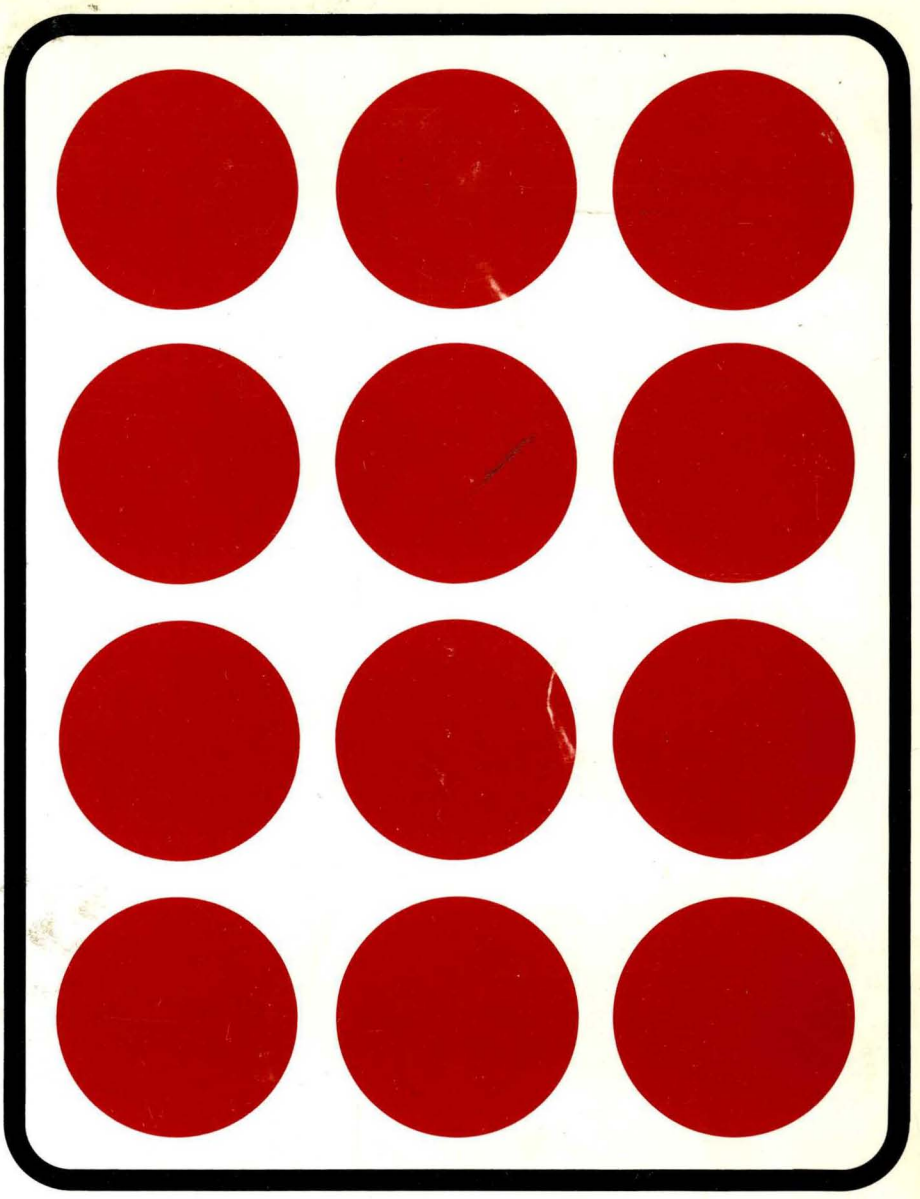
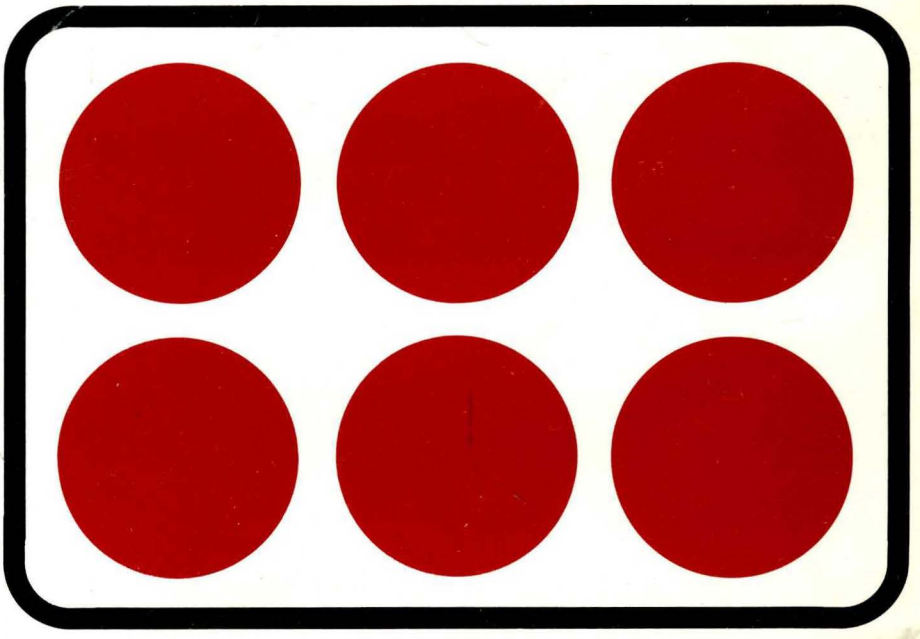


1979 DISK/TREND REPORT

FLEXIBLE DISK DRIVES



1979 DISK/TREND® REPORT

FLEXIBLE DISK DRIVES

September, 1979

James N. Porter
1224 Arbor Court
Mountain View, California 94040
415/961-6209

FOREWORD

In its third year the DISK/TREND Report is bigger than ever, mostly because the disk drive industry has more products, more companies, and more change than ever.

As in the past, this year's DISK/TREND Report is in two sections. This volume covers flexible disk drives, and a separate report published in July covered moving head rigid disk drives.

Occasionally, most subscribers would like to have more detail on various aspects of the disk drive business, and I'm always willing to help when I can. Your inquiries are most welcome, and I will be happy to provide any non-proprietary information from my files which can be extracted without extensive research. Projects requiring more elaborate research and analysis can be addressed on a normal consulting basis if desired.

I solicit suggestions for any improvements to the DISK/TREND Report which would make it more useful to you. Quite a few user ideas are already incorporated into the report, and I'm confident that many future improvements will originate in the same way.

James N. Porter

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

INTRODUCTION

Here are some changes to watch for

An effort has been made to keep the DISK/TREND Report's format as consistent as possible from year to year, so that regular users will find it simpler to use. That approach will continue, but a few changes have been made in 1979's report to improve clarity, and new information has also been added. Here are the principal changes:

* Unit shipments in each product group are now shown in much more detail, in a format similar to the revenue tables.

* Non-captive market share information in each product group is now on a worldwide basis.

* Coverage of non-U.S. products and companies has been expanded

* Page numbering is now organized by each of the report's sections, so you will be able to find reference data faster. Notice that numbering of product sections follows the DISK/TREND product group number sequence.

As usual, please note these key points

* Users can save time by familiarizing themselves with the definitions section. Industry nomenclature is rife with ambiguous meanings, and the DISK/TREND definitions should help clarify the language used in this report.

* All unit totals are given in spindles -- so a disk drive containing two spindles is counted in DISK/TREND statistics as two spindles.

SUMMARY

Industry size

Worldwide shipments by flexible disk drive manufacturers generated estimated sales revenues of $477,400,000 in 1978, and 1979 sales are projected to be up 60%, to $763,900,000. Combined unit shipments of all floppy configurations grew 97.7%, from 732,500 spindles in 1978 to 1,448,500 in 1979. The lower growth rate for revenue reflects the continuing decline in average selling prices for all industry market classes.

Despite the apparent presence of a recession in the United States, no slowdown in orders for flexible disk drives has been noted by manufacturers, to date. It is believed that floppy drives will feel the effects of the recession only slightly, with some softening of the 1980 growth for personal and hobby computers and certain other equipment. The expected mild recession is not likely to seriously affect growth in shipments for mainstream data processing and word processing applications.

1980 worldwide flexible disk drive revenues are projected to exceed $1 billion for the first time, with more than two million spindles shipped. By 1982, the DISK/TREND projection calls for worldwide revenues of $1,773,300, with combined unit shipments for all types of floppy drives to reach almost four million spindles.

Underlying the forecast increases in this edition of the DISK/TREND Report are: (1) Explosive growth of the market for very small business systems, (2) Displacement of other small recording devices using digital cassettes and mag cards, and (3) High purchase frequency of add-on floppy drives for very small business systems and some other equipment.

TABLE 1

CONSOLIDATED WORLDWIDE SHIPMENTS

ALL EXISTING FLEXIBLE DISK DRIVE GROUPS

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1978 Shipments		Forecast							
			1979		1980		1981		1982	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	84.5	120.0	111.6	163.3	145.8	212.4	171.2	255.1	184.6	278.6
Other U.S. Captive	61.2	87.5	86.4	123.5	113.7	162.2	154.0	220.4	211.5	309.3
TOTAL U.S. CAPTIVE	145.7	207.5	198.0	286.8	259.5	374.6	325.2	475.5	396.1	587.9
PCM	--	--	.4	.6	2.9	3.8	4.8	7.0	6.4	9.4
OEM	89.0	107.7	187.1	225.1	261.9	317.7	371.7	454.1	447.7	553.0
TOTAL U.S. NON-CAPTIVE	89.0	107.7	187.5	225.7	264.8	321.5	376.5	461.1	454.1	562.4
TOTAL U.S. SHIPMENTS	234.7	315.2	385.5	512.5	524.3	696.1	701.7	936.6	850.2	1,150.3
Non-U.S. Manufacturers										
Captive	8.4	100.7	9.8	149.1	13.3	190.6	22.2	286.0	33.0	386.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	7.7	61.5	25.5	102.3	37.3	131.9	57.5	183.9	78.8	236.6
TOTAL NON-U.S. SHIPMENTS	16.1	162.2	35.3	251.4	50.6	322.5	79.7	469.9	111.8	623.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	250.8	477.4	420.8	763.9	574.9	1,018.6	781.4	1,406.5	962.0	1,773.3

Industry structure

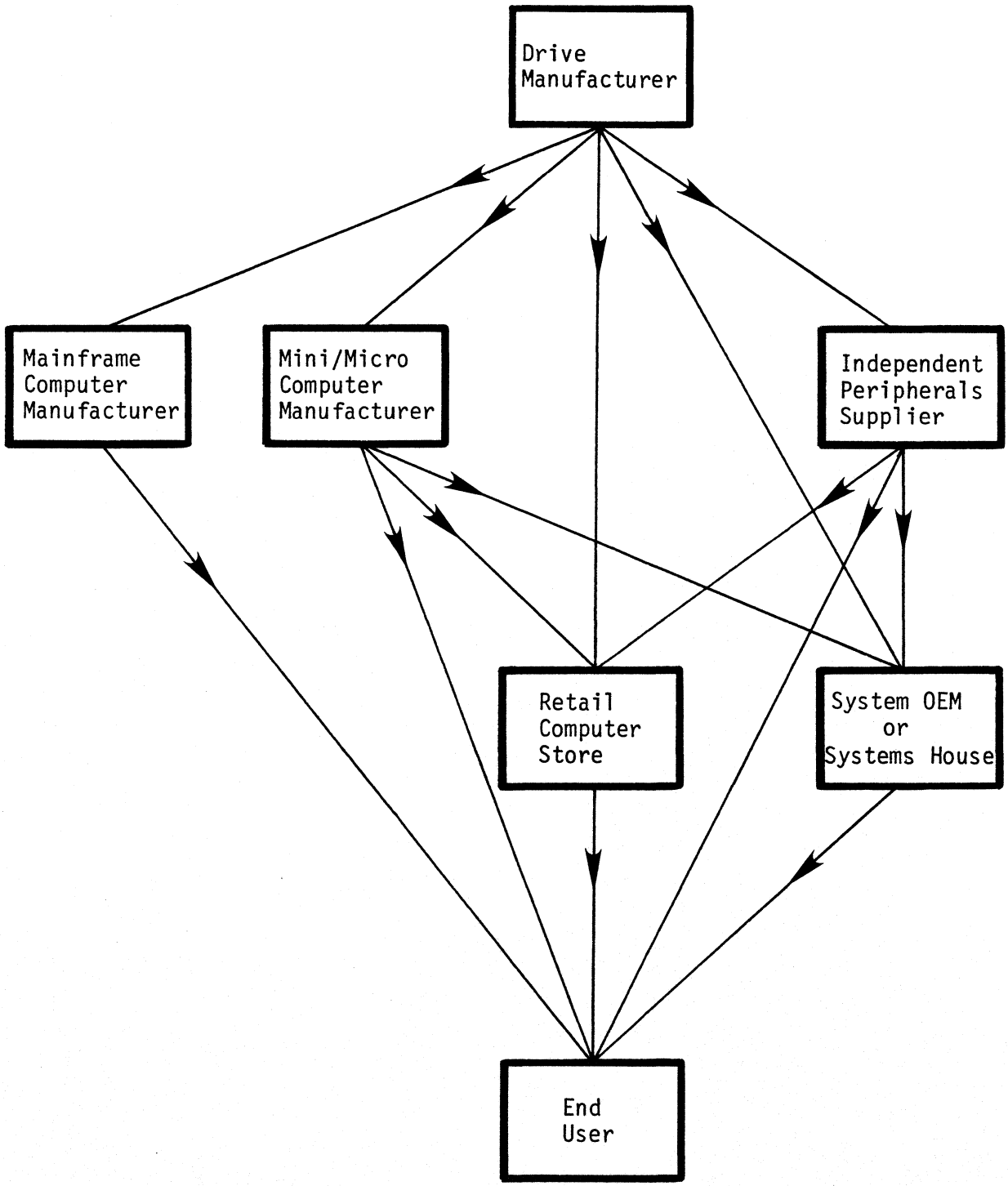
Flexible disk drives are now manufactured by 39 firms, including 21 in the United States, 9 in Japan and 9 in Europe. Except for the probable phase-out of marginal manufacturing programs by two European companies, most flexible disk drive producers are growing rapidly. Additional firms have entered the industry in the last year through both acquisition and production start-up, and more activity is expected.

Figure 1 illustrates the predominant patterns of distribution for non-captive flexible disk drives. Most OEM drives are purchased by computer manufacturers, system OEMs or independent peripherals suppliers, which add the necessary power supply, controller, interface electronics and enclosure. System OEMs of all types purchase over half of all floppy drives. Mini/microcomputer manufacturers and independent peripherals suppliers are also major buyers of OEM drives, with mainframe computer manufacturers and retail dealers taking smaller quantities.

Only a small portion of total drive shipments by non-captive manufacturers consist of complete floppy drive subsystems, ready to use with a minicomputer, microcomputer or small business system. Assembling the subsystem or integrating a subsystem into a complete system ready for the end user is the function of the computer manufacturer, system OEM, systems house or independent peripherals supplier.

Retail computer stores intended to serve the anticipated hobbyist market have appeared throughout the U.S. in recent years. Many of these dealers have started to concentrate on the market for very small business systems, with additional emphasis on outside selling and software support.

Figure 1
NON-CAPTIVE MARKETING STRUCTURE
FLEXIBLE DISK DRIVES



Marketing channels

Total flexible disk drive shipments by IBM continue to grow, despite a decline in production of 8 inch, one side drives. The DISK/TREND estimate for IBM floppy disk drive revenues is $163,300,000 in 1979, going up to $278,600,000 in 1982. IBM's share of total worldwide revenues is expected to drop from 21.4% in 1979, however, to 15.7% in 1982, as shipments by independent manufacturers grow at a faster rate. Even more significant is the fact that IBM now manufactures a very small portion of the total flexible disk drives shipped each year: DISK/TREND estimates indicate IBM shipped only 5.2% of the total spindles for 1979, with a projection of only 3.1% of worldwide unit shipments for 1982.

Manufacturers of OEM drives sharply increased their share of worldwide revenues this year, from 35.5% in 1978 to 42.9% in 1979. Key to this shift is rapid growth of the predominantly OEM 5.25 inch drive configurations, plus the start of high volume OEM shipments for 8 inch, two side drives. The share of worldwide revenues held by OEM drives is expected to peak in 1981 at 45.4%.

The portion of worldwide revenues held by non-IBM captive drives should decline slightly until 1981, in the face of dynamic growth by OEM drives. Starting in 1981, the natural tendency of major system OEMs toward vertical integration will start to swing the pendulum toward captive drive production.

The DISK/TREND forecast for PCM floppy drive shipments has been lowered, due to the slow market entrance caused by independent manufacturers' problems with two sided 8 inch drives, plus the inherent difficulties in selling effectively to small, widely dispersed user sites.

TABLE 2

CONSOLIDATED WORLDWIDE SHIPMENTS

ALL EXISTING FLEXIBLE DISK DRIVE GROUPS

MARKET CLASS SUMMARY

WORLDWIDE REVENUES BY MANUFACTURER TYPE	1978 Shipments $M	1978 Shipments %	FORECAST 1979 $M	1979 %	1980 $M	1980 %	1981 $M	1981 %	1982 $M	1982 %
U.S. Manufacturers										
IBM	120.0	25.1	163.3	21.4	212.4	20.9	255.1	18.1	278.6	15.7
Other U.S. Captive	87.5	18.3	123.5	16.2	162.2	15.9	220.4	15.7	309.3	17.4
PCM	--	--	.6	.1	3.8	.4	7.0	.5	9.4	.5
OEM	107.7	22.6	225.1	29.5	317.7	31.2	454.1	32.3	553.0	31.2
Total U.S. Mfgr's.	315.2	66.0	512.5	67.1	696.1	68.3	936.6	66.6	1,150.3	64.9
Non-U.S. Manufacturers										
Captive	100.7	21.1	149.1	19.5	190.6	18.7	286.0	20.3	386.4	21.8
PCM	--	--	--	--	--	--	--	--	--	--
OEM	61.5	12.9	102.3	13.4	131.9	12.9	183.9	13.1	236.6	13.3
Total Non-U.S. Mfgr's.	162.2	34.0	251.4	32.9	322.5	31.7	469.9	33.4	623.0	35.1
Worldwide Total	477.4	100.0	763.9	100.0	1,018.6	100.0	1,406.5	100.0	1,773.3	100.0

Product mix

8 inch, one side flexible disk drives have shown great strength in 1979, due to the extent of overall market growth and the shortage of 8 inch, two side drives. The production peak for 8 inch, one side drives is now expected in 1980, with worldwide shipments headed downhill starting in 1981. The industry's total production of all floppy drives will continue to grow rapidly, but newer formats will be the reason.

8 inch, two side drives have started to recover from a difficult manufacturing start-up phase. 1980 shipments are still expected to be partially limited by head shortages and the phase-in of new, more producible designs by several manufacturers. Nevertheless, worldwide shipments are projected at a respectable 424,300 units, climbing rapidly to 1,073,700 units in 1982.

5.25 inch drives will continue to lead in floppy drive growth through 1982. The DISK/TREND projection for 1979 shipments of one sided drives is a startling 434,300 units, with most manufacturers operating under various allocation schemes, due to unexpected market demand. The 1982 projection for one side drives is 1,204,700, with two side drives following closely behind with 1,026,100 units.

OEM market

Marketing trends in the disk drive industry usually occur early in the OEM market class. Such is again the pattern, as two sided 8 inch drives start to supersede one side drives. U.S. unit shipments of 8 inch, one side drives by non-IBM captive manufacturers are not expected to peak until 1981, with U.S. OEM shipments topping out a year earlier.

Figure 2

CHANGING PRODUCT MIX

WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS

CONSOLIDATED REVENUE

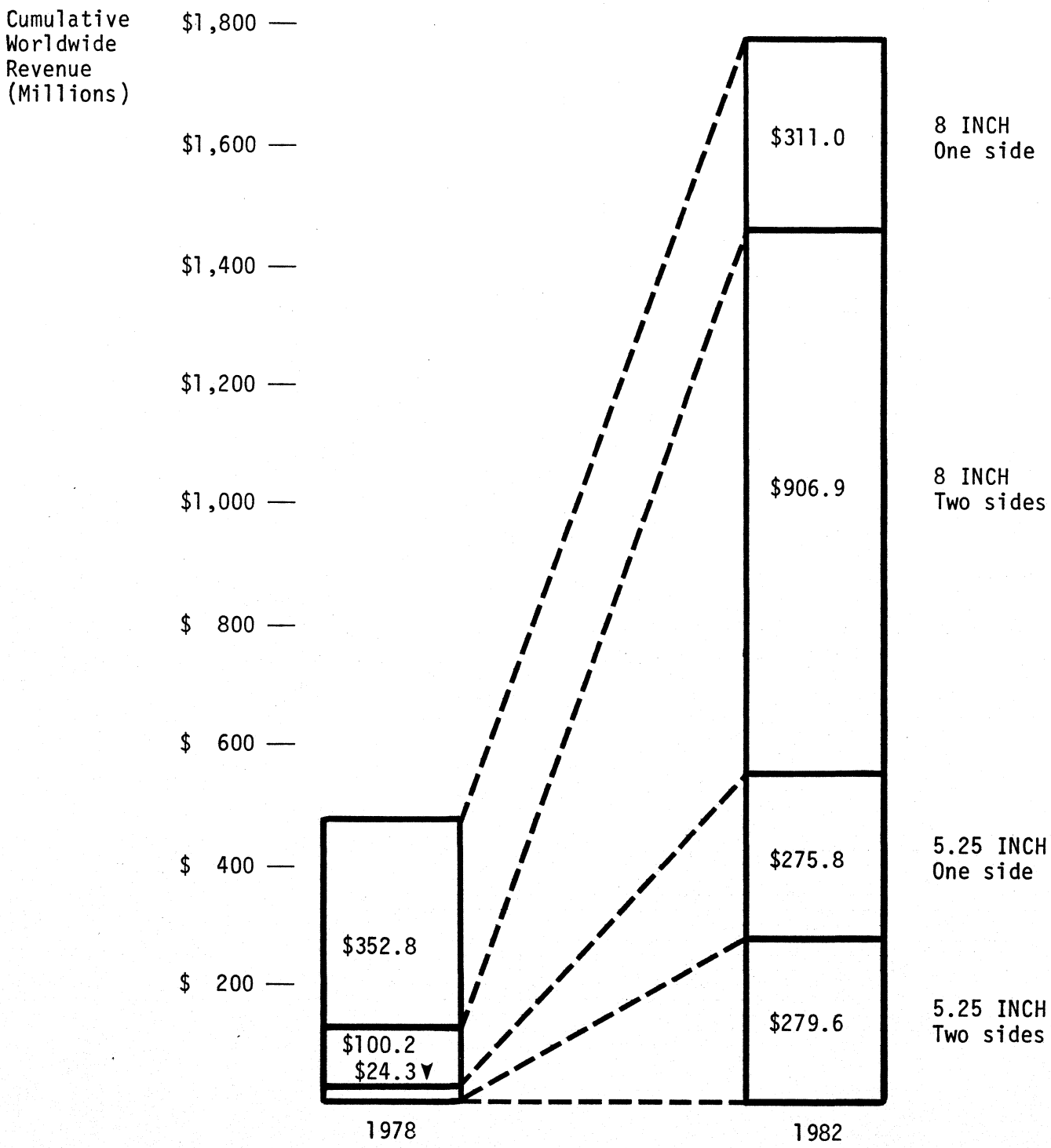


Figure 3

CHANGING PRODUCT MIX

WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
ALL MANUFACTURERS

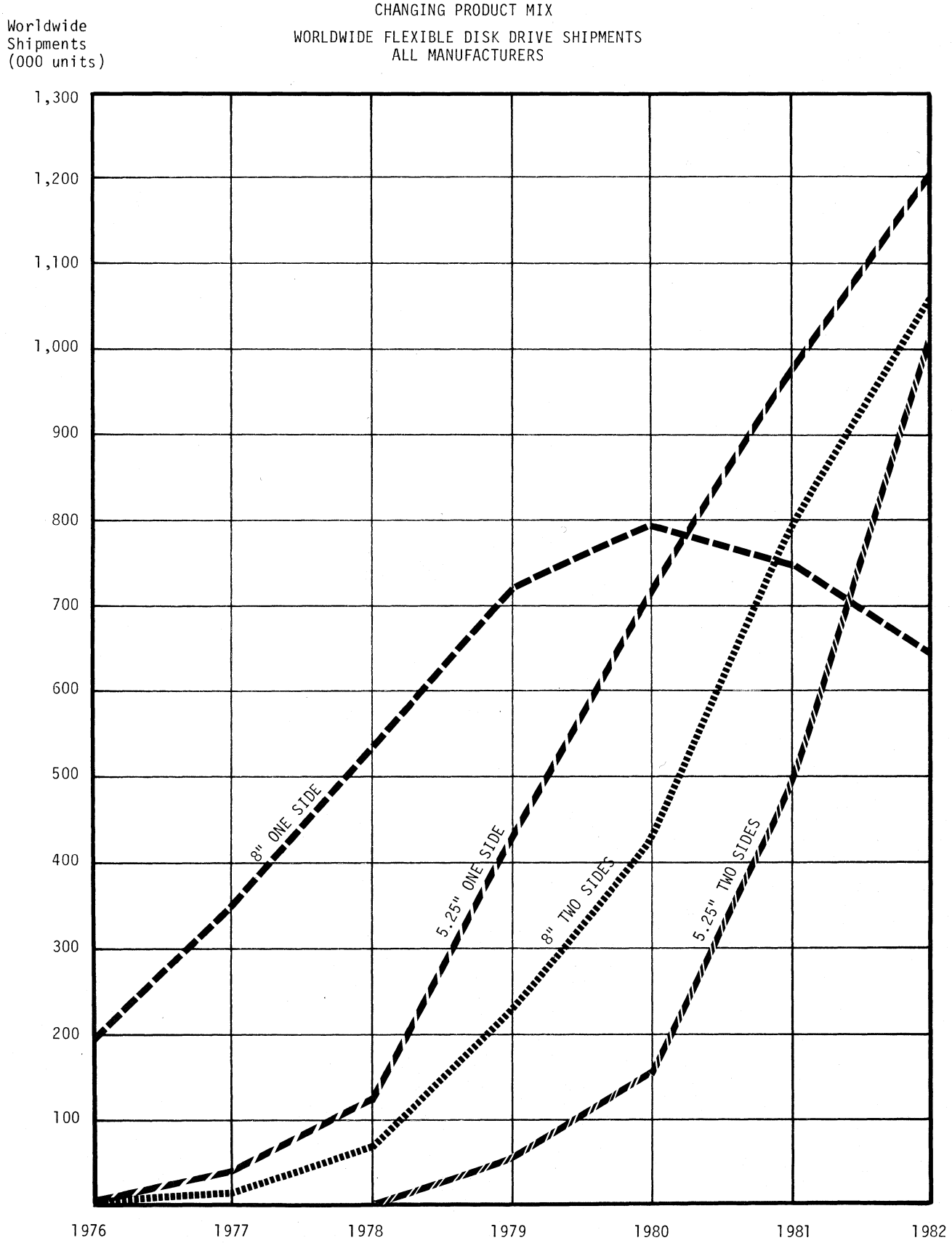


TABLE 4

WORLDWIDE SHIPMENTS

PRODUCT CATEGORY SUMMARY

MANUFACTURERS OF OEM DRIVES

Units: Thousands Dollars: $ Million		1978 Shipments		FORECAST							
				1979		1980		1981		1982	
		Ship	Δ%	Ship	Δ%	Ship	Δ%	Ship	Δ%	Ship	Δ%
8 Inch One Side	Units	370.5	+ 66.5	523.1	+ 41.2	572.0	+ 9.3	530.5	- 7.3	440.1	- 17.0
	$M	129.6	+ 68.5	170.2	+ 31.3	175.0	+ 2.8	156.4	- 10.6	126.9	- 18.9
8 Inch Two Sides	Units	31.1	--	147.8	+375.2	277.9	+ 88.0	570.1	+105.1	772.0	+ 35.4
	$M	16.6	--	71.4	+350.1	127.9	+ 79.1	243.9	+ 90.7	312.9	+ 28.3
8 Inch Total	Units	401.6	+ 79.4	670.9	+ 67.1	849.9	+ 26.7	1,100.6	+ 29.5	1,212.1	+ 10.1
	$M	146.2	+ 88.6	241.6	+ 65.3	302.9	+ 25.4	400.3	+ 32.2	439.8	+ 9.9
5.25 Inch One Side	Units	125.7	+187.6	427.8	+240.3	694.7	+ 62.4	881.4	+ 26.9	1,006.0	+ 14.1
	$M	22.9	+143.6	72.2	+215.3	108.8	+ 50.7	131.6	+ 21.0	143.2	+ 8.8
5.25 Inch Two Sides	Units	.3	--	54.2	--	155.8	+187.5	469.4	+201.3	968.7	+106.4
	$M	.1	--	13.6	--	37.9	+178.7	106.1	+179.9	206.6	+ 94.7
5.25 Inch Total	Units	126.0	+188.3	482.0	+282.5	850.5	+ 76.5	1,350.8	+ 58.8	1,974.7	+ 46.2
	$M	23.0	+144.7	85.8	+273.0	146.7	+ 71.0	237.7	+ 62.0	349.8	+ 47.2
TOTAL ALL DRIVES	Units	527.6	+ 97.2	1,152.9	+118.5	1,700.4	+ 47.5	2,451.4	+ 44.2	3,186.8	+ 30.0
	$M	169.2	+ 94.7	327.4	+ 93.5	449.6	+ 37.3	638.0	+ 41.9	789.6	+ 23.8

Figure 4

CHANGING PRODUCT MIX

WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
MANUFACTURERS OF OEM DRIVES

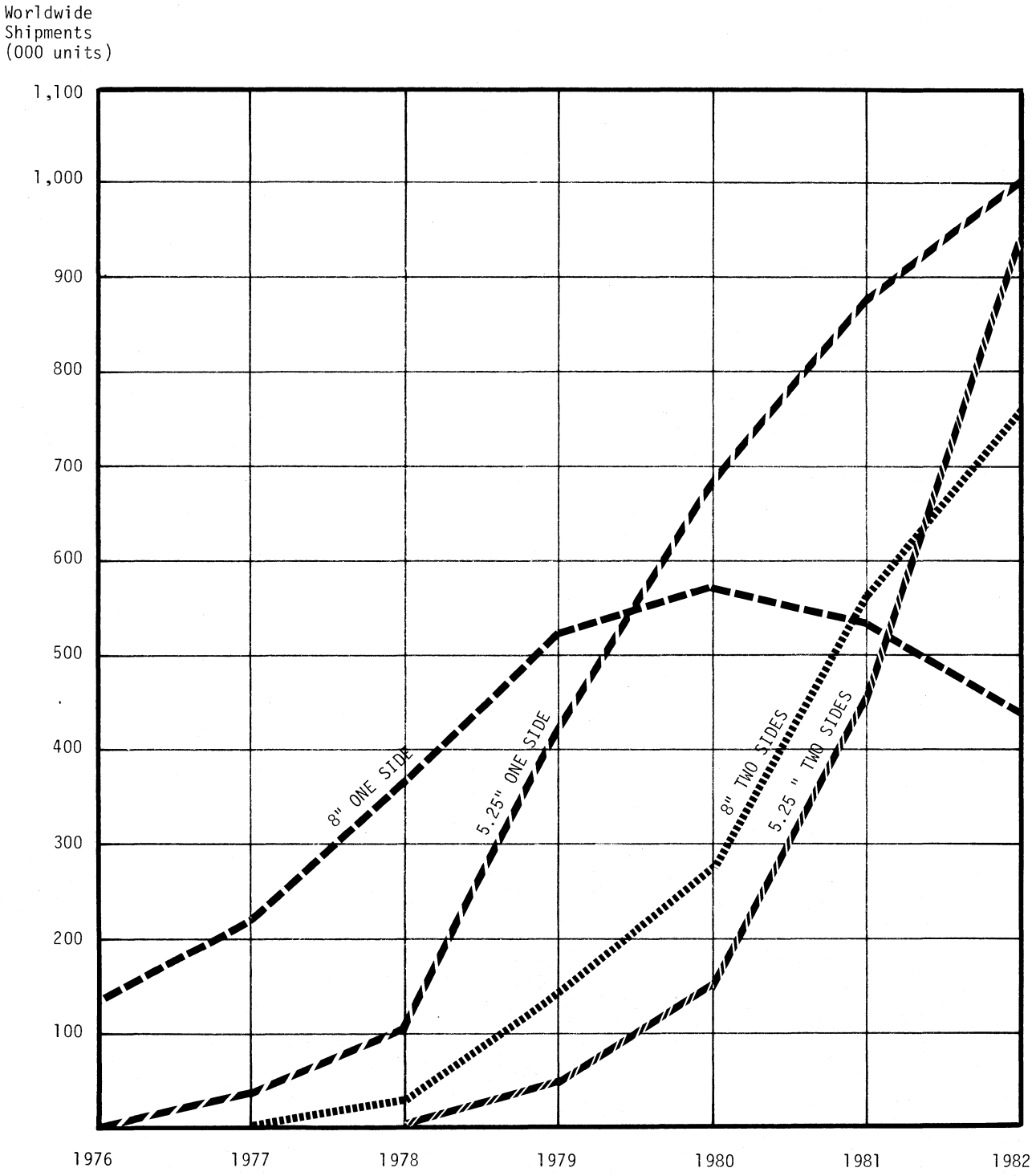


TABLE 5

1978 ESTIMATED MARKET SHARES

WORLDWIDE SHIPMENTS OF ALL FLEXIBLE DISK DRIVES

	CAPTIVE		OEM		TOTAL INDUSTRY	
	$M	%	$M	%	$M	%
U.S. MANUFACTURERS						
Burroughs	18.0	5.8	--	--	18.0	3.8
Calcomp*	--	--	4.9	2.9	4.9	1.0
Control Data	15.3	5.0	11.4	6.7	26.7	5.6
Datapoint	3.3	1.1	--	--	3.3	.7
Digital Equipment	30.0	9.7	--	--	30.0	6.3
IBM	120.0	38.9	--	--	120.0	25.1
Memorex	--	--	8.6	5.1	8.6	1.8
Micropolis	--	--	3.6	2.1	3.6	.7
Northern Telecom	8.0	2.6	--	--	8.0	1.7
Per Sci	--	--	5.8	3.4	5.8	1.2
Pertec	6.6	2.1	2.9	1.7	9.5	2.0
Remex	--	--	3.0	1.8	3.0	.6
Shugart	3.3	1.1	60.1	35.5	63.4	13.3
Wangco*	2.7	.9	3.9	2.3	6.6	1.4
Other U.S.	.3	.1	3.5	2.1	3.8	.8
U.S. Total	207.5	67.3	107.7	63.6	315.2	66.0
NON-U.S. MANUFACTURERS						
BASF	--	--	12.4	7.3	12.4	2.6
Hitachi	5.4	1.8	15.0	8.9	20.4	4.3
Logabax	3.8	1.2	--	--	3.8	.8
Matsushita	--	--	3.9	2.3	3.9	.8
MERA/Metronex	--	--	3.2	1.9	3.2	.7
Mitsubishi	9.8	3.2	5.8	3.4	15.6	3.3
Olivetti	54.0	17.5	--	--	54.0	11.3
Siemens	--	--	4.6	2.7	4.6	1.0
Toshiba	19.3	6.3	6.2	3.7	25.5	5.3
YE Data	2.9	.9	8.6	5.1	11.5	2.4
Other Non-U.S.	5.5	1.8	1.8	1.1	7.3	1.5
Non-U.S. Total	100.7	32.7	61.5	36.4	162.2	34.0
WORLDWIDE TOTAL	308.2	100.0	169.2	100.0	477.4	100.0

*These firms sold their flexible disk drive operations in 1979.

TABLE 6

CURRENT PRODUCT LINES

MANUFACTURERS OF FLEXIBLE DISK DRIVES

Code:
C = Captive
P = PCM
O = OEM

U.S. Manufacturers	Type	DISK/TREND PRODUCT GROUP: 10 8 INCH ONE SIDE	11 8 INCH TWO SIDES	12 5.25 INCH ONE SIDE	13 5.25 INCH TWO SIDES
Burroughs	C		X		
Caldisk	C,O	X	X		X
Control Data	C,P,O	X	X		
Datapoint	C	X			
Decitek	O	X	X		
Digital Equipment	C	X			
IBM	C	X	X		
Innotronics	O	X			
Memorex	C,O	X	X		
MFE	O	X	X		
Micro Peripherals	O			X	X
Micropolis	O			X	X
Northern Telecom	C	X			
PerSci	O	X	X		
Pertec	C,O	X	X	X	X
Qume	O		X		X
QYX	C			X	
Remex	O	X	X		
Shugart Associates	C,O	X	X	X	X
Sykes Datatronics	O	X			
Tandon Magnetics	O			X	X
Japanese Manufacturers					
Hitachi	C,O	X	X		
Matsushita	C,O	X	X	X	X
Mitsubishi	C,O	X	X		
Nippon Electric Company	C		X		
Oki Electric	C	X			
Ricoh	C	X			
TEAC	O		X	X	X
Toshiba	C,O	X	X		
YE Data	C,O	X	X		X
European Manufacturers					
BASF	O	X	X	X	X
Daisy Systems Holland	C	X			
Data Recording Equipment	O	X	X		
Logabax	C	X			
MERA/Metronex	C,O	X			
Olivetti	C	X	X		
SAGEM	O	X			
Siemens	C,O	X	X	X	X
Videoton	C,O	X			

Application mix

Small business systems were the dominant application area for all types of flexible disk drives in 1978 with 38% of combined worldwide unit shipments of all floppy drive configurations. The 1982 projection calls for a slight increase in share, to 40%, with annual drive consumption reaching 1,590,000 units. Small business systems from the traditional system OEMs, mainframers and minicomputer manufacturers have formed a continuing core for this market, and the growing wave of very small business systems from a new set of ambitious system OEMs has guaranteed a further increase in growth.

Miscellaneous mini/micro computer systems were second in usage of floppy drives in 1978, and seem destined to remain a major user for all types of floppy drives in 1982. This area includes dozens of varied applications, with microprocessor development systems currently enjoying the highest growth rate.

The share of total floppy shipments held by terminals is declining, from 16% in 1978 to an expected 8% in 1982. Principal applications such as key-to-diskette systems are gradually being displaced by direct input of data to systems through attached terminals.

Word processing is destined to increase in importance as a floppy drive market, moving from 16% in 1978 to 19% in 1982. Product mix in this application is undergoing a revolution: Dominance of 8 inch, one side drives in 1978 will be replaced by 1982 with dominance of 5.25 inch drives, both one and two sided.

Hobby and personal computers will also experience growth in share of total shipments, from 1978's 9% to 1982's 14%, with 5.25 inch, one side drives continuing to be the floppy format clearly leading in shipments.

TABLE 7

FLEXIBLE DISK DRIVE APPLICATION PROJECTION

CONSOLIDATED WORLDWIDE SHIPMENTS

	1978 Estimate					1982 Projection				
	ALL FDD	8" ONE SIDE	8" TWO SIDE	5.25" ONE SIDE	5.25" TWO SIDE	ALL FDD	8" ONE SIDE	8" TWO SIDE	5.25" ONE SIDE	5.25" TWO SIDE
SMALL BUSINESS SYSTEMS										
Units (000)	278.9	178.3	52.8	47.5	.3	1,590.0	297.8	723.1	135.7	433.4
Share %	38%	33%	75%	37%	100%	40%	46%	68%	11%	42%
MINI/MICRO COMPUTER SYSTEMS										
Units (000)	136.1	124.4	9.3	2.4	--	685.0	156.2	181.4	170.3	177.1
Share %	19%	23%	13%	2%	--	17%	24%	17%	14%	17%
TERMINALS										
Units (000)	115.0	100.3	7.2	7.5	--	299.1	125.0	34.5	113.4	26.2
Share %	16%	19%	10%	6%	--	8%	19%	3%	9%	3%
WORD PROCESSING										
Units (000)	117.8	90.7	1.2	25.9	--	757.7	25.3	67.9	345.6	318.9
Share %	16%	17%	2%	20%	--	19%	4%	6%	29%	31%
HOBBY/PERSONAL COMPUTERS										
Units (000)	67.9	26.7	.2	41.0	--	548.3	23.3	43.6	421.1	60.3
Share %	9%	5%	--	32%	--	14%	4%	4%	35%	6%
OTHER APPLICATIONS										
Units (000)	16.8	13.3	.2	3.3	--	72.2	20.2	23.2	18.6	10.2
Share %	2%	3%	--	3%	--	2%	3%	2%	2%	1%
TOTAL, ALL APPLICATIONS										
Units (000)	732.5	533.7	70.9	127.6	.3	3,952.3	647.8	1,073.7	1,204.7	1,026.1
Share %	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

TECHNICAL REVIEW

Competing technologies

Low cost, random access and media removability are the keys to today's outstanding commercial success of flexible disk drives. These features, in combination, have made it possible for shipments of all floppy drive configurations to total more than 1.4 million units worldwide in 1979, only six years after IBM's introduction of the basic 3740 format. In order to pose a serious challenge to the continued growth of floppy drive shipments, any competing storage technology would have to deliver actual improvements on the combination of floppies three principal features.

Five years ago, industry observers thought that a real contest would develop between the then-new OEM floppy drives, 1/4" tape cartridge, and digital cassettes for the low-cost storage device market. It is now clear that the logical applications for diskettes and small tape recording devices are basically different, just as the applications for large disk files and high performance 1/2" tape have evolved into different usage patterns. Serial recording devices really can't compete in random access applications, but have found an unexpectedly large market in backing up rigid disk drives.

At this time no electromechanical storage devices appear to offer potential competition to current floppy drives, except possible new floppy configurations. Current speculation centers on the future role of non-mechanical storage technologies such as CCD's and magnetic bubbles:

* Charge coupled devices: Few CCD advocates have ever seriously proposed them as replacements for any major flexible disk drive applications. Despite their volatility, CCD's have frequently been thought of as replacements for head-per-track rigid disk drives and as cache memories in many future systems -- applications which could exploit CCD fast access and non-mechanical

reliability. Suggestions have been made that CCD cache memories and higher capacity floppy drives might be paired in companion systems.

Major problems have occurred in 1979, however, with CCD availability. Some CCD vendors have withdrawn announced products, apparently concluding that CCD technology currently does not have an adequate cost differential over new 64 K-bit RAMs. The future development of storage subsystems using CCD's is now in question, at least for the next few years, as potential customers have serious doubts about the intentions of the semiconductor manufacturers with CCD programs.

* Magnetic bubbles: Through the 1982 forecast horizon of this report, bubbles are not expected to have any significant effect on growth of flexible disk drive shipments. They do, however, represent a significant memory technology, which will be used in a large number of products complementary to floppy disks. Bubbles have inherent advantages in reliability, adaptability to small storage requirements, moderately fast access, and ability to withstand severe environments. It is expected that bubbles will become the non-removable memory for numerous microprocessor-based systems, both commercial and military, and that they will be widely used in cache memory applications for mainframes and minicomputers using large data bases on low-cost-per-byte rigid disk drives.

  The 1979 announcement of Intel Magnetics' 1 M-bit bubble chip will help to flush out other 1 M-bit announcements from major semiconductor manufacturers with bubble plans. At the minimum, 1980 should see availability of these chips, plus a variety of previously announced 256 K-bit chips. With these developments, the non-captive bubble market is finally being established, and prices will stop being quotations in theory only. Bubbles are an ideal companion memory for the microprocessor, with extensive exploratory activity by systems OEMs expected in 1980. However, at least for the next several years, bubbles will be no threat to the mainstream of the floppy drive market, against floppies' lower price and removability.

Floppy drive enhancements

Flexible disk drives are a comparatively new technology in themselves, and further development of several technical parameters is to be expected. These areas bear watching:

* Double bit density: IBM's recording scheme for double linear density was introduced with the System/34 in December, 1977, and is now the

defacto standard for the industry. In addition to numerous controllers designed by system OEMs for this standard, single chip controllers using the IBM format have become available in the past year from multiple vendors. The trend is now strongly toward usage of OEM floppy drives of all configurations at double density, since the recording scheme no longer is in question. A by-product of this development is the companion trend toward soft sector OEM drives, instead of hard sector drives using diskette holes to identify individual sector locations.

It is probable that high capacity floppy drives will be introduced in the near future using net linear recording densities as much as double today's standard for double density 8 inch drives. Media changes will be required, using thinner coatings, perhaps down to 50 microinches, with higher coercivity magnetic particles, such as chromium dioxide.

* Double track density: Today's flexible disk media consists of an oxide coating on polyethylene terephthalate film, a very tough and flexible material, known to most of the world by its Dupont trademark, Mylar. The one real problem with Mylar is dimensional instability when exposed to changes in temperature or humidity. These changes do not occur uniformly, but vary in direction, dependent upon stresses built-in the material during manufacture. The result is that data tracks which were perfectly circular when written, may be somewhat egg-shaped after environmental changes. At the 48 TPI used by IBM in the basic floppy drive design, actual movement of track locations is not great enough to cause problems under environmental exposure limits recommended for drives and media. However, double track density for 8 inch drives is a very marginal situation for conventional floppy head positioning systems under a reasonable range of temperature and humidity. 5.25 inch drives using up to 100 TPI have been successful because of reduced track movement at the smaller diameter.

Attempts to develop more stable media have included usage of such diverse approaches as coating on plastic/foil laminations and the annealing of conventional Mylar. Laminations appear to be poor prospective substrates due to cost and potential problems with warping and loss of flexibility. Programs to anneal Mylar with heat treatments designed to relax inherent manufacturing stresses appear to have produced marginal results.

The industry knows how to design head positioning systems which can follow a non-concentric track, but they are more complicated than today's floppy actuator, and certainly will cost more. The approaches to be expected from drive manufacturers planning to offer higher capacity drives will probably fall into these groups: (1) Development of drives operating at 2 or 3 times the current

track density for 8 inch diskettes, by use of track-following servo systems, with actuator shared by dual drives to offset part of the high drive cost, and (2) Drives with a more modest increase in track density of about 50%, thus holding down cost of head positioning systems, and relying on doubling the linear recording density to achieve significant drive capacity improvements.

* Two sided drives: Manufacturing start-up problems with two sided drives have provided the industry's first large, continuing problem with flexible disk drives. Excessive media wear was the symptom noticed with many drives when evaluation tests were performed to load heads repeatedly at the same location. Changes in head contour, head carriages, timing of the loading cycle, combined with more durable media, have improved media wear sufficiently to allow a substantial increase in the shipping rate for two sided drives. The main problem remaining for drive manufacturers is the excessive labor cost in aligning drives and controlling quality with the existing drive designs. Drive manufacturers now have major internal programs to develop more producible drives, at lower cost. The general expectation is that these efforts will result in more reliable, as well as lower cost, floppy drives.

  Less certain is the final resolution of the battle between rival head carriage designs. Precise, predictable and fast alignment of heads is essential to achieving optimum production cost for any two sided drive. Both "IBM style" and "Tandon style", along with other variations, are now in use on production drives, with a new Shugart design expected in a few months. The winner may not be known for years.

* Access time: Per Sci is no longer alone as the sole manufacturer of flexible disk drives using a linear motor actuator. Decitek, a manufacturer of paper tape equipment now entering the floppy drive market, has announced a version of their basic drive with a linear motor actuator, also. These drives offer average access times completely out of the class of other floppy drives -- but so far all other competitors have found the trusty, low cost stepping motor to be cost-effective for the principal floppy markets.

* Revolutionary improvements: The prospect for emergence of floppy disks in new configurations remains good. One of the most obvious possibilities is a smaller disk diameter, with three inches being mentioned most frequently. It is possible to make a good theoretical case for a smaller floppy drive for applications such as smart typewriters and home computers. Only a dominant industry manufacturer could establish a defacto

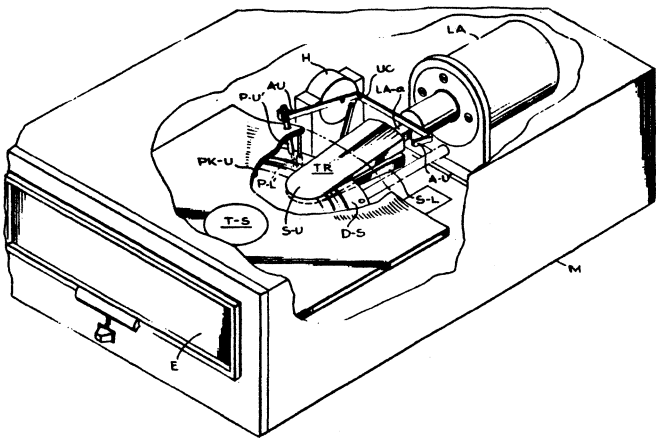
standard for such a drive -- but many manufacturers of OEM drives would add the product to their lines if such an introduction should occur.

Of greater interest to the typical system designer is the possibility of a floppy stack drive. Such a drive would use multiple disks to form a large, but low cost, storage system. Both IBM and Burroughs have been developing such drives for years, as indicated by the illustrations in Figure 5, representing only a few of the many patents issued to each firm for technology in the floppy stack area. IBM's patent activity covers many possible configurations, including some designs which apparently could hold large numbers of disks, in a drive with large on-line capacity. Burroughs' patents seem to indicate a smaller drive, using disks in a removable cartridge. Both companies' patents indicate use of sophisticated air flow systems to separate and stabilize rotating floppy disks during head access movements. The potential application of floppy stack systems would probably involve medium to large data bases associated with low to medium cost business computer systems. While access times would be slower than other disk systems, the amount of data available for direct access within a second or two could be large -- at least up to several hundred megabytes. Such a drive could be combined with a bubble memory cache, to form a highly cost effective back end processor for a wide variety of systems.

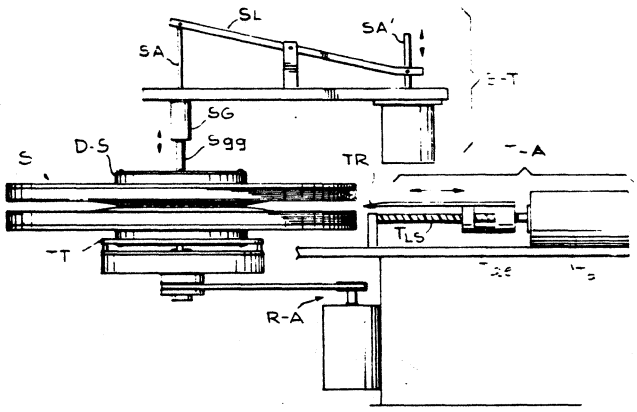
Figure 5

ILLUSTRATIONS FROM SELECTED PATENTS

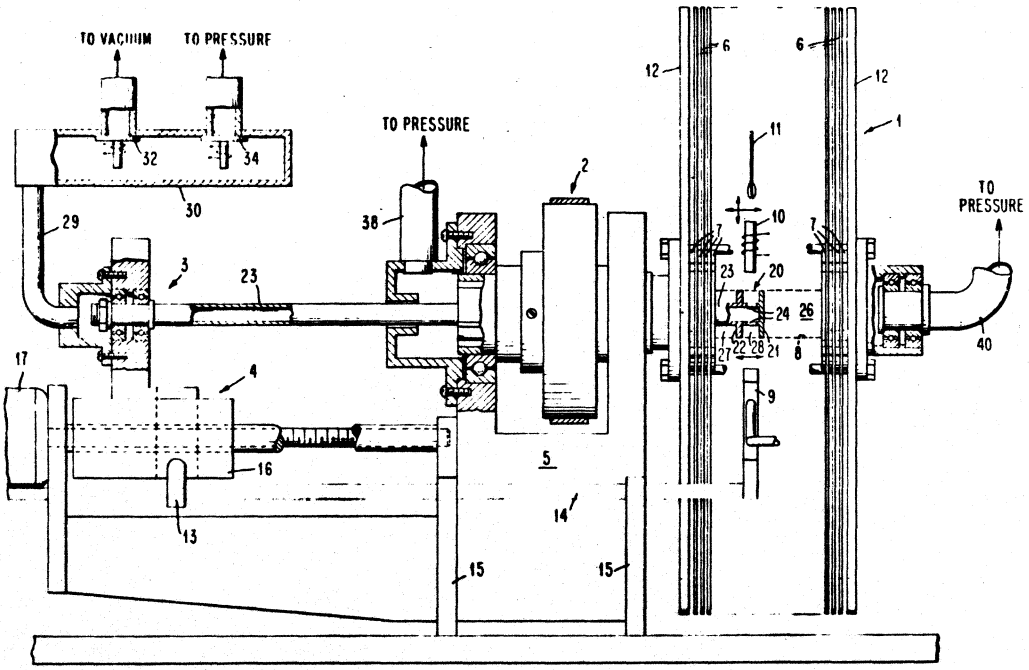
FLEXIBLE DISK STACK CONFIGURATIONS



Burroughs flexible disk cartridge design
U.S. PATENT 4,129,891 December 12, 1978



Burroughs flexible disk stack design
U.S. PATENT 4,118,746 October 3, 1978



IBM design for flexible disk stack air control system
U.S. PATENT 4,143,408 March 6, 1979

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 Olivetti 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 to 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.

Independent: Any disk drive manufacturer other than IBM.

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

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

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

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

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

* IBM, Memorex 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 and Mexico, 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.

* BASF is considered a non-U.S. manufacturer, although the firm manufactures flexible disk drives in the U.S. as well as in Germany.

Revenue: Based on sale of disk drives alone, as normally sold by individual manufacturers, without auxiliary hardware or spare parts. When sold as as 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 1979 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, the Per Sci drives which utilize a single actuator mechanism to control head movement on two separate flexible disks are counted as two spindles each.

Forecasts: Expected performance of 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 would probably 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 the emerging 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, Vydec or Tektronix. (2) Systems houses, of any size, which combine finished components and custom software to offer users complete systems.

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.

Retail computer stores: Outlets performing the function of local trading area dealers, usually with a store suitable for walk-in trade, offering low cost computer systems, peripherals, other components and advice to individual buyers. Includes chain stores and direct mail marketing companies -- however, firms which take system responsibility for stock computer products, such as Tandy's Radio Shacks and the Heathkit organization, are considered system OEMs.

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

1979 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

Coverage

Examples of flexible disk drives in this group include:

IBM	3740, System/32
BASF	6101, 6102
Caldisk	142M, 143M-1
Control Data	9400, 9404B
Datapoint	9381 series
Data Recording Equipment	7100
Decitek	DF8000/L, DF-8000/S
Digital Equipment	RX01, RX02
Hitachi	FDD 101A
Innotronics	410, 420
Logabax	LX 45D
Matsushita	JK-890/891, JK-880/881
Memorex	651, 550
Metronex	PLX45D
MFE	500
Mitsubishi	M892
Northern Telecom	Sycor 4505, FD 145
Olivetti	FDU 5600, AFD 6102
Per Sci	70, 277
Pertec	410, 500 series
Remex	RFD 1000, RFD 2000
Sagem	DS3
Shugart Associates	SA 900/901, SA 800/801
Siemens	100-8
Sykes Datatronics	7150, 9150
Toshiba	ND-10
Videoton	MFM-2
YE Data	YD-74C

This category includes all drives designed to use single sided flexible disks of nominal 8 inch diameter, 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 Memorex 651 format and the more widely used Shugart format.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1978	1979	1980	1981	1982
U.S. manufacturers	211.3	259.7	271.2	254.2	220.1
All manufacturers	352.8	408.6	404.5	367.5	311.0

Worldwide unit shipments of 8 inch, one side drives increased by 52.9% in 1978, and 1979 shipments are expected to reach 723,600 units, representing growth of 35.6%. However, during 1979 revenues are forecasted at an increase of only 15.8%, reflecting the continual annual decline in average selling price for drive shipments by all market classes.

Ironically, new production of IBM's 3740, the key-to-diskette subsystem which established basic drive and media specifications for 8 inch, one side floppies, was discontinued in March, 1979. And System/32, which also used large quantities of the same floppy drive, has not been in new production since October, 1978. IBM production of one side drives is believed to have peaked in 1977, but the firm still uses one side drives on several terminals, plus new word processing equipment.

All application areas for drives in this group remain strong in 1979, paced by the rapid growth of small business systems. Two sided drives are destined to dominate floppy usage with small business systems in future years, but they remain in short supply -- and one side drives are taking up the slack. OEM shipments continue to hold a dominant share of the worldwide total, reaching 72.3% in 1979.

DISK/TREND estimates of non-captive market shares, which now show market shares on a worldwide basis for non-U.S. as well as U.S. manufacturers, indicate

Shugart Associates held 41.6% of the worldwide market in 1978, with 61.0% of the U.S. market. Control Data remains in second place, while Memorex, Siemens and Per Sci each increased their share of the U.S. market. Among non-U.S. manufacturers, BASF, Toshiba and Hitachi held leading shares of the worldwide market.

Marketing trends

Total worldwide unit production of 8 inch, one side drives is expected to finally peak in 1980, as many drive manufacturers start high volume production of two sided drives. Approximately equal quantities of one and two sided 8 inch drives are expected to be shipped in 1980 with small business systems, the key application area. In 1981, total production of two sided 8 inch drives for all applications is forecasted to exceed one side drives for the first time. A continuing migration to 5.25 inch drives for non-IBM word processing systems will also contribute to the 1981 decline in 8 inch, one side drive production.

U.S. captive production of drives in this group is not expected to peak until 1981, following a product cycle which normally lags the OEM market by a year or two. Non-U.S. manufacture of both captive and OEM drives will peak during 1979/80, however, reflecting a concerted effort by Japanese manufacturers to move to two sided drives on a priority basis.

IBM's production of one side drives is expected to continue its decline, but very slowly. IBM apparently has no further plans to use these drives on new small business systems or key-to-diskette systems, but other applications will probably continue. Several specialized terminals use one side drives, and the role of Diskette 1 as a universal interchange medium should help the continuation

of this usage. Word processing applications will constitute a growing portion of IBM shipments. Office System/6 and the 3730 word processing system both use one side floppies.

Further decline in average OEM prices is inevitable. Despite the expected topping-out of production for one side drives, learning curve improvements in production cost will continue to be derived from production of other floppy drive configurations, all of which will experience rapid growth in future years. The worldwide average OEM price is forecasted at $306 for 1980, with the expectation that it will experience a further 8% reduction with each doubling of total 8 inch one side unit shipments.

Relative market positions in the OEM area will probably remain stable, with Shugart solidly in the lead. Numerous competitors are now producing at levels adequate for reasonable efficiency, with stable managements. History during the last few years has indicated that acquisitions may occur, but floppy drives continue to be produced in the same facilities. At this time, it appears that Sagem, with a minor share of the European market, is the only OEM manufacturer planning to phase out production.

Technical trends

The demand for more floppy capacity on small business systems, combined with a confused supply situation for two sided drives, has stimulated the movement to double density operation of one side 8 inch drives.

During the last few years, most OEM drives have been shipped with the capability to operate at either standard or double density, at the option of system OEMs. A growing proportion of these drives are now actually being operated at

double density, since, as a result of the industry's well publicized functional and delivery problems with two sided drives. IBM unintentionally gave the movement to double density recording on independent one side drives a big boost in late 1977, with deliveries of IBM's first double density drives, on System/34. The industry had lacked a concensus as to which of several recording schemes to use, and IBM's introduction provided another defacto standard welcomed by most participants. Low cost single chip controllers using the IBM double density code are now available from multiple sources, providing an added boost. An interesting byproduct of these developments is a strong tendency toward use of the IBM standard soft sector formats, both single and double density, on newly designed systems -- in preference to hard sector formats.

It remains unlikely that the various advances in flexible disk recording now being developed, such as double track density, faster head positioning systems or improved media, will be introduced first in the 8 inch, one side floppy format. However, many potential future improvements in other floppy formats will undoubtedly benefit drives in this group, also, as manufacturers attempt to maintain maximum commonality in parts and subassemblies.

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 systems designed during 1980 and later.

3. 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 format.

4. Existing applications for 8 inch, one side drives in word processing systems will be largely replaced by 5.25 inch drives within the next few years.

TABLE 8

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1978		Forecast							
	Shipments		1979		1980		1981		1982	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	41.8	62.6	32.9	49.4	26.3	39.6	24.1	35.7	22.4	32.8
Other U.S. Captive	48.1	66.8	65.0	92.4	73.4	106.3	71.6	105.2	64.1	95.7
TOTAL U.S. CAPTIVE	89.9	129.4	97.9	141.8	99.7	145.9	95.7	140.9	86.5	128.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	66.1	81.9	95.1	117.9	100.5	125.3	90.4	113.3	72.8	91.6
TOTAL U.S. NON-CAPTIVE	66.1	81.9	95.1	117.9	100.5	125.3	90.4	113.3	72.8	91.6
TOTAL U.S. SHIPMENTS	156.0	211.3	193.0	259.7	200.2	271.2	186.1	254.2	159.3	220.1
Non-U.S. Manufacturers										
Captive	8.4	93.8	8.7	96.6	8.3	83.6	7.7	70.2	6.7	55.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	5.6	47.7	8.3	52.3	7.9	49.7	7.0	43.1	5.8	35.3
TOTAL NON-U.S. SHIPMENTS	14.0	141.5	17.0	148.9	16.2	133.3	14.7	113.3	12.5	90.9
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	170.0	352.8	210.0	408.6	216.4	404.5	200.8	367.5	171.8	311.0
OEM Average Price ($000)	.327	.350	.308	.325	.292	.306	.282	.295	.277	.288

TABLE 9

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1978		Forecast							
	---Shipments--		-----1979-----		-----1980-----		-----1981-----		-----1982-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	20.9	31.3	17.3	26.0	14.6	22.0	14.2	21.0	14.0	20.5
Other U.S. Captive	50.0	69.4	74.2	105.5	91.7	132.9	95.4	140.3	91.6	136.7
TOTAL U.S. CAPTIVE	70.9	100.7	91.5	131.5	106.3	154.9	109.6	161.3	105.6	157.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	206.0	255.2	314.5	390.1	350.2	436.7	325.1	407.4	266.8	335.6
TOTAL U.S. NON-CAPTIVE	206.0	255.2	314.5	390.1	350.2	436.7	325.1	407.4	266.8	335.6
TOTAL U.S. SHIPMENTS	276.9	355.9	406.0	521.6	456.5	591.6	434.7	568.7	372.4	492.8
Non-U.S. Manufacturers										
Captive	5.6	62.5	6.2	69.0	6.4	64.3	6.4	58.5	6.1	50.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	13.5	115.3	21.0	133.0	21.6	135.3	19.9	123.1	17.1	104.5
TOTAL NON-U.S. SHIPMENTS	19.1	177.8	27.2	202.0	28.0	199.6	26.3	181.6	23.2	155.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	296.0	533.7	433.2	723.6	484.5	791.2	461.0	750.3	395.6	647.8
Installed at Year End										
IBM	145.8	190.1	163.1	216.1	177.7	238.1	191.9	259.1	205.9	279.6
Non-IBM	580.1	1,036.6	996.0	1,734.2	1,465.9	2,503.4	1,912.7	3,232.7	2,294.3	3,860.0
WORLDWIDE TOTAL	725.9	1,226.7	1,159.1	1,950.3	1,643.6	2,741.5	2,104.6	3,491.8	2,500.2	4,139.6

TABLE 10

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

Distribution Channel	1978 U.S. Net Shipments Units (000)	%	FORECAST 1979 %	1980 %	1981 %	1982 %
Mainframe computer manufacturers	17.4	8.5	8.1	7.7	7.3	6.9
Mini/micro computer manufacturers	46.9	22.7	22.0	21.4	20.7	20.1
System OEMs/systems houses	123.0	59.7	60.2	60.7	61.1	61.4
Independent peripherals suppliers	17.7	8.6	9.2	9.8	10.5	11.3
Direct to end user/retail dealers	1.0	.5	.5	.4	.4	.3
TOTAL	206.0					

TABLE 11

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

Drive Manufacturers	1978 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Shugart	134.0	61.0	154.0	41.6
Control Data	18.0	8.2	36.0	9.7
BASF	--	--	29.0	7.8
Memorex	18.0	8.2	20.0	5.4
Toshiba	--	--	18.0	4.9
Hitachi	--	--	14.4	3.9
Siemens	13.5	6.1	13.5	3.6
Per Sci	12.0	5.5	13.0	3.5
Calcomp (now Caldisk)	7.4	3.4	12.8	3.5
Mitsubishi	--	--	12.1	3.3
YE Data	--	--	10.8	2.9
Other U.S.	16.6	7.6	19.4	5.2
Other Non-U.S.	--	--	17.5	4.7
	219.5	100.0	370.5	100.0

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

1979 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

Coverage

Examples of flexible disk drives in this group include:

IBM	3600 series, System/34, 4964, 4966, 5114
BASF	6104
Burroughs	9489-11, 12
Caldisk	143M
Control Data	9406, 210-10
Data Recording Equipment	7200
Decitek	DF-8002/L, DF-8002/S
Hitachi	FDD 201, FDD 401
Matsushita	JK-885/886
Memorex	552
MFE	700
Mitsubishi	M2893, M2894
Nippon Electric Company	N7707
Per Sci	288, 299
Pertec	650
Qume	Datatrak 8
Remex	RFD 4000
Shugart Associates	SA 850/851
Siemens	200-8
TEAC	FD-100
Toshiba	ND-20, ND-20D
YE Data	YD-174

With one exception, all drives in this group are designed to use IBM's recording formats for two sided flexible disks -- either Diskette 2 for single density or Diskette 2D for double density. IBM's diskette magazine drive is included in the group. The Burroughs drive uses a completely different recording format, and is offered only with Burroughs systems.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1978	1979	1980	1981	1982
U.S. manufacturers	80.4	182.7	298.6	463.1	585.0
All manufacturers	100.2	264.9	445.9	718.4	906.9

Despite serious technical problems and frequent negative publicity during the past year, 8 inch, two sided drives are now being shipped in significant quantities. Worldwide shipments of 70,900 units in 1978 are expected to increase to 236,400 units in 1979.

The initial problem with two sided drives was excessive media wear when a single track was accessed repeatedly. While the problem was unusual in actual system operation, it created a very bad comparison with one sided drives in OEM engineering evaluations.

Improvements in heads, drives and media have resulted in drives considered to be adequately reliable by most system OEMs, but remaining problems involve producibility and manufacturing cost. To some extent, manufacturers have managed to deliver two sided drives at the expense of excessive labor costs, due to the alignment and quality assurance procedures necessary with existing drive designs. This situation has combined with start-up problems by head manufacturers to hold drive production to levels substantially below market demand. Shugart Associates, the largest floppy drive manufacturer, has announced that it is making significant changes in its design, with the expectation that major increases in production levels will be accomplished starting at the beginning of 1980.

Because IBM has used two sided drives on its newer small business systems and minicomputers, including the diskette magazine drive offered with System/34 and Series/1, the firm's shipping rate for drives in this group will reach an estimated 49,500 spindles in 1979, almost double the 1978 total.

U.S. manufacturers of OEM drives will increase shipments from 8,600 units in 1978 to an estimated 91,500 in 1979. Non-U.S. manufacturers will also

sharply increase shipments in 1979, reaching an estimated 80,000 spindles, with the largest portion of the growth by Japanese producers.

Marketing trends

The DISK/TREND forecast for 1980 total worldwide shipments of drives in this group is 424,300 spindles, a 79.5% increase over 1979. While representing a major escalation in shipment level, the figure would be higher had the industry not experienced severe start-up problems. During 1980, the remnants of these problems will still be present, in the form of head shortages and temporary production disruption caused by phasing-in new, more producible designs. It is believed that things should be going more smoothly by 1981, however, and the worldwide shipment total for that year is projected at 798,600, up another 88.2% with two sided 8 inch drive shipments passing up one sided drives for the first time.

The dynamic U.S. small business system marketplace, along with other applications, will turn strongly to the two sided 8 inch configuration, with shipments by U.S. manufacturers of OEM drives expected to reach 601,300 units in 1982, 56.0% of worldwide shipments in that year. This projection represents the market penetration expected for 8 inch, two sided OEM drives after allowance for sharing part of the key application areas with 5.25 inch, two sided drives and 8 inch fixed rigid disk drives. Shipments of PCM drives for IBM systems are expected to remain relatively small, due to high marketing costs involved in reaching users.

The slow start for U.S. drives in this group gave Japanese manufacturers an early lead in production of OEM drives, perhaps attributable to greater

emphasis on quality assurance techniques during head assembly and drive alignment. Now that the appetite of the larger U.S market for higher capacity floppy drives is starting to be felt, the U.S. share of worldwide shipments is expected to climb from 64.0% in 1978 to 72.3% in 1982.

Shugart Associates held only 15.4% of the worldwide non-captive market in 1978, behind Hitachi and YE Data, but this situation is due to change, with the growth of the OEM market discussed above. It is expected that Shugart will emerge as the largest producer of drives in this group, but probably with a smaller market share than it holds for 8 inch, one side drives.

OEM pricing for 8 inch, two sided drives is now significantly higher than early in 1979. Shugart Associates originally introduced a two sided drive in 1977 at prices about 25% above the equivalent one sided drive, and pricing by Shugart's U.S. competitors generally followed the same approach. Shugart has now acknowledged that a 25% differential is not realistic in view of higher manufacturing costs than planned, and has announced increased prices.

Technical trends

Long term DISK/TREND forecasts for this product group, especially after 1981, are vulnerable to potential introduction by IBM of new flexible disk drive configurations with higher capacity. Activity during 1979 has included projects such as "Bright", an 8 inch, two sided drive using a special chromium dioxide coated diskette, with 3 - 6 MB capacity, and "Sprat", an 8 inch, one sided drive with 4 - 5 MB capacity and fast access, using non-contact recording.

Whether or not the technology represented by the above projects is used, IBM is expected to introduce higher capacity diskettes to meet various system

requirements. Two of the more obvious possibilities are a diskette-based small business system to fill the gap between the 5110 and the System/32 (no longer in new production), or a diskette magazine drive using high capacity floppies to provide backup for the Piccolo 8 inch rigid fixed disk drive. As usual, any IBM flexible drive introduction will establish a standard for equivalent OEM drives, which may be expected to follow 12 to 18 months behind IBM's first shipment.

Burroughs has also been busy with the development of a high capacity 8 inch, two sided floppy drive, perhaps the most poorly kept secret in the industry's history. The design objective for this program has been to provide 5 MB, formatted, per spindle, but the program has had its share of problems with the planned 150 TPI, and it is possible the drive may be introduced sometime in the near future with a lower capacity.

IBM's sole announced approach to higher floppy capacity to date has been the diskette magazine drive, which can handle up to 23 Diskette 2D floppies under system control. At this time it appears that only IBM will offer this mechanism. Most system OEMs consider it too bulky, with excessive media costs for the capacity offered, and there are no known plans for drive manufacturers to offer independent versions.

Forecasting assumptions

1. Technical problems with two sided drives have been adequately solved to allow remaining head shortages and drive design problems to be solved during 1980, during a period of continuous production increases.

2. Introduction of higher capacity flexible disk drives will not impact shipments of existing drives through 1981.

3. OEM average selling prices, established at a 50% differential above one sided drive prices in 1980, will decline to a 40% differential in 1982.

TABLE 12

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1978		Forecast							
	Shipments		1979		1980		1981		1982	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	42.7	57.4	78.7	113.9	119.5	172.8	147.1	219.4	162.2	245.8
Other U.S. Captive	11.7	19.3	17.2	26.9	25.0	38.9	38.6	61.3	60.9	98.3
TOTAL U.S. CAPTIVE	54.4	76.7	95.9	140.8	144.5	211.7	185.7	280.7	223.1	344.1
PCM	--	--	.4	.6	2.9	3.8	4.8	7.0	6.4	9.4
OEM	3.1	3.7	33.9	41.3	67.7	83.1	142.1	175.4	185.2	231.5
TOTAL U.S. NON-CAPTIVE	3.1	3.7	34.3	41.9	70.6	86.9	146.9	182.4	191.6	240.9
TOTAL U.S. SHIPMENTS	57.5	80.4	130.2	182.7	215.1	298.6	332.6	463.1	414.7	585.0
Non-U.S. Manufacturers										
Captive	--	6.9	1.1	52.1	5.0	102.5	13.0	186.8	19.2	240.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	2.0	12.9	5.9	30.1	10.8	44.8	17.8	68.5	22.8	81.4
TOTAL NON-U.S. SHIPMENTS	2.0	19.8	7.0	82.2	15.8	147.3	30.8	255.3	42.0	321.9
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	59.5	100.2	137.2	264.9	230.9	445.9	363.4	718.4	456.7	906.9
OEM Average Price ($000)	.481	.534	.463	.483	.438	.460	.413	.428	.393	.405

TABLE 13

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1978		Forecast							
	Shipments		1979		1980		1981		1982	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	19.4	26.1	34.2	49.5	49.8	72.0	61.3	91.4	67.6	102.4
Other U.S. Captive	6.5	10.7	9.6	15.0	14.7	22.9	24.1	38.3	40.6	65.5
TOTAL U.S. CAPTIVE	25.9	36.8	43.8	64.5	64.5	94.9	85.4	129.7	108.2	167.9
PCM	--	--	.3	.4	2.1	2.7	3.7	5.4	4.9	7.2
OEM	7.1	8.6	75.0	91.5	159.4	195.6	352.5	435.2	481.0	601.3
TOTAL U.S. NON-CAPTIVE	7.1	8.6	75.3	91.9	161.5	198.3	356.2	440.6	485.9	608.5
TOTAL U.S. SHIPMENTS	33.0	45.4	119.1	156.4	226.0	293.2	441.6	570.3	594.1	776.4
Non-U.S. Manufacturers										
Captive	--	3.0	.5	23.7	2.4	48.8	6.5	93.4	10.1	126.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	3.5	22.5	11.0	56.3	19.8	82.3	35.1	134.9	47.8	170.7
TOTAL NON-U.S. SHIPMENTS	3.5	25.5	11.5	80.0	22.2	131.1	41.6	228.3	57.9	297.3
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	36.5	70.9	130.6	236.4	248.2	424.3	483.2	798.6	652.0	1,073.7
Installed at Year End										
IBM	23.3	32.1	57.5	81.6	107.3	153.6	168.6	245.0	236.2	347.4
Non-IBM	22.6	54.0	119.0	240.9	317.4	593.2	739.3	1,300.4	1,323.7	2,271.7
WORLDWIDE TOTAL	45.9	86.1	176.5	322.5	424.7	746.8	907.9	1,545.4	1,559.9	2,619.1

TABLE 14

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

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

Distribution Channel	1978 U.S. Net Shipments Units (000)	%	FORECAST 1979 %	1980 %	1981 %	1982 %
Mainframe computer manufacturers	.3	4.2	4.8	5.6	6.4	7.3
Mini/micro computer manufacturers	1.2	16.9	18.1	19.3	20.7	22.2
System OEMs/systems houses	5.0	70.4	68.3	65.8	62.9	59.7
Independent peripherals suppliers	.5	7.1	7.8	8.6	9.5	10.4
Direct to end user/retail dealers	.1	1.4	1.0	.7	.5	.4
TOTAL	7.1					

TABLE 15

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1978 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Hitachi	--	--	12.0	38.6
Ye Data	2.0	18.9	7.5	24.1
Shugart	4.1	38.7	4.8	15.4
Other U.S.	3.0	28.3	3.8	12.2
Other Non-U.S.	1.5	14.1	3.0	9.7
	10.6	100.0	31.1	100.0

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

1979 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

Coverage

Examples of flexible disk drives in this group include:

BASF	6106
Matsushita	JK-874
Micro Peripherals	B51
Micropolis	1015-II, 1041-II
Pertec	200
Shugart Associates	SA 400
Siemens	100-5
TEAC	FD-50A

The basic standard for 5.25 inch, one side drives was established by the Shugart Associates SA 400, introduced in 1976. Each of the manufacturers listed above offers drives with nominal media interchangeability using Shugart's 35 track recording standard. Several also offer 40 track drives with higher capacities, and Micropolis manufactures a family of drives which operate at 100 TPI, using 77 tracks per surface.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1978	1979	1980	1981	1982
U.S. manufacturers	23.5	62.3	102.8	149.0	197.6
All manufacturers	24.3	76.8	130.3	196.5	275.8

The current growth rate for 5.25 inch, one side drives is so steep that the industry's shipments have fallen far behind demand in 1979. 1978's worldwide total shipments of 127,600 units represented a major achievement only two years after introduction of the product. But the DISK/TREND estimate for 1979 is now 434,300 spindles, up 240.4% over 1978. The minifloppy has become a $76,900,000 business in only three years.

Although 5.25 inch, one side drives are now used in almost every floppy application area, the three largest are word processing, hobby and personal computers, and very small business systems. For most such systems, the combination of low price and small physical size has been irresistible to system designers. However, it is expected that two sided 5.25 inch drives will eventually divert a large share of the market available with very small business sytems, by offering double the capacity in the same space.

Only 1.5% of 1979's estimated worldwide shipments will be captive production, representing early-stage programs by Japanese manufacturers and Qyx, the Exxon Enterprises subsidiary now using 5.25 inch floppies in a family of smart typewriters.

U.S. OEM manufacturers will account for 82.8% of the 1979 worldwide shipment total, with non-U.S. OEM manufacturers at 15.7%. But while shipments by non-U.S. manufacturers will total 68,300 units, 39,000 of this number will actually be produced in the U.S. by subsidiary operations.

In 1978, Shugart Associates' share of the worldwide non-captive market fell to 66.8%, compared to 1977's 87.0%, as several competitors' marketing and manufacturing programs started to produce results. The Perkin-Elmer Wangco subsidiary was in second place in 1978 with 15.1% share, with Micropolis a strong third at 11.1%. Wangco's floppy operation was purchased by Siemens in early 1979, and shipments by this facility for the calendar year 1979 will be classified in DISK/TREND statistics as being made by a non-U.S. manufacturer.

Marketing trends

With the sharp growth of 5.25 inch drive purchases by individual system OEMs with substantial volume requirements, it is reasonable to expect the

emergence of new captive manufacturing programs. One of the first is expected to be Apple Computer, which already manufactures the electronics used with a mechanism-only drive purchased from Shugart Associates, and performs final assembly, alignment and testing in its own plant. It is believed that Apple will switch to a Japanese contract vendor for the drive mechanism by early 1980, and eventually may introduce a higher density version of its own design. Tandy's Radio Shack operation buys more 5.25 inch, one side drives than any other system OEM, and is considered another likely candidate for a move to captive production. Tandy was unsuccessful in at least one attempt to obtain production facilities by acquisition, but probably won't be stopped by that setback.

Despite the spectacular growth for this product group in 1979, DISK/TREND projections call for a more sedate 1980 increase in worldwide shipments of 67.0%, a total of 725,500 units. The growth rate would clearly be higher without the impact on 1980 growth of two sided 5.25 drives, and a mild dampening of demand for hobby and personal computers due to pressure by the recession. By 1981, shipments of 5.25 inch, one side drives are expected to exceed those of any other type of floppy drive, and by 1982 the worldwide total is forecasted at 1,204,700 units.

OEM annual production increases are expected to drop-off sharply by 1982, because of the impact of captive production programs and inroads by two sided 5.25 inch drives, but the 1982 OEM total should nevertheless reach 1,006,000 units. In that year worldwide shipments of OEM drives are expected to be 83.5% of the total, down from 1979's 98.5%.

OEM prices have been falling rapidly, responding to a combination of rapid growth and a tendency by some large system OEMs to buy only the drive mechanism

from the original drive manufacturer and add electronics. The industry also expects Shugart Associates to introduce an extremely low cost version of the 5.25 inch, one side drive targeted at the hobby and personal computer application area, which will tend to keep up the pressure for lower average prices. The DISK/TREND worldwide average OEM price for 1980 is forecasted at $157, declining to $142 in 1982. This projection represents a price decline of 6% with each doubling of cumulative industry shipments of drives in this group.

Technical trends

Low unit cost remains the most important factor behind the outstanding growth rate of 5.25 inch, one side drives. As a result, the products in this group are vulnerable to any lower cost random access device which might become available.

To date, the potential alternatives have not been serious threats, at least during the forecast period of this report. The smaller flexible disk format proposed by Standard Electrik Lorenz, a German ITT affiliate, has not been adopted by any manufacturer. Magnetic bubbles will not be serious cost competition for 5.25 inch, one side floppy drives through 1982, although they will be used in many small systems requiring bubbles' functional characteristics.

The prime vulnerability would be to a smaller flexible disk format offered by a major factor in the industry. Such a drive, possibly using flexible disks in the 3 inch range, could probably offer another large reduction in device cost, combined with the advantage of size appropriate for equipment such as typewriters and small home computers. Although specific plans to introduce such a drive are not known, it is considered a strong probability during the next

few years, and could establish a standard for OEM drives if offered by a dominant industry manufacturer.

Short term trends in this product group will include movements toward both low and high performance. The expected Shugart low cost drive will probably achieve its pricing targets through design simplification and relaxation of MTBF standards. Reliability will probably be adequate to satisfy the intended hobby and personal computer market, but below that expected for normal commercial applications. At the high end, more double track density drives are expected, although some may be designed for 96 TPI, instead of the 100 TPI pioneered by Micropolis. The rationale for 96 TPI is the possibility that many users will be completely satisfied with media tested at 48 TPI due to close proximity of corresponding track locations.

Forecasting assumptions

1. Introduction of a smaller floppy format by a major industry manufacturer will not occur before 1981.

2. 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 displaced in most applications also requiring larger capacity by two sided 5.25 inch drives.

3. Additional captive and OEM manufacturers will produce 5.25 inch, one side drives in 1980.

TABLE 16

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1978		Forecast							
	Shipments		1979		1980		1981		1982	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	1.4	1.4	4.2	4.2	15.3	17.0	38.0	47.5	63.5	88.2
TOTAL U.S. CAPTIVE	1.4	1.4	4.2	4.2	15.3	17.0	38.0	47.5	63.5	88.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	19.8	22.1	50.9	58.1	73.0	85.8	84.2	101.5	89.7	109.4
TOTAL U.S. NON-CAPTIVE	19.8	22.1	50.9	58.1	73.0	85.8	84.2	101.5	89.7	109.4
TOTAL U.S. SHIPMENTS	21.2	23.5	55.1	62.3	88.3	102.8	122.2	149.0	153.2	197.6
Non-U.S. Manufacturers										
Captive	--	--	--	.4	--	4.5	.9	17.4	3.5	44.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	.1	.8	8.2	14.1	11.8	23.0	14.1	30.1	14.9	33.8
TOTAL NON-U.S. SHIPMENTS	.1	.8	8.2	14.5	11.8	27.5	15.0	47.5	18.4	78.2
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	21.3	24.3	63.3	76.8	100.1	130.3	137.2	196.5	171.6	275.8
OEM Average Price ($000)	.181	.182	.167	.169	.154	.157	.147	.149	.141	.142

TABLE 17

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1978		Forecast							
	Shipments		1979		1980		1981		1982	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	1.9	1.9	6.0	6.0	22.9	25.4	59.4	74.2	104.1	144.6
TOTAL U.S. CAPTIVE	1.9	1.9	6.0	6.0	22.9	25.4	59.4	74.2	104.1	144.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	109.8	122.7	314.8	359.5	486.4	572.2	589.0	709.6	645.1	786.7
TOTAL U.S. NON-CAPTIVE	109.8	122.7	314.8	359.5	486.4	572.2	589.0	709.6	645.1	786.7
TOTAL U.S. SHIPMENTS	111.7	124.6	320.8	365.5	509.3	597.6	648.4	783.8	749.2	931.3
Non-U.S. Manufacturers										
Captive	--	--	--	.5	--	5.1	1.0	20.5	4.3	54.1
PCM	--	--	--	--	--	--	--	--	--	--
OEM	.2	3.0	39.5	68.3	62.5	122.5	80.7	171.8	96.5	219.3
TOTAL NON-U.S. SHIPMENTS	.2	3.0	39.5	68.8	62.5	127.6	81.7	192.3	100.8	273.4
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	111.9	127.6	360.3	434.3	571.8	725.2	730.1	976.1	850.0	1,204.7
Installed at Year End										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	139.8	156.7	500.1	591.0	1,071.9	1,316.2	1,802.0	2,292.3	2,652.0	3,497.0
WORLDWIDE TOTAL	139.8	156.7	500.1	591.0	1,071.9	1,316.2	1,802.0	2,292.3	2,652.0	3,497.0

TABLE 18

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

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

Distribution Channel	1978 U.S. Net Shipments Units (000)	%	FORECAST 1979 %	1980 %	1981 %	1982 %
Mainframe computer manufacturers	1.5	1.4	1.6	1.9	2.1	2.4
Mini/micro computer manufacturers	2.5	2.3	2.7	3.0	3.5	4.0
System OEMs/systems houses	82.7	75.3	75.0	75.6	76.1	77.0
Independent peripherals suppliers	20.6	18.7	17.9	16.2	14.8	13.9
Direct to end user/retail dealers	2.5	2.3	2.8	3.3	3.5	2.7
TOTAL	109.8					

TABLE 19

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1978 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Shugart	73.9	67.2	84.0	66.8
Wangco (now Siemens)	19.0	17.3	19.0	15.1
Micropolis	11.9	10.8	14.0	11.1
Pertec	3.0	2.7	3.7	3.0
BASF	.2	.2	3.0	2.4
Micro Peripherals	2.0	1.8	2.0	1.6
	110.0	100.0	125.7	100.0

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

1979 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

Coverage

Examples of flexible disk drives in this group include:

BASF	6108
Caldisk	14M
Matsushita	JK-875
Micro Peripherals	B52
Micropolis	1015-IV, 1055-IV
Pertec	250
Qume	Datatrak 5
Shugart Associates	SA 450
Siemens	200-5
Tandon Magnetics	TM-100
TEAC	FD-50B
YE Data	YD-274

With the exception of the Micropolis family of 100 TPI drives, all drives in this group are designed to offer media compatibility with the first announced 5.25 inch, two sided drive, the Shugart Associates SA 450, with 35 tracks. A few also offer 40 track options.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1978	1979	1980	1981	1982
U.S. manufacturers	--	7.8	23.5	70.3	147.6
All manufacturers	.1	13.6	37.9	124.1	279.6

Floppy drives in this group suffered from the same problems with excess media wear that have plagued 8 inch, two sided drives. The current situation finds several manufacturers shipping drives, but the build-up in total shipments has been delayed to the approximate extent envisioned in the 1978 DISK/TREND Report. Only minimal shipments were made in 1978, but worldwide shipments in 1979 are estimated at 54,200 units.

Despite the fact that Shugart Associates initiated activity in this product group with the October, 1977, announcement of the SA 450, the industry leader has elected to concentrate in solving its problems with 8 inch, two sided drives first. As a consequence, the firm made insignificant shipments of 5.25 inch, one side drives in the two years following product announcement, with first shipment of production drives finally expected in late 1979.

The Tandon Magnetics offer to supply completed drives or drive mechanisms to its head customers lacking 5.25 inch drives attracted no takers, and Tandon has entered the OEM drive market with the intention to secure a major share. Other drives announced since last year include Qume (YE Data license), Caldisk, Matsushita (Shugart license) and TEAC. The Wangco 282 is now offered as the Siemens 200-5, following the sale of the Wangco floppy operation by Perkin Elmer.

Marketing trends

Application areas expected to provide greatest demand are very small business systems and those word processing applications requiring a combination of small space but more capacity than 5.25 inch, one side drives. DISK/TREND projections indicate 73.3% of 5.25 inch, two side drives going to these two applications in 1982.

The fact is that 5.25 inch, two side drives offer an extremely cost-effective combination of size and price. They provide for system modularity by allowing capacity upgrades in the same physical space, with similar interfaces and controllers. And average OEM prices, although higher than expected a year ago due to more realistically known manufacturing costs, are still lower than prices for

8 inch, one side drives. OEM prices for 5.25 inch, two side drives are expected to average about 80% of those for 8 inch, one side drives in 1980, dropping to about 75% in 1982.

Because of these advantages, drives in this group are expected to achieve dynamic growth during the next three years, with 1982 worldwide shipments totaling 1,026,000 units. The start of captive production is forecasted for 1981, but total captive shipments in 1982 are not expected to exceed 6% of the worldwide total.

Technical trends

The primary reason for the existence of 5.25 inch, two side drives is the pressure for more capacity in small space. Low cost controller chips are already helping to insure that a high proportion of these drives are operated at double linear density. And the example set by Micropolis of successful double track density in 5.25 inch drives is finally attracting competitive interest, although several competitors will probably offer 96 TPI, instead of Micropolis' 100 TPI. It is also reasonable to expect that if any improved technology should be offered for 8 inch diskettes, in the form of better dimensional stability or higher resolution coatings, 5.25 inch versions will be close behind.

Forecasting assumptions

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

2. Additional 5.25 inch, two side drives will be introduced by manufacturers of OEM drives in 1980, and captive drives in 1981.

TABLE 20

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1978 Shipments		Forecast							
			1979		1980		1981		1982	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	--	--	--	--	5.8	6.4	23.0	27.1
TOTAL U.S. CAPTIVE	--	--	--	--	--	--	5.8	6.4	23.0	27.1
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	--	7.2	7.8	20.7	23.5	55.0	63.9	100.0	120.5
TOTAL U.S. NON-CAPTIVE	--	--	7.2	7.8	20.7	23.5	55.0	63.9	100.0	120.5
TOTAL U.S. SHIPMENTS	--	--	7.2	7.8	20.7	23.5	60.8	70.3	123.0	147.6
Non-U.S. Manufacturers										
Captive	--	--	--	--	--	--	.6	11.6	3.6	45.9
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	.1	3.1	5.8	6.8	14.4	18.6	42.2	35.3	86.1
TOTAL NON-U.S. SHIPMENTS	--	.1	3.1	5.8	6.8	14.4	19.2	53.8	38.9	132.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	--	.1	10.3	13.6	27.5	37.9	80.0	124.1	161.9	279.6
OEM Average Price ($000)		.333	.245	.251	.237	.243	.220	.226	.208	.213

TABLE 21

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1978		Forecast							
	Shipments		1979		1980		1981		1982	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	--	--	--	--	4.8	5.3	20.9	24.6
TOTAL U.S. CAPTIVE	--	--	--	--	--	--	4.8	5.3	20.9	24.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	--	31.0	33.7	91.9	104.4	261.8	304.4	502.6	605.5
TOTAL U.S. NON-CAPTIVE	--	--	31.0	33.7	91.9	104.4	261.8	304.4	502.6	605.5
TOTAL U.S. SHIPMENTS	--	--	31.0	33.7	91.9	104.4	266.6	309.7	523.5	630.1
Non-U.S. Manufacturers										
Captive	--	--	--	--	--	--	.4	7.7	2.6	32.8
PCM	--	--	--	--	--	--	--	--	--	--
OEM	.1	.3	11.0	20.5	24.2	51.4	72.6	165.0	148.9	363.2
TOTAL NON-U.S. SHIPMENTS	.1	.3	11.0	20.5	24.2	51.4	73.0	172.7	151.5	396.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	.1	.3	42.0	54.2	116.1	155.8	339.6	482.4	675.0	1,026.1
Installed at Year End										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	.1	.3	42.1	54.5	158.2	210.3	497.8	692.7	1,172.8	1,718.8
WORLDWIDE TOTAL	.1	.3	42.1	54.5	158.2	210.3	497.8	692.7	1,172.8	1,718.8

TABLE 22

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

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

	FORECAST			
Distribution Channel	1979 %	1980 %	1981 %	1982 %
Mainframe computer manufacturers	3.0	3.4	3.8	4.2
Mini/micro computer manufacturers	16.3	17.6	19.0	20.5
System OEMs/systems houses	70.8	68.1	65.8	63.2
Independent peripherals suppliers	7.5	8.3	9.1	10.0
Direct to end user/retail dealers	2.4	2.6	2.3	2.1

FLEXIBLE DISK DRIVE SPECIFICATIONS

1979 DISK/TREND REPORT

DISK DRIVE SPECIFICATIONS

Coverage

This listing includes most U.S. and many non-U.S. 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. Listings for most manufacturers are confined to OEM drive models, but 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 category for 8 inch, one sided drives includes not only the drives nominally compatible with IBM media, but also a variety of "hard sector" drives, including the unique Memorex 651. The newly announced IBM magazine drive has been included in the 8 inch, two sided group, since the magazine mechanism feeds diskettes to a single drive.

Generic Type

In most cases IBM drive and media model numbers are used to describe the general physical form of drives and media, since IBM's designations are well known throughout the industry. However, usage of an IBM model number is not

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 or stack of disks operated as a unit.

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

MANUFACTURER	BASF	BASF	BASF	BASF	BASF	BURROUGHS	BURROUGHS
DRIVE	6101	6102	6104	6106	6108	9489-11 9489-12	9489-17 9489-18
DISK/TREND GROUP	10	10	11	12	13	11	10
MEDIA COMPATIBILITY	BASF 601 Diskette 1	BASF 601 Diskette 1	Diskette 1 Diskette 2, 2D	BASF 606 SA 104/SA 105	BASF 606 SA 154/SA 155	Special	Diskette 1
SECTORING	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Hard	Soft
NOMINAL DISK DIAMETER	8"	8"	8"	5.25"	5.25"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	U: .401	U: .401/.802	U: .8/1.6	U: .125	U: .250	F: 1.014	F: .243
Capacity per track (Bytes)	U: 5,208	U: 5,208/10,416	U: 5,208/10,416	U: 3,125	U: 3,125	F: 5,760	F: 3,328
Data surfaces per spindle	1	1	2	1	2	2	1
Tracks per surface	77	77	77	40	40	88	77
TPI	48	48	48	48	48	64	48
BPI	3268	3268/6536	3268/6536	2767	2767	4775	3268
RPM	360	360	360	300	300	365	360
Actuator type	Lead Screw	Lead Screw	Lead Screw	Cam	Cam	Lead Screw	Lead Screw
POSITIONING: Track to track(msec)	6	6	3	12	12	5	10
Settling time (msec)	12	14	14	45	45	50	10
Head load time(msec)	40	40	40	35	35	85	60
Average rotational delay (msec)	83.3	83.3	83.3	100	100	82	83.3
Data transfer rate (KBytes/sec)	31.25	31.25/62.5	31.25/62.5	15.63	15.63	50	31.25
FIRST CUSTOMER SHIPMENT	1976	1976	1978	3Q78	4Q78	4Q76	
COMMENTS						9489-12 is Dual Version	9489-18 is Dual Version

BASF

BURROUGHS

MANUFACTURER	CALDISK	CALDISK	CALDISK	CALDISK	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	142M	143M-1	143M	14M	9400	9404	9404B
DISK/TREND GROUP	10	10	11	13	10	10	10
MEDIA COMPATIBILITY	Diskette 1	Diskette 1	Diskette 1 Diskette 2, 2D	SA 104 (S) SA 105/107 (H)	CDC 9878 Diskette 1	CDC 9878 Diskette 1	CDC 9878 Diskette 1
SECTORING	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
NOMINAL DISK DIAMETER	8"	8"	8"	5.25"	8"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	U: .401/.802	U: .401/.802	U: .8/1.6	U: .2188/.4375	U: .401	U: .401/.802	U: .401/.802
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	U; 3,125/6,250	U: 5,208	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	1	2	2	1	1	1
Tracks per surface	77	77	77	35	77	77	77
TPI	48	48	48	48	48	48	48
BPI	3268/6536	3268/6536	3268/6536	2581/5162	3268	3268/6536	3268/6536
RPM	360	360	360	300	360	360	360
Actuator type	Lead Screw	Lead Screw	Lead Screw	Band	Lead Screw	Lead Screw	Lead Screw
POSITIONING: Track to track(msec)	6	6	6	5	10	10	10
Settling time (msec)	10	10	10	15	10	10	15
Head load time(msec)	30	30	30		60	60	60
Average rotational delay (msec)	83.3	83.3	83.3	100	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25/62.5	15.63/31.25	31.25	31.25/62.5	31.25/62.5
FIRST CUSTOMER SHIPMENT	1/77		8/77	4Q70	3/74	11/75	2Q79
COMMENTS		Upgradable to 2-side recording					

CALDISK

CONTROL DATA

1979 DISK/TREND REPORT

MANUFACTURER	CONTROL DATA	CONTROL DATA	DATAPOINT	DATA RECORDING EQUIPMENT, LTD.	DATA RECORDING EQUIPMENT, LTD.	DECITEK	DECITEK
DRIVE	9406	210-10	9381 Series	7100	7200	DF-8000/L	DF-8000/S
DISK/TREND GROUP	11	11	10	10	11	10	10
MEDIA COMPATIBILITY	Diskette 1 Diskette 2, 2D	Diskette 1 Diskette 2, 2D	Diskette 1	Diskette 1 Diskette 2	Diskette 1 Diskette 2, 2D	Diskette 1	Diskette 1
SECTORING	Hard/Soft	Hard/Soft	Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
NOMINAL DISK DIAMETER	8"	8"	8"	8"	8"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	U: .8/1.6	F: .606208	F: .256	U: .401/.802	U: .8/1.6	U: .401/.802	U: .401/.802
Capacity per track (Bytes)	U: 5,208/10,416	F: 4,096	F: 3,328	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	2	2	1	1	2	1	1
Tracks per surface	77	74/3	77	77	77	77	77
TPI	48	48	48	48	48	48	48
BPI	3268/6536	3268/6536	3268	3268/6536	3268/6536	3268/6536	3268/6536
RPM	360	360	360	360	360	360	360
Actuator type	Band	Band	Lead Screw	Lead Screw	Lead Screw	Linear Motor	Linear Stepper
POSITIONING: Track to track(msec)	3	3	10	6	6	5	5
Settling time (msec)	20	20	20	14	14	12	12
Head load time(msec)	40	40	36	30	30	35	35
Average rotational delay (msec)	83.3	83.3	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	31.25/62.5	31.25/62.5
FIRST CUSTOMER SHIPMENT	2Q78	1/79	1976	1977	1977	4Q79	4Q79
COMMENTS		Series/1 Interface				Average Positioning Time 42 msec	

MANUFACTURER	DECITEK	DECITEK	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	DF-8002/L	DF-8002/S	RX01	RX02	FDD 101A	FDD 201	FDD 401
DISK/TREND GROUP	11	11	10	10	10	11	11
MEDIA COMPATIBILITY	Diskette 1 Diskette 2, 2D	Diskette 1 Diskette 2, 2D	RX01K Diskette 1	RX01K Diskette 1	Diskette 1	Diskette 1 Diskette 2	Diskette 1 Diskette 2, 2D
SECTORING	Hard/Soft	Hard/Soft	Soft	Soft	Soft	Soft	Soft
NOMINAL DISK DIAMETER	8"	8"	8"	8"	8"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	U: .8/1.6	U: .8/1.6	F: .256	F: .256/.512	F: .36	F: .718	F: 1.44
Capacity per track (Bytes)	U: 5,208/10.416	U: 5,208/10,416	F: 3,328	F: 3,328/6,656	F: 4,800	F: 4,800	F: 9,600
Data surfaces per spindle	2	2	1	1	1	2	2
Tracks per surface	77	77	77	77	77	77	77
TPI	48	48	48	48	48	48	48
BPI	3268/6536	3268/6536	3268	3268/6536	3268	3268	6816
RPM	360	360	360	360	360	360	360
Actuator type	Linear Motor	Linear Stepper	Lead Screw	Lead Screw	Lead Screw	Band	Band
POSITIONING: Track to track(msec)	5	5	6	6	8	3	3
Settling time (msec)	12	12	20	20	14	35	35
Head load time(msec)	35	35	16	16	25	50	50
Average rotational delay (msec)	83.3	83.3	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	31.25	31.25
FIRST CUSTOMER SHIPMENT	1Q80	1Q80	1976	4Q78		1978	1978
COMMENTS	Average Positioning Time 42 msec						

DECITEK DEC HITACHI

MANUFACTURER	IBM	IBM	IBM	IBM	IBM	IBM	IBM
DRIVE	3740 Series 3770 Series 3790 Series 3601/3602 (33FD Drive)	System/32 (33FD Drive)	System/34 (33FD Drive)	System/34 (43FD Drive)	System/34 System/38 (Magazine Drive)	3601-2B, 3B 3602-1A, 1B 3631/3632 (43FD Drive)	4964 (43FD Drive)
DISK/TREND GROUP	10	10	10	11	11	11	11
MEDIA COMPATIBILITY	Diskette 1	Diskette 1	Diskette 1	Diskette 1 Diskette 2D	Diskette 1 Diskette 2D	Diskette 1 Diskette 2	Diskette 1 Diskette 2
SECTORING	Soft	Soft	Soft	Soft	Soft	Soft	Soft
NOMINAL DISK DIAMETER	8"	8"	8"	8"	8"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	F: .242944	F: .246272 or F: .303104	F: .246272 or F: .303104	F: .985088 or F: 1.212416	F: .985088 or F: 1.212416	F: .246272 or F: .284160	F: .492544 or F: .568320 or F: .606208
Capacity per track (Bytes)	F: 3,328	F: 3,328/4,096	F: 3,328/4,096	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	1	1	1	2	2	2	2
Tracks per surface	74/3	74/3	74/3	74/3	74/3	74/3	74/3
TPI	48	48	48	48	48	48	48
BPI	3200	3200	3200	3200/6400	3200/6400	3200/6400	3200
RPM	360	360	360	360	720	360	360
Actuator type	Lead Screw	Lead Screw	Lead Screw	Band	Band	Band	Band
POSITIONING: Track to track(msec)	50	50	50	5	5	5	5
Settling time (msec)	20	20	20	35	35	35	35
Head load time(msec)	80	80	80				
Average rotational delay (msec)	83.3	83.3	83.3	83.3	41.7	83.3	83.3
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25/62.5	125	31.25/62.5	31.25
FIRST CUSTOMER SHIPMENT	6/73	1/75	12/77	12/77	1/79 (S/34)	1976 (3601/2)	11/76
COMMENTS	3540 - Input to S/370 3747 - Tape Converter				Capacity is 2 10-diskette magazines and 3 diskettes	3600	Similar drive included with some 4962 models Series/1

MANUFACTURER	IBM	IBM	IBM	IBM	INNOTRONICS	INNOTRONICS	LOGABAX
DRIVE	4966 (Magazine Drive)	5114 (1st Drive) 3240 (Add-on) (43FD Drive)	8130-A11 8140-A11	8101-A10 8101-A11 8101-A13	410	420	LX45D
DISK/TREND GROUP	11	11	11	11	10	10	10
MEDIA COMPATIBILITY	Diskette 1 Diskette 2D	Diskette 1 Diskette 2, 2D	Diskette 2D	Diskette 2D	Diskette 1	Diskette 1	Diskette 1
SECTORING	Soft	Soft	Soft	Soft	Soft	Hard	Hard/Soft
NOMINAL DISK DIAMETER	8"	8"	8"	8"	8"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	F: .985088 or F: 1.136640 or F: 1.212416	F: 1.212416	F: .985088	F: .985088	U: .401/.802	U: .401/.802	U: .401
Capacity per track (Bytes)	F: 6,656/7,680/ 8,192	F: 8,192	F: 6,656	F: 6,656	U: 5,208/10,416	U: 5,208/10,416	U: 5,208
Data surfaces per spindle	2	2	2	2	1	1	1
Tracks per surface	74/3	74/3	74/3	74/3	77	77	77
TPI	48	48	48	48	48	48	48
BPI	3200/6400	3200/6400	3200/6400	3200/6400	3268/6536	3268/6536	3268
RPM	720	360	360	360	360	360	360
Actuator type	Band	Band	Band	Band	Lead Screw	Lead Screw	Lead Screw
POSITIONING: Track to track(msec)	5	5	5	5	8	8	2.5
Settling time (msec)	35	35	35	35	8	8	27
Head load time(msec)					30	30	90
Average rotational delay (msec)	41.7	83.3	83.3	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	125	31.25/62.5	62.5	62.5	31.25/62.5	31.25/62.5	31.25
FIRST CUSTOMER SHIPMENT	2/79	2/78	Mid-1980	Mid-1980	2/77	2/77	1976
COMMENTS	Series 1 Capacity is 2 10-diskette magazines and 3 diskettes	Dual Drives for 5110	8100 System	8100 System			

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.	MEMOREX	MEMOREX
DRIVE	JK-890 JK-891	JK-880 JK-881	JK-885 JK-886	JK-874	JK-875	651	550
DISK/TREND GROUP	10	10	11	12	13	10	10
MEDIA COMPATIBILITY	Diskette 1	Diskette 1	Diskette 1,2,2D	SA 104 (S) SA 105/107 (H)	SA 154 (S) SA 155/157 (H)	FD/IV	Diskette 1
SECTORING	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Hard	Hard/Soft
NOMINAL DISK DIAMETER	8"	8"	8"	5.25"	5.25"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	U: .401	U: .401/.802	U: .8/1.6	U: .1094/.2188	U: .2188/.4375	U: .312	U: .401/.802
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	U: 4,875	U: 5,208/10,416
Data surfaces per spindle	1	1	2	1	2	1	1
Tracks per surface	77	77	77	35	35	64	77
TPI	48	48	48	48	48	48	48
BPI	3200	3200	3406/6816	2581/5162	2728/5456	3100	3268/6536
RPM	360	360	360	300	300	375	360
Actuator type	Lead Screw	Lead Screw	Band	Cam	Cam	Lead Screw	Lead Screw
POSITIONING: Track to track(msec)	10	8	3	40	25	10	6
Settling time (msec)	8	8	15	10	15	10	10
Head load time(msec)	35	35	35	75	50	40	35
Average rotational delay (msec)	83.3	83.3	83.3	100	100	80	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	31.25	31.25/62.5
FIRST CUSTOMER SHIPMENT	3/76	9/76	12/77	2/79	3Q79	12/72	1/77
COMMENTS	Shugart License: SA 900 SA 901	Shugart License: SA 800 SA 801	Shugart License: SA 850 SA 851	Shugart License: SA 400	Shugart License: SA 450		

MATSUSHITA

MEMOREX

MANUFACTURER	MEMOREX	MERA METRONEX	MFE CORPORATION	MFE CORPORATION	MICRO PERIPHERALS	MICRO PERIPHERALS	MICROPOLIS
DRIVE	552	PLX45D	500	700	B51	B52	1015 MOD I
DISK/TREND GROUP	11	10	10	11	12	13	12
MEDIA COMPATIBILITY	Diskette 1 Diskette 2, 2D	Diskette 1	Diskette 1	Diskette 1 Diskette 2, 2D	SA 104/SA 105	SA 154/SA 155	SA 105
SECTORING	Hard/Soft	Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
NOMINAL DISK DIAMETER	8"	8"	8"	8"	5.25"	5.25"	5.25"
PERFORMANCE							
Total capacity (MBytes)	U: .8/1.6	U: .401	U: .401/.802	U: .8/1.6	U: .125/.249	U: .249/.499	U: .218
Capacity per track (Bytes)	U: 5,208/10,416	U: 5,208	U: 5,208/10,416	U: 5,208/10,416	U: 3,118/6,235	U: 3,118/6,235	U: 6,250
Data surfaces per spindle	2	1	1	2	1	2	1
Tracks per surface	77	77	77	77	40	35	35
TPI	48	48	48	48	48	48	48
BPI	3408/6816	3268	3268/6536	3268/6536	2810/5620	2810/5620	5162
RPM	360	360	360	360	300	300	300
Actuator type	Lead Screw	Lead Screw	Band	Band	Band	Band	Lead Screw
POSITIONING: Track to track(msec)	3	2.5	3	3	5	5	30
Settling time (msec)	15	27.5	15	15	15	15	10
Head load time(msec)	35	90	35	35	35	35	75
Average rotational delay (msec)	83.3	83.3	83.3	83.3	100	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	31.25	31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25	31.25
FIRST CUSTOMER SHIPMENT	1/78	1977	8/77	8/77	10/77	1Q79	3/77
COMMENTS							OEM Drive

MANUFACTURER	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE	1015 MOD II	1015 MOD IV	1016 MOD II	1016 MOD IV	1041-I 1042-I	1021-I 1022-I	1041-II 1043-II 1053-II 1054-II
DISK/TREND GROUP	12	13	12	13	12	12	12
MEDIA COMPATIBILITY	Micropolis 1081	Micropolis 1081	Micropolis 1081	Micropolis 1081	SA 105	SA 105	Micropolis 1081
SECTORING	Hard/Soft	Hard/Soft	Soft	Soft	Hard	Hard	Hard
NOMINAL DISK DIAMETER	5.25"	5.25"	5.25"	5.25"	5.25"	5.25"	5.25"
PERFORMANCE							
Total capacity (MBytes)	U: .480	U: .960	U: .585	U: 1.170	F: .143	F: .143	F: .315
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 7,600	U: 7,600	F: 4,096	F: 4,096	F: 4,096
Data surfaces per spindle	1	2	1	2	1	1	1
Tracks per surface	77	77	77	77	35	35	77
TPI	100	100	100	100	48	48	100
BPI	5248	5248	6380	6380	5162	5162	5162
RPM	300	300	300	300	300	300	300
Actuator type	Lead Screw	Lead Screw	Lead Screw	Lead Screw	Lead Screw	Lead Screw	Lead Screw
POSITIONING: Track to track(msec)	30	30	30	30	30	30	30
Settling time (msec)	10	10	10	10	10	10	10
Head load time(msec)	75	75	75	75	75	75	75
Average rotational delay (msec)	100	100	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25	38.0	38.0	31.25	31.25	31.25
FIRST CUSTOMER SHIPMENT	3/77	8/78	6/78	9/78	1/78	1/78	3/77
COMMENTS	OEM Drive	OEM Drive	OEM Drive GCR	OEM Drive GCR	S-100 Subsystems 1041 w/o Power 1042 with Power	S-100 Subsystem Add-on Drives 1021 w/o Power 1022 with Power	S-100 Subsystems 1041 Single w/o Power 1043 Single 1053 Dual 1054 Quad

MICROPOLIS

MANUFACTURER	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION
DRIVE	1021-II 1023-II 1033-II	1055-II 1035-II	1055-IV 1035-IV	SBC-55-II SBC-16-II	SBC-55-IV SBC-16-IV	M892	M2893
DISK/TREND GROUP	12	12	13	12	13	10	11
MEDIA COMPATIBILITY	Micropolis 1081	Micropolis 1081	Micropolis 1081	Micropolis 1081	Micropolis 1081	Diskette 1	Diskette 2
SECTORING	Hard	Soft	Soft	Soft	Soft	Soft	Soft
NOMINAL DISK DIAMETER	5.25"	5.25"	5.25"	5.25"	5.25"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	F: .315	F: .473	F: .946	F: .394	F: .788	U: .401	U: .802
Capacity per track (Bytes)	F: 4,096	F: 6,144	F: 6,144	F: 5,360	F: 5,360	U: 5,208	U: 5,208
Data surfaces per spindle	1	1	2	1	2	1	2
Tracks per surface	77	77	77	77	77	77	77
TPI	100	100	100	100	100	48	48
BPI	5162	6380	6380	6380	6380	3268	3408
RPM	300	300	300	300	300	360	360
Actuator type	Lead Screw	Lead Screw	Lead Screw	Lead Screw	Lead Screw	Lead Screw	Band
POSITIONING: Track to track(msec)	30	30	30	30	30	7	3
Settling time (msec)	10	10	10	10	10	23	15
Head load time(msec)	75	75	75	75	75	50	50
Average rotational delay (msec)	100	100	100	100	100	83.3	83.3
Data transfer rate (KBytes/sec)	31.25	38.0	38.0	38.0	38.0	31.25	31.25
FIRST CUSTOMER SHIPMENT	3/77	6/78	9/78			1974	1978
COMMENTS	S-100 Subsystem Add-on Drives 1021 Single w/o Power 1023 Single 1033 Dual	OEM Subsystem 1055 Dual 1035 Dual Add-on GCR	OEM Subsystem 1055 Dual 1035 Dual Add-on GCR	Intel Subsystems SBC-55-II with Power SBC-16-II w/o Power GCR	Intel Subsystems SBC-55-IV with Power SBC-16-IV w/o Power GCR		

MICROPOLIS

MITSUBISHI

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	NIPPON ELECTRIC COMPANY	NORTHERN TELECOM SYSTEMS	OLIVETTI	OLIVETTI	OLIVETTI	OLIVETTI
DRIVE	M2894	N7707	SYCOR 4505 FD 145	FDU 5600	FDU 6102	AFD 6102	MDU 8008
DISK/TREND GROUP	11	11	10	10	10	10	Special
MEDIA COMPATIBILITY	Diskette 2D	Diskette 2D	Diskette 1	Diskette 1	Diskette 1	Diskette 1	Olivetti 2.5" Disk
SECTORING	Soft	Soft	Soft	Soft	Soft	Soft	N/A
NOMINAL DISK DIAMETER	8"	8"	8"	8"	8"	8"	2.5"
PERFORMANCE							
Total capacity (MBytes)	U: 1.6	F: 1.0	F: .243	F: .242 (26sec) F: .280 (15sec)	F: .246 (26sec) F: .284 (15sec)	F: .246 (26sec) F: .284 (15sec)	F: .008
Capacity per track (Bytes)	U: 10,416	F: 6,656	F: 3,328	F: 3,840	F: 3,840	F: 3,840	N/A
Data surfaces per spindle	2	2	1	1	1	1	1
Tracks per surface	77	77	77	77	77	77	1
TPI	48	48	48	48	48	48	N/A
BPI	6816	6816	3268	3268	3268	3268	980
RPM	360	360	360	360	360	360	Variable
Actuator type	Band	Band	Lead Screw	Lead Screw	Lead Screw	Lead Screw	N/A
POSITIONING: Track to track(msec)	3	5	2.5	10	10	10	N/A
Settling time (msec)	15	15	25	30	30	30	N/A
Head load time(msec)	50	50	30	40	40	40	N/A
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3	83.3	N/A
Data transfer rate (KBytes/sec)	62.5	62.5	31.25	31.25	31.25	31.25	2.5
FIRST CUSTOMER SHIPMENT	4Q78	12/78	1975				
COMMENTS		ASTRA 2 NEAC		A6 System	Dual Drive with Single Actuator	Dual Drive with Single Actuator. Automatically Loads 20 Diskettes.	8 K Bytes in Single Spiral Track of 78 inches. Max. Read Time 4.4 sec.

MITSUBISHI NEC NORTHERN TELECOM OLIVETTI

MANUFACTURER	PER SCI, INC.	PER SCI, INC.	PER SCI, INC.	PER SCI, INC.	PERTEC	PERTEC	PERTEC
DRIVE	70	277	288	299	FD 511 A FD 514 FD 5X0	FD 410	FD 650
DISK/TREND GROUP	10	10	11	11	10	10	11
MEDIA COMPATIBILITY	Diskette 1	Diskette 1	Diskette 1 Diskette 2, 2D	Diskette 1 Diskette 2, 2D	Diskette 1	Diskette 1	Diskette 1 Diskette 2, 2D
SECTORING	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft
NOMINAL DISK DIAMETER	8"	8"	8"	8"	8"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	U: .401/.802	U: .401/.802	U: .8/1.6	U: .8/1.6	U: .401/.802	U: .401/.802	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	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	1	2	2	1	1	2
Tracks per surface	77	77	77	77	77	77	77
TPI	48	48	48	48	48	48	48
BPI	3268/6536	3268/6536	3268/6536	3268/6536	3268/6536	3268/6536	3268/6536
RPM	360	360	360	360	360	360	360
Actuator type	Linear Motor	Linear Motor	Linear Motor	Linear Motor	Lead Screw	Lead Screw	Lead Screw
POSITIONING: Track to track(msec)	10	10	10	10	10	10	3
Settling time (msec)	0	0	0	0	20	20	15
Head load time(msec)	40	40	40	40	40	40	35
Average rotational delay (msec)	83.3	83.3	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	31.25/62.5	31.25/62.5
FIRST CUSTOMER SHIPMENT	1/76	3Q77	10/79	6/78			1/79
COMMENTS	Average Positioning Time 33 msec Single Drive	Average Positioning Time 33 msec Dual Drive	Average Positioning Time 33 msec Dual Drive	Average Positioning Time 33 msec Dual Drive		DC Power	

PER SCI

PERTEC

MANUFACTURER	PERTEC	PERTEC	QUME	QUME	REMEX	REMEX	REMEX
DRIVE	FD 200	FD 250	Datatrak 8	Datatrak 5	RFD 1000	RFD 2000 RFD 2001	RFD 4000 RFD 4001
DISK/TREND GROUP	12	13	11	13	10	10	11
MEDIA COMPATIBILITY	SA 104/SA 105	SA 154/SA 155	Diskette 1,2,2D	SA 154	Diskette 1	Diskette 1	Diskette 1 Diskette 2, 2D
SECTORING	Hard/Soft	Hard/Soft	Soft	Soft	Hard/Soft	Hard/Soft	Hard/Soft
NOMINAL DISK DIAMETER	5.25"	5.25"	8"	5.25"	8"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	U: .125/.250	U: .219/.438	U: .8/1.6	U: .4375	U: .401/.802	U: .401/.802	U: .8/1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416	U: 3,125/6,250	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	2	2	2	1	1	2
Tracks per surface	40	35	77	35	77	77	77
TPI	48	48	48	48	48	48	48
BPI	2768/5536	2768/5536	3408/6816	5456	3268/6536	3408/6816	3408/6816
RPM	300	300	360	300	360	360	360
Actuator type	Cam	Cam	Band	Lead Screw	Lead Screw	Band	Band
POSITIONING: Track to track(msec)	25	25	3	20	6	3	3
Settling time (msec)	10	10	15	15	24	15	15
Head load time(msec)	35	35	35	50	50	35	35
Average rotational delay (msec)	100	100	83.3	100	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	31.25/62.5	31.25	31.25/62.5	31.25/62.5	31.25/62.5
FIRST CUSTOMER SHIPMENT	12/77	1/79	1Q79	4Q79	4/76	1Q79	1Q79
COMMENTS							

1979 DISK/TREND REPORT

MANUFACTURER	REMEX	REMEX	SAGEM	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SHUGART ASSOCIATES
DRIVE	RFS 2400	RFS 4800	DS 3	SA 900 SA 901	SA 800 SA 801	SA 850 SA 851	SA 400
DISK/TREND GROUP	10	11	10	10	10	11	12
MEDIA COMPATIBILITY	Diskette 1	Diskette 2, 2D	Diskette 1	SA 100/SA 101 Diskette 1	SA 100/1/2/3 Diskette 1	SA 150/151 Diskette 1,2,2D	SA 104 (S) SA 105/107 (H)
SECTORING	Soft	Soft	Hard/Soft	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
NOMINAL DISK DIAMETER	8"	8"	8"	8"	8"	8"	5.25"
PERFORMANCE							
Total capacity (MBytes)	F: .315/.630	F: .630/1.261	U: .393	U: .401	U: .401/.802	U: .8/1.6	U: .1094/.2188
Capacity per track (Bytes)	F: 4,096/8,192	F: 4,096/8,192	U: 5,100	U: 5,208	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250
Data surfaces per spindle	1	2	1	1	1	2	1
Tracks per surface	77	77	77	77	77	77	35
TPI	48	48	48	48	48	48	48
BPI	3408/6816	3408/6816	3200	3200	3200	3408/6816	2581/5162
RPM	360	360	360	360	360	360	300
Actuator type	Band	Band	Lead Screw	Lead Screw	Lead Screw	Band	Cam
POSITIONING: Track to track(msec)	3	3	10	10	8	3	40
Settling time (msec)	15	15	10	8	8	15	10
Head load time(msec)	35	35	50	35	35	35	75
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3	83.3	100
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25	31.25	31.25/62.5	31.25/62.5	15.63/31.25
FIRST CUSTOMER SHIPMENT	1979	1979	1976	9/73	9/75	6/77	9/76
COMMENTS	Subsystem	Subsystem					

REMEX

SHUGART

MANUFACTURER	SHUGART ASSOCIATES	SIEMENS	SIEMENS	SIEMENS	SIEMENS	SYKES DATATRONICS	SYKES DATATRONICS
DRIVE	SA 450	FDD 100-8	FDD 200-8	FDD 100-5	FDD 200-5	7150 (Single) 7250 (Dual)	9150 (Single) 9250 (Dual)
DISK/TREND GROUP	13	10	11	12	13	10	10
MEDIA COMPATIBILITY	SA 154 (S) SA 155/157 (H)	Diskette 1	Diskette 1 Diskette 2, 2D	SA 104/SA 105	SA 154/SA 155	Diskette 1	Diskette 1
SECTORING	Soft/Hard	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Soft	Hard/Soft
NOMINAL DISK DIAMETER	5.25"	8"	8"	5.25"	5.25"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	U: .2188/.4375	U: .401/.802	U: .8/1.6	U: .125/.250	U: .250/.5	F: .256	F: .631
Capacity per track (Bytes)	U: 3,125/6,250	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250	U: 3,125/6,250	F: 3,328	F: 8,192
Data surfaces per spindle	2	1	2	1	2	1	1
Tracks per surface	35	77	77	40	40	77	77
TPI	48	48	48	48	48	48	48
BPI	2728/5456	3268/6536	3268/6536	2768/5536	2938/5876	3268	6536
RPM	300	360	360	300	300	360	360
Actuator type	Cam	Lead Screw	Lead Screw	Lead Screw	Lead Screw	Lead Screw	Lead Screw
POSITIONING: Track to track(msec)	25	6	6	25	25	6	6
Settling time (msec)	15	14	14	15	15	30	30
Head load time(msec)	50	25	25	50	50	30	30
Average rotational delay (msec)	100	83.3	83.3	100	100	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25	31.25	62.5
FIRST CUSTOMER SHIPMENT	8/78	1975	4/78	3/77	5/78	9/74	10/76
COMMENTS							

SHUGART SIEMENS SYKES

MANUFACTURER	TANDON MAGNETICS	TEAC CORPORATION	TEAC CORPORATION	TEAC CORPORATION	TEAC CORPORATION	TOSHIBA	TOSHIBA
DRIVE	TM-100	FD-50A	FD-50B	FD-50C	FD-100	ND-10	ND-20
DISK/TREND GROUP	12	12	13	12	11	10	10
MEDIA COMPATIBILITY	SA 104 (S) SA 105/107 (H)	SA 104/SA 105	SA 154/SA 155	Micropolis 1081	Diskette 1 Diskette 2, 2D	Diskette 1	Diskette 2
SECTORING	Soft/Hard	Hard/Soft	Hard/Soft	Hard/Soft	Hard/Soft	Soft	Soft
NOMINAL DISK DIAMETER	5.25"	5.25"	5.25"	5.25"	8"	8"	8"
PERFORMANCE							
Total capacity (MBytes)	U: .1094/.2188	U: .125	U: .250	U: .480	U: .8/1.6	U: .4	U: .8
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125	U: 3,125	U: 6,250	U: 5,208/10,416	U: 5,208	U: 5,208
Data surfaces per spindle	2	1	2	1	2	1	2
Tracks per surface	35	40	40	77	77	77	77
TPI	48	48	48	100	48	48	48
BPI	5456	2581	2581	5248	3406/6816	3268	3268
RPM	300	300	300	300	360	360	360
Actuator type	Band	Lead Screw	Lead Screw	Lead Screw	Lead Screw	Lead Screw	Band
POSITIONING: Track to track(msec)	5	25	25	25	25	10	3
Settling time (msec)	15	10	10	10	10	10	18
Head load time(msec)	*	35	35	35	35	50	50
Average rotational delay (msec)	100	100	100	100	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63	15.63	31.25	31.25/62.5	31.25	31.25
FIRST CUSTOMER SHIPMENT	11/78	4Q78	1Q80	4Q79	1979	1977	1977
COMMENTS	*Heads in Continuous Contact						

TANDON TEAC TOSHIBA

MANUFACTURER	TOSHIBA	VIDEOTON INDUSTRIE - AUSSENHALDELS	VIDEOTON INDUSTRIE - AUSSENHALDELS	YE DATA, INC.	YE DATA, INC.	YE DATA, INC.	
DRIVE	ND-20D	MFM-2	MFM-4	YD-74C	YD-174	YD-274	
DISK/TREND GROUP	11	10	11	10	11	13	
MEDIA COMPATIBILITY	Diskette 2 Diskette 2D	Diskette 1	Diskette 2D	Diskette 1	Diskette 1 Diskette 2, 2D	SA 104/SA 105	
SECTORING	Soft	Soft	Soft	Hard/Soft	Hard/Soft	Hard/Soft	
NOMINAL DISK DIAMETER	8"	8"	8"	8"	8"	5.25"	
PERFORMANCE							
Total capacity (MBytes)	U: .8/1.6	F: .512	F: .512	U: .401	U: .8/1.6	U: .125/.250	
Capacity per track (Bytes)	U: 5,208/10,416	F: 3,328	F: 3,328	U: 5,208	U: 5,208/10,416	U: 3,125/6250	
Data surfaces per spindle	2	1	1	1	2	2	
Tracks per surface	77	77	77	77	77	35	
TPI	48	48	48	48	48	48	
BPI	3268/6536	3200	3200	3408	3408/6816	2728/5456	
RPM	360	360	360	360	360	300	
Actuator type	Band	Lead Screw	Lead Screw	Lead Screw	Band	Lead Screw	
POSITIONING: Track to track(msec)	3	10	10	9	3	20	
Settling time (msec)	18	40	40	20	15	15	
Head load time(msec)	50			35	35	50	
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3	100	
Data transfer rate (KBytes/sec)	31.25/62.5	31.25	31.25	31.25	31.25/62.5	15.63/31.25	
FIRST CUSTOMER SHIPMENT	1977	1977	1977	1974	1977	1/79	
COMMENTS			Dual				

TOSHIBA VIDEOTON YE DATA

MANUFACTURER PROFILES

1979 DISK/TREND REPORT

MANUFACTURER PROFILES

Every known manufacturer of flexible disk drives is listed in this section, with a brief description of the firm's role in the industry. The heading "FDD sales" refers only to the DISK/TREND estimate of the sales of self-manufactured flexible disk drives -- no sales of other drive types are included, nor are sales of parts or other related products. "Total net sales" are for each parent company's 1978 fiscal year. Northern Telecom is listed with the U.S firms for convenience.

U.S. Manufacturers

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

1978 FDD sales: $18,000,000
1978 total net sales: $2,460,002,000 Net income: $253,364,000

In 1976 Burroughs started manufacturing a two sided 8 inch drive with unique specifications -- and which apparently has caused few of the problems associated with two sided drives providing media compatibility with the IBM design. The Burroughs one megabyte drive uses a pressure pad opposite each head, as do one sided drives, instead of the IBM approach, in which heads on each side of the media are directly opposite each other. In retrospect the Burroughs design looks like a good decision. Burroughs also uses an industry-commpatible one sided drive purchased from Control Data on several systems. It is expected that the next floppy drive from Burroughs will be a higher capacity two sided drive resulting from a development program at its Glenrothes, Scotland plant. The target was a dual drive with 5 MB formatted capacity per spindle, but problems with the planned 150 TPI could force introduction of the drive with lower capacity. Burroughs is also known to have a long-standing program to develop a floppy stack drive at its peripherals plant in Westlake Village, California.

CALDISK
Subsidiary of Billings Energy Corporation
2000 East Billings Avenue
Provo, UT 84601 801/375-0000

1978 FDD sales: $4,900,000 (Calcomp)
1978 total net sales: $1,856,000 Net income: ($1,119,000)

The flexible disk drive operation of California Computer Corporation (Calcomp) was purchased early in 1979 by Billings Computer Corporation, a subsidiary of Billings Energy Corporation. Billings Energy Corporation is involved with a

variety of research and development activities oriented to use of hydrogen as an energy source, and Billings Computer Corporation manufactures small computer systems, which emerged as a by-product of the parent's research projects. Caldisk now manufactures 8 inch floppy drives in Anaheim, California, and plans a production start-up at Provo, Utah, later this year for 5.25 inch drives. A marketing operation dedicated to OEM floppy drives has been established, with administrative headquarters at Provo.

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

1978 FDD sales: $26,700,000
1978 total net sales: $1,867,826,000 Net income: $89,464,000

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 responsibility vested in 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. Floppy disk drive development and production are located in MPI facilities in Oklahoma City. For the last few years CDC has held second place in unit shipments of OEM 8 inch, one side drives, and the firm is expected to start production of 5.25 inch drives in the near future.

DATAPOINT CORPORATION
9725 Datapoint Drive
San Antonio, TX 78285 512/699-7000

1978 FDD sales: $3,300,000
1978 total net sales: $162,261,000 Net income: $15,278,000

Datapoint manufactures captive 8 inch, one side drives for use with the firm's terminals and system products. Floppy drives currently in production are manufactured under a license from Shugart Associates.

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

1978 FDD sales: None
1978 total net sales: $65,561,000 Net income: $4,617,000

Decitek is a major industry supplier of paper tape equipment with an appetite for expansion. The firm has announced a family of 8 inch OEM floppy drives with some interesting differences from products produced by most existing com-

petitors. Decitek will become the second company to offer a floppy drive with a linear motor (voice coil) actuator, and the company will also offer drives using a unique linear stepping motor actuator. Both types of actuators will be available on either one sided or two sided drives.

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

1978 FDD sales: $30,000,000
1978 total net sales: $1,436,562,000 Net income: $142,189,000

Floppy drive production at DEC is still confined to 8 inch, one side drives. The firm is easily the largest producer of captive drives in the U.S. after IBM. DEC started floppy drive manufacturing operations in 1976, with a manufacturing license from its vendor of OEM drives, Calcomp. Drives offered today use a DEC design, and include a double density drive, the RX02, introduced in 1978. Because of DEC's leading role in minicomputers, it is probably inevitable that the firm will add 8 inch, two side drives, plus 5.25 inch models.

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

1978 FDD sales: $120,000,000
1978 total net sales: $21,076,089,000 Net income: $3,110,568,000

Although IBM received 25.1% of 1978 worldwide flexible disk revenues according to DISK/TREND estimates, it shipped only 7.8% of the units in 1978, considering all floppy configurations. Although IBM's revenues will surely continue to be a major part of the industry's total, its share of overall unit shipments is expected to dip to 5.2% in 1979 and drop further in the future. IBM's influence on the floppy drive industry, however, extends beyond its own shipments. By establishing floppy drive and media standards for 8 inch drives, IBM created industry confidence in the stability of the formats, and paved the way for rapid growth in shipments of OEM and other captive drives. It is probable that IBM will use floppy technology in new formats to be introduced during the next few years. Likely candidates are large capacity floppy stack drives, higher capacity versions of today's 8 inch, two side drives, and small floppy drives for use with smart typewriters and other equipment. Whatever, the next move, IBM's competitors will immediately start working on their own versions.

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

1978 FDD sales: $600,000

Innotronics is the successor to Innovex, a pioneer among flexible disk drive manufacturers. Innovex' assets were sold at auction in late 1977 by an unfriendly bank, but the product line, inventory and production equipment were purchased by key employees. The result was Innotronics, which operates very successfully as a semi-cottage industry. The firm is again in a growth mode, selling floppy drives to system OEMs and hobbyists who are willing to pay a few dollars extra for higher reliability.

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

1978 FDD sales: $8,600,000
1978 total net sales: $633,266,000 Net income: $50,197,000

Memorex' 651 was the first OEM floppy drive, introduced in 1972. However, the firm was late in establishing production for industry-compatible drives, so it missed an opportunity in the mid-1970's to challenge for the leadership in OEM drives. The firm's floppy drive program is now established in its own facility in Mountain View, California, and held fourth place in worldwide unit shipments of 8 inch, one side drives in 1978. The 651 is still in production, but the share of Memorex shipments held by standard OEM configurations is growing. Memorex' future in floppies seems to be dependent upon the level of resources future managements are willing to devote to the business -- with the greatest requirements in product line expansion and more extensive OEM marketing.

MFE
Keewaydin Drive
Salem, NH 03079 603/893-1921

1978 FDD sales: $500,000

MFE is a privately held firm with a well-established position as a manufacturer of digital cassette drives and other small computer peripherals. The firm entered the OEM floppy drive market in 1977, with the announcement of an 8 inch, two side drive. Due to the inevitable problems in initiating manufacture of an IBM-compatible two sided drive in 1977, the firm wasn't able to start volume shipments until 1978. Shipment volume is now building, and MFE is also planning to start floppy production at a new plant in Scotland.

MICRO PERIPHERALS, INC.
9754 Deering Avenue
Chatsworth, CA 91311 213/709-4202

1978 FDD sales: $400,000

Micro Peripherals is a privately held company started in 1977 by key personnel from Orbis (now owned by Siemens, after a period of operation by Perkin-Elmer). The firm is now in quantity production of 5.25 inch drives, both one and two sides, and moved into larger facilities recently. Micro Peripherals has benefited from the sensational recent growth in the market for 5.25 inch drives, and 1979 shipments by the firm are up sharply.

MICROPOLIS CORPORATION
7959 Deering Avenue
Canoga Park, CA 91304 213/703-1121

1978 FDD sales: $3,600,000

Micropolis hit the ground running when it started in 1977, offering the only floppy drive with 100 TPI. Originally oriented to the subsystem market through dealers, as a method of building initial cash flow, since 1978 the firm has emphasized the OEM markets for its 5.25 inch drives, which are now offered in one or two side configurations, with either 100 or 48 TPI. Micropolis' floppy business is now booming, and the firm has announced another new product line -- 8 inch fixed Winchester disk drives. Micropolis is soon to move company headquarters and hard disk manufacturing to a new plant, allowing expansion room for floppy drive manufacture at the existing facility.

NORTHERN TELECOM SYSTEMS CORPORATION
Subsidiary of Northern Telecom, Ltd. (Canada)
Data Park
Minneapolis, MN 55440 612/932-8000

1978 FDD sales: $8,000,000
1978 total net sales: $1,278,876,000 Net income: $85,619,000
(Basis: $1C = $0.85 U.S.)

Sycor and Data 100, both acquired in 1978, have been folded into the computer operations of Northern Telecom Systems, with headquarters established in Minneapolis. Since 1974, Sycor's internally produced floppy drives have been used with the firm's various terminal families. OEM marketing for floppy drives has been de-emphasized, after marginal sales activity. It is still not known how floppy drives will fit into the plans Northern Telecom has for its new U.S. organization.

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

1978 FDD sales: $5,800,000

Per Sci has demonstrated that its founders were correct in believing that there was a segment of the floppy disk OEM market ready to pay a little extra for fast access time. Per Sci is a privately held firm founded in 1974, and until recently the only source for floppy drives with linear motor actuators -- the same type of voice coil head positioning used on high performance rigid disk drives. Most of Per Sci's drives are a dual configuration which allows one linear motor to move heads for the equivalent of two drives, thus keeping costs within reach. It is to be expected that the shift to two sided drives at Per Sci will probably lead the industry somewhat, since much of its performance-oriented customer base will also be hungry for more capacity.

PERTEC COMPUTER CORPORATION
Peripherals Division
9600 Irondale Avenue
Chatsworth, CA 91311 213/882-0030

1978 FDD sales: $9,500,000
1978 total net sales: $131,802,000 Net income: $7,183,000

Pertec uses captive floppy drives in systems and in add-on subsystems, and as part of its line of tape and disk OEM products. The firm now produces both 8 and 5.25 inch drives, with one and two sided versions. As with the rest of the floppy drive industry, Pertec's trend is up. After an extended period of revolving management changes in its peripherals operation, Pertec is now well positioned with a full product line and new production facilities to participate more fully in market growth.

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

1978 FDD sales: None
1978 total net sales: $15,261,178,000 Net income: $661,807,000

Qume managed to achieve $50,000,000 annual sales within five years after its founding by establishing a leading position in daisywheel printers for word processing. The firm was acquired late in 1978 by ITT, the eleventh largest U.S. manufacturing company. Qume's ambitious program for floppy drives is built on a product line licensed from YE Data covering only two sided drives, both 8 and 5.25 inch. The Qume management believes in the value of having a large market share, and the firm can be expected to be an aggressive competitor in floppy disk drive OEM markets.

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

1978 FDD sales: $300,000
1978 total net sales: $63,895,527,000 Net income: $2,763,000,000

Qyx announced a family of smart typewriters in early 1978, and apparently has the potential to be one of the largest of the many Exxon Enterprises organizations in the office equipment market. The high end of Qyx' smart typewriter family uses 5.25 inch, one side drives, which the firm developed to a stringent specification for minimum height. Captive floppy drive production is now in high gear to support the typewriter business, and Qyx management has indicated it plans to enter the OEM floppy drive market by the beginning of 1980, hoping that the advantage of having the thinnest drive on the market will open doors.

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

1978 FDD sales: $3,000,000
1978 total net sales: $729,792,000 Net income: $39,412,000

Remex is a major factor in paper tape equipment, and started its floppy drive manufacturing program in 1975. After little progress for a few years, the firm is starting to make its move in floppy drives, with one and two sided drives, floppy subsystems, and an innovative data storage system combining a small fixed Winchester drive with floppies for backup, called the "Data Warehouse". The aggressive product line, combined with emphasis on floppy drive OEM marketing, is now producing results for Remex.

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

1978 FDD sales: $63,400,000
1978 total net sales: $5,901,900,000 Net income: $476,900,000

Shugart's competitors have been waiting for the world leader in OEM floppy drives to slow down, hoping somehow that the acquisition by Xerox would smother small company vigor with big company bureaucracy. The slowdown hasn't happened, however, and Shugart's current growth rate in floppy drives is at least as high as the overall industry. Because of its large market share, the industry problem with manufacturing two side drives attracted more negative attention for Shugart than for

most other drive manufacturers. But for the most part, competitors have been unable to exploit this weakness, since they shared the same problems. Shugart has now announced a redesign for its two sided drives, which it claims will make them capable of high volume production -- although at higher prices than originally quoted. It is assumed that breaking through the two-sided bottleneck on 8 inch drives will also mean the same for 5.25 inch drives -- with a real start expected soon on Shugart's long-delayed shipments of the SA 450. The rumored low cost 5.25 inch, one side drive intended for hobbyist and consumer applications should appear on the scene before many more months but presumably will be attractive only to OEMs planning purely consumer systems.

SYKES DATATRONICS, INC.
375 Orchard Street
Rochester, NY 14606 716/458-8000

1978 FDD sales: $2,000,000
1978 total net sales: $6,552,000 Net income: $714,000
(Fiscal year ended 2/28/79)

Sykes specializes in subsystems using digital cassettes and floppies, which are designed for attachment to terminals and minicomputers to add storage. The firm started internal manufacture of floppies under an Orbis license, and all drives are used in Sykes subsystems. The firm may have made its biggest sale this year, with the announcement by AT&T that the Bell System companies will market a Sykes floppy subsystem as a tariffed product.

TANDON MAGNETICS CORPORATION
9333 Oso Avenue
Chatsworth, CA 91311 213/993-6644

1978 FDD sales: None

Tandon Magnetics is a privately held firm that is widely known for dominating the independent market for one sided floppy heads, and for pioneering a design for two sided heads completely different from IBM's. Tandon has recently been issued a patent for its two sided design and has indicated that it intends to test the validity of its claims through the courts, if necessary, to make believers out of competitors. In the meantime, the firm has entered the business of manufacturing 5.25 inch floppy drives, at the risk of becoming a competitor with existing head customers. After an unsuccessful attempt to sell drives as a "trade source" to major head customers lacking 5.25 inch drives, Tandon has entered the OEM drive market and is establishing a sizable production facility.

Japanese Manufacturers (Exchange basis: 220 Yen = $1 U.S.)

HITACHI, LTD.
6-2, Otemachi, 2-chome
Chiyoda-ku, Tokyo 100 (03)270-2111

1978 FDD sales: $20,400,000
1978 total net sales: $10,804,418,000 Net income: $353,859,000

Less than 20% of Hitachi's sales are derived from the computer industry, which is only one of the numerous electrical and electronic markets served by the company. The company produced its first floppy drive under a GSI license, and has since become a major manufacturer of internally designed 8 inch floppy drives, both one and two sided. In addition to its substantial captive requirements for systems and terminals, Hitachi is a substantial factor in the Japanese OEM floppy drive market.

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

1978 FDD sales: $3,900,000
1978 total net sales: $477,000,000 Net income: $15,900,000

Matsushita Communication Industrial is one of several companies in the Matsushita group active in the design and manufacture of electronic equipment. Matsushita has a license to manufacture the Shugart floppy disk line for OEM sale in Japan. The firm is also a major supplier of floppy drive heads, active in Japan and elsewhere. It is expected that Matsushita may assume the manufacturing function for Shugart/Matsushita designed low-cost drives, which will then be marketed in non-Japanese markets by Shugart.

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

1978 FDD sales: $15,600,000
1978 total net sales: $3,919,509,000 Net income: $56,086,000

Mitsubishi is one of the largest factors in small business computer systems in the Japanese market. The firm manufactures 8 inch drives, both one and two sided, for use with its own systems, but sells an even larger quantity in the Japanese OEM market. Because of the breadth of the Mitsubishi systems product lines and the diversified character of its peripherals manufacturing programs, the firm may be expected to continue the growth of its floppy drive programs.

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

1978 FDD sales: $2,500,000
1978 total net sales: $3,249,140,000 Net income: $33,777,000

NEC is a diversified manufacturer of communications and computer equipment with worldwide distribution. The computer segment of the firm generates about 20% of total revenue, and consists of a broad line of mainframes, small business systems and minicomputers. In addition to a well-established rigid disk drive manufacturing program, NEC added an 8 inch, two sided floppy drive in 1978. To date all floppy drives have been shipped with NEC systems.

OKI ELECTRIC INDUSTRY CO., LTD.
1-7-12, Toranomon
Minato-ku, Tokyo 105 (03)501-3111

1978 FDD sales: $1,500,000
1978 total net sales: $653,182,000 Net income: ($433,000)

Oki is a manufacturer of telecommunications equipment and other electronic equipment. The firm manufactures small computer systems and peripheral equipment. Floppy drives have been manufactured internally for the past few years for use only with Oki's own systems, and only 8 inch, one side drives are produced. Negative financial results in 1978 were attributed to a slow-down in the telecommunications equipment market in Japan.

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

1978 FDD sales: None
1978 total net sales: $893,009,000 Net income: $39,018,000

Ricoh is a diversified manufacturer of office equipment and cameras. The firm is now preparing to initiate manufacture of 8 inch, one side drives under a license acquired from Calcomp. It is expected that Ricoh's immediate interest in floppy drive production is confined to captive requirements.

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

1978 FDD sales: None
1978 total net sales: $129,545,000 Net income: ($1,986,000)

Teac is known primarily as a manufacturer of quality audio tape decks, but also produces data recording devices using digital cassettes and open reel magnetic tape. The firm has entered the OEM floppy drive market in 1979 with a 5.25 inch drive offered both in Japan and the U.S. 5.25 inch, two sided drives, in both 48 and 100 TPI, plus an 8 inch, two side drive, are all planned for production by early 1980.

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

1978 FDD sales: $25,500,000
1978 total net sales: $6,840,309,000 Net income: $10,709,000

Toshiba is a major diversified manufacturer of consumer electric and electronic products, plus numerous industrial electronic products. In the computer field, Toshiba is a leading manufacturer of minicomputers, small business systems and peripherals. To date, floppy drives are limited to 8 inch, both one and two side versions -- with fairly rapid movement to two sided drives. The firm has a significant OEM floppy drive business, in addition to captive usage with its own systems.

YE DATA, INC.
Subsididary of Yaskawa Electric Mfg. Co., Ltd.
1-20-7 Suehiro Building, Kita-Otsuka
Toshima-ku, Tokyo 170

1978 FDD sales: $11,500,000
1978 total net sales: $245,550,000 Net income: ($8,409,000)

YE Data's parent company manufactures motors and industrial automation equipment, with poor recent financial results in older product lines. YE Data products include floppy drives, terminals and printers, with a line of small business systems. The firm was an early Japanese manufacturer of floppy drives, starting the program under an Orbis license, and quickly became a leader in the OEM market. A well-designed 8 inch, two sided drive helped YE Data become the only Japanese manufacturer to attract serious attention in the U.S. OEM floppy drive market. The U.S. program has been turned over to the company's new U.S. licensee, Qume, however, and YE Data is now concentrating on other OEM markets. A 5.25 inch, two sided drive was added in 1978.

European Manufacturers (Exchange basis: Indicated for each firm)

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

1978 FDD sales: $12,400,000
1978 total net sales: $11,131,647,000 Net income: $204,469,000
(Basis: DM 1.90 = $1 U.S.)

With headquarters in West Germany, BASF is a leading chemical industry conglomerate with worldwide facilities. The firm is one of the major manufacturers of magnetic tape and disk media products, including flexible disks. Production of flexible disk drives started in Germany in 1976, with BASF building its own version of the GSI drive, for which it owned manufacturing rights. Although the firm sells 8 inch, one side drives only in the European OEM market, it was third in worldwide non-captive unit shipments in 1978, according to DISK/TREND estimates. 8 inch, two sided drives are now in production, with distribution also limited to Europe. 5.25 inch drives, one and two sided, are now in production both in Germany and in the firm's U.S. magnetic media plant at Bedford, Massachusetts.

DAISY SYSTEMS HOLLAND B.V.
Nieuweweg 279
6600 AC Wychen
The Netherlands 08894-8170

1978 FDD sales: $1,500,000

Daisy Systems is the outgrowth of an attempt by the Dutch government to breathe new life into a Friden manufacturing facility, left to flounder during Friden's last days. Under government control, the facility first became known as Tealtronic, offering a small business system using a self-manufactured daisy wheel printer. Limited production of 8 inch, one side floppy drives was initiated during this period, under a license from Shugart Associates. After a management reorganization in 1977, the firm became Daisy Systems Holland, with primary emphasis on small business systems and OEM sales of daisy wheel printers. It is believed that floppy disk drive production will be phased out, due to the firm's relatively small requirements.

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

1978 FDD sales: $400,000
1978 total net sales: $48,300,000 Net income: ($808,500)
(Basis: 1 Pound = $2.10 U.S.)

Data Recording Instruments (DRI) is a well-established manufacturer of terminals, printers, rigid disk cartridge drives and tape cartridge drives for the European OEM market. In recent years, the Data Recording Equipment (DRE) subsidiary has had responsibility for the above products, and Data Recording Heads (DRH) has offered magnetic heads to drive manufacturers, including flexible disk heads. After several years of reselling the Orbis 8 inch, one side drive under private label to the European market, DRE started manufacture of its own 8 inch drives, both one and two sided, in 1978. In the meantime, DRI, which is controlled by the British government's National Enterprise Board, is entering a joint venture with Control Data, in which DRI's facilities will be included in a new company to be 76% owned by DRI and 24% by Control Data. The new firm will make selected CDC products for the European OEM market, as well as continue most of the DRI products. When it is all sorted out, DRI will presumably emerge as a major force in its traditional markets.

LOGABAX
146, avenue des Champs-Elysees
75008 Paris
France (1)359-61-24

1978 FDD sales: $3,800,000

Logabax manufactures small business systems, terminals and printers, throughout Europe, plus some activities in Brazil and the United States. Floppy disk drives are manufactured under a Sycor license, for captive use with Logabax systems.

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

1978 FDD sales: $3,200,000

MERA is the Polish Union of Automation and Measuring Instruments Industry, which manufactures computer systems and peripherals in wide use throughout Eastern Europe and the USSR. Flexible disk drives are manufactured under a 1975 license

from Logabax, with production at the MERA Krakowska Fabryka Aparatow Pomiarowych facility at Krakow. Metronex is the export organization for MERA products. Operating under a policy objective to increase exports to Western countries, Metronex has actively been soliciting business for floppy drives and heads throughout Europe for the last few years.

ING. C. OLIVETTI & C., S.P.A.
77 via Jervis
10015 Ivrea
Italy

1978 FDD sales: $54,000,000
1978 total net sales: $1,873,200,000 Net income: $2,500,000
(Basis: 770 Lira = $1 U.S.)

Olivetti is a worldwide manufacturer of office equipment and data processing systems. In 1978, the firm was the world's largest manufacturer of captive flexible disk drives, exceeding even IBM and DEC, according to DISK/TREND estimates. The company produces industry compatible 8 inch, one side drives for a wide range of small business and word processing systems, with production of two sided drives now starting. Olivetti also uses 2.5 inch flexible disks in a spiral track drive considered too unique for inclusion in DISK/TREND statistics. The drive has 8 kilobyte capacity, serially recorded, and is now being offered as an OEM product for low capacity requirements, in addition to wide use on Olivetti's own equipment.

SAGEM (Societe d'Applications Generales d'Electricite et de Mecanique)
6, avenue d'Lena
75783 Paris
France (1)747-81-80

1978 FDD sales: $900,000

SAGEM, a diversified manufacturer of electrical and electronic equipment, has manufactured 8 inch, one side flexible disk drives for the European OEM market since 1976. However, the drive has not been a commercial success, and it is believed the firm will phase out production in the near future.

SIEMENS AG
Wittelsbacherplatz 2
D-8000 Munchen 2
West Germany (089)2341

1978 FDD sales: $4,600,000
1978 total net sales: $15,607,889,000 Net income: $379,252,000
(Basis: DM 1.90 = $1 U.S.)

Siemens is a leading European manufacturer of computer systems, yet the company as a whole is so large that data processing revenues constitute only about 5% of the company's total. The firm is now a significant manufacturer of flexible

disk drives, as the result of its acquisitions of two California operations. General Systems International, with 8 inch drives, was acquired in early 1978. In early 1979, Siemens bought the Wangco floppy drive operation (originally Orbis), from Perkin-Elmer, thus obtaining a rapidly growing line of 5.25 inch drives. Much of the 8 inch manufacturing has been moved to a Siemens peripherals plant near Mexico City, but 5.25 inch drives are still produced at the old Orbis plant in Tustin, California. Siemens has indicated a desire to build a major role in worldwide marketing of peripherals, and may be expected to be an active competitor in OEM markets for floppy drives.

VIDEOTON INDUSTRIE-AUSSENHALDELS AG
1068 Budapest VI., Szofia u. 9
Hungary 228-821

1978 FDD sales: $500,000

Videoton is a Hungarian electronics manufacturing firm which manufactures minicomputers and peripherals for domestic use, and also conducts an export business, mostly with Eastern European countries. The firm offers 8 inch, one side industry compatible drives, both as OEM drives and as subsystems.