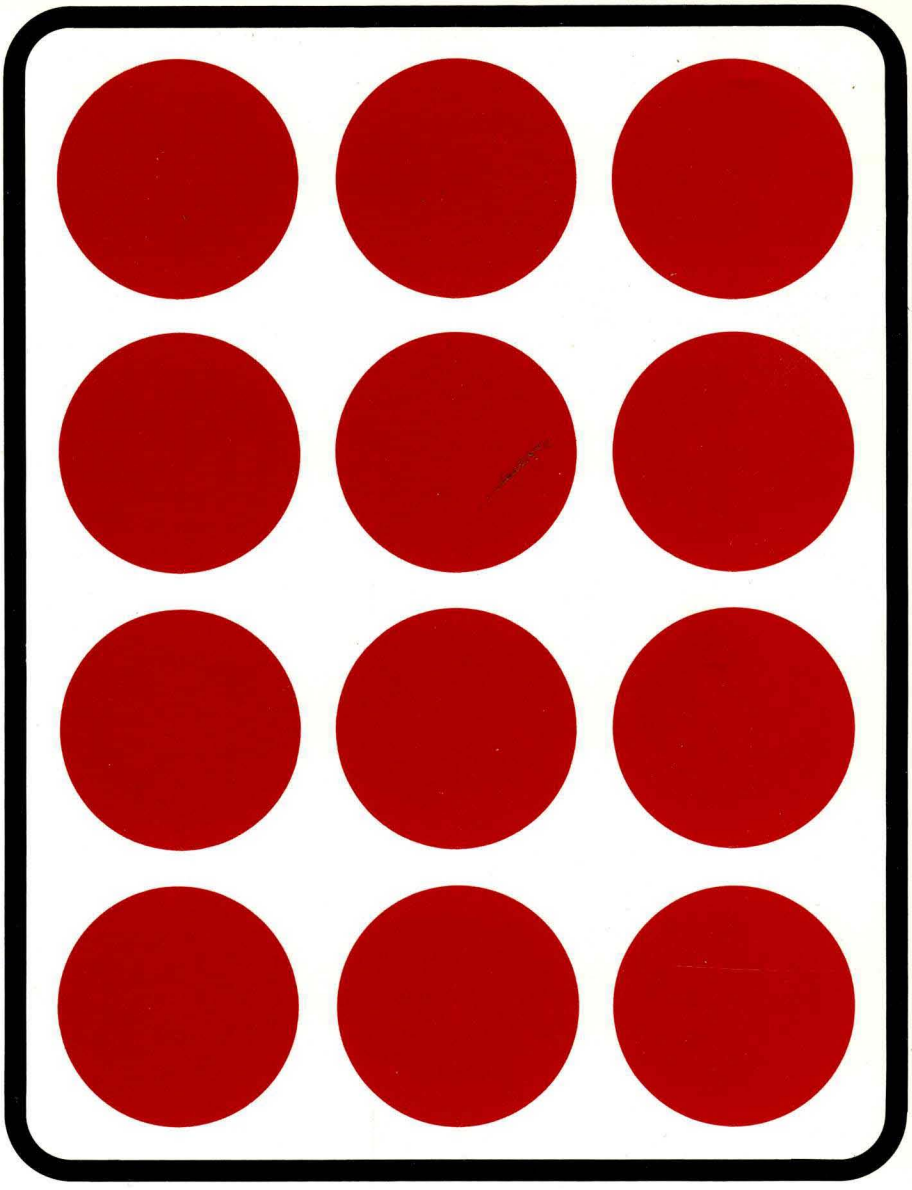
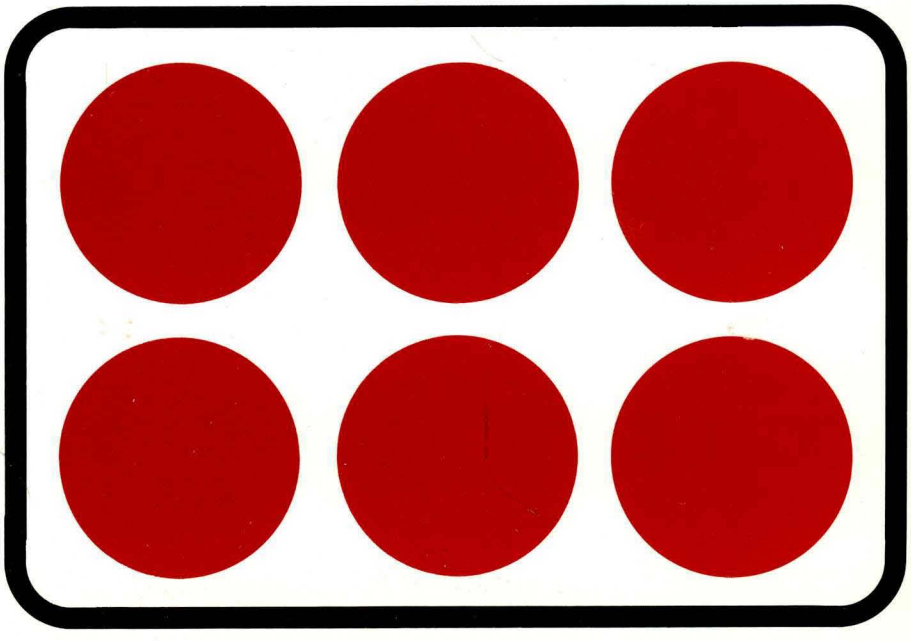


1981 DISK/TREND® REPORT



FLEXIBLE DISK DRIVES

1981 DISK/TREND® REPORT

FLEXIBLE DISK DRIVES

October, 1981

DISK/TREND, INC.
1224 Arbor Court
Mountain View, California 94040
415/961-6209

FOREWORD

This section of the DISK/TREND Report covers flexible disk drives. Each year, rigid disk drives are covered in a separate section, which was published this year in August.

The DISK/TREND Report is now in its fifth year, and the flexible disk drive industry remains dynamic, with high growth levels and the emergence of new product configurations. The new configurations are reviewed in depth in this report, but are not yet factored into the quantitative projections, since none have actually achieved significant market penetration to date.

As always, I am willing to help you at any time by providing any appropriate additional information on the industry which I may have available in my files. Projects requiring elaborate research and analysis can be addressed on a normal consulting basis if desired.

The format of future DISK/TREND Reports will continue to evolve with the industry and with the needs of its subscribers. Your suggestions for improvements in the report are always welcome.

James N. Porter

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INTRODUCTION

New flexible disk drive information in this report

No changes have been made in the basic formats used for several years in the presentation of DISK/TREND information, but several additions are included in the 1981 edition.

* A new section on special format flexible disk drives has been added, reflecting the introduction of several unique drives using small disk diameters or technology not yet in wide usage.

* The summary table of all manufacturers' product lines has been modified to display the track density for all drives.

* In the specification section, information on the physical size of most OEM drives has been added.

* In the two sections covering 5.25 inch drives, new tables have been added covering the history and projection for use of 48 TPI versus 96 or 100 TPI.

Please note these points

* For OEM floppy drives sold in the United States, prices are shown for most drives, usually the 500 unit price. However, prices are changed without notice, so please use the information with care.

* All unit totals are given in spindles -- so that a disk drive with two spindles is counted in DISK/TREND statistics as two spindles. Drives which use a single actuator mechanism to control head movement on two separate flexible disks are also counted as two spindles.

* Many terms used in the disk drive industry have different meanings for various people. You will find it helpful to refer to the definitions section of the report if in doubt.

SUMMARY

Industry size

1980 worldwide shipments for flexible disk drives grew to 2,018,900 units, providing $1,104,700,000 in revenues for the drive manufacturers. These totals approximated the forecasts from last year's DISK/TREND Report, but the product mix varied somewhat from the projection. Unit shipments for 5.25 inch, one side drives were 100,000 units higher than expected, and the other product groups were all slightly lower than expected.

In 1981, 5.25 inch, one side drives have grown even more rapidly in shipments, and this year will be the largest DISK/TREND product group in unit shipments, with 1,387,800 drives worldwide. Two sided drives, in both 8 inch and 5.25 inch sizes, are also climbing rapidly in shipments. Only the original floppy format, 8 inch, one side, is slowing down, with very limited growth forecasted in 1981. Through 1984, the 8 inch, one side format will decline significantly, but each of the other existing formats is expected to achieve major increases.

The combined growth rate for all floppy configurations is estimated at 70.7% for 1981, resulting in worldwide unit shipments of 3,445,300 drives. The particularly strong growth for 1981 is being driven by spectacular current increases in the shipment rate for 5.25 inch, one side drives used with desktop computers. Overall annual increases in unit shipments for the period 1982 through 1984 are expected to average 33.9%, resulting in 1984 shipments of 8,258,600 drives. 1984 worldwide revenues are projected at $4,257,300,000.

TABLE 1

CONSOLIDATED WORLDWIDE SHIPMENTS

ALL EXISTING FLEXIBLE DISK DRIVE GROUPS

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1980		Forecast							
	---Shipments--		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	175.7	262.8	243.2	362.3	344.8	510.6	450.2	664.6	545.2	802.6
Other U.S. Captive	151.3	208.3	259.4	328.2	385.1	513.3	562.0	764.9	824.4	1,156.0
TOTAL U.S. CAPTIVE	327.0	471.1	502.6	690.5	729.9	1,023.9	1,012.2	1,429.5	1,369.6	1,958.6
PCM	.6	.6	1.6	2.0	2.6	3.4	3.8	5.3	5.0	7.2
OEM	229.7	283.6	327.6	405.7	395.9	499.7	444.5	577.4	505.7	677.9
TOTAL U.S. NON-CAPTIVE	230.3	284.2	329.2	407.7	398.5	503.1	448.3	582.7	510.7	685.1
TOTAL U.S. SHIPMENTS	557.3	755.3	831.8	1,098.2	1,128.4	1,527.0	1,460.5	2,012.2	1,880.3	2,643.7
Non-U.S. Manufacturers										
Captive	4.5	212.8	6.6	329.1	16.1	520.9	37.5	802.0	68.8	1,125.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	26.9	136.6	62.4	227.9	89.0	313.1	105.8	407.8	116.9	488.0
TOTAL NON-U.S. SHIPMENTS	31.4	349.4	69.0	557.0	105.1	834.0	143.3	1,209.8	185.7	1,613.6
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	588.7	1,104.7	900.8	1,655.2	1,233.5	2,361.0	1,603.8	3,222.0	2,066.0	4,257.3

Industry structure

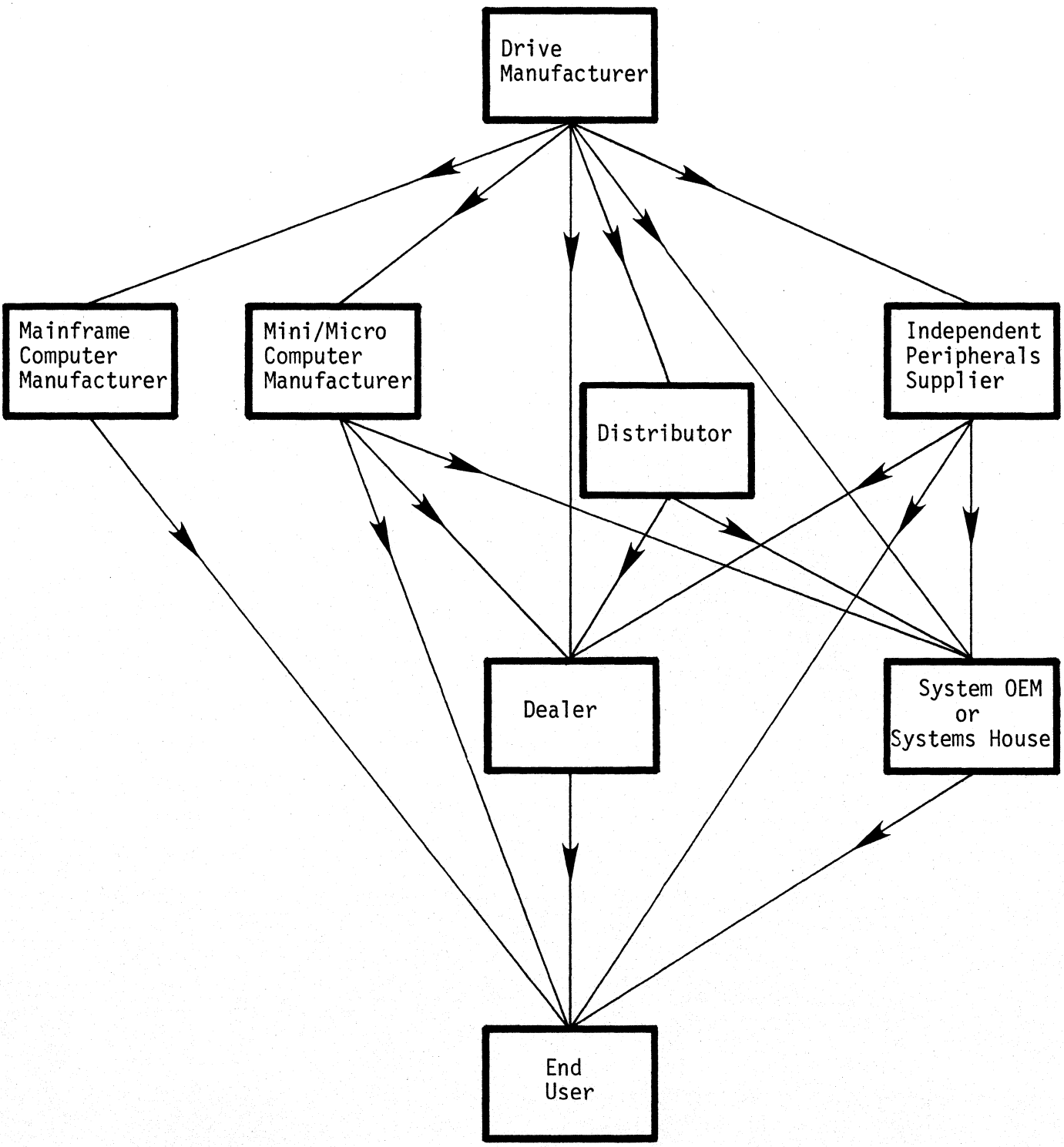
During the past year of rapid growth, the structure of the flexible disk drive industry has been relatively stable, with a continuation of distribution trends already established, and only a few new manufacturers. The majority of firms new to the industry plan to manufacture specialized floppy drives incorporating higher capacity, smaller size or multiple diskette cartridges. There are now 48 flexible disk drive manufacturers worldwide. 26 manufacturers are headquartered in the United States, 13 in Japan, and 9 in Europe.

Captive drives produced by manufacturers of mainframes, minicomputers or other systems are supplied to end users through the direct or third party distribution used for each manufacturer's systems. Non-captive drives, however, reach the end user through numerous channels, as illustrated in Figure 1.

Non-captive floppy drives are integrated into systems and subsystems by mainframe, minicomputer and various system OEMs. Complete subsystems are provided by a large number of independent peripherals suppliers which add controllers and other auxiliary hardware to floppy drives to provide complete subsystems. Floppy drives are purchased by system houses to be combined in specialized systems with other purchased hardware and proprietary software.

The dealer/distributor channels are still going through extensive changes, as new distribution is continually being established by manufacturers of small systems. Various types of dealers still buy drives for resale directly from drive manufacturers and subsystem builders, but the trend is to more reliance on packaged systems from the system manufacturer. And OEM drives are now carried by many electronics distributors for sale to small system integrators and sophisticated end users.

Figure 1
NON-CAPTIVE MARKETING STRUCTURE
FLEXIBLE DISK DRIVES



Marketing channels

No system manufacturer makes more extensive use of flexible disk drives than IBM. It is doubtful that IBM's product planners had any idea of the extent of the future role for floppy drives when they were first introduced in the existing format as part of a data entry system in 1973. IBM now uses floppies with dozens of products, including small business systems, word processing systems, and numerous terminals, work-stations and other specialized equipment. The DISK/TREND estimate of IBM revenues for floppy drives is based in some cases upon arbitrary unit price estimates, since the drives used with many systems are not priced separately, but are included with system components. This year's DISK/TREND estimate of IBM's total revenues for the floppy drives it manufactures indicates the firm has a 23.8% share of the worldwide total in 1980. But it is expected that IBM's share will fall to 18.9% by 1984, as the rest of the industry continues to expand at a somewhat faster pace.

A gradual, but continuing trend toward more captive production by other system manufacturers is reflected in the projections. Additional vertical integration programs are expected, as the quantities of floppy drives required by major OEMs become extremely large. During the 1980 to 1984 period, the share of worldwide shipments held by other U.S. captive manufacturers is forecasted to rise from 18.9% to 27.2%; for non-U.S. captive manufacturers, from 19.3% to 26.4%. OEM drive shipments will continue to achieve excellent growth, but the growth of captive programs will cut the 1980 OEM share of worldwide total revenues from 38.1% to 27.4% in 1984.

TABLE 2

CONSOLIDATED WORLDWIDE SHIPMENTS

ALL EXISTING FLEXIBLE DISK DRIVE GROUPS

MARKET CLASS SUMMARY

WORLDWIDE REVENUES BY MANUFACTURER TYPE	1980 Shipments $M	1980 Shipments %	FORECAST 1981 $M	1981 %	1982 $M	1982 %	1983 $M	1983 %	1984 $M	1984 %
U.S. Manufacturers										
IBM	262.8	23.8	362.3	21.9	510.6	21.6	664.6	20.6	802.6	18.9
Other U.S. Captive	208.3	18.9	328.2	19.8	513.3	21.7	764.9	23.7	1,156.0	27.2
PCM	.6	.1	2.0	.1	3.4	.1	5.3	.2	7.2	.2
OEM	283.6	25.7	405.7	24.5	499.7	21.2	577.4	17.9	677.9	15.9
Total U.S. Mfgr's.	755.3	68.4	1,098.2	66.3	1,527.0	64.7	2,012.2	62.5	2,643.7	62.1
Non-U.S. Manufacturers										
Captive	212.8	19.3	329.1	19.9	520.9	22.1	802.0	24.9	1,125.6	26.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	136.6	12.4	227.9	13.8	313.1	13.3	407.8	12.7	488.0	11.5
Total Non-U.S. Mfgr's.	349.4	31.6	557.0	33.7	834.0	35.3	1,209.8	37.5	1,613.6	37.9
Worldwide Total	1,104.7	100.0	1,655.2	100.0	2,361.0	100.0	3,222.0	100.0	4,257.3	100.0

Product mix

Because of widely differing average unit selling prices, floppy drive configurations which lead in unit shipments may not be revenue leaders.

8 inch, one side drives were still the worldwide leader in unit shipments in 1980, but 8 inch, two sided drives had already taken their position as the leader in generating worldwide revenue. In 1981, 5.25 inch, one side drives, pushed along by spectacular growth in desktop computers, have become the largest group in unit shipments. However, by 1984, 5.25 inch, two sided drives are expected to pass up all other product groups in unit shipments. And 8 inch, two sided drives are forecasted to produce over half of all floppy drive revenues in 1984.

Underlying the persistence of 8 inch, one side drives in holding their position in the industry has been the reluctance of many system OEMs to commit to two sided drives until the reliability problems experienced by most drive manufacturers were cured. The problems are now largely behind the industry, but countless OEMs stayed with one side drives on systems designed during the past few years. However, OEM confidence in two sided drives is now growing rapidly, and by 1982 this format will overshadow one side drives in unit shipments.

In 1981, 5.25 inch, one side drives are now growing at an unprecedented rate, with the year's worldwide shipments expected to total 1,387,800 units -- but 5.25 inch, two sided drives are actually achieving a higher growth rate. Two sided 5.25 inch drives are forecasted for 1981 growth in unit shipments of 172.8%, and the expected growth rate through 1984 is the highest of any floppy disk drive product group.

Figure 2
CHANGING PRODUCT MIX
WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
CONSOLIDATED REVENUE

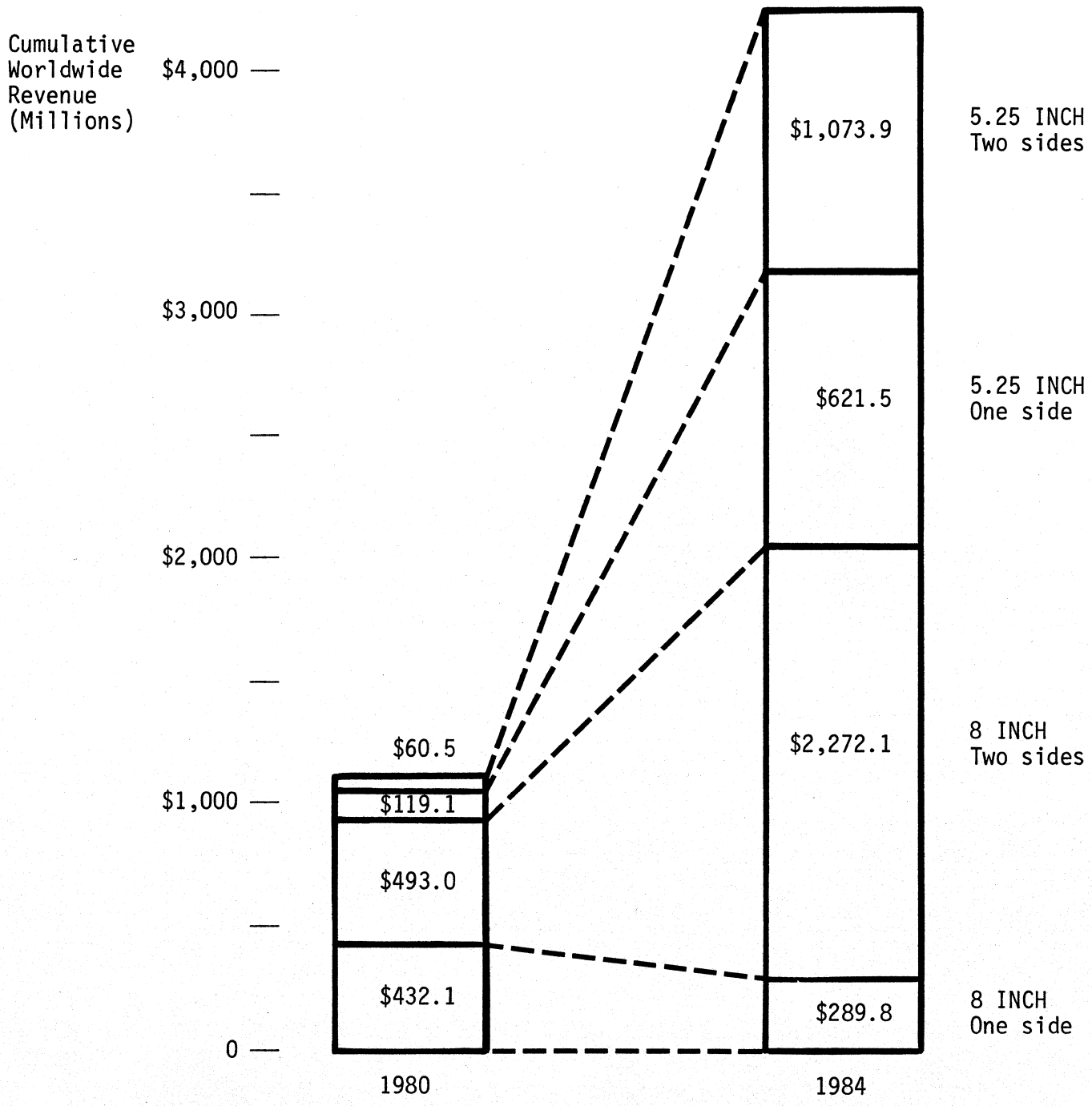


TABLE 3

WORLDWIDE SHIPMENTS

PRODUCT CATEGORY SUMMARY

ALL MANUFACTURERS

Units: Thousands / Dollars: $ Million		1980 Shipments Ship	1980 Shipments Δ%	1981 FORECAST Ship	1981 FORECAST Δ%	1982 FORECAST Ship	1982 FORECAST Δ%	1983 FORECAST Ship	1983 FORECAST Δ%	1984 FORECAST Ship	1984 FORECAST Δ%
8 INCH DRIVES											
One Side	Units	724.0	+13.5	771.5	+6.6	768.3	-.4	670.4	-12.7	501.0	-25.3
	$M	432.1	+5.8	429.9	-.5	421.1	-2.0	371.8	-11.7	289.8	-22.1
Two Sides	Units	428.1	+95.9	718.2	+67.8	1,177.7	+64.0	1,781.9	+51.3	2,573.8	+44.4
	$M	493.0	+70.5	774.9	+57.2	1,195.4	+54.3	1,692.6	+41.6	2,272.1	+34.2
8 INCH TOTAL	Units	1,152.1	+34.6	1,489.7	+29.3	1,946.0	+30.6	2,452.3	+26.0	3,074.8	+25.4
	$M	925.1	+32.6	1,204.8	+30.2	1,616.5	+34.2	2,064.4	+27.7	2,561.9	+24.1
5.25 INCH DRIVES											
One Side	Units	658.7	+54.5	1,387.8	+110.7	1,788.6	+28.9	2,106.7	+17.8	2,357.6	+11.9
	$M	119.1	+58.8	263.8	+121.5	373.5	+41.6	477.0	+27.7	621.5	+30.3
Two Sides	Units	208.1	+194.8	567.8	+172.8	1,117.7	+96.8	1,872.1	+67.5	2,826.2	+51.0
	$M	60.5	+247.7	186.6	+208.4	371.0	+98.8	680.6	+83.5	1,073.9	+57.8
5.25 INCH TOTAL	Units	866.8	+74.4	1,955.6	+125.6	2,906.3	+48.6	3,978.8	+36.9	5,183.8	+30.3
	$M	179.6	+94.4	450.4	+150.8	744.5	+65.3	1,157.6	+55.5	1,695.4	+46.5
TOTAL ALL DRIVES											
	Units	2,018.9	+49.2	3,445.3	+70.7	4,852.3	+40.8	6,431.1	+32.5	8,258.6	+28.4
	$M	1,104.7	+39.8	1,655.2	+49.8	2,361.0	+42.6	3,222.0	+36.5	4,257.3	+32.1

Figure 3

CHANGING PRODUCT MIX

WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
ALL MANUFACTURERS

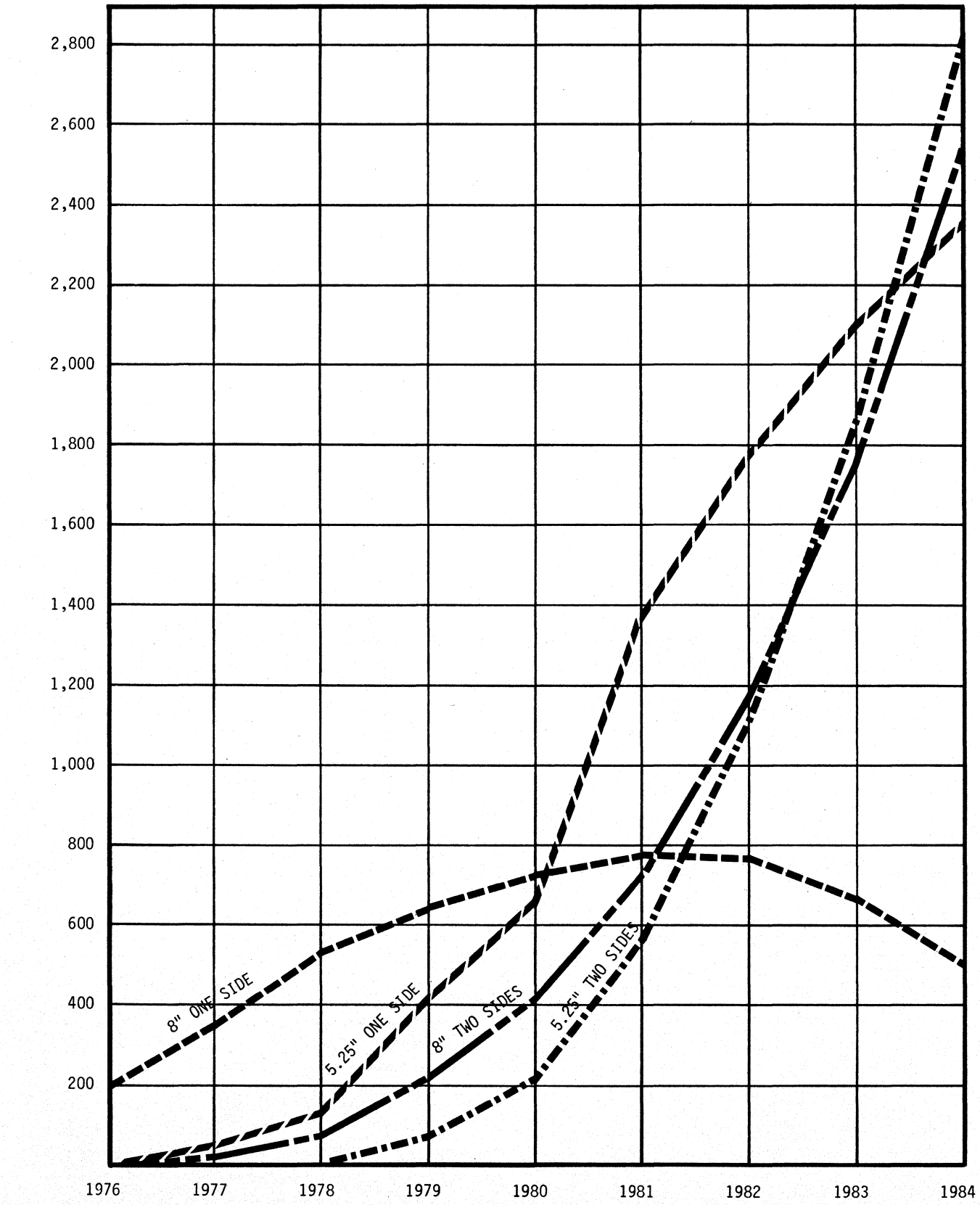


TABLE 4

WORLDWIDE SHIPMENTS

PRODUCT CATEGORY SUMMARY

MANUFACTURERS OF OEM DRIVES

Units: Thousands / Dollars: $ Million		1980 Shipments Ship	1980 Shipments Δ%	1981 Ship	1981 Δ%	1982 Ship	1982 Δ%	1983 Ship	1983 Δ%	1984 Ship	1984 Δ%
8 INCH DRIVES											
One Side	Units	477.0	+6.7	514.8	+7.9	487.0	-5.4	398.2	-18.2	272.2	-31.6
	$M	157.5	+7.2	165.1	+4.8	146.3	-11.4	115.5	-21.1	77.3	-33.1
Two Sides	Units	231.2	+115.1	397.9	+72.1	668.1	+67.9	1,043.1	+56.1	1,568.1	+50.3
	$M	106.1	+108.0	174.2	+64.2	274.3	+57.5	408.8	+49.0	597.2	+46.1
8 INCH TOTAL	Units	708.2	+27.7	912.7	+28.9	1,155.1	+26.6	1,441.3	+24.8	1,840.3	+27.7
	$M	263.6	+33.2	339.3	+28.7	420.6	+24.0	524.3	+24.7	674.5	+28.6
5.25 INCH DRIVES											
One Side	Units	645.3	+52.8	1,229.7	+90.6	1,475.5	+20.0	1,611.6	+9.2	1,544.2	-4.2
	$M	108.5	+51.1	172.1	+58.6	186.1	+8.1	187.9	+1.0	170.3	-9.4
Two Sides	Units	196.8	+178.8	495.4	+151.7	925.4	+86.8	1,359.1	+46.9	1,766.3	+30.0
	$M	48.1	+176.4	122.2	+154.1	206.1	+68.7	273.0	+32.5	321.1	+17.6
5.25 INCH TOTAL	Units	842.1	+70.8	1,725.1	+104.9	2,400.9	+39.2	2,970.7	+23.7	3,310.5	+11.4
	$M	156.6	+75.6	294.3	+87.9	392.2	+33.3	460.9	+17.5	491.4	+6.6
TOTAL ALL DRIVES											
	Units	1,550.3	+48.0	2,637.8	+70.1	3,556.0	+34.8	4,412.0	+24.1	5,150.8	+16.7
	$M	420.2	+46.4	633.6	+50.8	812.8	+28.3	985.2	+21.2	1,165.9	+18.3

Figure 4

CHANGING PRODUCT MIX

WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
MANUFACTURERS OF OEM DRIVES

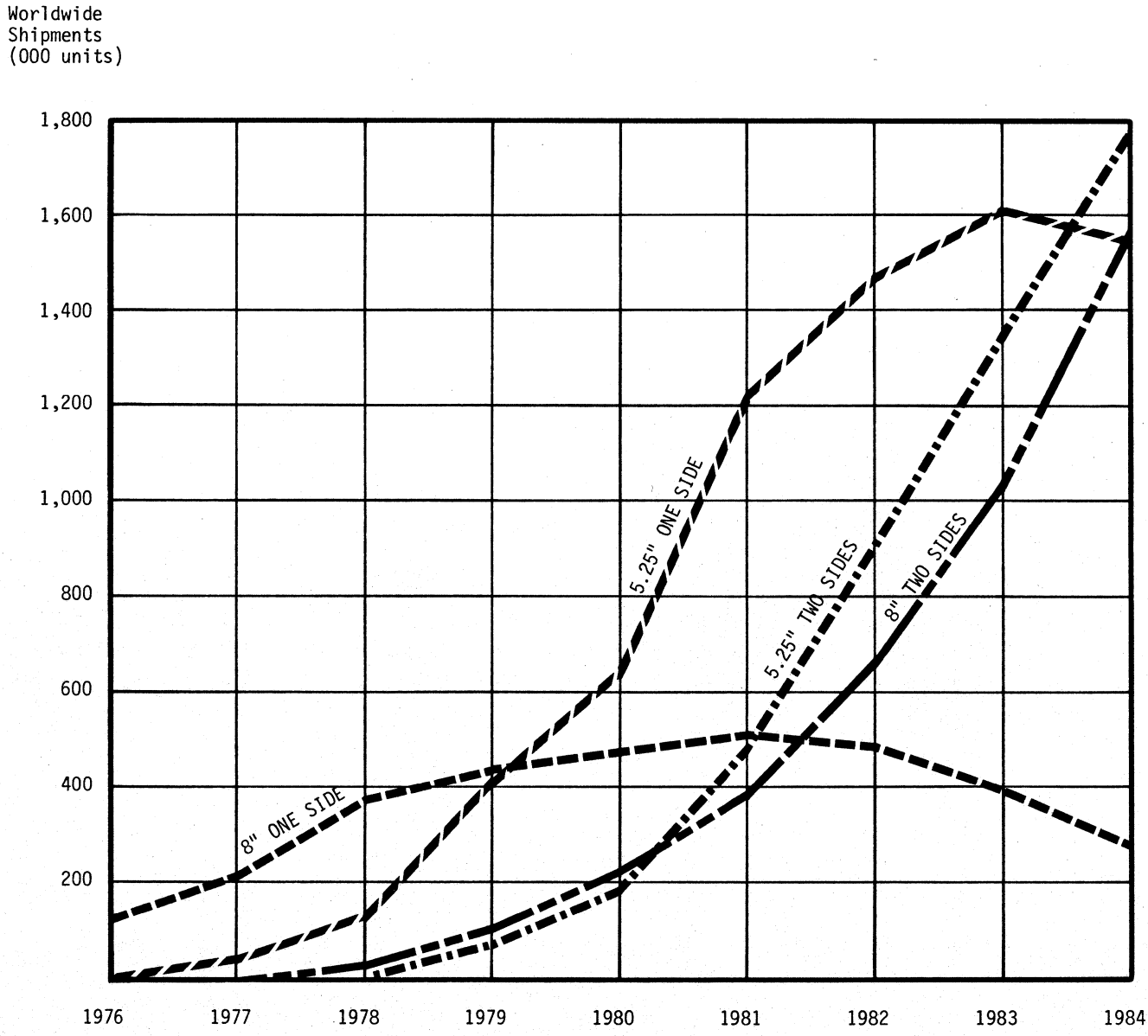


TABLE 5

1980 ESTIMATED MARKET SHARES

WORLDWIDE SHIPMENTS OF ALL FLEXIBLE DISK DRIVES
(Value of non-U.S. currencies estimated at July, 1981, rates)

	CAPTIVE		OEM*		TOTAL INDUSTRY	
	$M	%	$M	%	$M	%
U.S. MANUFACTURERS						
Burroughs	26.2	3.8	--	--	26.2	2.4
Caldisk	4.9	.7	2.9	.7	7.8	.7
Control Data	16.5	2.4	25.3	6.0	41.8	3.8
Datapoint	15.0	2.2	--	--	15.0	1.4
Digital Equipment	55.0	8.1	--	--	55.0	5.0
IBM	262.8	38.4	--	--	262.8	23.8
Memorex	--	--	7.7	1.8	7.7	.7
Micro Peripherals	--	--	20.9	5.0	20.9	1.9
Micropolis	--	--	20.3	4.8	20.3	1.8
PerSci	--	--	8.5	2.0	8.5	.8
Pertec	3.6	.5	4.6	1.1	8.2	.7
Qume	--	--	13.4	3.2	13.4	1.2
Remex	--	--	26.2	6.2	26.2	2.4
Shugart Associates	48.8	7.2	122.9	29.2	171.7	15.5
Sykes Datatronics	24.0	3.5	--	--	24.0	2.2
Tandon	--	--	24.6	5.9	24.6	2.2
Other U.S.	14.3	2.1	6.9	1.6	21.2	1.9
U.S. Total	471.1	68.9	284.2	67.5	755.3	68.4
NON-U.S. MANUFACTURERS						
Alps	12.4	1.8	--	--	12.4	1.1
BASF	--	--	38.9	9.3	38.9	3.5
Hitachi	11.6	1.7	10.7	2.5	22.3	2.0
Matsushita	--	--	20.3	4.8	20.3	1.8
Mitsubishi	16.5	2.4	7.0	1.7	23.5	2.1
Nippon Electric Company	52.9	7.8	--	--	52.9	4.8
Olivetti	79.3	11.6	--	--	79.3	7.2
Ricoh	19.9	2.9	--	--	19.9	1.8
Siemens	.8	.1	17.0	4.0	17.8	1.6
TEAC	--	--	8.7	2.1	8.7	.8
Toshiba	18.0	2.6	3.3	.8	21.3	1.9
YE Data	--	--	17.2	4.1	17.2	1.6
Other Non-U.S.	1.4	.2	13.5	3.2	14.9	1.4
Non-U.S. Total	212.8	31.1	136.6	32.5	349.4	31.6
WORLDWIDE TOTAL	683.9	100.0	420.8	100.0	1,104.7	100.0

*Includes PCM.

TABLE 6

CURRENT PRODUCT LINES

MANUFACTURERS OF FLEXIBLE DISK DRIVES

Codes: 48 = 48 TPI C = Captive
64 = 64 TPI P = PCM
96 = 96 TPI O = OEM
100 = 100 TPI
150 = 150 TPI DISK/TREND
170 = 170 TPI PRODUCT GROUP:

U.S. MANUFACTURERS	TYPE	10 8 INCH ONE SIDE	11 8 INCH TWO SIDES	12 5.25 INCH ONE SIDE	13 5.25 INCH TWO SIDES	14 SPECIAL
Amlyn	O			170		
Burroughs	C,O		64,150			
Caldisk	C,O	48	48			
Control Data	C,P,O	48	48	48	48,96	
Data Master	O			96	96	
Datapoint	C	48	48			
Decitek	O	48	48			
Digital Equipment	C	48				
Exxon Office Systems	C			48		
Hewlett-Packard	C				48	
IBM	C	48	48			
Innotronics	O	48	48			
Iomega	O					7.8",300 TPI
Memorex	O	48				
Micro Peripherals	O	48	48	48,96,100	48,96,100	
Micropolis	O			48,96,100	96,100	
Miltope	O	48	48			
Northern Telecom	C	48				
PerSci	O	48	48,96,150			
Pertec	C,O	48	48	48	48	
Qume	O		48		48	
Remex	O	48	48	96	48,96	
Shugart Associates	C,O	48	48	48,96	48,96	
Sykes Datatronics	C,O	48				
Tandon	O	48	48	48,96,100	48,96,100	
Texas Peripherals	C	48	48	48		
JAPANESE MANUFACTURERS						
Alps	C,O			48	48	
Canon	C,O			48	48	3.8",25.4 TPI
Hitachi	C,O	48	48			
Matsushita	C,O	48	48	48	48	
Mitsubishi	C,O	48	48			
Nippon Electric Company	C,O		48			
Oki Electric	C	48				
Ricoh	C	48	48			
Sankyo Seiki	O					2.6",Spiral
Sony	C,O					3.5", 135 TPI
TEAC	O			48,96,100	48,96	
Toshiba	C,O	48	48	48	48	
YE Data	C,O	48	48		48,96	
EUROPEAN MANUFACTURERS						
BASF	O	48	48	48	48	
Data Recording Equipment	O	48	48			
Elcomatic	C,O	48	48			
Isotimpex	O	48		48		
MERA/Metronex	C,O	48				
Olivetti	C,O	48	48	48	48	2.5",Spiral
Philips	C,O				48	
Siemens	C,O	48	48	48,96	48,96	
Videoton	C,O	48		48		

Application mix

Floppy drives continue to find their largest market in small business systems. In 1980, 45.8% of all floppy drive unit shipments were used with small business systems, and this share is expected to grow to 50.5% by 1984. During this period, one side drives will decline in usage with small business systems, and two sided drives of both 5.25 inch and 8 inch diameter will become completely dominant in the application. 5.25 inch, two sided drives, especially those with 1 MB or higher capacity, will be used primarily with desktop systems, and 8 inch, two sided drives will be the choice for physically larger systems or where media compatibility with systems using 8 inch floppy formats is essential.

Word processing is the second largest application area for floppy drives, with 16.3% of 1980's worldwide unit shipments. In 1980, word processing systems still used more 8 inch, one side drives than any other single format. But the combined usage of one and two sided 5.25 inch drives was just as great during 1980, and these two formats are expected to account for 78% of the total unit shipments for word processing in 1984.

Hobby and personal computers are expected to achieve a higher rate of growth than any other application through 1984, rising from 9.2% of worldwide unit shipments in 1980 to 15.4% in 1984. It is clear that 5.25 inch, one side drives will maintain their dominance in this application; the 1984 DISK/TREND forecast shows an 82% share of this application for 5.25 inch, one side drives. Current developments in very low cost, half high 5.25 inch drives will only serve to consolidate the hold of 5.25 inch, one side drives on this market.

TABLE 7

FLEXIBLE DISK DRIVE APPLICATION PROJECTION

CONSOLIDATED WORLDWIDE SHIPMENTS

	1980 Estimate					1984 Projection				
	ALL FDD	8" ONE SIDE	8" TWO SIDES	5.25" ONE SIDE	5.25" TWO SIDES	ALL FDD	8" ONE SIDE	8" TWO SIDES	5.25" ONE SIDE	5.25" TWO SIDES
SMALL BUSINESS SYSTEMS										
Units (000)	925.9	286.3	277.6	297.8	64.2	4,169.2	83.4	1,917.8	416.9	1,751.1
Share %	45.8%	39.5%	64.8%	45.2%	30.8%	50.5%	16.7%	74.5%	17.7%	62.0%
MINI-MICRO COMPUTER SYSTEMS										
Units (000)	269.2	130.4	61.5	58.3	19.0	652.0	97.8	228.2	156.5	169.5
Share %	13.3%	18.0%	14.4%	8.9%	9.1%	7.9%	19.5%	8.9%	6.6%	6.0%
TERMINALS										
Units (000)	225.7	103.3	61.0	46.4	15.0	397.6	79.5	167.0	99.4	51.7
Share %	11.2%	14.3%	14.3%	7.0%	7.2%	4.8%	15.9%	6.5%	4.2%	1.8%
WORD PROCESSING										
Units (000)	328.5	151.4	16.4	101.9	58.8	1396.3	181.5	125.7	558.5	530.6
Share %	16.3%	20.9%	3.8%	15.5%	28.3%	16.9%	36.2%	4.9%	23.7%	18.8%
HOBBY/PERSONAL COMPUTERS										
Units (000)	184.8	4.4	7.3	125.9	47.2	1,268.3	2.5	3.8	1,040.0	222.0
Share %	9.2%	.6%	1.7%	19.1%	22.7%	15.4%	.5%	.1%	44.1%	7.8%
OTHER APPLICATIONS										
Units (000)	84.8	48.2	4.3	28.4	3.9	375.2	56.3	131.3	86.3	101.3
Share %	4.2%	6.7%	1.0%	4.3%	1.9%	4.5%	11.2%	5.1%	3.7%	3.6%
TOTAL, ALL APPLICATIONS										
Units (000)	2,018.9	724.0	428.1	658.7	208.1	8,258.6	501.0	2,573.8	2,357.6	2,826.2
Share %	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

TECHNICAL REVIEW

Competing technologies

The combination of low cost, random access and media removability provided by flexible disk drives is the key reason for their rapid growth and wide usage. No would-be alternative to floppy drives is likely to have any major impact on the large markets now enjoyed by these products unless it offers a significant improvement to this combination of features.

Adding to the difficulty for potential competitive data storage technologies is the continual refinement of flexible disk recording -- making it difficult for competitors to catch up. Since the introduction of floppy drives in their present form in 1973, numerous improvements have been made in capacity, access time, reliability and physical size. And the very rapid growth in production volumes has resulted in ever lower prices for both hardware and media.

Rather than be impacted by other data storage technologies, shipments of existing flexible disk drive configurations have been affected significantly by new flexible and rigid disk drives with functional or price advantages. For example, the original 8 inch, one side drive format introduced by IBM is now reaching the peak of its product life cycle, having been displaced in most newly designed systems by two sided drives or by smaller drives. The floppy configurations with the highest current growth rates and the brightest futures are no more than five years old. And the competitors with the greatest chance to grab important hunks of

market share from these configurations are smaller, higher density or cheaper floppy drives introduced during the past year or soon to be announced.

Any challenger using another technology will have to exceed the capability of flexible disk drives in providing low cost, random access and media removability if any serious impact on floppy markets is to be accomplished. The products with the most potential to challenge floppy drives for some of their existing and potential future application areas are:

* Magnetic bubbles: It has been a tough year for magnetic bubble advocates. After years of build-up in the technical and trade press as the probable successor to large portions of the magnetic disk drive market, the magnetic bubble industry lost three major participants in 1981. Rockwell International, Texas Instruments and National Semiconductor all dropped their bubble programs, with the explanation that the market was developing too slowly to justify their continued investment in the technology. Intel Magnetics is the only U.S. company currently in non-captive production. Motorola, which had a second sourcing agreement with National Semiconductor, has indicated that it still plans to start production in 1982. Hitachi is acknowledged to be the current production leader, with most of that firm's production going to Nippon Telephone and Telegraph.

  The bubble was born at Bell Laboratories, and the AT&T manufacturing operation, Western Electric, is preparing a captive manufacturing program to produce bubble memories for extensive use in telephone switching systems for Bell system operating companies. But the most important future captive manufacturing program is expected from IBM, on an uncertain timetable. Although IBM's investment in the technology is large, and the firm is assumed to be a technical leader in the area, it is not clear which applications will come first. It is probable that IBM sees several appropriate applications, including cache memories, intelligent typewriters, point of sale terminals and various intelligent workstations.

  In the meantime, magnetic bubles' cost per bit stored is not comparable to magnetic disk drives, and removability, so important on most small systems, is available only by removing the entire bubble memory. So it now appears that bubbles will not have a measurable impact on the existing markets for floppy drives before the late 1980s at the earliest. Instead, they

appear to be destined for applications not very well suited for floppy drives, such as with equipment intended for operation in harsh environments or for on line storage requirements considered too small for most rigid or floppy drives. Examples of promising applications are the potential IBM products mentioned above, plus industrial control systems, military systems, portable terminals, and medical instrumentation.

* Small rigid disk drives: The availability of 8 inch Winchester disk drives during the last few years has meant the displacement of the first floppy drive in many two-floppy drive systems. And the successful introduction of 5.25 inch Winchester disk drives during the last year will extend the penetration of rigid disk drives into small systems even further. The 1981 DISK/TREND forecast for rigid fixed disk drives less than 30 MB indicates 1984 worldwide unit shipments of 247,500 8 inch drives and 644,000 5.25 inch drives.

  Despite the displacement of the large number of floppy drives which would be shipped if the above rigid disk drives were not available, the net impact on overall floppy shipments by this displacement will hardly be noticeable, because of the sharp rate of growth in floppy drive shipments. The total of 891,500 5.25 inch and 8 inch rigid disk drives less than 30 MB forecasted for 1984 is less than 11% of the 8,258,600 total for all floppy drives forecasted for 1984 shipment. Underlying these numbers are the assumptions that the majority of small systems will continue to use floppies as their only disk, and that a majority of those systems using small rigid disks will be paired with floppy drives for backup, save/restore and program distribution requirements.

* Tape drives: The limited capacity available with floppy drives places them at a disadvantage to various types of tape drives when used to back up rigid disk drives under certain circumstances. Floppy drives are frequently seen by OEMs and users as adequate to back up small rigid disk drives when the operating system involved provides for selective back up by file, and when typical file size is matched by the capacity of the floppy used on the system. But when large files are involved, when data base management systems are used, or when backup of all user data is frequently required, floppy disk capacity limitations may be considered critical.

  Tape cartridge drives and digital cassette drives have been available as long as floppies have, but at much lower total production levels, with a narrower range of applications. Their principal disadvantage compared to floppies has been lack of direct access to individual records, plus generally higher prices for the tape cartridge drives.

However, 1/4 inch tape cartridge drives have found a growing market in recent years in connection with the backup requirement for small fixed disk drives, especially in the 10-40 MB range. Tape cartridge drives designed for operation in a start/stop mode, with up to 17 MB capacity, have been available for several years from Data Electronics, Inc., and other manufacturers have recently started production of similar drives. DEI has been joined by Archive in pioneering the market for streaming tape cartridge drives with capacities up to 20 MB. The streaming tape drives, which carry pricetags comparable to those for high capacity floppy drives, have had a slow market introduction period because the industry lacked experience in their impact on software and operating systems. It is expected that tape cartridge drives will displace floppies, nevertheless, in many applications actually requiring the backup medium to have capacity similar to the system's rigid disk drive. For now, this phenomenon is mostly limited to the 8 inch disk area, because of the low capacities available with early 5.25 inch Winchester drives. But as capacities for 5.25 inch drives increase, and as tape cartridge drives are modified to complement the 5.25 inch disk drive form factor, tape drives will start to be serious rivals to the floppy drive in these applications, also.

Floppy drive enhancements

The mainstream flexible disk drive formats have largely stayed with the physical media standards established by IBM in 1973 for 8 inch drives and by Shugart Associates in 1976 for 5.25 inch drives, but changes in recording format have been introduced by others, with considerable impact on the market. Beyond the basic formats, several completely new configurations have recently been introduced, and more are expected.

The floppy drive industry is destined to see more increases in recording density and completely new drive configurations in the coming years. Here are the areas to watch:

* Linear recording density: The current industry standard for "double density" recording was introduced by IBM in 1977. There is a movement today, especially among manufacturers of 5.25 inch drives, to double linear densities again, to the 12,000 BPI range. Micropolis has announced a series of 5.25 inch drives operating at that density which would provide 2 MB capacity. In Japan, Nippon Telephone and Telegraph has issued specifications for a 5.25 inch drive with 9647 BPI and 1.6 MB capacity. However,

media with adequate quality and functional characteristics for such recording density has not actually been available, and the drives are not yet in use. It is probable that this media limitation will be solved by one or more of the following activities now underway:

Spin coated oxide media: Amlyn, a new firm offering a 5.25 inch drive using cartridges holding five diskettes, has designed its drive to use spin coated diskettes, which have been sampled to manufacturers by Nashua, Dysan and Brown Disk Manufacturing, a new media manufacturer. The spin coating technique, similar to that used for rigid disks, makes possible a thinner, more consistent dispersion of the coating. Amlyn's drive records at 9500 BPI, and new drives using this media at high densities are expected from other firms.

Web coated oxide media: Considerable refinement of existing web coating techniques has been undertaken by media manufacturers with the objective to make possible much higher density recording of video and digital signals. These refinements principally involve making coatings thinner, improving magnetic properties and reducing the frequency of coating defects. Both 3M and Maxell have provided samples of diskettes with advanced web coated media to drive manufacturers, and are actively competing with the spin coated diskettes mentioned above for endorsement by drive manfuacturers.

Web coated chromium dioxide media: IBM is believed to be developing an 8 inch floppy drive with capacity from 4 to 5 MB, which will use diskettes with a chromium dioxide coating. The higher coercivity and effective resolution available with such media will probably make possible linear recording densities in the range of 10,000 to 15,000 BPI. The IBM program, under the code name "Bright", will undoubtedly establish an instant industry de facto standard when it is introduced, but the timetable is uncertain. It is to be expected that independent media manufacturers will rapidly offer media meeting IBM's standard, in both 8 inch and 5.25 inch diskettes, and that this media will provide significant competition to the thin oxide coatings discussed above for the expected next generation of high density floppy drives.

* Track density: Most of today's floppy drives use stepping motors to position heads with "open loop" systems in which heads are moved to predetermined locations without prerecorded information on the media as a location reference. However, due to dimensional stability problems with plastic media substrates when exposed to extremes of humidity or temperature, the effective limit for 5.25 inch drives appears to be 96/100 TPI, with a lower limit for 8 inch drives.

Although not yet in production, PerSci has announced an 8 inch drive which uses an embedded servo with a "closed loop" head positioning technique to achieve 150 TPI. Burroughs introduced an 8 inch drive

in 1980 which uses two prerecorded servo tracks to establish the location and shape of data tracks by microcomputer analysis, also achieving 150 TPI. The new Amlyn 5.25 inch drive uses a single prerecorded reference track to achieve 170 TPI, with a positioning scheme comparable to Burroughs'. Amlyn uses a stepping motor for the actual head positioning, while PerSci and Burroughs use more expensive linear motor positioning mechanisms. Product manufacturing cost is the main problem in effecting major improvements in floppy head positioning, Because of the price sensitive nature of most floppy applications it is considered probable that any high TPI drive with a chance in the OEM market will use a combination of microprocessor and stepping motor, the lowest cost approach -- but it is too early to predict a winner.

* Two sided drives: The well known problems experienced by the industry with 8 inch, two sided drives have been tamed by most drive manufacturers. The original IBM two sided drive involved simultaneous loading and retracting of heads on both sides of the diskette. Each head was held in place by a thin flexure. When many drive manufacturers tried to duplicate this arrangement in large volume production, the problems in aligning the flexible media with the flexible heads caused high manufacturing costs and poor product reliability. The answer for many drive manufacturers was to go to a type of head assembly using one static head, combined with one head which loads and retracts. Patent rights to this technology are now the subject of lawsuits between some of the manufacturers. In the meantime, the newer type of head assembly is used in a majority of 8 inch drives and in most of the 5.25 inch drives.

* Physical size: The industry's appetite for smaller physical size has not been satisfied by the SA 400 package introduced by Shugart Associates. That product form is certainly the dominant size for today's 5.25 inch floppy drives, and has become the standard for the rapidly growing step-up product, the 5.25 inch Winchester. But the systems become smaller, and system designers now are able to choose from several smaller alternatives:

  Thin versions of existing floppy formats: BASF was first to shrink the 5.25 inch drive, with its 1978 introduction of a two thirds high drive. Several others have recently introduced drives with similar dimensions, and Tandon and Alps Electric are now preparing to ship drives one half the height of the SA 400. And at least five firms are now offering 8 inch drives one half the height of the industry standard SA 800. All of these drives maintain the media standards already established for 5.25 and 8 inch drives, and make it possible for system OEMs to offer media interchangeability with older systems as they transition to smaller hardware. It is expected that a significant share of desktop systems will eventually use drives in these smaller formats, with the thin 5.25 inch drives especially attractive for electronic typewriters, portable computers and personal computers.

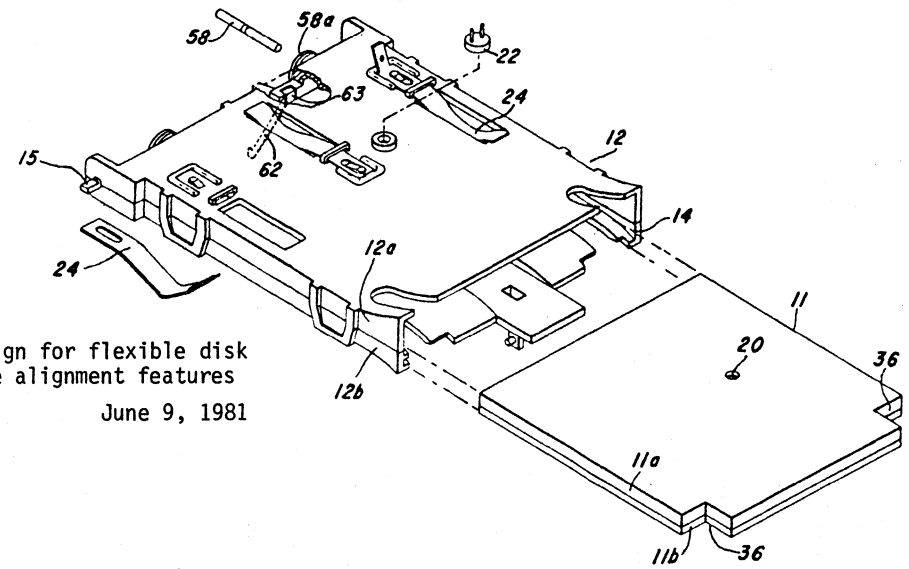
New small floppy formats: Some manufacturers of planned office systems have committed themselves to floppy drives with even smaller physical size, such as the Sony and Canon 3.5 inch drives, both of which are being offered in the OEM market as well as used for captive applications. It is too early to be confident of the impact of these drives on established floppy drive formats. Much will depend on the success of the systems in which their sponsors use them and whether they can convince others in the industry to join them in use of common standards. The one possible exception is IBM, which, as usual, would instantly establish another world standard if it should introduce a smaller floppy format. IBM is known to have underway a project called "Spark", which will probably eventually result in a smaller diameter floppy, with modest capacity -- but the first shipments are not planned before late 1983.

* Multiple disk cartridge drives: IBM started shipping an 8 inch, two sided drive in 1979 which uses standard diskettes in a 10-diskette magazine. IBM uses this drive, which holds two magazines plus three individual diskettes, to back up Piccolo 8 inch rigid disk drives on certain systems. Because it is a relatively expensive method of backing up a fixed disk drive in the Piccolo capacity range, no other firm has copied the IBM magazine drive. Amlyn, the startup firm discussed above in connection with the high BPI and TPI used on its 5.25 inch drive, uses spin coated media in a standard floppy diskette jacket, with five diskettes loaded in a plastic cartridge. Each diskette is loaded in the drive or restored to the cartridge under system control, providing 8 MB capacity per cartridge. It's too early to make specific predictions, but the Amlyn concept has excellent promise as a companion drive to 5.25 inch Winchesters, and its cartridge may win wide use as part of that package.

* Changes in recording technology: Major changes in recording technology are now being offered to the industry, but the extent and pace of the market impact of the changes proposed is not easily predicted. A high performance disk drive using flexible media is now being prepared for shipment by Iomega, a firm started in 1980 by veterans of IBM programs concerned with development of a "Bernoulli principle" floppy drive. Both IBM and Texas Instruments have been issued patents for various methods of controlling flexible disks in rigid cartridges. Like these programs, Iomega's drive is a high performance, high capacity device bearing little resemblance to conventional floppy drives. With 10 MB formatted capacity, the Iomega drive has a potential market of some size as a companion drive to fixed rigid disks or as the sole disk on a system. Like any unique product, however, this drive must overcome the usual conservative reaction of the industry to any new recording device not introduced by an industry leader. At best, most OEMs will go through an extended period of evaluation before committing to such a product. If all goes well during these evalu-

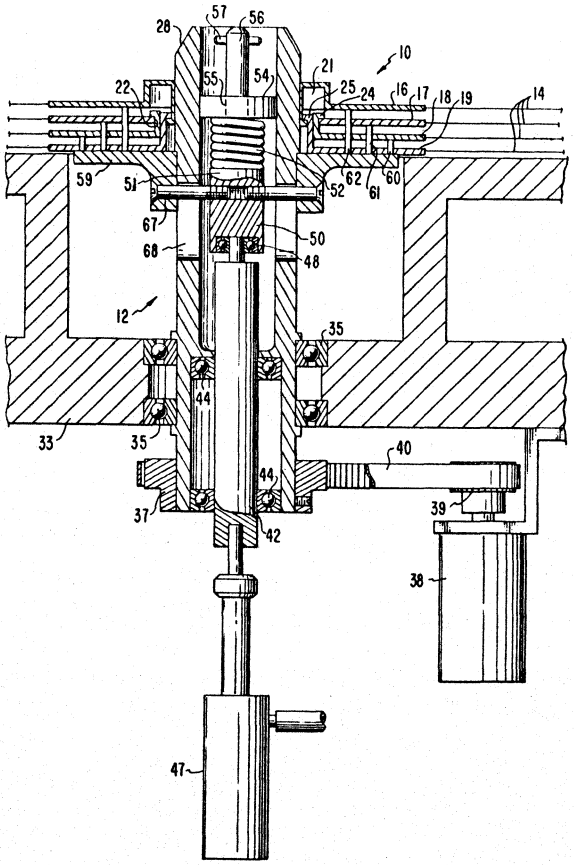
Figure 5

ILLUSTRATIONS FROM SELECTED PATENTS



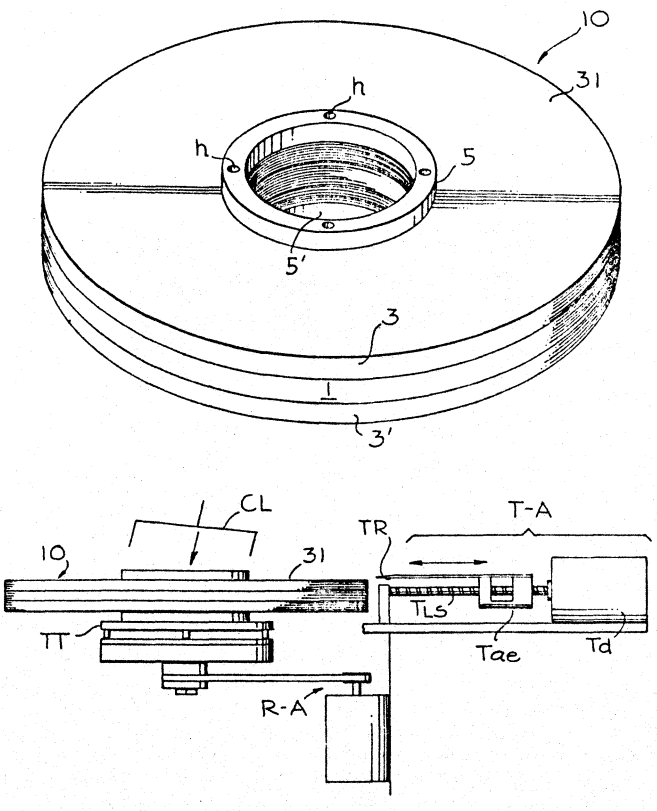
Texas Instruments design for flexible disk cartridge with precise alignment features

U.S. PATENT 4,272,795 June 9, 1981



IBM design for stack of flexible disks, with axially extending pins to open disks

U.S. PATENT 4,250,529 February 10, 1981



Burroughs design for read/write head access to a stack of flexible disks

U.S. PATENT 4,237,503 December 2, 1980

ations, and if Iomega has the staying power to wait out the decisions and design-in phase, this could prove to be a worthy competitor to rigid disk drives in its capacity range.

It remains uncertain whether the lengthy development activities by IBM and Burroughs in the area of multiple-floppy stacks will ever result in actual products. Every year more patents describing phases of this activity are issued, but early introductions of actual hardware seem unlikely. If systems with this technology are not eventually introduced, it will probably be because other methods were chosen for the intended application, not because of impossible development problems.

In the meantime, one of the most promising future improvements in flexible media recording density may come from the current activity in perpendicular recording. Much of the work in this area has involved rigid disk media, but at least one program is now underway to provide suitable media for vertically oriented flexible disk recording. Vertimag, a new Minneapolis company, plans to provide vertically oriented flexible disks for digital and video applications. The firm has already demonstrated media operating at 40,000 BPI, and could be influential in accelerating the development of disk drives operating at densities much higher than those of today.

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 class: 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 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 the OEM market class are classified accordingly. Most DISK/TREND statistics separate data between IBM and "other captive", but the term still pertains to the disk drives involved, not the manufacturer. Examples:

* Drives sold by DEC, Burroughs or Sykes Datatronics are considered captive, if internally manufactured.

* In the case of a joint venture disk drive manufacturer such as Magnetic Peripherals, Inc., a joint venture of Control Data and Honeywell, MPI drives sold by Honeywell are included in captive, and MPI drives sold by CDC are included in captive, PCM or OEM groups, as appropriate.

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

* Shipments by Pertec or Caldisk are non-captive, except for drives sold with systems by parent companies or subsidiaries.

* CDC drive sales to NCR are non-captive, in that NCR does not share in ownership of MPI, and are included in OEM totals.

PCM: Disk drives sold or leased by "plug compatible manufacturers" directly to end users; to be included in this category, drives must be supplied in plug compatible configurations for installation with systems sold by other manufacturers. Although the PCM category currently consists primarily of drives intended for use with IBM systems, such as Series/1, it may include any drives which are suitably equipped to be connected without additional hardware to systems of all types, including minicomputers and small business systems.

OEM: Floppy drives sold through any non-captive distribution channel except PCM. 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.

U.S. vs. worldwide destination: 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 shipment totals.

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

* A Burroughs shipment of a drive manufactured in Europe to a European end user is included in worldwide shipment totals.

U.S. vs. non-U.S. origin: 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 Burroughs are considered U.S. manufacturers, even though each firm manufactures some of its disk drives in non-U.S. locations.

* Siemens, which manufactures flexible disk drives in California, is considered a non-U.S. manufacturer. Siemens acquired General Systems International's flexible disk product line in early 1978 and the Wangco flexible disk product line in early 1979; shipments before the Siemens acquisitions are classified as originating from U.S. manufacturers.

Revenue: Based on sale of disk drives alone, as normally sold by individual manufacturers, without auxiliary hardware or spare parts. When sold as an integral part of a system or subsystem, the value of the disk drive alone has been estimated for DISK/TREND purposes. Sale prices are actual public sale transaction prices, whether at captive end user, PCM, or OEM levels. All projected prices are in 1981 constant dollars.

Spindles: The basic unit used in counting disk drives. One spindle consists of the disk drive mechanism required to utilize a single disk or stack of disks operated as a unit, whether disks are fixed, completely removable, or a combination of fixed and removable. All DISK/TREND unit totals are counted in spindles, even though some drive configurations include more than one spindle. On an arbitrary basis, drives which utilize a single actuator mechanism to control head movement on two separate flexible disks are counted as two spindles.

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 two sided recording, disks in non-standard sizes, or new physical configurations may require establishment of new DISK/TREND product categories.

Distribution channels: Shipments of non-captive drives are analyzed by each of the following distribution channels:

Mainframe computer manufacturers: The major manufacturers of medium and large scale computers. In the U.S. this group consists of IBM, Sperry Univac, Honeywell, Burroughs, Control Data and NCR.

Mini/micro computer manufacturers: Computer manufacturers primarily oriented to the minicomputer class, such as DEC, Hewlett-Packard or Data General, etc., and manufacturers of microprocessor-based systems, such as Intel and National Semiconductor.

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

Independent peripherals suppliers: Specialized manufacturers which buy drives, add controllers, interfaces, power supplies and other equipment or software, and offer complete subsystems to end users, system OEMs and system houses. Examples are Data Systems Design and Advanced Electronic Design.

Distributors, dealers, end users: (1) Distributors which perform the classic wholesaler function, such as Hamilton Avnet. (2) Dealers which act as local trading area outlets, frequently with stores suitable for walk-in trade, such as Byte shops, Computerland stores and Tandy's Radio Shack stores. (3) Direct sales to end users, usually of plug compatible drives, by the disk drive manufacturer.

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

1981 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

Coverage

Examples of flexible disk drives in this group include:

IBM	3740, Systems 32/34, Displaywriter
BASF	6101
Caldisk	142M, 142M1
Control Data	9404, 9404B
Datapoint	9381, 1404
Data Recording Equipment	7100
Decitek	8000/S, 8300/S, 8400/S
Digital Equipment	RX01, RX02
Hitachi	FDD 101A, FDD 102D
Innotronics	410, 420
Isotimpex	ES 5074
Matsushita	JK-880
Memorex	651, 550
MERA/Metronex	PLX45D
Micro Peripherals	41
Miltope	DD 400
Mitsubishi	M 892
Northern Telecom	4505
Olivetti	FD 801
PerSci	277
Pertec	FD 410, FD 510
Remex	RFD 2000
Ricoh	RD-2
Shugart Associates	SA 800
Siemens	FDD 100-8
Sykes Datatronics	7150, 9150
Tandon	848-1
Toshiba	ND-10S
Videoton	MFM-2
YE Data	YD-74C

All drives designed to use single sided flexible disks of nominal 8 inch diameter are included in this group, including both "soft sector" and "hard sector" drives. Most soft sector drives are designed to use IBM compatible media, with a single index hole. Hard sector drives use additional holes in the disks to identify sectors, and include both the original Memorex 651 format and the more widely used Shugart

Associates formats. Most of the drives in this group may be operated at "standard density" or "double density" at the option of the system integrator and depending upon controllers used. The OEM drives have generally been designed to the same physical dimensions as the Shugart Associates drives, except for the new "half high" drives offered by Micro Peripherals and Tandon.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1980	1981	1982	1983	1984
U.S. manufacturers	309.2	331.5	344.6	310.6	248.7
All manufacturers	432.1	429.9	421.1	371.8	289.8

Worldwide shipments of 8 inch, one side drives continue to grow, but at a lower rate of increase each year. 1980's worldwide total for all drives in this group was 724,000, expected to rise to 771,500 in 1981. Revenues for 1981 are expected to decline for the first year in 1981 to $429,900,000, down from $432,100,000 in 1980.

Continued growth in this product group is attributable to the momentum of existing U.S. and European systems originally designed with 8 inch, one side floppies. A significant number of these system OEMs found it prudent to remain with this floppy drive configuration longer than previously expected, due to the well-publicized technical and availability problems associated with two sided drives. Although these problems are largely behind the industry at this point, many OEMs have been cautious about plunging rapidly into usage of two sided drives. Japanese system manufacturers, on the other hand, have

moved very rapidly to usage of two sided drives, with very rapid displacement of one sided drives. Both captive and OEM drive shipments by non-U.S. manufacturers are now declining, due primarily to the change in the Japanese market.

Small business systems continue to provide the largest application for 8 inch, one side drives, using 39.5% of worldwide shipments in 1980. Shipments for word processing applications are starting to decline, despite the continued loyalty of some word processing system manufacturers to the format, with significant displacement by 5.25 inch drives, especially two sided versions.

This is now a mature product group, and relative positions among competitors in the OEM drive market changed very little in 1980. The DISK/TREND market share statistics in Table 11 appear to show Shugart Associates down approximately 5 percentage points from 1979, but this table shows each firm's share of drives manufactured. During 1980, Shugart Associates resold some drives manufactured by Matsushita, its Japanese licensee, and the company's share of drives sold to OEMs in 1980 was approximately the same as in 1979.

Marketing trends

Worldwide revenues and shipments for 8 inch, one side drives are expected to decline after 1981. By 1984, the rate of decline in all shipments is forecasted to reach 25% per year. The reduction in OEM drive shipments will be even sharper, as the hundreds of major OEM customers for these drives shift to two sided drives in both 8 inch and 5.25 inch diameters.

Non-U.S. captive drive production for this group will continue its steady drop, led by Japanese companies, but U.S. captive shipments are not expected to decline until after 1982. The U.S. momentum in captive shipments is being led by IBM's usage of one side, 8 inch drives with the Displaywriter, which is now being shipped at high levels, with more growth to come. While IBM's shipments are forecasted to increase through 1984, shipments by other U.S. captive manufacturers are expected to peak in 1982. After IBM, Digital Equipment Corporation will probably remain the largest producer of captive drives in this group, but other significant captive shipments are also expected by Xerox (Shugart Associates), for the firm's fast-growing word processing systems, and by Sykes Datatronics, for terminal oriented storage systems sold through AT&T operating companies.

It is considered unlikely that the relative positions of leading firms in the OEM drive market will change significantly during the next few years. Shugart Associates will probably retain over half of the total market, on the strength of the momentum of the systems which already use its drives. Control Data and BASF appear to have a continuing hold on second and third place in the worldwide market. In the case of BASF, this represents a major achievement, since the firm sells 8 inch drives only in Europe.

Technical trends

It is not likely that any of the new floppy drive technology under development by various manufacturers will be introduced initially in 8 inch, one side drives. It is possible, however, that some of the

industry's innovations in higher track density, improved media and faster head positioning may be introduced in this group later, as manufacturers take advantage of commonality in parts and subassemblies.

This phenomenon is already occurring with the new "half high" 8 inch drives now starting to appear. Although it is clear that the main interest among drive manufacturers is in the two sided versions of these drives, a few are also available in one side versions. Micro Peripherals and Tandon, both new to the 8 inch drive field, are offering their thin drives in one side as well as two sided models.

Forecasting assumptions

1. IBM usage of one side drives in new systems will be limited to selected terminals and word processing equipment.

2. Availability and perceived reliability of two sided drives will be adequate to insure their use on most capacity sensitive system requirements needing floppy drives during 1981 and later.

3. Although declining in shipments, 8 inch, one side drives will remain in wide usage for several application areas, including data entry and various other devices requiring media interchange in the IBM Diskette 1 format.

TABLE 8

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1980		Forecast							
	---Shipments--		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	32.0	48.0	38.6	56.9	49.7	72.7	62.0	90.2	75.8	109.5
Other U.S. Captive	116.7	158.1	115.1	154.1	118.7	160.5	98.8	133.6	60.6	81.9
TOTAL U.S. CAPTIVE	148.7	206.1	153.7	211.0	168.4	233.2	160.8	223.8	136.4	191.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	88.9	103.1	104.4	120.5	96.4	111.4	75.1	86.8	49.5	57.3
TOTAL U.S. NON-CAPTIVE	88.9	103.1	104.4	120.5	96.4	111.4	75.1	86.8	49.5	57.3
TOTAL U.S. SHIPMENTS	237.6	309.2	258.1	331.5	264.8	344.6	235.9	310.6	185.9	248.7
Non-U.S. Manufacturers										
Captive	2.2	68.5	2.0	53.8	1.6	41.6	1.4	32.5	.9	21.1
PCM	--	--	--	--	--	--	--	--	--	--
OEM	9.7	54.4	7.8	44.6	6.1	34.9	5.0	28.7	3.5	20.0
TOTAL NON-U.S. SHIPMENTS	11.9	122.9	9.8	98.4	7.7	76.5	6.4	61.2	4.4	41.1
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	249.5	432.1	267.9	429.9	272.5	421.1	242.3	371.8	190.3	289.8
OEM Average Price ($000)	.309	.330	.306	.321	.289	.300	.279	.290	.273	.284

TABLE 9

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1980		Forecast							
	Shipments		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	26.7	40.0	33.6	49.5	44.2	64.6	56.4	82.0	68.9	99.5
Other U.S. Captive	116.7	158.1	124.4	166.6	135.7	183.4	119.8	161.9	80.8	109.2
TOTAL U.S. CAPTIVE	143.4	198.1	158.0	216.1	179.9	248.0	176.2	243.9	149.7	208.7
PCM	--	--	--	--	--	--	--	--	--	--
OEM	294.9	341.9	346.7	400.2	337.0	389.6	272.0	314.4	183.5	212.1
TOTAL U.S. NON-CAPTIVE	294.9	341.9	346.7	400.2	337.0	389.6	272.0	314.4	183.5	212.1
TOTAL U.S. SHIPMENTS	438.3	540.0	504.7	616.3	516.9	637.6	448.2	558.3	333.2	420.8
Non-U.S. Manufacturers										
Captive	1.6	48.9	1.5	40.6	1.3	33.3	1.2	28.3	.9	20.1
PCM	--	--	--	--	--	--	--	--	--	--
OEM	24.0	135.1	20.0	114.6	17.1	97.4	14.7	83.8	10.5	60.1
TOTAL NON-U.S. SHIPMENTS	25.6	184.0	21.5	155.2	18.4	130.7	15.9	112.1	11.4	80.2
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	463.9	724.0	526.2	771.5	535.3	768.3	464.1	670.4	344.6	501.0
Installed at Year End										
IBM	217.9	297.6	251.5	347.1	295.7	411.7	352.1	493.7	421.0	593.2
Non-IBM	1,375.5	2,316.3	1,868.1	3,038.3	2,359.2	3,742.0	2,766.9	4,330.4	3,042.6	4,731.9
WORLDWIDE TOTAL	1,593.4	2,613.9	2,119.6	3,385.4	2,654.9	4,153.7	3,119.0	4,824.1	3,463.6	5,325.1

TABLE 10

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

Distribution Channel	1980 U.S. Net Shipments Units (000)	%	FORECAST 1981 %	1982 %	1983 %	1984 %
Mainframe computer manufacturers	15.1	4.7	4.2	3.8	3.4	3.1
Mini/micro computer manufacturers	45.2	14.2	13.8	13.4	13.0	12.6
System OEMs/systems houses	223.9	70.2	69.3	68.5	67.4	65.7
Independent peripherals suppliers	21.8	6.8	7.3	8.1	9.1	10.4
Direct to end user/retail dealers	12.9	4.1	5.4	6.2	7.1	8.2
TOTAL	318.9					

TABLE 11

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1980 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Shugart Associates	221.8	69.5	246.4	51.7
Control Data	33.4	10.5	50.6	10.6
BASF	--	--	35.0	7.3
Matsushita	16.0	5.0	25.0	5.2
Memorex	19.0	6.0	20.0	4.2
Hitachi	--	--	16.0	3.4
Siemens	8.0	2.5	13.0	2.7
Mitsubishi	--	--	10.0	2.1
Toshiba	--	--	9.0	1.9
Other U.S.	20.7	6.5	24.9	5.2
Other Non-U.S.	--	--	27.1	5.7
TOTAL	318.9	100.0	477.0	100.0

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

1981 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

Coverage

Examples of flexible disk drives in this group include:

IBM	4964, 4966, Systems 34/38, 5525, 5281
BASF	6104
Burroughs	9489-11, 9489-21, MD 122
Caldisk	143M, 145M
Control Data	9406-1, 210-10
Datapoint	1401
Data Recording Equipment	7200
Decitek	8400/S, 8302/T
Hitachi	201, 401, 403
Matsushita	JK-885
Micro Peripherals	42
Miltope	DD 450
Mitsubishi	M 2893, M 2894
Nippon Electric Company	N7707, FD 1160, FD 1165
Olivetti	FD 802
PerSci	299B, 699, 899
Pertec	FD 650
Qume	Qumetrak 842, 842DC
Remex	RFD 4000
Ricoh	RD-2D
Shugart Associates	SA 850
Siemens	FD 200-8
Tandon	848-2
TEAC	FD-100
Toshiba	ND-20D
YE Data	YD-174D, YD-180

Most drives in this group are designed to use IBM's recording formats for two sided flexible disks -- either Diskette 2 for standard density or Diskette 2D for double density. The exceptions use diskette media of the same physical size, but different recording formats, and include the Burroughs drives (with capacities up to 3 MB) and the PerSci 899 (embedded servo, with capacity up to 3.7 MB). IBM's diskette magazine drive is also included in the group, since it uses standard media in a conventional drive, fed by a diskette-changing mechanism. OEM drives are usually available in either hard or soft sectored versions.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1980	1981	1982	1983	1984
U.S. manufacturers	335.1	500.3	749.1	1,022.0	1,329.4
All manufacturers	493.0	774.9	1,195.4	1,692.6	2,272.1

Although shipments of 8 inch, two sided drives are currently below the level expected a few years ago, the product group is nevertheless achieving a growth rate which would be considered excellent in most industries. Worldwide unit shipments rose 95.9% in 1980, to 428,100 spindles, and 1981 unit shipments are expected to reach 718,200.

Shipments of OEM drives grew even more rapidly in 1980, up 115.1% over 1979, for a worldwide total of 231,200 units. In 1981, the worldwide OEM unit shipment total is expected to be up another 72.1%. Because of the numerous technical problems associated with 8 inch, two sided drives from 1977 through 1979, these products have recently carried a heavy burden of weakened system OEM confidence in their reliability. These concerns led many system OEMs to stay with 8 inch, one side drives for new systems much longer than they really wanted to, and were a contributing factor in the decisions of other OEMs to use 5.25 inch, two sided drives, since these products escaped many of the reliability failures experienced with 8 inch, two sided drives. However, there now appears to be a consensus in the industry that most manufacturers of 8 inch, two sided drives have solved their reliability problems. The drives are now available in large quantities, and healthy growth in OEM drive shipments is underway.

No single supplier of OEM drives has established a dominant position in this product group. Remex moved into the lead in worldwide unit shipments in 1980 with 24.2%, followed by Shugart Associates, Qume and Control

Data. The jockeying for market share is still underway, as numerous system OEMs select vendors for new applications.

Captive shipments have also grown rapidly during the past few years, paced by IBM's shipments of drives with a wide variety of small business systems, terminals and word processing systems. DISK/TREND estimates of IBM's shipments indicate growth exceeding 50% annually during 1980 and 1981, reaching 174,500 units during 1981, representing 54.7% of all 1981 captive shipments worldwide.

Although overshadowed by IBM's total usage of 8 inch, two sided drives, shipments by other captive drive manufacturers in this product group are actually growing at a higher rate, with worldwide shipments up 126.5% to 80,400 units in 1980, and with 1981 up 80.0% to 144,300 units. Non-U.S. captive manufacturers are still shipping twice the number of drives in this group as U.S. manufacturers, as the result of heavy activity by several Japanese manufacturers and Olivetti.

Marketing trends

Worldwide unit shipments of 8 inch, two sided drives are expected to maintain a vigorous growth rate through 1984. The average annual increase from 1982 through 1984 is forecasted at 53.2%, representing shipment of 2,573,800 spindles in 1984. Worldwide revenue for all drives is expected to reach $2,272,100,000 in 1984.

The DISK/TREND forecasts for IBM shipments have been increased again this year, based on the numerous applications for which IBM is already shipping large quantities of 8 inch, two sided drives, plus new introductions in 1981, such as the System/23 Datamaster and the addition of two sided drives to the Displaywriter.

It is still expected that PCM shipments will remain small. The attachment possibilities for independent floppy drives on IBM equipment are limited, and most PCM floppy drives will be included as part of subsystems sold to IBM users.

Other captive shipments are destined for a continued high growth rate, but it is expected that non-U.S. shipments will remain well in the lead, because of the continued emphasis of Japanese manufacturers on 8 inch flexible disk drives for office computers at the expense of 5.25 inch drives. By 1984 non-U.S. captive manufacturers' shipments are forecasted at 363,000 drives.

The growth rate for OEM drives is expected to stay slightly ahead of captive drives through 1984, with the worldwide total for that year reaching 1,568,100 units. The small business system market is the driving force behind the overall market for 8 inch, two sided drives -- and it is especially significant in the OEM drive segment. By 1984, in excess of 75% of all OEM drives are expected to be used in small business systems.

It is unlikely that any OEM manufacturer will achieve an overwhelming share of the market in this group, such as Shugart Associates did with one sided drives. No drive manufacturer has an early lead of any consequence, and delays associated with the lengthy resolution of the industry's reliability problems with these drives have provided time for several manufacturers to establish the capability for quantity production. No single drive manufacturer is expected to secure more than about one quarter of the worldwide market.

Technical trends

There is little doubt that higher capacity 8 inch drives will be introduced, but the specific introductory sequence and the technology to be employed are still open to speculation. Burroughs is shipping a drive with 3 MB capacity per diskette, and PerSci has announced an embedded servo drive with 3.7 MB capacity per diskette. However, these drives appear to be relatively costly approaches to the demand for more capacity, and are not expected to establish a wide following.

Other manufacturers have development projects which could lead to higher capacity drives, but most remain reluctant to introduce actual hardware, on the assumption that IBM will announce a drive with the potential to establish another industry defacto standard for both drives and media. The IBM "Bright" project is considered the most likely probability, but its introduction is taking longer than the industry expected. Bright will probably use an 8 inch flexible medium coated with chromium dioxide, with higher density recording, yielding a formatted capacity in the 4 to 5 MB range. Although most drive manufacturers would prefer that IBM set the standard for the next generation of floppies, with a product such as Bright, and thus eliminate years of confusion over rival standards, several manufacturers are becoming impatient and one or two might act if IBM delays much longer.

Forecasting assumptions

1. The industry's confidence in the reliability of 8 inch, two sided drives will continue to improve.
2. Introduction of higher capacity flexible disk drives will not impact shipments of drives in this group through at least 1982.
3. Average OEM selling prices will follow experience curve patterns similar to the history of one side drives.
4. 8 inch, two sided drives will remain the leading floppy drive configuration for small business systems through 1984.

TABLE 12

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1980		Forecast							
	Shipments		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	143.7	214.8	204.6	305.4	295.1	437.9	388.2	574.4	469.4	693.1
Other U.S. Captive	28.5	42.9	58.0	81.9	98.4	140.6	142.8	206.9	191.0	284.9
TOTAL U.S. CAPTIVE	172.2	257.7	262.6	387.3	393.5	578.5	531.0	781.3	660.4	978.0
PCM	.6	.6	1.6	2.0	2.6	3.4	3.8	5.3	5.0	7.2
OEM	56.0	76.8	83.1	111.0	123.8	167.2	171.8	235.4	247.8	344.2
TOTAL U.S. NON-CAPTIVE	56.6	77.4	84.7	113.0	126.4	170.6	175.6	240.7	252.8	351.4
TOTAL U.S. SHIPMENTS	228.8	335.1	347.3	500.3	519.9	749.1	706.6	1,022.0	913.2	1,329.4
Non-U.S. Manufacturers										
Captive	2.3	128.6	4.6	211.4	10.3	339.2	19.8	497.2	34.6	689.7
PCM	--	--	--	--	--	--	--	--	--	--
OEM	.6	29.3	7.2	63.2	16.1	107.1	29.5	173.4	48.1	253.0
TOTAL NON-U.S. SHIPMENTS	2.9	157.9	11.8	274.6	26.4	446.3	49.3	670.6	82.7	942.7
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	231.7	493.0	359.1	774.9	546.3	1,195.4	755.9	1,692.6	995.9	2,272.1
OEM Average Price ($000)	.450	.459	.433	.438	.405	.411	.387	.392	.376	.381

TABLE 13

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1980		Forecast							
	Shipments		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	77.7	116.1	116.9	174.5	173.6	257.6	235.3	348.1	293.4	433.2
Other U.S. Captive	16.3	24.5	34.1	48.2	61.5	87.9	95.2	137.9	136.4	203.5
TOTAL U.S. CAPTIVE	94.0	140.6	151.0	222.7	235.1	345.5	330.5	486.0	429.8	636.7
PCM	.4	.4	1.2	1.5	2.0	2.6	3.0	4.2	4.2	6.0
OEM	124.7	171.1	192.5	257.3	307.1	415.0	447.4	612.9	664.3	922.7
TOTAL U.S. NON-CAPTIVE	125.1	171.5	193.7	258.8	309.1	417.6	450.4	617.1	668.5	928.7
TOTAL U.S. SHIPMENTS	219.1	312.1	344.7	481.5	544.2	763.1	780.9	1,103.1	1,098.3	1,565.4
Non-U.S. Manufacturers										
Captive	1.0	55.9	2.1	96.1	4.9	161.5	9.9	248.6	18.2	363.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	1.2	60.1	16.0	140.6	38.0	253.1	73.1	430.2	122.6	645.4
TOTAL NON-U.S. SHIPMENTS	2.2	116.0	18.1	236.7	42.9	414.6	83.0	678.8	140.8	1,008.4
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	221.3	428.1	362.8	718.2	587.1	1,177.7	863.9	1,781.9	1,239.1	2,573.8
Installed at Year End										
IBM	159.5	236.1	276.4	410.6	450.0	668.2	685.3	1,016.3	978.7	1,449.5
Non-IBM	238.6	509.3	484.5	1,053.0	898.0	1,973.1	1,526.6	3,406.9	2,472.3	5,547.5
WORLDWIDE TOTAL	398.1	745.4	760.9	1,463.6	1,348.0	2,641.3	2,211.9	4,423.2	3,451.0	6,997.0

TABLE 14

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

Distribution Channel	1980 U.S. Net Shipments Units (000)	%	FORECAST 1981 %	1982 %	1983 %	1984 %
Mainframe computer manufacturers	10.9	8.6	9.0	9.3	9.6	9.9
Mini/micro computer manufacturers	44.3	35.1	34.1	33.0	32.4	31.7
System OEMs/systems houses	62.2	49.3	48.8	48.4	47.2	45.8
Independent peripherals suppliers	4.2	3.3	3.8	4.4	5.2	6.1
Direct to end user/retail dealers	4.7	3.7	4.3	4.9	5.6	6.5
TOTAL	126.3					

TABLE 15

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1980 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Remex	33.6	26.6	56.0	24.2
Shugart Associates	36.3	28.7	45.4	19.6
Qume	27.0	21.4	30.0	12.9
Control Data	15.7	12.4	23.6	10.2
YE Data	--	--	16.2	7.0
BASF	--	--	15.0	6.5
Hitachi	--	--	10.4	4.5
Matsushita	--	--	9.0	3.9
PerSci	7.2	5.7	9.0	3.9
Other U.S.	5.3	4.2	7.5	3.2
Other Non-U.S.	1.2	1.0	9.5	4.1
TOTAL	126.3	100.0	231.6	100.0

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

1981 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

Coverage

Examples of flexible disk drives in this group include:

Alps Electric	FDM 2000, 5100
Amlyn	5850, A506
BASF	6106A, 6107
Canon	MDD 6106
Control Data	9408
Isotimpex	Minifloppy
Matsushita	JK-874
Micro Peripherals	51, 91, 101
Micropolis	1015-II, 1016-II, 1117-II
Olivetti	FD 501
Pertec	FD 200
Remex	Pico RFD 961
Shugart Associates	SA 400, SA 410, SA 210
Siemens	FDD 100-5, FDD 111-5A/B, FDD 196-5
Tandon	TM-100-1, TM-100-3, TM-50-1
TEAC	FD-50A, FD-50C, FD-50E
Toshiba	ND-01
Videoton	Momflex 900

The basic recording format and physical size for 5.25 inch floppy drives were established by Shugart Associates in 1976, with the introduction of the SA 400. Most manufacturers active in this product group offer drives similar to the SA 400, but the rapid growth in desktop computer shipments has stimulated extensive innovation by others. Micropolis pioneered 100 TPI drives in 1977, and has been joined by seven additional manufacturers offering 96 or 100 TPI one side drives. When BASF entered the 5.25 inch drive market in 1978, the firm introduced drives two thirds the height of the SA 400. In 1981, at least three additional manufacturers have matched the BASF drive dimensions. Tandon and Alps Electric have further reduced drive height on special new models, to one half that of the SA 400, so that two drives may be mounted in the same space required by an SA 400. The most innovative drive in this group was announced in 1981

by Amlyn, a newly formed company. The Amlyn drive occupies the same space as an SA 400 or a 5.25 inch Winchester rigid disk and uses five special diskettes in a cartridge, with recording at 170 TPI and 9500 BPI.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1980	1981	1982	1983	1984
U.S. manufacturers	77.5	179.6	256.3	312.8	425.9
All manufacturers	119.1	263.8	373.5	477.0	621.5

The volatile market for desktop computers has created explosive growth for 5.25 inch, one side floppy drives in 1981. Worldwide unit shipments grew a very respectable 54.5% in 1980 to 658,700 drives, but the shipment rate has accelerated in 1981 to an estimated increase of 110.7%, with a forecasted total for the year of 1,387,800 units.

The 1981 leap in shipments is being driven primarily by the spectacular increase in the market for desktop computers. During 1981, shipments by Apple, Tandy, Commodore, and dozens of other manufacturers of desktop systems have been increasing significantly every month. Most of these systems are now being shipped with one or more floppy drives, because of software requirements.

Although captive drive shipments were nominal in 1980, major production programs are underway in 1981. Tandy's Radio Shack requirements are currently providing the largest boost in captive shipments. That firm's joint venture with Datapoint, Texas Peripherals, is now assembling large quantities of drives in this product group. Other captive shipments by Xerox (Shugart Associates), Exxon Office Systems (Qyx) and Olivetti will contribute to an estimated worldwide total of 158,100 drives in 1981, in contrast to only 13,400 in 1980.

OEM drive shipments, however, remain dominant in this product group, with 88.6% of the estimated 1981 worldwide total. Despite initiation of captive production, Tandy is still a major customer for OEM drives in 1981. The current giants of the desktop computer business -- Apple, Tandy and Commodore -- will individually buy 5.25 inch, one side drives by the hundreds of thousands in 1981. And potential new giants in the same desktop marketplace, such as IBM and DEC, have also started purchases of OEM drives this year.

The worldwide OEM shipment total for 1981 is estimated at 1,229,700 units, up 90.6% over the 645,300 drives shipped in 1980. However, worldwide 1981 OEM revenues are expected to total only $172,100,000, a mere 58.6% increase over 1980. The reason is a sharp drop in average OEM prices caused by by the increase in shipments of mechanism-only drives to a few major desktop system manufacturers and the normal experience curve price reductions created by a rapid build-up of total cumulative production experience.

Shugart Associates' share of the worldwide OEM market for 1980 was 259,000 drives, 40.1% of the total, down from 60.6% in 1979. Micropolis and Siemens both held over 10%, followed by BASF, Micro Peripherals, Tandon and TEAC -- all at substantial shipment levels.

Shipments of 96 and 100 TPI drives remain at only 14.5% of the worldwide total of 5.25 inch, one side drives in 1981. Micropolis, the pioneer, remains responsible for a very large portion of the higher TPI drives being shipped, with significant activity starting in 1981 by Tandon, Micro Peripherals and TEAC.

Marketing trends

While still a growth area for the industry, 5.25 inch, one side drive production through 1984 is expected to increase at a slower rate than in the recent past. The largest portion of 1981's big increase involves low capacity, low cost floppy drives intended for the price sensitive personal computer market. This market segment will obviously continue a pattern of high growth, but many of the customers for such systems will prefer higher capacity disk storage. Thus, a part of the current market for floppy drives in this group will graduate to higher capacity floppy configurations and to small Winchester fixed disk drives.

The DISK/TREND forecast for total worldwide shipments in 1984 is 2,357,600 units, but encompassed within this forecast is the expectation that captive production will displace a significant portion of the existing market share held by OEM drives. It is expected that captive shipments will account for 34.5% of the worldwide total in 1984, compared with 11.4% in 1981.

Captive shipments by United States manufacturers, now most of the worldwide total, are expected to remain much larger than captive shipments by non-U.S. manufacturers. The 1984 forecast for U.S. captive shipments is 620,100 drives, 76.2% of the worldwide captive total. It is probable that Tandy will become completely self-sufficient in 5.25 inch, one side drives in 1982, and that certain other major manufacturers of small systems, such as DEC and Apple, will eventually produce such drives internally. And it would certainly be no surprise if IBM were to undertake internal production of a small floppy drive for use with its new personal computer and other applications, but there is a good possibility that IBM would create a new small floppy drive configuration, rather than use the 5.25 inch format.

Because of the expected build-up in captive shipments, DISK/TREND forecasts indicate a slowing in the growth rate for worldwide OEM drive shipments, and a mild decline starting in 1984. However, it should be recognized that these forecasts assume that vertical integration decisions concerning floppy drives, although having a major impact, will be made by a very small number of companies. If some of the decisions go the other way, OEM drive shipments could stay very healthy.

The market shares held by manufacturers of OEM drives are due for a reshuffling, starting in 1981. For several years, a significant portion of Shugart Associates' dominant share of this market has been composed of a mechanism-only version of its basic drive which has been sold to a few of the major personal computer manufacturers, for later addition of electronics and final testing. Alps Electric has started to be a major participant in this portion of the OEM market in 1981, and along with TEAC, is expected to be positioned among the leaders for 1981.

Through 1984, shipments of 96/100 TPI drives are not expected to rise above about one quarter of the worldwide total, as the emphasis in this product group will remain on low price. See Table 18 for more details on this forecast.

Technical trends

There will be a future market for smaller floppy drives, but it appears that several formats will be offered. The 3.5 inch drives offered by Sony and Canon are discussed in the new DISK/TREND section on special drives.

Several manufacturers are now offering drives two thirds the height of the SA 400 standard. But both Alps Electric and Tandon are now offering very low cost drives only one half the height of the SA 400. These

drives could develop sizable markets with personal computers, electronic typewriters and other applications, and will provide stiff competition to other small drives using unique media. The ability of the Alps Electric and Tandon drives to use industry standard media is an important consideration in the OEM drive market, due to the multiple sources for diskettes and availability of a multitude of stock programs. The introduction of a new small drive configuration by IBM would certainly have a profound effect on the industry, but such an introduction is not expected before 1983, at the earliest.

In the meantime, Amlyn has introduced an innovative drive using five 5.25 inch diskettes in a cartridge. This drive achieves a capacity of 1.6 MB per diskette (8 MB per cartridge), using a spin coated diskette which will be manufactured by Dysan and a new media manufacturer, Brown Disk Manufacturing. The spin coating technique, similar to that used with rigid disks, makes practical a high linear density of 9500 BPI. The combination of a pre-recorded reference track and micro processor control of head positioning produces adequate interchangability at 170 TPI. Because of these techniques, an interface strategy which takes advantage of industry standard controllers, and the pressing need for such a drive to back up 5.25 inch Winchesters, Amlyn's initial product seems destined to have an impact on the industry.

Forecasting assumptions

1. 5.25 inch, one side drives will continue to be the dominant choice for floppy applications sensitive to cost and physical size requirements, but will be replaced in many applications requiring higher capacity by two sided 5.25 inch drives.

2. Additional major system manufacturers will initiate internal captive manufacturing programs for 5.25 inch, one side drives.

3. Penetration of the U.S. market for OEM drives by non-U.S. manufacturers will remain high.

TABLE 16

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1980 Shipments		Forecast							
	1981		1982		1983		1984			
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	6.0	7.1	75.4	78.4	124.7	155.9	160.3	210.9	234.4	325.6
TOTAL U.S. CAPTIVE	6.0	7.1	75.4	78.4	124.7	155.9	160.3	210.9	234.4	325.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	57.0	70.4	82.0	101.2	80.3	100.4	79.5	101.9	76.3	100.3
TOTAL U.S. NON-CAPTIVE	57.0	70.4	82.0	101.2	80.3	100.4	79.5	101.9	76.3	100.3
TOTAL U.S. SHIPMENTS	63.0	77.5	157.4	179.6	205.0	256.3	239.8	312.8	310.7	425.9
Non-U.S. Manufacturers										
Captive	--	3.5	--	13.3	1.0	31.5	4.7	78.2	10.1	125.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	14.1	38.1	41.8	70.9	55.7	85.7	53.3	86.0	40.6	70.0
TOTAL NON-U.S. SHIPMENTS	14.1	41.6	41.8	84.2	56.7	117.2	58.0	164.2	50.7	195.6
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	77.1	119.1	199.2	263.8	261.7	373.5	297.8	477.0	361.4	621.5
OEM Average Price ($000)	.163	.168	.140	.140	.126	.126	.117	.117	.111	.110

TABLE 17

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1980		Forecast							
	Shipments		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	8.0	9.5	137.1	142.5	216.9	271.1	291.4	383.4	446.5	620.1
TOTAL U.S. CAPTIVE	8.0	9.5	137.1	142.5	216.9	271.1	291.4	383.4	446.5	620.1
PCM	--	--	--	--	--	--	--	--	--	--
OEM	362.3	447.0	581.5	717.6	632.2	790.3	673.8	863.8	680.9	895.9
TOTAL U.S. NON-CAPTIVE	362.3	447.0	581.5	717.6	632.2	790.3	673.8	863.8	680.9	895.9
TOTAL U.S. SHIPMENTS	370.3	456.5	718.6	860.1	849.1	1,061.4	965.2	1,247.2	1,127.4	1,516.0
Non-U.S. Manufacturers										
Captive	--	3.9	--	15.6	1.3	42.0	6.7	111.7	15.5	193.3
PCM	--	--	--	--	--	--	--	--	--	--
OEM	73.5	198.3	301.8	512.1	445.4	685.2	463.6	747.8	376.0	648.3
TOTAL NON-U.S. SHIPMENTS	73.5	202.2	301.8	527.7	446.7	727.2	470.3	859.5	391.5	841.6
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	443.8	658.7	1,020.4	1,387.8	1,295.8	1,788.6	1,435.5	2,106.7	1,518.9	2,357.6
Installed at Year End										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	926.3	1,244.3	1,946.7	2,632.1	3,242.5	4,420.7	4,678.0	6,527.4	6,196.9	8,885.0
WORLDWIDE TOTAL	926.3	1,244.3	1,946.7	2,632.1	3,242.5	4,420.7	4,678.0	6,527.4	6,196.9	8,885.0

TABLE 18

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

TRACK DENSITY ANALYSIS

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1980		Forecast							
	--Shipments--		-----1981----		-----1982----		-----1983----		-----1984----	
	Units	%	Units	%	Units	%	Units	%	Units	%
U.S. MANUFACTURERS										
Captive Total	9.5	--	142.5	--	271.1	--	383.4	--	620.1	--
48 TPI	9.5	100.0%	142.5	100.0%	260.3	96.0%	337.4	88.0%	514.7	83.0%
96 TPI	--	--	--	--	10.8	4.0%	46.0	12.0%	105.4	17.0%
OEM Total	447.0	--	717.6	--	790.3	--	863.8	--	895.9	--
48 TPI	371.5	83.1%	545.0	76.0%	569.0	72.0%	587.4	68.0%	555.5	62.0%
96/100 TPI	75.5	16.9%	172.6	24.0%	221.3	28.0%	276.4	32.0%	340.4	38.0%
Total U.S.	456.5	--	860.1	--	1,061.4	--	1,247.2	--	1,516.0	--
48 TPI	381.0	83.5%	687.5	79.9%	829.3	78.1%	924.8	74.2%	1,070.2	70.6%
96/100 TPI	75.5	16.4%	172.6	20.1%	232.1	21.9%	322.4	25.8%	445.8	29.4%
NON-U.S. MANUFACTURERS										
Captive Total	3.9	--	15.6	--	42.0	--	111.7	--	193.3	--
48 TPI	3.9	100.0%	15.6	100.0%	41.2	98.0%	101.7	91.0%	164.3	85.0%
96 TPI	--	--	--	--	.8	2.0%	10.0	9.0%	29.0	15.0%
OEM Total	198.3	--	512.1	--	685.2	--	747.8	--	648.3	--
48 TPI	187.1	94.4%	483.1	94.3%	630.4	92.0%	635.6	85.0%	492.7	76.0%
96/100 TPI	11.2	5.6%	29.0	5.7%	54.8	8.0%	112.2	15.0%	155.6	24.0%
Total Non-U.S.	202.2	--	527.7	--	727.2	--	859.5	--	841.6	--
48 TPI	191.0	94.5%	498.7	94.5%	671.6	92.4%	737.3	85.8%	657.0	78.1%
96/100 TPI	11.2	5.5%	29.0	5.5%	55.6	7.6%	122.2	14.2%	184.6	21.9%
WORLDWIDE RECAP										
Total Shipments	658.7	--	1,387.8	--	1,788.6	--	2,106.7	--	2,357.6	--
48 TPI	572.0	86.8%	1,186.2	85.5%	1,500.9	83.9%	1,662.1	78.9%	1,727.2	73.3%
96/100 TPI	86.7	13.2%	201.6	14.5%	287.7	16.1%	444.6	21.1%	630.4	26.7%

TABLE 19

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

Distribution Channel	1980 U.S. Net Shipments Units (000)	%	FORECAST 1981 %	1982 %	1983 %	1984 %
Mainframe computer manufacturers	4.9	1.1	1.3	1.6	1.8	2.1
Mini/micro computer manufacturers	55.3	12.7	11.4	9.7	7.7	6.3
System OEMs/systems houses	322.7	74.1	74.6	75.1	75.8	75.5
Independent peripherals suppliers	38.9	8.9	9.2	9.4	9.8	10.3
Direct to end user/retail dealers	14.0	3.2	3.5	4.2	4.9	5.8
TOTAL	435.8					

TABLE 20

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1980 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Shugart Associates	220.2	50.5	259.0	40.1
Micropolis	48.3	11.1	75.0	11.6
Siemens	61.8	14.2	65.0	10.1
BASF	5.0	1.2	55.0	8.5
Micro Peripherals	42.8	9.8	53.5	8.3
Tandon	46.0	10.5	50.0	7.8
TEAC	6.7	1.5	46.7	7.2
Matsushita	--	--	21.0	3.3
Canon	--	--	10.0	1.5
Other U.S.	5.0	1.2	9.5	1.5
Other Non-U.S.	--	--	.6	.1
TOTAL	435.8	100.0	645.3	100.0

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

1981 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

Coverage

Examples of flexible disk drives in this group include:

Alps Electric	FDM 5200
BASF	6108A, 6109
Canon	MDD 6108
Control Data	9409, 9409-T
Hewlett-Packard	9130K
Matsushita	JK-875
Micro Peripherals	52, 92, 102
Micropolis	1015-IV, 1016-IV, 1117-VI
Olivetti	FD 502
Pertec	FD 250
Philips	H1100
Qume	Qumetrak 542
Remex	Pico RFD 480, 960
Shugart Associates	SA 450, SA 460
Siemens	FDD 200-5, 211-5A/B, 221-5A/B
Tandon	TM-100-2, TM-100-4, TM-50-2
TEAC	FD-50B, FD-50F
Toshiba	ND-02D
YE Data	YD-274, YD-280

All drives in this group are designed to use the basic media standard announced by Shugart Associates for the SA 450 in 1977. The Shugart Associates drive, with the same dimensions as the one sided SA 400, set the industry standard for physical size, with a few exceptions. BASF's "two thirds" high drive was introduced in 1978 and recently other manufacturers have offered two sided drives with similar dimensions. Tandon has announced the only 5.25 inch, two sided drive with height one half that of the standard. Ten manufacturers now offer 1 MB drives, with 96 or 100 TPI, and more are expected in the near future.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1980	1981	1982	1983	1984
U.S. manufacturers	33.5	86.8	177.0	366.8	639.7
All manufacturers	60.5	186.6	371.0	680.6	1,073.9

Volume shipments for 5.25 inch, two sided drives did not start until 1979, but the product group has maintained the fastest growth rate for any type of floppy drive. 1979's worldwide shipments of 70,600 drives grew to 208,600 in 1980, with the DISK/TREND forecast for 1981 set at 567,800 units.

Although nine companies in the United States, Europe and Japan are now shipping captive drives, OEM shipments remain dominant in 1981, with 87.3% of the worldwide unit total. Dozens of highly entrepreneurial system OEMs active in developing the desktop computer market have been quick to respond to the availability of 5.25 inch, two sided floppy drives, to upgrade capacity on small systems designed to use low capacity single sided 5.25 inch floppy drives. In 1980, over 80% of these drives were used in small business systems, word processing systems and personal computers.

Further evidence of the growing orientation of drives in this group to higher capacity applications may be seen in the rapid current growth of shipments for drives with higher track capacity. In 1980, 8.7% of worldwide shipments involved drives with 96 or 100 TPI -- but the 1981 forecast is for 25.8%

The early leaders in OEM shipments still held the top three positions in 1980. Tandon shipped 81,000 drives, for 41.2% of the worldwide total. Micro Peripherals rose to 23.4% and YE Data held 13.2%.

Marketing trends

Today's 96 TPI two sided 5.25 inch drives provide 1 MB capacity unformatted, and it is likely that 2 MB drives operating at twice the linear density of the current models will be placed in production in 1982, depending on availability of suitable media. The market is ready for these drives, with capacity-hungry desktop small business systems in the lead. While the majority of the two sided 5.25 inch floppies will be used in pairs as the only disks on desktop systems, a significant portion will be employed as the backup device on systems using a 5.25 inch Winchester as the primary disk. The DISK/TREND forecast for 1984 indicates 62.0% of the drives in this group will be used in small business system applications, followed by word processing with 18.8%.

During 1982 through 1984, the average annual increase in worldwide unit shipments is forecasted at 71.8%. The 1984 projection for worldwide unit shipments is 2,826,200 drives, largest of any of the DISK/TREND flexible disk drive product groups. Although each year will see a reduced share of total worldwide shipments going to the OEM market, OEM drive shipments for 1984 are expected to reach 1,766,300 units.

Non-U.S. captive shipments are currently higher than those by U.S. manufacturers, but it is expected that these roles will be reversed before 1984. A major increase in captive production by United States manufacturers is forecasted for 1983, growing to 686,800 drives in 1984. If the expected build-up of captive production does not occur on this timetable, OEM drive shipments will benefit to the extent of the shortfall.

The trend toward higher track density is well established, and in 1984 is expected to lead to a 72.5% share of worldwide shipments for 96/100 TPI. A significantly higher portion of drives from U.S. manufacturers

will be 96/100 TPI, as the fast-reacting U.S. system OEMs respond to small business system requirements for more disk capacity.

Technical trends

Demand for more capacity in the 5.25 inch, two sided floppy format will generate continued technical innovation in this product group. The limitations of existing media are now holding up drive manufacturers' plans for more capacity. It is not yet clear which type of improved media will prevail, but the most promising development activities are: (1) Very thin oxide coatings applied by a spin coating process about to be introduced for one sided floppies by Dysan and Brown Disk Manufacturing; (2) Very thin oxide coatings applied by improved web coating techniques being developed by 3M and Maxell; (3) Chromium dioxide coatings being developed by IBM for a new 8 inch floppy drive, which presumably would be offered by independent media manufacturers in the 5.25 inch, two sided format. It is believed that the impact of one or more of the above programs will be felt in the marketplace soon. Micropolis has already announced its 11,997 BPI 1117 series of drives, which will be reliant upon higher resolution media, and other drive manufacturers are ready to act when media is actually available.

Forecasting assumptions

1. 5.25 inch, two sided drives will tend to be favored by system OEMs for applications sensitive to cost considerations and physical size requirements, but for which more than minimum capacity levels are required.

2. Initiation of captive manufacturing programs by additional major system OEMs will occur in 1982 and 1983.

TABLE 21

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1980		Forecast							
	---Shipments--		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	.1	.2	10.9	13.8	43.3	56.3	160.1	213.5	338.4	463.6
TOTAL U.S. CAPTIVE	.1	.2	10.9	13.8	43.3	56.3	160.1	213.5	338.4	463.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	27.8	33.3	58.1	73.0	95.4	120.7	118.1	153.3	132.1	176.1
TOTAL U.S. NON-CAPTIVE	27.8	33.3	58.1	73.0	95.4	120.7	118.1	153.3	132.1	176.1
TOTAL U.S. SHIPMENTS	27.9	33.5	69.0	86.8	138.7	177.0	278.2	366.8	470.5	639.7
Non-U.S. Manufacturers										
Captive	--	12.2	--	50.6	3.2	108.6	11.6	194.1	23.2	289.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	2.5	14.8	5.6	49.2	11.1	85.4	18.0	119.7	24.7	145.0
TOTAL NON-U.S. SHIPMENTS	2.5	27.0	5.6	99.8	14.3	194.0	29.6	313.8	47.9	434.2
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	30.4	60.5	74.6	186.6	153.0	371.0	307.8	680.6	518.4	1,073.9
OEM Average Price ($000)	.236	.244	.240	.247	.218	.223	.197	.201	.179	.182

TABLE 22

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1980		Forecast							
	Shipments		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	.1	.2	12.8	16.2	52.5	68.2	213.5	284.6	501.4	686.8
TOTAL U.S. CAPTIVE	.1	.2	12.8	16.2	52.5	68.2	213.5	284.6	501.4	686.8
PCM	--	--	--	--	--	--	--	--	--	--
OEM	119.4	142.8	244.1	306.7	441.5	558.9	605.5	786.3	746.1	994.8
TOTAL U.S. NON-CAPTIVE	119.4	142.8	244.1	306.7	441.5	558.9	605.5	786.3	746.1	994.8
TOTAL U.S. SHIPMENTS	119.5	143.0	256.9	322.9	494.0	627.1	819.0	1,070.9	1,247.5	1,681.6
Non-U.S. Manufacturers										
Captive	--	11.1	--	56.2	3.7	124.1	13.7	228.4	29.9	373.1
PCM	--	--	--	--	--	--	--	--	--	--
OEM	9.1	54.0	21.4	188.7	47.7	366.5	85.9	572.8	131.2	771.5
TOTAL NON-U.S. SHIPMENTS	9.1	65.1	21.4	244.9	51.4	490.6	99.6	801.2	161.1	1,144.6
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	128.6	208.1	278.3	567.8	545.4	1,117.7	918.6	1,872.1	1,408.6	2,826.2
Installed at Year End										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	187.0	279.0	465.3	846.8	1,010.7	1,964.5	1,929.3	3,836.6	3,337.9	6,662.8
WORLDWIDE TOTAL	187.0	279.0	465.3	846.8	1,010.7	1,964.5	1,929.3	3,836.6	3,337.9	6,662.8

TABLE 23

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

TRACK DENSITY ANALYSIS

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1980		Forecast							
	--Shipments--		-----1981----		-----1982----		-----1983----		-----1984----	
	Units	%	Units	%	Units	%	Units	%	Units	%
U.S. MANUFACTURERS										
Captive Total	.2	--	16.2	--	68.2	--	284.6	--	686.8	--
48 TPI	.2	100.0%	13.2	81.5%	51.2	75.0%	165.1	58.0%	185.4	27.0%
96 TPI	--	--	3.0	18.5%	17.0	25.0%	119.5	42.0%	501.4	73.0%
OEM Total	142.8	--	306.7	--	558.9	--	786.3	--	994.8	--
48 TPI	124.8	87.4%	189.9	61.9%	245.9	44.0%	220.2	28.0%	109.4	11.0%
96/100 TPI	18.0	12.6%	116.8	38.1%	313.0	56.0%	566.1	72.0%	885.4	89.0%
Total U.S.	143.0	--	322.9	--	627.1	--	1,070.9	--	1,681.6	--
48 TPI	125.0	87.4%	203.1	62.9%	297.1	47.4%	385.3	36.0%	294.8	17.5%
96/100 TPI	18.0	12.6%	119.8	37.1%	330.0	52.6%	685.6	64.0%	1,386.8	82.5%
NON-U.S. MANUFACTURERS										
Captive Total	11.1	--	56.2	--	124.1	--	228.4	--	373.1	--
48 TPI	11.1	100.0%	56.2	100.0%	117.9	95.0%	187.3	82.0%	235.1	63.0%
96 TPI	--	--	--	--	6.2	5.0%	41.1	18.0%	138.0	37.0%
OEM Total	54.0	--	188.7	--	366.5	--	572.8	--	771.5	--
48 TPI	53.8	99.6%	161.9	85.8%	271.2	74.0%	309.3	54.0%	246.9	32.0%
96/100 TPI	.2	.4%	26.8	14.2%	95.3	26.0%	263.5	46.0%	524.6	68.0%
Total Non-U.S.	65.1	--	244.9	--	490.6	--	801.2	--	1,144.6	--
48 TPI	64.9	99.7%	218.1	89.1%	389.1	79.3%	496.6	62.0%	482.0	42.1%
96/100 TPI	.2	.3%	26.8	10.9%	101.5	20.7%	304.6	38.0%	662.6	57.9%
WORLDWIDE RECAP										
Total Shipments	208.1	--	567.8	--	1,117.7	--	1,872.1	--	2,826.2	--
48 TPI	189.9	91.3%	421.2	74.2%	686.2	61.4%	881.9	47.1%	776.8	27.5%
96/100 TPI	18.2	8.7%	146.6	25.8%	431.5	38.6%	990.2	52.9%	2,049.4	72.5%

TABLE 24

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

Distribution Channel	1980 U.S. Net Shipments Units (000)	%	FORECAST 1981 %	1982 %	1983 %	1984 %
Mainframe computer manufacturers	--	--	1.8	2.4	2.9	3.5
Mini/micro computer manufacturers	28.3	22.0	19.8	17.8	16.0	14.4
System OEMs/systems houses	84.1	65.5	66.1	67.9	69.3	70.0
Independent peripherals suppliers	15.4	12.0	10.8	9.9	9.4	9.0
Direct to end user/retail dealers	.7	.5	1.5	2.0	2.4	3.1
TOTAL	128.5					

TABLE 25

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1980 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Tandon	74.5	58.0	81.0	41.2
Micro Peripherals	36.8	28.6	46.0	23.4
YE Data	1.9	1.5	26.0	13.2
BASF	3.0	2.3	18.0	9.1
Other U.S.	8.1	6.3	15.8	8.0
Other Non-U.S.	4.2	3.3	10.0	5.1
TOTAL	128.5	100.0	196.8	100.0

FLEXIBLE DISK DRIVES, SPECIAL

1981 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, SPECIAL

Coverage

The flexible disk drives included in this group are:

Canon	CMD-300
Iomega	Alpha 10
Olivetti	FD 258
Sankyo Seiki	FMC-100
Sony	OA-D30V

The disk drives in this product group are sufficiently different from those in the other DISK/TREND groups as to require separate analysis. Only the Olivetti drive has an established production history. The others are recently introduced products. The functional and physical characteristics of these products are varied, and will be individually discussed below.

Special flexible disk drive products and markets

Olivetti FD 258 and Sankyo Seiki FMC-100

Both of these drives record 8,000 bytes in a single spiral track on a flexible disk of about 2.5 inch diameter. The drives' physical size, interfaces and media are not mutually compatible. The Olivetti drive has been produced in large quantities, starting in 1977, and has performed as a program loader and data storage medium on a variety of Olivetti word processing and data processing equipment. The drive has also been offered as an OEM product during the last few years, without much apparent market impact. Sankyo Seiki's drive was introduced in 1980 as an OEM product, for similar applications. These drives are serial recording devices, similar in function to small cassette tape drives or paper tape reader/

punches, and lack the direct access capability of moving head disk drives using flexible or rigid media. It is conceivable that they may find a specialized niche in the market, but they are not expected to compete with existing mainstream flexible disk drive formats.

Sony OA-D30V and Canon CMD-300

Both of these devices are random access disk drives using flexible disks of about 3.5 inch diameter, but they are different in every other respect.

Sony, one of the world's leading companies in magnetic recording technology for audio and video applications, announced an expanded line of office products in 1980, including the Series 35 word processing system. This system will use Sony's new miniature floppy drive, which will also be sold as an OEM product. As initially announced, the Sony drive offers up to 437.5 Kilobyte capacity on one side of a flexible disk coated with cobalt modified oxide, and enclosed in a rigid cartridge. The firm's officials have indicated that a two sided version is planned for 1982.

Although a product introduction of this nature by Sony must be taken very seriously, its eventual impact on the industry is still unclear. It is assumed that the drive will be produced in substantial quantities for use with the announced word processing system and with other Sony office equipment yet to come. But the drive is not likely to seriously impact the OEM markets for disk drives unless Sony is successful in completing alternate sourcing arrangements with other manufacturers for the disk drive and the media.

Canon's "Micro Floppy" CMD-300 records 10 Kilobytes on one side of an oxide coated flexible disk enclosed in a rigid cartridge. A higher

capacity CMD-500 model has been shown at electronics shows in Japan. So far, these drives have been announced only as OEM products, but it is assumed that they will also show up on Canon's own small computer systems. Both drives are being offered at extremely low prices in the Japanese OEM market -- as low as about $50.00. However, with the limited capacity provided, they are not candidates to replace existing flexible disk drives for most applications. The significance of these drives may be as the early examples of attempts by Japanese companies to produce low end, physically small floppy drives suitable for home computing systems. It is expected that other Japanese manufacturers may also introduce comparable drives, intended for small size, minimum capacity, low cost and suitable for very large production quantities.

Iomega Alpha 10

Iomega's Alpha 10 is a high performance disk drive which records 10 MB on one side of an 8 inch flexible disk enclosed in a rigid cartridge. Except for the fact that the recording disk is flexible, the Iomega drive bears little resemblance to current flexible disk drive recording technology. The unit employs a flying head, with the disk spinning at 1500 RPM. A sophisticated internal air flow guidance system maintains the proper positioning of the disk relative to the recording head. Recording densities are the highest used with flexible media to date: 300 TPI and 18,000 FCI. An embedded servo is used in conjunction with a rotary actuator for head positioning.

This product is not in competition with any other existing flexible disk drive. Its capacity, performance and price place it in competition with small Winchester disks and rigid disk cartridge drives or for use

as a removable media device for use as backup for 8 inch Winchesters. Because the specifications for this drive make it potentially attractive for many small computer system applications, and because of the unique technology employed, the Iomega drive has attracted great interest in the industry. If the firm's founders are able to accomplish a smooth production start-up, this drive may be successfully sold to some of the more adventurous small system manufacturers. A major market penetration is less likely, however, unless the firm is able to establish alternate sources for drives and media.

Marketing trends

Specific forecasts covering shipments and revenues for the products in this section have not been included in the 1981 DISK/TREND Report. When appropriate, additional sections will be added to future editions of the DISK/TREND Report for products which become commercially significant.

DISK DRIVE SPECIFICATIONS

Changes for 1981

The format of the specification section has been reoriented for easier reading, and some additions have been made. Every drive is now identified as to its normal market class: Captive, OEM or PCM. Physical dimensions have been provided for most OEM drives.

Coverage

This listing includes most flexible disk drives now in new production or announced. Also included for reference are several IBM systems in which flexible disk drives are used, even though the drives are not sold as separate products.

Generally, no attempt has been made to include drives sold by computer system manufacturers but purchased on an OEM basis from others. Also not listed in most cases are captive drives which are similar to OEM models made by the same manufacturer. Disk subsystems complete with power supply, controller and interface are listed for some manufacturers, for clarity.

DISK/TREND Categories

In most cases category assignments noted 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 feeds diskettes to a single drive. The new Amlyn drive, which uses diskettes in a special magazine, is included with 5.25 inch, one side drives.

Generic Type

Because they are generally understood throughout the industry, IBM media designations are used to define types of 8 inch media, and Shugart Associate's media designations are used to define 5.25 inch media types. However, usage of these model numbers is not intended to imply interchangeability. Individual drives may require media with a variety of special characteristics, such as non-standard recording disks, sectors, initialization, etc.

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

Accuracy

All information has been cross-checked for accuracy. However, it is anticipated that some errors may be included, due primarily to the problem that 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 DISK DRIVE GROUPS

Flexible disk drives

10. 8 inch, one side
11. 8 inch, two sides
12. 5.25 inch, one side
13. 5.25 inch, two sides
14. Special

MANUFACTURER	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC	AMLYN	BASF
DRIVE	FDM 2000	FDM 5100	FDM 5200	5850 A506	6101
DISK/TREND GROUP	12	12	13	12	10
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 104	SA 104 (S) SA 105/107 (H)	SA 154 (S) SA 155/157 (H)	Dysan UHR in Spec. Cartridge	BASF 601 Diskette 1
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Spin Coated Oxide on Mylar	Oxide Coated
Sectoring	Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE				8.0 MB Capacity per Cartridge	
Total capacity (MBytes)	U: .125/.250	U: .125/.250	U: .5/1.0	U: 1.6	U: .401
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 10,417	U: 5,208
Data surfaces per spindle	1	1	2	1	1
Tracks per surface	40	40	40	154	77
TPI	48	48	48	170	48
BPI	2768/5536	2768/5536	2938/5876	9500	3268
RPM	300	300	300	360	360
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING: Track to track (msec)	12	5	5	3	6
Settling time (msec)	15	15	15	15	12
Head load time (msec)	35	35	35	Heads in Continuous Contact	40
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	31.25
SIZE (Inches: H x W x D)	1.61 x 5.75 x 8.0	3.25 x 5.75 x 7.75	3.25 x 5.75 x 7.75	3.25 x 5.75 x 7.88	4.33 x 8.66 x 14.17
FIRST CUSTOMER SHIPMENT	1981	1980	1980	10/81	1976
U.S. OEM PRICE FOR 500 UNITS	--	--	--	$750	--
COMMENTS				Special cartridge holds 5 spin coated diskettes. Interfaces: 5850 = SA850 A506 = ST506	

MANUFACTURER	BASF	BASF	BASF	BASF	BASF
DRIVE	6102	6104	6106A	6107	6108A
DISK/TREND GROUP	10	11	12		13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	BASF 601 Diskette 1	Diskette 1, 2, 2D	BASF 606 SA 104/105/107	BASF 606 SA 104/105/107	BASF 606 SA 154/155/157
Nominal disk diameter	8"	8"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .401/.802	U: .8/1.6	U: .125/.250	U: .125/.250	U: .250/.5
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	1	2	1	1	2
Tracks per surface	77	77	40	40	40
TPI	48	48	48	48	48
BPI	3268/6536	3406/6816	2768/5536	2768/5536	2938/5876
RPM	360	360	300	300	300
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Cam, Stepping Motor	Cam, Stepping Motor	Cam, Stepping Motor
POSITIONING: Track to track (msec)	6	3	6	6	6
Settling time (msec)	14	14	15	15	15
Head load time (msec)	40	40	*	*	*
Average rotational delay (msec)	83.3	83.3	100	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	4.33 x 8.66 x 14.17	4.33 x 8.66 x 14.17	2.1 x 5.75 x 7.5	2.1 x 5.75 x 7.5	2.1 x 5.75 x 7.5
FIRST CUSTOMER SHIPMENT	1976	1978	3Q78	--	4Q78
U.S. OEM PRICE FOR 500 UNITS	--	--	$200	--	$250
COMMENTS			*Heads in continuous contact.	*Heads in continuous contact. Mechanism only.	*Heads in continuous contact.

MANUFACTURER	BASF	BURROUGHS	BURROUGHS	BURROUGHS	CALDISK
DRIVE	6109	9489-11 9489-12	9489-21 9489-23	MD-122	142M
DISK/TREND GROUP		11	11	11	10
MARKET	OEM	OEM	OEM	OEM	OEM/Captive
MEDIA: Generic type	BASF 606 SA 154/155/157	Special	Special	Burroughs MD 110-1	Diskette 1
Nominal disk diameter	5.25"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard	Soft	Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	F: 1.014	F: 3.016	F: 3.131	U: .401/.802
Capacity per track (Bytes)	U: 3,125/6,250	F: 5,760	F: 10,620	F: 11,264	U: 5,208/10,416
Data surfaces per spindle	2	2	2	2	1
Tracks per surface	40	88	142	139	77
TPI	48	64	150	150	48
BPI	2938/5876	4775	7040	7100	3268/6536
RPM	300	365	524	524	360
Actuator type	Cam, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Lead Screw, Stepping Motor
POSITIONING: Track to track (msec)	6	5	40 (Including Settling)	40 (Including Settling)	6
Settling time (msec)	15	50	--	--	10
Head load time (msec)	*	85	--	--	30
Average rotational delay (msec)	100	82	57.25	57.25	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	50	125	125	31.25/62.5
SIZE (Inches: H x W x D)	2.1 x 5.75 x 7.5		10.0 x 5.5 x 20.5	5.5 x 10.0 x 20.5	4.9 x 8.4 x 15.0
FIRST CUSTOMER SHIPMENT	--	4Q76	3Q80	3Q80	1/77
U.S. OEM PRICE FOR 500 UNITS	--	--	--	$2575 (Dual)	$420
COMMENTS	*Heads in continuous contact. Mechanism only.	9489-12 is dual version.	Dual drive, single head positioning system.	Dual drive, single head positioning system. Built-in controller compatible with Burroughs FD 211/214.	

MANUFACTURER	CALDISK	CALDISK	CANON	CANON	CANON
DRIVE	143M1	143M	Canon Micro Floppy CMD-300	MDD 6106	MDD 6108
DISK/TREND GROUP	10	11	14	12	13
MARKET	OEM/Captive	OEM/Captive	OEM	OEM, Captive	OEM, Captive
MEDIA: Generic type	Diskette 1	Diskette 1, 2, 2D	Canon Micro Floppy Cassette	SA 104 (S) SA 105/107 (H)	SA 154 (S) SA 155/157 (H)
Nominal disk diameter	8"	8"	97 mm OD 28.57 mm ID	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .401/.802	U: .8/1.6	U: .010	U: .125/.250	U: .250/.5
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208/10,416	U: 625	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	2	1	1	2
Tracks per surface	77	77	16	40	40
TPI	48	48	25.4	48	48
BPI	3268/6536	3408/6816	698	2768/5536	2768/5536
RPM	360	360	100	300	300
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Belt, Stepping Motor	Cam, Stepping Motor	Cam, Stepping Motor
POSITIONING: Track to track (msec)	6	6	40	12	12
Settling time (msec)	10	10		48	48
Head load time (msec)	30	30	Heads in Continuous Contact	35	35
Average rotational delay (msec)	83.3	83.3	300	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	1.04	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	4.9 x 8.4 x 15.0	4.9 x 8.4 x 15.0	2.75 x 4.25 x 5.9	2.1 x 5.75 x 7.74	2.1 x 5.75 x 7.74
FIRST CUSTOMER SHIPMENT	1/77	8/77	12/80	3/79	1/80
U.S. OEM PRICE FOR 500 UNITS	$427	$505	--	--	--
COMMENTS			Both sides of disk may be used.		

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	9404	9404B	9406-1	9406-2	9406-3
DISK/TREND GROUP	10	10	11	11	11
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	CDC 9821/9823 Diskette 1	CDC 9821/9823 Diskette 1	CDC 9825 Diskette 1/2/2D	CDC 9825 Diskette 1/2/2D	CDC 9825 Diskette 1/2/2D
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .401/.802	U: .401/.802	U: .8/1.6	U: .8/1.6	U: .8/1.6
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	1	2	2	2
Tracks per surface	77	77	77	77	77
TPI	48	48	48	48	48
BPI	3268/6536	3268/6536	3408/6816	3408/6816	3408/6816
RPM	360	360	360	360	360
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING: Track to track (msec)	10	10	3	3	3
Settling time (msec)	10	10	20	20	20
Head load time (msec)	60	60	40	40	40
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
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)	4.97 x 8.78 x 14.0	4.97 x 8.78 x 14.0	4.97 x 8.78 x 14.0	4.97 x 8.78 x 14.0	4.65 x 8.55 x 13.75
FIRST CUSTOMER SHIPMENT	11/75	2Q79	4Q78	4Q78	4Q78
U.S. OEM PRICE FOR 500 UNITS	$375	$375	$555	$555	$555
COMMENTS			CDC interface.	Shugart interface.	Shugart interface.

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	DATAPOINT
DRIVE	210-10	9408	9409	9409-T	9381 Series
DISK/TREND GROUP	11	12	13	13	10
MARKET	PCM	OEM	OEM	OEM	Captive
MEDIA: Generic type	CDC 9821/315 Diskette 1/2/2D	SA 104 (S) SA 105/107 (H)	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)	Diskette 1
Nominal disk diameter	8"	5.25"	5.25"	5.25"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Hard/Soft	Hard/Soft	Hard/Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .606208	U: .125/.250	U: .250/.5	U: .5/1.0	F: .256
Capacity per track (Bytes)	F: 4,096	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	F: 3,328
Data surfaces per spindle	2	1	2	2	1
Tracks per surface	74/3	40	40	80	77
TPI	48	48	48	96	48
BPI	3406/6816	2768/5536	2938/5876	2961/5922	3268
RPM	360	300	300	300	360
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING: Track to track (msec)	3	5	5	5	10
Settling time (msec)	20	15	15	15	20
Head load time (msec)	40	50	50	50	36
Average rotational delay (msec)	83.3	100	100	100	83.3
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)	4.97 x 8.78 x 14.0	3.38 x 5.88 x 8.0	3.38 x 5.88 x 8.0	3.38 x 5.88 x 8.0	--
FIRST CUSTOMER SHIPMENT	1/79	3/80	1980	1981	1976
U.S. OEM PRICE FOR 500 UNITS	--	$220	$300	$380	--
COMMENTS	Series/1 interface.				

MANUFACTURER	DATAPOINT	DATAPOINT	DATA RECORDING EQUIPMENT, LTD.	DATA RECORDING EQUIPMENT, LTD.	DECITEK
DRIVE	1404 1412	1401 1403 1411 1413	7100	7200	8000/S
DISK/TREND GROUP	10	11	10	11	10
MARKET	Captive	Captive	OEM	OEM	OEM
MEDIA: Generic type	Diskette 1	Diskette 1, 2, 2D	Diskette 1	Diskette 1, 2, 2D	Diskette 1
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .256/.512	F: .512/1.024	U: .401/.802	U: .8/1.6	U: .401/.802
Capacity per track (Bytes)	F: 3,328/6,656	F: 3,328/6,656	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	2	1	2	1
Tracks per surface	77	77	77	77	77
TPI	48	48	48	48	48
BPI	3268/6536	3408/6816	3268/6536	3408/6816	3268/6536
RPM	360	360	360	360	360
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Linear, Stepping Motor
POSITIONING: Track to track(msec)	10	10	6	6	6
Settling time (msec)	20	20	14	14	15
Head load time(msec)	36	36	30	30	35
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
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)	--	--	4.5 x 8.55 x 14.0	4.5 x 8.55 x 14.0	4.62 x 8.55 x 14.0
FIRST CUSTOMER SHIPMENT	1Q81	1Q81	1977	1977	2Q80
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	$325
COMMENTS					

MANUFACTURER	DECITEK	DECITEK	DECITEK	DECITEK	DIGITAL EQUIPMENT CORPORATION
DRIVE	8300/S	8400/S	8302/T	8402/T	RX01
DISK/TREND GROUP	10	10	11	11	10
MARKET	OEM	OEM	OEM	OEM	Captive
MEDIA: Generic type	Diskette 1	Diskette 1	Diskette 1, 2, 2D	Diskette 1, 2, 2D	RX01K Diskette 1
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .401/.802	U: .401/.802	U: .8/1.6	U: .8/1.6	F: .256
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	F: 3,328
Data surfaces per spindle	1	1	2	2	1
Tracks per surface	77	77	77	77	77
TPI	48	48	48	48	48
BPI	3268/6536	3268/6536	3268/6536	3268/6536	3268
RPM	360	360	360	360	360
Actuator type	Linear, Stepping Motor	Linear, Stepping Motor	Linear, Stepping Motor	Linear, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING: Track to track (msec)	6	6	3	3	6
Settling time (msec)	15	15	15	15	20
Head load time (msec)	35	35	35	35	16
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25/62.5	31.25/62.5	31.25
SIZE (Inches: H x W x D)	4.5 x 8.55 x 14.0	4.5 x 9.5 x 14.0	4.5 x 8.55 x 14.0	4.5 x 9.5 x 14.0	17 x 10.5 x 19
FIRST CUSTOMER SHIPMENT	3/81	3/81	6/81	6/81	1976
U.S. OEM PRICE FOR 500 UNITS	$325	$325	$485	$485	--
COMMENTS					Dual drive system.

MANUFACTURER	DIGITAL EQUIPMENT CORPORATION	HEWLETT-PACKARD	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	RX02	9130K	FDD 101A	FDD 102D	FDD 201
DISK/TREND GROUP	10	13	10	10	11
MARKET	Captive	Captive	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Generic type	RX01K Diskette 1	SA 154	Diskette 1	Diskette 1	Diskette 1, 2
Nominal disk diameter	8"	5.25"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .256/.512	U: .5	F: .359	F: .243 or F: .359	F: .718
Capacity per track (Bytes)	F: 3,328/6,656	U: 6,250	F: 4,800	F: 3,328/4,800	F: 4,800
Data surfaces per spindle	1	2	1	1	2
Tracks per surface	77	40	77	77	77
TPI	48	48	48	48	48
BPI	3268/6536	5877	3268	3268	3408
RPM	360	300	360	360	360
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING: Track to track(msec)	6	5	8	3	3
Settling time (msec)	20	15	14	35	35
Head load time(msec)	16	*	25	50	50
Average rotational delay (msec)	83.3	100	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	17 x 10.5 x 19	3.25 x 5.75 x 8.0	8.54 x 4.61 x 14.0	8.54 x 4.61 x 14.0	8.54 x 4.61 x 14.0
FIRST CUSTOMER SHIPMENT	4Q78	1/81	1976	1981	1978
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	Dual drive system.	*Heads in continuous contact.			

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	IBM	IBM
DRIVE	FDD 401	FDD 402D	FDD 403	3740 Series 3770 Series 3790 Series 3601/3602 (33 FD Drive)	System/32 System/34 (33 FD Drive)
DISK/TREND GROUP	11	11	11	10	10
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	Captive	Captive
MEDIA: Generic type	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1	Diskette 1
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .720/1.44	F: .720/1.44	U: .8/1.6	F: .242944	F: .246272 or F: .303104
Capacity per track (Bytes)	F: 4,800/9,600	F: 4,800/9,600	U: 5,208/10,416	F: 3,328	F: 3,328/4,096
Data surfaces per spindle	2	2	2	1	1
Tracks per surface	77	77	77	74/3	74/3
TPI	48	48	48	48	48
BPI	3408/6816	3408/6816	3408/6816	3268	3268
RPM	360	360	360	360	360
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor,	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING: Track to track(msec)	3	3	3	50	50
Settling time (msec)	35	35	35	20	20
Head load time(msec)	50	50	50	80	80
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25/62.5	31.25	31.25
SIZE (Inches: H x W x D)	8.54 x 4.61 x 14.0	8.54 x 4.61 x 14.0	8.54 x 4.61 x 14.0	--	--
FIRST CUSTOMER SHIPMENT	1978	1981	1980	1/75	System/32: 1/75 System/34:12/77
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	Displaywriter (33 FD Drive)	Displaywriter 6360-20 Single 6360-22 Dual	5281-Z01/2/6 5282-Z01/2/6 5285-X01/2/6 5286-X02 5286/XXX	5281-Z05/6/10 5281-Z05/6/10 5285-X05/6/10 5286-X10 5288-XXX	5265-A1X 5265-A2X 5265-B1X 5265-B2X
DISK/TREND GROUP	10	11	10	11	10
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Generic type	Diskette 1	Diskette 1, 2D	Diskette 1	Diskette 1, 2, 2D	Diskette 1
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .284160	F: .284160 or F: 1.136640	F: .246272 or F: .284160 or F: .303104	F: .985088 or F: 1.136640 or F: 1.212416	F: .246272
Capacity per track (Bytes)	F: 3,840	F: 3,840/7,680	F: 3,328/3,840/ 4,096	F: 6,656/7,680/ 8,192	F: 3,328
Data surfaces per spindle	1	2	1	2	1
Tracks per surface	74/3	74/3	74/3	74/3	74/3
TPI	48	48	48	48	48
BPI	3268	3408/6816	3268	3408/6816	3268
RPM	360	360	360	360	360
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING: Track to track (msec)	50	5	50	5	50
Settling time (msec)	20	35	20	35	20
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	31.25/62.5	31.25	31.25/62.5	31.25
SIZE (Inches: H x W x D)	--	--	--	--	--
FIRST CUSTOMER SHIPMENT	1/81	6/81	10/80	10/80	--
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS			5280 Terminal System.	5280 Terminal System.	5265 Point of Sale Terminal.

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5265-X3X 5265-X4X 5265-X5X 5265-X6X 5265-X7X 5265-X8X	System/34 (43 FD Drive)	System/34 System/38 (Magazine Drive)	3601-2B/3B 3602-1A/1B 3631/3632 (43 FD Drive)	4964 (43 FD Drive)
DISK/TREND GROUP	11	11	11	11	11
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Generic type	Diskette 2D	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1, 2	Diskette 1, 2
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .985088	F: .985088 or F: 1.212416	F: .985088 or F: 1.212416	F: .492544 or F: .568320	F: .492544 or F: .568320 or F: .606208
Capacity per track (Bytes)	F: 6,656	F: 6,656/8,192	F: 6,656/8,192	F: 3,328/3,840	F: 3,328/3,840/ 4,096
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	74/3	74/3	74/3	74/3	74/3
TPI	48	48	48	48	48
BPI	3408/6816	3408/6816	3408/6816	3408	3408
RPM	360	360	360	360	360
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	83.3
Data transfer rate (KBytes/sec)	62.5	31.25/62.5	31.25/62.5	31.25	31.25
SIZE (Inches: H x W x D)	--	--	--	--	--
FIRST CUSTOMER SHIPMENT	--	12/77	1/79 (S/34)	1976 (3601/2)	11/76
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	5265 Point of Sale Terminal.		Capacity is 2 10-diskette magazines and 3 diskettes.	3600 Financial System.	Similar drive included with some 4962 models. Series/1.

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	4965	4966 (Magazine Drive)	8130-All Models 8140-All Models (43 FD Drive)	8101-A10 8101-A11 (43 FD Drive)	5525-020 5525-030 5525-040
DISK/TREND GROUP	11	11	11	11	11
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Generic type	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 2D
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .985088 or F: 1.136640 or F: 1.212416	F: .985088 or F: 1.136640 or F: 1.212416	F: .492544 or F: .985088	F: .492544 or F: .985088	F: 1.212416
Capacity per track (Bytes)	F: 6,656/7,680/ 8,192	F: 6,656/7,680/ 8,192	F: 3,328/6,656	F: 3,328/6,656	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
TPI	48	48	48	48	48
BPI	3408/6816	3408/6816	3408/6816	3408/6816	6816
RPM	360	720	360	360	360
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	41.7	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	62.5/125	31.25/62.5	31.25/62.5	62.5
SIZE (Inches: H x W x D)	--	--	--	--	--
FIRST CUSTOMER SHIPMENT	8/81	2/79	1980	1980	2/80
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	Similar drive included with 4952 Model C. Series/1.	Capacity is 2 10-diskette magazines and 3 diskettes. Series/1.	8100 System.	8100 System.	5520 Administrative System.

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5525-050 (Magazine Drive)	5114 (43 FD Drive)	5120	5322	5246
DISK/TREND GROUP	11	11	11	11	11
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Generic type	Diskette 2D	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1, 2, 2D
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: 1.212416	F: .303104 or F: .606208 or F: 1.212416	F: .303104 or F: .606208 or F: 1.212416	F: .303104 or F: 1.136640	F: .303104 or F: 1.136640
Capacity per track (Bytes)	F: 8,192	F: 4,096/8,192	F: 4,096/8,192	F: 4,096/7,680	F: 4,096/7,680
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	74/3	74/3	74/3	74/3	74/3
TPI	48	48	48	48	48
BPI	6816	3408/6816	3408/6816	3408/6816	3408/6816
RPM	720	360	360	360	360
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)	41.7	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	125	31.25/62.5	31.25/62.5	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	--	--	--	--	--
FIRST CUSTOMER SHIPMENT	11/80	2/78	2/80	8/81	8/81
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	5520 Administrative System.	Add-on drive for 5110, 5120 desktop computers.	Uses "Trim" drive, with smaller dimensions.	Uses "Trim" drive, with smaller dimensions. System/23 Datamaster Desktop Computer.	Add-on drive for 5322. System/23 Datamaster Desktop Computer.

MANUFACTURER	INNOTRONICS	INNOTRONICS	IOMEGA	ISOTIMPEX	ISOTIMPEX
DRIVE	410	420	Alpha 10	ES 5074	Mini Floppy
DISK/TREND GROUP	10	10	14	10	12
MARKET	OEM	OEM	OEM	OEM, Captive	OEM, Captive
MEDIA: Generic type	Diskette 1	Diskette 1	Special	Diskette 1	SA 104 (S) SA 105/107 (H)
Nominal disk diameter	8"	8"	15 mm ID 198 mm OD	8"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	High Energy Coating	Oxide Coated	Oxide Coated
Sectoring	Soft	Hard	Soft	Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .401/.802	U: .401/.802	U: 13.88 F: 10.027	F: .4	U: .1094
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208/10,416	U: 45,360 F: 32,768	F: 3,328	U: 3,125
Data surfaces per spindle	1	1	1	1	1
Tracks per surface	77	77	306	77	35
TPI	48	48	300	48	48
BPI	3268/6536	3268/6536	24000*	3268	2768
RPM	360	360	1500	360	300
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Rotary, Voice Coil	Lead Screw, Stepping Motor	Cam, Stepping Motor
POSITIONING: Track to track (msec)	8	8	12	10	40
Settling time (msec)	8	8	Included	10	10
Head load time (msec)	30	30	Continuous Contact		
Average rotational delay (msec)	83.3	83.3	20	83.3	100
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	1,130	31.25	15.63
SIZE (Inches: H x W x D)	4.38 x 9 x 14	4.38 x 9 x 14	4.62 x 8.55 x 14.25	5.2 x 10.3 x 16.1	3.25 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	2/77	2/77	7/81	1979	1980
U.S. OEM PRICE FOR 500 UNITS	$455	$470	First: $2300 Add'l: $1250	--	--
COMMENTS			*18,000 FCI. Embedded servo.		

MANUFACTURER	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.
DRIVE	JK-890 JK-891	JK-880 JK-881	JK-885 JK-886 JK-888	JK-873 JK-874	JK-875
DISK/TREND GROUP	10	10	11	12	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Diskette 1	Diskette 1	Diskette 1, 2, 2D	SA 104 (S) SA 105/107 (H)	SA 154 (S) SA 155/157 (H)
Nominal disk diameter	8"	8"	8"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .401	U: .401/.802	U: .8/1.6	U: .125/.250	U: .250/.5
Capacity per track (Bytes)	U: 5,208	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	1	2	1	2
Tracks per surface	77	77	77	40	40
TPI	48	48	48	48	48
BPI	3268	3268/6536	3408/6816	2768/5536	2938/5876
RPM	360	360	360	300	300
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Cam, Stepping Motor	Cam, Stepping Motor
POSITIONING: Track to track (msec)	10	8	3	20	20
Settling time (msec)	8	8	15	15	15
Head load time (msec)	35	35	45	75	75
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
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)		JK-881: 4.62 x 8.55 x 14.25	JK-886/888: 4.62 x 8.55 x 14.25	3.25 x 5.75 x 8.25	3.25 x 5.75 x 8.25
FIRST CUSTOMER SHIPMENT	3/76	9/76	12/77	2/79	3Q79
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	Shugart Associates license: SA 900 SA 901	Shugart Associates license: SA 800 SA 801	Shugart Associates license: SA 850 SA 851	Shugart Associates license: SA 400	Shugart Associates license: SA 450

MANUFACTURER	MEMOREX	MEMOREX	MERA METRONEX	MICRO PERIPHERALS	MICRO PERIPHERALS
DRIVE	651	550	PLX45D	41	42
DISK/TREND GROUP	10	10	10	10	11
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	FD/IV	Diskette 1	Diskette 1	Diskette 1	Diskette 1, 2, 2D
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard	Hard/Soft	Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .312	U: .401/.802	U: .401	U: .4/.8	U: .8/1.6
Capacity per track (Bytes)	U: 4,875	U: 5,208/10,416	U: 5,208	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	1	1	1	2
Tracks per surface	64	77	77	77	77
TPI	48	48	48	48	48
BPI	3100	3268/6536	3268	3268/6536	3268/6536
RPM	375	360	360	360	360
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)	10	6	2.5	3	3
Settling time (msec)	10	10	27.5	15	15
Head load time (msec)	40	35	90	35	35
Average rotational delay (msec)	80	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25	31.25/62.5	31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	4.5 x 9 x 14	4.38 x 8.75 x 14.0	8.66 x 12.2 x 12.4	2.0 x 8.55 x 11.5	2.0 x 8.55 x 11.5
FIRST CUSTOMER SHIPMENT	12/72	1/77	1977	9/81	9/81
U.S. OEM PRICE FOR 500 UNITS	$600	$350	--	$395	$500
COMMENTS					

MANUFACTURER	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS
DRIVE	51	91	101	52	92
DISK/TREND GROUP	12	12	12	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 104 (S) SA 105/107 (H)	SA 104 (S) SA 105/107 (H)	Micropolis 1081	SA 154 (S) SA 155/157 (H)	
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .250/.5	U: .240/.480	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	1	2	2
Tracks per surface	40	80	77	40	80
TPI	48	96	100	48	96
BPI	2768/5536	2788/5576	2624/5248	2938/5876	2961/5922
RPM	300	300	300	300	300
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)	15	15	15	15	15
Head load time(msec)	35	35	35	35	35
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	15.63/31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 7.75	3.25 x 5.75 x 7.75	3.25 x 5.75 x 7.75	3.25 x 5.75 x 7.75	3.25 x 5.75 x 7.75
FIRST CUSTOMER SHIPMENT	10/77	4/80	1981	3/79	4/80
U.S. OEM PRICE FOR 500 UNITS	$220	$300	$300	$300	$400
COMMENTS					

MANUFACTURER	MICRO PERIPHERALS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE	102	1015-II	1015-IV	1015-V	1015-VI
DISK/TREND GROUP	13	12	13	12	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Micropolis 1081	Micropolis 1081	Micropolis 1081	Micropolis 1081	Micropolis 1081
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .480/.960	U: .480	U: .960	U: .5	U: 1.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	1	2	1	2
Tracks per surface	77	77	77	80	80
TPI	100	100	100	96	96
BPI	2776/5552	5248	5248	5248	5248
RPM	300	300	300	300	300
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	10	10	10	10
Settling time (msec)	15	15	15	15	15
Head load time(msec)	35	75	75	75	75
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 7.75	3.375 x 5.875 x 8.5	3.375 x 5.875 x 8.5	3.375 x 5.875 x 8.5	3.375 x 5.875 x 8.5
FIRST CUSTOMER SHIPMENT	1981	3/77	8/78	2Q80	2Q80
U.S. OEM PRICE FOR 500 UNITS	$400	$271	$321	$271	$320
COMMENTS					

MANUFACTURER	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE	1016-II	1016-IV	1041-I 1042-I	1021-I 1022-I	1041-II 1043-II 1053-II 1054-II
DISK/TREND GROUP	12	13	12	12	12
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Micropolis 1081	Micropolis 1081	SA 105	SA 105	Micropolis 1081
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Hard	Hard	Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .585	U: 1.170	F: .143	F: .143	F: .315
Capacity per track (Bytes)	U: 7,600	U: 7,600	F: 4,096	F: 4,096	F: 4,096
Data surfaces per spindle	1	2	1	1	1
Tracks per surface	77	77	35	35	77
TPI	100	100	48	48	100
BPI	6380 GCR	6380 GCR	5162	5162	5162
RPM	300	300	300	300	300
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)	10	10	10	10	10
Settling time (msec)	15	15	15	15	15
Head load time (msec)	75	75	75	75	75
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	38.0	38.0	31.25	31.25	31.25
SIZE (Inches: H x W x D)	3.375 x 5.875 x 8.5	3.375 x 5.875 x 8.5			4.0 x 5.9 x 12.2
FIRST CUSTOMER SHIPMENT	6/78	9/78	1/78	1/78	3/77
U.S. OEM PRICE FOR 500 UNITS	$284	$335	--	--	--
COMMENTS			S-100 subsystems.	S-100 subsystem add-on drives.	S-100 subsystems.

MANUFACTURER	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE	1021-II 1023-II 1033-II	1117-II	1117-IV	1117-V	1117-VI
DISK/TREND GROUP	12	12	13	12	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Micropolis 1081	Special High Density	Special High Density	Special High Density	Special High Density
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .315	U: 1.2	U: 2.175	U: 1.1125	U: 2.025
Capacity per track (Bytes)	F: 4,096	U: 12,500	U: 12,500	U: 12,500	U: 12,500
Data surfaces per spindle	1	1	2	1	2
Tracks per surface	77	96	87	89	81
TPI	100	100	100	96	96
BPI	5162	11,997	11,937	11,937	11,937
RPM	300	300	300	300	300
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)	10	6	6	6	6
Settling time (msec)	15	15	15	15	15
Head load time(msec)	75	50	50	50	50
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	62.5	62.5	62.5	62.5
SIZE (Inches: H x W x D)	4.0 x 5.9 x 12.2	3.375 x 5.875 x 8.25	3.375 x 5.875 x 8.25	3.375 x 5.875 x 8.25	3.375 x 5.875 x 8.25
FIRST CUSTOMER SHIPMENT	3/77	4Q81	4Q81	4Q81	4Q81
U.S. OEM PRICE FOR 500 UNITS	--	$330	$390	$330	$390
COMMENTS	S-100 subsystem add-on drives.				

MANUFACTURER	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MILTOPE
DRIVE	1055-II 1035-II	1055-IV 1035-IV	SBC-55-II SBC-16-II	SBC-55-IV SBC-16-IV	DD 400
DISK/TREND GROUP	12	13	12	13	10
MARKET	OEM				OEM
MEDIA: Generic type	Micropolis 1081	Micropolis 1081	Micropolis 1081	Micropolis 1081	Diskette 1
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .473	F: .946	F: .394	F: .788	U: .401/.802
Capacity per track (Bytes)	F: 6,144	F: 6,144	F: 5,360	F: 5,360	U: 5,208/10,416
Data surfaces per spindle	1	2	1	2	1
Tracks per surface	77	77	77	77	77
TPI	100	100	100	100	48
BPI	6380 GCR	6380 GCR	6380 GCR	6380 GCR	3268/6536
RPM	300	300	300	300	360
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)	10	10	10	10	6
Settling time (msec)	15	15	15	15	10
Head load time (msec)	75	75	75	75	16
Average rotational delay (msec)	100	100	100	100	83.3
Data transfer rate (KBytes/sec)	38.0	38.0	38.0	38.0	31.25/62.5
SIZE (Inches: H x W x D)			--	--	5.44 x 8.44 x 18.0
FIRST CUSTOMER SHIPMENT	6/78	9/78	--	--	1977
U.S. OEM PRICE FOR 500 UNITS	$1126 (Dual)	$1400 (Dual)	--	--	$4800
COMMENTS	Subsystem 1035: Add-on.	Subsystem 1035: Add-on.	Intel subsystems.	Intel subsystems.	Sold as militarized subsystem.

MANUFACTURER	MILTOPE	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	NIPPON ELECTRIC COMPANY
DRIVE	DD 450	M892	M2893	M2894	N7707
DISK/TREND GROUP	11	10	11	11	11
MARKET	OEM	OEM, Captive	OEM, Captive	OEM, Captive	Captive
MEDIA: Generic type	Diskette 2, 2D	Diskette 1	Diskette 2	Diskette 2D	Diskette 2D
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .8/1.6	U: .401	U: .802	U: 1.6	F: 1.0
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208	U: 5,208	U: 10,416	F: 6,656
Data surfaces per spindle	2	1	2	2	2
Tracks per surface	77	77	77	77	77
TPI	48	48	48	48	48
BPI	3408/6816	3268	3408	6816	6816
RPM	360	360	360	360	360
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING: Track to track (msec)	5	7	3	3	5
Settling time (msec)	10	23	15	15	15
Head load time (msec)	16	50	35	35	50
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	31.25	31.25	62.5	62.5
SIZE (Inches: H x W x D)	5.44 x 8.44 x 18.0	4-3/4 x 8-1/3 x 14-1/8	4-5/8 x 8-1/2 x 14-1/8	4-5/8 x 8-1/2 x 14-1/8	
FIRST CUSTOMER SHIPMENT	1980	1974	1978	1978	12/78
U.S. OEM PRICE FOR 500 UNITS	$5600	--	--	$475	--
COMMENTS	Sold as militarized subsystem.				

MANUFACTURER	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NORTHERN TELECOM	OLIVETTI	OLIVETTI
DRIVE	FD 1160	FD 1165	4505	FD 801	FD 802
DISK/TREND GROUP	11	11	10	10	11
MARKET	OEM, Captive	OEM, Captive	Captive	OEM	OEM
MEDIA: Generic type	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1	Diskette 1	Diskette 2, 2D
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide	Oxide
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .8/1.6	U: .8/1.6	F: .243	U: .401/.802	U: .8/1.6
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208/10,416	F: 3,328	U: 5,208	U: 5,208/10,416
Data surfaces per spindle	2	2	1	1	2
Tracks per surface	77	77	77	77	77
TPI	48	48	48	48	48
BPI	3406/6816	3406/6816	3268	3408/6816	3408/6816
RPM	360	360	360	360	360
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Stepping Motor, Band	Stepping Motor, Band
POSITIONING: Track to track (msec)	5	5	2.5	3	3
Settling time (msec)	15	15	25	15	15
Head load time (msec)	50	50	30	35	35
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	4.62 x 8.68 x 14.45	2.28 x 8.68 x 13.19	--	4.52 x 9.05 x 12.3	4.52 x 9.05 x 12.3
FIRST CUSTOMER SHIPMENT	8/81	4Q81	1975	1974	1979
U.S. OEM PRICE FOR 500 UNITS	$470	--	--	$270	$385
COMMENTS					

MANUFACTURER	OLIVETTI	OLIVETTI	OLIVETTI	PER SCI, INC.	PER SCI, INC.
DRIVE	FD 501	FD 502	FD 258	277	299B
DISK/TREND GROUP	12	13	14	10	11
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 104	SA 154	Olivetti 2.5" Disk	Diskette 1	Diskette 1, 2, 2D
Nominal disk diameter	5.25"	5.25"	2.5"	8"	8"
Magnetic surface	Oxide	Oxide	Oxide	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	N/A	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .250/.5	U: .008	U: .401/.802	U: .8/1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 8,000	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	2	1	1	2
Tracks per surface	40	40	1	77	77
TPI	48	48	N/A	48	48
BPI	2768/5536	2893/5786	980	3268/6536	3268/6536
RPM	300	300	Variable	360	360
Actuator type	Stepping Motor, Cam	Stepping Motor, Cam	N/A	Linear, Voice Coil	Linear, Voice Coil
POSITIONING: Track to track (msec)	25	25	N/A	1.2	1.2
Settling time (msec)	20	20	N/A	8.8	8.8
Head load time (msec)	60	60	N/A	40	40
Average rotational delay (msec)	100	100	N/A	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	2.5	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	2.51 x 5.75 x 8	2.51 x 5.75 x 8	3.5 x 6 x 7.75	4.4 x 8.6 x 15.0	4.38 x 8.72 x 15.4
FIRST CUSTOMER SHIPMENT	1980	1981	1977	3Q77	6/78
U.S. OEM PRICE FOR 500 UNITS	$170	$200	--	$1050 (Dual)	$1600 (Dual)
COMMENTS			8 KBytes in single spiral track of 78".	Dual drive, single head positioning mechanism.	Dual drive, single head positioning mechanism.

MANUFACTURER	PER SCI, INC.	PER SCI, INC.	PERTEC	PERTEC	PERTEC
DRIVE	699	899	FD 511A FD 514 FD 510	FD 410	FD 650
DISK/TREND GROUP	11	11	10	10	11
MARKET	OEM	OEM	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Generic type	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1	Diskette 1	Diskette 1, 2, 2D
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	*	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: 1.6/3.2	F: 1.888/3.776	U: .401/.802	U: .401/.802	U: .8/1.6
Capacity per track (Bytes)	U: 5,208/10,416	F: 4,096/8,192	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	2	2	1	1	2
Tracks per surface	154	231	77	77	77
TPI	96	144/150	48	48	48
BPI	3268/6536	3268/6536	3268/6536	3268/6536	3408/6816
RPM	360	360	360	360	360
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING: Track to track (msec)	1.0	0.4	10	10	3
Settling time (msec)	6.5	7	20	20	15
Head load time (msec)	40	40	40	40	35
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
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)	4.38 x 8.72 x 15.4	4.38 x 8.72 x 15.4	3.45 x 8.6 x 14.9	3.45 x 8.6 x 14.9	4.5 x 8.55 x 14.0
FIRST CUSTOMER SHIPMENT	4Q81	1982			1/79
U.S. OEM PRICE FOR 500 UNITS	$1650 (Dual)	$1950 (Dual)	See Below	$490	$560
COMMENTS	Dual drive, single head positioning mechanism.	Dual drive, single head positioning mechanism. *Embedded servo.	FD 511A: $500 FD 514: $485 FD 470: $470	DC power.	

MANUFACTURER	PERTEC	PERTEC	PHILIPS DATA SYSTEMS	QUME	QUME
DRIVE	FD 200	FD 250	H1100	Qumetrak 842	Qumetrak 842 DC
DISK/TREND GROUP	12	13	13	11	11
MARKET	OEM, Captive	OEM, Captive	OEM	OEM	OEM
MEDIA: Generic type	SA 104 (S) SA 105/107 (H)	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)	Diskette 1, 2, 2D	Diskette 1, 2, 2D
Nominal disk diameter	5.25"	5.25"	5.25"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .219/.438	U: 437.5	U: .8/1.6	U: .8/1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 6,250	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	2	2	2	2
Tracks per surface	40	35	35	77	77
TPI	48	48	48	48	48
BPI	2768/5536	2768/5536	5456	3408/6816	3408/6816
RPM	300	300	300	360	360
Actuator type	Cam, Stepping Motor	Cam, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING: Track to track (msec)	25	25	5	3	3
Settling time (msec)	10	10	15	15	15
Head load time (msec)	35	35	30	35	35
Average rotational delay (msec)	100	100	100	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	2.26 x 5.9 x 8.37	8.55 x 4.62 x 14.57	8.55 x 4.62 x 14.57
FIRST CUSTOMER SHIPMENT	12/77	1/79	4Q80	1Q79	3Q81
U.S. OEM PRICE FOR 500 UNITS	$200	$305	--	$475	--
COMMENTS					

MANUFACTURER	QUME	REMEX	REMEX	REMEX	REMEX
DRIVE	Qumetrak 542	RFD 2000 RFD 2001	RFS 2400	20	24
DISK/TREND GROUP	13	10	10	10	10
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 154	Diskette 1	Diskette 1	Diskette 1	Diskette 1
Nominal disk diameter	5.25"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Hard/Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .401/.802	26 Sectors: F: .256/.512	26 Sectors: U: .256/.512	26 Sectors: U: .256/.512
Capacity per track (Bytes)	U: 3,125/6,250	U: 5,208/10,416	F: 3,328/6,656	F: 3,328/6,656	F: 3,328/6,656
Data surfaces per spindle	2	1	1	1	1
Tracks per surface	40	77	77	77	77
TPI	48	48	48	48	48
BPI	2768/5536	3268/6536	3268/6536	3268/6536	3268/6536
RPM	300	360	360	360	360
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	12	3	3	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	50	35	35	35	35
Average rotational delay (msec)	100	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	31.25/62.5	31.25/62.5	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	5.75 x 3.25 x 8.00	4.62 x 8.55 x 14.0	4.62 x 8.55 x 14.0	5.22 x 19.0 x 21.32	5.22 x 19.0 x 21.32
FIRST CUSTOMER SHIPMENT	4Q79	1Q79	1979	1979	1980
U.S. OEM PRICE FOR 500 UNITS	$268	$380	2410: $762 2420: $342	$1296 (Dual)	$1649 (Dual)
COMMENTS			Subsystem Master: 2410 Add-On: 2420	Subsystem with two drives.	Subsystem with two drives.

MANUFACTURER	REMEX	REMEX	REMEX	REMEX	REMEX
DRIVE	RFD 4000 RFD 4001	RFS 4800	40	48	PICO RFD 961
DISK/TREND GROUP	11	11	11	11	12
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1, 2, 2D	Diskette 1, 2, 2D	SA 104 (S) SA 105/107 (H)
Nominal disk diameter	8"	8"	8"	8"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Soft	Soft	Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .8/1.6	26 Sectors: F: .512/1.025	26 Sectors: F: .512/1.025	26 Sectors: F: .512/1.025	U: .250/.5
Capacity per track (Bytes)	U: 5,208/10,416	F: 3,328/6,658	F: 3,328/6,658	F: 3,328/6,658	U: 3,125/6,250
Data surfaces per spindle	2	2	2	2	1
Tracks per surface	77	77	77	77	80
TPI	48	48	48	48	96
BPI	3408/6816	3408/6816	3408/6816	3408/6816	2788/5576
RPM	360	360	360	360	300
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	5
Settling time (msec)	15	15	15	15	25
Head load time(msec)	35	35	35	35	*
Average rotational delay (msec)	83.3	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)	4.62 x 8.55 x 14.0	4.62 x 8.55 x 14.0	5.22 x 19.0 x 21.32	5.22 x 19.0 x 21.32	2.11 x 5.75 x 8.0**
FIRST CUSTOMER SHIPMENT	1Q79	1979	1979	1980	2/82
U.S. OEM PRICE FOR 500 UNITS	$465	4810: $795 4820: $505	$1323 (Dual)	$1799 (Dual)	--
COMMENTS		Subsystem Master: 4810 Add-On: 4820	Subsystem with two drives.	Subsystem with two drives.	*Heads in continuous contact. **Available physically interchange-able with SA 400.

MANUFACTURER	REMEX	REMEX	RICOH	RICOH	SANKYO SEIKI
DRIVE	PICO RFD 480	PICO RFD 960	RD-2	RD-2D	FMC-100
DISK/TREND GROUP	13	13	10	11	14
MARKET	OEM	OEM	Captive	Captive	OEM
MEDIA: Generic type	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)	Diskette 1	Diskette 1, 2, 2D	Special Disk
Nominal disk diameter	5.25"	5.25"	Soft	Soft	2.598"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Soft	Soft	N/A
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	F: .225	F: .568 or F: .985	F: .008
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	F: 3,040	F: 3,840/6,656	F: 8,000
Data surfaces per spindle	2	2	1	2	1
Tracks per surface	40	80	74/3	74/3	1
TPI	48	96	48	48	N/A
BPI	2938/5876	2961/5922	3268	3408/6816	1069
RPM	300	300	360	360	405
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Lead Screw	Lead Screw	N/A
POSITIONING: Track to track (msec)	5	5	6	6	N/A
Settling time (msec)	25	25	10	10	N/A
Head load time (msec)	*	*	50	50	N/A
Average rotational delay (msec)	100	100	83.3	83.3	N/A
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	31.25	31.25/62.5	2
SIZE (Inches: H x W x D)	2.11 x 5.75 x 8.0**	2.11 x 5.75 x 8.0**			1.96 x 2.95 x 4.88
FIRST CUSTOMER SHIPMENT	11/81	11/81	12/79	12/79	8/80
U.S. OEM PRICE FOR 500 UNITS	$299	$350	--	--	$212
COMMENTS	*Heads in continuous contact. **Available physically interchangeable with SA 400.	*Heads in continuous contact. **Available physically interchangeable with SA 400.	TX 220 Word Processing System; DE 2000 Business System.	TC 2200 TC 2400 Small Business Systems.	8,000 bytes in single spiral track.

MANUFACTURER	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SHUGART ASSOCIATES
DRIVE	SA 800 SA 801	SA 850 SA 851	SA 210	SA 400	SA 410
DISK/TREND GROUP	10	11	12	12	12
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive	OEM
MEDIA: Generic type	SA 100/1/2/3 Diskette 1	SA 150/SA 151 Diskette 1/2/2D	SA 104	SA 104 (S) SA 105/107 (H)	SA 104 (S) SA 105/107 (H)
Nominal disk diameter	8"	8"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .401/.802	U: .8/1.6	U: .110/.220	U: .125/.250	U: .250/.5
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	1	2	1	1	1
Tracks per surface	77	77	35	40	80
TPI	48	48	48	48	96
BPI	3268/6536	3408/6816	2581/5162	2768/5536	2788/5576
RPM	360	360	300	300	300
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Cam, Stepping Motor	Cam, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING: Track to track(msec)	8	3	100	20	6
Settling time (msec)	8	15	20	15	10
Head load time(msec)	35	45	*	75	*
Average rotational delay (msec)	83.3	83.3	100	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	SA 801: 4.62 x 8.55 x 14.25	SA 851: 4.62 x 8.55 x 14.25	2.05 x 5.75 x 7.72	3.25 x 5.75 x 8.25	3.25 x 5.75 x 8.25
FIRST CUSTOMER SHIPMENT	9/75	6/77	4Q81	9/76	2/81
U.S. OEM PRICE FOR 500 UNITS	$360	$520	--	$200	$285
COMMENTS			*Heads in continuous contact.		*Heads in continuous contact.

MANUFACTURER	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SIEMENS	SIEMENS	SIEMENS
DRIVE	SA 450	SA 460	FDD 100-8	FDD 200-8	FDD 100-5
DISK/TREND GROUP	13	13	10	11	12
MARKET	OEM, Captive	OEM	OEM, Captive	OEM, Captive	OEM
MEDIA: Generic type	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)	Diskette 1	Diskette 1, 2, 2D	SA 104 (S) SA 105/107 (H)
Nominal disk diameter	5.25"	5.25"	8"	8"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: .401/.802	U: .8/1.6	U: .125/.250
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250
Data surfaces per spindle	2	2	1	2	1
Tracks per surface	40	80	77	77	40
TPI	48	96	48	48	48
BPI	2938/5876	2961/5922	3268/6536	3408/6816	2768/5536
RPM	300	300	360	360	300
Actuator type	Cam, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING: Track to track (msec)	20	6	6	3	20
Settling time (msec)	15	10	8	15	15
Head load time (msec)	75	*	25	25	50
Average rotational delay (msec)	100	100	83.3	83.3	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	31.25/62.5	31.25/62.5	15.63/31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.25	3.25 x 5.75 x 8.25	4.5 x 8.55 x 14.25	4.5 x 8.55 x 14.25	3.25 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1/80	3/81	1975	4/78	3/77
U.S. OEM PRICE FOR 500 UNITS	$285	$355	$355	$480	$210
COMMENTS		*Heads in continuous contact.			

MANUFACTURER	SIEMENS	SIEMENS	SIEMENS	SIEMENS	SIEMENS
DRIVE	FDD 111-5A	FDD 111-5B	FDD 196-5	FDD 121-5A	FDD 121-5B
DISK/TREND GROUP	12	12	12	12	12
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 104 (S) SA 105/107 (H)	SA 104 (S) SA 105/107 (H)	SA 104 (S) SA 105/107 (H)	SA 104 (S) SA 105/107 (H)	SA 104 (S) SA 105/107 (H)
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .125/.250	U: .250/.5	U: .250/.5	U: .250/.5
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	1	1	1
Tracks per surface	40	40	40	80	80
TPI	48	48	96	96	96
BPI	2768/5536	2768/5536	2788/5576	2788/5576	2788/5576
RPM	300	300	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	5	5	10	5	5
Settling time (msec)	15	15	15	15	15
Head load time(msec)	35*	35*	50	35*	35*
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	15.63/31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 7.5	2.11 x 5.75 x 7.5	3.25 x 5.75 x 8.25	2.11 x 5.75 x 7.5	2.11 x 5.75 x 7.5
FIRST CUSTOMER SHIPMENT	8/81	8/81	1/81	1/82	1/82
U.S. OEM PRICE FOR 500 UNITS	$210	$210	$260	$260	--
COMMENTS	*Option of heads in continuous contact.	*Option of heads in continous contact.		*Option of heads in continuous contact.	*Option of heads in continuous contact.

MANUFACTURER	SIEMENS	SIEMENS	SIEMENS	SIEMENS	SIEMENS
DRIVE	FDD 200-5	FDD 211-5A	FDD 211-5B	FDD 296-5	FDD 221-5A
DISK/TREND GROUP	13	13	13	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .250/.5	U: .250/.5	U: .5/1.0	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	2	2	2	2	2
Tracks per surface	40	40	40	80	80
TPI	48	48	48	96	96
BPI	2938/5876	2938/5876	2938/5876	2872/5744	2872/5744
RPM	300	300	300	300	300
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor
POSITIONING: Track to track (msec)	20	5	5	10	5
Settling time (msec)	15	15	15	15	15
Head load time (msec)	50	35*	35*	50	35*
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	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 7.5	2.11 x 5.75 x 7.5	3.25 x 5.75 x 8.25	3.25 x 5.75 x 7.5
FIRST CUSTOMER SHIPMENT	5/78	1/82	1/82	3/81	8/81
U.S. OEM PRICE FOR 500 UNITS	$260	$260	$260	$350	$350
COMMENTS		*Option of heads in continuous contact.	*Option of heads in continuous contact.		*Option of heads in continuous contact.

MANUFACTURER	SIEMENS	SONY	SYKES DATATRONICS	SYKES DATATRONICS	TANDON
DRIVE	FDD 221-5B	OA-D30V	7150 (Single) 7250 (Dual)	9150 (Single) 9250 (Dual)	TM 848-1
DISK/TREND GROUP	13	14	10	10	10
MARKET	OEM	OEM	OEM, Captive	OEM, Captive	OEM
MEDIA: Generic type	SA 154 (S) SA 155/157 (H)	Sony OM-D30V	Diskette 1	Diskette 1	Diskette 1
Nominal disk diameter	5.25"	3.5"	8"	8"	8"
Magnetic surface	Oxide Coated	Cobalt-Modified Oxide Coating	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Soft	Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .5/1.0	U: 218.8/437.5	F: .256	F: .631	U: .401/.802
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	F: 3,328	F: 8,192	U: 5,208/10,416
Data surfaces per spindle	2	1	1	1	1
Tracks per surface	80	70	77	77	77
TPI	96	135	48	48	48
BPI	2872/5744	3805/7610	3268	6536	3268/6536
RPM	300	600	360	360	360
Actuator type	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor
POSITIONING: Track to track (msec)	5	15	6	6	3
Settling time (msec)	15	15	30	30	15
Head load time (msec)	35*	35*	30	30	*
Average rotational delay (msec)	100	50	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	31.25/62.5	31.25	62.5	31.25/62.5
SIZE (Inches: H x W x D)	2.11 x 5.75 x 7.5	2.0 x 4.0 x 5.1	5.25 x 17.0 x 26.0	5.25 x 17.0 x 26.0	2.3 x 8.55 x 13.25
FIRST CUSTOMER SHIPMENT	8/81	11/81	9/74	10/76	4/81
U.S. OEM PRICE FOR 500 UNITS	--	$265	--	--	$375
COMMENTS	*Option of heads in continuous contact.				D.C. drive. *Heads in continuous contact.

MANUFACTURER	TANDON	TANDON	TANDON	TANDON	TANDON
DRIVE	TM-848-2	TM-100-1	TM-100-3	TM-100-3M	TM-50-1
DISK/TREND GROUP	11	12	12	12	12
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Diskette 1, 2, 2D	SA 104 (S) SA 105/107 (H)	SA 104 (S) SA 105/107 (H)	Micropolis 1081	SA 104 (S) SA 105/107 (H)
Nominal disk diameter	8"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .8/1.6	U: .125/.250	U: .250/.5	U: .240/.480	U: .125/.250
Capacity per track (Bytes)	U: 5,208/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	1	1	1	1
Tracks per surface	77	40	80	77	40
TPI	48	48	96	100	48
BPI	3406/6816	2768/5535	2768/5535	2653/5305	2768/5536
RPM	360	300	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING: Track to track (msec)	3	5	3	3	35
Settling time (msec)	15	15	15	15	20
Head load time (msec)	*	*	*	*	*
Average rotational delay (msec)	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	15.63/31.25
SIZE (Inches: H x W x D)	2.3 x 8.55 x 13.25	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	4/81	11/78	2/80	2/80	1Q82
U.S. OEM PRICE FOR 500 UNITS	$430	$200	$275	$275	--
COMMENTS	D.C. drive. *Heads in continuous contact.	*Heads in continuous contact.	*Heads in continuous contact.	*Heads in continuous contact.	*Heads in continuous contact.

MANUFACTURER	TANDON	TANDON	TANDON	TANDON	TEAC CORPORATION
DRIVE	TM-50-2	TM-100-2	TM-100-4	TM-100-4M	FD-50A
DISK/TREND GROUP	13	13	13	13	12
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)	Micropolis 1081	SA 104 (S) SA 105/107 (H)
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .250/.5	U: .5/1.0	U: .480/.960	U: .125/.250
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	2	2	2	2	1
Tracks per surface	40	40	80	77	40
TPI	48	48	96	100	48
BPI	2938/5876	2938/5877	2938/5877	2725/5450	2768/5536
RPM	300	300	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	35	5	3	3	25
Settling time (msec)	20	15	15	15	10
Head load time(msec)	*	*	*	*	35
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	15.63/31.25
SIZE (Inches: H x W x D)	1.625 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	3.25 x 5.75 x 7.99
FIRST CUSTOMER SHIPMENT	1Q82	11/78	2/80	2/80	4Q78
U.S. OEM PRICE FOR 500 UNITS	--	$275	$350	$350	$185
COMMENTS	*Heads in continuous contact.	*Heads in continuous contact.	*Heads in continuous contact.	*Heads in continuous contact.	

MANUFACTURER	TEAC CORPORATION	TEAC CORPORATION	TEAC CORPORATION	TEAC CORPORATION	TOSHIBA CORPORATION
DRIVE	FD-50B	FD-50C	FD-50E	FD-50F	ND-10S
DISK/TREND GROUP	13	12	12	13	10
MARKET	OEM	OEM	OEM	OEM	OEM, Captive
MEDIA: Generic type	SA 154 (S) SA 155/157 (H)	SA 104 (S) SA 105/107 (H)	SA 104 (S) SA 105/107 (H)	SA 154 (S) SA 155/157 (H)	Diskette 1
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .2406/.4812	U: .250/.5	U: .5/1.0	U: .4
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: 5,208
Data surfaces per spindle	2	1	1	2	1
Tracks per surface	40	77	80	80	77
TPI	48	100	96	96	48
BPI	2938/5876	2623/5246	2788/5576	2961/5922	3268
RPM	300	300	300	300	360
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)	25	25	25	10	3
Settling time (msec)	10	10	10	15	18
Head load time (msec)	35	35	35	35	50
Average rotational delay (msec)	100	100	100	100	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 7.99	3.25 x 5.75 x 7.99	3.25 x 5.75 x 7.99	3.25 x 5.75 x 7.99	4.9 x 10.0 x 14.4
FIRST CUSTOMER SHIPMENT	6/81	4Q79	2Q80	6/81	1977
U.S. OEM PRICE FOR 500 UNITS	$290	$250	$250	$370	--
COMMENTS					

MANUFACTURER	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	VIDEOTON INDUSTRIE-AUSSENHALDELS	VIDEOTON INDUSTRIE-AUSSENHALDELS
DRIVE	ND-20D ND-20DL	ND-01	ND-02D	MFM-2 MFM-4	Momflex 3200
DISK/TREND GROUP	11	12	13	10	10
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	OEM	OEM
MEDIA: Generic type	Diskette 1, 2, 2D	SA 104	SA 154	Diskette 1	Diskette 1
Nominal disk diameter	8"	5.25"	5.25"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide	Oxide
Sectoring	Soft	Soft	Soft	Soft	Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .8/1.6	U: .1094	U: .2188/.4375	F: .256	U: .401
Capacity per track (Bytes)	U: 5,208	U: 3,125	U: 3,125/6,250	F: 3,328	U: 5,208
Data surfaces per spindle	2	1	2	1	1
Tracks per surface	77	35	35	77	77
TPI	48	48	48	48	48
BPI	3408/6816	2728	2728/5456	3268	3268
RPM	360	300	300	360	360
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)	3	25	25	10	10
Settling time (msec)	18	15	15	40	25
Head load time (msec)	50	50	50	40	40
Average rotational delay (msec)	83.3	100	100	83.3	83.3
Data transfer rate (KBytes/sec)	31.25	15.62	15.62/31.25	31.25	31.25
SIZE (Inches: H x W x D)	4.9 x 10.0 x 14.4	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	10.5 x 19.0 x 22.0	5.28 x 8.5 x 14.8
FIRST CUSTOMER SHIPMENT	1977	1Q80	1Q80	1977	1978
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	VIDEOTON INDUSTRIE-AUSSENHALDELS	VIDEOTON INDUSTRIE-AUSSENHALDELS	YE DATA, INC.	YE DATA, INC.	YE DATA, INC.
DRIVE	Momflex 6400	Momflex 900	YD-74C	YD-174D	YD-180
DISK/TREND GROUP	10	12	10	11	11
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Diskette 1	SA 104 (S) SA 105/107 (H)	Diskette 1	Diskette 1, 2, 2D	Diskette 1, 2, 2D
Nominal disk diameter	8"	5.25"	8"	8"	8"
Magnetic surface	Oxide	Oxide	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .802	U: 109.4	U: .401	U: .8/1.6	U: .8/1.6
Capacity per track (Bytes)	U: 10,416	U: 3,125	U: 5,208	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	1	1	2	2
Tracks per surface	77	35	77	77	77
TPI	48	48	48	48	48
BPI	6536	2616	3268	3408/6816	3408/6816
RPM	360	300	360	360	360
Actuator type	Stepping Motor	Cam, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING: Track to track(msec)	4	40	9	3	3
Settling time (msec)	25	10	20	15	15
Head load time(msec)	40	75	35	35	35
Average rotational delay (msec)	83.3	100	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	62.5	15.63	31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	4.4 x 8.5 x 14.7	3.27 x 5.75 x 8.0	4.5 x 9.0 x 14.1	4.5 x 8.55 x 14.57	2.24 x 8.54 x 12.6
FIRST CUSTOMER SHIPMENT	1980	1980	10/73	1977	8/81
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					DC drive.

MANUFACTURER	YE DATA, INC.	YE DATA, INC.			
DRIVE	YD-274	YD-280			
DISK/TREND GROUP	13	13			
MARKET	OEM	OEM			
MEDIA: Generic type	SA 154 (S) SA 155/157 (H)	SA 154 (S) SA 155/157 (H)			
Nominal disk diameter	5.25"	5.25"			
Magnetic surface	Oxide Coated	Oxide Coated			
Sectoring	Hard/Soft	Hard/Soft			
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0			
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250			
Data surfaces per spindle	2	2			
Tracks per surface	40	80			
TPI	48	96			
BPI	2938/5876	2961/5922			
RPM	300	300			
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor			
POSITIONING: Track to track (msec)	20	3			
Settling time (msec)	15	15			
Head load time (msec)	50	50			
Average rotational delay (msec)	100	100			
Data transfer rate (KBytes/sec)	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			
FIRST CUSTOMER SHIPMENT	1/79	8/81			
U.S. OEM PRICE FOR 500 UNITS	--	--			
COMMENTS					

MANUFACTURER PROFILES

1981 DISK/TREND REPORT

MANUFACTURER PROFILES

All manufacturers now producing flexible disk drives, or which have indicated specific plans to enter the market, are listed in this section. The heading "FDD sales" refers only to the DISK/TREND estimate of sales of flexible disk drives -- no sales of other drive types are included, nor are sales of parts or other related products. "1980 total net sales" covers the fiscal year ending in 1980 for each listed firm, or for the parent company if the disk drive manufacturer is a subsidiary. Northern Telecom is listed with U.S. firms for convenience.

U.S. Manufacturers

AMLYN CORPORATION
1758-H Junction Avenue
San Jose, CA 95112 408/275-8616

1980 FDD sales: None

Amlyn was formed in October, 1980, to develop and manufacture a high density floppy drive which uses five 5.25 inch spin coated diskettes in a plastic cartridge. With a capacity of up to 1.6 MB unformatted, the drive is interface compatible with either the Seagate 5.25 inch Winchester drive or the Shugart Associates SA 850 two sided 8 inch floppy drive. Track capacity and tracks per surface are also matched to these drives. Amlyn is supplying evaluation units in 4th quarter of 1981 and expects to be in production in the first half of 1982. Founders of the firm have experience at Dysan and other California high technology companies, and seed money for the development program came from Dysan and a venture capital firm. Media will be available from Dysan and Brown Disk Manufacturing, a new firm in Colorado Springs which will offer compatible spin coated diskettes. Amlyn's drive is well timed for the spectacular growth expected from 5.25 Winchesters, and its product design provides the features needed to back up these drives. If the company is successful in its plans to license additional sources for the hardware, and if its management starts up volume production without hitches, Amlyn's product could be very influential in the industry.

BURROUGHS CORPORATION
Burroughs Place
Detroit, MI 48232 313/972-7000

1980 FDD sales: $26,200,000
1980 total net sales: $2,857,186,000 Net income: $81,972,000

Burroughs started manufacturing floppy drives in 1976, with an 8 inch, two sided drive in a unique design. This one megabyte drive avoided the media wear problems other early two sided drives experienced by using a pressure pad opposite each recording head, instead of the IBM approach in which heads on each side of the diskette directly oppose each other. In 1980, Burroughs started shipments of another unique floppy drive, which uses a single voice coil actuator to position heads on two 8 inch diskettes, each with 3 MB capacity. The modified closed loop system records at 150 TPI. The new drive is used on Burroughs small business systems, and has also been offered as an OEM drive. To date, the OEM version appears to have attracted few customers, due to high price and lack of alternate sources.

CALDISK
Subsidiary of Billing Energy Corporation
2000 East Billings Avenue
Provo, UT 84111 801/375-0000

1980 FDD sales: $7,800,000
1980 total net sales: $11,600,000 Net income: ($2,171,000)

Billings Computer Corporation, a subsidiary of Billings Energy Corporation, acquired the Calcomp flexible disk drive product line in 1979. During the past year, production was moved to the parent company's facilities at Provo, Utah, and 5.25 inch floppy drives added to the line in recent years were dropped. Drives are used with Billings computers, and sales in the OEM market have been continued.

CONTROL DATA CORPORATION
8100 - 34th Avenue South
Minneapolis, MN 55440 612/853-8100

1980 FDD sales: $41,800,000
1980 total net sales: $2,790,500,000 Net income: $150,600,000

Although Control Data is the run-away leader in OEM rigid disk revenues, the firm has never achieved similar preeminence in flexible disk drives. Nevertheless, CDC is ranked among the majors, and its shipments are growing. During 1980, 5.25 inch one and two sided drives were added, and a 96 TPI version of the two sided drive was added in 1981. Floppy drives credited to CDC in DISK/TREND statistics are manufactured by Magnetic Peripherals, Inc., a firm jointly owned by CDC and Honeywell, with management by CDC. Drives sold by either parent company with their own systems are considered captive drives, and are included in the CDC total, as the manager of the joint venture company.

DATA MASTER, INC.
389 North Carmen Drive
Camarillo, CA 93010 805/498-8466

1980 FDD sales: None

Data Master was formed in 1980 by Ko Ko Gyi, a veteran of advanced rigid and flexible disk drive development programs at Burroughs. The firm announced one and two sided versions of a 96 TPI dual 5.25 inch drive in 1980, but that drive design has been dropped. The company is now redesigning the drive for higher density, and will aim at the 5.25 inch Winchester backup market, with a new introduction in 1982.

DATAPOINT CORPORATION
9725 Datapoint Drive
San Antonio, TX 78285 515/699-7000

1980 FDD sales: $15,000,000
1980 total net sales: $318,826,000 Net income: $33,478,000

Datapoint has manufactured captive 8 inch, one side drives for use with the firm's terminal and system products for several years, under a license from Shugart Associates. However, Datapoint and Tandy Corporation last year formed a joint venture to be known as Texas Peripherals, which will manufacture flexible disk drives for both parent companies. Although the original 8 inch, one side drive is still in production by Datapoint, a new series of 8 inch, one and two sided drives is already in production at Texas Peripherals for use with Datapoint systems. It is expected that floppy drive production in Datapoint's own facilities will be phased out.

DECITEK
A Division of Jamesbury Corporation
129 Flanders Road
Westboro, MA 01581 617/366-8334

1980 FDD sales: Not significant
1980 total net sales: $97,054,000 Net income: $8,225,000

Decitek is a manufacturer of paper tape equipment for the computer industry. The firm started deliveries in 1980 for its first flexible disk drive, an 8 inch, one side drive, an unusual design employing a linear stepping motor for head positioning. Shipments of a two sided version were added in 1981.

DIGITAL EQUIPMENT CORPORATION
146 Main Street
Maynard, MA 01754 617/897-5111

1980 FDD sales: $55,000,000
1980 total net sales: $2,368,045,000 Net income: $249,861,000

DEC has manufactured increasing quantities of 8 inch, one side floppy drives, since exercising a manufacturing license from Calcomp in 1976. Design of the original drive has been enhanced, but to date no two sided version has been added to the 8 inch drives, nor have 5.25 inch drives been introduced. DEC has been working on designs for both, and is widely rumored to have acquired rights to make a previously developed 5.25 inch drive. In the meantime, the firm has decided to buy 5.25 inch drives from external sources for a desktop computer requirement.

EXXON OFFICE SYSTEMS
Division of Exxon Enterprises, Inc.
329 Gordon Drive
Lionville, PA 19353 215/363-3000

1980 FDD sales: $7,100,000
1980 total net sales: $103,142,834,000 Net income: $5,650,090,000

Qyx, the intelligent typewriter operation of Exxon Enterprises, was combined with other office equipment activities of Exxon to form Exxon Office Systems in late 1980. Since 1978, 5.25 inch, one side floppy drives have been in production for use with various models of the intelligent typewriter. Exxon Office Systems has had disappointing sales results to date, due to a flood of capable new products from competitors, and major layoffs have occurred in the second half of 1981. Whether the firm will continue with its own floppy manufacturing program indefinitely or select from available OEM drives for future systems is not yet clear.

HEWLETT-PACKARD COMPANY
Greeley Division
3400 East Harmony Road
Fort Collins, CO 80525 303/226-3800

1980 FDD sales: Not significant
1980 total net sales: $3,099,000,000 Net income: $269,000,000

Hewlett-Packard, a major buyer of floppy drives for its own extensive line of computer systems, started to assemble floppy drives internally in 1980. The Greeley Division, temporarily housed at the firm's Fort Collins, Colorado, facilities, has responsibility for floppies. The division will eventually move to a major plant site at nearby Greeley, but has started production of 48 TPI 5.25 inch, two sided floppy drives at Fort Collins, under license from Tandon Corporation.

INTERNATIONAL BUSINESS MACHINES CORPORATION
Route 22
Armonk, NY 10504 914/765-1900

1980 FDD sales: $262,800,000
1980 total net sales: $26,213,000,000 Net income: $3,562,000,000

IBM's floppy disk drive unit shipments continue to climb, but the company's share of the worldwide total continues to decline, due to the explosive growth in small systems shipped by other firms. IBM's share of worldwide unit shipments of all types of floppy drives was down to 7.7% in 1980. Of course, IBM's floppy disk estimated revenues of $262,800,00 were far larger than any other company's, and represented 23.8% of the worldwide total. In 1981 IBM is using 8 inch drives, both one and two sided versions, on more systems than ever. It has even gone to an outside vendor of OEM drives, Tandon Corporation, for 5.25 inch, one side floppy drives for use with the new IBM personal computer. But IBM has not introduced any new floppy drive configuration since 1976, nor any increase in recording density since 1977. It is expected to take IBM a few more years to introduce its own small diameter floppy drive, but higher density 8 inch drives may not be too far away, as discussed elsewhere in this report.

INNOTRONICS
Brooks Road
Lincoln, MA 01773 617/259-0600

1980 FDD sales: $1,400,000

When the flexible disk pioneer company Innovex was liquidated in late 1977 at the insistence of impatient bankers, the firm's assets were purchased at auction by key employees. The new company name, Innotronics, was coined, and production continued without delay. Manufacturing operations are now at Fall River, Massachusetts, and sales are gradually increasing. The firm emphasizes hardware reliability, and is now placing more emphasis on subsystems.

IOMEGA CORPORATION
4646 South 1500 West
Ogden, UT 84403 801/392-7581

1980 FDD sales: None

Iomega has started to ship evaluation units of its unique 10 MB drive, which uses flexible media spinning at 1500 RPM in a special cartridge. Iomega's product is a high performance disk drive, and it is intended as a replacement for small rigid disk drives or as a companion drive used for backup purposes. Because of its unconventional nature, the Iomega drive will be regarded skeptically by many system OEMs, and its ability to achieve major penetration in the intended markets will probably be dependent upon setting up alternate sources for hardware and media.

MEMOREX CORPORATION
San Tomas and Central Expressways
Santa Clara, CA 95052 408/987-1000

1980 FDD sales: $7,700,000
1980 total net sales: $768,661,000 Net income: ($28,978,000)

Memorex marketed an OEM flexible disk drive before any other company, in 1972. However, the firm was late in introducing a drive compatible with IBM's 8 inch, one side floppy. While the original Memorex floppy drive achieved a measure of success with certain word processing and terminal OEMs, it has not been successful for several years in competing with IBM compatible drives for new systems, and now is in decline. IBM compatible two sided drives have been discontinued. After a history of moving floppy drive production to a different facility under different management every few years, Memorex has not achieved the improvements in cost and quality now needed to be competitive in the industry. Floppy drives have a questionable future at Memorex, now made even more uncertain in light of the impending acquisition of the company by Burroughs.

MICRO PERIPHERALS, INC.
9754 Deering Avenue
Chatsworth, CA 91311 213/709-1213

1980 FDD sales: $20,900,000

Started in 1977, Micro Peripherals has become one of the leading manufacturers of 5.25 inch floppy drives for the OEM market, including 96 TPI versions. The firm was also first to show a "half high" 8 inch floppy drive, at the 1980 NCC, although shipments were delayed until late 1981. The firm underwent management changes in 1981, and also established a joint venture with The Robin Group, a holding company based in Singapore. The joint venture is known as MPS (Pte) Ltd., and has already started assembly of 5.25 inch floppy drives which will be sold by Micro Peripherals.

MICROPOLIS CORPORATION
21329 Nordhoff Avenue
Chatsworth, CA 91311 213/709-3300

1980 FDD sales: $20,300,000

Micropolis introduced the industry to 100 TPI 5.25 inch drives with its first product, in 1977. As the lonely pioneer in high capacity 5.25 inch floppies for three years, the company was able to establish a growing customer base with microcomputer-based system OEMs oriented to capacity hungry business applications. Although competitors arrived on the scene by early 1980 with high track density drives, Micropolis still shipped 73% of all 5.25 inch floppies with 96/100 TPI in 1980. The company has also become an active competitor in the market for two sided 5.25 inch drives, after a slow start with that product line.

MILTOPE CORPORATION
Nine Fairchild Avenue
Plainview, NY 11803 516/349-9500

1980 FDD sales: $2,000,000

Miltope provides an extensive line of militarized peripherals, including disk, tape and bubble memory subsystems. The firm manufactures its own 8 inch drives in both one and two sided versions, which are included in subsystems intended for military and other rugged applications.

NORTHERN TELECOM, INC.
Subsidiary of Northern Telecom, Ltd. (Canada)
Data Park
Minnetonka, MN 55343 612/932-8000

1980 FDD sales: $7,000,000
1980 total net sales: $1,643,649,000 Net income: ($148,124,000)

Northern Telecom entered the floppy drive business with the acquisition in 1978 of Sycor. Sycor was an early manufacturer of floppy drives, having introduced in 1974 8 inch, one side drives for captive use with its terminal systems and for OEM sale. OEM sales were dropped before Sycor was acquired, and the program is now limited to making drives for Northern Telecom systems.

PER SCI, INC.
12210 Nebraska Avenue
West Los Angeles, CA 90025 213/820-3764

1980 FDD sales: $8,500,000

PerSci has been the flexible disk drive industry's advocate for high performance in the 8 inch floppy drive format. Since 1977, the company has been shipping drives using standard floppy media, but with a voice coil head positioning technique which provides access times similar to high performance rigid disk drives. All drives, including 2 sided models, use a single positioning mechanism to control heads on two diskettes. Unfortunately the market available for such a drive, at the higher prices required by the costly head positioning system, has been limited. PerSci has announced two sided drives with track densities up to 150 TPI and capacities up to 3.7 MB, but these products are not yet in production.

PERTEC COMPUTER CORPORATION
Subsidiary of Triumph Werke Nurnberg AG
9600 Irondale Avenue
Chatsworth, CA 91311 213/882-0030

1980 FDD sales: $8,200,000

Although Pertec was an early manufacturer of OEM floppy drives, the company's sales results in these products have been flat for the past few

years. Pertec was acquired in 1980 as part of Triumph Adler's ambitious expansion plans for the United States, but the Pertec operations ran in the red in 1980, as did the parent company. It is expected to take a year or two for Triumph Adler's strategies, as part of the worldwide Volkswagen holdings, to be revised adequately to cope with the rapid collapse of the market for its main products, mechanical and electric typewriters. In the meantime, Pertec produces both 8 and 5.25 inch, one and two side floppy drives, and has made a number of management changes in an attempt to reestablish sales momentum.

QUME CORPORATION
Subsidiary of International Telephone & Telegraph Corporation
2350 Qume Drive
San Jose, CA 95150 408/942-4000

1980 FDD sales: $13,400,000
1980 total net sales: $18,529,655,000 Net income: $894,326,000

After Qume's success in the daisywheel printer market, the company apparently expected to quickly take the floppy disk market by storm. The firm was able to secure manufacturing rights to the YE Data two sided 8 and 5.25 inch drives, products known for an excellent quality reputation. Shipments by Qume started in 1979, and its market share in 8 inch, two sided drives for 1980 was third in the world, but lower for 5.25 inch drives. Apparently seeking a higher growth rate, the company reorganized its marketing and manufacturing programs in 1981, and moved manufacturing from Hayward, California, to the headquarters facility in San Jose.

REMEX DIVISION
EX-CELL-O CORPORATION
1733 Alton Street
Irvine, CA 92713 714/557-6860

1980 FDD sales: $26,200,000
1980 total net sales: $1,020,677,000 Net income: $50,404,000

Remex has been a leading manufacturer of paper tape equipment for the data processing industry, and added floppy drives to its product line in 1975. After several years of limited market penetration, a change in management was made, and Remex started to become a factor in the OEM floppy market. The firm became the market leader for 8 inch, two sided drives in 1980, with 24.2% of the worldwide OEM market. 5.25 inch drives in a two thirds high design, including 96 TPI models, were added in 1981. A complete change in marketing management also occurred in 1981, with an unknown impact on future sales programs.

SHUGART ASSOCIATES
Subsidiary of Xerox Corporation
475 Oakmead Parkway
Sunnyvale, CA 94086 408/733-0100

1980 FDD sales: $171,700,000
1980 total net sales: $8,196,500,000 Net income: $619,000,000

Shugart Associates is still the giant of the OEM disk drive market, with 1980 worldwide shipments of all types of drives reaching a total of 553,500 units. But the dynamic growth of previous years was gone; the 553,500 units represented an increase over 1979 of only 4.8%. Ironically, much of the cause for this slowdown was probably the very high growth rate during the previous year, with the resulting quality problems and long lead-times for shipments. These customer annoyances, plus the loss of such a large customer as Tandy, combined with the prolonged delay in resolving reliability problems with two sided drives were reason enough for the loss of momentum. In 1981, Shugart Associates is fighting back with many additions in management and technical positions, and shipments are moving upward again. Captive shipments for Xerox office equipment programs are increasing rapidly. And the company no longer lacks the capability to compete in the rapidly growing OEM markets for 8 and 5.25 inch two sided drives; the product lines in these areas are now up to speed.

SYKES DATATRONICS, INC.
159 East Main Street
Rochester, NY 14604 716/325-9000

1980 FDD sales: $24,000,000
1980 total net sales: $24,174,408 Net income: $3,354,015

Sykes has manufactured 8 inch, one side floppy drives for several years, primarily for use with its own subsystems. An 8 inch, two sided drive is expected by the end of 1981. Sykes' principal product is a communications storage unit, which is now marketed by all of the AT&T operating companies, and which has been responsible for the firm's spectacular growth rate during the last few years. The company is also expanding into several other application areas with floppy-based systems.

TANDON CORPORATION
20320 Prairie Street
Chatsworth, CA 91311 213/993-6644

1980 FDD sales: $24,600,000
1980 total net sales: $22,761,000 Net income: $1,507,000
(Fiscal year ended 9/26/80)

Tandon is now primarily a disk drive manufacturer, after several years as the leading independent manufacturer of floppy drive recording heads. From the first shipments of floppy drives in early 1979, the firm has become

one of the fastest growing companies in the industry, by providing key OEM customers with quantity deliveries of two sided drives and highly competitive pricing. Half high 8 inch drives, in one and two sided versions, are being added in 1981. Tandon is also active in developing the 96 TPI market for 5.25 inch drives. Tandon may have some of the best costs in the industry, due to its vertical integration in heads, subassemblies and motors manufactured in India, plus a manufacturing facility in Singapore. Because of these factors, its strong base of major OEM customers, and an aggressive product development program, Tandon seems destined to be one of the leaders of the industry.

TEXAS PERIPHERALS
Joint venture of Datapoint Corporation and Tandy Corporation
1010 East 8th
Odessa, TX 79761 915/332-0277

1980 FDD sales: None

Texas Peripherals will manufacture flexible disk drives and other products of mutual interest to Datapoint and Tandy, for captive shipment with the systems produced by each parent. Datapoint has had many years of flexible disk drive production, with an 8 inch, one side drive made under a Shugart Associates license. A new generation of 8 inch, one and two sided drives is now in production by Texas Peripherals for Datapoint. An even larger program to produce 5.25 inch drives for Tandy's Radio Shack desktop computers is also underway. Texas Peripherals is already assembling sizeable quantities of one sided 5.25 inch drives, and new tooling and expanded facilities should make it possible to produce most or all of the Radio Shack 5.25 inch drive requirements in 1982.

Japanese Manufacturers (Exchange basis: 210 Yen = U.S. $1)

ALPS ELECTRIC CO., LTD.
1-7, Yukigawa Ohtsuka-cho
Ohta-ku, Tokyo 145 (03) 726-1211

1980 FDD sales: $12,400,000
1980 total net sales: $584,324,000 Net income: $9,019,000

Alps Electric manufactures numerous electronic components and subassemblies for television, audio, instruments and computer applications, with a growing market in the data processing industry. After getting its start in floppy drive manufacturing with a license from Micro Peripherals, Inc., the firm has become a major factor in worldwide OEM shipments during 1981. Alps is now shipping very large quantities of a mechanism-only 5.25 inch, one side drive similar to the Shugart SA 390 to Apple Computer. The company is also supplying samples of a low cost one half high 5.25 inch drive targeted at high volume markets such as personal computer and electronic typewriters.

CANON ELECTRONICS CO., INC.
Subsidiary of Canon, Inc.
1248, Shimokagemori, Chichibu-city
Saitama 369-18 (04942) 3-3111

1980 FDD sales: $2,700,000
1980 total net sales: $1,988,638,000 Net income: $115,895,000

Although Canon is known primarily as a leading manufacturer of cameras, low cost office copiers and calculators, the Canon Electronics subsidiary produces electronic subassemblies for Canon cameras and other electronic components and devices. One and two sided 5.25 inch floppy drives have been in production since 1979 under a BASF license, for sale in the OEM market and for use with Canon's own word processing and small business systems. In 1981 Canon introduced a new drive using 97 mm diskettes, intended for applications such as electronic typewriters, personal computers and point of sale terminals.

HITACHI, LTD.
6-2, Otemachi, 2-chome
Chiyoda-ku, Tokyo 100 (02) 270-2111

1980 FDD sales: $22,300,000
1980 total net sales: $14,025,638,000 Net income: $548,529,000

Hitachi is the largest electric and electronic manufacturer in Japan, with about one fifth of its total sales generated by the computer industry. In production on floppy drives since 1976, Hitachi currently manufactures one and two sided versions of its 8 inch floppy drives for the OEM market and for the company's own system and terminal product lines.

MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.
4-3-1 Tsunashima-Higashi
Hohoku-ku, Yokohama 223 (045) 531-1231

1980 FDD sales: $20,300,000
1980 total net sales: $769,405,000 Net income: $35,957,000

As the licensee for Shugart Associates in Japan, Matsushita Communication Industrial manufactures the Shugart 8 and 5.25 inch, one and two sided floppy drives for the Japanese OEM market. The two firms cooperated on the design of the SA 210, a low cost two thirds high 5.25 inch, one side drive which will be manufactured by Matsushita and will be sold by both companies. Matsushita Communication Industrial is a member of the Matsushita Electric Industrial group, a giant in appliances and electronics, and manufactures a diversified line of communications, audio-visual, automotive and other electronic equipment.

MITSUBISHI ELECTRIC CORPORATION
2-3, Marunouchi 2-chome
Chiyoda-ku, Tokyo 100 (03) 218-2111

1980 FDD sales: $23,500,000
1980 total net sales: $5,664,114,000 Net income: $155,338,000

Mitsubishi Electric's Melcom family of minicomputers and small business systems is a leader in the Japanese domestic market. The firm is one of the country's large electrical-electronic conglomerates, with a major position in heavy electric machinery, industrial electronics, home appliances and communications equipment. 8 inch floppy drives, in one and two sided versions, have been produced for several years for captive use with Melcom systems and for the OEM market. The firm is currently preparing an introduction for 5.25 inch floppy and Winchester drives.

NIPPON ELECTRIC COMPANY, LTD.
33-1 Shiba Gochome
Minato-ku, Tokyo 108 (03) 454-1111

1980 FDD sales: $52,900,000
1980 total net sales: $4,105,071,000 Net income: $69,629,000

NEC has produced 8 inch, two sided drives since 1978 primarily for the firm's own captive requirements with NEC systems, but in the last year has established a growing involvement with the OEM market. The firm is one of the earliest to offer a half high 8 inch drive, with deliveries starting in late 1981 in Japan, early 1982 elsewhere. Computer mainframes, small business systems, minicomputers and desktop systems account for about 20% of NEC's revenues, with the balance derived from telecommunications, semiconductors and other electronic equipment.

OKI ELECTRIC INDUSTRY CO., LTD.
1-17-12, Toranomon
Minato-ku, Tokyo 105 (03) 501-3111

1980 FDD sales: $1,400,000
1980 total net sales: $883,067,000 Net income: $12,057,000

Oki manufactures telecommunication equipment, electronic devices and components, and data processing equipment. The firm manufactures 8 inch, one side flexible disk drives which are sold on a captive basis with Oki systems.

RICOH CO., LTD.
1-3-6 Naka-Magome
Ohta-ku, Tokyo 143 (03) 543-5111

1980 FDD sales: $19,900,000
1980 total net sales: $1,248,805,000 Net income: $68,000,000

Ricoh has achieved high growth as a manufacturer of copiers, sensitized papers, and photographic equipment -- with a growing emphasis in data processing equipment. The company initiated production of one and two sided 8 inch floppy drives in 1979, under a manufacturing license from Calcomp. Floppy drives are marketed on a captive basis with Ricoh small business systems and word processing systems.

SANKYO SEIKI MFG. CO., LTD.
17-2, 1-chome, Shinbashi
Minato-ku, Tokyo 105 (03) 508-1154

1980 FDD sales: Not significant
1980 total net sales: $232,810,000 Net income: ($2,962,000)

Sankyo Seiki manufactures a wide mix of electronic and electromechanical equipment, including magnetic heads, tape recorders, motors, musical movements and photographic equipment. The company is now offering a small spiral track flexible disk drive which provides 8 kilobyte capacity on a 2.598 inch diameter disk, and is attempting to develop an OEM market in word processing, program loading and special industrial applications.

SONY CORPORATION
6-7-35, Kita-Shinagawa
Shinagawa-ku, Tokyo 141 (03) 448-2111

1980 FDD sales: None
1980 total net sales: $4,251,252,000 Net income: $326,871,000

Sony's management has indicated that it plans to derive one third of the company's revenues from office products by 1985. At present the firm is a leading consumer electronics company, with a minor portion of revenues

generated by professional audio-video equipment and office dictating equipment. The products necessary to achieve Sony's planned office automation revenues have apparently only started to be introduced. In late 1980, the firm announced a diminutive portable terminal which will be used in conjunction with a new word processing system. The latter will use a new floppy drive which records up to 437.5 kilobytes on one side of a 3.5 inch flexible disk with a cobalt modified coating. A two sided version of the drive is expected in 1982. In addition to captive usage with Sony systems, the floppy drive is also being offered on an OEM basis.

TEAC CORPORATION
3-7-3, Naka-cho
Musashino, Tokyo 180 (0422) 53-1111

1980 FDD sales: $8,700,000
1980 total net sales: $177,600,000 Net income: $3,638,000

TEAC has participated in the worldwide market for OEM 5.25 inch flexible disk drives since late 1978, when it started shipping a one side drive. Two sided drives, as well as 96/100 TPI versions have been added, and the company's floppy drive shipments are now increasing rapidly. TEAC is a leading marketer of quality audio tape decks, but also has an established line of digital electronic products which produce about 25% of the firm's revenues.

TOSHIBA CORPORATION
1-6, Uchisaiwaicho 1-chome
Chiyoda-ku, Tokyo 100 (03) 501-5411

1980 FDD sales: $21,300,000
1980 total net sales: $9,074,362,000 Net income: $215,833,000

One of the largest Japanese companies, Toshiba is an electric and electronics giant, making products ranging from nuclear generating plants to home appliances and consumer electronics. The company has a major role in the Japanese market for minicomputers and small business systems, and has produced floppy drives for this equipment since 1977. The floppy drive line now consists of both 8 and 5.25 inch drives, in one and two sided versions, which are sold on an OEM basis, as well as with Toshiba systems.

YE DATA, INC.
Subsidiary of Yaskawa Electric Mfg. Co., Ltd.
1-1, Higashi-Ikebukuro 3-chome
Toshima-ku, Tokyo 170 (03) 989-8001

1980 FDD sales: $17,200,000
1980 total net sales: $373,376,000 Net income: $9,624,000

Yaskawa Electric is a significant factor in the Japanese markets for heavy electric equipment, numerical control systems and robots. YE Data, the firm's subsidiary for data processing equipment, has manufactured 8 inch, one side flexible disk drives under an Orbis license since 1974. The company became a major Japanese manufacturer of OEM disk drives and now holds the leading position in two sided drives, both 8 and 5.25 inch. The latter are now manufactured in the United States by Qume, under a YE Data license. YE Data has introduced a half high 8 inch drive, with shipments starting in the second half of 1981.

European Manufacturers (Exchange basis indicated for each firm)

BASF AG
D-6700 Ludwigshafen
West Germany (0621) 4 00 81

1980 FDD sales: $38,900,000
1980 total net sales: $16,479,000,000 (Basis: DM 1.82 = U.S.$1) Net income: $213,000,000

BASF is best known in the computer industry as a manufacturer of a broad line of magnetic media products. The company's rigid and flexible disk drive equipment product lines are marketed in the United States as well as throughout Europe. After a start with 8 inch, one side floppy drives in Germany in 1976, BASF in 1978 added 8 inch, two sided drives, plus one and two sided 5.25 inch drives. The 5.25 inch drives are two thirds the height of the industry standard SA 400, and have attracted several imitators in 1981. BASF's major penetration of the European OEM market has been the key factor in boosting the firm's sales to second place worldwide in total 1980 sales of OEM floppy drives of all configurations.

DATA RECORDING EQUIPMENT LIMITED
Subsidiary of Data Recording Instruments Co., Ltd.
Hawthorne Road, Staines
Middlesex TW18 3BJ
England (0784) 61141

1980 FDD sales: $1,300,000
1980 total net sales: $63,111,000 (Basis: .45 Pound = U.S.$1) Net income: ($22,978,000)

All manufacturing for DRE was turned over two years ago to United Peripherals, Ltd. UPL is a joint venture company established by DRE's parent firm, Data Recording Instruments, and Magnetic Peripherals, Inc., the U.S. disk drive development and manufacturing firm owned primarily by Control Data and Honeywell. DRE continues to market 8 inch, one and two sided floppy drives in the European OEM market. The new organization is also selling the CDC rigid disk drives now being made by UPL, and floppy drives are no longer being emphasized.

ELCOMATIC LTD.
Subsidiary of British & Commonwealth Shipping Co., Ltd.
Kirktonfield
Nielston, Glasgow
Scotland (041) 881-5825

1980 FDD sales: None

Elcomatic acquired the MFE 8 inch flexible disk drive product line in July, 1981. Until that time, MFE had manufactured the drives, mostly a two sided version, at plants in Salem, Massachusetts, and in Livingston, Scotland. Elcomatic plans to continue OEM sales of the drives to systems manufacturers in Europe and the United States.

ISOTIMPEX
51, Chapaev St.
Sofia, Bulgaria

1980 FDD sales: $1,400,000

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 and to China. Rigid disk drives, in several older IBM configurations, have been produced for several years, later joined by one sided 8 inch and 5.25 inch floppy drives.

MERA/METRONEX
Al. Jerozolimskie 44
00-950 Warszawa
Poland 26-22-21

1980 FDD sales: $3,600,000

Since 1977, 8 inch, one side floppy drives have been manufactured by MERA, which is the acronym for the Polish Union of Automation and Measuring Instruments Industry, the state organization for manufacture of computer systems and peripherals. Flexible disk drives are manufactured under a 1975 license from Logabax (no longer in floppy drive production), with production at the MERA Krakowska Fabryka Aparatow Pomiarowych facility at Krakow. Exports throughout Eastern Europe and to the USSR are the responsibility of Metronex.

OLIVETTI PERIPHERAL EQUIPMENT
Subsidiary of Ing. C. Olivetti & C., S.p.A.
via Torino, 603
10090 S. Bernardo d'Ivrea (Torino)
Italy (0125) 525

1980 FDD sales: $79,300,000
1980 total net sales: $2,550,840,000

In 1980, the printer and disk memory activities of Olivetti were placed in a new subsidiary, Olivetti Peripheral Equipment, with responsibility to develop and manufacture these product lines for the company's captive system requirements, as well as develop OEM markets. Since starting to produce 8 inch, one side drives in 1974, Olivetti has been one of Europe's leading manufacturers of floppy drives. Two sided 8 inch drives were added in 1979 and are now in large volume production. One and two sided 5.25 inch drives were added in the last year. Olivetti also makes a unique 2.5 inch floppy drive which records a single spiral track on each media unit. It is expected that shipments of this device will be displaced by the firm's newer 5.25 inch drives.

PHILIPS DATA SYSTEMS
Subsidiary of N. V. Philips Gloeilampenfabrieken
Postbus 245
7300 AE Apeldoorn
The Netherlands (055)330123

1980 FDD sales: None
1980 total net sales: $18,359,798,000 (Basis: Fl 1.99 = U.S.$1) Net income: $164,824,000

Philips product lines cover a broad mix of electrical and electronic equipment sold to consumer, commercial and industrial markets. Although computer industry revenues contribute less than 5% of total company sales, the firm's minicomputer, terminal and office computer products are sold throughout Europe. For several years, Philips has manufactured rigid disk drives of various types for captive distribution with its systems. Starting in late 1980, the firm initiated shipments of a 5.25 inch, two sided 48 TPI floppy drive for captive and OEM markets.

SIEMENS AG
Hofmannstrasse 51
D-8000 Munchen 70
West Germany

1980 FDD sales: $17,800,000
1980 total net sales: $17,560,673,000 (Basis: DM 1.82 = U.S.$1) Net income: $347,540,000

Siemens is one of Europe's leading computer systems manufacturers, despite the fact that data processing accounts for only about 5% of the company's total sales. The firm entered the floppy drive business by acquiring the General Systems International and the Orbis (later Wangco, then Perkin Elmer) floppy product lines. Manufacturing is now entirely in Orange County, California, facilities, and the activity remains primarily oriented to OEM markets. Products include all 8 and 5.25 inch configurations, including new 96 TPI and two thirds high 5.25 inch models.

VIDEOTON INDUSTRIE-AUSSENHALDELS AG
1068 Budapest VI., Szofiz u. 9
Hungary 228-921

1980 FDD sales: $4,500,000

Videoton is an Hungarian electronics manufacturing organization which makes peripherals and minicomputers for domestic use and for export to Eastern Bloc countries. 8 inch, one side floppy drives have been in production for several years, offered as various subsystems and as OEM drives. A 5.25 inch, one side drive was added in 1980.