	100
Data transfer rate (KBytes/sec)	31.25	31.25/62.5	15.63	31.25/62.5	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 7.9	4.4 x 8.5 x 13.9	3.25 x 5.75 x 8.0	2.2 x 8.6 x 12.1	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1/85	1980	1985	1/82	6/82
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS				Sold only in Japan	Sold only in Japan

MANUFACTURER	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL
DRIVE	JU-455 JA-551*	JU-475 JU-595*	JU-521	JU-581	JU-313 JU-314
DISK/TREND GROUP	16	16	16	16	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/40	5.25" -- 2/80	5.25"- 2/160 HD	5.25" -- 2/77	3.5" -- 1/40
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	3.5"
Recording medium	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density, Oxide Coated	High Density Oxide Coated
Sectoring	Soft/Hard	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .5	U: .5/1.0 or U: .8/1.6	U: 1.67/3.33	U: .8/1.6	U: .125/.250
Capacity per track (Bytes)	U: 6,250	U: 6,250/10,416	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250
Data surfaces per spindle	2	2	2	2	1
Tracks per surface	40	77/80	160	77	40
Track density (TPI)	48	96	192	96	67.5
Maximum linear density (BPI)	5876	5876/9646	9914	4823/9646	4093/8186
Rotational speed (RPM)	300	300/360	360	360	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	3	3	3	6
Settling time (msec)	15	15	35 (avg.)	15	15
Head load time(msec)	50	50	50	50	Continuous Contact
Average rotational delay (msec)	100	100/83.3	83.3	83.3	100
Data transfer rate (KBytes/sec)	31.25	31.25/62.5	31.25/62.5	31.25/62.5	15.63/31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.26 x 4.0 x 5.9
FIRST CUSTOMER SHIPMENT	6/82	4Q83	3Q86	2/83	1984
U.S. OEM PRICE FOR 500 UNITS	$98	$137	--	--	--
COMMENTS	*Sold only in Japan	*Sold only in Japan		Sold only in Japan	JU-313 is low power version

MANUFACTURER	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL
DRIVE	JU-323 JU-324	JU-363 JU-364	JU-363A JU-364A	JU-386	JU-394
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 1/80	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80 HD	3.5" -- 2/80 HD
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: 0.5/1.0	U: 1.0/1.6	U: 1.0/2.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 6,250/10,417	U: 6,250/12,500
Data surfaces per spindle	1	2	2	2	2
Tracks per surface	80	80	80	80/70	80
Track density (TPI)	135	135	135	135	135
Maximum linear density (BPI)	4093/8186	4359/8717	4359/8717	8717/14184	8717/17434
Rotational speed (RPM)	300	300	300	300/360	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100/83.3	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.26 x 4.0 x 5.9	1.26 x 4.0 x 5.9	1.26 x 4.0 x 5.9	1.26 x 4.0 x 5.9	1.26 x 4.0 x 5.9
FIRST CUSTOMER SHIPMENT	1984	1984	1Q86	2Q86	2Q86
U.S. OEM PRICE FOR 500 UNITS	--	$98	$98	$147	$152
COMMENTS	JU-323 is low power version	JU-363 is low power version	JU-363A is 5vdc single power supply version		

MANUFACTURER	MATSUSHITA ELECTRONIC COMPONENTS	MATSUSHITA ELECTRONIC COMPONENTS	MATSUSHITA ELECTRONIC COMPONENTS	MATSUSHITA ELECTRONIC COMPONENTS	MATSUSHITA ELECTRONIC COMPONENTS
DRIVE	EME-131	EME-140	EME-155	EME-160	EME-180
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.0" -- 1/80	3.0" -- 2/80	3.0" -- 1/40	3.0" -- 2/40	3.0" -- 2/40
Nominal disk diameter	3"	3"	3"	3"	3"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .5	U: 1.0	U: .250	U: .5	U: .250
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	1	2	1	2	2
Tracks per surface	80	80	40	40	20
Track density (TPI)	200	200	100	100	50
Maximum linear density (BPI)	8997	9891	8946	9830	8900
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	12	12	12	20	20
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	1.5 x 3.5 x 5.9	1.14 x 3.5 x 2.6	1.5 x 3.5 x 5.9	1.14 x 3.5 x 2.6	1.14 x 3.5 x 2.6
FIRST CUSTOMER SHIPMENT	1985	6/86	1985	4/86	4/86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS		Disk extends from front of drive		Disk extends from front of drive	Disk extends from front of drive

MANUFACTURER	MATSUSHITA ELECTRONIC COMPONENTS	MILTOPE	MILTOPE	MILTOPE	MITAC
DRIVE	EME-231	DD 400	DD 450	DD 550	AD-3 AD-3C
DISK/TREND GROUP	17	13	14	14	15
MARKET	OEM	OEM	OEM	OEM	OEM,PCM
MEDIA: Generic type	3.0" -- 2/80	8" -- 1/77	8" -- 2/77	8" -- 2/77	5.25" -- 1/40
Nominal disk diameter	3"	8"	8"	8"	5.25"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	U: .401/.802	U: .8/1.6	U: .8/1.6	U: .125/.250
Capacity per track (Bytes)	U: 6,250	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250
Data surfaces per spindle	2	1	2	2	1
Tracks per surface	80	77	77	77	40
Track density (TPI)	200	48	48	48	48
Maximum linear density (BPI)	9891	3268/6536	3408/6816	3408/6816	2768/5536
Rotational speed (RPM)	300	360	360	360	300
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	12	6	5	5	6
Settling time (msec)	15	10	10	10	20
Head load time(msec)	Continuous Contact	16	16	16	Continuous Contact
Average rotational delay (msec)	100	83.3	83.3	83.3	100
Data transfer rate (KBytes/sec)	31.25	31.25/62.5	31.25/62.5	31.25/62.5	15.63/31.25
SIZE (Inches: H x W x D)	1.5 x 3.5 x 5.9	5.44 x 8.44 x 18.0	5.44 x 8.44 x 18.0	5.44 x 8.44 x 18.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1985	1977	1980	1982	11/85
U.S. OEM PRICE FOR 500 UNITS	--	$4950	$5400	$4000	--
COMMENTS		Sold as militarized subsystem	Sold as militarized subsystem	Sold as militarized subsystem	

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION
DRIVE	M2896-63	MF501A MF501B	MF503A	MF504A MF504B	MF353AF MF353B
DISK/TREND GROUP	14	16	16	16	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	8" -- 2/77	5.25" -- 2/40	5.25" -- 2/80	5.25" - 2/80 HD	3.5" -- 2/80
Nominal disk diameter	8"	5.25"	5.25"	5.25"	3.5"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated	High Density, Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.6	U: .5	U: 1.0	U: 1.0/1.6	U: 1.0
Capacity per track (Bytes)	U: 10,416	U: 6,250	U: 6,250	U: 6,250/10,416	U: 6,250
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	77	40	80	80/77	80
Track density (TPI)	48	48	96	96	135
Maximum linear density (BPI)	6816	5877	5922	5922/9870	8717
Rotational speed (RPM)	360	300	300	300/360	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	3	6	3	3	3
Settling time (msec)	15	25	15	15	15
Head load time(msec)	50	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	83.3	100	100	100/83.3	100
Data transfer rate (KBytes/sec)	62.5	31.25	31.25	31.25/62.5	31.25
SIZE (Inches: H x W x D)	2.25 x 8.55 x 12.4	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.26 x 4.0 x 5.9
FIRST CUSTOMER SHIPMENT	1982	4Q85	2Q86	4Q85	4Q85
U.S. OEM PRICE FOR 500 UNITS	$350	$105	--	$145	$110
COMMENTS					Low power model - 3.2 watts

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUMI ELECTRIC CO.
DRIVE	MF354	MF354B	MF355	MF355B	D 501
DISK/TREND GROUP	17	17	17	17	15
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 2/80 HD	3.5" -- 2/80 HD	3.5" -- 2/80 HD	3.5" -- 2/80 HD	5.25" -- 1/40
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	5.25"
Recording medium	High Density Oxide Coated	High Density, Oxide Coated	High Density Oxide Coated	High Density, Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.6	U: 1.0/1.6	U: 2.0	U: 1.0/1.6	U: .250
Capacity per track (Bytes)	U: 10,416	U: 6,250/10,416	U: 12,500	U: 6,250/12,500	U: 6,250
Data surfaces per spindle	2	2	2	2	1
Tracks per surface	77	80/77	80	80	40
Track density (TPI)	135	135	135	135	48
Maximum linear density (BPI)	14184	8717/14184	17434	8717/17434	5535
Rotational speed (RPM)	360	300/360	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	3	10
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	83.3	100/83.3	100	100	100
Data transfer rate (KBytes/sec)	62.5	31.25/62.5	62.5	31.25/62.5	31.25
SIZE (Inches: H x W x D)	1.625 x 4.0 x 5.75	1.26 x 4.0 x 5.9	1.625 x 4.0 x 5.75	1.26 x 4.0 x 5.9	1.625 X 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1/86	1986	1/86	1986	12/83
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	Sold only in Japan	Sold only in Japan	Sold only in Japan	Sold only in Japan	

MANUFACTURER	MITSUMI ELECTRIC CO.	MITSUMI ELECTRIC CO.	MITSUMI ELECTRIC CO.	MITSUMI ELECTRIC CO.	MITSUMI ELECTRIC CO.
DRIVE	D 503	D 351	D 355	D 357	D 281
DISK/TREND GROUP	16	17	17	17	18
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/40	3.5" -- 1/40	3.5" -- 1/80	3.5" -- 2/80	Maxell QD-2
Nominal disk diameter	5.25"	3.5"	3.5"	3.5"	72 mm
Recording medium	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	N/A
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .500	U: .250	U: .500	U: 1.0	U: .064
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250	U: 64,000
Data surfaces per spindle	2	1	1	2	1
Tracks per surface	40	40	80	80	1
Track density (TPI)	48	67.5	135	135	59
Maximum linear density (BPI)	5876	8125	8187	8717	4410
Rotational speed (RPM)	300	300	300	300	423
PERFORMANCE					
Actuator type	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	N/A
POSITIONING:Track to track(msec)	10	12	3	3	N/A
Settling time (msec)	15	15	15	15	N/A
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	N/A
Average rotational delay (msec)	100	100	100	100	N/A
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25	12.63
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.26 x 4.0 x 6.1	1.26 x 4.0 x 6.1	1.26 x 4.0 x 6.1	1.73 x 4.6 x 4.1
FIRST CUSTOMER SHIPMENT	3/85	1/85	4/85	7/85	2/86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					64,000 bytes in single spiral track Front loading QDM-02 is MSX subsystem

MANUFACTURER	MITSUMI ELECTRIC CO.	MULTIDIGIT	MULTIDIGIT	MULTIDIGIT	MULTIDIGIT
DRIVE	QUICK DISK QDM-01	DF0211	DF0511	DF1011	DF1611 DF1622
DISK/TREND GROUP	18	15	16	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Maxell QD-2	5.25" -- 1/40	5.25" -- 2/40	5.25" -- 2/80	5.25" - 2/80 HD
Nominal disk diameter	72 mm	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated
Sectoring	N/A	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .064	U: .218	U: .5	U: 1.0	U: 1.6
Capacity per track (Bytes)	U: 64,000	U: 6,250	U: 6,250	U: 6,250	U: 10,416
Data surfaces per spindle	1	1	2	2	2
Tracks per surface	1	35	40	80	77
Track density (TPI)	59	48	48	96	96
Maximum linear density (BPI)	4410	5536	5877	5922	9646
Rotational speed (RPM)	423	300	300	300	360
PERFORMANCE					
Actuator type	N/A	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	N/A	6	6	6	3
Settling time (msec)	N/A	15	25	15	15
Head load time(msec)	N/A	Continuous Contact	50	50	50
Average rotational delay (msec)	N/A	100	100	100	83.3
Data transfer rate (KBytes/sec)	12.63	31.25	31.25	31.25	62.5
SIZE (Inches: H x W x D)	1.73 x 4.6 x 4.1	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1984	1986	1985	1985	1986
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	64,000 bytes in single spiral track Top loading MSX subsystem				

MANUFACTURER	MULTIDIGIT	NEC	NEC	NEC	NEC
DRIVE	DF2011	FD 1165	FD 1053	FD 1055	FD 1155C
DISK/TREND GROUP	16	14	16	16	16
MARKET	OEM	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	5.25" - 2/80 HD	8" -- 2/77	5.25" -- 2/40	5.25" -- 2/80	5.25" - 2/80 HD
Nominal disk diameter	5.25"	8"	5.25"	5.25"	5.25"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 2.0	U: .8/1.6	U: .5	U: 1.0	U: 1.0/1.6
Capacity per track (Bytes)	U: 12,500	U: 5,208/10,416	U: 6,250	U: 6,250	U: 6,250/10,416
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	80	77	40	80	80
Track density (TPI)	96	48	48	96	96
Maximum linear density (BPI)	11844	3408/6816	5876	5922	5922/9870
Rotational speed (RPM)	300	360	300	300	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	6	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	50	50	35	35	35
Average rotational delay (msec)	100	83.3	100	100	83.3
Data transfer rate (KBytes/sec)	62.5	31.25/62.5	31.25	31.25	37.5/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	2.28 x 8.54 X 12.7	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1986	4Q81	1984	1984	1/85
U.S. OEM PRICE FOR 500 UNITS	--	$280 (1000)	--	$132 (1000)	$140 (1000)
COMMENTS					

MANUFACTURER	NEC	NEC	NEC	NEC	NEC
DRIVE	FD 1155D	FD 1035	FD 1036A	FD 1135C	FD 1135D
DISK/TREND GROUP	16	17	17	17	17
MARKET	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	5.25" - 2/80 HD	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80 HD	3.5" -- 2/80 HD
Nominal disk diameter	5.25"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/1.6	U: .5/1.0	U: .5/1.0	U: 1.0/1.6	U: 1.0/1.6
Capacity per track (Bytes)	U: 6,250/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 6,250/10,416	U: 6,250/10,416
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	80	80	80	80	80
Track density (TPI)	96	135	135	135	135
Maximum linear density (BPI)	5922/9870	4359/8717	4359/8717	8717/14528	8717/14528
Rotational speed (RPM)	300/360	300	300	300/360	300/360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	35	35	Continuous Contact	35	35
Average rotational delay (msec)	100/83.3	100	100	100/83.3	100/83.3
Data transfer rate (KBytes/sec)	37.5/62.5	15.63/31.25	15.63/31.25	37.5/62.5	37.5/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.614 x 4.0 x 5.2	1.18 x 4.0 x 5.75	1.625 x 4.0 x 5.3	1.625 x 4.0 x 5.3
FIRST CUSTOMER SHIPMENT	3/86	11/84	9/85	11/85	1/86
U.S. OEM PRICE FOR 500 UNITS	--	$105 (1000)	$100 (1000)	--	--
COMMENTS					

MANUFACTURER	NEC	OCEANIC	OCEANIC	OCEANIC	OCEANIC
DRIVE	FD 1136C	OC-116 OC-116C	OC-118 OC-118N	OH-2	OB-1
DISK/TREND GROUP	17	15	15	15	16
MARKET	Captive, OEM	OEM, PCM	OEM, PCM	OEM, PCM	OEM, PCM
MEDIA: Generic type	3.5" -- 2/80 HD	5.25" -- 1/40	5.25" -- 1/40	5.25" -- 1/40	5.25" -- 2/40
Nominal disk diameter	3.5"	5.25"	5.25"	5.25"	5.25"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/1.6	U: .143	U: .174	U: .143	U: .5
Capacity per track (Bytes)	U: 6,250/10,416	U: 3,972	U: 4,833	U: 3,972	U: 6,250
Data surfaces per spindle	2	1	1	1	2
Tracks per surface	80	36	36	36	40
Track density (TPI)	135	48	48	48	48
Maximum linear density (BPI)	8717/14528	2768/5536	2768/5536	2768/5536	5536
Rotational speed (RPM)	300/360	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	6	6	4	4
Settling time (msec)	15	15	15	15	20
Head load time(msec)	Continuous Contact	35	35	35	Continuous Contact
Average rotational delay (msec)	100/83.3	100	100	100	100
Data transfer rate (KBytes/sec)	37.5/62.5	15.63	15.63	15.63	31.25
SIZE (Inches: H x W x D)	1.18 x 4.0 x 5.75	1.65 x 5.75 x 7.05	1.57 x 5.67 x 7.95	1.65 x 5.75 x 7.05	1.57 x 5.67 x 7.95
FIRST CUSTOMER SHIPMENT	6/86	--	--	--	9/86
U.S. OEM PRICE FOR 500 UNITS	--	$50	$86	$55	$62
COMMENTS		For Apple II	For Commodore	For Apple II	

MANUFACTURER	OKI ELECTRIC	OKI ELECTRIC	OKI ELECTRIC	OLIVETTI PERIPHERAL EQUIPMENT	OLIVETTI PERIPHERAL EQUIPMENT
DRIVE	GM3305BU GM3315BU	GM3305CU	GM3505BU	FD 802	FD 595
DISK/TREND GROUP	16	16	16	14	16
MARKET	Captive, OEM	OEM	OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	5.25" -- 2/40	5.25" -- 2/40	5.25" - 2/80 HD	8" -- 2/77	5.25" - 2/80 HD
Nominal disk diameter	5.25"	5.25"	5.25"	8"	5.25"
Recording medium	Oxide Coated	Oxide Coated	High Density Oxide Coated	Oxide Coated	High Density, Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .5	U: .5	U: 1.0/1.6	U: .8/1.6	U: .8/1.6
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250/10,416	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	40	40	80	77	77
Track density (TPI)	48	48	96	48	96
Maximum linear density (BPI)	5876	5876	5922/9646	3408/6816	4935/9870
Rotational speed (RPM)	300	300	300/360	360	360
PERFORMANCE					
Actuator type	Linear, Stepping Motor	Linear, Stepping Motor	Linear, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	4	4	3	3	3
Settling time (msec)	25	15	15	15	15
Head load time(msec)	50	Continuous Contact	Continuous Contact	35	25
Average rotational delay (msec)	100	100	100/83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25	31.25	31.25/62.5	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.1 x 5.75 x 8.0	1.1 x 5.75 x 8.0	1.1 x 5.75 x 8.0	4.52 x 9.05 x 12.3	3.25 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1Q85	2Q86	2Q86	1979	1983
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	OLIVETTI PERIPHERAL EQUIPMENT	OLIVETTI PERIPHERAL EQUIPMENT	OLIVETTI PERIPHERAL EQUIPMENT	OMEK	OMEK
DRIVE	FD 602	FD 692	FD 301	OM55	OM56
DISK/TREND GROUP	16	16	17	16	16
MARKET	Captive, OEM	Captive, OEM	Captive, OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/40	5.25" -- 2/80	3.5" -- 1/80	5.25" -- 2/40	5.25" -- 2/80
Nominal disk diameter	5.25"	5.25"	3.5"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: .5	U: .5	U: 1.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	2	1	2	2
Tracks per surface	40	80	80	40	80
Track density (TPI)	48	96	135	48	96
Maximum linear density (BPI)	5922	5922	8191	5877	5922
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	3	3	6	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.625/31.25	15.625/31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 4.0 x 5.0	1.625 X 5.75 X 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1Q84	2Q84	1985	1Q85	1Q85
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	OMEK	ORIENTAL PRECISION	ORIENTAL PRECISION	ORIENTAL PRECISION	RICOH
DRIVE	OM57	OFD 543	OFD 546	OFD 596	RF8160
DISK/TREND GROUP	16	15	16	16	14
MARKET	OEM	PCM	Captive	Captive	Captive, OEM
MEDIA: Generic type	5.25" - 2/80 HD	5.25" -- 1/40	5.25" -- 2/40	5.25" -- 2/80	8" -- 2/77
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	8"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft/Hard	Soft/Hard	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.6	U: .125/.250	U: .250/.5	U: .5/1.0	U: .8/1.6
Capacity per track (Bytes)	U: 6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416
Data surfaces per spindle	2	1	2	2	2
Tracks per surface	80	40	40	80	77
Track density (TPI)	96	48	48	96	48
Maximum linear density (BPI)	9646	2768/5536	2938/5876	2961/5922	3408/6816
Rotational speed (RPM)	360	300	300	300	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	6	6	6	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	50	50	50	50
Average rotational delay (msec)	83.3	100	100	100	83.3
Data transfer rate (KBytes/sec)	62.5	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	2.2 x 8.5 x 12.6
FIRST CUSTOMER SHIPMENT	1Q85	1983	1983	1983	6/83
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS		Licensed by TEAC Apple compatible	Licensed by TEAC	Licensed by TEAC	

MANUFACTURER	RICOH	RICOH	ROBOTRON	ROBOTRON	SAMSUNG ELECTRONICS
DRIVE	RF5050	RF5160	K 5600.10	K 5600.20	SFD-500K
DISK/TREND GROUP	16	16	15	15	16
MARKET	OEM	Captive, OEM	Captive,OEM	Captive,OEM	OEM, Captive
MEDIA: Generic type	5.25" -- 2/40	5.25" - 2/80 HD	5.25" -- 1/40	5.25" -- 1/80	5.25" -- 2/40
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .8/1.6	U: .125/.250	U: .250/.5	U: .5
Capacity per track (Bytes)	U: 3,125/6,250	U: 5,208/10,416	U: 3,250/6,250	U: 3,250/6,250	U: 6,250
Data surfaces per spindle	2	2	1	1	2
Tracks per surface	40	77	40	80	40
Track density (TPI)	48	96	48	96	48
Maximum linear density (BPI)	2938/5876	4823/9646	2768/5536	2788/5576	5876
Rotational speed (RPM)	300	360	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	3	10	8	3
Settling time (msec)	15	15	12	10	15
Head load time(msec)	50	50	40	40	35
Average rotational delay (msec)	100	83.3	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	31.25/62.5	15.63/31.25	15.63/31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	2.36 x 5.55 x 7.87	2.36 x 5.55 x 7.87	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	3Q84	3Q84	1984	1984	6/86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	SAMSUNG ELECTRONICS	SAMSUNG ELECTRONICS	SANKYO SEIKI	SANKYO SEIKI	SANKYO SEIKI
DRIVE	SFD-510K	SFD-560K	FDH-350-D	FDU-350-DB	FDU-350-SB
DISK/TREND GROUP	16	16	17	17	17
MARKET	OEM, Captive	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/80	5.25" - 2/80 HD	3.5" -- 2/80 HD	3.5" -- 2/40	3.5" -- 1/40
Nominal disk diameter	5.25"	5.25"	3.5"	3.5"	3.5"
Recording medium	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	U: 1.6	U: 1.6	U: .5	U: .250
Capacity per track (Bytes)	U: 6,250	U: 10,416	U: 10,416	U: 6,250	U: 6,250
Data surfaces per spindle	2	2	2	2	1
Tracks per surface	80	80/77	80	40	40
Track density (TPI)	96	96	135	67.5	67.5
Maximum linear density (BPI)	5922	9870/9642	14184	8647	8126
Rotational speed (RPM)	300	360	360	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	6	6	6
Settling time (msec)	15	15	30	30	30
Head load time(msec)	35	35	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	83.3	83.3	100	100
Data transfer rate (KBytes/sec)	31.25	62.5	62.5	31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.57 x 4.0 x 5.9	1.575 x 4.0 x 5.9	1.575 x 4.0 x 5.9
FIRST CUSTOMER SHIPMENT	6/86	1986	7/86	11/84	11/84
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	SANKYO SEIKI	SANKYO SEIKI	SANKYO SEIKI	SANKYO SEIKI	SANKYO SEIKI
DRIVE	FDU-355-DB	FDU-355-SB	FDU-360-D	FDU-360-S	FDU-365-D
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 2/80	3.5" -- 1/80	3.5" -- 2/40	3.5" -- 1/40	3.5" -- 2/80
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	U: .5	U: .5	U: .250	U: 1.0
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	1	2	1	2
Tracks per surface	80	80	40	40	80
Track density (TPI)	135	135	67.5	67.5	135
Maximum linear density (BPI)	8717	8184	8647	8126	8717
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	3	3	6	6	6
Settling time (msec)	30	30	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	1.575 x 4.0 x 5.9	1.575 x 4.0 x 5.9	1.18 x 4.0 x 5.1	1.18 x 4.0 x 5.1	1.18 x 4.0 x 5.1
FIRST CUSTOMER SHIPMENT	11/84	6/84	1/86	1/86	1/86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	SANKYO SEIKI	SANKYO SEIKI	SANKYO SEIKI	SHUGART	SHUGART
DRIVE	FDU-365-S	FDU-250	FMC-270	801	848-1
DISK/TREND GROUP	17	18	18	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 1/80	Special Disk	Special Disk	8" -- 1/77	8" -- 1/77
Nominal disk diameter	3.5"	2.598"	2.598"	8"	8"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	N/A	N/A	Soft/Hard	Soft/Hard
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .5	U: 86.5	U: .016	U: .401/.802	U: .401/.802
Capacity per track (Bytes)	U: 6,250	U: 5,400	U: .016	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	1	1	1	1
Tracks per surface	80	16	1	77	77
Track density (TPI)	135	48	N/A	48	48
Maximum linear density (BPI)	8187	10417	2138	3268/6536	3268/6536
Rotational speed (RPM)	300	270	405	360	360
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	N/A	N/A	Lead Screw, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	80	N/A	8	3
Settling time (msec)	15	50	N/A	8	15
Head load time(msec)	Continuous Contact	Continuous Contact	N/A	35	Continuous Contact
Average rotational delay (msec)	100	111	N/A	83.3	83.3
Data transfer rate (KBytes/sec)	31.25	25	4	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.18 x 4.0 x 5.1	.87 x 3.16 x 4.39	2.677 x 3.047 x 4.902	4.62 x 8.55 x 14.25	2.3 x 8.55 x 13.125
FIRST CUSTOMER SHIPMENT	1/86	2Q86	5/83	9/75	4/81
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS			16,000 bytes in single spiral track		

MANUFACTURER	SHUGART	SHUGART	SONY	SONY	SONY
DRIVE	848-2	851	OA-D31V	OA-D32V	OA-D32W
DISK/TREND GROUP	14	14	17	17	17
MARKET	OEM	OEM	Captive, OEM	OEM	OEM
MEDIA: Generic type	8" -- 2/77	8" -- 2/77	3.5" -- 1/70	3.5" -- 1/80	3.5" -- 2/80
Nominal disk diameter	8"	8"	3.5"	3.5"	3.5"
Recording medium	Oxide Coated	Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .8/1.6	U: .8/1.6	U: .2188/.4375	U: .250/.5	U: .5/1.0
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	2	1	1	2
Tracks per surface	77	77	70	80	80
Track density (TPI)	48	48	135	135	135
Maximum linear density (BPI)	3406/6816	3408/6816	3805/7610	4094/8187	4359/8717
Rotational speed (RPM)	360	360	600	600	600
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	3	3	15	12	12
Settling time (msec)	15	15	15	30	30
Head load time(msec)	Continuous Contact	50	60	60	60
Average rotational delay (msec)	83.3	83.3	50	50	50
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25/62.5	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	2.3 x 8.55 x 13.125	4.62 x 8.55 x 14.25	2.0 x 4.0 x 5.1	2.0 x 4.0 x 5.1	2.0 x 4.0 x 5.1
FIRST CUSTOMER SHIPMENT	4/81	6/77	11/82	9/83	1Q84
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	SONY	SONY	SONY	SONY	SONY
DRIVE	OA-D33V	MP-F52V	MP-F52W	MP-F53V	MP-F53W MP-F53W-00D
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	3.5" -- 1/80	3.5" -- 1/80	3.5" -- 2/80	3.5" -- 1/80	3.5" -- 2/80
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .250/.5	U: .5/1.0	U: .250/.5	U: .5/1.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	1	2	1	2
Tracks per surface	80	80	80	80	80
Track density (TPI)	135	135	135	135	135
Maximum linear density (BPI)	4094/8187	4094/8187	4359/8717	4094/8187	4359/8717
Rotational speed (RPM)	300	600	600	300	300
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	12	6	6	6	6
Settling time (msec)	30	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	50	50	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	2.0 x 4.0 x 5.1	1.18 x 4.0 x 5.9	1.18 x 4.0 x 5.9	1.18 x 4.0 x 5.9	1.18 x 4.0 x 5.9
FIRST CUSTOMER SHIPMENT	9/83	2Q85	2Q85	3Q85	3Q85
U.S. OEM PRICE FOR 500 UNITS	--	--	$100	--	$100
COMMENTS					

MANUFACTURER	SONY	SONY	SONY	TANDON	TANDON
DRIVE	MP-F63W-00D MP-F63W-01D	MP-F73W-00D MP-F73W-01D	MP-F83W-00D	TM-65-2L	TM-65-4
DISK/TREND GROUP	17	17	17	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 2/80	3.5" -- 2/80 HD	3.5" -- 2/80 HD	5.25" -- 2/40	5.25" -- 2/80
Nominal disk diameter	3.5"	3.5"	3.5"	5.25"	5.25"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft/Hard	Soft/Hard
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	U: 1.0/2.0	U: 1.0/1.6	U: .250/.5	U: .5/1.0
Capacity per track (Bytes)	U: 6,250	U: 6,250/12,500	U: 6,250/10,416	U: 6,250	U: 6,250
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	80	80	80	40	80
Track density (TPI)	135	135	135	48	96
Maximum linear density (BPI)	8717	8717/17434	8717/14528	2938/5877	2961/5922
Rotational speed (RPM)	300	300	300/360	300	300
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	6	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	83.3/100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.18 x 4.0 x 5.9	1.18 x 4.0 x 5.9	1.18 x 4.0 x 5.9	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1Q86	1Q86	1Q86	10/82	10/82
U.S. OEM PRICE FOR 500 UNITS	$100	$140	--	$90 (2500)	$114 (2500)
COMMENTS					

MANUFACTURER	TANDON	TANDON	TANDON	TANDON	TEAC
DRIVE	TM-65-8	TM-75-2	TM-75-8	TM-100-2	FD-55AV
DISK/TREND GROUP	16	16	16	16	15
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" - 2/80 HD	5.25" -- 2/40	5.25" - 2/80 HD	5.25" -- 2/40	5.25" -- 1/40
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	High Density Oxide Coated	Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft	Soft	Soft/Hard	Soft/Hard
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/1.6	U: .5	U: 1.0/1.6	U: .250/.5	U: .125/.250
Capacity per track (Bytes)	U: 6,250/10,416	U: 6,250	U: 6,250/10,416	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	2	2	2	1
Tracks per surface	80/77	40	80/77	40	40
Track density (TPI)	96	48	96	48	48
Maximum linear density (BPI)	4823/9646	5877	4823/9646	2938/5877	2768/5536
Rotational speed (RPM)	300/360	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	6	3	5	6
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	50	Continuous Contact	50
Average rotational delay (msec)	100/83.3	100	100	100	100
Data transfer rate (KBytes/sec)	37.5/62.5	31.25	37.5/62.5	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	3.25 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1984	4Q85	4Q85	11/78	4/82
U.S. OEM PRICE FOR 500 UNITS	$114 (2500)	$115 (2500)	$128 (2500)	$110 (2500)	$78 (1000)
COMMENTS					

MANUFACTURER	TEAC	TEAC	TEAC	TEAC	TEAC
DRIVE	FD-55EV	FD-55BV	FD-55FV	FD-55GFV	FD-55GV
DISK/TREND GROUP	15	16	16	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 1/80	5.25" -- 2/40	5.25" -- 2/80	5.25" - 2/80 HD	5.25" - 2/80 HD
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	Oxide Coated	Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .250/.5	U: .5/1.0	U: .5/1.0 or U: .8/1.6	U: .8/1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 6,250/10,416	U: 5,208/10,416
Data surfaces per spindle	1	2	2	2	2
Tracks per surface	80	40	80	80/77	77
Track density (TPI)	96	48	96	96	96
Maximum linear density (BPI)	2788/5576	2938/5876	2961/5922	5922/9646	4823/9646
Rotational speed (RPM)	300	300	300	300/360	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	6	3	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	50	50	50	50	50
Average rotational delay (msec)	100	100	100	100/83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	4/82	4/82	6/82	3/84	4/83
U.S. OEM PRICE FOR 500 UNITS	$85 (1000)	$82 (1000)	$93 (1000)	$103 (1000)	$101 (1000)
COMMENTS				Dual Speed	

MANUFACTURER	TEAC	TEAC	TEAC	TEAC	TEAC
DRIVE	FD-35EN	FD-35FN	FD-35FN-18	FD-35GFN	FD-35GN
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 1/80	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80 HD	3.5" -- 2/80 HD
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Recording medium	High density oxide coated	High density oxide coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: .5/1.0	U: 1.0/1.6	U: 1.0/1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 6,250/10,416	U: 6,250/10,416
Data surfaces per spindle	1	2	2	2	2
Tracks per surface	80	80	80	80/77	80/77
Track density (TPI)	135	135	135	135	135
Maximum linear density (BPI)	4094/8187	4359/8717	4359/8717	14528/14184	14528/14184
Rotational speed (RPM)	300	300	600	300/360	360
PERFORMANCE					
Actuator type	Band, Stepping motor	Band, Stepping motor	Band, Stepping motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	1.5	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous contact	Continuous contact	Continuous contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	50	100/83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.57 x 4.0 x 5.3	1.57 x 4.0 x 5.3	1.57 x 4.0 x 5.3	1.57 x 4.0 x 5.3	1.57 x 4.0 x 5.3
FIRST CUSTOMER SHIPMENT	2Q84	2Q84	1986	1986	1986
U.S. OEM PRICE FOR 500 UNITS	$70 (1000)	$82 (1000)	$84 (1000)	--	$87 (1000)
COMMENTS					

MANUFACTURER	TEAC	TEAC	TEAC	TECMATE	TECMATE
DRIVE	FD-35HFN	FD-135	FD-135FN	MT-501A NPH-501A	MT-502 NPH-502
DISK/TREND GROUP	17	17	17	15	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 2/80 HD	3.5" -- 1/80	3.5" -- 2/80	5.25" -- 1/40	5.25" -- 2/40
Nominal disk diameter	3.5"	3.5"	3.5"	5.25"	5.25"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/2.0	U: .250/.5	U: .5/1.0	U: .218	U: .125/.250
Capacity per track (Bytes)	U: 6,250/12,500	U: 3,125/6,250	U: 3,125/6,250	U: 3,125	U: 3,125/6,250
Data surfaces per spindle	2	1	2	1	2
Tracks per surface	80	80	80	35	40
Track density (TPI)	135	135	135	48	48
Maximum linear density (BPI)	8717/17434	4094/8187	4359/8717	5162	2938/5876
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Lead Screw, Stepping motor	Lead Screw, Stepping motor	Band, Stepping motor	Band, Stepping motor
POSITIONING:Track to track(msec)	3	3	3	6	9
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous contact	Continuous contact	Continuous contact	Continuous contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	15.63/31.25	15.63/31.25	31.25	15.625/31.25
SIZE (Inches: H x W x D)	1.57 x 4.0 x 5.3	1.0 x 4.0 x 5.9	1.0 x 4.0 x 5.9	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1986	7/85	7/85	1983	8/86
U.S. OEM PRICE FOR 500 UNITS	--	$75 (1000)	$81 (1000)	$67	$65
COMMENTS				Apple compatible	

MANUFACTURER	TECMATE	TECMATE	TECMATE	TECO	TOKYO ELECTRIC COMPANY
DRIVE	MT-504 NPH-504	MT-301 NPH-301	MT-302 NPH-302	VF 3540	FB-501
DISK/TREND GROUP	16	17	17	17	15
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/80	3.5" -- 1/80	3.5" -- 2/80	3.5" -- 2/80	5.25" -- 1/40
Nominal disk diameter	5.25"	3.5"	3.5"	3.5"	5.25"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.6	U: .250/.5	U: .5/1.0	U: 1.0	U: .250
Capacity per track (Bytes)	U: 10,416	U: 3,125/6,250	U: 3,125/6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	1	2	2	1
Tracks per surface	77	80	80	80	40
Track density (TPI)	96	135	135	135	48
Maximum linear density (BPI)	9646	4094/8187	4359/8717	8717	5536
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping motor	Lead Screw, Stepping motor	Lead Screw, Stepping motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	6	6	3	6
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous contact	Continuous contact	Continuous contact	Continuous contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	15.63/31.25	15.63/31.25	31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 4.0 x 6.0	1.625 x 4.0 x 6.0	1.18 x 4.0 x 5.9	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	9/86	1986	1986	12/86	3Q82
U.S. OEM PRICE FOR 500 UNITS	$85	--	$80	$79 (5000)	--
COMMENTS					

MANUFACTURER	TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY
DRIVE	FB-504	FB-506	FB-351	FB-352	FB-353
DISK/TREND GROUP	16	16	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" -- 2/80	5.25" - 2/80 HD	3.5" -- 1/40	3.5" -- 1/80	3.5" -- 2/40
Nominal disk diameter	5.25"	5.25"	3.5"	3.5"	3.5"
Recording medium	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	U: 1.0/1.6	U: .250	U: .5	U: .5
Capacity per track (Bytes)	U: 6,250	U: 6,250/10,416	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	2	1	1	2
Tracks per surface	80	80/77	40	80	40
Track density (TPI)	96	96	67.5	135	67.5
Maximum linear density (BPI)	5922	5922/9646	8126	8187	8647
Rotational speed (RPM)	300	300/360	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	3	3	6	3	6
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100/83.3	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25/62.5	31.25	31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 X 5.75 X 8.0	1.18 x 4.0 x 5.3	1.18 x 4.0 x 5.3	1.18 x 4.0 x 5.3
FIRST CUSTOMER SHIPMENT	1Q83	1Q85	3Q84	3/84	3Q84
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS		FU-506-XT and FT-506-XT are subsystems for IBM PC			

MANUFACTURER	TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY	TOSHIBA	TOSHIBA
DRIVE	FB-354	MC-116	MC-132	ND-40D ND-40DL	ND-04DT
DISK/TREND GROUP	17	18	18	14	16
MARKET	OEM	OEM	OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	3.5" -- 2/80	Special	Special	8" -- 2/77	5.25" -- 2/40
Nominal disk diameter	3.5"	66 mm OD	66 mm OD	8"	5.25"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	N/A	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	F: .016	F: .032	U: .8/1.6	U: .250/.5
Capacity per track (Bytes)	U: 6,250	F: 16,000	F: 32,000	U: 5,208/10,416	U: 3,125/6,250
Data surfaces per spindle	2	1	1	2	2
Tracks per surface	80	1	1	77	40
Track density (TPI)	135	33	N/A	48	48
Maximum linear density (BPI)	8717	2138	2768	3408/6816	2938/5876
Rotational speed (RPM)	300	405	425	360	300
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor	N/A	N/A	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	N/A	N/A	3	5
Settling time (msec)	15	N/A	N/A	18	15
Head load time(msec)	Continuous Contact	N/A	N/A	50	50
Average rotational delay (msec)	100	N/A	N/A	83.3	100
Data transfer rate (KBytes/sec)	31.25	6.25	10.4	31.25/62.5	15.63/31.25
SIZE (Inches: H x W x D)	1.18 x 4.0 x 5.3	1.61 x 3.0 X 4.9	1.61 x 3.0 X 6.3	2.24 x 8.54 x 12.4	1.625 x 5.75 x 8.3
FIRST CUSTOMER SHIPMENT	3/84	4Q82	4/84	1Q82	2Q83
U.S. OEM PRICE FOR 500 UNITS	--	--	--	$230 (1000)	$70 (1000)
COMMENTS		16,000 bytes in single spiral track	Up to 32,000 bytes in single spiral track		

MANUFACTURER	TOSHIBA	TOSHIBA	TOSHIBA	TOSHIBA	TOSHIBA
DRIVE	ND-06DT	ND-08D	ND-08DE	ND-351S/T	ND-352S/T
DISK/TREND GROUP	16	16	16	17	17
MARKET	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	5.25" -- 2/80	5.25" - 2/80 HD	5.25" - 2/80 HD	3.5" -- 1/80	3.5" -- 2/80
Nominal disk diameter	5.25"	5.25"	5.25"	3.5"	3.5"
Recording medium	Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .5/1.0	U: .8/1.6	U: 1.0/1.6	U: .5	U: 1.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 5,208/10,416	U: 6,250/10,416	U: 6,250	U: 6,250
Data surfaces per spindle	2	2	2	1	2
Tracks per surface	80	77	80/77	80	80
Track density (TPI)	96	96	96	135	135
Maximum linear density (BPI)	2961/5922	4823/9646	5922/9646	8187	8717
Rotational speed (RPM)	300	360	300/360	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	6	6
Settling time (msec)	15	15	15	15	15
Head load time(msec)	50	35	35	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	83.3	100/83.3	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	31.25/62.5	37.5/62.5	31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.3	1.625 x 5.75 x 8.3	1.625 x 5.75 x 8.3	1.0 x 4.0 x 5.9	1.0 x 4.0 x 5.9
FIRST CUSTOMER SHIPMENT	2Q82	2Q84	1984	3/86	3/86
U.S. OEM PRICE FOR 500 UNITS	$85 (1000)	$90 (1000)	$90 (1000)	--	$82 (1000)
COMMENTS					

MANUFACTURER	TOSHIBA	TOSHIBA	TOSHIBA	TOSHIBA	TOSHIBA
DRIVE	ND-352SH	ND-353A/S	ND-354A/S	ND-355S	ND-356S
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM	Captive, OEM	Captive, OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 2/80	3.5" -- 1/80	3.5" -- 2/80	3.5" -- 2/80 HD	3.5" -- 2/80 HD
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	U: .250/.5	U: .5/1.0	U: 1.0/1.6	U: 2.0
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250/10,416	U: 12,500
Data surfaces per spindle	2	1	2	2	2
Tracks per surface	80	80	80	80/77	80
Track density (TPI)	135	135	135	135	135
Maximum linear density (BPI)	8717	4096/8187	4359/8717	8717/14184	17434
Rotational speed (RPM)	300	300	300	300/360	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100/83.3	100
Data transfer rate (KBytes/sec)	31.25	15.63/31.25	15.63/31.25	31.25/62.5	62.5
SIZE (Inches: H x W x D)	1.0 x 4.0 x 5.9	1.625 x 4.0 x 5.9	1.625 x 4.0 x 5.9	1.0 x 4.0 x 5.9	1.0 x 4.0 x 6.3
FIRST CUSTOMER SHIPMENT	1986	3Q84	3Q84	1986	1Q87
U.S. OEM PRICE FOR 500 UNITS	--	$82 (1000)	$82 (1000)	--	--
COMMENTS					

MANUFACTURER	TOSHIBA	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN
DRIVE	BA-Ferrite FD	MDP-100 MDP-1	MDP-200 MDP-2	MDP-300	MDP-1000
DISK/TREND GROUP	17	16	16	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- Special	5.25" -- 2/80	5.25" -- 2/40	5.25" -- 2/80	5.25" - 2/80 HD
Nominal disk diameter	3.5"	5.25"	5.25"	5.25"	5.25"
Recording medium	Barium Ferrite	Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 4.0	U: 1.0	U: .5	U: 1.0	U: 1.6
Capacity per track (Bytes)	U: 25,000	U: 6,250	U: 6,250	U: 6,250	U: 10,416
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	80	80	40	80	77
Track density (TPI)	135	96	48	96	96
Maximum linear density (BPI)	34868	5922	5876	5922	9646
Rotational speed (RPM)	300	300	300	300	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	6	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	35	35	35	35
Average rotational delay (msec)	100	100	100	100	83.3
Data transfer rate (KBytes/sec)	125	31.25	31.25	31.25	62.5
SIZE (Inches: H x W x D)	1.625 x 4.0 x 5.6	1.625 x 5.75 x 7.9	1.625 x 5.75 x 7.9	1.625 x 5.75 x 7.9	1.625 x 5.75 x 7.9
FIRST CUSTOMER SHIPMENT	1987	2Q84	3Q84	4Q84	4Q84
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	Preliminary specification				

MANUFACTURER	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN
DRIVE	MDP-3000	MFD-5102MP	MFD-5162Z MDP-2000	MFD-5502Z	MDP-10
DISK/TREND GROUP	16	16	16	16	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" - 2/80 HD	5.25" -- 2/80	5.25" - 2/80 HD	5.25" -- 2/40	3.5" -- 1/80
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	3.5"
Recording medium	High Density Oxide Coated	Oxide Coated	High Density Oxide Coated	Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/1.6	U: 1.0	U: 1.0/1.6	U: .5	U: .5
Capacity per track (Bytes)	U: 6,250/10,416	U: 6,250	U: 6,250/10,416	U: 6,250	U: 6,250
Data surfaces per spindle	2	2	2	2	1
Tracks per surface	80/77	80	80/77	40	80
Track density (TPI)	96	96	96	48	135
Maximum linear density (BPI)	5922/9646	5922	5922/9646	5876	8187
Rotational speed (RPM)	300	300	300/360	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	6	3	6	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	35	35	35	35	35
Average rotational delay (msec)	100	100	100/83.3	100	100
Data transfer rate (KBytes/sec)	37.5/62.5	31.25	31.25/62.5	31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 7.9	1.625 x 5.75 x 8.6	1.625 x 5.75 x 7.9	1.625 x 5.75 x 8.6	1.625 x 4.0 x 5.1
FIRST CUSTOMER SHIPMENT	4Q84	1/87	4Q84	12/86	1Q85
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS			Dual Speed		

MANUFACTURER	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN
DRIVE	MDP-20	MDP-30	MDP-30F	MDP-30FD	MDP-30FDW
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 2/80	3.5" -- 1/80	3.5" -- 1/40	3.5" -- 1/80	3.5" -- 2/80
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	U: .5	U: .250	U: .5	U: 1.0
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	1	1	1	2
Tracks per surface	80	80	40	80	80
Track density (TPI)	135	135	67.5	135	135
Maximum linear density (BPI)	8717	8187	8125	8187	8717
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	3	3	6	6	6
Settling time (msec)	15	15	20	20	20
Head load time(msec)	35	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 4.0 x 5.1	1.1 x 4.0 x 5.1	1.57 x 4.0 x 6.4	1.57 x 4.0 x 6.4	1.57 x 4.0 x 6.4
FIRST CUSTOMER SHIPMENT	1Q85	1Q85	4/85	4/85	4/85
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN	VICTOR COMPANY OF JAPAN	VIDEO TECHNOLOGY	VIDEO TECHNOLOGY
DRIVE	MDP-40	MFD-3103Z	MFD-3503Z	FDM 110	FDM 145
DISK/TREND GROUP	17	17	17	15	16
MARKET	OEM	OEM	OEM	OEM, PCM	OEM, PCM
MEDIA: Generic type	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 1/80	5.25" -- 1/40	5.25" -- 2/40
Nominal disk diameter	3.5"	3.5"	3.5"	5.25"	5.25"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	U: 1.0	U: .5	U: .250	U: .5
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	2	1	1	2
Tracks per surface	80	80	80	40	40
Track density (TPI)	135	135	135	48	48
Maximum linear density (BPI)	8717	8717	8187	5536	5876
Rotational speed (RPM)	300	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	12	12
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	1.1 x 4.0 x 5.1	1.26 x 4.0 x 5.3	1.26 x 4.0 x 5.3	1.625 x 5.75 x 7.6	1.625 x 5.75 x 7.6
FIRST CUSTOMER SHIPMENT	1Q85			1984	2Q85
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS				FDM 110 & FD 100 are Apple II PCM versions	

MANUFACTURER	VIDEO TECHNOLOGY	WELTEC DIGITAL	WELTEC DIGITAL	WELTEC DIGITAL	WONG'S ELECTRONICS
DRIVE	FDM 160	M 16-A M 16-R M 16-P	M 48D	M 96D	WST 212-5 TITAN
DISK/TREND GROUP	16	16	16	16	16
MARKET	OEM, PCM	OEM, PCM	OEM	OEM	Captive
MEDIA: Generic type	5.25" -- 2/80	5.25" - 2/80 HD	5.25" -- 2/40	5.25" -- 2/80	5.25" -- 2/40
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0	U: 1.6/1.0	U: .250/.5	U: .5/1.0	U: .250/.5
Capacity per track (Bytes)	U: 6,250	U:10,416/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	80	80	40	80	40
Track density (TPI)	96	96	48	96	48
Maximum linear density (BPI)	5922	9870/5922	2938/5876	2961/5922	2938/5876
Rotational speed (RPM)	300	360/300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	2.8	5.6	2.8	6
Settling time (msec)	15	10	10	10	20
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	83/100	100	100	100
Data transfer rate (KBytes/sec)	31.25	62.5/31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 7.6	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	2Q85	1984	7/83	7/83	4/83
U.S. OEM PRICE FOR 500 UNITS	--	$115 (1000)	$79 (1000)	$92 (1000)	--
COMMENTS	FDM 150 is Apple II PCM version	Compatiblity: M16-A:IBM PC AT M16-P:IBM PC XT			

MANUFACTURER	YE DATA	YE DATA	YE DATA	YE DATA	YE DATA
DRIVE	YD-180	YD-380-1710	YD-380-1714	YD-380B-1710B	YD-380B-1711B
DISK/TREND GROUP	14	16	16	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	8" -- 2/77	5.25" - 2/80 HD	5.25" - 2/80 HD	5.25" - 2/80 HD	5.25" - 2/80 HD
Nominal disk diameter	8"	5.25"	5.25"	5.25"	5.25"
Recording medium	Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft/Hard	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .8/1.6	U: .8/1.6	U: .5/1.0 or U: .8/1.6	U: 1.6	U: 1.0/1.666
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208/10,416	U: 6,250/10,416	U: 10,416	U: 6,250/10,416
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	77	77	80/77	77	80
Track density (TPI)	48	96	96	96	96
Maximum linear density (BPI)	3408/6816	4823/9646	5922/9646	9646	5922/9870
Rotational speed (RPM)	360	360	300/360	360	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	50	50	50	50	50
Average rotational delay (msec)	83.3	83.3	100/83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25/62.5	62.5	37.5/62.5
SIZE (Inches: H x W x D)	2.25 x 8.55 x 12.6	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 X 8.0	1.625 x 5.75 X 8.0
FIRST CUSTOMER SHIPMENT	9/81	2/82	1984	4/86	4/86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	YE DATA	YE DATA	YE DATA	YE DATA	YE DATA
DRIVE	YD-380B-1714B	YD-480	YD-480B	YD-580	YD-580B-1354B YD-580B-1355B
DISK/TREND GROUP	16	16	16	16	16
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	5.25" - 2/80 HD	5.25" -- 2/80	5.25" -- 2/80	5.25" -- 2/40	5.25" -- 2/40
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Recording medium	High Density Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft/Hard	Soft	Soft/Hard	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/1.6	U: .5/1.0	U: 1.0	U: .250/.5	U: .5
Capacity per track (Bytes)	U: 6,250/10,416	U: 3,125/6,250	U: 6,250	U: 3,125/6,250	U: 6,250
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	80/77	80	80	40	40
Track density (TPI)	96	96	96	48	48
Maximum linear density (BPI)	5922/9646	2961/5922	5922	2938/5876	5876
Rotational speed (RPM)	300/360	300	300	300	300
PERFORMANCE					
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	5	5
Settling time (msec)	15	15	15	15	15
Head load time(msec)	50	50	50	50	50
Average rotational delay (msec)	100/83.3	100	100	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	15.63/31.25	31.25	15.63/31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 X 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 X 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 X 8.0
FIRST CUSTOMER SHIPMENT	4/86	4Q82	4/86	4Q82	4/86
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	YE DATA	YE DATA	YE DATA	YE DATA	YE DATA
DRIVE	YD-620B YD-625B	YD-640B YD-645B	YD-645C	YD-665B	YD-665C
DISK/TREND GROUP	17	17	17	17	17
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	3.5" -- 2/40	3.5" -- 2/80	3.5" -- 2/80	3.5" -- 2/80 HD	3.5" -- 2/80 HD
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Recording medium	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: .5/1.0	U: 1.6	U: 1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 10,416	U: 10,416
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	40	80	80	77	77
Track density (TPI)	67.5	135	135	135	135
Maximum linear density (BPI)	4324/8647	4358/8717	4358/8717	14184	14184
Rotational speed (RPM)	300	300	300	360	360
PERFORMANCE					
Actuator type	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	5	6	6	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	62.5	62.5
SIZE (Inches: H x W x D)	1.625 x 4.0 x 6.0	1.625 x 4.0 x 6.0	1.0 x 4.0 x 5.9	1.625 x 4.0 x 6.0	1.0 x 4.0 x 5.9
FIRST CUSTOMER SHIPMENT	4/84	4/85	1986	10/85	1986
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	YE DATA				
DRIVE	YD-700				
DISK/TREND GROUP	17				
MARKET	OEM				
MEDIA: Generic type	3.5" -- 2/80 HD				
Nominal disk diameter	3.5"				
Recording medium	High Density Oxide Coated				
Sectoring	Soft				
CAPACITY/RECORDING DENSITY					
Total capacity (MBytes)	U: 1.0/1.6				
Capacity per track (Bytes)	U: 6,250/10,416				
Data surfaces per spindle	2				
Tracks per surface	80/77				
Track density (TPI)	135				
Maximum linear density (BPI)	8717/14184				
Rotational speed (RPM)	300/360				
PERFORMANCE					
Actuator type	Lead Screw, Stepping Motor				
POSITIONING:Track to track(msec)	3				
Settling time (msec)	15				
Head load time(msec)	Continuous Contact				
Average rotational delay (msec)	100/83.3				
Data transfer rate (KBytes/sec)	31.25/62.5				
SIZE (Inches: H x W x D)	1.0 x 4.0 x 5.9				
FIRST CUSTOMER SHIPMENT	1Q87				
U.S. OEM PRICE FOR 500 UNITS	--				
COMMENTS					

MANUFACTURER PROFILES

1986 DISK/TREND REPORT

MANUFACTURER PROFILES

All manufacturers now producing flexible magnetic disk drives, or which have indicated specific plans to enter the market, are listed in this section. The heading "1985 disk sales" refers to the DISK/TREND estimate of flexible disk drive sales only -- no sales of other drive types are included, nor are sales of parts or other disk drive related products such as controllers. "1985 total net sales" covers the fiscal year ending in 1985 for each firm unless noted otherwise, or for the parent company if the disk drive manufacturer is a subsidiary. The fiscal year of listed firms ends on December 31, 1985, unless otherwise noted.

Exchange rates

The exchange rates used in converting the financial data of non-U.S. manufacturers to dollars is given below. The average exchange rate for 1985 is used, as reported by the U.S. Federal Reserve Bulletin and rounded to three significant figures.

Country	Currency	Currency units per U.S. dollar
Hong Kong	Dollar	7.791
Italy	Lira	1909.00
Japan	Yen	238.00
Korea	Won	862.00
Singapore	Dollar	2.201
Taiwan	Dollar	39.9
West Germany	Deutsch mark	2.942

U.S Manufacturers

AU PERIPHERAL PRODUCTS
176 Race Street
San Jose, CA 95126

Composed of veterans from IBM's San Jose facility, Au developed a 3.5 inch microfloppy using an internally designed and manufactured stepping motor. After financing delays in 1985, the firm still hopes to start production in 1987, The initial product is expected to be a conventional 3.5 inch drive, with up to 1 megabyte capacity.

CALDISK
Subsidiary of Billings Corporation
18600 East 37th Terrace South
Independence, MO 64067

Billings has spent years developing both hydrogen powered vehicles and small computer systems, without developing a profitable business. The Calcomp flexible disk drive product line was acquired in 1979 and moved to the company's facilities in Provo, then to the firm's headquarters location in Missouri. After an abortive introduction of 5.25 inch drives, the firm now manufactures only 8 inch drives, used with Billings computers and sold in a limited OEM marketing program.

CONTROL DATA CORPORATION
8100 - 34th Avenue South
Minneapolis, MN 55440

1985 FDD sales: $40,200,000
1985 total net sales: $3,679,700,000 Net income: ($567,500)

Although an early supplier of 8 inch flexible disk drives, Control Data was a latecomer to 5.25 inch drives, starting shipments in 1980. Large production increases for 5.25 inch drives until 1984 were attributable heavily to purchases by IBM. Programs to sell peripherals on a PCM basis to users of IBM minicomputers and personal computers resulted in negligible sales in the Series/1 market and modest sales in the PC market before the program was discontinued. Manufacturing responsibility for floppy drives credited to CDC in DISK/TREND statistics was held by Magnetic Peripherals, Inc., a joint venture with ownership shared by CDC, Honeywell, Sperry and Cii-Honeywell Bull. Control Data manages the joint venture and has exclusive responsibility for sales of its products in non-captive markets. MPI drives offered for sale with any of the parent company's systems are considered captive CDC drives for the purposes of DISK/TREND statistics. During 1984 the firm started moving manufacturing for floppy drives from the MPI Oklahoma facilities to Asian contract manufacturing firms. A decision to withdraw completely from the floppy drive business was made in 1985, and Control Data has withdrawn from the floppy drive market. Rights to make the CDC 8 inch floppy drive models were sold to the Narlinger Group, now operating as Shugart Corporation.

DATA TECHNOLOGY CORPORATION
2775 Northwestern Parkway
Santa Clara, CA 95051

DTC has operated for several years as a controller manufacturer and subsystem vendor, with founders originally from Xebec. Eastman Kodak has a minority investment in the firm, and arrangements have been made to manufacture and market the 12 megabyte 5.25 inch floppy drive developed by Kodak, and which will also be manufactured and marketed by that firm.

DIGITAL EQUIPMENT CORPORATION
146 Main Street
Maynard, MA 01754

1985 FDD sales: $81,600,000
1985 total net sales: $6,686,000,000 (FY ending 6/30/85) Net income: $447,000,000

Since 1976, DEC has produced 8 inch one sided floppy drives, originally under a Calcomp license. All of these drives were produced for captive use with its own systems, and production has topped out. DEC introduced its first 5.25 inch floppy, the RX50, along with the company's personal computer systems in late 1982 -- and has been producing large quantities during the last few years. The RX50 uses a single stepping motor to position heads on two 96 TPI one sided diskettes, and is adapted from a product acquired originally from T & E Engineering, a late 1970's floppy drive startup that never achieved large scale production.

EASTMAN KODAK COMPANY
343 State Street
Rochester, NY 14650

1985 total net sales: $10,631,000,000 Net income: $332,000,000

Although the Spin Physics operation of Eastman Kodak had previously introduced flexible disk media using isotropic particulate coatings, Kodak's action in licensing the Drivetec embedded servo 5.25 inch drive was the firm's first step into disk drive hardware. Production started in 1984 at the Rochester, New York, facilities. Sales for the floppy drive program are now handled exclusively by Eastman Kodak, replacing an earlier OEM marketing program by Data Technology Corporation, a Santa Clara controller manufacturer in which Kodak has an investment. Although not specifically announced, captive applications on Kodak equipment are also likely, eventually. In late 1985, the company announced 6.6 and 12 megabyte half high 5.25 inch drives. The major product is expected to be the 12 megabyte drive, with shipments promised by the end of 1986.

HI-TECH PERIPHERALS CORPORATION
15192 Triton Lane
Huntington Beach, CA 92649

Hi-Tech Peripherals was started in 1982, with founders from Xerox and Remex, to develop and manufacture 5.25 inch half high OEM flexible disk drives. Production started third quarter, 1983, at its Huntington Beach facility, and in Hong Kong. In late 1984, Hi-Tech went into Chapter 11, caught in a cash shortage as a major customer suddenly returned excess purchases. The company remains in production, however, and currently makes mostly subsystems compatible with Apple and IBM personal computers.

INTERNATIONAL BUSINESS MACHINES CORPORATION
Route 22
Armonk, NY 10504

1985 FDD sales: $311,200,000
1985 total net sales: $50,056,000,000 Net income: $6,555,000,000

IBM introduced the original one and two sided 8 inch flexible disk drives, and has used them on a wide variety of business systems, word processing systems, terminals and specialized equipment. After years of neglecting the minifloppy product area, IBM emerged as the world's largest buyer of OEM floppy drives, when it started purchasing two sided 48 TPI 5.25 inch drives for the hugely successful PC program. This choice established the two sided 48 TPI format as the mainstream minifloppy configuration for the worldwide computer industry. More recently, the IBM blessing has been given to 1.6 megabyte 5.25 inch drives and to one megabyte 3.5 inch microfloppies, and these configurations are now industry standards. An expected 1987 introduction of a "small footprint" personal computer using 2 megabyte 3.5 inch microfloppies is expected to give that format a major boost. IBM made extensive preparations to design and manufacture its own 5.25 inch and microfloppy drives, but abruptly cancelled the program in mid-1985 -- probably on the basis that current floppy drive models are available from numerous suitable vendors at prices that would be impossible to match with internal manufacturing. Internal production of 8 inch floppy drives also appears to be on the way out. IBM will rely on the outside world for its floppy drives, at least for the next few years.

IOMEGA CORPORATION
1821 West 4000 South
Roy, UT 84067

1985 FDD sales: $95,800,000
1985 total net sales: $116,000,000 Net income: $7,810,000

Iomega was successful in establishing production capability for its unique 8 inch drive, which maintains control of head/disk contact with the Bernoulli effect, and a 5.25 inch version was added in mid-1983. The products were originally intended as OEM drives, but Iomega has had much better luck with 8 and 5.25 inch subsystems sold in the personal computer add-on

market. The 8 inch subsystem for the IBM PC market has been shipping since 1983 and has provided most of the company's outstanding revenue growth. Half high 8 inch drives are now the major products, including models introduced in 1985 which increase the original 10 megabytes capacity to 20 megabytes per drive. SCI Systems has been licensed to make Iomega drives for use with its own systems and for sale by Iomega. Nippon Chemi-Con has been licensed to make and sell Iomega drives in Japan, and Verbatim has been granted a media license. The company's next major growth phase will probably be built around its new half high 5.25 inch 21 megabyte drive, offered so far only in the OEM market.

MILTOPE CORPORATION
1770 Walt Whitman Road
Melville, NY 11747

1985 total net sales: $61,300,000 Net income: $5,430,000

8 inch flexible disk drives are manufactured internally by Miltope for use in its line of militarized peripherals, which includes disk, tape and bubble memory subsystems. Both one and two sided 8 inch drives are manufactured.

OMEK
1835 Dawns Way
Fullerton, CA 92631

Omek is a new manufacturer of 5.25 inch flexible disk drives, started by veterans of various Memorex disk drive operations. After a start in Northern California, the firm moved in 1985 to a new Orange County location and is now producing half high 5.25 inch drives with up to 1.6 megabyte capacity, with major emphasis on low power and quiet operation. During 1986 operations were cut back, as changes in the dollar/yen exchange rate triggered sharp increases in costs of purchased components.

PER SCI, INC.
Subsidiary of EF Industries
12624 Daphne
Hawthorne, CA 20250

After suffering a decline in shipments for its fast but expensive 8 inch floppy drive, PerSci was sold in late 1982 to EF Industries, a firm which has acquired other declining computer industry manufacturing operations in the past few years. PerSci's activities now include service and low volume manufacturing of the old PerSci floppy drive line, plus similar functions for discontinued 14 inch rigid disk cartridge lines acquired from other firms.

QUME CORPORATION
Subsidiary of International Telephone & Telegraph Corporation
2350 Qume Drive
San Jose, CA 95150

1985 FDD sales: $22,500,000
1985 total net sales: $11,871,150,000 Net income: $293,501,000

Qume's floppy drive operations started in 1979, with a manufacturing license from YE Data. Except for some confusion when the firm reorganized its marketing and manufacturing programs in 1981, Qume has maintained continuous growth in the OEM market -- and received a big boost in 1983 by being selected as a vendor for half high 5.25 inch floppy drives to IBM for the PC Junior. However, Qume's management didn't care for today's floppy drive prices, and has closed down floppy drive manufacturing.

SHUGART CORPORATION
23501 Ridge Route Drive
Laguna Hills, CA 92653

The original Shugart Associates became the world leader in OEM floppy drives before being acquired by Xerox in the late 1970's. Within a few years of the acquisition, the spark was gone and the company was in trouble. Product reliability problems and a failure to keep the product line up to date left Shugart in bad shape when confronted by increasing competition. In the end Xerox management decided to stop the bleeding, and most of the Shugart operations were closed down in 1985. U.S. distribution rights to the half high 5.25 inch floppy products were sold to Matsushita. 8 inch floppy drives remained in production until the end, but were sold to the Narlinger Group in early 1986, along with rights to use of the Shugart Corporation name. The new Shugart Corporation continues to manufacture the 8 inch product line, along with additional models acquired from Control Data and Tandon.

TANDON CORPORATION
20320 Prairie Street
Chatsworth, CA 91311

1985 FDD sales: $128,600,000
1985 total net sales: $269,000,000 (FY ending 6/30/85) Net income: ($135,000,000)

Tandon Corporation started shipment of two sided 5.25 inch floppy drives in 1979, and by 1982 Tandon had also become the world leader in OEM floppy drives by aggressive introduction of new products and development of low cost manufacturing facilities through extensive vertical integration. The firm still makes many of its own heads, and has added motors and subassemblies from related companies in India, while establishing an assembly facility in Singapore. IBM became Tandon's largest (and dominant) cus-

tomer for floppy drives as the IBM PC grew to prominence, and IBM's purchases were critical to keeping Tandon's OEM floppy drive revenues at a high level. But with the collapse in floppy drive prices during 1984-85 Tandon found it impossible to stay profitable. The company has now changed direction, with its entry into the IBM compatible personal computer business, and is hoping the disk drive business will provide enough cash to adequately launch the new venture. Tandon's patent on two-sided floppy heads may also help with cash flow, as more Japanese companies sign up for licenses following Tandon's enforcement actions in the U.S. federal courts and the ITC.

Asian Manufacturers

(All fiscal years for Japanese companies end in March, 1985, unless otherwise noted.)

ALPS ELECTRIC CO., LTD.
1-7, Yukigaya Ohtsuka-cho
Ohta-ku, Tokyo 145
Japan

1985 FDD sales: $80,700,000
1985 total net sales: $1,321,210,000 Net income: $53,265,000

Alps Electric is a high-growth manufacturer of electronic components and subassemblies for television, audio, instruments and computer applications. Production of captive 5.25 inch floppy drives for use with Alps systems started several years ago, but has not been emphasized. The firm's big increase in floppy drive shipments came in 1981, with a rapid build-up of shipments to Apple Computer. Alps' shipments of one side 5.25 inch drives have topped all other floppy drive manufacturers worldwide since 1981. Alps also started shipping 3.5 inch microfloppy drives in mid-1984, and has been selected by IBM as a microfloppy drive supplier. Alps has also announced a product line of 5.25 inch and 3.5 inch rigid disk drives.

ASIA COMMERCIAL CO., LTD.
444-452 Des Voeux Road West
Hong Kong

Asia Commercial offers floppy drives for IBM, Apple, MSX and other microcomputers. Shipments of 5.25 inch one-side drives began in 1985, and two-sided drives were added in 1986. Manufacturing is done by Manhattan Electronics, a closely associated firm at the same location.

BROTHER INDUSTRIES
9-35, Horita-dori
Mizuhoku, Nagoya 467
Japan

1985 total net sales: $768,101,000 (FY ending 11/30/85 Net income: $34,370,000

Brother is Japan's largest manufacturer of sewing machines, knitting machines and typewriters, with rapid growth in recent years in printers and other office equipment. Brother has been shipping a 100 kilobyte 3.5 inch microfloppy drive since 1984 and added 1.0 inch high 1 and 2 megabyte versions in 1986.

CANON ELECTRONICS CO., INC.
Subsidiary of Canon, Inc.
1248, Shimokagemori, Chichibu-city
Saitama, 369-18
Japan

1985 FDD sales: $56,800,000
1985 total net sales: $2,417,517,000 (FY ending 12/31/85) Net income: $101,050,000

Canon Electronics produces electronic subassemblies for Canon cameras, as well as other electronic components and systems. One and two sided 5.25 inch floppy drives have been in production since 1979 under a BASF license, and the firm has added captive and OEM one third high drives of its own design. Canon also developed its own unique microfloppy using a 97 mm disk, but these drives have been dropped, and the firm began shipments of 3.5 inch microfloppies in late 1984. Floppy drives are produced for both captive applications and for sale to the OEM market, both domestic and export.

CHINON INDUSTRIES, INC.
21-17 Takashima 1-chome
Suwa-City, Nagano 392
Japan

1985 total net sales: $106,571,000 Net income: $2,235,000

Chinon is a manufacturer of cameras and auto radios, with worldwide distribution. Eastman Kodak is a minority shareholder in the firm, holding about 9.4% ownership. Due to decreasing growth in the camera industry, Chinon intends to emphasize its data product lines in the future. The company produces printers as well as floppy disk drives. During 1984, the firm introduced its flexible disk drive product line, consisting of half high 5.25 inch drives and 3.5 inch microfloppies. In 1984, data products accounted for less than 10% of company revenues, but grew to 21% in 1985, with a major proportion contributed by floppy drive shipments.

CITIZEN WATCH CO., LTD.
2-1-1, Nishi-Shinjuku
Shinjuku-ku, Tokyo 160
Japan

1985 total net sales: $620,803,000 Net income: $24,811,000

Citizen is steadily expanding its diversification into additional products, from its basic position of strength as Japan's second largest watch manufacturer. Watches are now down to 72% of sales, while machine tools and office equipment are rapidly rising. In addition to printers, displays, and small computers, Citizen introduced 3.5 inch microfloppies in 1984, offering the first one-inch floppy drive and has begun an aggressive sales program in the U.S. and Europe, aimed at the OEM market.

COPAL CO., LTD.
2-16-20, Shimura
Itabashi-ku, Tokyo 174
Japan

1985 total net sales: $238,357,000 Net income: $4,282,000

Starting with camera shutters, still the firm's largest product, Copal has diversified into a wide range of electronic components, photographic equipment, clocks, machine tools and printers. Copal has been involved in contract manufacturing for floppy drives, and announced its own 3.5 inch microfloppy drives for shipment in early 1985. A line of 5.25 inch drives is also in production. Fujitsu, Ltd. has a 6.5% ownership position in Copal and has supplied key personnel to assist in joint product development efforts. Copal manufactures the floppy drives sold by Fujitsu America.

ERGO ELECTRONICS COMPANY LIMITED
388 Castle Peak Road
Tsuen Wan, New Territories
Hong Kong

Ergo was founded in 1978 as the Evergo Corporation and changed its name in 1985 to reflect new management. The firm assembles personal computers and also manufactures 5.25 inch floppy disk drives for the Apple-compatible market, with drives for the IBM personal computer market added in 1986.

FUJITSU LIMITED
6-1, Marunouchi 2-chome
Chiyoda-ku, Tokyo 100
Japan

1985 total net sales: $6,564,118,000 Net income: $374,067,000

Despite its role as Japan's leading computer manufacturer and a major participant in the worldwide market for OEM rigid disk drives, Fujitsu was not a participant in the flexible disk drive industry until 1984, except as a buyer of OEM drives for use with its systems. After a short-lived internal manufacturing program, an investment was made in Copal, which is now producing Fujitsu's floppy drives. In 1985, marketing of floppy drives began in the U.S., with production to be provided by Copal. Fujitsu and Copal have publicly disclosed work on a 3.3 megabyte drive, but no product announcement has yet been made.

GOLD STAR TELE-ELECTRIC CO., LTD.
Kukdong Building, #60-1, Choongmu-Ro 3-Ka
Choong-Ku, Seoul
South Korea

A member of the Lucky-Gold Star Group, one of Korea's major industrial families, Gold Star Tele-Electric is a diversified manufacturer of telecommunication equipment, automation systems and computer peripherals. In an effort to expand beyond existing terminal and printer products, the company markets half high 5.25 inch floppy drives with distribution limited, so far, to Korea. Sales in the U.S. have been delayed due to a lawsuit by Tandon Corporation claiming improper use of Tandon product designs by ex-employees.

HITACHI, LTD.
6-2, Otemachi 2-chome
Chiyoda-ku, Tokyo 100
Japan

1985 FDD sales: $50,400,000
1985 total net sales: $21,064,270,000 Net income: $883,038,000

While Hitachi is Japan's largest electric and electronics manufacturer, only about a fifth of its total sales are generated by the computer industry. Hitachi has been making 8 inch floppy drives since 1976 for both captive and OEM applications. In 1982, the firm entered the 5.25 inch market, and also joined in the 3.0 inch microfloppy standard being promoted by Hitachi, Matsushita Electric Industrial, and Hitachi's magnetic media subsidiary, Maxell. Since early 1986, however, the firm has also been shipping a 1.6 megabyte 3.5 inch drive. Hitachi has taken something of a leadership role in introducing high capacity flexible disk drives designed to use high density particulate media developed by Maxell, including a 9.6 megabyte 8 inch drive and a 6.5 megabyte 5.25 inch drive. The firm has also made technology announcements concerning vertical recording.

HO SHIN SUB-SYSTEM CO., LTD.
3-5 Lane 145
Hsien Sheng S. Road, Section 1
Taipei 106
Taiwan

Founded in 1983, Ho Shin originally produced 8 inch drives, but later switched to production of 5.25 inch drives. Current products include half high drives for IBM type systems and models for Apple systems.

HYUNDAI MAGNETICS CO., LTD
Joint venture of Tandon Corporation
and Hyundai Electronics Industries Co., Ltd.
South Korea

Hyundai Magnetics was established as a joint venture to make flexible and rigid disk drives in Korea, with a license to use Tandon head technology in two sided floppy drives. The initial products are half high 5.25 inch floppy drives with capacities up to 1.6 megabytes, with marketing by Hyundai Electronics Industries, part of the Hyundai Business Group, Korea's largest company.

INVENTA ELECTRONICS CO., LTD.
66 Hou-Kang Street
Shih-Lin, Taipei
Taiwan

5.25 inch, half high drives are manufactured by Inventa. The firm has a subsidiary, Technico Precision, located in Japan, that produces major elements of the drive.

JANOME SEWING MACHINE CO., LTD.
1-1, Kyobashi 3-chome
Chuo-ku, Tokyo 104
Japan

1985 total net sales: $281,784,000 Net income: $9,088,000

Janome is one of the world's leaders in consumer and industrial sewing machines, and supplies private label sewing machines to Sears. Due to slow growth in its basic field, Janome has started to expand into such fields as printers and disk drives. In October, 1983, the firm announced a 3 inch OEM microfloppy drive for delivery in mid-1984, and followed up with a 3.5 inch OEM drive in late 1984.

KYOCERA CORPORATION
52-11, Inouecho, Higashino
Yamashinaku, Kyoto 607
Japan

1985 total net sales: $1,190,273,000 Net income: $132,824,000

Kyocera is the world's largest supplier of ceramic IC packages, and has launched a broad program of expansion into manufacture of audio equipment, office automation and other electronic equipment. Included in the expansion plans are disk drives, and the firm made its first showing of a 5.25 inch flexible disk drive in 1984 at Hanover Fair. This product, and a 3.5 inch floppy drive shown later, have never been put in production. Kyocera has also begun to make 3.5 inch rigid disk drives designed by La Pine Technology.

LUNG HWA ELECTRONICS CO., LTD.
33, Pao-Hsing Road, 5th Floor
Hsin-Tien, Taipei
Taiwan

Established in 1973, Lung Hwa offers 5.25 inch and 3.5 inch floppy disk drives. Most are shipped to the U.S. add-on market for use with home computers. A line of controller cards is also supplied.

MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.
4-3-1 Tsunashima-Higashi
Kohoku-ku, Yokohama 223
Japan

1985 FDD sales: $80,400,000
1985 total net sales: $1,264,525,000 (FY ending 11/30/85) Net income: $45,454,000

Matsushita Communication Industrial is a member of the Matsushita Electric Industrial group, a worldwide giant in appliances and electronics. MCI manufactured most of the Shugart floppy drive line under license for the Japanese OEM market. MCI later added floppy drives of its own design, including half high 5.25 inch and 3.5 inch microfloppy drives, with high level production now underway at a new plant at Hanamaki. The firm made half high 5.25 inch drives on a contract manufacturing basis for Shugart and in 1985 acquired the rights to market them in the United States. MCI also has major customers for its OEM drives in Japan, including IBM.

MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.
1006, Kadoma, Kadoma City
Osaka 571
Japan

1985 FDD sales: $27,300,000
1985 total net sales: $14,387,122,000 (FY ending 11/30/85) Net income: $469,282,000

MEI's Panasonic, National, Technics and Quasar brandnames are among the most widely known in the world for appliances, consumer electronics and communications equipment. MEI has joined with Hitachi in attempting to establish a 3.0 inch microfloppy standard, and now manufactures 3.0 inch microfloppy drives for the worldwide OEM market. Three new two sided drives with capacities up to one megabyte were announced in 1986. MEI has been particularly successful in the European market.

MITAC, INC
75 Nanking East Road, Section 4
Taipei
Taiwan

Mitac is a ten year old firm which started as an importer and system integrator of U.S. and European computer systems and has evolved into a manufacturer of microcomputers, terminals and flexible disk drives. The firm initially acquired a Shugart license, and has more recently designed its own half high 5.25 inch drive, sold mainly in the personal computer add-on market, but also as an OEM drive.

MITSUBISHI ELECTRIC CORPORATION
2-3, Marunouchi 2-chome
Chiyoda-ku, Tokyo 100
Japan

1985 FDD sales: $164,100,000
1985 total net sales: $7,807,849,000 Net income: $145,109,000

Mitsubishi Electric is a leader in the Japanese domestic small business systems market, and one of the country's leading electronic and electrical products manufacturers. Captive 8 inch drives have been used with the firm's Melcom systems for several years, and the firm also participates in the domestic OEM market. A family of half high two sided 5.25 inch floppy drives was introduced in 1982, with capacities up to 2.0 megabytes. Mitsubishi also started shipping a 3.5 inch microfloppy drive in 1983 and introduced a 2.0 megabyte version in 1985. Production of flexible disk drives has been moved to expanded facilities at Mitsubishi's Koriyama Works.

MITSUMI ELECTRIC CO., LTD.
8-8-2, Kokuryo-cho
Chofu-City, Tokyo 182
Japan

1985 FDD sales: $25,200,000
1985 total net sales: $352,387,000 (FY ending 1/31/86) Net income: $3,794,000

Mitsumi is a leading manufacturer of electronic subassemblies and components, including magnetic heads. The firm established a joint venture facility with Commodore, named Newtronics, to produce 5.25 inch and 3.5 inch floppy drives, and acquired complete ownership of Newtronics in 1986. In 1984, Mitsumi introduced a very low cost 2.8 inch drive using a special Maxell disk under the name "Quick Disk", which uses a single spiral track with 64,000 kilobytes capacity. It is used primarily in low end home systems, including games, and has experienced major growth in shipments during 1986.

NEC CORPORATION
5-33-1 Shiba
Minato-ku, Tokyo 108
Japan

1985 FDD sales: $457,600,000
1985 total net sales: $9,488,970,000 Net income: $282,088,000

About one fifth of NEC's revenues are generated by computer mainframes, small business systems, minicomputers and desktop systems -- and the firm is the clear leader in the growing Japan domestic personal computer market. Since 1978 the company has manufactured two sided 8 inch floppy drives, and was one of the earliest firms to offer half high 8 inch drives, with shipments starting in late 1981. 3.5 inch microfloppy drives and half high 5.25 inch drives were introduced in 1984. Most of NEC's floppy drive shipments have been for captive applications, with total revenues making the company the world leader in total DISK/TREND revenues for flexible disk drives.

OCEANIC ELECTRONICS CORP.
123 Section 1, Nei Hu Road
Taipei, Taiwan

Oceanic began shipments in 1985 one side 5.25 inch floppy drives. The product line now includes single and double sided drives for Apple, Commodore and IBM compatible personal computers. Current production emphasizes two sided half-height drives.

OKI ELECTRIC INDUSTRY CO., LTD.
1-17-12, Toranomon
Minato-ku, Tokyo 105, Japan

1985 total net sales: $1,520,445,000 Net income: $46,252,000

Oki is a diversified manufacturer of electronic communications and data processing equipment, with a major role in the Japanese market for terminals. For several years the company has manufactured 8 inch one side floppy drives at low levels for captive applications. In 1983, the firm introduced one third high 5.25 inch drives for captive and OEM usage.

ORIENTAL PRECISION COMPANY, LTD.
Tae Wha Building, 11th Floor
194-27 Insa-dong, Chongno-gu
Seoul, South Korea

OPC, established in 1953, is a diversified producer of electronic products and systems including terminals, telecommunication products, small computers and radio products. The firm manufactures a line of 5.25 inch floppy drives under license from Teac, and also does contract manufacturing of a 3.9 inch rigid cartridge drive for SyQuest.

RICOH CO., LTD.
1-15-5 Minami-Aoyama
Minato-ku, Tokyo 107
Japan

1985 total net sales: $2,292,151,000 Net income: $70,420,000

Copiers, sensitized papers and photographic equipment provide the major part of Ricoh's revenues, but the firm has been investing in the growing line of data processing equipment now manufactured. Since 1979, Ricoh has made 8 inch floppy drives, in both one and two sided versions, originally under a Calcomp manufacturing license. The firm has introduced half high 5.25 inch drives intended for both captive and OEM applications.

SAMSUNG ELECTRONICS
Subsidiary of the Samsung Group
Taipyung-ro, Chung-ku
Seoul
South Korea

Samsung got started in floppy drive production in 1983 when Shugart granted a license to manufacture and market the Shugart 5.25 inch floppy drives in South Korea. Samsung is currently making half high 5.25 inch drives with capacities up to 1.6 megabytes, and has initiated an export program.

SANKYO SEIKI MFG. CO., LTD.
17-2, 1-chome, Shinbashi
Minato-ku, Tokyo 105
Japan

1985 total net sales: $413,000,000 Net income: $6,748,000

Sankyo Seiki is a leading manufacturer of musical movements, industrial robots and a wide variety of small electromechanical components used in cameras, video recorders, timers and other products. Since 1981, the firm has been shipping a spiral track flexible disk drive for word processing, program loading and special industrial applications, and in mid-1984 added 3.5 inch microfloppies.

SEIKO EPSON CORPORATION
3-5, Owa 3-chome, Suwa-shi
Nagano, 392
Japan

1985 FDD sales: $74,600,000

Seiko Epson is the new name for the privately held Suwa Seikosha/Epson group owned by members of the Hattori family, who also control Japan's Seiko companies active in watches and electronics. Epson is best known

for matrix printers, now used worldwide with personal computers. Epson also manufactures line printers, LCD's, paper tape equipment, watch components, and its own portable computer. The first Epson floppy drive was a captive 5.25 inch one third high unit first shipped in 1982 and used with the Epson portable computer. Starting in October, 1983, Epson added an OEM floppy drive product line with a variety of 5.25 and 3.5 inch models, including 3.5 inch drives with very low power requirements. At the 1985 Fall Comdex, Seiko Epson showed a 2.5 inch floppy disk drive prototype for which development is still underway, with media to be available from Maxell.

SEIKOSHA CO., LTD.
Subsidiary of Hattori Seiko Co., Ltd.
4-1-1, Taihei
Sumida-ku, Tokyo 130
Japan

Seikosha is a diversified manufacturer of clocks, camera shutters, semiconductors, small computers and printers, and a key member of the Seiko group. As part of an expansion in the computer area, Seikosha designed and was preparing to manufacture microfloppy drives using the Dysan 3.25 inch diskette by the end of 1984 -- but was left stranded by collapse of the Dysan/Tabor efforts in the U.S. A 3.5 inch microfloppy was introduced in 1985, but the firm subsequently terminated all floppy disk drive manufacturing at year end.

SONY CORPORATION
6-7-35, Kita-Shinagawa
Shinagawa-ku, Tokyo 141
Japan

1985 FDD sales: $96,800,000
1985 total net sales: $4,501,517,000 (FY ending 10/31/85) Net income: $205,702,000

As it becomes more difficult to meet Sony's growth objectives in the consumer electronics market, several portions of which appear saturated, the firm's management has made it clear that expansion in office products markets is a major company objective. Among the products announced so far are word processing and personal computer equipment -- both of which use the Sony 3.5 inch microfloppy which has been shipping since late 1981. The drive has also been offered worldwide as an OEM product, with growing success. After initially taking a somewhat stiff posture on granting licenses, Sony demonstrated flexibility in working with the U.S. manufacturers concerned with establishing common standards. The result was agreement on the 3.5 inch media standard by Sony and several U.S. drive and media manufacturers -- and a growing number of Japanese firms rushing to make 3.5 inch microfloppy drives. After a big early boost when Hewlett-Packard selected Sony's drive for a variety of personal computers, there was a two year period of attack from contentious sponsors of rival standards, but the industry consensus on the Sony media standard is now

firmly established. Sony's microfloppy drive and media shipments have grown, as Apple chose the drive for its Macintosh system and other systems manufacturers signed on. Sony proposed to the industry a 2.0 megabyte, 3.5 inch media standard in 1985, which other Japanese firms have adopted, and which now is becoming a de facto industry standard, with a little help from IBM. Sony is also an active producer of CD-ROM and write-once optical disk drives, and introduced its first rigid disk drive in 1986.

TEAC CORPORATION
3-7-3, Naka-cho
Musashino, Tokyo 180
Japan

1985 FDD sales: $139,400,000
1985 total net sales: $289,399,000 (FY ending 9/30/85) Net income: ($2,857,000)

TEAC is a leading manufacturer of consumer and professional audio recorders, but digital recording equipment is a growing portion of the firm's product mix, now accounting for over 70% of total revenues. Shipments of 5.25 inch floppies for the worldwide OEM market started in 1978, and rapid growth has made TEAC the worldwide leader in 1985 worldwide OEM floppy drive revenues. Major products today are half high 5.25 inch drives, plus microfloppy drives. In 1985, Teac announced a line of high capacity 3.5 inch products including a 2.0 megabyte model, plus one inch high models offering capacities up to one megabyte.

TECMATE ELECTRONIC INC.
30 Section 3, Chung-Shan N. Road
Taipei
Taiwan

Tecmate, also known under its NPH brand name, was founded in 1982. The firm produces floppy disk drives and other electronic products for small computers. 5.25 inch and 3.5 inch drives are offered by the company. Initial shipments started with single sided drives, but current production has shifted strongly to double sided drives.

TECO ELECTRIC & MACHINERY CO., LTD.
156-2 Sung-Chiang Road
Taipei
Taiwan

1985 total net sales: $168,031,250 Net income: $13,525,000

Founded in 1956, TECO began as a supplier of electric motors. Its product line now includes electric motors, including stepper motors, consumer appliances, heavy industrial equipment, and computer peripherals. TECO announced a 3.5 inch, one megabyte floppy drive in 1986.

TOKYO ELECTRIC COMPANY, LTD.
14-10, 1-chome, Uchikanda
Chiyoda-ku, Tokyo
Japan

1985 total net sales: $739,155,000 Net income: $22,382,000

Tokyo Electric is a member of the Toshiba group, and manufactures electronic cash registers, POS systems, lighting fixtures, household appliances, and a growing family of data processing products. The firm makes 5.25 inch floppy drives for the worldwide OEM market, with half high models added late in 1982. The company also added late in 1982 a small spiral track drive using 66 mm flexible disks, plus 3.5 inch microfloppy drives in early 1984.

TOSHIBA CORPORATION
1-1-1, Shibaura
Minato-ku, Tokyo 105
Japan

1985 FDD sales: $120,800,000
1985 total net sales: $14,045,470,000 Net income: $361,845,000

Toshiba is one of Japan's major diversified electric and electronics manufacturers, with products ranging from heavy electric machinery to home electric appliances and communications equipment. Toshiba has a major share of the Japanese minicomputer and small business system markets. 8 inch floppy drives for both captive and OEM markets have been produced since 1977. Half high two sided 5.25 inch drives were added in 1982, with the more recent addition of both 3.0 and 3.5 inch microfloppy drives. Toshiba has actively promoted advanced technology, including optical drives. High capacity barium ferrite media has been proposed by the firm for 4 megabyte 3.5 inch floppy drives, which have been announced on a preliminary basis, with the intention to start production in 1987.

VICTOR COMPANY OF JAPAN, LIMITED
4-1, Nihonbashi-Honcho
Chuo-ku, Tokyo 103
Japan

1985 total net sales: $2,731,361,000 Net income: $82,761,000

JVC's revenues are generated mostly by consumer electronics products; the firm has been the beneficiary of sharp growth in home video tape recorder shipments, and VTRs account for almost 70% of total revenues. JVC is now expanding into computer peripherals, with 3.5 inch Winchester and flexible disk drives among its first products in the field. Half high 5.25 inch drives were first shipped in mid-1984 and the firm began shipping 3.5 inch microfloppies in early 1985.

VIDEO TECHNOLOGY, LTD.
23/F, Tai Ping Ind. Centre, Blk.1, Lot No. 1637
Ting Kok Road, Nam Hang
Tai Po, N.T.
Hong Kong

Video Technology is a nine year old Hong Kong firm active in manufacture of consumer electronics, personal computers and computer peripherals. The firm is now making half high 5.25 inch floppy drives which are marketed as OEM and add-on drives in the personal computer market.

WELTEC DIGITAL, INC.
Subsidiary of Wearnes Brothers
17875 Skypark North
Irvine, CA 92714

The Remex flexible disk drive operation was sold to a group controlled by Wearnes Brothers, Singapore manufacturers of electronics products, in mid-1984. All manufacturing is now in Singapore, with marketing responsibility still maintained in California. Products are 5.25 inch drives.

WONG'S ELECTRONICS, LTD.
Subsidiary of Wong's Industrial (Holdings) Ltd.
Sime Darby Industrial Building
420 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong

The Wong's Group is a major Hong Kong manufacturer of printed circuit boards and assembler of electronic products. The origins of this floppy drive manufacturing organization go back to the mid-1970s, in the form of Orbis and General Systems International, pioneer makers of OEM floppy drives. Both firms' product lines eventually ended up under Siemens ownership, and then were sold to World Storage Technology. In late 1983 Wong acquired complete ownership of World Storage Technology from other investors, and in the second half of 1984 completed moving manufacturing and engineering from California to Hong Kong. The products are 5.25 inch single and double sided drives. In 1986, production responsibility was transferred to Wong's Electronics Co., Ltd., also located in Hong Kong. Most current production goes into the personal computer add-on market.

YE DATA, INC.
Subsidiary of Yaskawa Electric Mfg. Co., Ltd.
60, 1-1, Higashi-Ikebukuro 3-chome
Toshima-ku, Tokyo 170

1985 FDD sales: $133,600,000
1985 total net sales: $134,437,000 Net income: $3,739,000

Yaskawa Electric's heavy electric equipment is the largest segment of the company, but factory automation and data processing equipment is growing fast. The data processing products are the responsibility of YE Data, which first manufactured 8 inch one side floppy drives in 1974 under an Orbis license. YE Data became an early leader in the Japanese OEM markets for both 8 and 5.25 inch two sided drives, and has introduced half high drives in both disk dimensions. YE Data also cooperated with NTT on the standard for 1.6 megabyte 5.25 inch drives and has been shipping its version since early 1982. Microfloppy drives were added in 1984. YE Data's biggest sale of all came in 1984, with IBM's selection of the firm's 1.6 megabyte 5.25 inch drive for use with the PC AT.

European Manufacturers

BASF AG
D-6700 Ludwigshafen
West Germany

1985 total net sales: $16,207,000,000 Net income: $339,225,000

BASF, a worldwide chemical giant and pioneer in magnetic recording, first manufactured 8 inch one side drives in 1976, using rights to designs originated by GSI, a pioneer California floppy drive manufacturer. 8 inch two sided drives were added in 1978, as were one and two sided 5.25 inch drives. BASF originated the two thirds high 5.25 inch drive, which attained major market share only in Europe, and in 1983 added one third high 5.25 inch drives obtained from Canon on a contract manufacturing basis. In 1986 BASF is closing down all floppy disk drive operations.

ELCOMATIC LTD
Subsidiary of British & Commonwealth Shipping Co., Ltd.
Kirktonfield Road
Nielston, Glasgow
Scotland

In July, 1981, Elcomatic acquired the 8 inch flexible disk product line of MFE. These drives had been manufactured mostly in a two sided version at plants in Salem, Massachusetts, and in Livingston, Scotland. Elcomatic moved manufacturing to a Glasgow plant and is continuing to produce 8 inch two sided floppy drives for the European market.

INSTRUMENTATION AND AUTOMATION
Boulevard Cherni Vrah, 57
1113 Sofia
Bulgaria

Instrumentation and Automation has the charter from the Bulgarian government to develop personal computers and appropriate peripherals, and to establish high volume manufacturing facilities, in order to facilitate usage throughout the country. With assistance from ISOT, plus acquisition of tooling from outside countries, the organization started production of 5.25 inch flexible disk drives in 1985.

ISOT
51, Chapaev St.
1113 Sofia 49
Bulgaria

Isotimpex is the foreign trade organization for Bulgarian computer equipment and other electronic products. Disk drives manufactured by ISOT, the Bulgarian state computer organization, are exported to Eastern bloc countries, with some magnetic media products also exported to Western countries. Rigid disk drives, in several older IBM configurations, have been produced for several years, later joined by one side 8 inch and 5.25 inch floppy drives.

MAGYAR OPTIKAI MUVEK
XII, Csorsz u.35
H-1525 Budapest
Hungary

Usually known by the abbreviation of its Hungarian name, MOM, or the "Hungarian Optical Works", this organization has produced 8 inch, one side floppy drives for several years, including various subsystems. A 5.25 inch, one side drive was added in 1980. MOM's extensive export program, primarily to other Eastern Bloc countries, is handled through Videoton, a state-run foreign trade organization.

OLIVETTI PERIPHERAL EQUIPMENT
Subsidiary of Ing. C. Olivetti & C., S.p.A.
via Torino, 603
10090 S. Bernardo d'Ivrea (Torino)
Italy

1985 FDD sales: $178,320,000
1985 total net sales: $3,216,605,000 Net income: $263,855,000

Olivetti has made many changes in the last few years. In order to stay competitive in the rapidly changing office equipment market, investments have been made in a long list of high technology growth firms, and older Olivetti products have been discontinued. In 1980, Olivetti Peripheral Equipment was established as a consolidation of the firm's printer and disk memory activities. OPE now makes 5.25 inch Winchesters plus 8, 5.25, and 3.5 inch floppy drives at Ivrea, for OEM markets as well as the firm's established captive requirements. During 1984 and 1985, Olivetti has been engaged in a major build up of production for AT&T, its new major customer and part owner. It is considered likely that in the future Olivetti will utilize the production facilities it has available for disk drive production exclusively for rigid disk drives, and will probably discontinue floppy drive manufacturing.

PHILIPS DATA SYSTEMS
Subsidiary of N. V. Philips Gloeilampenfabrieken
Eiserfelder Strasse 316
5900 Siegen-Eiserfeld
West Germany

Although Philips' computer industry revenues contribute less than 5% of total company revenues, the firm's minicomputer, terminal and office computer products are sold throughout Europe. The company has found it difficult to maintain profitable operations in the disk drive business, however. A few years ago it phased out production of rigid disk drives, which were manufactured in Holland for several years, and in 1985 closed down its floppy drive program in Germany.

ROBOTRON
VEB Robotron-Buchungsmaschinenwerk Karl-Marx-Stadt
Annabergerstrasse 93
DDR-9010 Karl-Marx-Stadt
East Germany

The Robotron group is the East German organization responsible for manufacture of computing and office equipment, communication equipment, electronic instruments and consumer electronics devices. The Robotron facility for peripheral equipment initiated manufacture of 5.25 inch one side floppy drives during 1984, after several years of buying similar drives from outside sources for Robotron equipment.

South American Manufacturers

COBRA COMPUTADORES E SISTEMAS BRASILEIROS S.A.
Avenida Commandante Guaranys, 447
Jacarepagua
22700 Rio de Janeiro/RJ
Brazil

Cobra, founded in 1974, is Brazil's largest computer company. Its products include minicomputers, microcomputers, terminals and other computer peripherals. The company makes a variety of floppy and rigid disk drives, usually under license from U.S. manufacturers. Cobra's floppy disk manufacturing is currently limited to an 8 inch, single side drive originally designed by Caldisk. Production levels are modest, and the drives are used in Cobra's own system products.

ELEBRA INFORMATICA S.A.
Rua Maestro Joaquim Capocchi, 165
Jurubatuba
04696 Sao Paulo/SP
Brazil

Elebra was founded in 1979, and is believed to be the most significant specialized manufacturer of computer peripherals in South America. Its product lines include floppy disks, rigid disks, printers and tape drives. Floppy disk production includes single and double sided 5.25 inch drives, both 48 and 96 tpi versions.

FLEXDISC TECHNOLGIA S.A.
Rua Francisco Tramontano, 100
05686 Sao Paulo/SP
Brazil

Originally known as Electrodigi S.A. Electronica Digital, Flexdisc has had several name changes. Its present name was adopted in mid-1986. Floppy disk drives have been produced by Flexdisc since 1979, originally under a Shugart license. Current products also include rigid disk drives, controllers, and other peripheral products. The floppy disk product line began with 8 inch drives, but now includes one and two sided 5.25 inch floppy drives.

MULTIDIGIT TECHNOLOGIA S.A.
BR 290, Km 75
Distrito Industrial de Gravatai
94000 Gravatai/RS
Brazil

Multidigit was founded in 1980 with a cadre of Brazilian university students, and so qualifies as a genuinely home grown company. Products include floppy and rigid drives, controllers, and tape drives. The floppy drives are all half high 5.25 inch models using both 48 and 96 TPI, with capacities up to 2 megabytes.