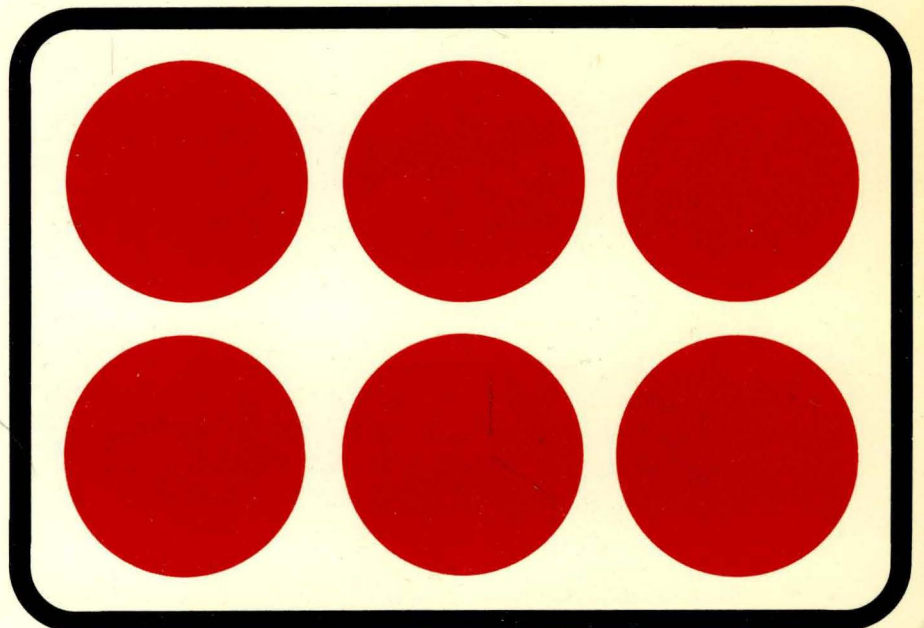


1983 DISK/TREND[®] REPORT

**FLEXIBLE
DISK
DRIVES**



1983 DISK/TREND® REPORT

FLEXIBLE DISK DRIVES

December, 1983

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FOREWORD

This section of the DISK/TREND Report, which covers flexible disk drives, completes the seventh year of publication for the report. A separate section covering rigid disk drives was published in October.

The DISK/TREND report for 1983 was again published on a later schedule than planned, although not quite as late as last year. The industry now has 52 announced manufacturers of flexible disk drives and 285 individual disk drives -- and the information gathering process has become formidable. The messy job of getting the DISK/TREND word processing and number crunching requirements running on our own computer system is now almost completed, however, and we have real hopes of achieving an earlier schedule next year.

Please let me know if I may assist you by providing additional information on the industry -- I am always happy to pass on any non-proprietary information I may have accumulated. Projects requiring elaborate research and analysis can be addressed on a normal consulting basis if desired.

And, as always, your suggestions for improvements in the report are always welcome -- and gratefully received.

James N. Porter

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	SUM-1
SUMMARY	SUM-2
Industry size	SUM-2
Marketing channels	SUM-4
Product mix	SUM-6
Application mix	SUM-14
TECHNICAL REVIEW	SUM-16
Competing technologies	SUM-16
Flexible disk drive enhancements	SUM-21
DEFINITIONS	SUM-24
FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE	DT10-1
FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES	DT11-1
FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE	DT12-1
FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES	DT13-1
FLEXIBLE DISK DRIVES, MICROFLOPPIES	DT14-1
FLEXIBLE DISK DRIVES, SPECIAL	DT15-1
DISK DRIVE SPECIFICATIONS	SPEC-1
MANUFACTURER PROFILES	MFGR-1

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1 CONSOLIDATED WORLDWIDE SHIPMENTS, All Drive Groups, Revenue Summary	SUM-3
2 CONSOLIDATED WORLDWIDE SHIPMENTS, All Drive Groups, Market Class Summary	SUM-5
3 PRODUCT CATEGORY SUMMARY, Worldwide Shipments, All Manufacturers	SUM-8
4 PRODUCT CATEGORY SUMMARY, Worldwide Shipments, Manufacturers of OEM Drives..	SUM-10
5 1982 MARKET SHARES Worldwide Flexible Disk Drive Manufacturers	SUM-12
6 CURRENT PRODUCT LINES, Flexible Disk Drive Manufacturers	SUM-13
7 FLEXIBLE DISK DRIVE APPLICATION PROJECTION, Consolidated Worldwide Shipments	SUM-15
8 FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE, Revenue Summary	DT10-6
9 FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE, Unit Shipment Summary	DT10-7
10 FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE, Drive Height Analysis	DT10-8
11 FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE, Distribution Channel Summary, U.S. Non-Captive Drives	DT10-9
12 FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE, Market Share Summary, Non-Captive Drives	DT10-9
13 FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES, Revenue Summary	DT11-8
14 FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES, Unit Shipment Summary	DT11-9

LIST OF TABLES (Continued)

<u>Table</u>	<u>Page</u>
15 FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES, Drive Height Analysis	DT11-10
16 FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES, Distribution Channel Summary, U.S. Non-Captive Drives	DT11-11
17 FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES, Market Share Summary, Non-Captive Drives	DT11-11
18 FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE, Revenue Summary	DT12-9
19 FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE, Unit Shipment Summary	DT12-10
20 FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE, Drive Height Analysis	DT12-11
21 FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE, Track Density Analysis	DT12-12
22 FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE, Distribution Channel Summary, U.S. Non-Captive Drives	DT12-13
23 FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE, Market Share Summary, Non-Captive Drives	DT12-13
24 FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES, Revenue Summary	DT13-9
25 FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES, Unit Shipment Summary	DT13-10
26 FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES, Drive Height Analysis	DT13-11
27 FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES, Track Density Analysis	DT13-12
28 FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES, Distribution Channel Summary, U.S. Non-Captive Drives	DT13-13

LIST OF TABLES (Continued)

<u>Table</u>	<u>Page</u>
29 FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES, Market Share Summary, Non-Captive Drives	DT13-13
30 FLEXIBLE DISK DRIVES, MICROFLOPPIES, Revenue Summary	DT14-7
31 FLEXIBLE DISK DRIVES, MICROFLOPPIES, Unit Shipment Summary	DT14-8

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1 CHANGING PRODUCT MIX, Consolidated Revenue, Worldwide Flexible Disk Drive Shipments	SUM-7
2 CHANGING PRODUCT MIX, All Manufacturers, Worldwide Flexible Disk Drive Shipments	SUM-9
3 CHANGING PRODUCT MIX, Manufacturers of OEM Drives, Worldwide Flexible Disk Drive Shipments	SUM-11

INTRODUCTION

As the industry grows, DISK/TREND Report stays the same

Rapid growth and changing products are normal for the flexible disk drive industry, but the organization of the DISK/TREND Report has been kept basically the same again this year -- to provide a consistent basis of comparison between new and old. Here is how some of the newer developments have been handled:

- * New "drive height analysis" tables have been added to each of the 8 inch and 5.25 inch product sections, to compare statistics for full size and half high drives. "Two thirds high" and "one third high" 5.25 inch drives have been grouped with half high drives in these tables.
- * The section on microfloppy drives, new last year, has been continued in the same form. One and two sided drives are combined in a single product group, since there are still only one sided drives in the market. As two sided drives become realities, and as mainstream product configurations emerge, this group will probably be divided.
- * Special flexible disk drives have been covered again this year in a separate section. Drives included are those sufficiently different from those in established DISK/TREND product groups to require special treatment. No statistical information is included for these products.

Watching these points will save you time

- * For OEM floppy drives sold in the United States, prices are shown for most drives, usually the 500 unit price. However, prices are changed without notice, so please use the information with care.
- * All unit totals are given in spindles -- so that a disk drive with two spindles is counted in DISK/TREND statistics as two spindles. Drives which use a single actuator mechanism to control head movement on two separate flexible disks are also counted as two spindles.
- * Even if you are thoroughly familiar with the industry's terminology, you will find it helpful to review the definitions section of the report, since several terms with conflicting meanings have been resolved on an arbitrary basis.

SUMMARYIndustry size

Flexible disk drives produced \$2,239,700,000 in worldwide revenues for 1982, representing shipments totaling 5,253,600 units. These figures are close to those forecasted in last year's DISK/TREND Report, as is the revenue forecast for 1983 -- but the unit shipment estimate for 1983 is dramatically higher than last year's forecast.

It is now estimated that 1983 total worldwide shipments will reach 11,052,500 drives, 42.9% higher than previously forecast and up 110.3% from 1982 actual unit shipments. Underlying these changes are a faster than anticipated build-up of 5.25 inch drive shipments, mostly OEM drives, combined with much lower shipments for 8 inch drives than expected. The shifting product mix and market channels are currently driving overall average prices down, as less expensive 5.25 inch drives displace 8 inch models and as lower priced OEM drives grow faster than captive drives, at least in 1983.

In 1986 worldwide unit shipments of 23,592,800 drives are forecast, with revenues of \$4,979,900,000-- representing an expectation that the dynamic markets for small computer systems will continue to grow rapidly. Two sided 5.25 inch drives have become the leading floppy drive configuration in 1983, and by 1986 are expected to provide over 60% of worldwide shipments for all floppy drives, with 14,555,200 units. Microfloppy drives were statistically insignificant in 1982, but are expected to constitute 12.8% of 1986's unit shipments. 8 inch drives will play a minor role by 1986, and one side 5.25 inch drives will be flat after 1984.

1983 DISK/TREND REPORT

TABLE 1
 CONSOLIDATED WORLDWIDE SHIPMENTS
 ALL EXISTING FLEXIBLE DISK DRIVE GROUPS
 REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1982		-----Forecast-----		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	307.2	452.1	402.1	591.4	542.1	774.4	785.1	1,097.6	1,056.6	1,531.4
Other U.S. Captive	363.6	441.2	362.4	443.2	367.8	453.2	355.5	443.4	328.6	415.8
TOTAL U.S. CAPTIVE	670.8	893.3	764.5	1,034.6	909.9	1,227.6	1,140.6	1,541.0	1,385.2	1,947.2
PCM	.4	.4	3.0	3.0	7.7	7.7	9.8	9.8	11.6	11.6
OEM	337.9	407.1	634.9	731.8	709.4	829.1	721.8	870.3	708.3	878.4
TOTAL U.S. NON-CAPTIVE	338.3	407.5	637.9	734.8	717.1	836.8	731.6	880.1	719.9	890.0
TOTAL U.S. SHIPMENTS	1,009.1	1,300.8	1,402.4	1,769.4	1,627.0	2,064.4	1,872.2	2,421.1	2,105.1	2,837.2
Non-U.S. Manufacturers										
Captive	34.2	672.6	97.8	811.1	144.4	948.8	201.3	1,023.3	268.1	1,066.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	91.6	266.3	237.9	577.4	369.3	773.1	462.1	917.9	559.6	1,076.7
TOTAL NON-U.S. SHIPMENTS	125.8	938.9	335.7	1,388.5	513.7	1,721.9	663.4	1,941.2	827.7	2,142.7
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	1,134.9	2,239.7	1,738.1	3,157.9	2,140.7	3,786.3	2,535.6	4,362.3	2,932.8	4,979.9

Marketing channels

Although the total number of manufacturers with announced floppy drives has increased by only two since last year, six new manufacturers arrived, partially offset by others which left the scene. Of the manufacturers currently participating in the industry, 25 are headquartered in the United States, 17 in Japan and 10 in Europe. Additional floppy drive manufacturing programs are planned, in South America, Asia and the United States, with the emphasis on minifloppy and microfloppy drives.

IBM, of course, has been the leading manufacturer of captive floppy drives since 1973, producing only 8 inch models. It is expected that IBM will initiate production of two sided 5.25 inch drives in 1984, with large quantities forecast for use with the IBM personal computer family, and the giant's share will become even larger. IBM's 1982 floppy drive shipments, all 8 inch drives, generated estimated revenues of \$452,100,000, with 1986 forecasted at \$1,531,400, mostly from 5.25 inch drives.

Other captive revenues will rise from \$1,113,800,000 in 1982 to an estimated \$1,481,800,000 in 1986, but share of the worldwide total for all floppy drive revenues will drop from 49.7% in 1982 to 30.0% in 1986. Unless their plans change, many U.S. system manufacturers that previously would probably have made their own floppy drives prefer to buy OEM drives at low prices and avoid the scramble to keep up with the continuing parade of new drive configurations.

Makers of OEM drives introduced the high-growth new drives, and their share of the industry is growing -- from 30.1% of 1982 revenues to 39.3% of 1986 revenues. Given the continually falling prices for OEM drives, these sales represent a huge portion of total industry shipments.

TABLE 2
 CONSOLIDATED WORLDWIDE SHIPMENTS
 ALL EXISTING FLEXIBLE DISK DRIVE GROUPS
 MARKET CLASS SUMMARY

WORLDWIDE REVENUES BY MANUFACTURER TYPE	-----1982-----		-----Forecast-----							
	---Shipments---		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
	\$M	%	\$M	%	\$M	%	\$M	%	\$M	%
-----	----	----	----	----	----	----	----	----	----	----
U.S. Manufacturers										

IBM	452.1	20.2	591.4	18.7	774.4	20.4	1,097.6	25.2	1,531.4	30.8
Other U.S. Captive	441.2	19.7	443.2	14.0	453.2	12.0	443.4	10.2	415.8	8.4
PCM	.4	--	3.0	.1	7.7	.2	9.8	.2	11.6	.2
OEM	407.1	18.2	731.8	23.2	829.1	21.9	870.3	19.9	878.4	17.6
Total U.S. Mfgr's.	1,300.8	58.1	1,769.4	56.0	2,064.4	54.5	2,421.1	55.5	2,837.2	57.0
Non-U.S. Manufacturers										

Captive	672.6	30.0	811.1	25.7	948.8	25.1	1,023.3	23.5	1,066.0	21.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	266.3	11.9	577.4	18.3	773.1	20.4	917.9	21.0	1,076.7	21.6
Total Non-U.S. Mfgr's.	938.9	41.9	1,388.5	44.0	1,721.9	45.5	1,941.2	44.5	2,142.7	43.0
Worldwide Total	2,239.7	100.0	3,157.9	100.0	3,786.3	100.0	4,362.3	100.0	4,979.9	100.0

Product mix

Comparative total revenue figures can provide a misleading impression of unit shipments when the proportion of captive drives for a product group is higher than the industry average, as it is with 8 inch drives. When using revenue figures alone, it is also necessary to keep in mind the large spread between selling prices for low cost drives, such as one sided 5.25 inch drives, and high end products, such as two sided 8 inch drives.

In 1982, one sided 5.25 inch drives still held the lead in unit shipments with 40.4% of worldwide total, but these shipments produced only 16.2% of worldwide floppy drive revenues. Competition from other floppy drive formats will undercut the one sided 5.25 inch drive's appeal, with little growth expected after 1984.

Two sided 5.25 inch drives are providing almost half of the industry's worldwide unit shipments in 1983, and these drives will stay on top for many years, as higher capacity versions expand their range of usefulness. Because of these capacity enhancements and availability of half high models from most drive manufacturers, these drives are positioned better than any other group to exploit the high growth market for desktop and portable computers used for business applications.

Microfloppy drives are expected to grow rapidly in portable computer and certain desktop system applications. Shipments should exceed three million drives in 1986, including all microfloppy configurations.

8 inch drives, especially one sided versions, are being abandoned rapidly by manufacturers of small business systems and word processing equipment. Manufacturers of these systems must move to desktop system configurations, and 8 inch drives are judged too large and too costly.

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

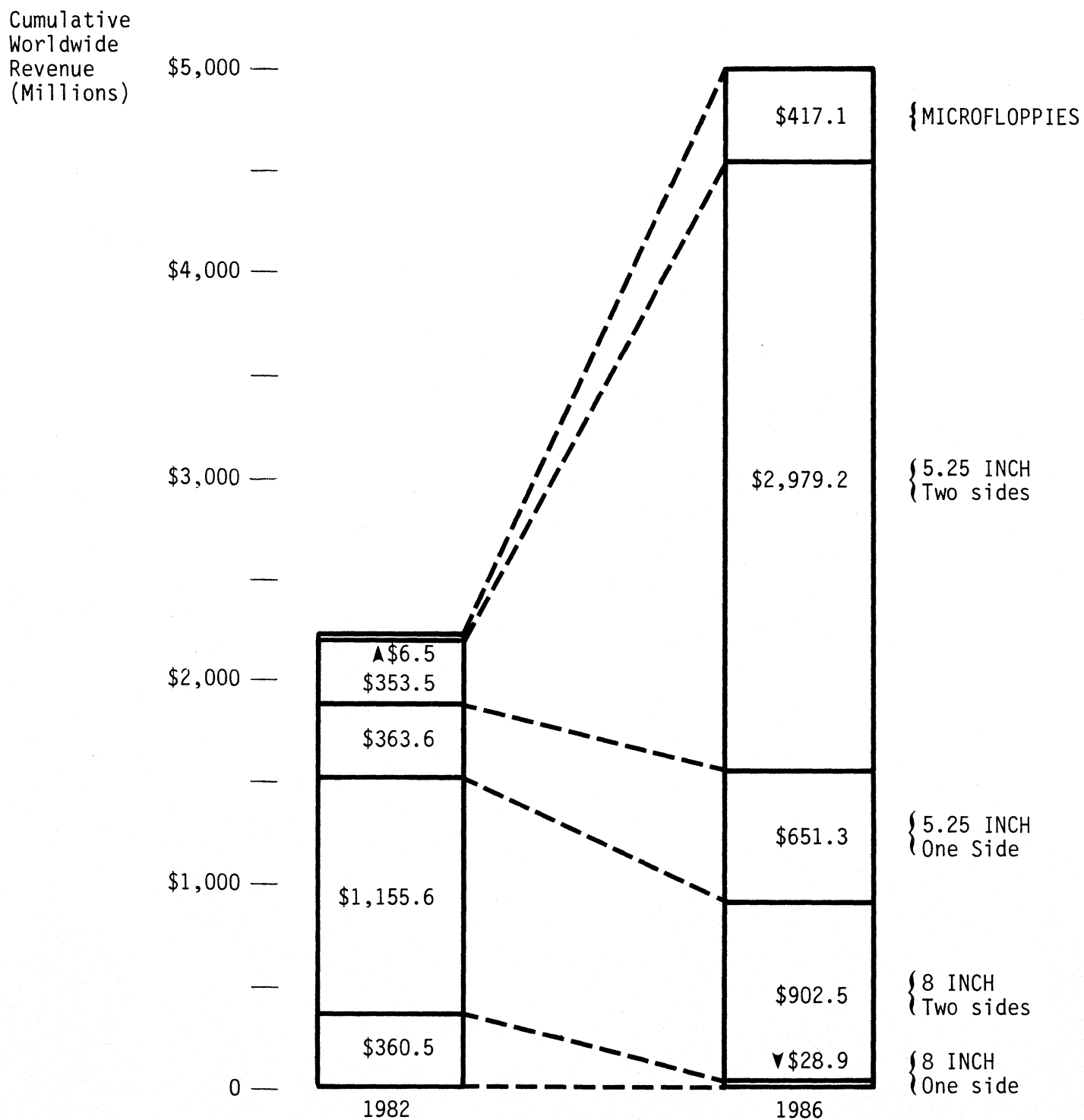


TABLE 3
WORLDWIDE SHIPMENTS
PRODUCT CATEGORY SUMMARY
ALL MANUFACTURERS

Units: Thousands
Dollars: \$ Million

		-----1982-----		-----1983-----		-----1984-----		-----Forecast-----		-----1986-----	
		---Shipments---		Ship Δ%		Ship Δ%		Ship Δ%		Ship Δ%	
		Ship	Δ%	Ship	Δ%	Ship	Δ%	Ship	Δ%	Ship	Δ%
8 INCH DRIVES											
One Side	Units	597.7	-19.9	329.3	-44.9	209.8	-36.2	118.5	-43.5	63.8	-46.1
	\$M	360.5	-18.5	183.2	-49.1	116.1	-36.6	60.9	-47.5	29.8	-51.0
Two Sides	Units	1,032.5	+53.3	1,301.8	+26.0	1,429.4	+9.8	1,340.7	-6.2	1,098.0	-18.1
	\$M	1,155.6	+50.6	1,302.8	+12.7	1,376.8	+5.6	1,143.2	-16.9	902.5	-21.0
8 INCH TOTAL	Units	1,630.2	+14.8	1,631.1	--	1,639.2	+0.4	1,459.2	-10.9	1,161.8	-20.3
	\$M	1,516.1	+25.3	1,486.0	-1.9	1,492.9	+4	1,204.1	-19.3	932.3	-22.5
5.25 INCH DRIVES											
One Side	Units	2,120.1	+31.0	3,636.2	+71.5	4,446.7	+22.2	4,835.2	+8.7	4,862.8	+5
	\$M	363.6	+10.7	582.6	+60.2	657.0	+12.7	676.6	+2.9	651.3	-3.7
Two Sides	Units	1,477.8	+151.5	5,492.8	+271.6	8,583.4	+56.2	11,660.1	+35.8	14,555.2	+24.8
	\$M	353.5	+107.5	1,035.4	+192.8	1,502.0	+45.0	2,231.5	+48.5	2,979.2	+33.5
5.25 INCH TOTAL	Units	3,597.9	+63.1	9,129.0	+153.7	13,030.1	+42.7	16,495.3	+26.5	19,418.0	+17.7
	\$M	717.1	+43.7	1,618.0	+125.6	2,159.0	+33.4	2,908.1	+34.6	3,630.5	+24.8
MICROFLOPPY DRIVES											
	Units	25.5	+410.0	292.4	+1046.6	810.0	+177.0	1,693.0	+109.0	3,013.0	+77.9
	\$M	6.5	+170.8	53.9	+729.2	134.4	+149.3	250.1	+86.0	417.1	+66.7
TOTAL ALL DRIVES											
	Units	5,253.6	+44.7	11,052.5	+110.3	15,479.3	+40.0	19,647.5	+26.9	23,592.8	+20.0
	\$M	2,239.7	+31.0	3,157.9	+40.9	3,786.3	+19.8	4,362.3	+15.2	4,979.9	+14.1

Figure 2
CHANGING PRODUCT MIX
WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
ALL MANUFACTURERS

Worldwide
Shipments
(000 units)

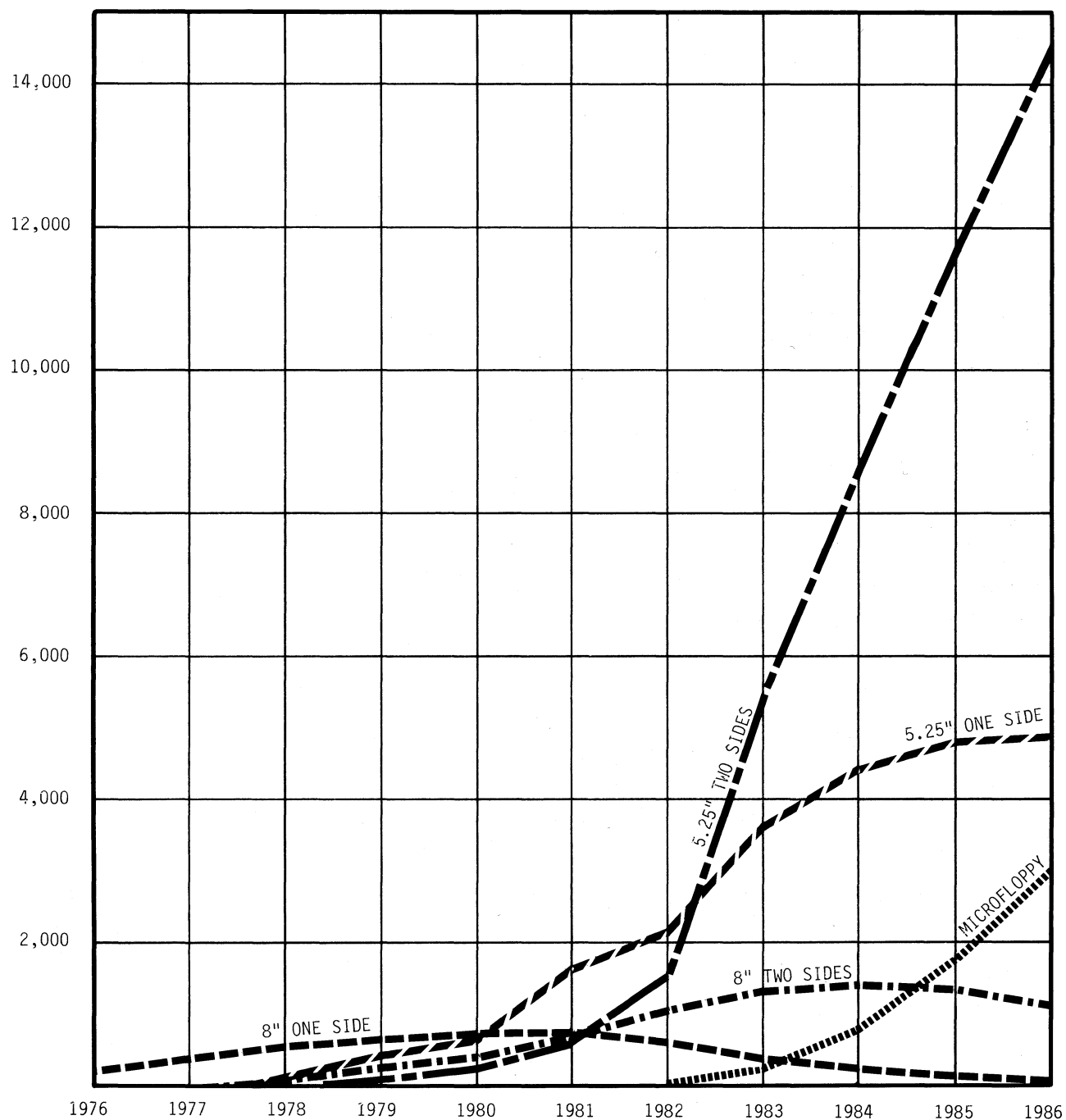


TABLE 4
WORLDWIDE SHIPMENTS
PRODUCT CATEGORY SUMMARY
MANUFACTURERS OF OEM DRIVES

Units: Thousands Dollars: \$ Million		Forecast									
		-----1982-----		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
		Shipments		Ship	Δ%	Ship	Δ%	Ship	Δ%	Ship	Δ%
		Ship	Δ%	Ship	Δ%	Ship	Δ%	Ship	Δ%	Ship	Δ%
8 INCH DRIVES											
One Side	Units	340.2	-27.8	215.2	-36.7	133.5	-37.9	79.3	-40.5	45.9	-42.1
	\$M	102.3	-30.0	66.2	-35.2	40.6	-38.6	24.4	-39.9	14.2	-41.8
Two Sides	Units	481.3	+34.2	664.4	+38.0	726.5	+9.3	744.0	+2.4	602.0	-19.0
	\$M	167.5	+10.1	198.5	+18.5	201.4	+1.4	190.1	-5.6	142.5	-25.0
8 INCH TOTAL	Units	821.5	-1.0	879.6	+7.0	860.0	-2.2	823.3	-4.2	647.9	-21.3
	\$M	269.8	-9.5	264.7	-1.8	242.0	-8.5	214.5	-11.3	156.7	-26.9
5.25 INCH DRIVES											
One Side	Units	1,754.0	+29.6	2,979.1	+69.8	3,599.7	+20.8	3,902.8	+8.4	3,929.2	+6
	\$M	176.8	-.9	272.5	+54.1	304.9	+11.8	313.6	+2.8	306.5	-2.2
Two Sides	Units	1,269.4	+146.1	4,930.1	+288.3	7,470.8	+51.5	9,226.1	+23.4	10,742.7	+16.4
	\$M	223.4	+95.9	738.0	+230.3	964.9	+30.7	1,096.0	+13.5	1,225.2	+11.7
5.25 INCH TOTAL	Units	3,023.4	+61.8	7,909.2	+161.5	11,070.5	+39.9	13,128.9	+18.5	14,671.9	+11.7
	\$M	400.2	+36.8	1,010.5	+152.4	1,269.8	+25.6	1,409.6	+11.0	1,531.7	+8.6
MICROFLOPPY DRIVES											
	Units	19.5	+6400.0	250.7	+1185.6	707.2	+182.0	1,479.7	+109.2	2,615.3	+76.7
	\$M	3.4	--	34.0	+900.0	90.4	+165.8	164.1	+81.5	266.7	+62.5
TOTAL ALL DRIVES											
	Units	3,864.4	+43.1	9,039.5	+133.9	12,637.7	+39.8	15,431.9	+22.1	17,935.1	+16.2
	\$M	673.4	+13.9	1,309.2	+94.4	1,602.2	+22.3	1,788.2	+11.6	1,955.1	+9.3

Figure 3
CHANGING PRODUCT MIX
WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
MANUFACTURERS OF OEM DRIVES

Worldwide
Shipments
(000 units)

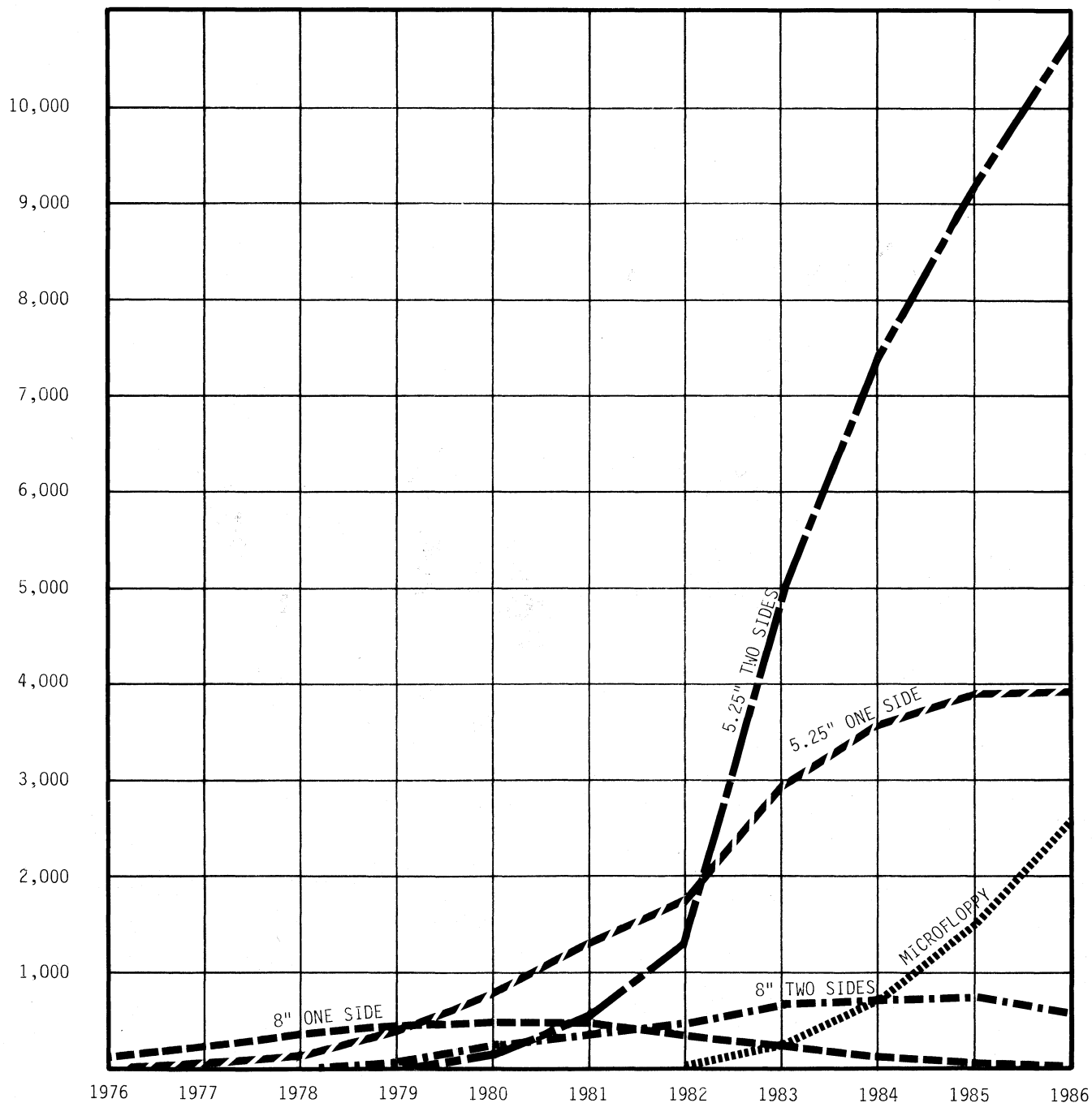


TABLE 5
1982 ESTIMATED MARKET SHARES
WORLDWIDE SHIPMENTS OF ALL FLEXIBLE DISK DRIVES
(Value of non-U.S. currencies estimated at July, 1982, rates)

	CAPTIVE		OEM*		TOTAL INDUSTRY	
	\$M	%	\$M	%	\$M	%
<u>U.S. MANUFACTURERS</u>						
Control Data	16.9	1.1	38.2	5.7	55.1	2.5
Digital Equipment	32.8	2.1	--	--	32.8	1.4
IBM	452.0	28.9	--	--	452.0	20.2
Micro Peripherals	--	--	37.4	5.5	37.4	1.7
Micropolis	--	--	10.9	1.6	10.9	.5
Qume	--	--	24.3	3.6	24.3	1.1
Remex	--	--	10.1	1.5	10.1	.4
Shugart	130.1	8.3	126.8	18.8	256.9	11.5
Sykes Datatronics	11.5	.7	--	--	11.5	.5
Tandon	--	--	150.7	22.4	150.7	6.7
Tandy	221.1	14.1	--	--	221.1	9.9
Other U.S.	28.9	1.8	9.1	1.4	38.0	1.7
U.S. TOTAL	893.3	57.0	407.5	60.5	1,300.8	58.1
<u>NON-U.S. MANUFACTURERS</u>						
Alps Electric	3.5	.2	48.8	7.2	52.3	2.3
BASF	--	--	22.1	3.3	22.1	1.0
Canon	17.1	1.1	4.1	.6	21.2	.9
Epson	24.0	1.5	--	--	24.0	1.1
Hitachi	44.8	2.9	13.3	2.0	58.1	2.6
Matsushita Communication Ind.	--	--	13.1	1.9	13.1	.6
Mitsubishi Electric	18.8	1.2	24.4	3.6	43.2	1.9
NEC	328.5	21.0	6.8	1.0	335.3	15.0
Olivetti	119.0	7.6	.6	.1	119.6	5.4
Ricoh	33.3	2.1	--	--	33.3	1.5
Siemens	.8	.1	21.5	3.2	22.3	1.0
TEAC	--	--	43.5	6.5	43.5	1.9
Toshiba	62.6	4.0	3.3	.5	65.9	2.9
YE Data	3.5	.2	49.8	7.4	53.3	2.4
Other Non-U.S.	16.7	1.1	15.0	2.2	31.7	1.4
NON-U.S. TOTAL	672.6	43.0	266.3	39.5	938.9	41.9
WORLDWIDE TOTAL	1,565.9	100.0	673.8	100.0	2,239.7	100.0

*Includes PCM drives.

TABLE 6
CURRENT PRODUCT LINES

MANUFACTURERS OF FLEXIBLE DISK DRIVES

Codes: C = Captive
P = PCM
O = OEM

Numbers in table
indicate TPI

U.S. MANUFACTURERS	DISK/TREND PRODUCT GROUP: TYPE	10	11	12	13	14	15
		8 INCH ONE SIDE	8 INCH TWO SIDES	5.25 INCH ONE SIDE	5.25 INCH TWO SIDES	MICRO FLOPPIES	SPECIAL
Amlyn	O			170	170		
Apple Computer	C				62.5		
Burroughs	C		64,150				
Caldisk	C,O	48	48				
Control Data	C,P,O	48	48	48	48,96		
Digital Equipment	C	48		96			
Drivetec	O				192		
Eastman Kodak	O				192		
Exxon Office Systems	C			48			
Format	O				48,96		
Hi-Tech Peripherals	O			96	48,96		
IBM	C	48	48				
Innotronics	O	48	48				
Iomega	O						300,394
Micro Peripherals	O	48	48	48,96,100	48,96,100	100,140	
Micropolis	O			96,100	96,100		
Miltope	O	48	48				
Qume	O		48		48,96		
Remex	O			48,96	48,96		
Shugart	C,O	48	48	48,96	48,96	135	
Sykes Datatronics	C,O	48	48				
Tabor	O					140	
Tandon	O	48	48	48,96	48,96	135	
Tandy	C			48			
World Storage Technology	O	48	48	48,96	48,96		

JAPANESE MANUFACTURERS

Alps Electric	O			48,96	48,96	67.5,135	
Canon	C,O			48	48,96		
Epson	C,O				48,96	67.5,135	
Hitachi	C,O	48	48,96		48,96	100	
Janome Sewing Machine	O					100	
Matsushita Com. Ind.	C,O	48	48	48	48,96	100	
Matsushita Elect. Ind.	O					100	
Mitsubishi	C,O	48	48		48,96	135	
NEC	C,O		48				
Okí Electric	C,O	48			48,96		
Ricoh	C	48	48				
Sankyo Seiki	O					100	2.6" Spiral
Sony	C,O					135	
TEAC	O			48,96,100	48,96	67.5,135	
Tokyo Electric Company	O			48,96	48,96		2.6" Spiral
Toshiba	C,O		48		48,96		
YE Data	C,O	48	48		48,96		

EUROPEAN MANUFACTURERS

BASF	O	48	48	48	48,96		
Data Track Technology	O			96	96		
Elcomatic	O	48	48,96				
ISOT	C,O	48		48			
Metrimpex/BRG	O					100	
Metronex	C,O	48					
Olivetti	C,O	48	48	48,96	48,96		
Philips	C,O			48,96	48,96		
Robotron	C,O			48			
Videoton/MOM	C,O	48		48			

Application mix

Small business and professional systems used slightly more than half of all floppy drives shipped worldwide in 1982, a total of 2,709,000 units. Although 5.25 inch, one side drives were used more frequently than any other type of floppy drive in these systems, with 1,191,900 units, that lead will be short lived. Two sided 5.25 inch drives are now passing up one sided minifloppies, and in 1986 they are expected to account for over 10 million of the 12,161,900 floppy drives shipped with small business and professional systems. By then, microfloppies will be in second place for this application, and no other configuration will even be close.

Consumer and hobby computers became the second largest application area for 1982, based on heavy shipments of one sided 5.25 inch drives. Although most low-end consumer computers do not use disk drives of any kind, the DISK/TREND definition of this application recognizes the usage of individual computer systems, rather than other criteria such as price level of hardware -- so the mid-range and high-end personal computers, which do use floppy drives, are included. In 1986, 20.6% of floppy worldwide unit shipments are expected to be used with consumer and hobby computers, a total of 2,472,100 drives, with one sided 5.25 inch drives still in the lead, followed by two sided versions and microfloppies.

Word processing has slipped to third place, with 14.7% of all floppy drives shipped, for 772,900 units. The diversity of word processing applications and equipment explains why all of the established floppy drive formats do well in this market. One sided 8 inch drives lead, but all except microfloppies, the newcomer, have significant shares.

1983 DISK/TREND REPORT

TABLE 7
FLEXIBLE DISK DRIVE APPLICATION PROJECTION
CONSOLIDATED WORLDWIDE SHIPMENTS

	-----1982 ESTIMATE-----						-----1986 PROJECTION-----					
	All FDD	8" One Side	8" Two Sides	5.25" One Side	5.25" Two Sides	Micro Floppies	All FDD	8" One Side	8" Two Sides	5.25" One Side	5.25" Two Sides	Micro Floppies
SMALL BUSINESS AND PROFESSIONAL SYSTEMS -----												
Units (000)	2,709.0	156.2	508.1	1,191.9	832.8	20.0	12,161.9	12.1	447.7	387.5	10,139.5	1,175.1
Share %	51.5%	26.1%	49.2%	56.2%	56.4%	78.4%	51.5%	18.9%	40.8%	8.0%	69.7%	39.0%
GENERAL PURPOSE MINI/MICRO SYSTEMS -----												
Units (000)	449.1	69.6	119.0	115.4	145.1	--	1,024.9	9.3	328.8	193.4	409.0	84.4
Share %	8.6%	11.7%	11.5%	5.4%	9.8%	--	4.3%	14.6%	29.9%	4.0%	2.8%	2.8%
TERMINALS -----												
Units (000)	350.6	47.7	124.7	60.7	117.5	--	579.7	16.7	205.3	142.6	197.0	18.1
Share %	6.7%	8.0%	12.1%	2.9%	7.9%	--	2.5%	26.2%	18.7%	2.9%	1.3%	.6%
WORD PROCESSING -----												
Units (000)	772.9	260.7	158.6	183.3	167.8	2.5	2,026.4	20.4	59.9	336.7	1,003.9	605.5
Share %	14.7%	43.6%	15.4%	8.6%	11.4%	9.8%	8.6%	32.0%	5.5%	6.9%	6.9%	20.1%
CONSUMER AND HOBBY COMPUTERS -----												
Units (000)	828.7	4.4	93.1	535.7	193.5	2.0	7,359.9	--	--	3,710.3	2,601.1	1,048.5
Share %	15.8%	.7%	9.0%	25.3%	13.1%	7.9%	31.2%	--	--	76.3%	17.9%	34.8%
OTHER APPLICATIONS -----												
Units (000)	143.3	59.1	29.0	33.1	21.1	1.0	440.0	5.3	56.3	92.3	204.7	81.4
Share %	2.7%	9.9%	2.8%	1.6%	1.4%	3.9%	1.9%	8.3%	5.1%	1.9%	1.4%	2.7%
TOTAL, ALL APPLICATIONS -----												
Units (000)	5,253.6	597.7	1,032.5	2,120.1	1,477.8	25.5	23,592.8	63.8	1,098.0	4,862.8	14,555.2	3,013.0
Share %	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

TECHNICAL REVIEW

Competing technologies

The many changes in flexible disk drive configurations now underway are the result of perceived market opportunities for floppy drives with various attributes such as smaller size, lower price or higher capacity -- with very little effective competition from other technologies.

Because flexible disk drives themselves are evolving so rapidly to new sizes and capacities, and new designs and manufacturing methods are continually making them more cost effective, competitive data storage technologies have had limited success in breaking into floppies' established markets. And the rate of innovation currently enjoyed by floppy drives is not going to soon slow down -- in fact, the rate at which new technologies and capabilities is introduced will surely increase through the remainder of this decade.

The unique combination of low cost, random access and media removability provided by flexible disk drives continues to be the key reason for their incessant growth and ever wider usage. In order to have any impact on the markets now held by floppy drives, any competing technology must offer a significant improvement to the features floppies already offer. These products are the ones with the most potential to challenge flexible disk drives in selected markets for data storage requirements with small systems and specialized applications:

- * Tape drives: When disk drive capacities used with small computer systems rise above 20-30 megabytes, the functional requirements for a removable media backup device frequently cannot be met by a flexible disk drive. Floppies' comparatively limited capacity is usually adequate for systems on which the typical file is also small, such as with word processing systems, many small business

systems, and most personal computers. But if files are typically large, if a data base management system is used, or if it is necessary to back up an entire rigid disk for protection at the end of each day, most of today's floppies are usually not the best answer.

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

The streaming tape cartridge drives now offered by several manufacturers are likely to achieve a major penetration of this market. Streamers have been available from a few suppliers during the past few years, but with different interfaces and recording formats from each manufacturer -- a situation which discouraged many system manufacturers from investing in the controller and software development needed to use these drives. However, the advent of the high capacity 5.25 inch Winchester has provided the stimulus for most of the tape cartridge drive manufacturers to quickly agree on common standards for interfaces and recording formats. These standards, plus new tape cartridge drives designed to the same form factor as 5.25 inch Winchesters, will probably result in major penetration by tape cartridge streamers of the backup market with 5.25 inch Winchesters in the 20-30 megabyte range and above. Will this development displace flexible disk drives? No, not significantly, since floppies never had a logical market opportunity with higher capacity 5.25 inch Winchesters, except for applications using files typically small enough to fit a floppy. Anything larger probably will create a demand for tape streamers or removable rigid disk drives. In any event, floppy drives will undoubtedly be used on many small systems with large capacity Winchester drives, for software distribution, and as a convenient backup method for the small files which usually accompany the large ones.

- * Small rigid disk drives: The rapid growth of small Winchester disk drives has displaced large quantities of floppy drives which otherwise would have been sold, but availability of these rigid disk drives has probably also served to increase the size of the total market for small computer systems, and therefore boost the market for floppy drives. For almost all small fixed disk drives installed, a companion removable media recording device is necessary to provide for software distribution, save/restore of programs and files, and backup to protect against hardware, software or operator error. And most of the time that removable device is a floppy disk drive.

The rigid disk challenge to flexible disk drives will probably be most effectively presented by 5.25 inch rigid disk cartridge drives. Small disk cartridge drives are one of the best ways to accomplish fast save and restore of files in the 5-10 megabyte range, and offer access times fast enough to be satisfactory as a basic system disk, in lieu of a fixed Winchester drive. Availability has been the limiting factor in growth of the disk cartridge share of this market, with several announced products, but only one manufacturer so far in production. DMA Systems has been shipping a drive in the standard 5.25 inch floppy form factor since mid-1982, has developed a half high version, and has licensed other manufacturers. Drives of this type may be expected to secure a significant share of the market requirement for 5-10 megabyte removable media devices, providing major competition to high capacity floppy drives.

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

Bubbles' markets were obviously not the mainstream data storage applications dominated by magnetic disk and tape drives. As expected by disk and tape manufacturers, but not by many bubble manufacturers, the older products were well established, mostly multiple sourced, and getting better all the time. But there are many practical limitations for disk and tape, and applications where they are unsuitable or marginal because of environmental limitations or minimum practical size thresholds.

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

The successful bubble program of Intel Magnetix has been instrumental in developing a wide variety of applications. Intel led the market with 1 Mbit chips, the introduction of support circuits and a guaranteed future price reduction policy. The company has attracted a variety of customers in specialized and harsh environment applications -- at least sufficient to establish quantity production, and start down the learning curve. The hottest new market area for bubbles is potentially the largest one: Portable computers. Several of the new portable computer manufacturers have incorporated bubble memories as basic auxiliary memory devices, because of bubbles' advantages of physical size and durability.

The non-volatility of magnetic bubbles and their suitability for capacities too small to be cost effective for magnetic disk drives has also proven to be attractive to system manufacturers for applications such as industrial control systems, robots, point of sale terminals, medical instrumentation, avionic systems and militarized systems.

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

- * Non-reversible optical disks: The first optical disk recording systems to enter the market use "ablative" recording methods, in which a laser burns a pit in the disk's recording surface. Since the pit cannot be removed, ablative systems are not able to rewrite data in the same physical location and are usually called "non-reversible" or "write once" systems. Such systems are now starting to be introduced as actual products, after many years of costly development programs by several manufacturers in the United States, Japan and Europe.

Write once systems are capable of higher areal densities than magnetic recording techniques now in use, with some planned systems providing several gigabytes on a single removable disk, and the promise of mass storage systems which could access large numbers of such disks under system control. Although not yet demonstrated, advocates of the various types of optical disk media technologies believe that their disks will provide archival lives which equal or exceed those of magnetic media.

In broad terms, two kinds of systems will be offered: Document storage and data storage systems. Systems intended to store images of documents are already on the market in Japan, offered by Toshiba and Matsushita Electric. Document storage systems do not require the extremely low error rates demanded for data storage, and can live with the relatively poor error rates common to all optical recording systems. At this time, it does not appear that optical document storage systems will be able to compete on a price per image basis with microfilm for bulk storage of images which are not frequently referred to. However, the fast and convenient access to stored images provided by optical disk systems will probably create a major place for them in the emerging office automation market, for numerous specialized applications. The early emphasis on optical document storage systems in the Japanese market is explained by the extremely complicated character of the Japanese alphabet. Since most business communication and records are in handwritten characters, the emphasis first on copying machines, then facsimile transmission, and now optical document storage systems is understandable.

Optical data storage systems from a variety of firms, including Storage Technology, Control Data, Xerox and Thomson-CSF are planned for first shipments in late 1983/early 1984. STC's 7600 is probably the most ambitious of these projects, involving a program intended to rapidly build a major market among users of large IBM mainframes. The disk subsystem carries a list purchase price of \$130,000, uses the STC 8880 controller, and has a transfer rate of 3 megabytes/second, the same as the 3380 magnetic disk drive. Each disk cartridge contains a single 14" disk, is priced from \$140 to \$225, depending on quantity, and has a capacity of four gigabytes. STC has identified a large number of target applications involving data bases which are infrequently or never updated, and for which a write once system would not be at a disadvantage -- such as stock market history, legal files, seismic data and banking transaction logs. Replacement of magnetic tape for archival storage is also high on the target list.

The other write once systems about to enter the market use comparable, but different technologies, with capacities per disk in the range of one to three gigabytes. These systems will be marketed as OEM drives. Obviously, the market for this generation of optical disk systems will be limited to the niches which can tolerate nonreversability. It is believed that these niches do exist and that the low cost per byte stored will start to open selected markets to optical disk systems. But the markets will be specialized, with system manufacturers slow to act. Little displacement of magnetic disk drives will result in the foreseeable future.

- * Reversible optical disks: The possibility for real inroads into the market for magnetic disk drives exists with reversible optical disk systems, if either of the principal proposed technologies reaches the status of a reliable production product. Magneto-optical recording has seen development activity for twenty years, and "phase change" optical recording has attracted considerable attention during the past few years.

Most current magneto-optical development programs involve using a low powered laser to change the magnetic state of an amorphous gadolinium coating on a disk, by raising surface temperatures into the range of the coating's Curie point, while a magnetic field is present. These changes are detected during reading, as the affected spot on the disk causes a small rotation in the polarized light reflected from the surface or transmitted through the disk.

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

Advocates of both technologies claim the ability to reverse the state at individual disk locations more times than would ever be necessary, and believe that their disks will be adequately stable

for archival storage. Individual firms are also working on other proposed reversible optical recording technologies, but none of these are known to have overcome all of the problems, which have included: Slow completion of the reversal cycle, limitations on the number of reversals before degradation, poor shelf life, and low recording density.

Magneto-optical and phase change technologies have been developed to the point where they both appear to have some hope of becoming reliable, producible products. But from the character of the reported development programs underway in the United States, Japan and Europe, actual production products are not expected in the next two to three years, at the earliest. Various difficulties still must be overcome in areas such as media stability, marginal signal to noise ratios and availability of appropriate lasers. It is a promising area, but the bugs have to be worked out.

Flexible disk drive enhancements

The development of higher density recording techniques for flexible disk drives has been undertaken by many organizations in recent years. Although most of the original floppy drive technology was developed by IBM, that firm's delay of several years in producing small disk drives left the field to others. As a result, the industry has seen the rapid development of several aspects of flexible disk recording technology, with many additional improvements expected.

- * Media: The polyester substrate used with flexible disks suffers from limitations in its dimensional stability which derive from the manufacturing process used. As a result, today's mainstream floppy drive products using open loop head positioning systems for low cost are limited to 48 TPI with 8 inch drives, 96/100 TPI with 5.25 inch drives, and 135/140 TPI with microfloppy drives. The relatively small tonnage of polyester required for diskettes did not inspire plastics manufacturers to invest heavily in research targeted at dimensional stability improvements until the last few years, when the quantities became too large to ignore. However, the magnetic recording industry has been actively developing several methods of increasing linear recording density.

Longitudinal particulate coatings: The conventional 8 and 5.25 inch diskettes used for the last 10 years, with 300 Oersted oxide coatings, have generally been recorded at 5,000 to 6,000 flux reversals per inch (FCI). The 600 Oersted cobalt modified oxide coatings now used in high density 5.25 inch and micro-floppy diskettes from several manufacturers are used in numerous production drives at 8,000 to 10,000 FCI, and special types are

available for use at even higher densities. 2 megabyte 5.25 inch drives from Tandon and Mitsubishi use diskettes at almost 12,000 FCI, and a new 8 inch Hitachi drive with 9.6 megabyte capacity records at about 13,700 FCI. The Iomega Bernoulli effect 8 inch and 5.25 inch drives achieve up to 18,000 FCI, with a diskette using similar coercivity but a thinner coating. A few of the above drive/media systems use spin coated diskettes, but most employ diskettes with conventional web coating. It is obvious that longitudinal particulate recording has many good years left, with the full exploitation of its potential recording density probably to be paced primarily by market forces.

Isotropic coatings: It is theoretically possible, by reducing the length of magnetic particles, which are normally very long and thin, to resolve magnetic flux changes at much higher densities. Spin Physics, a subsidiary of Eastman Kodak, has produced such particles and used them in manufacturing 5.25 inch flexible disks with greatly enhanced abilities to handle high recording densities. Spin Physics has announced that it will manufacture an 800 Oersted version of this coating in a 5.25 inch diskette and will make available coated rolls of the material for conversion into diskettes by other media manufacturers, but it is unclear what the firm's policies will be toward licensing and other attempts to create an industry standard. It has been demonstrated that such diskettes could be recorded at up to 50,000 BPI. Since diskettes suitable for isotropic recording could easily be produced in great quantities on coating equipment widely used by media manufacturers today, it seems likely that other media manufacturers will further develop the work on small magnetic particles which has already been widely undertaken. In addition, it is known that some media manufacturers are working with barium ferrite technology, which also has the potential for very high density recording if stable materials become available in commercial quantities.

Sputtered disks for perpendicular recording: Perpendicular recording offers great potential for increased recording densities on flexible disks, and may have a better short-term outlook with flexible disk drives than with rigid disk drives because of floppies' slow spin rate. The flying head technology used with rigid disks requires a high revolution rate, which will result in very high data transfer rates with perpendicular recording -- faster than most systems and controllers are now ready to handle. However, the contact recording method used with flexible disk drives makes possible slower rates of revolution, with the result that even the very high densities of perpendicular recording produce transfer rates comparable to the small Winchester disk drives now in wide use.

Three firms have announced tentative specifications for small flexible disk drives using perpendicular recording. Toshiba's 3.5 inch drive will use 50,000 FCI, with 3 megabytes capacity.

Sony's experimental 3.5 inch drive provides 4 megabytes using 65,500 FCI. The Vertimag 5.25 inch drive, which will use a conventional 96 TPI drive mechanism, is currently planned for 3.46 megabytes with 30,000 FCI linear density.

All planned flexible disk drives using perpendicular recording are expected to employ disks with sputtered magnetic surfaces. Sputtering technology is highly developed, but throughput is relatively slow, because it is usually a batch process. If the millions of low cost diskettes necessary to support any significant penetration of the flexible disk market by perpendicular recording are to be produced by sputtering, major improvements in production rates are probably necessary. Continuous sputtering production processes have been announced by Vertimag, for 1984 startup, to produce diskettes for its own drive, and by Anelva, a joint venture of Nippon Electric Company and Varian Associates, to produce diskettes for the OEM market. Commercial success for perpendicular recording in the flexible disk market during the next few years will probably depend upon these or similar programs.

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

Two manufacturers of high capacity 5.25 inch drives are currently attempting to develop the market for drives which use high track density. Amlyn started shipments of its one sided 1.6 megabyte drive in early 1982, using 170 TPI. A two sided version with 3.2 megabyte capacity has been announced. Drivetec has been shipping its 3.3 megabyte two sided drive since mid 1983. Amlyn's drive uses a single prerecorded servo track to provide information on the shape of all tracks on each diskette, allowing a microprocessor to control head positioning for optimum operation. Drivetec uses embedded servo information on each diskette to provide tracking information and insure media interchange. Eastman Kodak has taken a license to make and sell the Drivetec drive, with production to start in 1984.

DEFINITIONS

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

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

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

- * Drives sold by DEC, Burroughs or Sykes Datatronics are considered captive, if internally manufactured.
- * In the case of a joint venture disk drive manufacturer such as Magnetic Peripherals, Inc., a joint venture of Control Data, Sperry and Honeywell, MPI drives sold by Honeywell or Sperry 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 Shugart Associates 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 distributors or 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 or the Personal Computer family, it may include any drives which are suitably equipped to be connected without any additional hardware to systems of all types.

OEM: Floppy drives sold through any non-captive distribution channel except PCM. Drives are normally sold to OEMs to be included in complete systems or subsystems; such drives are included in OEM totals whether or not the OEM actually manufactures the remainder of the system or subsystem, or merely assembles components and adds software. Sales by a disk drive manufacturer to a second drive manufacturer for resale are included only in shipment totals for the originating drive manufacturer.

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

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

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

Revenue: Based on sale of disk drives alone, as normally sold by individual manufacturers, without auxiliary hardware or spare parts. When sold as an integral part of a system or subsystem, the value of the disk drive alone has been estimated for DISK/TREND purposes. Sale prices are estimated public sale transaction prices, whether at captive end user, PCM, or OEM levels. All projected prices are in 1983 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. All DISK/TREND unit totals are counted in spindles, even though some drive configurations include more than one spindle. On an arbitrary basis, drives which utilize a single actuator mechanism to control head movement on two separate flexible disks are counted as two spindles.

Forecasts: Expected shipments and revenues for current or announced production 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 disks in non-standard sizes or new physical configurations may require establishment of new DISK/TREND product categories.

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

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

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

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

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

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

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

1983 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

Coverage

Examples of flexible disk drives in this group include:

IBM	3740 series, 5280 series
BASF	6102
Caldisk	142M, 842D
Control Data	9404B
Digital Equipment	RX01, RX02
Elcomatic	ACP 500
Hitachi	FDD-102D
Innotronics	410, 420
ISOT	ES 5074
Matsushita Communication Ind.	JK-880, JK-881
Metronex	PLX45D
Micro Peripherals	41
Miltope	DD 400
Mitsubishi Electric	M892
Okii Electric	GM 3101
Olivetti	FD 801
Shugart	SA 800, SA 801, SA 810
Sykes Datatronics	7150
Tandon	TM-848E-1
Videoton	MFM-2, Momflex 3200
World Storage Technology	FDD 100-8
YE Data	YD-74C

All drives designed to use single sided flexible disks of nominal 8 inch diameter are included in this group, including both "soft sector" and "hard sector" drives. Most soft sector drives use IBM compatible media, with a single index hole. Hard sector drives use additional holes to identify sectors. Most drives in this group may be operated at "standard density" or "double density" at the option of the system integrator, dependent upon controllers used. The older OEM drives in this group were generally designed to the same physical dimensions as the Shugart Associates SA 801, but most of the recently introduced OEM drives are "half high" models.

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
U.S. manufacturers	331.4	160.5	100.0	49.8	23.2
All manufacturers	360.5	183.2	116.1	60.9	29.8

Old age has finally caught up with the 8 inch, one side floppy drive. Production peaked in 1981, and the drop in current shipment levels is even sharper than previously expected. 1981's total worldwide shipments of 746,600 units declined to 597,700 in 1982, and will be down to an estimated 329,300 drives in 1983.

All application areas except word processing used fewer drives from this group in 1982 than in 1981. Small business and professional systems, previously the largest market for 8 inch, one sided drives, provided the greatest decline in usage for 1982.

U.S. captive production peaked in 1982. It is believed that all U.S. captive manufacturing programs for drives in this group are declining in 1983, with a large portion of the drop attributable to Tandy's discontinuance of internal manufacturing for 8 inch drives. Most non-U.S. manufacturers of captive 8 inch, one sided drives have long-since started moving to other configurations.

Shugart's early dominance in the OEM market for 8 inch, one sided drives has been maintained. Shugart held 62.8% of worldwide OEM shipments for 1982, with 213,700 units. Tandon replaced Control Data in second place for 1982, with 11.8%. Tandon ships only a half high version of the 8 inch drive, and its growth in this static market confirms that most of the newly designed systems using 8 inch, one sided drives are using half high models. 12.7% of all worldwide shipments for this product group in 1983

1983 DISK/TREND REPORT

are expected to be half high drives from U.S. manufacturers, with few drives from non-U.S. manufacturers. However, while shipments of half high OEM drives during 1983 are expected to roughly equal those for 1982, movement of full size drives is dropping fast.

Marketing trends

Because many traditional captive and OEM sponsors of the 8 inch, one side floppy format have moved on to other flexible disk drive configurations, DISK/TREND forecasts have been reduced even further from previous editions. It is now expected that 1984-1986 shipments will decline an average of 42% per year, with total worldwide shipments for 1986 down to 63,800 units.

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

Technical trends

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

1983 DISK/TREND REPORT

Half high 8 inch, one sided drives have appeared from several manufacturers, but they were not developed especially for this product group. The main interest of most drive manufacturers in 8 inch drives has been in two sided versions. And since the additional cost in offering one sided versions is very low, several manufacturers have introduced them. As noted above, most system manufacturers which have added 8 inch, one sided drives in the last few years have used half high drives -- but the total number has not been enough to turn the tide.

Forecasting assumptions

1. IBM usage of 8 inch, one side drives in new systems will decline in favor of smaller diameter flexible disk drives.
2. Although retaining momentum as a recognized data interchange standard, 8 inch, one side drives will be displaced in most new system design by smaller diameter drives.

TABLE 8
FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1982		-----Forecast-----							
	---Shipments---		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW

U.S. Manufacturers										

IBM	50.0	70.9	45.2	63.9	31.7	45.8	15.4	22.5	6.5	9.6
Other U.S. Captive	141.1	173.9	32.9	46.5	18.7	26.0	9.2	12.8	4.3	6.0
TOTAL U.S. CAPTIVE	191.1	244.8	78.1	110.4	50.4	71.8	24.6	35.3	10.8	15.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	71.7	86.6	41.4	50.1	23.2	28.2	11.8	14.5	6.1	7.6
TOTAL U.S. NON-CAPTIVE	71.7	86.6	41.4	50.1	23.2	28.2	11.8	14.5	6.1	7.6
TOTAL U.S. SHIPMENTS	262.8	331.4	119.5	160.5	73.6	100.0	36.4	49.8	16.9	23.2
Non-U.S. Manufacturers										

Captive	--	13.4	--	6.6	--	3.7	--	1.2	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	3.5	15.7	.2	16.1	.6	12.4	.3	9.9	--	6.6
TOTAL NON-U.S. SHIPMENTS	3.5	29.1	.2	22.7	.6	16.1	.3	11.1	--	6.6
Worldwide Recap										

TOTAL WORLDWIDE SHIPMENTS	266.3	360.5	119.7	183.2	74.2	116.1	36.7	60.9	16.9	29.8
OEM Average Price (\$000)	.295	.301	.285	.308	.275	.304	.265	.308	.256	.309

TABLE 9
FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1982		1983		1984		Forecast		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	41.7	59.1	39.3	55.6	28.8	41.6	14.7	21.5	6.5	9.6
Other U.S. Captive	152.5	188.0	37.6	53.1	22.7	31.5	11.9	16.6	5.9	8.3
TOTAL U.S. CAPTIVE	194.2	247.1	76.9	108.7	51.5	73.1	26.6	38.1	12.4	17.9
PCM	--	--	--	--	--	--	--	--	--	--
OEM	242.1	293.1	145.6	176.1	84.6	102.7	44.6	54.6	23.8	29.5
TOTAL U.S. NON-CAPTIVE	242.1	293.1	145.6	176.1	84.6	102.7	44.6	54.6	23.8	29.5
TOTAL U.S. SHIPMENTS	436.3	540.2	222.5	284.8	136.1	175.8	71.2	92.7	36.2	47.4
Non-U.S. Manufacturers										
Captive	--	10.4	--	5.4	--	3.2	--	1.1	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	12.6	47.1	.6	39.1	2.1	30.8	1.0	24.7	--	16.4
TOTAL NON-U.S. SHIPMENTS	12.6	57.5	.6	44.5	2.1	34.0	1.0	25.8	--	16.4
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	448.9	597.7	223.1	329.3	138.2	209.8	72.2	118.5	36.2	63.8
Installed at Year End										
IBM	291.1	403.2	330.4	458.8	359.2	500.4	373.9	521.9	380.4	531.5
Non-IBM	2,267.3	3,530.6	2,451.1	3,804.3	2,560.5	3,972.5	2,618.0	4,069.5	2,647.7	4,123.7
WORLDWIDE TOTAL	2,558.4	3,933.8	2,781.5	4,263.1	2,919.7	4,472.9	2,991.9	4,591.4	3,028.1	4,655.2

TABLE 10
FLEXIBLE DISK DRIVES, 8 Inch, One Side
WORLDWIDE SHIPMENTS (000)
DRIVE HEIGHT ANALYSIS

	1982		-----Forecast-----							
	--Shipments--		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
	Units	%	Units	%	Units	%	Units	%	Units	%

U.S. MANUFACTURERS										

Captive Total	247.1		108.7		73.1		38.1		17.9	
Full Size	247.1	100.0	108.7	100.0	73.1	100.0	38.1	100.0	17.9	100.0
OEM Total	293.1		176.1		102.7		54.6		29.5	
Full Size	251.0	85.6	134.3	76.3	66.6	64.8	30.0	54.9	12.4	42.0
Half High	42.1	14.4	41.8	23.7	36.1	35.2	24.6	45.1	17.1	58.0
Total U.S.	540.2		284.8		175.8		92.7		47.4	
Full Size	498.1	92.2	243.0	85.3	139.7	79.5	68.1	73.5	30.3	63.9
Half High	42.1	7.8	41.8	14.7	36.1	20.5	24.6	26.5	17.1	36.1
NON-U.S. MANUFACTURERS										

Captive Total	10.4		5.4		3.2		1.1		--	
Full Size	10.4	100.0	5.4	100.0	3.2	100.0	1.1	100.0	--	--
OEM Total	47.1		39.1		30.8		24.7		16.4	
Full Size	47.1	100.0	38.5	98.5	28.7	93.2	23.7	96.0	16.4	100.0
Half High	--	--	.6	1.5	2.1	6.8	1.0	4.0	--	--
Total Non-U.S.	57.5		44.5		34.0		25.8		16.4	
Full Size	57.5	100.0	43.9	98.7	31.9	93.8	24.8	96.1	16.4	100.0
Half High	--	--	.6	1.3	2.1	6.2	1.0	3.9	--	--
WORLDWIDE RECAP										

Total Shipments	597.7		329.3		209.8		118.5		63.8	
Full Size	555.6	93.0	286.9	87.1	171.6	81.8	92.9	78.4	46.7	73.2
Half High	42.1	7.0	42.4	12.9	38.2	18.2	25.6	21.6	17.1	26.8

TABLE 11
FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

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

<u>Distribution Channel</u>	1982 U.S. Net Shipments		FORECAST			
	<u>Units (000)</u>	<u>%</u>	<u>1983 %</u>	<u>1984 %</u>	<u>1985 %</u>	<u>1986 %</u>
Mainframe computer manufacturers	28.0	11.0	10.5	10.0	9.7	9.4
Mini/micro computer manufacturers	95.1	37.3	41.0	44.7	48.3	51.7
System OEMs/systems houses	81.0	31.8	28.7	25.2	21.6	18.1
Independent peripherals suppliers	3.6	1.4	1.0	.7	.4	.2
Direct to end user/retail dealers	<u>47.0</u>	18.5	18.8	19.4	20.0	20.6
TOTAL	254.7					

TABLE 12
FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	1982 Net Shipments			
	<u>To United States Destinations</u>		<u>Worldwide</u>	
	<u>Units (000)</u>	<u>%</u>	<u>Units (000)</u>	<u>%</u>
Shugart	174.1	68.4	213.7	62.8
Tandon	38.1	15.0	40.1	11.8
Control Data	13.0	5.1	19.6	5.8
Siemens	12.6	4.9	14.0	4.1
BASF	--	--	12.0	3.5
Other U.S.	16.9	6.6	19.7	5.8
Other Non-U.S.	<u>--</u>	<u>--</u>	<u>21.1</u>	<u>6.2</u>
TOTAL	254.7	100.0	340.2	100.0

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

1983 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

Coverage

Examples of flexible disk drives in this group include:

IBM	4964, 4966, Systems 23 & 34
BASF	6104
Burroughs	9489-11, 9489-21
Caldisk	143M
Control Data	9406, 210-10
Elcomatic	ACP 700, ACP 1500
Hitachi	FDD-412, FDD-441
Matsushita Communication Ind.	JK-885, JA-751
Micro Peripherals	42
Miltope	DD 450, DD 550
Mitsubishi Electric	M2894-63
NEC	FD 1160, FD 1165
Olivetti	FD 802
Qume	242, 842
Ricoh	RD-2D
Shugart	SA 850, SA 851, SA 860
Tandon	TM-848E-2
Toshiba	ND-20D, ND-40D
World Storage Technology	FDD 200-8
YE Data	YD-174D, YD-180

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

Drives using special recording formats are offered by three manufacturers. Hitachi has recently announced a half-high drive with 9.6 megabytes capacity, achieved with 96 TPI and 20,560 BPI, using a run length limited encoding algorithm, with cobalt modified oxide coated media. Elcomatic's ACP 1500 provides 3.2 megabytes by using 96 TPI and

normal recording densities. Burroughs' floppy drives, with capacities up to 3 megabytes, use special recording formats and employ a reference track technique to achieve track densities up to 150 TPI.

Market size

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
U.S. manufacturers	573.3	703.9	756.6	597.9	475.7
All manufacturers	1,155.6	1,302.8	1,376.8	1,143.2	902.5

1982 worldwide shipments of 8 inch, two sided drives totaled 1,032,500 units, up 53.3% from 1981. The growth in total worldwide shipments continues in 1983, but the rate of increase is slowing down. The 1983 total of 1,301,800 drives represents an increase of 26%.

While shipments of most U.S. captive drives in this group have been declining during 1982 and 1983, captive drive shipments by Japanese manufacturers have been increasing sharply. This difference reflects the continuing momentum of the 8 inch floppy format in the Japanese domestic market for small business systems, in contrast to the stampede by U.S. system manufacturers to 5.25 inch drives. IBM's increased shipments are the exception, driven by growth of the firm's word processing and other small systems and terminal products, with all IBM systems except the personal computer group still using only 8 inch floppy drive models.

OEM drive shipments are also growing, but the share held by U.S. drive manufacturers is lagging. Shipments by non-U.S. drive manufacturers in 1982 remained slightly ahead, and their shipments will be up an estimated 61% in 1983, compared with an increase of only 15% for U.S.

1983 DISK/TREND REPORT

drive manufacturers. The Japanese domestic market is absorbing most of the non-U.S. increase, and the growth is all in newer half high models from both U.S. and non-U.S. producers, with full size drive shipments in decline.

In 1982 for the first year, Shugart dropped to second place in OEM shipments of 8 inch, two sided drives, with 16.9% of the worldwide total. YE Data held the lead with 96,500 drives, for 20.0% of total worldwide shipments, and Tandon rose to 11.9%, with 57,000 drives.

Marketing trends

Despite healthy growth in this product group during the last few years, DISK/TREND forecasts have been revised downward. 1984 is now expected to be the peak year for worldwide shipments of 8 inch, two sided drives, at 1,429,400 units.

It is believed that this product group's current lack of vigor is traceable to a combination of factors: (1) The reliability problems most manufacturers experienced with 8 inch, two sided drives in the late 1970's, which kept many OEMs from committing to the format, (2) Lack of further development of the 8 inch drive format by IBM, which inhibited manufacturers of OEM drives from investing in higher density versions, and (3) Rapid development of the 5.25 inch format by both U.S. and Japanese drive manufacturers, in a product area free from the dominance of IBM until now.

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

1983 DISK/TREND REPORT

floppy drive developed under the sponsorship of Nippon Telephone & Telegraph makes it possible to do so with a half high 5.25 inch drive. 1983 shipments of these drives are moving into high gear in Japan, and they will displace most of the growth which would have otherwise gone to 8 inch, two sided drives.

Another nail in the coffin for 8 inch, two side drives is expected to be driven by IBM, their originator. Current DISK/TREND forecasts assume that starting in 1984 IBM will use 1.6 megabyte 5.25 inch drives in additional models of its personal computer family, superseding the existing Displaywriter word processing system and System/23 Datamaster small business system. An obvious result will be the decline of IBM's production of 8 inch, two sided drives. Another predictable effect of this action will be IBM's influence on other word processing and small business system manufacturers: Even more rapid movement to 5.25" formats.

Because of the expected movement from 1.6 megabyte 8 inch drives to 1.6 megabytes 5.25 inch drives in the Japanese market, unit shipments by U.S. manufacturers for products in this group are expected to once again exceed those of non-U.S. manufacturers, starting in 1984. OEM drive shipments by U.S. manufacturers are not expected to peak until 1985, a year later than for non-U.S. manufacturers.

The market for PCM drives will remain small. The attachment possibilities for independent drives on IBM's Series/1 minicomputers are limited by the wide dispersion of the minicomputer market and the poor cost effectiveness of marketing efforts to sell individual floppy drive subsystems to minicomputer users. Most of the PCM floppy drives sold will continue to be included in larger disk subsystems sold to IBM users and systems houses by Control Data.

1983 DISK/TREND REPORT

Technical trends

Few serious attempts to introduce higher capacity drives in this group have occurred. Until recently, only two high capacity 8 inch, two sided drives had ever been announced, by Burroughs and PerSci. Burroughs successfully produced a 3 megabyte drive but attracted no following, and PerSci's announced 3.7 megabyte drive was never manufactured because of the firm's financial problems.

The key reason that development of 8 inch drives has been stuck at 1.6 megabytes since 1977 is IBM's lack of innovation in the area. Since the existing 8 inch diskette's physical design and recording format were defined by IBM, and because of the firm's dominant leadership in the applications for which 8 inch, two sided floppies are used, most manufacturers of OEM drives have hesitated to attempt the introduction of their own improvements.

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

Finally, during 1983, Elcomatic, which acquired the MFE floppy drive products and is manufacturing them in Scotland, announced a 3.2 megabyte drive using 96 TPI. In October, 1983, Hitachi announced a 9.6 megabyte drive which will use a special Maxell cobalt modified oxide coated diskette. The Hitachi drive uses 96 TPI and triples the effective linear

1983 DISK/TREND REPORT

density to 20,560 BPI, by roughly doubling the actual recording density and using a run length limited code. It is not yet clear what applications Hitachi has in mind for this drive.

After all the waiting, the momentum may have passed to the smaller diameter floppy formats. 600 Oersted magnetic coatings have been introduced in minifloppy and microfloppy formats by several media manufacturers, and two 5.25 inch drives with capacities over 3 megabytes have been announced. With the uncertainties of IBM's plans to contend with, combined with the high growth of desktop systems, most manufacturers now are putting their development resources into smaller drives.

Forecasting assumptions

1. IBM will transition to high capacity 5.25 inch floppy drives for new versions of its major word processing and small business systems starting in 1984, reducing its requirement for 8 inch, two sided drives.
2. The Japanese domestic market will move rapidly away from 8 inch, two sided floppy drives starting in 1984, in favor of 1.6 megabyte 5.25 inch drives.
3. U.S. system manufacturers competing in the word processing and small business system markets with IBM will be heavily influenced by IBM's expected move to 1.6 megabyte 5.25 inch drives, causing a reduction in OEM shipments of 8 inch, two sided drives after 1985.

TABLE 13
FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1982		-----Forecast-----							
	---Shipments---		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>U.S. Manufacturers</u>										
IBM	257.2	381.2	356.9	527.5	405.5	597.5	299.0	447.4	243.4	369.3
Other U.S. Captive	76.5	100.6	65.8	83.2	47.6	61.9	32.7	41.2	16.8	21.6
TOTAL U.S. CAPTIVE	333.7	481.8	422.7	610.7	453.1	659.4	331.7	488.6	260.2	390.9
PCM	.4	.4	.4	.4	.6	.6	.6	.6	.7	.7
OEM	66.3	91.1	70.9	92.8	72.5	96.6	80.5	108.7	61.4	84.1
TOTAL U.S. NON-CAPTIVE	66.7	91.5	71.3	93.2	73.1	97.2	81.1	109.3	62.1	84.8
TOTAL U.S. SHIPMENTS	400.4	573.3	494.0	703.9	526.2	756.6	412.8	597.9	322.3	475.7
<u>Non-U.S. Manufacturers</u>										
Captive	3.7	505.9	5.8	493.2	7.7	515.4	7.9	463.9	7.0	368.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	11.9	76.4	26.7	105.7	29.3	104.8	22.2	81.4	16.0	58.4
TOTAL NON-U.S. SHIPMENTS	15.6	582.3	32.5	598.9	37.0	620.2	30.1	545.3	23.0	426.8
<u>Worldwide Recap</u>										
TOTAL WORLDWIDE SHIPMENTS	416.0	1,155.6	526.5	1,302.8	563.2	1,376.8	442.9	1,143.2	345.3	902.5
OEM Average Price (\$000)	.364	.348	.315	.299	.285	.277	.257	.256	.233	.237

TABLE 14
FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1982		1983		1984		1985		1986	
	---Shipments---		-----Forecast-----							
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	139.0	206.0	198.3	293.1	231.7	341.4	175.9	263.2	147.5	223.8
Other U.S. Captive	45.0	59.2	40.5	51.2	30.7	39.9	22.2	28.0	12.0	15.4
TOTAL U.S. CAPTIVE	184.0	265.2	238.8	344.3	262.4	381.3	198.1	291.2	159.5	239.2
PCM	.2	.2	.2	.2	.3	.3	.3	.3	.4	.4
OEM	177.8	240.2	211.9	276.3	244.7	326.2	307.7	415.7	259.8	355.8
TOTAL U.S. NON-CAPTIVE	178.0	240.4	212.1	276.5	245.0	326.5	308.0	416.0	260.2	356.2
TOTAL U.S. SHIPMENTS	362.0	505.6	450.9	620.8	507.4	707.8	506.1	707.2	419.7	595.4
Non-U.S. Manufacturers										
Captive	2.0	285.8	3.5	292.9	4.8	321.3	5.2	305.2	4.9	256.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	37.1	241.1	98.1	388.1	112.0	400.3	92.6	328.3	72.5	246.2
TOTAL NON-U.S. SHIPMENTS	39.1	526.9	101.6	681.0	116.8	721.6	97.8	633.5	77.4	502.6
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	401.1	1,032.5	552.5	1,301.8	624.2	1,429.4	603.9	1,340.7	497.1	1,098.0
Installed at Year End										
IBM	409.1	607.6	607.4	900.7	839.1	1,242.1	1,015.0	1,505.3	1,162.5	1,729.1
Non-IBM	658.2	1,843.1	1,012.4	2,851.8	1,404.9	3,939.8	1,832.9	5,017.3	2,182.5	5,891.5
WORLDWIDE TOTAL	1,067.3	2,450.7	1,619.8	3,752.5	2,244.0	5,181.9	2,847.9	6,522.6	3,345.0	7,620.6

TABLE 15
FLEXIBLE DISK DRIVES, 8 Inch, Two Sides
WORLDWIDE SHIPMENTS (000)
DRIVE HEIGHT ANALYSIS

	1982		-----Forecast-----							
	--Shipments--		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
	Units	%	Units	%	Units	%	Units	%	Units	%

U.S. MANUFACTURERS										

Captive Total	265.2		344.3		381.3		291.2		239.2	
Full Size	265.2	100.0	343.6	99.8	378.1	99.2	282.7	97.1	232.0	97.0
Half High	--	--	.7	.2	3.2	.8	8.5	2.9	7.2	3.0
OEM Total	240.4		276.5		326.5		416.0		356.2	
Full Size	178.8	74.4	146.7	53.1	114.5	35.1	79.3	19.1	32.4	9.1
Half High	61.6	25.6	129.8	46.9	212.0	64.9	336.7	80.9	323.8	90.9
Total U.S.	505.6		620.8		707.8		707.2		595.4	
Full Size	444.0	87.8	490.3	79.0	492.6	69.6	362.0	51.2	264.4	44.4
Half High	61.6	12.2	130.5	21.0	215.2	30.4	345.2	48.8	331.0	55.6
NON-U.S. MANUFACTURERS										

Captive Total	285.8		292.9		321.3		305.2		256.4	
Full Size	89.1	31.2	58.1	19.8	48.2	15.0	33.6	11.0	20.5	8.0
Half High	196.7	68.8	234.8	80.2	273.1	85.0	271.6	89.0	235.9	92.0
OEM Total	241.1		388.1		400.3		328.3		246.2	
Full Size	107.4	44.5	70.4	18.1	48.0	12.0	29.6	9.0	19.7	8.0
Half High	133.7	55.5	317.7	81.9	352.3	88.0	298.7	91.0	226.5	92.0
Total Non-U.S.	526.9		681.0		721.6		633.5		502.6	
Full Size	196.5	37.3	128.5	18.9	96.2	13.3	63.2	10.0	40.2	8.0
Half High	330.4	62.7	552.5	81.1	625.4	86.7	570.3	90.0	462.4	92.0
WORLDWIDE RECAP										

Total Shipments	1,032.5		1,301.8		1,429.4		1,340.7		1,098.0	
Full Size	640.5	62.0	618.8	47.5	588.8	41.2	425.2	31.7	304.6	27.7
Half High	392.0	38.0	683.0	52.5	840.6	58.8	915.5	68.3	793.4	72.3

TABLE 16
FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

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

<u>Distribution Channel</u>	1982 U.S. Net Shipments		FORECAST			
	<u>Units (000)</u>	<u>%</u>	<u>1983 %</u>	<u>1984 %</u>	<u>1985 %</u>	<u>1986 %</u>
Mainframe computer manufacturers	5.4	2.5	2.4	2.2	2.0	1.9
Mini/micro computer manufacturers	68.6	31.9	32.9	33.8	34.8	35.5
System OEMs/systems houses	105.5	49.1	47.9	46.8	45.6	44.6
Independent peripherals suppliers	6.3	2.9	2.7	2.5	2.3	2.1
Direct to end user/retail dealers	<u>29.3</u>	13.6	14.1	14.7	15.3	15.9
TOTAL	215.1					

TABLE 17
FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	1982 Net Shipments			
	<u>To United States Destinations</u>		<u>Worldwide</u>	
	<u>Units (000)</u>	<u>%</u>	<u>Units (000)</u>	<u>%</u>
YE Data	1.5	.7	96.5	20.0
Shugart	51.9	24.1	81.5	16.9
Tandon	51.3	23.9	57.0	11.9
Qume	43.7	20.3	46.0	9.6
Mitsubishi	24.7	11.5	41.4	8.6
Control Data	18.6	8.6	37.9	7.9
Hitachi	--	--	30.0	6.2
NEC	4.0	1.9	20.1	4.2
BASF	--	--	18.0	3.7
Other U.S.	12.5	5.8	18.0	3.7
Other Non-U.S.	<u>6.9</u>	<u>3.2</u>	<u>35.1</u>	<u>7.3</u>
TOTAL	215.1	100.0	481.5	100.0

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDECoverage

Examples of flexible disk drives in this group include:

48 tracks per inch

Alps Electric	FDD 2125
BASF	6106
Canon	MDD 110, MDD 6106
Control Data	9408
Hi-Tech Peripherals	H548-25
ISOT	5050E, ES 5088
Matsushita Communication Ind.	JA-200, JK-873
Micro Peripherals	51, 501, 501C
Olivetti	FD 501
Philips	X 3111, X 3131
Remex	RFD 481, RFD 486
Robotron	K 5600
Shugart	SA 200, SA 400
Tandon	TM-100-1, TM-50-1
TEAC	FD-55A
Tokyo Electric Company	FB-201, FB-202, FB-501
Videoton	Momflex 900
World Storage Technology	FDD 100-5, 111-5, 112-5

96/100 tracks per inch

Alps Electric	FDD 2745
Data Track Technology	Tracker 1.0
Digital Equipment	RX50
Hi-Tech Peripherals	H596-05, H596-08
Micro Peripherals	91, 901, 101
Micropolis	1115-V, 1115-II
Olivetti	FD 591
Philips	X 3113, X 3133
Remex	RFD 961, RFD 966
Shugart	SA 410
Tandon	TM-100-3
TEAC	FD-55E
Tokyo Electric Company	FB-502
World Storage Technology	FDD 121-5

Over 100 tracks per inch

Amlyn	5850, 5855
-------	------------

Shugart Associates created the basic standards for physical size and recording format for this product group with the introduction of the SA 400, the original minifloppy, in 1976. Most of the manufacturers now active in minifloppies offer drives similar to the SA 400, but the explosive growth in small microcomputer based systems has inspired extensive innovation in 5.25 inch drives.

An early pioneer was Micropolis, which introduced 100 TPI drives in 1977, matching the standard 77 track format of 8 inch floppy drives in the minifloppy form factor. In 1980 Tandon and Micro Peripherals joined Micropolis in offering 96 TPI drives in a standardized format, which established the existing 80 track standard.

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

Other innovative one sided 5.25 inch drives have been introduced, with unusual design features. Early in 1982, Amlyn started shipping a drive matching the SA 400 physical size, but which uses a special cartridge of five diskettes to provide a total capacity of 8 MB (1.6 MB per diskette, each recorded on one side at 170 TPI and 9500 BPI). And Digital Equipment Corporation offers a one sided drive which uses a single head positioning system for two diskettes.

1983 DISK/TREND REPORT

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
U.S. manufacturers	239.1	431.0	490.4	501.8	471.7
All manufacturers	363.6	582.6	657.0	676.6	651.3

5.25 inch, one side drives have displayed an erratic growth curve. Worldwide unit shipments have slumped to a modest 31.0% increase for 1982, but are rebounding again in 1983 with an estimated 71.5% jump. The estimated 1983 total of 3,636,200 drives is almost 50% higher than last year's DISK/TREND forecast for 1983.

Most of the sharp current growth is from shipments of OEM drives, by both U.S. and non-U.S. manufacturers. The booming market for personal computers destined for individual and business use is clearly the cause, given a big boost by the growth of 1982 and 1983 shipments for portable computers, many of which use 5.25 inch one side drives. These applications consumed 81.5% of 1982 shipments of drives in this group.

Shipments of OEM drives by non-U.S. manufacturers continue to exceed those by U.S. firms, given a assist by Alps Electric's large sales of drive mechanisms to U.S. personal computer manufacturers such as Apple Computer. Alps held 37.1% of 1982's worldwide non-captive shipments, with 650,000 units. Micro Peripherals, Tandon and Shugart followed, with 15.2%, 14.5% and 11.4%, respectively. While the traditional full size drives still lead in unit shipments, half size models are now available from most manufacturers of 5.25 inch drives and are currently growing at a much faster rate than full size drives.

1983 DISK/TREND REPORT

Marketing trends

Despite 1983's big jump in shipments, DISK/TREND projections for this product group assume growth of only 22.2% in 1984, with essentially no growth for the group by 1986. Worldwide total revenues are expected to turn down by 1986, dampened by continued large shipments of mechanism-only OEM drives at low prices and displacement of full size drives by half high models at lower prices.

The future growth potential for 5.25 inch, one side drives will be impacted heavily by competition from both two sided 5.25 inch drives and microfloppy drives. During the next few years, two sided 5.25 inch drives will be the toughest competitor, by far. It should be noted that a system manufacturer wishing to offer a 500 kilobyte 5.25 inch floppy drive can choose between a one sided 96 TPI drive and a two sided 48 TPI. The fact is that many system manufacturers are still wary of committing to 96 TPI, due to the past difficulties of some drive manufacturers in producing hardware with adequate media interchange capability. Two sided 48 TPI drives, because of more relaxed track positioning tolerances, are not known for media interchange problems.

IBM's actions in offering two sided 48 TPI 5.25 inch drives with various models in its personal computer product line have influenced the firm's competitors greatly. The outstanding success of IBM's personal computer family has made the industry hungry for compatibility. And, while 5.25 inch one side drives were offered with the original personal computer model, two sided drives have dominated shipments on that and subsequent models.

Microfloppy drives will directly displace 5.25 inch, one side drives which otherwise would have been used in portable and desktop computers.

1983 DISK/TREND REPORT

While the widespread use of 5.25 inch diskette media provides considerable momentum for the format, it is expected that microfloppies will gradually build up shipment momentum in the portable and "small-footprint" desktop computer markets, at the expense of 5.25 inch drives.

Another factor causing movement from one side 5.25 inch drives to two sided versions is the increasing demand for more data storage on small systems. Driven to a large extent by evolving software capabilities, this demand prompts many OEMs to change to two sided drives. The availability of 96 TPI with one side drives, yielding 500 kilobytes capacity, is too small an incentive -- especially when IBM has provided the industry's role model, with the same capacity offered on two sided drives. For this reason, 96 TPI's share of shipments in this product group will stay at modest levels.

The share of worldwide shipments held by half high drives is now in a rapid growth phase expected to continue through 1986. Few, if any, system manufacturers intend to design any more of their systems with full size drives. Most are enthusiastic about the smaller size of half high drives and the modularity of these drives with existing hardware -- plus the generally lower prices.

It is expected that non-U.S. manufacturers will continue to hold the lead in shipments of OEM drives through 1986, with heavy shipments of mechanism-only units. However, in total shipments the U.S. quantities should remain larger, due to continued production of more than 800,000 units per year by captive manufacturers such as Tandy and Digital Equipment.

Technical trends

The industry has not invested heavily in development activities for this product group, and most of the work undertaken has been intended to result in smaller, cheaper floppy drives. Well publicized programs by Alps Electric, Tandon and Shugart have resulted in mechanism-only versions of 5.25 inch, one side drives priced in the range of \$50 for very large quantities.

More significant to the industry as a whole, however, are the new generation of half high drives, just 1.625 inches in height. Most of these drives are designed for both one sided and two sided versions, but the one sided versions will be especially important in providing competition for the microfloppy drives now available in several formats, from a growing number of drive manufacturers.

Half high 5.25 inch drives are the same height as most microfloppy drives and many (the 3.5 inch disk versions) are only 1.75 inches wider -- so the size advantage of microfloppy drives becomes less impressive. When the additional advantages of 5.25 inch drives in maintaining media compatibility and existing low manufacturing costs are considered, the minifloppy still has the ability to fight for its markets.

Significant changes in technology for this group during the next few years are not expected, with the exception of the Amlyn cartridge drive. This drive uses five high density diskettes in a cartridge with up to 8 MB total capacity, or 1.6 MB per diskette. A prerecorded servo track and microprocessor control of head positioning produces satisfactory media interchange capabilities at 170 TPI. The more recent product announcements by Amlyn, however, indicate that the firm will probably be active primarily with two sided drives.

1983 DISK/TREND REPORT

Forecasting assumptions

1. After 1984, shipments of 5.25 inch, one side drives will be flat, due to competition from microfloppies and 5.25 inch, two sided drives.
2. Most growth in this product group will be generated by half high drives, with full size drives in decline.
3. Average prices for OEM drives will continue to be depressed by shipment of a high proportion of OEM drives in mechanism-only versions, plus the transition to lower priced half high models.

TABLE 18
FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1982		1983		1984		Forecast		1985	
	---Shipments---		-----		-----		-----		-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW

U.S. Manufacturers										

IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	135.7	151.8	242.8	286.7	272.0	327.9	270.8	335.5	245.8	310.6
TOTAL U.S. CAPTIVE	135.7	151.8	242.8	286.7	272.0	327.9	270.8	335.5	245.8	310.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	73.4	87.3	117.3	144.3	128.2	162.5	130.0	166.3	125.9	161.1
TOTAL U.S. NON-CAPTIVE	73.4	87.3	117.3	144.3	128.2	162.5	130.0	166.3	125.9	161.1
TOTAL U.S. SHIPMENTS	209.1	239.1	360.1	431.0	400.2	490.4	400.8	501.8	371.7	471.7
Non-U.S. Manufacturers										

Captive	--	35.0	--	23.4	--	24.2	--	27.5	--	34.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	65.8	89.5	91.9	128.2	104.1	142.4	99.7	147.3	84.7	145.4
TOTAL NON-U.S. SHIPMENTS	65.8	124.5	91.9	151.6	104.1	166.6	99.7	174.8	84.7	179.6
Worldwide Recap										

TOTAL WORLDWIDE SHIPMENTS	274.9	363.6	452.0	582.6	504.3	657.0	500.5	676.6	456.4	651.3
OEM Average Price (\$000)	.096	.101	.088	.091	.084	.085	.080	.080	.078	.078

TABLE 19
FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1982		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	282.9	316.1	530.5	623.1	677.5	810.0	726.0	888.4	704.0	876.6
TOTAL U.S. CAPTIVE	282.9	316.1	530.5	623.1	677.5	810.0	726.0	888.4	704.0	876.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	636.3	761.9	1,127.2	1,412.9	1,326.6	1,688.3	1,407.3	1,807.0	1,404.7	1,799.6
TOTAL U.S. NON-CAPTIVE	636.3	761.9	1,127.2	1,412.9	1,326.6	1,688.3	1,407.3	1,807.0	1,404.7	1,799.6
TOTAL U.S. SHIPMENTS	919.2	1,078.0	1,657.7	2,036.0	2,004.1	2,498.3	2,133.3	2,695.4	2,108.7	2,676.2
Non-U.S. Manufacturers										
Captive	--	50.0	--	34.0	--	37.0	--	44.0	--	57.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	811.6	992.1	1,253.0	1,566.2	1,441.2	1,911.4	1,479.2	2,095.8	1,308.8	2,129.6
TOTAL NON-U.S. SHIPMENTS	811.6	1,042.1	1,253.0	1,600.2	1,441.2	1,948.4	1,479.2	2,139.8	1,308.8	2,186.6
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	1,730.8	2,120.1	2,910.7	3,636.2	3,445.3	4,446.7	3,612.5	4,835.2	3,417.5	4,862.8
Installed at Year End										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	3,920.5	4,955.2	6,831.2	8,591.4	10,276.5	13,038.1	13,889.0	17,873.3	17,306.5	22,736.1
WORLDWIDE TOTAL	3,920.5	4,955.2	6,831.2	8,591.4	10,276.5	13,038.1	13,889.0	17,873.3	17,306.5	22,736.1

TABLE 20

FLEXIBLE DISK DRIVES, 5.25 Inch, One Side

WORLDWIDE SHIPMENTS (000)

DRIVE HEIGHT ANALYSIS

	1982		-----Forecast-----							
	---Shipments---		---1983---		---1984---		---1985---		---1986---	
	Units	%	Units	%	Units	%	Units	%	Units	%

U.S. MANUFACTURERS										

Captive Total	316.1		623.1		810.0		888.4		876.6	
Full Size	310.1	98.1	620.1	99.5	809.0	99.9	888.4	100.0	876.6	100.0
Half High	6.0	1.9	3.0	.5	1.0	.1	--	--	--	--
OEM Total	761.9		1,412.9		1,688.3		1,807.0		1,799.6	
Full Size	759.5	99.7	1,052.4	74.5	972.5	57.6	683.3	37.8	327.5	18.2
Half High	2.4	.3	360.5	25.5	715.8	42.4	1,123.7	62.2	1,472.1	81.8
Total U.S.	1,078.0		2,036.0		2,498.3		2,695.4		2,676.2	
Full Size	1,069.6	99.2	1,672.5	82.1	1,781.5	71.3	1,571.7	58.3	1,204.1	45.0
Half High	8.4	.8	363.5	17.9	716.8	28.7	1,123.7	41.7	1,472.1	55.0
NON-U.S. MANUFACTURERS										

Captive Total	50.0		34.0		37.0		44.0		57.0	
Full Size	5.0	10.0	7.0	20.6	18.0	48.6	29.0	65.9	42.0	73.7
Half High	45.0	90.0	27.0	79.4	19.0	51.4	15.0	34.1	15.0	26.3
OEM Total	992.1		1,566.2		1,911.4		2,095.8		2,129.6	
Full Size	878.3	88.5	1,140.2	72.8	1,122.0	58.7	901.2	43.0	585.6	27.5
Half High	113.8	11.5	426.0	27.2	789.4	41.3	1,194.6	57.0	1,544.0	72.5
Total Non-U.S.	1,042.1		1,600.2		1,948.4		2,139.8		2,186.6	
Full Size	883.3	84.8	1,147.2	71.7	1,140.0	58.5	930.2	43.5	627.6	28.7
Half High	158.8	15.2	453.0	28.3	808.4	41.5	1,209.6	56.5	1,559.0	71.3
WORLDWIDE RECAP										

Total Shipments	2,120.1		3,636.2		4,446.7		4,835.2		4,862.8	
Full Size	1,952.9	92.1	2,819.7	77.5	2,921.5	65.7	2,501.9	51.7	1,831.7	37.7
Half High	167.2	7.9	816.5	22.5	1,525.2	34.3	2,333.3	48.3	3,031.1	62.3

TABLE 21
FLEXIBLE DISK DRIVES, 5.25 Inch, One Side
WORLDWIDE SHIPMENTS (000)
TRACK DENSITY ANALYSIS

	1982		Forecast									
	--Shipments--		-----1983-----		-----1984-----		-----1985-----		-----1986-----			
	Units	%	Units	%	Units	%	Units	%	Units	%		
U.S. MANUFACTURERS												
Captive Total	316.1		623.1		810.0		888.4		876.6			
48 TPI	306.1	96.8	423.1	67.9	526.0	64.9	561.8	63.2	533.7	60.9		
96/100 TPI	10.0	3.2	200.0	32.1	284.0	35.1	326.6	36.8	342.9	39.1		
OEM Total	761.9		1,412.9		1,688.3		1,807.0		1,799.6			
48 TPI	668.9	87.8	1,219.2	86.3	1,381.0	81.8	1,405.6	77.8	1,334.9	74.2		
96/100 TPI	93.0	12.2	193.7	13.7	307.3	18.2	401.4	22.2	464.7	25.8		
Total U.S.	1,078.0		2,036.0		2,498.3		2,695.4		2,676.2			
48 TPI	975.0	90.4	1,642.3	80.7	1,907.0	76.3	1,967.4	73.0	1,868.6	69.8		
96/100 TPI	103.0	9.6	393.7	19.3	591.3	23.7	728.0	27.0	807.6	30.2		
NON-U.S. MANUFACTURERS												
Captive Total	50.0		34.0		37.0		44.0		57.0			
48 TPI	38.0	76.0	22.0	64.7	23.0	62.2	29.0	65.9	42.0	73.7		
96/100 TPI	12.0	24.0	12.0	35.3	14.0	37.8	15.0	34.1	15.0	26.3		
OEM Total	992.1		1,566.2		1,911.4		2,095.8		2,129.6			
48 TPI	952.8	96.0	1,522.2	97.2	1,817.8	95.1	1,944.9	92.8	1,923.0	90.3		
96/100 TPI	39.3	4.0	44.0	2.8	93.6	4.9	150.9	7.2	206.6	9.7		
Total Non-U.S.	1,042.1		1,600.2		1,948.4		2,139.8		2,186.6			
48 TPI	990.8	95.1	1,544.2	96.5	1,840.8	94.5	1,973.9	92.2	1,965.0	89.9		
96/100 TPI	51.3	4.9	56.0	3.5	107.6	5.5	165.9	7.8	221.6	10.1		
WORLDWIDE RECAP												
Total Shipments	2,120.1		3,636.2		4,446.7		4,835.2		4,862.8			
48 TPI	1,965.8	92.7	3,186.5	87.6	3,747.8	84.3	3,941.3	81.5	3,833.6	78.8		
96/100 TPI	154.3	7.3	449.7	12.4	698.9	15.7	893.9	18.5	1,029.2	21.2		

Note: Track densities greater than 100 TPI are grouped with 96/100 TPI totals in this table.

TABLE 22

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

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

<u>Distribution Channel</u>	1982 U.S. Net Shipments		FORECAST			
	<u>Units (000)</u>	<u>%</u>	<u>1983 %</u>	<u>1984 %</u>	<u>1985 %</u>	<u>1986 %</u>
Mainframe computer manufacturers	92.2	6.4	5.2	3.7	2.1	1.3
Mini/micro computer manufacturers	243.6	16.8	15.8	14.8	13.9	13.2
System OEMs/systems houses	938.6	64.8	66.3	67.9	69.4	69.9
Independent peripherals suppliers	58.4	4.0	4.2	4.5	4.8	5.1
Direct to end user/retail dealers	<u>115.1</u>	8.0	8.5	9.1	9.8	10.5
TOTAL	1,447.9					

TABLE 23

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	1982 Net Shipments			
	<u>To United States Destinations</u>		<u>Worldwide</u>	
	<u>Units (000)</u>	<u>%</u>	<u>Units (000)</u>	<u>%</u>
Alps Electric	637.0	44.0	650.0	37.1
Micro Peripherals	227.0	15.7	266.8	15.2
Tandon	229.2	15.8	254.6	14.5
Shugart	151.4	10.5	199.7	11.4
TEAC	36.3	2.5	153.3	8.8
Siemens	127.5	8.8	134.0	7.6
Micropolis	23.1	1.6	35.0	2.0
BASF	--	--	25.0	1.4
Other U.S.	5.6	.4	5.8	.3
Other Non-U.S.	<u>10.8</u>	<u>.7</u>	<u>29.8</u>	<u>1.7</u>
TOTAL	1,447.9	100.0	1,754.0	100.0

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

1983 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDESCoverage

Examples of flexible disk drives in this group include:

48 tracks per inch

Alps Electric	FDD 2225
BASF	6108
Canon	210, 211, 413, 6108
Control Data	9409, 9428
Epson	TF-20, SD-321, SD-521
Format	48 DS
Hi-Tech Peripherals	H548-50
Hitachi	HFD 505B
Matsushita Communication Ind.	JA-551, JK-875
Micro Peripherals	52, 502
Mitsubishi Electric	M4851
Okidata	GM 3305
Olivetti	FD 502
Philips	X 3112, X 3132
Qume	142, 542
Remex	RFD 480, RFD 485
Shugart	SA 450F, SA 455
Tandon	TM-50-2, TM-100-2, TM-55-2
TEAC	FD-55B
Tokyo Electric Company	FB-503
Toshiba	ND-02D, ND04D
World Storage Technology	FDD 200-5, 211-5, 212-5
YE Data	YD-274, YD-580

96/100 tracks per inch

Alps Electric	FDD 2845
BASF	6118
Canon	MDD-220, MDD-221, MDD-422
Control Data	9429, 9409-T
Data Track Technology	Tracker 2.0
Epson	SD-540, SD-560
Format	96 DS, 96 DS 360
Hitachi	HFD 510B, HFD 516B
Matsushita Communication Ind.	JA-561, JU-581
Micro Peripherals	92, 902, 102
Micropolis	1115-IV, 1115-VI, 1117-VI
Mitsubishi Electric	M4853, M4854, M4855
Okidata	GM 3405
Olivetti	FD 592, FD 595
Philips	X 3114, X 3116, X 3118, X 3134
Qume	192, 592

96/100 tracks per inch (continued)

Remex	RFD 960, RFD 965
Shugart	SA 460, SA 465
Tandon	TM-100-4, TM-55-4, TM-102-2
TEAC	FD-55F, FD-55G
Tokyo Electric Company	FB-504
Toshiba	ND-06D
World Storage Technology	FDD 221-5
YE Data	YD-280, YD-380, YD-480

Over 100 tracks per inch

Amlyn	1860, 5860
Drivetec	320
Eastman Kodak	Kodak 3.3

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

The first two thirds high drives were pioneered by BASF, also in 1978, followed by a handful of others, with sales predominantly in Europe. However, during the last two years most manufacturers of 5.25 inch drives have introduced half high (1.625 inches) models, and have received a generally enthusiastic reaction from system manufacturers. In addition, Canon, Oki Electric and Epson offer drives only one third the height of standard drives, but the reaction of the OEM market is not yet clear.

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

In 1982, 1.6 megabyte 5.25 inch drives were first shipped by YE Data and Mitsubishi, designed to a standard coordinated by Nippon Telephone and Telegraph. These drives match the capacity and file organization of two sided 8 inch drives by using 77 tracks (at 96 TPI) per side at 9600 BPI.

1983 DISK/TREND REPORT

Half high 1.6 megabyte drives are now offered by several Japanese manufacturers, with substantial 1983 shipments of drives used on systems sold in the Japanese domestic market. To date, the leading U.S. manufacturers of floppy drives have not offered comparable models.

Even higher capacity 5.25 inch drives are currently offered by two U.S. firms, which are competing in a race to set the de facto standard for drives in the 3 megabyte range. Amlyn offers up to 3.2 megabytes per diskette (and 16 megabytes per cartridge of five diskettes) by using a single prerecorded "reference" track, and 170 TPI. Drivetec is shipping a half high drive using an embedded servo technique, with 192 TPI, and capacity of 3.3 megabytes. Drivetec recently licensed Eastman Kodak, a new entry in the disk drive industry, and Eastman's production of a drive compatible with Drivetec's unit is expected to start in 1984.

Apple Computer's long expected introduction of its "Twiggy" drive finally occurred in 1983, but so did the announcement of its withdrawal. The drive was an industry oddity, at 62.5 TPI, using eight separate bands of tracks, each with different RPM, track capacity and latency -- and probably was expensive to manufacture.

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
U.S. manufacturers	157.0	471.8	704.8	1,243.6	1,809.0
All manufacturers	353.5	1,035.4	1,502.0	2,231.5	2,979.2

Previous editions of the DISK/TREND Report have forecast a dominant role for 5.25 inch, two sided drives, but have understated the magnitude of the explosive growth now underway. 1983 is the year it is indeed

1983 DISK/TREND REPORT

happening -- with over five million drives expected to be shipped worldwide for the year. 1982's total worldwide shipments of 1,477,800 drives were up 151.5% over the previous year, and 1983's forecasted total of 5,492,800 units will constitute an increase of 271.6%.

Manufacturers of small business and professional systems used 56.4% of the drives in this product group in 1982, and that share is increasing. The 48 TPI two sided 5.25 inch drive dominates current shipments. These applications are absorbing most of the 5.25 inch Winchester drives shipped to date, and the .5 and 1.0 megabyte minifloppy has provided a natural companion product, for software distribution and backup of user files.

5.25 inch, two sided drives were well on their way to becoming the industry's mainstream floppy configuration before IBM started introducing its continuing procession of personal computer models with great success, but IBM's choice of this format for the PC family has proven decisive. The panic to achieve IBM compatibility in processors, software and disk drives has engulfed a majority of IBM's PC competitors, with an impact on two sided 5.25 inch drive shipments that is now obvious.

Tandon Corporation has exploited its early lead in two sided 5.25 inch drives, and shipped 480,900 units in 1982, 37.9% of the worldwide total. Runners up were TEAC with 12.0% and YE Data with 11.4%. Despite the existence of several captive manufacturing programs, mostly by non-U.S. firms, OEM drives will still hold 89.8% of total worldwide shipments in 1983.

Marketing trends

Prospects for future growth in two sided 5.25 inch floppy drives are excellent, and DISK/TREND forecasts reflect that expectation. The 1986

1983 DISK/TREND REPORT

forecast for total unit shipments is 14,555,200 drives, an average annual increase for 1984-1986 of 38.9%.

Captive shipments are expected to reach 25.8% of the 1986 total, and the largest contribution to this growth is expected to come from IBM. None of the immense quantities of 5.25 inch drives IBM is shipping with various PC models is internally produced, but it is believed that the firm will start internal production of two sided 5.25 inch drives in mid-1984. This program will involve both 48 and 96 TPI drives and will build to an estimated two and one half million drives in 1986, a level equal to about half of IBM's total requirements for 5.25 inch drives in that year.

In the next three years, there will be drastic changes in the product mix for this product group -- in the balance between 48, 96 and higher TPI, and in full size versus half high models. Over 70% of today's two sided 5.25 inch drives are 48 TPI models, but the 48 TPI share is expected to drop below 40% by 1986. The inexorable trend to higher capacity data storage devices for individual applications is a factor in the shift to 96 TPI drives, driven by introduction of more multiple-function software, larger user files and more systems with small Winchester disk drives.

But IBM's choices of floppy drives for its desktop computer systems are also expected to exert a major influence. It is expected that IBM will start using 1.6 megabyte two sided 5.25 inch drives in 1984 on new versions of its PC family which will supersede the existing Displaywriter word processing system and System/23 Datamaster small business system.

1.6 megabyte 5.25 inch floppy drives are an exact logical equivalent to the 8 inch floppy drives now used with these systems, and offer the advantage of compatibility with existing software and user files, while conforming to the half high 5.25 inch drive box size. IBM will be able to

1983 DISK/TREND REPORT

buy 1.6 megabyte 5.25 inch drives already in quantity production from Japanese drive manufacturers if it chooses to do so, and initiate its internal production program when convenient.

An expected byproduct of IBM's adoption of this drive format will be frenzied activity by IBM's word processing and high-end microcomputer competitors to find sources of their own for two sided 5.25 inch drives, in order to achieve media compatibility. Until now, U.S. system manufacturers have reacted coolly to the 5.25 inch 1.6 megabyte drives, and only one U.S. drive manufacturer, the startup firm Hi-Tech Peripherals, has announced a half high 1.6 megabyte model. However, IBM's expected action will undoubtedly also produce a rash of belated product announcements for similar devices from U.S. floppy drive manufacturers.

The rate at which the market for drives above 1.6 megabytes will develop is more difficult to forecast. Drivetec and Amlyn, plus their licensees, are offering half high 5.25 inch drives in the three megabyte range. These drives work, and production is available. It is assumed that specialized applications will enable these firms to gradually ramp up production -- but the bigger question is how soon the mainstream business and professional market for personal computers will develop an appetite for floppy drives in this capacity range. Current DISK/TREND forecasts predict worldwide unit shipments of 173,500 drives of this type in 1986, but this projection could be affected by the rate at which applications software conducive to the creation of larger user files is introduced.

Perhaps the most obvious trend in floppy drives is the market strength of the half high. With significant quantity shipments really just starting last year, the acceptance by system manufacturers has been immediate, and most floppy drive manufacturers are now offering half high

versions of most basic 5.25 inch floppy formats. By 1986 over 90% of the drives in this product group are expected to be half high models.

Technical trends

Except for drives using perpendicular recording or isotropic particulate media, discussed elsewhere in this report, it is questionable that major changes in the recording technology used in 5.25 inch two sided drives will occur during the next few years.

With 1.6 and 3.2 megabyte 5.25 inch drives already available and waiting for the market to develop, investment in yet higher densities may be hard to justify. If significant demand becomes apparent, the head positioning systems used by Drivetec and Amlyn are probably capable of reliable operation with doubled TPI, and isotropic particulate media should be usable at the 20,000 flux reversals per inch required to double the current BPI, even without using run length limited codes. Combination of both improvements would yield a 12.8 megabyte drive -- which might be ahead of its time in 1984.

Forecasting assumptions

1. IBM will initiate captive production during 1984 of two sided 5.25 inch drives, in 48 and 96 TPI models.
2. Market demand for the combination of small package size and increasing capacity will continue to make two sided 5.25 inch drives the leading floppy drive configuration.
3. Growth in demand for high capacity 5.25 inch drives in the Japanese domestic market and the leadership taken by Japanese floppy drive manufacturers in 1.6 megabyte OEM drives will enable non-U.S. drive manufacturers to pass up U.S. manufacturers in worldwide shipments, starting in 1985.

TABLE 24
FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES
REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	104.9	131.1	470.7	627.7	806.7	1,152.5
Other U.S. Captive	10.3	14.9	20.8	26.7	25.0	32.6	32.9	43.1	43.3	57.2
TOTAL U.S. CAPTIVE	10.3	14.9	20.8	26.7	129.9	163.7	503.6	670.8	850.0	1,209.7
PCM	--	--	2.6	2.6	7.1	7.1	9.2	9.2	10.9	10.9
OEM	126.5	142.1	403.4	442.5	478.9	534.0	484.9	563.6	483.3	588.4
TOTAL U.S. NON-CAPTIVE	126.5	142.1	406.0	445.1	486.0	541.1	494.1	572.8	494.2	599.3
TOTAL U.S. SHIPMENTS	136.8	157.0	426.8	471.8	615.9	704.8	997.7	1,243.6	1,344.2	1,809.0
Non-U.S. Manufacturers										
Captive	29.7	115.2	89.0	268.1	126.5	366.3	161.8	455.5	197.4	533.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	9.1	81.3	96.7	295.5	177.5	430.9	240.0	532.4	309.7	636.8
TOTAL NON-U.S. SHIPMENTS	38.8	196.5	185.7	563.6	304.0	797.2	401.8	987.9	507.1	1,170.2
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	175.6	353.5	612.5	1,035.4	919.9	1,502.0	1,399.5	2,231.5	1,851.3	2,979.2
OEM Average Price (\$000)	.183	.176	.152	.150	.131	.129	.120	.119	.115	.114

TABLE 25
FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1982		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers	-----									
IBM	--	--	--	--	228.0	285.0	1,012.5	1,350.0	1,736.0	2,480.0
Other U.S. Captive	15.4	22.8	36.1	45.6	44.6	57.2	62.6	80.9	89.7	117.4
TOTAL U.S. CAPTIVE	15.4	22.8	36.1	45.6	272.6	342.2	1,075.1	1,430.9	1,825.7	2,597.4
PCM	--	--	12.0	12.0	38.0	38.0	51.0	51.0	63.0	63.0
OEM	689.0	777.2	2,571.3	2,821.8	3,585.9	3,974.5	3,927.5	4,548.5	4,070.1	4,952.4
TOTAL U.S. NON-CAPTIVE	689.0	777.2	2,583.3	2,833.8	3,623.9	4,012.5	3,978.5	4,599.5	4,133.1	5,015.4
TOTAL U.S. SHIPMENTS	704.4	800.0	2,619.4	2,879.4	3,896.5	4,354.7	5,053.6	6,030.4	5,958.8	7,612.8
Non-U.S. Manufacturers	-----									
Captive	49.3	185.6	175.2	505.1	268.4	732.4	360.7	952.1	450.5	1,152.1
PCM	--	--	--	--	--	--	--	--	--	--
OEM	50.2	492.2	710.6	2,108.3	1,435.4	3,496.3	2,104.6	4,677.6	2,810.5	5,790.3
TOTAL NON-U.S. SHIPMENTS	99.5	677.8	885.8	2,613.4	1,703.8	4,228.7	2,465.3	5,629.7	3,261.0	6,942.4
Worldwide Recap	-----									
TOTAL WORLDWIDE SHIPMENTS	803.9	1,477.8	3,505.2	5,492.8	5,600.3	8,583.4	7,518.9	11,660.1	9,219.8	14,555.2
Installed at Year End	-----									
IBM	--	--	--	--	228.0	285.0	1,240.5	1,635.0	2,976.5	4,115.0
Non-IBM	1,248.4	2,334.8	4,753.6	7,827.6	10,125.9	16,126.0	16,632.3	26,436.1	24,116.1	38,511.3
WORLDWIDE TOTAL	1,248.4	2,334.8	4,753.6	7,827.6	10,353.9	16,411.0	17,872.8	28,071.1	27,092.6	42,626.3

TABLE 26
FLEXIBLE DISK DRIVES, 5.25 Inch, Two Sides
WORLDWIDE SHIPMENTS (000)
DRIVE HEIGHT ANALYSIS

	1982		-----Forecast-----							
	--Shipments--		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
	Units	%	Units	%	Units	%	Units	%	Units	%
-----U.S. MANUFACTURERS-----										
Captive Total	22.8		45.6		342.2		1,430.9		2,597.4	
Full Size	22.8	100.0	24.6	53.9	31.2	9.1	36.4	2.5	35.2	1.4
Half High	--	--	21.0	46.1	311.0	90.9	1,394.5	97.5	2,562.2	98.6
OEM Total	777.2		2,833.8		4,012.5		4,599.5		5,015.4	
Full Size	747.9	96.2	2,357.3	83.2	3,085.0	76.9	2,564.7	55.8	1,320.1	26.3
Half High	29.3	3.8	476.5	16.8	927.5	23.1	2,034.8	44.2	3,695.3	73.7
Total U.S.	800.0		2,879.4		4,354.7		6,030.4		7,612.8	
Full Size	770.7	96.3	2,381.9	82.7	3,116.2	71.6	2,601.1	43.1	1,355.3	17.8
Half High	29.3	3.7	497.5	17.3	1,238.5	28.4	3,429.3	56.9	6,257.5	82.2
-----NON-U.S. MANUFACTURERS-----										
Captive Total	185.6		505.1		732.4		952.1		1,152.1	
Full Size	14.5	7.8	21.6	4.3	33.7	4.6	15.1	1.6	3.2	.3
Half High	171.1	92.2	483.5	95.7	698.7	95.4	937.0	98.4	1,148.9	99.7
OEM Total	492.2		2,108.3		3,496.3		4,677.6		5,790.3	
Full Size	207.2	42.1	110.2	5.2	67.3	1.9	24.2	.5	--	--
Half High	285.0	57.9	1,998.1	94.8	3,429.0	98.1	4,653.4	99.5	5,790.3	100.0
Total Non-U.S.	677.8		2,613.4		4,228.7		5,629.7		6,942.4	
Full Size	221.7	32.7	131.8	5.0	101.0	2.4	39.3	.7	3.2	--
Half High	456.1	67.3	2,481.6	95.0	4,127.7	97.6	5,590.4	99.3	6,939.2	100.0
-----WORLDWIDE RECAP-----										
Total Shipments	1,477.8		5,492.8		8,583.4		11,660.1		14,555.2	
Full Size	992.4	67.2	2,513.7	45.8	3,217.2	37.5	2,640.4	22.6	1,358.5	9.3
Half High	485.4	32.8	2,979.1	54.2	5,366.2	62.5	9,019.7	77.4	13,196.7	90.7

TABLE 27
FLEXIBLE DISK DRIVES, 5.25 Inch, Two Sides
WORLDWIDE SHIPMENTS (000)
TRACK DENSITY ANALYSIS

	1982		-----Forecast-----							
	--Shipments--		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
	Units	%	Units	%	Units	%	Units	%	Units	%
U.S. MANUFACTURERS										
Captive Total	22.8		45.6		342.2		1,430.9		2,597.4	
48 TPI	22.6	99.1	24.6	53.9	259.2	75.7	778.9	54.4	1,027.2	39.5
96/100 TPI	.2	.9	21.0	46.1	26.0	7.6	314.5	22.0	801.4	30.9
96 TPI 1.6 MB	--	--	--	--	57.0	16.7	337.5	23.6	768.8	29.6
OEM Total	777.2		2,833.8		4,012.5		4,599.5		5,015.4	
48 TPI	514.3	66.2	2,275.7	80.3	3,186.5	79.4	3,241.4	70.5	2,787.2	55.6
96/100 TPI	262.7	33.8	554.1	19.6	777.0	19.4	1,219.6	26.5	1,843.2	36.8
96 TPI 1.6 MB	.2	--	4.0	.1	49.0	1.2	138.5	3.0	385.0	7.6
Total U.S.	800.0		2,879.4		4,354.7		6,030.4		7,612.8	
48 TPI	536.9	67.1	2,300.3	79.9	3,445.7	79.1	4,020.3	66.7	3,814.4	50.1
96/100 TPI	262.9	32.9	575.1	20.0	803.0	18.4	1,534.1	25.4	2,644.6	34.7
96 TPI 1.6 MB	.2	--	4.0	.1	106.0	2.5	476.0	7.9	1,153.8	15.2
NON-U.S. MANUFACTURERS										
Captive Total	185.6		505.1		732.4		952.1		1,152.1	
48 TPI	169.0	91.1	420.0	83.2	557.3	76.1	691.4	72.6	771.0	66.9
96/100 TPI	16.5	8.9	50.8	10.1	82.1	11.2	96.8	10.2	117.3	10.2
96 TPI 1.6 MB	.1	--	34.3	6.7	93.0	12.7	163.9	17.2	263.8	22.9
OEM Total	492.2		2,108.3		3,496.3		4,677.6		5,790.3	
48 TPI	345.4	70.2	1,193.5	56.6	1,548.9	44.3	1,510.9	32.3	1,175.4	20.3
96/100 TPI	142.4	28.9	674.2	32.0	1,207.4	34.5	1,741.7	37.2	2,215.1	38.3
96 TPI 1.6 MB	4.4	.9	240.6	11.4	740.0	21.2	1,425.0	30.5	2,399.8	41.4
Total Non-U.S.	677.8		2,613.4		4,228.7		5,629.7		6,942.4	
48 TPI	514.4	75.9	1,613.5	61.7	2,106.2	49.8	2,202.3	39.1	1,946.4	28.0
96/100 TPI	158.9	23.4	725.0	27.7	1,289.5	30.5	1,838.5	32.7	2,332.4	33.6
96 TPI 1.6 MB	4.5	.7	274.9	10.6	833.0	19.7	1,588.9	28.2	2,663.6	38.4
WORLDWIDE RECAP										
Total Shipments	1,477.8		5,492.8		8,583.4		11,660.1		14,555.2	
48 TPI	1,051.3	71.1	3,913.8	71.3	5,551.9	64.7	6,222.6	53.4	5,760.8	39.6
96/100 TPI	421.8	28.5	1,300.1	23.7	2,092.5	24.4	3,372.6	28.9	4,977.0	34.2
96 TPI 1.6 MB	4.7	.4	278.9	5.0	939.0	10.9	2,064.9	17.7	3,817.4	26.2

Note: Track densities greater than 100 TPI are grouped with 96/100 TPI totals in this table.

1983 DISK/TREND REPORT

TABLE 28

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

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

<u>Distribution Channel</u>	<u>1982 U.S. Net Shipments</u>		<u>FORECAST</u>			
	<u>Units (000)</u>	<u>%</u>	<u>1983 %</u>	<u>1984 %</u>	<u>1985 %</u>	<u>1986 %</u>
Mainframe computer manufacturers	281.3	38.1	37.4	36.6	35.5	34.1
Mini/micro computer manufacturers	168.2	22.8	21.7	20.5	20.0	19.4
System OEMs/systems houses	209.2	28.3	28.8	29.0	30.2	31.7
Independent peripherals suppliers	38.0	5.1	6.2	7.7	8.0	8.4
Direct to end user/retail dealers	<u>42.5</u>	5.7	5.9	6.2	6.3	6.4
TOTAL	739.2					

TABLE 29

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	<u>1982 Net Shipments</u>			
	<u>To United States Destinations</u>		<u>Worldwide</u>	
	<u>Units (000)</u>	<u>%</u>	<u>Units (000)</u>	<u>%</u>
Tandon	447.5	60.5	480.9	37.9
TEAC	17.5	2.4	152.0	12.0
YE Data	--	--	144.4	11.4
Micro Peripherals	65.9	8.9	79.6	6.3
Micropolis	43.1	5.8	65.2	5.1
Control Data	63.0	8.5	63.5	5.0
Mitsubishi	23.1	3.1	58.6	4.6
Matsushita Com. Ind.	.3	.1	51.8	4.1
BASF	--	--	38.0	3.0
Shugart	27.0	3.7	35.9	2.8
Remex	25.4	3.4	32.0	2.5
Qume	17.1	2.3	20.1	1.6
Other Non-U.S.	<u>9.3</u>	<u>1.3</u>	<u>47.4</u>	<u>3.7</u>
TOTAL	739.2	100.0	1,269.4	100.0

1983 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, MICROFLOPPIES

Coverage

Examples of flexible disk drives in this group include:

3.5" disk diameter

Alps Electric	FDD 7374, FDD 7364, FDD 7464
Epson	SMD-110, SMD-150, SMD-140
Mitsubishi Electric	MF351
Shugart	SA 300, SA 350
Sony	OA-D31V, OA-D32V, OA-D33W
Tandon	TM35-1, TM35-2, TM35-4
TEAC	FD-35A, FD-35E, FD-35F

3.25" disk diameter

Tabor	TC-500, TC-1000
-------	-----------------

3.0" disk diameter

Hitachi	HFD 305S, HFD 305D
Janome Sewing Machine Company	MFD-80
Matsushita Communication Ind.	JU-311
Matsushita Electric Industrial	EME-101, EME-112
Metrimpex (BRG)	MCD-1
Micro Peripherals	301F
Sankyo Seiki	FDU-300-S, FDU-300-D
TEAC	FD-30A
Toshiba	ND-301D

Because shipments to date of products in this group have consisted entirely of one sided drives, this year's DISK/TREND Report continues to treat microfloppy drives as a single product group. It is expected that it will be necessary to split the group into separate sections in future years, as the two sided drives already announced become production realities.

Among the various microfloppy drives now offered, there are three principal media standards contending for market leadership: (1) Sony,

plus the U.S. drive and media manufacturers trying to establish a standard, have agreed on a 3.5 inch rigid plastic cartridge, using a spring loaded shutter, with 80 tracks per side. Alps Electric, Epson and TEAC have also recently announced 3.5 inch drives. (2) Matsushita Electric Industrial, Hitachi and Hitachi/Maxell have introduced a 3 inch rigid plastic cartridge, also using a spring loaded shutter, but intended initially for 40 tracks per side. Also announcing 3.0 inch drives in 1983 were Sankyo Seiki, TEAC, Toshiba, Janome Sewing Machine Company, and Micro Peripherals. (3) Dysan and Tabor are offering a 3.25 inch diskette in a flexible plastic jacket, with 80 tracks per side. Seagate Technology obtained a license for the Tabor drive in 1982, but so far has not announced a specific product. Drives in each of these groups use 6,250 bytes per track, the same track capacity as "double density" 5.25 inch diskettes.

Another 3 inch microfloppy drive is now in production by BRG in Budapest, with export by Metrimpex, an Hungarian export organization. This drive uses a unique rigid plastic cartridge, with 45 tracks per side, and capacities up to 250 Kbytes.

IBM created a stir in the industry early in 1983 by announcing a 4 inch microfloppy drive for the OEM market, but withdrew the product in September, due to an indifferent market reaction. Even IBM's prestige wasn't sufficient to sell the announced drive, due to its slow access time, large box size, unusual file organization and special controller requirements.

1983 DISK/TREND REPORT

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
U.S. manufacturers	--	2.2	12.6	28.0	57.6
All manufacturers	6.5	53.9	134.4	250.1	417.1

Despite the continuing aura of confusion created by noisy promotion of competing media standards, microfloppy drive shipments are starting to take off. Following first shipments of microfloppy drives by the leading contenders in late 1981, then modest worldwide shipments of 25,500 drives in 1982, sales in 1983 are moving up rapidly. The 1983 worldwide total for all drives is forecasted at 292,400 units, over 90% of which will be OEM drives.

The current leader in shipment volume is Sony's 3.5 inch microfloppy, buoyed by growing shipments to its largest OEM customer, Hewlett-Packard. With this microfloppy already in use with several H-P systems and more expected, Sony has been able to achieve substantial production levels while undertaking a broader market development program. In addition to 1982 product announcements by Tandon, Shugart and Mitsubishi, the 3.5 inch microfloppy cause was given a major boost recently through drive introductions by TEAC, Epson and Alps Electric.

But Sony's rivals selling 3.0 and 3.25 inch floppy drives have not given up. The original 3.0 inch drives from Hitachi and Matsushita Electric have now been joined by microfloppy drives from TEAC, Sankyo Seiki, Toshiba, Janome Sewing Machine and Micro Peripherals. It is believed that a majority of the shipments of 3.0 microfloppy drives to date has been in the Japanese domestic market, but the U.S. add-on subsystem market has also seen activity.

1983 DISK/TREND REPORT

Tabor has been joined by Dysan in a campaign to persuade U.S. system manufacturers that the 3.25 inch diskette is the only way to go, because of a variety of suggested advantages in the Dysan soft-jacket 3.25 inch diskette. Micro Peripherals and Seagate Technology have both announced support for the Dysan-type diskette, but neither firm has indicated definite production plans for 3.25 inch microfloppy drives.

Marketing trends

The DISK/TREND projection for 1986 total worldwide shipments is 3,013,000 microfloppy drives, an average annual increase of 121.3% for the 1984-1986 period. Despite excellent competition from half high 5.25 inch floppy drives and continued infighting between the microfloppy contenders, the latent market available to microfloppy drives is very large. Portable computers, small-footprint desktop systems, word processing and various specialized systems are all applications in which a growing number of system manufacturers will wish to use microfloppies.

The next big breakthrough for microfloppies will be Apple Computer's expected use of Sony 3.5 inch drives on the Mackintosh, which is expected in the first half of 1984. Mackintosh is the junior version of the Lisa, on which 3.5 inch drives may also be used as a substitute for Apple's own "Twiggy" 5.25 inch drive, which is being shelved. IBM is breathing down Apple's neck in the personal computer market these days, and the firm desperately needs a successful new product. Apparently, the firm believes the small size of the 3.5 inch diskette will help its sales pitch.

Undoubtedly, the best bet for dominant market leadership in micro-floppy drive shipments is the Sony format, although most shipments in future years will probably be 1.625 inches high, rather than the 2 inches

1983 DISK/TREND REPORT

of Sony's original drive. It is expected that the products already introduced will be joined in the first half of 1984 by 3.5 inch microfloppy drives from ten additional Japanese companies, plus a few U.S. and European firms -- altogether, substantial momentum for the 3.5 inch format.

Technical trends

The technology to be used in microfloppy drives for the next several years seems to be well established. Most leading contenders use cobalt modified oxide coatings in the 600 Oersted range, on conventional polyester film. With the exception of the Dysan diskette, all use a spring loaded self closing shutter, with a rigid plastic cartridge.

No displacement of the basic technology used in today's microfloppies is expected through 1986, although recording methods with the potential for significantly higher densities, such as perpendicular recording and magneto optical recording, may be announced before 1986.

Forecasting assumptions

1. The 3.5 inch microfloppy format will be shipped with a significant number of portable and desktop computers starting in 1984, and existing drives will be joined by additional new drives from at least ten other manufacturers.
2. Apple Computer will use 3.5 inch microfloppy drives on the Mackintosh system, with deliveries starting first half 1984.
3. IBM will not use microfloppies on any systems with significant shipments through 1986.

TABLE 30
FLEXIBLE DISK DRIVES, MICROFLOPPIES
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1982		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	.1	.1	4.5	4.8	9.9	10.8	18.4	20.4
TOTAL U.S. CAPTIVE	--	--	.1	.1	4.5	4.8	9.9	10.8	18.4	20.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	--	1.9	2.1	6.6	7.8	14.6	17.2	31.6	37.2
TOTAL U.S. NON-CAPTIVE	--	--	1.9	2.1	6.6	7.8	14.6	17.2	31.6	37.2
TOTAL U.S. SHIPMENTS	--	--	2.0	2.2	11.1	12.6	24.5	28.0	50.0	57.6
Non-U.S. Manufacturers										
Captive	.8	3.1	3.0	19.8	10.2	39.2	31.6	75.2	63.7	130.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	1.3	3.4	22.4	31.9	57.8	82.6	99.9	146.9	149.2	229.5
TOTAL NON-U.S. SHIPMENTS	2.1	6.5	25.4	51.7	68.0	121.8	131.5	222.1	212.9	359.5
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	2.1	6.5	27.4	53.9	79.1	134.4	156.0	250.1	262.9	417.1
OEM Average Price (\$000)	.173	.174	.139	.136	.128	.128	.111	.111	.102	.102

1983 DISK/TREND REPORT

FLEXIBLE DISK DRIVES, SPECIALCoverage

The flexible disk drives included in this group are:

Iomega	Alpha 10, Beta 5
Sankyo Seiki	FMC-170, FMC-270
Tokyo Electric Company	MC-108, MC-116
Vertimag	VSC530

The flexible disk drives in this group are analyzed separately, because the drives included are significantly different from those in other DISK/TREND product groups. The functional and physical characteristics of these products are varied, and will be individually discussed below.

Specific shipment and revenue forecasts for products in this section have not been included in this DISK/TREND Report. Future editions will have individual sections, and forecasts, for products which become commercially significant.

Special flexible disk drive products and marketsIomega Alpha-10 and Beta-5

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

Iomega announced the 8 inch Alpha-10 in May, 1981, and deliveries of

production drives started in September, 1982. This drive has 10 MB formatted capacity, using 300 TPI and 18,000 FCI, and spins at 1,500 RPM. The Beta-5 was announced at the 1982 NCC, with first deliveries in July, 1983, and uses the standard SA 400 form factor for minifloppies. The drive offers 5.25 MB formatted capacity, with 394 TPI at 17,200 BPI, and maintains the 625 KByte/second transfer rate standard with most 5.25 Winchester drives, by using 1,964 RPM.

The capacity, performance, and pricing of Iomega's drives place them in competition with small Winchester disks and removable rigid disk cartridge drives, rather than in the existing flexible disk drive market. Iomega has attracted great interest in the industry, but orders for significant quantities were slow in coming because of delays in availability of a low cost controller and lack of a drive in the 5.25 inch floppy form factor. Both are now available, and Iomega has a chance to demonstrate whether there is really a market for drives using its unique technology. One difficulty lies in lack of alternate sources for the drive. The products are unique, and system manufacturers, as always, are reluctant to take a chance on a sole-source product from a new company. The first step was taken with a license to SCI Systems to manufacture Iomega's drives, but no specific plans to enter the OEM market as a second source have been announced. A license has been granted to Verbatim to make and sell media for Iomega drives. Further development of alternate sources for drives and media is probably essential to major success for this drive family.

Sankyo Seiki FMC-170, FMC-270
Tokyo Electric Company MC-108, MC-116

All of these drives record in a single spiral track on a flexible disk of about 2.5 inch diameter. The drives' physical size, interfaces and

1983 DISK/TREND REPORT

media are not mutually compatible. Olivetti offered a similar drive, starting in 1977, but phased it out a few years ago. Olivetti's drive was used as a program loader and data storage medium on a variety of word processing and data processing equipment, but has been replaced with Olivetti's internally manufactured 5.25 inch floppy drives. The drive was offered as an OEM product for several years, without much market impact.

Sankyo Seiki's drive was introduced in 1980, and the newer Tokyo Electric drives were introduced in 1982. Both drives are, like Olivetti's, intended to develop the market for very small, low priced serial recording devices in applications such as electronic typewriters, POS terminals, personal computers, and for other specialized systems. Most early shipments have been in connection with Japanese produced electronic typewriters.

Vertimag Systems

Vertimag is pioneering the market for very high density flexible disk drives using perpendicular recording. The company has indicated that its initial product will be a 5.25 inch drive to be shipped in 1984, using a standard 96 TPI drive mechanism modified with Vertimag's electronics and special recording head. It is believed that there is also a possibility that the firm may produce a drive in a microfloppy configuration on the same timetable.

Recording density of the initial product is planned for about 30,000 FCI, using MFM recording, which will yield about 3.5 megabytes capacity for a one sided 5.25 inch drive.

The short term prospects for Vertimag's drive to become a major factor in the industry will depend on whether the firm can demonstrate

that the drive design is producible at a competitive cost, whether a cost-effective method of manufacturing sputtered flexible disks in very large quantities can be established, and whether alternate sources are established. It is probable that the drive can be made producible and alternate sources can be established, given the appropriate policies and use of resources, but the question of producing adequate supplies of sputtered media may be more difficult to answer.

By any measure, the number of diskettes required each year, if this technology were to be widely used, would run into the millions. Vertimag's diskettes have so far been produced one at a time in a batch mode using conventional sputtering equipment. Such equipment involves loading a blank diskette in a chamber from which the air is then evacuated, the metal film is deposited by sputtering, and finally the chamber is opened and the diskette removed. Clearly, a continuous process is required if sputtered disks are to be available in adequate numbers to support Vertimag's drives in the marketplace. The firm has engineered such a process and plans to have it installed during the second half of 1984.

Vertimag's competitors in the market for high capacity floppy drives will not all be using perpendicular recording. Also worth watching are firms such as Drivetec and Amlyn, which use cobalt modified oxide media for high linear densities by particulate media standards and track following servo systems to double current floppy TPI densities. Both firms are now in production, and their pricing policies as production increases may squeeze Vertimag's early profit margins. Drives designed for isotropic particulate media have not yet appeared, but may also be tough competitors for perpendicular recording when they do.

FLEXIBLE DISK DRIVE SPECIFICATIONS

Coverage

This listing includes most flexible disk drives now in new production or announced, arranged alphabetically by manufacturer. Most of the listed drives are still in production, but a number of IBM drives no longer in new production are listed for reference.

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

Generic type

Because they are generally understood throughout the industry, IBM media designations are used to define types of 8 inch media, and Shugart's media designations are used to define 5.25 inch media types, except high density diskettes, for which there are still no industry standards. However, usage of these model numbers is not intended to imply interchangeability. Individual drives may require media with a variety of special characteristics.

Capacities

Capacities are listed as "U" for unformatted or "F" for formatted. All capacities are per spindle. For DISK/TREND purposes, one spindle

consists of the disk drive mechanism required to utilize a single disk. Drives which use a single head positioning mechanism with two diskettes are considered to be two spindles.

OEM prices

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

Accuracy

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

DISK/TREND product groups

In most cases the product groups used for individual drives are clear, but a few arbitrary decisions have been made. The IBM magazine drive has been included in the 8 inch, two sided group, since the magazine mechanism uses a single drive. Amlyn drives, which use diskettes in a special magazine, are included with 5.25 inch one and two sided drives, as appropriate.

DISK/TREND PRODUCT GROUPS FOR FLEXIBLE DISK DRIVES

10. 8 inch, one side
11. 8 inch, two sides
12. 5.25 inch, one side
13. 5.25 inch, two sides
14. Microflopies
15. Special flexible disk drives

MANUFACTURER	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC
DRIVE					
	FDD 2125	FDD 2745	FDD 2225	FDD 2845	FDD 7364
DISK/TREND GROUP	12	12	13	13	14
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 104	SA 114	SA 154	SA 164	Sony OM-D3440
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	3.5"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250	U: .5	U: .5	U: 1.0	U: .5
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	1	1	2	2	1
Tracks per surface	40	80	40	80	80
TPI	48	96	48	96	135
BPI	5536	5576	5876	5922	8180
RPM	300	300	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	6 or 12	3	6 or 12	3	6
Settling time (msec)	15	15	15	15	15
Head load time(msec)	35	35	35	35	Continuous Contact 100
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	1.69 x 5.75 x 8.0	1.69 x 5.75 x 8.0	1.69 x 5.75 x 8.0	1.69 x 5.75 x 8.0	1.38 x 4.1 x 4.9
FIRST CUSTOMER SHIPMENT	2/80	9/83	9/82	9/83	3/84
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

1983 DISK/TREND REPORT

SPEC-5

MANUFACTURER	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC	ALPS ELECTRIC
DRIVE					
	FDD 7368	FDD 7374	FDD 7464	FDD 7468	FDD 7474
DISK/TREND GROUP	14	14	14	14	14
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Sony OM-D3440	Sony OM-D3440	Sony OM-D4440	Sony OM-D4440	Sony OM-D4440
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	3.5"
Magnetic surface	High Density Oxide Coated Soft	High Density Oxide Coated Soft	High Density Oxide Coated Soft	High Density Oxide Coated Soft	High Density Oxide Coated Soft
Sectoring					
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .5	U: .250	U: 1.0	U: 1.0	U: .5
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	1	1	2	2	2
Tracks per surface	80	40	80	80	40
TPI	135	67.5	135	135	67.5
BPI	8180	8140	8720	8720	8650
RPM	600	300	300	600	300
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	6	12	6	6	12
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	50	100	100	50	100
Data transfer rate (KBytes/sec)	62.5	31.25	31.25	62.5	31.25
SIZE (Inches: H x W x D)	1.38 x 4.1 x 4.9	1.38 x 4.1 x 4.9	1.38 x 4.1 x 4.9	1.38 x 4.1 x 4.9	1.38 x 4.1 x 4.9
FIRST CUSTOMER SHIPMENT	3/84	3/84	3/84	3/84	3/84
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	AMLYN	AMLYN	AMLYN	APPLE COMPUTER	BASF
DRIVE	5850 5855	1860	5860	871	6102
DISK/TREND GROUP	12	13	13	13	10
MARKET	OEM	OEM	OEM	Captive	OEM
MEDIA: Generic type	High Density, Spec. Cartridge 5.25"	High Density 5.25"	High Density, Spec. Cartridge 5.25"	Apple "Fileware" 5.25"	BASF 601 Diskette 1 8"
Nominal disk diameter					
Magnetic surface	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft	Oxide Coated
Sectoring					Soft/Hard
CAPACITY/PERFORMANCE	8.0 MB capacity per cartridge		16.0 MB capacity per cartridge		
Total capacity (MBytes)	U: 1.6	U: 3.2	U: 3.2	F: .871	U: .401/.802
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	F: 7,680 to 11,264	U: 5,208/10,416
Data surfaces per spindle	1	2	2	2	1
Tracks per surface	154	154	154	46	77
TPI	170	170	170	62.5	48
BPI	9500	9500	9500	10,000	3268/6536
RPM	360	360	360	218 to 321	360
Actuator type	Band, Stepping Motor 3	Band, Stepping Motor 2	Band, Stepping Motor 2	Lead Screw, Stepping Motor 43 (including settling)	Lead Screw, Stepping Motor 6
POSITIONING:Track to track(msec)	3	2	2		
Settling time (msec)	15	15	15	--	14
Head load time(msec)	Continuous Contact 83	Continuous Contact 83	Continuous Contact 83	Continuous Contact 137.6 to 93.5	40
Average rotational delay (msec)					83.3
Data transfer rate (KBytes/sec)	62.5	62.5	62.5	62.5	31.25/62.5
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	--	4.33 x 8.66 x 14.17
FIRST CUSTOMER SHIPMENT	4/82	9/83	4/84	2Q83	1976
U.S. OEM PRICE FOR 500 UNITS	\$580	\$300 (1000)	\$710	--	--
COMMENTS	Special cartridge holds 5 diskettes		Special cartridge holds 5 diskettes	Records in 8 bands, each with different RPM, track capacity and latency	

1983 DISK/TREND REPORT

SPEC-7

MANUFACTURER	BASF	BASF	BASF	BASF	BURROUGHS
DRIVE					
	6104	6106	6108	6118	9489-11 9489-12
DISK/TREND GROUP	11	12	13	13	11
MARKET	OEM	OEM	OEM	OEM	Captive
MEDIA: Generic type	Diskette 1,2,2D	BASF 606	BASF 606	SA 164	Special
Nominal disk diameter	8"	SA 104 5.25"	SA 154 5.25"	5.25"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .8/1.6	U: .125/.250	U: .250/.5	U: .5/1.0	F: 1.014
Capacity per track (Bytes)	U: 5,208/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	F: 5,760
Data surfaces per spindle	2	1	2	2	2
Tracks per surface	77	40	40	80	88
TPI	48	48	48	96	64
BPI	3406/6816	2768/5536	2938/5876	2961/5922	4775
RPM	360	300	300	300	365
Actuator type	Lead Screw, Stepping Motor	Cam, Stepping Motor	Cam, Stepping Motor	Cam, Stepping Motor	Linear, Voice Coil
POSITIONING:Track to track(msec)	3	6	6	6	5
Settling time (msec)	14	15	15	15	50
Head load time(msec)	40	Continuous Contact	Continuous Contact	Continuous Contact	85
Average rotational delay (msec)	83.3	100	100	100	82
Data transfer rate (KBytes/sec)	31.25/62.5	15.63/31.25	15.63/31.25	15.63/31.25	50
SIZE (Inches: H x W x D)	4.33 x 8.66 x 14.17	2.1 x 5.75 x 7.5	2.1 x 5.75 x 7.5	2.1 x 5.75 x 7.5	
FIRST CUSTOMER SHIPMENT	1978	3Q78	4Q78	1982	4Q76
U.S. OEM PRICE FOR 500 UNITS	--	\$200	\$250	--	--
COMMENTS					9489-12 is dual version

1983 DISK/TREND REPORT

MANUFACTURER	BURROUGHS	CALDISK	CALDISK	CALDISK	CANON
DRIVE	9489-21 9489-23	142M 842D	143M1	143M	MDD 110
DISK/TREND GROUP	11	10	10	11	12
MARKET	Captive	OEM, Captive	OEM, Captive	OEM, Captive	OEM
MEDIA: Generic type	Special	Diskette 1	Diskette 1	Diskette 1,2,2D	SA 104
Nominal disk diameter	8"	8"	8"	8"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft/Hard	Soft/Hard	Soft/Hard	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: 3.016	U: .401/.802	U: .401/.802	U: .8/1.6	U: .125/.250
Capacity per track (Bytes)	F: 10,620	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250
Data surfaces per spindle	2	1	1	2	1
Tracks per surface	142	77	77	77	40
TPI	150	48	48	48	48
BPI	7040	3268/6536	3268/6536	3408/6816	2768/5536
RPM	524	360	360	360	300
Actuator type	Linear, Voice Coil	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	40 (including settling)	6	6	6	6
Settling time (msec)	--	10	10	10	30
Head load time(msec)	--	30	30	30	30
Average rotational delay (msec)	57.25	83.3	83.3	83.3	100
Data transfer rate (KBytes/sec)	125	31.25/62.5	31.25/62.5	31.25/62.5	15.63
SIZE (Inches: H x W x D)	10.0 x 5.5 x 20.5	4.9 x 8.4 x 15.0	4.9 x 8.4 x 15.0	4.9 x 8.4 x 15.0	2.26 x 5.75 x 7.7
FIRST CUSTOMER SHIPMENT	3Q80	1/77	1/77	8/77	1/83
U.S. OEM PRICE FOR 500 UNITS	--	\$420	\$427	\$505	--
COMMENTS	Dual drive, single head positioning system				

1983 DISK/TREND REPORT

SPEC-9

MANUFACTURER	CANON	CANON	CANON	CANON	CANON
DRIVE					
	MDD 6106	MDD 6108	MDD 210	MDD 211	MDD 220
DISK/TREND GROUP	12	13	13	13	13
MARKET	OEM	OEM, Captive	OEM	OEM	OEM, Captive
MEDIA: Generic type	SA 104	SA 154	SA 154	SA 154	SA 164
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .250/.5	U: .250/.5	U: .250/.5	U: .5/1.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	2	2	2	2
Tracks per surface	40	40	40	40	80
TPI	48	48	48	48	96
BPI	2768/5536	2768/5536	2938/5876	2938/5876	2961/5922
RPM	300	300	300	300	300
Actuator type	Cam, Stepping Motor	Cam, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	12	12	6	6	3
Settling time (msec)	48	48	30	20	15
Head load time(msec)	35	35	30	25	25
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	2.1 x 5.75 x 7.74	2.1 x 5.75 x 7.74	2.26 x 5.75 x 7.7	1.3 x 5.75 x 8.7	2.26 x 5.75 x 7.74
FIRST CUSTOMER SHIPMENT	3/79	1/80	10/82	5/83	4/82
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	CANON	CANON	CANON	CONTROL DATA	CONTROL DATA
DRIVE					
	MDD 221	MDD 413	MDD 422 MDD 423	9404B	210-10
DISK/TREND GROUP	13	13	13	10	11
MARKET	OEM	OEM	OEM	OEM	PCM
MEDIA: Generic type	SA 164	SA 154	SA 164	CDC 9821/9823 Diskette 1	CDC 9821/315 Diskette 1,2,2D
Nominal disk diameter	5.25"	5.25"	5.25"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft/Hard	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .5/1.0	U: .250/.5	U: .5/1.0	U: .401/.802	F: .606208
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416	F: 4,096
Data surfaces per spindle	2	2	2	1	2
Tracks per surface	80	40	80	77	74/3
TPI	96	48	96	48	48
BPI	2961/5922	2938/5876	2961/5922	3268/6536	3408/6816
RPM	300	300	300	360	360
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	6	3	10	3
Settling time (msec)	15	20	15	15	20
Head load time(msec)	25	25	25	60	40
Average rotational delay (msec)	100	100	100	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.3 x 5.75 x 8.7	2.26 x 5.75 x 8.7	2.26 x 5.75 x 8.7	4.97 x 8.78 x 14.0	4.97 x 8.78 x 14.0
FIRST CUSTOMER SHIPMENT	4/83	2/84	6/83	2Q79	1/79
U.S. OEM PRICE FOR 500 UNITS	--	--	--	\$375	--
COMMENTS		Dual drive	Dual drives. MDD 422 has single head positioning system.		Series/1 interface

1983 DISK/TREND REPORT

SPEC-11

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE					
	9406-4	9408	9409	9409-T	9428
DISK/TREND GROUP	11	12	13	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	CDC 9825	SA 104	SA 154	SA 164	SA 154
Nominal disk diameter	Diskette 1,2,2D 8"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .8/1.6	U: .125/.250	U: .250/.5	U: .5/1.0	U: .250/.5
Capacity per track (Bytes)	U: 5,208/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	1	2	2	2
Tracks per surface	77	40	40	80	40
TPI	48	48	48	96	48
BPI	3408/6816	2768/5536	2938/5876	2961/5922	2938/5876
RPM	360	300	300	300	300
Actuator type	Band, Stepping Motor 3	Band, Stepping Motor 5	Band, Stepping Motor 5	Band, Stepping Motor 5	Band, Stepping Motor 5
POSITIONING:Track to track(msec)					
Settling time (msec)	15	15	15	15	15
Head load time(msec)	35	50	50	50	Continuous Contact 100
Average rotational delay (msec)	83.3	100	100	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	15.63/31.25	15.63/31.25	15.63/31.25	15.625/31.25
SIZE (Inches: H x W x D)	4.65 x 8.55 x 14.0	3.38 x 5.88 x 8.0	3.38 x 5.88 x 8.0	3.38 x 5.88 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1981	3/80	1980	1981	11/83
U.S. OEM PRICE FOR 500 UNITS	\$500	\$205	\$270	\$315	\$235
COMMENTS	Shugart interface				

1983 DISK/TREND REPORT

MANUFACTURER	CONTROL DATA	DATA TRACK TECHNOLOGY	DATA TRACK TECHNOLOGY	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION
DRIVE					
	9429	Tracker 1.0	Tracker 2.0	RX01	RX02
DISK/TREND GROUP	13	12	13	10	10
MARKET	OEM	OEM	OEM	Captive	Captive
MEDIA: Generic type	SA 164	SA 114	SA 164	RX01K Diskette 1 8"	RX01K Diskette 1 8"
Nominal disk diameter	5.25"	5.25"	5.25"		
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .5/1.0	Per Diskette: U: .5 Per Drive: U: 1.0	Per Diskette: U: 1.0 Per Drive: U: 2.0	F: .256	F: .256/.512
Capacity per track (Bytes)	U: 3,125/6,250	U: 6,250	U: 6,250	F: 3,328	F: 3,328/6,656
Data surfaces per spindle	2	1	2	1	1
Tracks per surface	80	80	80	77	77
TPI	96	96	96	48	48
BPI	2961/5922	5922	5922	3268	3268/6536
RPM	300	300	300	360	360
Actuator type	Band, Stepping Motor 3	Band, Stepping Motor 3	Band, Stepping Motor 3	Lead Screw, Stepping Motor 6	Lead Screw, Stepping Motor 6
POSITIONING:Track to track(msec)	15	15	15	20	20
Settling time (msec)	Continuous Contact 100	Continuous Contact 100	Continuous Contact 100	16	16
Head load time(msec)	15.625/31.25	31.25	31.25	83.3	83.3
Average rotational delay (msec)	15.625/31.25	31.25	31.25	31.25	31.25
Data transfer rate (KBytes/sec)	1.625 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	17 x 10.5 x 19	17 x 10.5 x 19
SIZE (Inches: H x W x D)	12/83	2Q83	2Q83	1976	4Q78
FIRST CUSTOMER SHIPMENT	\$250	--	--	--	--
U.S. OEM PRICE FOR 500 UNITS					
COMMENTS		Dual drive with single head position- ing system	Dual drive with single head position- ing system	Dual drive	Dual drive

1983 DISK/TREND REPORT

SPEC-13

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

DIGITAL EQUIPMENT CORPORATION	DRIVETEC	EASTMAN KODAK	ELCOMATIC	ELCOMATIC
RX50	320	KODAK 3.3	ACP 500 ACP 550	ACP 700 ACP 750
12	13	13	10	11
Captive	OEM	OEM, Captive	OEM	OEM
SA 114	High density	High density	Diskette 1,2,2D	Diskette 1,2,2D
5.25"	5.25"	5.25"	8"	8"
Oxide Coated	High density, oxide coated	High density, oxide coated	Oxide Coated	Oxide Coated
Soft	Soft	Soft	Soft/Hard	Soft/Hard
Per Diskette: U: 409 Per Drive: U: 818	U: 3.33	U: 3.33	U: .401/.802	U: .8/1.6
F: 5,120	U: 10,416	U: 10,416	U: 5,208/10,416	U: 5,208/10,416
1 per diskette 2 per drive	2	2	1	2
80	160	160	77	77
96	192	192	48	48
5536	9908	9908	3268/6536	3408/6816
300	360	360	360	360
Cam, Stepping Motor	Lead screw/dual stepping motors	Lead screw/Dual stepping motors	Band, Stepping Motor	Band, Stepping Motor
6	3	3	3	3
	15	15	15	15
	Continuous contact	Continuous contact	35	35
100	83	83	83.3	83.3
31.25	62.5	62.5	31.25/62.5	31.25/62.5
3.25 x 5.75 x 8.5	1.625 x 5.75 x 8.5	1.625 x 5.75 x 8.5	4.35 x 8.55 x 12.0	4.35 x 8.55 x 12.0
4Q82	6/83	1Q84	4Q81	4Q81
--	\$345	--	--	--
Dual drive with single head positioning system	Embedded servo	Embedded servo. Manufactured under Drivetec license; sold by Data Tech- nology Corp.	ACP 500: AC ACP 550: DC	ACP 700: AC ACP 750: DC

1983 DISK/TREND REPORT

MANUFACTURER	ELCOMATIC	EPSON	EPSON	EPSON	EPSON
DRIVE					
	ACP 1500	SD-320	SD-321	SD-521	SD-540
DISK/TREND GROUP	11	13	13	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	--	SA 154	SA 154	SA 154	SA 164
Nominal disk diameter	8"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: 1.6/3.2	U: .250/.5	U: .250/.5	U: .250/.5	U: .5/1.0
Capacity per track (Bytes)	U: 10,416	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6250	U: 3,125/6250
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	154	40	40	40	80
TPI	96	48	48	48	96
BPI	3408/6816	2938/5876	2938/5876	2938/5876	2938/5876
RPM	360	300	300	300	300
Actuator type	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	1.5	15	15	6	3
Settling time (msec)	32	15	15	15	15
Head load time(msec)	35	35	Continuous Contact	Continuous Contact	35
Average rotational delay (msec)	83.3	100	100	100	100
Data transfer rate (KBytes/sec)	31.25/62.5	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	4.35 x 8.55 x 12.0	1.1 x 5.75 x 9.27	1.1 x 5.75 x 9.27	1.625 x 5.75 x 7.7	1.625 x 5.75 x 7.7
FIRST CUSTOMER SHIPMENT	1983	10/83	10/83	10/83	10/83
U.S. OEM PRICE FOR 500 UNITS	--	\$220	\$220	\$185	\$215
COMMENTS					

1983 DISK/TREND REPORT

SPEC-15

MANUFACTURER	EPSON	EPSON	EPSON	EPSON	EPSON
DRIVE					
	SD-560	TF-20	SMD-110 SMD-150	SMD-120 SMD-160	SMD-130 SMD-170
DISK/TREND GROUP	13	13	14	14	14
MARKET	OEM	Captive, PCM	OEM	OEM	OEM
MEDIA: Generic type	Maxell MD2-HD	SA 154	Sony OM-D3440	Sony OM-D4440	Sony OM-D3440
Nominal disk diameter	5.25"	5.25"	3.5"	3.5"	3.5"
Magnetic surface	High Density, Oxide Coated Soft	Oxide Coated Soft/Hard	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft
Sectoring					
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .8/1.6	U: .250/.5 F: .164/.328	U: .125/.250	U: .250/.5	U: .250/.5
Capacity per track (Bytes)	U: 5,208/10,416	F: 4,100	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	2	1	2	1
Tracks per surface	77	40	40	40	80
TPI	96	48	67.5	67.5	135
BPI	4823/9646	2990/5980	4064/8128	4325/8650	4095/8190
RPM	360	300	300	300	300
Actuator type	Band, Stepping Motor	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	15	6	6	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	35	20	Continuous Contact 100	Continuous Contact 100	Continuous Contact 100
Average rotational delay (msec)	83.3	100			
Data transfer rate (KBytes/sec)	31.25/62.5	31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 7.7	3.15 x 6.5 x 13.78*	1.57 x 4 x 5.8	1.57 x 4 x 5.8	1.57 x 4 x 5.8
FIRST CUSTOMER SHIPMENT	10/83	9/82	10/83	10/83	10/83
U.S. OEM PRICE FOR 500 UNITS	\$240	--	\$180/\$190	\$200/\$210	\$195/\$205
COMMENTS		*Dual drive subsystem	SMD-150 is low power model (2.9 watts, operating)	SMD-160 is low power model (2.9 watts, operating)	SMD-170 is low power model (2.9 watts, operating)

1983 DISK/TREND REPORT

MANUFACTURER	EPSON	FORMAT	FORMAT	FORMAT	HI-TECH PERIPHERALS
DRIVE	SMD-140 SMD-180	48 DS	96 DS	96 DS 360	H548-25
DISK/TREND GROUP	14	13	13	13	12
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Sony OM-D4440	SA 154	SA 164	Maxell MD2-HD	SA 104
Nominal disk diameter	3.5"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	High Density, Oxide Coated Soft	Oxide Coated Soft	Oxide Coated Soft	High Density Oxide Coated Soft	Oxide Coated Soft
Sectoring					
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .5/1.0	U: .250/.5	U: .5/1.0	U: .8/1.6	U: .125/.250
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416	U: 3,125/6,250
Data surfaces per spindle	2	2	2	2	1
Tracks per surface	80	40	80	77	40
TPI	135	48	96	96	48
BPI	4360/8720	2938/5876	2961/5922	4823/9646	2768/5536
RPM	300	300	300	360	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	5	3	3	6
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	83.3	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5	15.63/31.25
SIZE (Inches: H x W x D)	1.57 x 4 x 5.8	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	10/83				8/83
U.S. OEM PRICE FOR 500 UNITS	\$220/\$230	--	--	--	\$165
COMMENTS	SMD-180 is low power model (2.9 watts, operating)	Manufactured by Gold Star Tele-Electric	Manufactured by Gold Star Tele-Electric	Manufactured by Gold Star Tele-Electric	

MANUFACTURER	HI-TECH PERIPHERALS	HI-TECH PERIPHERALS	HI-TECH PERIPHERALS	HI-TECH PERIPHERALS	HI-TECH PERIPHERALS
DRIVE					
	H596-05	H596-08	H548-50	H596-10	H596-16
DISK/TREND GROUP	12	12	13	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 114	Maxell MD2-HD	SA 154	SA 164	Maxell MD2-HD
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	High Density, Oxide Coated	Oxide Coated	Oxide Coated	High Density, Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .4/.8	U: .250/.5	U: .5/1.0	U: .8/1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 5,208/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416
Data surfaces per spindle	1	1	2	2	2
Tracks per surface	80	77	40	80	77
TPI	96	96	48	96	96
BPI	2788/5576	4823/9646	2938/5876	2961/5922	4823/9646
RPM	300	360	300	300	360
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	6	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	83.3	100	100	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	31.25/62.5	15.63/31.25	15.63/31.25	31.25/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	8/83	8/83	8/83	8/83	8/83
U.S. OEM PRICE FOR 500 UNITS	\$195	--	\$195	\$255	\$325
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	HITACHI	HITACHI	HITACHI	HITACHI	HITACHI
DRIVE					
	FDD-102D	FDD-402D	FDD-403	FDD-412 FDD-413B	FDD-441
DISK/TREND GROUP	10	11	11	11	11
MARKET	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM	OEM
MEDIA: Generic type	Diskette 1	Diskette 1,2,2D	Diskette 1,2,2D	Diskette 1,2,2D	Maxell FD2-HD
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	High Density Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .243 or F: .359	F: .720/1.44	U: .8/1.6	U: .8/1.6	U: 9.6
Capacity per track (Bytes)	F: 3,328/4,800	F: 4,800/9,600	U: 5,208/10,416	U: 5,208/10,416	U: 31,250
Data surfaces per spindle	1	2	2	2	2
Tracks per surface	77	77	77	77	154
TPI	48	48	48	48	96
BPI	3268	3408/6816	3408/6816	3408/6816	20560*
RPM	360	360	360	360	360
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	3	3
Settling time (msec)	35	35	35	35	15
Head load time(msec)	50	50	50	50	Continuous Contact
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25	31.25/62.5	31.25/62.5	31.25/62.5	187.5
SIZE (Inches: H x W x D)	4.61 x 8.54 x 14.0	4.61 x 8.54 x 14.0	4.61 x 8.54 x 14.0	2.24 x 8.54 x 13.0	2.24 x 8.54 x 12.9
FIRST CUSTOMER SHIPMENT	1981	1981	1980	2/82	12/83
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					*Uses 2,7 RLL Code

1983 DISK/TREND REPORT

MANUFACTURER	HITACHI	HITACHI	HITACHI	HITACHI	HITACHI
DRIVE					
	HFD 505B	HFD 510B	HFD 516B	HFD 305S	HFD 305D
DISK/TREND GROUP	13	13	13	14	14
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 154	SA 164	Maxell MD2-HD	Maxell Compact Floppy Disk	Maxell Compact Floppy Disk
Nominal disk diameter	5.25"	5.25"	5.25"	3"	3"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: .8/1.6	U: .125/.250	U: .250/.5
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: 3,125/6,250
Data surfaces per spindle	2	2	2	1	2
Tracks per surface	40	80	77	40	40
TPI	48	96	96	100	100
BPI	2938/5876	2961/5922	4823/9646	4473/8946	4473/8946
RPM	300	300	360	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	3	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	50	50	50	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	83.3	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	31.25/62.5	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.57 x 3.54 x 5.83	1.57 x 3.54 x 5.83
FIRST CUSTOMER SHIPMENT	9/82	4Q83	4/83	10/82	4Q83
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	3470 Series 3770 Series 3790 Series 3601/3602 (33 FD Drive)	5265-A1X 5265-A2X 5265-B1X 5265-B2X	5281-Z01/2/6 5282-Z01/2/6 5285-X01/2/6 5286-X02 5286-XXX	System/32 (33 FD Drive)	3601-2B/3B 3602-1A/1B 3631/3632 (43 FD Drive)
DISK/TREND GROUP	10	10	10	10	11
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Generic type	Diskette 1	Diskette 1	Diskette 1	Diskette 1	Diskette 1, 2
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE			F: .246272 or F: .284160 or F: .303104	F: .246272 or F: .303104	F: .492544 or F: .568320
Total capacity (MBytes)	F: .242944	F: .246272			
Capacity per track (Bytes)	F: 3,328	F: 3,328	F: 3,328/3,840/ 4,096	F: 3,328/4,096	F: 3,328/3,840
Data surfaces per spindle	1	1	1	1	2
Tracks per surface	74/3	74/3	74/3	74/3	74/3
TPI	48	48	48	48	48
BPI	3268	3268	3268	3268	3408
RPM	360	360	360	360	360
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	50	50	50	50	5
Settling time (msec)	20	20	20	20	35
Head load time(msec)	80	80	80	80	
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	--	--	--	--	--
FIRST CUSTOMER SHIPMENT	1/75	--	10/80	1/75	1976 (3601/2)
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS		5265 point of sale terminal	5280 terminal system		3600 finance communication controller

1983 DISK/TREND REPORT

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

IBM	IBM	IBM	IBM	IBM
4701-1	4701-2	4964 (43 FD Drive)	4965	4966 (Magazine Drive)
11	11	11	11	11
Captive	Captive	Captive	Captive	Captive
Diskette 1, 2	Diskette 1,2,2D	Diskette 1, 2	Diskette 1,2,2D	Diskette 1,2,2D
8"	8"	8"	8"	8"
Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Soft	Soft	Soft	Soft	Soft
F: .568320	F: .985088	F: .492544 or F: .568320 or F: .606208	F: .985088 or F: 1.136640 or F: 1.212416	F: .985088 or F: 1.136640 or F: 1.212416
F: 3,840	F: 6,656	F: 3,328/3,840/ 4,096	F: 6,656/7,680/ 8,192	F: 6,656/7,680/ 8,192
2	2	2	2	2
74/3	74/3	74/3	74/3	74/3
48	48	48	48	48
3408/6816	3408/6816	3408	3408/6816	3408/6816
360	360	360	360	720
Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
5	5	5	5	5
35	35	35	35	35
83.3	83.3	83.3	83.3	41.7
31.25/62.5	31.25/62.5	31.25	31.25/62.5	62.5/125
--	--	--	--	--
1982	1982	11/76	8/81	2/79
--	--	--	--	--
4701 finance communication controller	4701 finance communication controller	Similar drive included with some 4962 models Series/1	Similar drive included with 4952 Model C Series 1	Capacity is 2 10-diskette magazines and 3 diskettes Series 1

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5114 (43 FD Drive)	5120	5246	5265-X3X 5265-X4X 5265-X5X 5265-X6X 5265-X7X	5281-Z05/6/10 5281-Z05/6/10 5285-X05/6/10 5286-X10 5288-XXX
DISK/TREND GROUP	11	11	11	11	11
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Generic type	Diskette 1,2,2D	Diskette 1,2,2D	Diskette 1,2,2D	Diskette 2D	Diskette 1,2,2D
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .303104 or F: .606208 or F: 1.212416	F: .303104 or F: .606208 or F: 1.212416	F: .303104 or F: 1.136640	F: .985088	F: .985088 or F: 1.136640 or F: 1.212416
Capacity per track (Bytes)	F: 4,096/8,192	F: 4,096/8,192	F: 4,096/7,680	F: 6,656	F: 6,656/7,680/ 8,192
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	74/3	74/3	74/3	74/3	74/3
TPI	48	48	48	48	48
BPI	3408/6816	3408/6816	3408/6816	3408/6816	3408/6816
RPM	360	360	360	360	360
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	5	5	5	5	5
Settling time (msec)	35	35	35	35	35
Head load time(msec)					
Average rotational delay (msec)	83.3	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	31.25/62.5	62.5	31.25/62.5
SIZE (Inches: H x W x D)	--	--	--	--	--
FIRST CUSTOMER SHIPMENT	2/78	2/80	8/81	--	10/80
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS	Add-on drive for 5110, 5120 desktop computers	Uses "Trim" drive, with smaller dimensions	Add-on drive for 5322 System/23 Datamaster Desktop Computer	5265 point of sale terminal	5280 terminal system

1983 DISK/TREND REPORT

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5322	5525-020 5525-030 5525-040	5525-050 (Magazine Drive)	8101-A10 8101-A11 (43 FD Drive)	8130-A11 Models 8140-A11 Models (43 FD Drive)
DISK/TREND GROUP	11	11	11	11	11
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Generic type	Diskette 1,2,2D	Diskette 2D	Diskette 2D	Diskette 1,2,2D	Diskette 1,2,2D
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE	F: .303104 or F: 1.136640	F: 1.212416	F: 1.212416	F: .492544 or F: .985088	F: .492544 or F: .985088
Total capacity (MBytes)	F: 4,096/7,680	F: 8,192	F: 8,192	F: 3,328/6,656	F: 3,328/6,656
Capacity per track (Bytes)	2	2	2	2	2
Data surfaces per spindle	74/3	74/3	74/3	74/3	74/3
Tracks per surface	48	48	48	48	48
TPI	3408/6816	6816	6816	3408/6816	3408/6816
BPI	360	360	720	360	360
RPM	Band, Stepping Motor 5	Band, Stepping Motor 5	Band, Stepping Motor 5	Band, Stepping Motor 5	Band, Stepping Motor 5
Actuator type	5	5	5	5	5
POSITIONING:Track to track(msec)	35	35	35	35	35
Settling time (msec)					
Head load time(msec)	83.3	83.3	41.7	83.3	83.3
Average rotational delay (msec)	31.25/62.5	62.5	125	31.25/62.5	31.25/62.5
Data transfer rate (KBytes/sec)	--	--	--	--	--
SIZE (Inches: H x W x D)	8/81	2/80	11/80	1980	1980
FIRST CUSTOMER SHIPMENT	--	--	--	--	--
U.S. OEM PRICE FOR 500 UNITS					
COMMENTS	Uses "Trim" drive, with smaller dimensions System/23 Datamaster Desktop Computer	5520 administrative system	5520 administrative system	8100 system	8100 system

MANUFACTURER	IBM	IBM	IBM	INNOTRONICS	INNOTRONICS
DRIVE	Displaywriter 6360-20 Single 6360-22 Dual	System/34 (43 FD Drive)	System/34 System/38 (Magazine Drive)	410	420
DISK/TREND GROUP	11	11	11	10	10
MARKET	Captive	Captive	Captive	OEM	OEM
MEDIA: Generic type	Diskette 1, 2D	Diskette 1,2,2D	Diskette 1,2,2D	Diskette 1	Diskette 1
Nominal disk diameter	8"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Hard
CAPACITY/PERFORMANCE	F: .284160 or F: 1.136640	F: .985088 or F: 1.212416	F: .985088 or F: 1.212416	U: .401/.802	U: .401/.802
Total capacity (MBytes)	F: 3,840/7,680	F: 6,656/8,192	F: 6,656/8,192	U: 5,208/10,416	U: 5,208/10,416
Capacity per track (Bytes)	2	2	2	1	1
Data surfaces per spindle	74/3	74/3	74/3	77	77
Tracks per surface	48	48	48	48	48
TPI	3408/6816	3408/6816	3408/6816	3268/6536	3268/6536
BPI	360	360	360	360	360
RPM	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
Actuator type	5	5	5	8	8
POSITIONING:Track to track(msec)	35	35	35	8	8
Settling time (msec)				30	30
Head load time(msec)	83.3	83.3	41.7	83.3	83.3
Average rotational delay (msec)	31.25/62.5	31.25/62.5	31.25/62.5	31.25/62.5	31.25/62.5
Data transfer rate (KBytes/sec)	--	--	--	4.38 x 9 x 14	4.38 x 9 x 14
SIZE (Inches: H x W x D)	6/81	12/77	1/79 (S/34)	2/77	2/77
FIRST CUSTOMER SHIPMENT	--	--	--	\$455	\$470
U.S. OEM PRICE FOR 500 UNITS			Capacity is 2 10-diskette magazines and 3 diskettes		
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	IOMEGA	IOMEGA	ISOT	ISOT	ISOT
DRIVE					
	Alpha-10	Beta-5	ES 5074	ES 5088	ISOT 5050E
DISK/TREND GROUP	15	15	10	12	12
MARKET	OEM	OEM	OEM, Captive	OEM, Captive	Captive, OEM
MEDIA: Generic type	Alpha-10 Cartridge	Beta-5 Cartridge	Diskette 1	SA 104	SA 104
Nominal disk diameter	8"	5.25"	8"	5.25"	5.25"
Magnetic surface	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft	Oxide Coated Soft	Oxide Coated Soft/Hard	Oxide Coated Soft/Hard
Sectoring					
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: 13.88 F: 10.027	U: 7.5 F: 5.25	U: .401	U: .1094	U: 218.3/.250
Capacity per track (Bytes)	U: 45,360 F: 32,768	F: 13,312	U: 5,208	U: 3,125	U: 3,125
Data surfaces per spindle	1	1	1	1	1
Tracks per surface	306	394	77	35	35/40
TPI	300	394	48	48	48
BPI	24000 BPI 18000 FCI	17200 MFM	3268	2768	5536
RPM	1500	1964	360	300	300
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Lead Screw, Stepping Motor	Cam, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	10 (including settling)	15 (including settling)	10	40	40
Settling time (msec)	--	--	10	10	15
Head load time(msec)	Continuous Contact	Continuous Contact			
Average rotational delay (msec)	20	15.3	83.3	100	100
Data transfer rate (KBytes/sec)	1,130	625	31.25	15.63	31.25
SIZE (Inches: H x W x D)	4.5 x 8.54 x 14.09	3.25 x 5.75 x 8.0	5.2 x 10.3 x 16.1	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	9/82	8/83	1978	1979	1982
U.S. OEM PRICE FOR 500 UNITS		\$595	--	--	--
COMMENTS	1st Drive \$1295 2nd Drive \$625				

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

JANOME SEWING MACHINE CO.	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL
MFD-80	JK-880 JK-881	JA-751	JK-885 JK-886 JK-888	JA-200
14	10	11	11	12
OEM	OEM	OEM	OEM	OEM
Maxell Compact Floppy Disk 3"	Diskette 1 8"	Diskette 1,2,2D 8"	Diskette 1,2,2D 8"	SA 104 5.25"
Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Soft	Soft/Hard	Soft/Hard	Soft/Hard	Soft
U: .250/.5	U: .401/.802	U: .8/1.6	U: .8/1.6	U: .125/.250
U: 3,125/6,250	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250
1	1	2	2	1
40	77	77	77	40
100	48	48	48	48
4473/8946	3268/6536	3408/6816	3408/6816	2768/5536
300	360	360	360	300
Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Cam, Stepping Motor
10	10	3	3	26
15	8	15	15	20
Continuous Contact	35	50	50	Continuous Contact
100	83.3	83.3	83.3	100
15.63/31.25	31.25/62.5	31.25/62.5	31.25/62.5	15.63/31.25
1.57 x 3.54 x 5.9	JK-881: 4.62 x 8.55 x 14.25	2.2 x 8.6 x 12.1	JK-886: 4.62 x 8.55 x 14.25	2.05 x 5.75 x 7.87
1/84	9/76	1/82	12/77	3/83
\$125 (10,000)	--	--	--	--
Capable of using 48 tracks per surface. Mechanism-only version is 3.25" wide.	Shugart Associates license: SA 800 SA 801		Shugart Associates license: SA 850 SA 851	

1983 DISK/TREND REPORT

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA COMMUNICATION INDUSTRIAL
JK-873 JK-874	JA-551	JA-561	JK-875	JU-581
12	13	13	13	13
OEM	OEM	OEM	OEM	OEM
SA 104	SA 154	SA 164	SA 154	Maxell MD2-HD 5.25"
5.25"	5.25"	5.25"	5.25"	5.25"
Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	High Density, Oxide Coated
Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft
U: .1094/.2198	U: .5	U: 1.0	U: .250/.5	U: .8/1.6
U: 3,125/6,250	U: 6,250	U: 6,250	U: 3,125/6,250	U: 5,208/10,416
1	2	2	2	2
40	40	80	40	77
48	48	96	48	96
2581/5162	5876	5876	2768/5456	4823/9646
300	300	300	300	360
Cam, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Cam, Stepping Motor	Band, Stepping Motor
25	6	3	20	3
20	15	15	15	15
40	50	50	75	50
83.3	100	100	83.3	83.3
15.63/31.25	31.25	31.25	15.63/31.25	31.25/62.5
3.25 x 5.75 x 8.25	1.625 x 5.75 x 8.5	1.625 x 5.75 x 8.5	3.25 x 5.75 x 8.25	1.625 x 5.75 x 8.0
2/79	6/82	6/82	3Q79	2/83
--	--	--	--	--
Shugart Associates license: SA 400			Shugart Associates license: SA 450	

MANUFACTURER	MATSUSHITA COMMUNICATION INDUSTRIAL	MATSUSHITA ELECTRIC INDUSTRIAL	MATSUSHITA ELECTRIC INDUSTRIAL	METRIMPEX (BRG)	METRONEX
DRIVE					
	JU-311	EME-101	EME-112	MCD-1	PLX45D
DISK/TREND GROUP	14	14	14	14	10
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Maxell Compact Floppy Disk 3"	Maxell Compact Floppy Disk 3"	Maxell Compact Floppy Disk 3"	MCD Cassette 3"	Diskette 1 8"
Nominal disk diameter					
Magnetic surface	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft	High Density Oxide Coated Soft	Oxide Coated Soft	Oxide Coated Soft
Sectoring					
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .125/.250	U: .250/.5	U: .100/.200	U: .401
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 2,221/4,442	U: 5,208
Data surfaces per spindle	1	1	2	1	1
Tracks per surface	40	40	40	45	77
TPI	100	100	100	100	48
BPI	4473/8946	4473/8946	4473/8946	3125/6250	3268
RPM	300	300	300	422	360
Actuator type	Band, Stepping Motor 3	Band, Stepping Motor 3	Band, Stepping Motor 3	Cam, Stepping Motor 20	Lead Screw, Stepping Motor 2.5
POSITIONING:Track to track(msec)					
Settling time (msec)	10	15	15	10	27.5
Head load time(msec)	Continuous Contact 100	Continuous Contact 100	Continuous Contact 100	35	90
Average rotational delay (msec)	100	100	100	71	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	31.25
SIZE (Inches: H x W x D)	1.57 x 3.5 x 5.9	1.57 x 3.5 x 5.9	1.57 x 3.5 x 5.9	1.65 x 3.35 x 4.6	8.66 x 12.2 x 12.4
FIRST CUSTOMER SHIPMENT	6/83	5/83	4Q83	2/83	1977
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS
41	42	51	91	101
10	11	12	12	12
OEM	OEM	OEM	OEM	OEM
Diskette 1	Diskette 1,2,2D	SA 104	SA 104	Micropolis 1081
8"	8"	5.25"	5.25"	5.25"
Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
U: .4/.8	U: .8/1.6	U: .125/.250	U: .250/.5	U: .262/.525
U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
1	2	1	1	1
77	77	40	80	84
48	48	48	96	100
3268/6536	3268/6536	2768/5536	2788/5576	2788/5576
360	360	300	300	300
Band, Stepping Motor 3	Band, Stepping Motor 3	Band, Stepping Motor 5	Band, Stepping Motor 5	Band, Stepping Motor 5
15	15	15	25	25
35	35	35	35	35
83.3	83.3	100	100	100
31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25	15.63/31.25
2.0 x 8.55 x 11.5	2.0 x 8.55 x 11.5	3.25 x 5.75 x 7.75	3.25 x 5.75 x 7.75	3.25 x 5.75 x 7.75
9/82	9/82	10/77	4/80	1981
\$320	\$370	\$180	\$220	\$220

1983 DISK/TREND REPORT

MANUFACTURER	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS
DRIVE					
	501	501C	901	52	92
DISK/TREND GROUP	12	12	12	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 104	SA 104	SA 114	SA 154	SA 164
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .125/.250	U: .250/.5	U: .250/.5	U: .5/1.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	1	1	2	2
Tracks per surface	40	40	80	40	80
TPI	48	48	96	48	96
BPI	2768/5536	2768/5536	2788/5576	2938/5876	2961/5922
RPM	300	300	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	6	20	3	5	5
Settling time (msec)	10	10	10	15	25
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	35	35
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	1.625 x 5.75 x 7.5	1.625 x 5.75 x 7.5	1.625 x 5.75 x 7.5	3.25 x 5.75 x 7.75	3.25 x 5.75 x 7.75
FIRST CUSTOMER SHIPMENT	11/82	10/82	4/83	3/79	4/80
U.S. OEM PRICE FOR 500 UNITS	\$165	\$155	\$205	\$220	\$275
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS	MICRO PERIPHERALS
DRIVE					
	102	502	902	301F	321
DISK/TREND GROUP	13	13	13	14	14
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Micropolis 1081	SA 154	SA 164	Maxell Compact Floppy Disk 3"	Dysan 3 1/4" Flex Diskette 3.25"
Nominal disk diameter	5.25"	5.25"	5.25"		
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard		
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .525/1.050	U: .250/.5	U: .5/1.0	U: .125/.250	U: .250/.5
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	2	2	1	1
Tracks per surface	77	40	80	40	80
TPI	100	48	96	100	140
BPI	2961/5922	2938/5876	2961/5922	4473/8946	4625/9250
RPM	300	300	300	300	300
Actuator type	Band, Stepping Motor 5	Band, Stepping Motor 6	Band, Stepping Motor 3	Band, Stepping Motor 3	Lead Screw, Stepping Motor 6
POSITIONING:Track to track(msec)	5				
Settling time (msec)	25	10	10	15	15
Head load time(msec)	35	Continuous Contact 100	Continuous Contact 100	50	Continuous Contact 100
Average rotational delay (msec)	100			100	
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 7.75	1.625 x 5.75 x 7.5	1.625 x 5.75 x 7.5	1.5 x 3.5 x 5.9	1.625 x 4.0 x 5.5
FIRST CUSTOMER SHIPMENT	1981	2/83	3/83	1984	1984
U.S. OEM PRICE FOR 500 UNITS	\$275	\$205	\$260	\$245	\$185
COMMENTS				Licensed by Hitachi	Licensed by Tabor

1983 DISK/TREND REPORT

MANUFACTURER	MICRO PERIPHERALS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE					
	322	1115-II	1115-V	1115-IV	1115-VI
DISK/TREND GROUP	14	12	12	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Dysan 3 1/4" Flex Diskette 3.25"	Micropolis 1081	SA 114	Micropolis 1081	SA 164
Nominal disk diameter		5.25"	5.25"	5.25"	5.25"
Magnetic surface	High Density, Oxide Coated Soft	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring		Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .5/1.0	U: .480	U: .5	U: .960	U: 1.0
Capacity per track (Bytes)	U: 3,125/6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	1	1	2	2
Tracks per surface	80	77	80	77	80
TPI	140	100	96	100	96
BPI	4625/9250	5246	5577	5549	5921
RPM	300	300	300	300	300
Actuator type	Lead Screw, Stepping Motor 6	Lead Screw, Stepping Motor 6	Lead Screw, Stepping Motor 6	Lead Screw, Stepping Motor 6	Lead Screw, Stepping Motor 6
POSITIONING:Track to track(msec)	6	6	6	6	6
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	1.625 x 4.0 x 5.5	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1984	7/82	7/82	7/82	7/82
U.S. OEM PRICE FOR 500 UNITS	\$240	\$208	\$208	\$258	\$258
COMMENTS	Licensed by Tabor				

1983 DISK/TREND REPORT

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

MICROPOLIS	MILTOPE	MILTOPE	MILTOPE	mitsubishi ELECTRIC CORPORATION
1117-VI	DD 400	DD 450	DD 550	M892
13	10	11	11	10
OEM	OEM	OEM	OEM	Captive, OEM
UHR-1	Diskette 1	Diskette 2, 2D	Diskette 2, 2D	Diskette 1
5.25"	8"	8"	8"	8"
High Density, Oxide Coated Soft/Hard	Oxide Coated Soft	Oxide Coated Soft	Oxide Coated Soft	Oxide Coated Soft
U: 1.666	U: .401/.802	U: .8/1.6	U: .8/1.6	U: .401
U: 10,416	U: 5,208/10,416	U: 5,208/10,416	U: 5,208/10,416	U: 5,208
2	1	2	2	1
80	77	77	77	77
96	48	48	48	48
9868	3268/6536	3408/6816	3408/6816	3268
360	360	360	360	360
Lead Screw, Stepping Motor 6	Lead Screw, Stepping Motor 6	Lead Screw, Stepping Motor 5	Band, Stepping Motor 5	Lead Screw, Stepping Motor 7
15	10	10	10	23
Continuous Contact 100	16	16	16	50
83.3	83.3	83.3	83.3	83.3
62.5	31.25/62.5	31.25/62.5	31.25/62.5	31.25
3.375 x 5.875 x 8.25	5.44 x 8.44 x 18.0	5.44 x 8.44 x 18.0	5.44 x 8.44 x 18.0	4.76 x 8.35 x 14.76
9/82	1977	1980	1982	1974
\$314	\$4500	\$5400	\$4500	--
	Sold as militarized subsystem	Sold as militarized subsystem	Sold as militarized subsystem	

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION
DRIVE					
	M2894-63	M2896-63	M4851	M4852	M4853
DISK/TREND GROUP	11	11	13	13	13
MARKET	Captive, OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Diskette 1,2,2D	Diskette 1,2,2D	SA 154	SA 164	SA 164
Nominal disk diameter	8"	8"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: 1.6	U: .8/1.6	U: .5	U: 1.0	U: 1.0
Capacity per track (Bytes)	U: 10,416	U: 5,208/10,416	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	77	77	40	80	80
TPI	48	48	48	96	96
BPI	6816	3408/6816	5877	5922	5922
RPM	360	360	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	6	3	3
Settling time (msec)	15	15	25	15	15
Head load time(msec)	50	50	50	50	50
Average rotational delay (msec)	83.3	83.3	100	100	100
Data transfer rate (KBytes/sec)	62.5	31.25/62.5	31.25	31.25	31.25
SIZE (Inches: H x W x D)	4.62 x 8.55 x 14.18	2.25 x 8.55 x 12.4	1.625 x 5.75 x 8.0	3.25 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1978	1982	2/83	8/82	1982
U.S. OEM PRICE FOR 500 UNITS	\$430	\$430	\$260	\$300	\$300
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	NEC	NEC
DRIVE					
	M4854	M4855	MF351	FD 1165	N 7707 FD 1160
DISK/TREND GROUP	13	13	14	11	11
MARKET	OEM	OEM	OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	Maxell MD2-HD	High Density	Sony OM-D3440	Diskette 1,2,2D	Diskette 1,2,2D
Nominal disk diameter	5.25"	5.25"	3.5"	8"	8"
Magnetic surface	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft	Oxide Coated Soft	Oxide Coated Soft	Oxide Coated Soft
Sectoring					
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: 1.6	U: 2.0	U: .250/.5	U: .8/1.6	U: .8/1.6
Capacity per track (Bytes)	U: 10,416	U: 12,500	U: 3,125/6,250	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	2	2	1	2	2
Tracks per surface	77	80	80	77	77
TPI	96	96	135	48	48
BPI	9646	11844	4094/8187	3408/6816	3408/6816
RPM	360	300	300	360	360
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	3	3	3	5
Settling time (msec)	15	15	15	15	15
Head load time(msec)	50	50	50	30	50
Average rotational delay (msec)	83.3	100	100	83.3	83.3
Data transfer rate (KBytes/sec)	62.5	62.5	15.63/31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 4.0 x 5.2	2.28 x 8.68 x 13.19	4.62 x 8.68 x 14.45
FIRST CUSTOMER SHIPMENT	1982	4/83	1983	4Q81	8/81
U.S. OEM PRICE FOR 500 UNITS	\$360	\$380	\$250	\$330	--
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	OKI ELECTRIC	OKI ELECTRIC	OKI ELECTRIC	OLIVETTI	OLIVETTI
DRIVE					
	GM 3101	GM 3305	GM 3405	FD 801	FD 802
DISK/TREND GROUP	10	13	13	10	11
MARKET	Captive	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	Diskette 1	SA 154	SA 164	Diskette 1	Diskette 2, 2D
Nominal disk diameter	8"	5.25"	5.25"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .243	U: .5	U: 1.0	U: .401/.802	U: .8/1.6
Capacity per track (Bytes)	F: 3,328	U: 6,250	U: 6,250	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	2	2	1	2
Tracks per surface	77	40	80	77	77
TPI	48	48	96	48	48
BPI	3268	5876	5922	3268/6536	3408/6816
RPM	360	300	300	360	360
Actuator type	Lead Screw, Stepping Motor	Linear, Stepping Motor	Linear, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	8	20	5	3	3
Settling time (msec)	30	15	30	15	15
Head load time(msec)	50	50	50	35	35
Average rotational delay (msec)	83.3	100	100	83.3	83.3
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	5.0 x 8.8 x 14.4	1.1 x 5.75 x 8.0	1.1 x 5.75 x 8.0	4.52 x 9.05 x 12.3	4.52 x 9.05 x 12.3
FIRST CUSTOMER SHIPMENT	1975	10/82	5/83	1974	1979
U.S. OEM PRICE FOR 500 UNITS	--	--	--	\$270	\$385
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	OLIVETTI	OLIVETTI	OLIVETTI	OLIVETTI	OLIVETTI
DRIVE					
	FD 501	FD 591	FD 502	FD 592	FD 595
DISK/TREND GROUP	12	12	13	13	13
MARKET	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM	Captive, OEM
MEDIA: Generic type	SA 104	SA 114	SA 154	SA 164	Maxell MD2-HD
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	High Density, Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .250/.5	U: .250/.5	U: .5/1.0	U: .8/1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416
Data surfaces per spindle	1	1	2	2	2
Tracks per surface	40	80	40	80	77
TPI	48	96	48	96	96
BPI	2768/5536	2788/5576	2938/5876	2961/5922	4935/9870
RPM	300	300	300	300	360
Actuator type	Cam, Stepping Motor	Band, Stepping Motor	Cam, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	25	3	25	3	3
Settling time (msec)	20	15	20	15	15
Head load time(msec)	60	25	60	25	25
Average rotational delay (msec)	100	100	100	100	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5
SIZE (Inches: H x W x D)	2.51 x 5.75 x 8.0	3.25 x 5.75 x 8.0	2.51 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1980	6/82	1981	6/82	1983
U.S. OEM PRICE FOR 500 UNITS	\$176	\$295	\$235	\$345	--
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	PHILIPS	PHILIPS	PHILIPS	PHILIPS	PHILIPS
DRIVE					
	X 3111	X 3113	X 3131	X 3133	X 3112
DISK/TREND GROUP	12	12	12	12	13
MARKET	Captive, OEM	Captive, OEM	OEM	OEM	Captive, OEM
MEDIA: Generic type	SA 104	SA 114	SA 104	SA 114	SA 154
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft	Soft	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250	U: .5	U: .250	U: .5	U: .5
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	1	1	1	1	2
Tracks per surface	40	80	40	80	40
TPI	48	96	48	96	48
BPI	5876	5876	5536	5576	5876
RPM	300	300	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	5	5	6	3	5
Settling time (msec)	20	20	15	15	20
Head load time(msec)	Continuous Contact	Continuous Contact	30	30	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	2.1 x 5.75 x 8.0	2.1 x 5.75 x 8.0	1.625 x 5.75 x 7.9	1.625 x 5.75 x 7.9	2.1 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1982	1982	10/83	10/83	4Q80
U.S. OEM PRICE FOR 500 UNITS	\$158	\$167	--	--	\$192
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

PHILIPS	PHILIPS	PHILIPS	PHILIPS	PHILIPS
X 3114	X 3116	X 3118	X 3132	X 3134
13	13	13	13	13
Captive, OEM	OEM	OEM	OEM	OEM
SA 164	High Density	High Density	SA 154	SA 164
5.25"	5.25"	5.25"	5.25"	5.25"
Oxide Coated	High Density Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated
Soft/Hard	Soft	Soft	Soft	Soft
U: 1.0	U: 2.0	U: 1.6	U: .5	U: 1.0
U: 6,250	U: 12,500	U: 10,416	U: 6,250	U: 6,250
2	2	2	2	2
80	80	80	40	80
96	96	96	48	96
5876	11844	9870	5876	5922
300	300	360	300	300
Band, Stepping Motor 5	Band, Stepping Motor 3	Band, Stepping Motor 3	Band, Stepping Motor 6	Band, Stepping Motor 3
20	15	15	15	15
Continuous Contact 100	30	30	30	30
100	100	83.3	100	100
31.25	62.5	62.5	31.25	31.25
2.1 x 5.75 x 8.0	2.26 x 5.75 x 8.2	2.26 x 5.75 x 8.2	1.625 x 5.75 x 7.9	1.625 x 5.75 x 7.9
1982	10/83	10/83	10/83	10/83
\$208	\$284	\$284	\$187	\$218

1983 DISK/TREND REPORT

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

QUME	QUME	QUME	QUME	QUME
242 Qume Trak	842 Qume Trak	142 Qume Trak	192 Qume Trak	542 Qume Trak
11	11	13	13	13
OEM	OEM	OEM	OEM	OEM
Diskette 1,2,2D	Diskette 1,2,2D	SA 154	SA 164	SA 154
8"	8"	5.25"	5.25"	5.25"
Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Soft	Soft	Soft	Soft	Soft
U: .8/1.6	U: .8/1.6	U: .250/.5	U: .5/1.0	U: .250/.5
U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
2	2	2	2	2
77	77	40	80	40
48	48	48	96	48
3408/6816	3408/6816	5876	2961/5922	2728/5456
360	360	300	300	300
Band, Stepping Motor 3	Band, Stepping Motor 3	Band, Stepping Motor 12	Band, Stepping Motor 3	Lead Screw, Stepping Motor 12
15	15	15	15	15
50	35	Continuous Contact 100	Continuous Contact 100	50
83.3	83.3	100	100	100
31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25	15.63/31.25
2.25 x 8.55 x 12.6	4.62 x 8.55 x 14.57	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	3.25 x 5.75 x 8.0
6/82	1Q79	3Q82	11/83	1Q80
\$415	\$455	\$185	--	\$210

1983 DISK/TREND REPORT

SPEC-41

MANUFACTURER	QUME	REMEX	REMEX	REMEX	REMEX
DRIVE	592 Qume Trak	RFD 481	RFD 486	RFD 961	RFD 966
DISK/TREND GROUP	13	12	12	12	12
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 164	SA 104	SA 104	SA 114	SA 114
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .5/1.0	U: .125/.250	U: .125/.250	U: .250/.5	U: .250/.5
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	1	1	1	1
Tracks per surface	80	40	40	80	80
TPI	96	48	48	96	96
BPI	2961/5922	2768/5536	2768/5536	2788/5576	2788/5576
RPM	300	300	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	3	5	5	5	3
Settling time (msec)	15	25	15	25	15
Head load time(msec)	50	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.0	2.11 x 5.75 x 8.0	1.625 x 5.75 x 8.0	2.11 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	3Q81	4Q82	7/83	4Q82	7/83
U.S. OEM PRICE FOR 500 UNITS	\$315	\$180	\$155	\$210	\$195
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	REMEX	REMEX	REMEX	REMEX	RICOH
DRIVE					
	RFD 480	RFD 485	RFD 960	RFD 965	RD-2D
DISK/TREND GROUP	13	13	13	13	11
MARKET	OEM	OEM	OEM	OEM	Captive
MEDIA: Generic type	SA 154	SA 154	SA 164	SA 164	Diskette 1,2,2D
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft
CAPACITY/PERFORMANCE					F: .568 or F: .985
Total capacity (MBytes)	U: .250/.5	U: .250/.5	U: .5/1.0	U: .5/1.0	
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	F: 3,840/6,656
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	40	40	80	80	74/3
TPI	48	48	96	96	48
BPI	2938/5876	2938/5876	2961/5922	2961/5922	3408/6816
RPM	300	300	300	300	360
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	5	5	5	3	6
Settling time (msec)	25	15	25	15	10
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	50
Average rotational delay (msec)	100	100	100	100	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5
SIZE (Inches: H x W x D)	2.11 x 5.75 x 8.0	1.625 x 5.75 x 8.0	2.11 x 5.75 x 8.0	1.625 x 5.75 x 8.0	
FIRST CUSTOMER SHIPMENT	11/81	7/83	11/81	7/83	12/79
U.S. OEM PRICE FOR 500 UNITS	\$210	\$195	\$230	\$215	--
COMMENTS					TC 2200 TC 2400 small business systems

1983 DISK/TREND REPORT

MANUFACTURER	ROBOTRON	ROBOTRON	SANKYO SEIKI	SANKYO SEIKI	SANKYO SEIKI
DRIVE					
	K 5600	K 5600.10	FDU-300-S	FDU-300-D	FMC-170
DISK/TREND GROUP	12	12	14	14	15
MARKET	Captive, OEM	Captive	OEM	OEM	OEM
MEDIA: Generic type	SA 104	SA 104	Maxell Compact Floppy Disk 3"	Maxell Compact Floppy Disk 3"	Special Disk 2.598"
Nominal disk diameter	5.25"	5.25"			
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	N/A
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .125/.250	U: .125/.250	U: .250/.5	U: .008
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,250/6,250	U: 3,125/6,250	U: 3,125/6,250	U: .008
Data surfaces per spindle	1	1	1	2	1
Tracks per surface	40	40	40	40	1
TPI	48	48	100	100	N/A
BPI	2768/5536	2768/5536	4473/8946	4915/9830	1069
RPM	300	300	300	300	405
Actuator type		Lead Screw, Stepping Motor 10	Band, Stepping Motor 3	Band, Stepping Motor 3	N/A
POSITIONING:Track to track(msec)	12				N/A
Settling time (msec)	40	12	30	30	N/A
Head load time(msec)			Continuous Contact 100	Continuous Contact 100	N/A
Average rotational delay (msec)	100	100			N/A
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	2
SIZE (Inches: H x W x D)	2.36 x 5.75 x 7.9	2.36 x 5.55 x 7.87	1.57 x 3.54 x 5.9	1.57 x 3.54 x 5.9	2.677 x 3.047 x 4.902
FIRST CUSTOMER SHIPMENT	1982	1981	6/83	6/83	5/83
U.S. OEM PRICE FOR 500 UNITS	--	--	\$186	\$197	\$124
COMMENTS					8,000 bytes in single spiral track

1983 DISK/TREND REPORT

MANUFACTURER	SANKYO SEIKI	SHUGART	SHUGART	SHUGART	SHUGART
DRIVE					
	FMC-270	SA 800 SA 801	SA 810	SA 850 SA 851	SA 860
DISK/TREND GROUP	15	10	10	11	11
MARKET	OEM	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Generic type	Special Disk	SA 100 Diskette 1	SA 100 Diskette 1	SA 150 Diskette 1,2,2D	SA 150 Diskette 1,2,2D
Nominal disk diameter	2.598"	8"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	N/A	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .016	U: .401/.802	U: .4/.8	U: .8/1.6	U: .8/1.6
Capacity per track (Bytes)	U: .016	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	1	2	2
Tracks per surface	1	77	77	77	77
TPI	N/A	48	48	48	48
BPI	2138	3268/6536	3268/6536	3408/6816	3408/6816
RPM	405	360	360	360	360
Actuator type	N/A	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	N/A	8	3	3	3
Settling time (msec)	N/A	8	13	15	13
Head load time(msec)	N/A	35	Continuous Contact	45	Continuous Contact
Average rotational delay (msec)	N/A	83.3	83.3	83.3	83.3
Data transfer rate (KBytes/sec)	4	31.25/62.5	31.25/62.5	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	2.677 x 3.047 x 4.902	SA 801: 4.62 x 8.55 x 14.25	2.31 x 8.55 x 12.0	SA 851: 4.62 x 8.55 x 14.25	2.31 x 8.55 x 12.0
FIRST CUSTOMER SHIPMENT	5/83	9/75	8/82	6/77	2/82
U.S. OEM PRICE FOR 500 UNITS	\$140	\$376	\$365	\$453	\$409
COMMENTS	16,000 bytes in single spiral track				

1983 DISK/TREND REPORT

SPEC-45

MANUFACTURER	SHUGART	SHUGART	SHUGART	SHUGART	SHUGART
DRIVE					
	SA 200	SA 400	SA 410	SA 450F	SA 455
DISK/TREND GROUP	12	12	12	13	13
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive	OEM
MEDIA: Generic type	SA 104	SA 104	SA 114	SA 154	SA 154
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .125/.250	U: .250/.5	U: .250/.5	U: .250/.5
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	1	1	2	2
Tracks per surface	40	40	80	40	40
TPI	48	48	96	48	48
BPI	2768/5536	2768/5536	2788/5576	2938/5876	2938/5876
RPM	300	300	300	300	300
Actuator type	Cam, Stepping Motor	Cam, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	26	20	6	5.5	6
Settling time (msec)	20	15	10	15	15
Head load time(msec)	Continuous Contact	75	Continuous Contact	75	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	2.05 x 5.75 x 7.87	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.25	3.25 x 5.75 x 8.25	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1982	9/76	2/81	8/83	10/82
U.S. OEM PRICE FOR 500 UNITS	\$135	\$149	\$245	\$177	\$197
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	SHUGART	SHUGART	SHUGART	SHUGART	SONY
DRIVE					
	SA 460	SA 465	SA 300	SA 350	OA-D31V
DISK/TREND GROUP	13	13	14	14	14
MARKET	OEM	OEM	OEM	OEM	OEM, Captive
MEDIA: Generic type	SA 164	SA 164	Sony OM-D3440	Sony OM-D4440	Sony OM-D3320
Nominal disk diameter	5.25"	5.25"	3.5"	3.5"	3.5"
Magnetic surface	Oxide Coated	Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .5/1.0	U: .5/1.0	U: .250/.5	U: .5/1.0	U: .2188/.4375
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	2	2	1	2	1
Tracks per surface	80	80	80	80	70
TPI	96	96	135	135	135
BPI	2961/5922	2961/5922	4102/8204	4102/8204	3805/7610
RPM	300	300	300	300	600
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	6	3	6	6	15
Settling time (msec)	10	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	60
Average rotational delay (msec)	100	100	100	100	50
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.25	1.625 x 5.75 x 8.0	1.625 x 4.0 x 6.0	1.625 x 4.0 x 6.0	2.0 x 4.0 x 5.1
FIRST CUSTOMER SHIPMENT	3/81	10/82	2Q83	1Q84	11/82
U.S. OEM PRICE FOR 500 UNITS	\$273	\$246	\$168	--	\$185
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	SONY	SONY	SONY	SONY	SYKES DATATRONICS
DRIVE					
	0A-D32V	0A-D32W	0A-D33V	0A-D33W	7150 (Single) 7520 (Dual)
DISK/TREND GROUP	14	14	14	14	10
MARKET	OEM	OEM	OEM	OEM	OEM, Captive
MEDIA: Generic type	Sony OM-D3440	Sony OM-D4440	Sony OM-D3440	Sony OM-D4440	Diskette 1
Nominal disk diameter	3.5"	3.5"	3.5"	3.5"	8"
Magnetic surface	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft	High Density Oxide Coated Soft	High Density, Oxide Coated Soft	Oxide Coated Soft
Sectoring					
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: .250/.5	U: .5/1.0	F: .256
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	F: 3,328
Data surfaces per spindle	1	2	1	2	1
Tracks per surface	80	80	80	80	77
TPI	135	135	135	135	48
BPI	4094/8187	4359/8717	4094/8187	4359/8717	3268
RPM	600	600	300	300	360
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	12	12	12	12	6
Settling time (msec)	30	30	30	30	30
Head load time(msec)	60	60	Continuous Contact 100	Continuous Contact 100	30
Average rotational delay (msec)	50	50			83.3
Data transfer rate (KBytes/sec)	31.25/62.5	31.25/62.5	15.63/31.25	15.63/31.25	31.25
SIZE (Inches: H x W x D)	2.0 x 4.0 x 5.1	2.0 x 4.0 x 5.1	2.0 x 4.0 x 5.1	2.0 x 4.0 x 5.1	5.25 x 17.0 x 26.0
FIRST CUSTOMER SHIPMENT	9/83	1Q84	9/83	2Q84	9/74
U.S. OEM PRICE FOR 500 UNITS	\$185	--	\$185	--	--
COMMENTS					

MANUFACTURER	SYKES DATATRONICS	TABOR	TABOR	TANDON	TANDON
DRIVE	9150 (Single) 9250 (Dual)	TC-500	TC-1000	TM-848E-1	TM-848E-2
DISK/TREND GROUP	10	14	14	10	11
MARKET	OEM, Captive	OEM	OEM	OEM	OEM
MEDIA: Generic type	Diskette 1	Dysan 3 1/4"	Dysan 3 1/4"	Diskette 1	Diskette 1,2,2D
Nominal disk diameter	8"	Flex Diskette 3.25"	Flex Diskette 3.25"	8"	8"
Magnetic surface	Oxide Coated	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard			Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	F: .631	U: .250/.5	U: .5/1.0	U: .401/.802	U: .8/1.6
Capacity per track (Bytes)	F: 8,192	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	1	1	2	1	2
Tracks per surface	77	80	80	77	77
TPI	48	140	140	48	48
BPI	6536	4625/9250	4625/9250	3268/6536	3406/6816
RPM	360	300	300	360	360
Actuator type	Lead Screw, Stepping Motor 6	Lead Screw, Stepping Motor 6	Lead Screw, Stepping Motor 6	Band, Stepping Motor 3	Band, Stepping Motor 3
POSITIONING:Track to track(msec)					
Settling time (msec)	30	15	15	15	15
Head load time(msec)	30	Continuous Contact 100	Continuous Contact 100	Continuous Contact 83.3	Continuous Contact 83.3
Average rotational delay (msec)	83.3				
Data transfer rate (KBytes/sec)	62.5	15.63/31.25	15.63/31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	5.25 x 17.0 x 26.0	1.625 x 4.0 x 5.5	1.625 x 4.0 x 5.5	2.3 x 8.55 x 13.125	2.3 x 8.55 x 13.125
FIRST CUSTOMER SHIPMENT	10/76	12/82	11/83	4/81	4/81
U.S. OEM PRICE FOR 500 UNITS	--	\$185	\$240	\$250 (2500)	\$305 (2500)
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	TANDON	TANDON	TANDON	TANDON	TANDON
DRIVE					
	TM-100-1	TM-100-3	TM-50-1	TM-50-2	TM-55-2
DISK/TREND GROUP	12	12	12	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 104	SA 114	SA 104	SA 154	SA 154
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .250/.5	U: .125/.250	U: .250/.5	U: .250/.5
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 6,250
Data surfaces per spindle	1	1	1	2	2
Tracks per surface	40	80	40	40	40
TPI	48	96	48	48	48
BPI	2768/5535	2788/5576	2768/5536	2938/5877	2938/5877
RPM	300	300	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	5	3	20	20	3
Settling time (msec)	15	15	20	20	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	11/78	2/80	3Q82	1Q82	10/82
U.S. OEM PRICE FOR 500 UNITS	\$137 (2500)	\$187 (2500)	\$110 (2500)	\$137 (2500)	\$170 (2500)
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

TANDON	TANDON	TANDON	TANDON	TANDON
TM-55-4	TM-100-2	TM-100-4	TM-101-4	TM-102-2
13	13	13	13	13
OEM	OEM	OEM	OEM	OEM
SA 164	SA 154	SA 164	SA 164	High Density
5.25"	5.25"	5.25"	5.25"	5.25"
Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	High Density, Oxide Coated
Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
U: .5/1.0	U: .250/.5	U: .5/1.0	U: .5/1.0	U: 2.0
U: 6,250	U: 3,125/6,250	U: 3,125/6,250	U: 6,250	U: 12,500
2	2	2	2	2
80	40	80	80	80
96	48	96	96	96
2961/5922	2938/5877	2961/5922	2961/5922	11754
300	300	300	300	300
Band, Stepping Motor 3	Band, Stepping Motor 5	Band, Stepping Motor 3	Band, Stepping Motor 20 (including settling)	Band, Stepping Motor 20 (including settling)
15	15	15	--	--
Continuous Contact 100	Continuous Contact 100	Continuous Contact 100	Continuous Contact 100	Continuous Contact 100
15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	62.5
1.625 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0
10/82	11/78	2/80	9/82	1Q83
\$198 (2500)	\$187 (2500)	\$248 (2500)	\$220 (2500)	\$286 (2500)

1983 DISK/TREND REPORT

SPEC-51

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

TANDON	TANDON	TANDON	TANDON	TEAC
TM35-1	TM35-2	TM35-3	TM35-4	FD-55A
14	14	14	14	12
OEM	OEM	OEM	OEM	OEM
Sony OM-D3440	Sony OM-D4440	Sony OM-D3440	Sony OM-D4440	SA 104
3.5"	3.5"	3.5"	3.5"	5.25"
High Density, Oxide Coated Soft/Hard	High Density, Oxide Coated Soft/Hard	High Density, Oxide Coated Soft	High Density, Oxide Coated Soft	Oxide Coated Soft/Hard
U: .250/.5	U: .5/1.0	U: .5	U: 1.0	U: .125/.250
U: 3,125/6,250	U: 3,125/6,250	U: 6,250	U: 6,250	U: 3,125/6,250
1	2	1	2	1
80	80	80	80	40
135	135	135	135	48
4105/8210	4338/8776	8210	8776	2768/5536
300	300	600	600	300
Band, Stepping Motor 3	Band, Stepping Motor 3	Band, Stepping Motor 3	Band, Stepping Motor 3	Band, Stepping Motor 6
15	15	15	15	15
Continuous Contact 100	Continuous Contact 100	Continuous Contact 50	Continuous Contact 50	50 100
15.63/31.25	15.63/31.25	62.5	62.5	15.63/31.25
1.625 x 4.0 x 6.0	1.625 x 4.0 x 6.0	1.625 x 4.0 x 6.0	1.625 x 4.0 x 6.0	1.625 x 5.75 x 8.0
6/83	6/83	3Q83	3Q83	4/82
\$182 (2500)	\$204 (2500)	\$182 (2500)	\$209 (2500)	\$150

1983 DISK/TREND REPORT

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

TEAC	TEAC	TEAC	TEAC	TEAC
FD-55E	FD-55B	FD-55F	FD-55G	FD-30A
12	13	13	13	14
OEM	OEM	OEM	OEM	OEM
SA 114	SA 154	SA 164	Maxell MD2-HD 5.25"	Maxell Compact Floppy Disk 3"
5.25"	5.25"	5.25"	5.25"	
Oxide Coated	Oxide Coated	Oxide Coated	High Density, Oxide Coated	High Density, Oxide Coated
Soft/Hard	Soft/Hard	Soft/Hard	Soft	Soft
U: .250/.5	U: .250/.5	U: .5/1.0	U: .8/1.6	U: .125/.250
U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 5,208/10,416	U: 3,125/6,250
1	2	2	2	1
80	40	80	77	40
96	48	96	96	100
2788/5576	2938/5876	2961/5922	4823/9646	4473/8946
300	300	300	360	300
Band, Stepping Motor 3	Band, Stepping Motor 6	Band, Stepping Motor 3	Band, Stepping Motor 3	Lead Screw, Stepping Motor 12
15	15	15	15	15
50	50	50	50	50
100	100	100	83.3	100
15.63/31.25	15.63/31.25	15.63/31.25	31.25/62.5	15.625/31.25
1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8	1.57 x 3.54 x 5.9
4/82	4/82	6/82	4/83	9/83
\$200	\$200	\$250	\$275	\$120

1983 DISK/TREND REPORT

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

TEAC	TEAC	TEAC	TEAC	TOKYO ELECTRIC COMPANY
FD-35A	FD-35B	FD-35E	FD-35F	FB-201
14	14	14	14	12
OEM	OEM	OEM	OEM	OEM
Sony OM-D3440	Sony OM-D4440	Sony OM-D3440	Sony OM-D4440	SA 104
3.5"	3.5"	3.5"	3.5"	5.25"
High density oxide coated Soft	High density oxide coated Soft	High density oxide coated Soft	High density oxide coated Soft	Oxide Coated Soft
U: .125/.250	U: .250/.5	U: .250/.5	U: .5/1.0	U: .2188
U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 6,250
1	2	1	2	1
40	40	80	80	35
67.5	67.5	135	135	48
4064/8128	4325/8650	4094/8188	4359/8718	5536
300	300	300	300	300
Band, stepping motor 6	Band, stepping motor 6	Band, stepping motor 3	Band, stepping motor 3	Cam, Stepping Motor 30
15	15	15	15	30
Continuous contact 100	Continuous contact 100	Continuous contact 100	Continuous contact 100	Continuous Contact 100
15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	31.25
1.625 x 4.0 x 5.3	1.625 x 4.0 x 5.3	1.625 x 4.0 x 5.3	1.625 x 4.0 x 5.3	3.25 x 5.75 x 8.0
2Q84	2Q84	2Q84	2Q84	4/82
--	--	--	--	--

MANUFACTURER	TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY
DRIVE					
	FB-202	FB-501	FB-502	FB-503	FB-504
DISK/TREND GROUP	12	12	12	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 104	SA 104	SA 114	SA 154	SA 164
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft	Soft	Soft	Soft	Soft
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250	U: .250	U: .5	U: .5	U: 1.0
Capacity per track (Bytes)	U: 6,250	U: 6,250	U: 6,250	U: 6,250	U: 6,250
Data surfaces per spindle	1	1	1	2	2
Tracks per surface	40	40	80	40	80
TPI	48	48	96	48	96
BPI	5536	5536	5576	5876	5922
RPM	300	300	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	5	6	3	6	3
Settling time (msec)	15	15	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	35	35
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	31.25	31.25	31.25	31.25	31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	4/82	3Q82	3Q82	3Q82	1Q83
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

TOKYO ELECTRIC COMPANY	TOKYO ELECTRIC COMPANY	TOSHIBA	TOSHIBA	TOSHIBA
MC-108	MC-116	ND-20D ND-20DL	ND-40D ND-40DL	ND-02D
15	15	11	11	13
OEM	OEM	Captive, OEM	Captive, OEM	Captive, OEM
Special	Special	Diskette 1,2,2D	Diskette 1,2,2D	SA 154
66 mm OD	66 mm OD	8"	8"	5.25"
Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
N/A	N/A	Soft	Soft	Soft
F: .008	F: .016	U: .8/1.6	U: .8/1.6	U: .219/.438
F: 8,000	F: 16,000	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250
1	1	2	2	2
1	1	77	77	35
33	33	48	48	48
1069	2138	3408/6816	3408/6816	2581/5456
405	405	360	360	300
N/A	N/A	Band, Stepping Motor 3	Band, Stepping Motor 3	Lead Screw, Stepping Motor 25
N/A	N/A	18	18	15
N/A	N/A	50	50	50
N/A	N/A	83.3	83.3	100
3.1	6.25	31.25/62.5	31.25/62.5	15.63/31.25
1.61 x 3.0 X 4.9	1.61 x 3.0 X 4.9	4.9 x 10.0 x 14.4	2.24 x 8.54 x 12.4	3.25 x 5.75 x 8.0
4Q82	4Q82	1977	1Q82	1Q80
--	--	--	--	--
8,000 bytes in single spiral track	16,000 bytes in single spiral track			

MANUFACTURER

DRIVE

DISK/TREND GROUP

MARKET

MEDIA: Generic type

Nominal disk diameter

Magnetic surface

Sectoring

CAPACITY/PERFORMANCE

Total capacity (MBytes)

Capacity per track (Bytes)

Data surfaces per spindle

Tracks per surface

TPI

BPI

RPM

Actuator type

POSITIONING:Track to track(msec)

Settling time (msec)

Head load time(msec)

Average rotational delay (msec)

Data transfer rate (KBytes/sec)

SIZE (Inches: H x W x D)

FIRST CUSTOMER SHIPMENT

U.S. OEM PRICE FOR 500 UNITS

COMMENTS

TOSHIBA	TOSHIBA	TOSHIBA	VIDEOTON INDUSTRIE- AUSSENHALDELS	VIDEOTON INDUSTRIE- AUSSENHALDELS
ND-04D	ND-06D	ND-301D	MFM-2 MFM-4	Momflex 3200
13	13	14	10	10
Captive, OEM	Captive, OEM	Captive, OEM	OEM	OEM
SA 154	SA 164	Maxell Compact Floppy Disk	Diskette 1	Diskette 1
5.25"	5.25"	3.0"	8"	8"
Oxide Coated	Oxide Coated	High Density Oxide Coated	Oxide Coated	Oxide Coated
Soft	Soft	Soft	Soft	Hard
U: .250/.5	U: .5/1.0	U: .125/.250	F: .256	U: .401
U: 3,125/6,250	U: 3,125/6,250	U: 6,125	F: 3,328	U: 5,208
2	2	1	1	1
40	80	40	77	77
48	96	100	48	48
2938/5876	2788/5576	4473/8946	3268	3268
300	300	300	360	360
Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
5	3	3	10	10
15	18	54	40	25
50	50	Continuous Contact	40	40
100	100	100	83.3	83.3
15.63/31.25	15.63/31.25	15.63/31.25	31.25	31.25
1.625 x 5.75 x 8.3	1.625 x 5.75 x 8.27	1.625 x 3.5 x 5.9	10.5 x 19.0 x 22.0	5.28 x 8.5 x 14.8
2Q83	2Q82		1977	1978
--	--	--	--	--

1983 DISK/TREND REPORT

MANUFACTURER	VIDEOTON INDUSTRIE- AUSSENHALDELS	VIDEOTON INDUSTRIE- AUSSENHALDELS	WORLD STORAGE TECHNOLOGY	WORLD STORAGE TECHNOLOGY	WORLD STORAGE TECHNOLOGY
DRIVE	Momflex 6400	Momflex 900	FDD 100-8	FDD 200-8	FDD 100-5
DISK/TREND GROUP	10	12	10	11	12
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	Diskette 1	SA 104	Diskette 1	Diskette 1,2,20	SA 104
Nominal disk diameter	8"	5.25"	8"	8"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .8	U: 109.4	U: .401/.802	U: .8/1.6	U: .125/.250
Capacity per track (Bytes)	U: 10,416	U: 3,125	U: 5,208/10,416	U: 5,208/10,416	U: 3,125/6,250
Data surfaces per spindle	1	1	1	2	1
Tracks per surface	77	35	77	77	40
TPI	48	48	48	48	48
BPI	6536	2616	3268/6536	3408/6816	2768/5536
RPM	360	300	360	360	300
Actuator type	Stepping Motor	Cam, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor
POSITIONING:Track to track(msec)	4	40	6	3	20
Settling time (msec)	25	10	8	15	15
Head load time(msec)	40	75	25	25	50
Average rotational delay (msec)	83.3	100	83.3	83.3	100
Data transfer rate (KBytes/sec)	31.25/62.5	15.63	31.25/62.5	31.25/62.5	15.63/31.25
SIZE (Inches: H x W x D)	4.4 x 8.5 x 14.1	3.27 x 5.75 x 8.0	4.5 x 8.55 x 14.25	4.5 x 8.55 x 14.25	3.25 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	1980	1980	1975	4/78	3/77
U.S. OEM PRICE FOR 500 UNITS	--	--	\$350	\$465	\$215
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	WORLD STORAGE TECHNOLOGY	WORLD STORAGE TECHNOLOGY	WORLD STORAGE TECHNOLOGY	WORLD STORAGE TECHNOLOGY	WORLD STORAGE TECHNOLOGY
DRIVE					
	FDD 111-5	FDD 112-5	FDD 121-5	FDD 200-5	FDD 211-5
DISK/TREND GROUP	12	12	12	13	13
MARKET	OEM	OEM	OEM	OEM, Captive	OEM
MEDIA: Generic type	SA 104	SA 104	SA 114	SA 154	SA 154
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .125/.250	U: .125/.250	U: .250/.5	U: .250/.5	U: .250/.5
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250	U: 3,125/6,250
Data surfaces per spindle	1	1	1	2	2
Tracks per surface	40	40	80	40	40
TPI	48	48	96	48	48
BPI	2768/5536	2768/5536	2788/5576	2938/5876	2938/5876
RPM	300	300	300	300	300
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Lead Screw, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	5	5	5	20	5
Settling time (msec)	15	20	15	15	15
Head load time(msec)	Continuous Contact	Continuous Contact	Continuous Contact	50	Continuous Contact
Average rotational delay (msec)	100	100	100	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.0	1.625 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0
FIRST CUSTOMER SHIPMENT	11/81	4/83	4/82	5/78	4/82
U.S. OEM PRICE FOR 500 UNITS	\$215	\$170	\$290	\$300	\$300
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	WORLD STORAGE TECHNOLOGY	WORLD STORAGE TECHNOLOGY	YE DATA	YE DATA	YE DATA
DRIVE					
	FDD 212-5	FDD 221-5	YD-74C	YD-174D	YD-180
DISK/TREND GROUP	13	13	10	11	11
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 154	SA 164	Diskette 1	Diskette 1,2,2D	Diskette 1,2,2D
Nominal disk diameter	5.25"	5.25"	8"	8"	8"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: .401	U: .8/1.6	U: .8/1.6
Capacity per track (Bytes)	U: 3,125/6,250	U: 3,125/6,250	U: 5,208	U: 5,208/10,416	U: 5,208/10,416
Data surfaces per spindle	2	2	1	2	2
Tracks per surface	40	80	77	77	77
TPI	48	96	48	48	48
BPI	2938/5876	2961/5922	3268	3408/6816	3408/6816
RPM	300	300	360	360	360
Actuator type	Band, Stepping Motor 6	Band, Stepping Motor 5	Lead Screw, Stepping Motor 9	Band, Stepping Motor 3	Band, Stepping Motor 3
POSITIONING:Track to track(msec)					
Settling time (msec)	20	15	20	15	15
Head load time(msec)	Continuous Contact 100	Continuous Contact 100	35	35	50
Average rotational delay (msec)			83.3	83.3	83.3
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	31.25	31.25/62.5	31.25/62.5
SIZE (Inches: H x W x D)	1.625 x 5.75 x 8.0	3.25 x 5.75 x 8.0	4.5 x 9.0 x 14.1	4.5 x 8.55 x 14.57	2.25 x 8.55 x 12.6
FIRST CUSTOMER SHIPMENT	4/83	11/81	10/73	1977	9/81
U.S. OEM PRICE FOR 500 UNITS	\$210	\$350	--	--	--
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER	YE DATA	YE DATA	YE DATA	YE DATA	YE DATA
DRIVE					
	YD-274	YD-280	YD-380 YD-380T	YD-480	YD-580
DISK/TREND GROUP	13	13	13	13	13
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Generic type	SA 154	SA 164	Maxell MD2-HD	SA 164	SA 154
Nominal disk diameter	5.25"	5.25"	5.25"	5.25"	5.25"
Magnetic surface	Oxide Coated	Oxide Coated	High Density, Oxide Coated	Oxide Coated	Oxide Coated
Sectoring	Soft/Hard	Soft/Hard	Soft	Soft/Hard	Soft/Hard
CAPACITY/PERFORMANCE					
Total capacity (MBytes)	U: .250/.5	U: .5/1.0	U: .8/1.6	U: .5/1.0	U: .250/.5
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: 3,125/6,250
Data surfaces per spindle	2	2	2	2	2
Tracks per surface	40	80	77	80	40
TPI	48	96	96	96	48
BPI	2938/5876	2961/5922	4823/9646	2961/5922	2938/5876
RPM	300	300	360	300	300
Actuator type	Lead Screw, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
POSITIONING:Track to track(msec)	20	3	3	3	5
Settling time (msec)	15	15	15	15	15
Head load time(msec)	50	50	50	50	50
Average rotational delay (msec)	100	100	83.3	100	100
Data transfer rate (KBytes/sec)	15.63/31.25	15.63/31.25	31.25/62.5	15.63/31.25	15.63/31.25
SIZE (Inches: H x W x D)	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0	1.625 x 5.75 x 8.0	1.625 x 5.75 x 8	1.625 x 5.75 x 8
FIRST CUSTOMER SHIPMENT	1/79	4/81	2/82	4Q82	4Q82
U.S. OEM PRICE FOR 500 UNITS	--	--	--	--	--
COMMENTS					

1983 DISK/TREND REPORT

MANUFACTURER PROFILES

All manufacturers now producing flexible disk drives, or which have indicated specific plans to enter the market, are listed in this section. The heading "1982 FDD sales" refers to the DISK/TREND estimate of flexible disk drive sales only -- no sales of other disk drive types are included, nor are sales of parts or other related products. "1982 total net sales" covers the fiscal year ending in 1982 for each listed firm unless noted otherwise, or for the parent company if the disk drive manufacturer is a subsidiary.

U.S Manufacturers

AMLYN CORPORATION
2450 Autumnvale Drive
San Jose, CA 95131

408/946-8616

Amlyn has developed a unique flexible disk drive which uses five 5.25 inch high density diskettes in a plastic cartridge. The original version, which was first shipped in early 1982, uses diskettes with 1.6 MB capacity on one side (8 MB per cartridge), achieved by recording at 9,500 BPI and 170 TPI. A full size two sided drive with 3.2 megabytes on a single diskette (without cartridge capability) is now available, and a half high version is expected to be introduced in 1984. Amlyn was funded by Dysan and venture capitalists. Media for Amlyn's drives is a high density spin coated diskette available from Dysan and Brown Disc Manufacturing. In an attempt to provide an alternate source and to initiate some momentum toward industry standardization, Amlyn concluded a licensing agreement with Rhone Poulenc, a French chemical conglomerate with an investment in Dysan, covering non-U.S. manufacturing and marketing for the original Amlyn drive models. Potential licensing arrangements with several U.S. manufacturers have been discussed but not yet consummated.

APPLE COMPUTER, INC.
20525 Mariani Avenue
Cupertino, CA 95014

408/996-1010

1982 total net sales: \$583,061,000

Net income: \$61,306,000

In recent years Apple has been one of the world's largest OEM customers for 5.25 inch one side drives, and during much of that time has quietly

1983 DISK/TREND REPORT

been preparing to manufacture floppy drives on a captive basis. The firm's "Twiggy" project finally emerged in a late 1982 announcement as Apple's first internally manufactured floppy drive, the 871. An odd combination of features was used, ostensibly for engineering reasons, but probably also to discourage outside subsystem builders from attempting to sell competitive drives to Apple dealers and users. The 871 is a two sided drive with heads 180° out of phase with each other, and using 62.5 TPI. The 46 tracks on each surface are arranged in eight bands, each with different rotational speed and track capacity. The 871 was delivered with the first shipments of Apple's Lisa computer in Spring of 1983, but the firm later announced its intention to discontinue all manufacture of flexible disk drives. So far, the 871's replacement on the Lisa has not emerged, but it is assumed that it will be a 3.5 inch drive, similar to the microfloppy Apple plans to use with the lower cost Mackintosh computer planned for introduction in Spring, 1984. It is known that Apple is making commitments for 3.5 inch microfloppy drives from Sony and perhaps also from other drive manufacturers.

BURROUGHS CORPORATION
Burroughs Place
Detroit, MI 48232

313/972-7000

1982 FDD sales: \$7,700,000

1981 total net sales: \$4,095,000,000

Net income: \$91,000,000

Burroughs initiated a floppy drive manufacturing program in 1976 for a unique 1.0 MB 8 inch two sided drive, with a follow-on 3.0 MB drive in 1980. The second drive used a single voice coil actuator to position heads on two 8 inch diskettes at 150 TPI, using two precoded servo tracks as references for the closed loop head positioning system. Attempts to market these drives as OEM products drew little response, and they were used basically as captive drives with Burroughs systems. No further development of the Burroughs flexible disk drives has apparently been undertaken, and production is now declining. Memorex was acquired by Burroughs in late 1981, and the Memorex 651, the first OEM flexible disk drive, was phased out in 1982.

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

816/373-0000

1982 FDD sales: \$4,500,000

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

1983 DISK/TREND REPORT

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

612/853-8100

1982 FDD sales: \$55,100,000

1982 total net sales: \$4,292,000,000

Net income: \$155,100,000

Although an early supplier of 8 inch flexible disk drives, Control Data was a latecomer to 5.25 inch drives, starting shipments in 1980. Control Data's unit shipments of flexible disk drives are growing faster than the DISK/TREND total for 1982 seems to indicate, because of a shift in distribution mix favoring OEM drives and growing 5.25 inch drive shipments. The firm also has ambitious plans for a new program to sell PCM 5.25 inch two sided drives through various distribution channels for use with IBM personal computers. An older program for 8 inch PCM floppy drives aimed at IBM's Series/1 minicomputers has resulted in negligible shipments. Floppy drives credited to CDC in DISK/TREND statistics are manufactured by Magnetic Peripherals, Inc., a joint venture with ownership now shared by CDC, Honeywell, Sperry and Cii-Honeywell Bull. Control Data manages the joint venture and has exclusive responsibility for sales of its products in the OEM and PCM markets. Drives made by MPI for sale with any of the parent company's systems are considered captive CDC drives for the purposes of DISK/TREND statistics.

DIGITAL EQUIPMENT CORPORATION
146 Main Street
Maynard, MA 01754

617/897-5111

1982 FDD sales: \$32,800,000

1982 total net sales: \$3,880,771,000

Net income: \$417,155,000

Since 1976, DEC has produced large quantities of 8 inch one sided floppy drives, originally under a Calcomp license. All of these drives were produced for captive use with its own systems, and production has probably topped out. Somewhat tardily, DEC has introduced its first 5.25 inch floppy, the RX50, which was shipped for the first time in late 1982, along with the company's new personal computer systems. The RX50 uses a single stepping motor to position heads on two 96 TPI one sided diskettes, and is adapted from a product acquired about two years from T & E Engineering.

DRIVETEC
2140 Bering Drive
San Jose, CA 95131

408/942-1515

Drivetec's first product is one of the most advanced 5.25 inch floppy drives announced to date. Using a preformatted high density diskette, Drivetec's 320 is a half high 5.25 inch drive offering 3.3 MB capacity, and employing embedded servo techniques to achieve adequate interchangeability at 192 TPI. Two stepping motors are used, the second for fine

1983 DISK/TREND REPORT

adjustments of head position. Drivetec was founded in 1981 by veterans of the floppy drive programs at IBM, Memorex and Shugart Associates, and made its first shipments in June, 1983. In November, 1983, the firm announced a license agreement allowing Eastman Kodak to market the drive.

EASTMAN KODAK COMPANY
343 State Street
Rochester, NY 14650

716/724-4000

1982 total net sales: \$10,815,000,000 Net income: \$1,162,000,000

Although the Spin Physics operation of Eastman Kodak has previously introduced flexible disk media using isotropic particulate coatings, the recent announcement of Kodak's intent to manufacture the Drivetec 3.3 megabyte 5.25 inch drive is the firm's first step into disk drive hardware. A 1984 production startup is expected, at the Rochester, New York, facilities of Kodak's U.S. Apparatus Division -- the entity which makes cameras, copiers, microfilm, and other equipment. Worldwide OEM marketing for the floppy drive will be handled by Data Technology Corporation, a Santa Clara controller manufacturer in which Kodak has an investment. Although not specifically announced, captive applications on Kodak equipment are also likely, eventually. Kodak plans to introduce 600 Oersted versions of its isotropic diskettes, intended for use with this drive.

EXXON OFFICE SYSTEMS COMPANY
Subsidiary of Exxon Corporation
777 Long Ridge Road
Stamford, CT 06902

203/329-5000

1982 FDD sales: \$4,200,000
1982 total net sales: \$97,172,523,000 Net income: \$4,185,932,000

Captive production of 5.25 inch one sided flexible disk drives was initiated by Qyx in 1978 for use in the firm's intelligent typewriter. Qyx and several other Exxon startups were combined into Exxon Office Systems in 1980, but the new organization has been unable to maintain momentum in the rapidly changing office equipment market and has experienced two years of retrenchments and layoffs. The future of the floppy drive manufacturing program is probably questionable.

FORMAT CORPORATION
2630 Townsgate Road
Westlake Village, CA 91361

213/889-2300

Format has designed a line of half high 5.25 inch drives with capacities ranging from .5 to 1.6 megabytes, which will be manufactured in Korea by Gold Star Tele-Electric, an established producer of telecommunication and other electronic equipment. Format will market the drives worldwide, and it is expected that Gold Star will also sell the drives separately in Asia.

1983 DISK/TREND REPORT

HEWLETT-PACKARD COMPANY
 Greeley Division
 700 71st Avenue
 Greeley, CO 80634

303/3569103

1982 FDD sales: \$6,800,000

1982 total net sales: \$4,254,000,000

Net income: \$383,000,000

H-P initiated production in 1980 of 5.25 inch two sided drives under license from Tandon Corporation. However, the firm terminated internal production of flexible disk drives in 1982, in favor of microfloppy drives, which will be widely used throughout the H-P product lines for applications requiring small floppy drives. The firm has an agreement with Sony to supply 3.5 inch microflopies in large quantities during the next several years, and announced the first system applications for these drives in late 1982.

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

714/891-0027

Hi-Tech Peripherals was started in 1982, with founders from Xerox and Remex, to develop and manufacture 5.25 inch half high OEM flexible disk drives. Production started third quarter, 1983, at its Huntington Beach facility, and the firm is also establishing manufacturing facilities in Hong Kong. In addition to the usual .5 and 1.0 megabyte 48 and 96 TPI models, Hi-Tech Peripherals has included a 1.6 megabyte 5.25 inch drive in its product line, the first U.S. drive manufacturer to do so.

INTERNATIONAL BUSINESS MACHINES CORPORATION
 Route 22
 Armonk, NY 10504

914/765-1900

1982 FDD sales: \$452,000,000

1982 total net sales: \$34,364,000,000

Net income: \$4,409,000,000

IBM introduced the original one and two sided 8 inch flexible disk drives, and has continually increased its usage of these drives, on a wide variety of business systems, word processing systems, terminals and specialized equipment. But although IBM's revenue from flexible disk drives exceeds that of any other firm by far, its share of total unit shipments continues to decline, as the rest of the world rapidly increases its floppy drive usage, especially small drives. However, this trend is about to be reversed, as IBM apparently proceeds with plans to make 5.25 inch drives internally, instead of continuing to rely completely on external sources for the floppy drives needed to support the firm's booming personal computer shipments. In addition to the two sided 48 TPI drives now used with existing PC models, it is believed that IBM will adopt the Japanese 1.6 megabyte standard for 5.25 inch floppy drives (the logical equivalent of

1983 DISK/TREND REPORT

1.6 megabyte 8 inch drives), for use with future PC models replacing 8 inch floppy-based systems such as the Displaywriter and System/23 Data-master. IBM's adventure in the microfloppy area was aborted the same year it was launched, with the withdrawal of the 4 inch drive announced in January, 1983. Offered only as an OEM drive, it had so many disadvantages in access time, physical size, special controller requirements and unique file organization that even IBM's name failed to attract customers.

INNOTRONICS
Brooks Road
Lincoln, MA 01773

617/259-0600

Innotronics has been in operation since late 1977, when the key employees of Innovex, a pioneer floppy drive manufacturer, purchased the assets of the original firm at an auction forced by impatient bankers. Innotronics still makes 8 inch one sided drives at Fall River, Massachusetts, but the firm's emphasis is now on subsystems.

IOMEGA CORPORATION
4646 South 1500 West
Ogden, UT 84403

801/399-2171

Iomega has been successful in establishing production capability for its unique 8 inch drive, which uses a flexible disk spinning at 1500 RPM and maintains control of head/disk contact with the Bernoulli effect. A 5.25 inch version has also been introduced, with deliveries in third quarter of 1983. Also in 1983 Iomega licensed Verbatim as a media second source, and made an arrangement with SCI Systems under which SCI will manufacture the drives for use with its own systems and for sale by Iomega. SCI has the option to acquire marketing rights for the OEM market.

MICRO PERIPHERALS, INC.
Subsidiary of CTS Corporation
9754 Deering Avenue
Chatsworth, CA 91311

213/709-4202

1982 FDD sales: \$37,400,000
1982 total net sales: \$223,388,000
(FY end 1/2/83)

Net income: \$8,825,000

Micro Peripherals was acquired in mid-1983 by CTS Corporation, a diversified manufacturer of electronic components. Despite management changes and a few abortive product introductions, Micro Peripherals has become a leading manufacturer of both one and two sided 5.25 inch floppy drives. The firm assembles drives in Singapore as well as at Chatsworth. Although Micro Peripherals was the first to announce a half high 8 inch floppy drive, at the 1980 NCC, development of the product was delayed by defec-

1983 DISK/TREND REPORT

tions of key personnel to the competition, and first shipments of a redesigned version were not made until 1982. Micro Peripherals is the only U.S. firm to date to announce support of the Matsushita Electric/Hitachi 3 inch microfloppy standard, and has also announced support for the 3.25 inch Dysan microfloppy.

MICROPOLIS CORPORATION
21123 Nordhoff Street
Chatsworth, CA 91311

213/709-3300

1982 FDD sales: \$10,900,000

1982 total net sales: \$33,009,000

Net income: \$83,000

As the pioneer in 100 TPI floppies, Micropolis was able to establish a thriving business, even though it remained the only source for the drives for the first three years. However, with many microcomputer system manufacturers oriented to business applications, the additional capacity of Micropolis' drives developed a following, which was vindicated by the 1980 introduction of competitive drives, in both 96 and 100 TPI models. Although exclusively one sided drives were shipped for the first several years, Micropolis also became a major participant in the market for two sided 5.25 inch drives. The firm has indicated that it plans to concentrate its future development efforts on Winchester disk drives, rather than on floppy drives.

MILTOPE CORPORATION
1770 Walt Whitman Road
Melville, NY 117473

516/420-0200

1982 FDD sales: \$2,900,000

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

PER SCI, INC.
12210 Nebraska Avenue
West Los Angeles, CA 90025

213/777-7536

1982 FDD sales: \$2,500,000

After suffering a decline in shipments during the past two years, PerSci was sold in late 1982 to Jana Enterprises, Inc., of Hawthorne, California. The new owner has acquired other declining computer industry manufacturing operations in the past few years. Production of floppy drives has been discontinued, and the firm's inventory is being eliminated.

1983 DISK/TREND REPORT

QUME CORPORATION

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

408/942-4000

1982 FDD sales: \$24,300,000

1982 total net sales: \$15,958,440,000

Net income: \$702,816,000

Qume started flexible disk drive shipments in 1979, after emerging as a highly successful manufacturer of daisywheel printers in the mid-1970's. The initial floppy drive product was an 8 inch two sided drive licensed from YE Data, which had acquired a reputation for reliable two sided drives during a period when most others were in trouble. Two sided 48 and 96 TPI 5.25 inch drives were later added. Except for some confusion when the firm reorganized its marketing and manufacturing programs in 1981, Qume has maintained continuous growth in the OEM market -- and received a big boost in 1983 by being selected as a vendor for half high 5.25 inch floppy drives to IBM for the PC Junior.

REMEX DIVISION

EX-CELL-O CORPORATION
2991 East White Star
Anaheim, CA 92806

714/630-7020

1982 FDD sales: \$10,100,000

1982 total net sales: \$1,027,123,000

Net income: \$48,202,000

Remex has had its ups and downs in the flexible disk drive OEM market. The organization has been a leading manufacturer of paper tape equipment for the data processing industry for years. Floppy drives were added in 1975, but the firm did not start to make significant market penetration until the end of the 1970's when it was able to offer a two sided 8 inch drive with better than average reliability. This surge culminated with the world leadership in non-captive 8 inch two side drive shipments for 1980, but dissolved in 1981 with the breakup of the management team behind it. 8 inch drives are being dropped, with complete current emphasis on 5.25 inch drives. Remex initially offered only two thirds high drives, but introduced half high models in the second half of 1983.

SEAGATE TECHNOLOGY

920 Disc Drive
Scotts Valley, CA 95066

408/438-6550

1982 total net sales: \$40,445,000(FY end 6/82) Net income: \$9,891,000

Seagate is obviously well positioned to develop the market for micro-size Winchester drives that will inevitably be right behind the market for microfloppies. But so far the temptation to take this opportunity to also enter the microfloppy market has been somewhat confusing for Seagate followers. The firm first announced a tentative agreement with Sony to license and manufacture that firm's 3.5 inch microfloppy drive, then

1983 DISK/TREND REPORT

dropped the arrangement in favor of the Tabor drive and the Dysan 3.25 inch diskette. At this time, the Sony standard seems to have a better chance at future market dominance because of the lineup of firms supporting it and earlier availability of hardware. Seagate has not announced a specific floppy drive of any kind to date, and shows no signs of making preparations to do so.

SHUGART CORPORATION
Subsidiary of Xerox Corporation
475 Oakmead Parkway
Sunnyvale, CA 94086

408/733-0100

1982 FDD sales: \$256,900,000

1982 total net sales: \$8,455,600,000

Net income: \$423,700,000

From the beginning of the OEM flexible disk drive industry, Shugart was always number one in total shipments, but was passed up in 1982 by Tandon Corporation. The firm's growth rate slowed during recent years as the result of several factors: Loss of certain major customers which set up internal manufacturing programs or switched to other suppliers, prolonged technical difficulties in the late 1970's on two sided drives, and failure to achieve early introduction of new floppy drive configurations and features. However, Shugart's management is attempting to use entrepreneurial-style rewards for the development and production teams assigned to the company's microfloppy and other projects in order to speed things up, and the results of these programs appear to be encouraging. Shugart has been the most aggressive U.S. disk drive manufacturer in establishing licensing agreements with overseas organizations. The firm now has arrangements with Matsushita Communication Industrial in Japan, Flexidisk Technologia Electronica in Brazil, Sujata Sales and Exports in India, Samsung Precision Industries in Korea, Mitac International in Taiwan and the Hangzhou Magnetic Recording Equipment Plant in China -- and all should be in production in 1984.

SYKES DATATRONICS, INC.
159 East Main Street
Rochester, NY 14604

716/325-9000

1982 FDD sales: \$11,500,000

1982 total net sales: \$23,609,000
(FY end 2/83)

Net income: \$609,000

Sykes became one of Wall Street's favorite over-the-counter technology growth stocks during the last three years, after the firm's communications and storage systems were adopted for marketing throughout the U.S. by all of the AT&T operating companies. These systems use 8 inch floppy drives, which have been manufactured on a captive basis for several years. The financial community's interest has cooled, as growth and profitability have declined during the last year -- the result of uncertainty by key customers while the details of the splitup of its largest customer, AT&T, are settled.

1983 DISK/TREND REPORT

TABOR CORPORATION
Lyberty Way
Westford, MA 01886

617/692-2535

Tabor was started at the beginning of 1982 to develop and market a microfloppy drive using Dysan's soft-jacketed 3.25 inch diskette. The founders have experience with BASF's 5.25 inch flexible disk drive manufacturing program, and seed money was provided by Dysan. Tabor has obtained major allies with Dysan providing the media and Seagate Technology taking a license to manufacture and sell the drive, but the head start held by the 3.5 inch standard will not make Tabor's life easy.

TANDON CORPORATION
20320 Prairie Street
Chatsworth, CA 91311

213/993-6644

1982 FDD sales: \$150,700,000

1982 total net sales: \$150,000,000 (FY end 9/82) Net income: \$15,700,000

After establishing itself as the leading independent manufacturer of heads for flexible disk drives in the mid-1970's, Tandon Corporation started shipment of two sided 5.25 inch floppy drives in 1979. Tandon's product philosophy of maximum vertical integration has paid off handsomely, by providing some of the lowest costs in the industry and a high level of control over the firm's ability to grow with demand. The firm still makes many of its own heads, and has added motors and subassemblies from a related company in India, while establishing an assembly facility in Singapore. Tandon's philosophy also involves being early with new product configurations, and the firm has done just that with mainstream products such as half high 8 and 5.25 inch drives, 96 TPI 5.25 inch drives, and recently with microfloppies. The result of Tandon's energetic approach has been continued high growth -- and the firm's 1982 unit shipments of OEM floppy drives are substantially higher than those of any other company in the world.

TEXAS PERIPHERALS
Subsidiary of Tandy Corporation
1010 East 8th
Odessa, TX 79761

915/332-0277

1982 FDD sales: \$221,100,000

1982 total net sales: \$2,032,555,000

Net income: \$224,085,000

Texas Peripherals was established in 1980 in Odessa, Texas, as a joint venture by Tandy and Datapoint Corporation, with the mission to develop and manufacture flexible disk drives and other items for the captive use of the parent companies. Production got underway in 1981 for both 5.25 and 8 inch drives, but Datapoint sold its interest in the joint venture to Tandy in late 1982. Manufacturing volume is still ramping up, and Tandy is still buying some floppy drives for Radio Shack systems from outside vendors. 8 inch drives are no longer in production.

1983 DISK/TREND REPORT

VERTIMAG SYSTEMS CORPORATION
2545 West County Road C
Roseville, MN 55113

612/633-7161

Perpendicular recording technology is widely expected to be an important part of the future of magnetic recording, and Vertimag plans to use it in developing the market for high capacity flexible disk drives. The firm will formally introduce next year a drive using diskettes with a sputtered magnetic surface. Vertimag plans to provide a suitable drive by modifying standard drives with special electronics and heads of its own design, but production of media in adequate quantities poses special problems. So far, the firm is producing limited quantities of sputtered diskettes with its own equipment, and plans to install a continuous sputter line in mid-1984, with the capability to produce several million diskettes per year.

WORLD STORAGE TECHNOLOGY
14251 Franklin Avenue
Tustin, CA 92680

714/838-1491

1982 FDD sales: \$22,300,000

World Storage Technology consists of the California flexible disk drive manufacturing facilities sold by Siemens to a new entity managed by former Siemens executives and financed by a group of Hong Kong investors. Siemens had acquired two California operations to enter the floppy drive business: General Systems International and the Orbis (later Wangco, then Perkin Elmer) floppy product lines. The activity is aimed primarily at OEM markets, and all manufacturing involves the original California facilities, plus new operations in Hong Kong. Although the product line includes 8 inch one and two sided drives, most product development activity in recent years has involved the 5.25 inch models, in which one and two sided drives, in 48 and 96 TPI versions, are offered, plus new half high units.

Asian Manufacturers

Several additional manufacturers in Asian countries are expected to start production of flexible disk drives during 1984, including organizations in India, Taiwan, Korea, China, and Japan -- all of which will be covered in future DISK/TREND editions, when production is established. The companies described below are all in Japan and are all in production or have announced specific products.

(Exchange basis: 235 Yen = \$1)

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

(03) 726-1211

1982 FDD sales: \$52,300,000

1982 total net sales: \$859,179,000

Net income: \$35,694,000

Alps Electric is a high-growth manufacturer of electronic components and subassemblies for television, audio, instruments and computer applications. Production of captive 5.25 inch floppy drives for use with Alps systems started several years ago, but has not been emphasized. The firm's big increase in floppy drive shipments came in 1981, with a rapid build-up of shipments to Apple Computer. Alps' shipments of a mechanism-only model made it the world leader in 1981 and 1982 for 5.25 inch one side drives, and a family of half high drives has been added in an attempt to broaden the customer base. Alps also announced a family of 3.5 inch microfloppy drives in October, 1983.

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

(04942) 3-3111

1982 FDD sales: \$21,200,000

1982 total net sales: \$2,470,213,000

Net income: \$95,140,000

Canon Electronics produces electronic subassemblies for Canon cameras, as well as other electronic components and systems. One and two sided 5.25 inch floppy drives have been in production since 1979 under a BASF license, and the firm has added captive and OEM one third high drives of its own design. Canon also developed its own unique microfloppy using a 97 mm disk, but these drives are being dropped, and 3.5 inch microflopies are expected to be introduced in late 1983.

EPSON CO., LTD.
80 Hirooka, Shiojiri-city
Nagano, 399-07

(02635) 2-2552

1982 FDD sales: \$24,000,000

Epson is the new company name for Shinshu Seiki, a high growth member of the Seiko group, and best known for the Epson brand of matrix printers now widely used with personal computers worldwide. Epson also manufactures line printers, LCD's, paper tape equipment, watch components, and its own successful portable computer. Until recently, all floppy drive shipments were 5.25 inch one third high captive units used with the Epson portable computer. However, in October, 1983, Epson announced an OEM floppy drive product line with a variety of 5.25 and 3.5 inch models, including 3.5 inch drives with very low power requirements. The 5.25 inch drives include both one third high and half high units.

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

(03) 270-2111

1982 FDD sales: \$58,100,000

1982 total net sales: \$15,739,268,000

Net income: \$583,370,000

While Hitachi is Japan's largest electric and electronics manufacturer, only about a fifth of its total sales are generated by the computer industry. Hitachi has been making 8 inch floppy drives since 1976 for both captive and OEM applications, and is currently a leader in the Japanese domestic OEM market for two sided 8 inch drives. In 1982, the firm entered the two sided 5.25 inch market, and also joined in the 3.0 inch microfloppy standard being promoted by Hitachi, Matsushita Electric Industrial, and Hitachi's magnetic media subsidiary, Maxell.

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

(03) 277-2066

1982 total net sales: \$336,570,000

Net income: \$11,468,000

Janome is one of the world's leaders in consumer and industrial sewing machines, and supplies private label sewing machines to Sears. Due to slow growth in its basic field, Janome has started to expand into such fields as printers and disk drives. In October, 1983, the firm announced a 3 inch OEM microfloppy drive for delivery early in 1984, featuring smaller physical size than competitive drives. The Janome drive was designed by a California consulting organization.

1983 DISK/TREND REPORT

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

(045) 531-1231

1982 FDD sales: \$13,100,000

1982 total net sales: \$939,055,000

Net income: \$45,855,000

Matsushita Communication Industrial is a member of the Matsushita Electric Industrial group, a worldwide giant in appliances and electronics. MCI manufactures most of the Shugart Associates floppy drive line, under license for the Japanese OEM market. Although MCI's floppy drive product line consisted only of models identical to Shugart Associate's drives for a number of years, the firm has embarked on several designs of its own, including half high 5.25 inch and microfloppy drives.

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

(06) 908-1121

1982 total net sales: \$15,530,089,000

Net income: \$668,600,000

MEI's Panasonic, National, Technics and Quasar brandnames are among the most widely known in the world for appliances, consumer electronic equipment and communications equipment. MEI has joined with Hitachi in attempting to establish a 3.0 inch microfloppy standard, and now manufactures microfloppy drives for the worldwide OEM market.

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

(03) 218-2111

1982 FDD sales: \$43,200,000

1982 total net sales: \$6,132,757,000

Net income: \$147,409,000

Mitsubishi Electric is a leader in the Japanese domestic small business systems market, and one of the country's leading electronic and electrical products manufacturers. Captive 8 inch drives, in both one and two sided versions, have been used with the firm's Melcom systems for several years, and the firm also participates in the domestic OEM market. A family of half high two sided 5.25 inch drives was introduced in 1982, with capacities up to 2.0 MB. Mitsubishi also introduced a 3.5 inch microfloppy drive in late 1982, with deliveries starting in 1983.

NEC CORPORATION
33-1 Shiba Gochome
Minato-ku, Tokyo 108

(03) 454-1111

1982 FDD sales: \$335,300,000

1982 total net sales: \$5,328,596,000

Net income: \$118,762,000

About one fifth of NEC's revenues are generated by computer mainframes, small business systems, minicomputers and desktop systems -- and the firm is a leader in the growing personal computer market. Since 1978 the company has manufactured two sided 8 inch floppy drives, and was one of the earliest firms to offer half high 8 inch drives, with shipments starting in late 1981. Most of NEC's floppy drive shipments have been for captive applications. The firm is expected to also be active with smaller diameter floppy disk drives.

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

(03) 501-3111

1982 FDD sales: \$4,100,000

1982 total net sales: \$1,033,357,000

Net income: \$15,791,000

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

RICOH CO., LTD.
1-3-6 Naka-Magome
Ohta-ku, Tokyo 143

(03) 543-5111

1982 FDD sales: \$33,300,000

1982 total net sales: \$1,487,902,000

Net income: \$47,396,000

Copiers, sensitized papers and photographic equipment provide the major part of Ricoh's revenues, but the firm has been investing in the growing line of data processing equipment now manufactured. Since 1979, Ricoh has made 8 inch floppy drives, in both one and two sided versions, under a Calcomp manufacturing license. The drives are sold only on a captive basis, with Ricoh small business systems and word processing systems.

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

(03) 508-1154

1982 total net sales: \$238,311,000

Net income: \$3,996,000

Sankyo Seiki is a leading manufacturer of musical movements, industrial robots and a wide variety of small electromechanical components used in cameras, video recorders, timers and other products. Since 1981, the firm has been shipping a small spiral track flexible disk drive, with substantial success in developing the OEM market in word processing, program loading and special industrial applications. Since mid-1983, the company has also been shipping a 3 inch microfloppy.

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

(03) 448-2111

1982 FDD sales: \$4,300,000

1982 total net sales: \$4,739,668,000

Net income: \$194,979,000

As it becomes more difficult to meet Sony's growth objectives in the consumer electronics market, several portions of which appear saturated, the firm's management has made it clear that major expansion in office products markets is planned. Among the products announced so far are word processing and personal computer equipment -- both of which use the Sony 3.5 inch microfloppy which has been shipping since late 1981. The drive has also been offered worldwide as an OEM product, with some success. Sony's microfloppy design has had the advantage of being in production about a year before its principal competitors. After initially taking a somewhat stiff posture on granting licenses, Sony demonstrated flexibility in working with the U.S. manufacturers concerned with establishing common standards. The result has been agreement on the 3.5 inch media standard by Sony and several U.S. drive and media manufacturers -- and a growing number of Japanese firms rushing to make 3.5 inch microfloppy drives. In the meantime, Sony has been selling substantial quantities of its own drive to Hewlett-Packard and has been chosen by Apple Computer to supply microfloppy drives for the Mackintosh computer, due for introduction in the first half of 1984.

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

(0422) 53-1111

1982 FDD sales: \$43,500,000

1982 total net sales: \$179,740,000

Net income: (\$6,464,000)

TEAC is a leading manufacturer of consumer and professional audio recorders, but digital recording equipment is a growing portion of the firm's product mix, now accounting for over 25% of total revenues. Shipments of 5.25 inch floppies for the worldwide OEM market started in

1983 DISK/TREND REPORT

1978, and the line now consists of two sided drives and 96/100 TPI versions. Half high 5.25 inch models were added in 1982. TEAC also has announced microfloppies in both 3 and 3.5 inch formats.

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

(03) 292-1011

1982 total net sales: \$655,847,000

Net income: \$14,098,000

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

TOSHIBA CORPORATION
1-6, Uchisaiwaicho 1-chome
Chiyoda-ku, Tokyo 100

(03) 501-5411

1982 FDD sales: \$65,900,000

1982 total net sales: \$9,973,362,000

Net income: \$188,562,000

Toshiba is one of Japan's major diversified electric and electronics manufacturers, with products ranging from heavy electric machinery to home electric appliances and communications equipment. Toshiba has a major share of the Japanese minicomputer and small business system markets. 8 inch floppy drives for both captive and OEM markets have been produced since 1977, and the product line now consists of both 8 and 5.25 inch drives, in one and two sided versions. Half high two sided drives were added in 1982, in both 8 and 5.25 inch diameters.

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

(03) 241-7811

1982 total net sales: \$2,429,574,000

Net income: \$110,609,000

JVC's revenues are generated mostly by consumer electronics products; the firm has been the beneficiary of sharp growth in home video tape recorder shipments, and VTRs account for almost 70% of total revenues. JVC is now expanding into computer peripherals, with 5.25 inch Winchester and flexible disk drives among its first products in the field. Half high 48 and 96 TPI floppy drives were first shown at the 1983 Fall Comdex, with deliveries in 1984.

1983 DISK/TREND REPORT

YE DATA, INC.

Subsidiary of Yaskawa Electric Mfg. Co., Ltd.

Sunshine 60, 1-1, Higashi-Ikebukuro 3-chome

Toshima-ku, Tokyo 170

(03) 989-8001

1982 FDD sales: \$53,300,000

1982 total net sales: \$478,030,000

Net income: \$16,809,000

Yaskawa Electric's heavy electric equipment is the largest segment of the company, but factory automation and data processing equipment is growing fast. The data processing products are the responsibility of YE Data, which has manufactured 8 inch one side floppy drives since 1974, under an Orbis license. YE Data became an early leader in the Japanese OEM markets for both 8 and 5.25 inch two sided drives, and has introduced half high drives in both disk dimensions. YE Data also cooperated with NTT on the standard for 1.6 MB 5.25 inch drives and has been shipping its version since early 1982. Microfloppy drives are expected to be introduced in 1984.

European Manufacturers

(Exchange basis indicated for each firm)

BASF AG
D-6700 Ludwigshafen
West Germany

(0621) 4 00 81

1982 FDD sales: \$22,100,000

1982 total net sales: \$13,235,000,000

Net income: \$152,800,000

(Basis: DM 2.40 = U.S.\$1)

BASF stopped manufacturing floppy drives in the U.S., but continues with both 8 and 5.25 inch drives produced in Germany. The company first produced 8 inch one side drives in 1976, using rights to designs originated by GSI. 8 inch two sided drives were added in 1978, as were one and two sided 5.25 inch drives. BASF pioneered the two thirds high 5.25 inch drive, which has achieved major market share only in the European market, but has attracted several second source suppliers.

DATA TRACK TECHNOLOGY LIMITED

7 Queensway, New Milton
Hampshire BH25 5NN
England

(0425) 619650

Data Track Technology initiated production in mid-1983 of a 5.25 inch flexible disk drive using a single stepping motor to position heads on two diskettes. Either one or two sided models are available, both 96 TPI. This firm was formerly the UK distributor for comparable drives manufactured a few years ago by T & E Engineering, a California company which sold its product design to Digital Equipment Corporation after exhausting its working capital.

ELCOMATIC LTD

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

(041) 881-5825

1982 FDD sales: \$1,500,000

In July, 1981, Elcomatic acquired the 8 inch flexible disk product line of MFE. These drives had been manufactured mostly in a two sided version at plants in Salem, Massachusetts, and in Livingston, Scotland. Elcomatic has moved manufacturing to a Glasgow plant and is continuing with plans to develop the European OEM market for 8 inch two sided floppy drives. The firm has announced a 96 TPI version of its 8 inch drives.

ISOT
51, Chapaev St.
1113 Sofia 49
Bulgaria

72-39-09

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

METRIMPEX/BRG
V. Munnich F. u. 21
1051 Budapest
Hungary

Metrimpex, the Hungarian trading company for electronic instruments, has introduced a microfloppy drive manufactured by Budapesti Radiotechnikai Gyar, the "Budapest Radio Works". This drive uses 72 mm flexible disks in a rigid plastic cartridge, with recording at 100 TPI and 6250 BPI, offering a capacity of 200 KBytes. BRG hopes to start manufacturing this drive during 1983, with marketing programs intended to develop European OEM sales in both Western Europe and Eastern bloc countries.

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

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

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

(0125) 525

1982 FDD sales: \$119,600,000

Olivetti is undergoing numerous changes in organization and product lines under its current management. In order to stay competitive in the rapidly

1983 DISK/TREND REPORT

changing office equipment market, investments have been made in a long list of high technology growth firms, and older Olivetti products have been discontinued. In 1980 Olivetti Peripheral Equipment was established as a consolidation of the firm's printer and disk memory activities. OPE now makes 8 and 5.25 inch Winchester and floppy drives at Ivrea, for OEM markets as well as the firm's established captive requirements. The firm is also expected to introduce microfloppy drives. In 1983, Olivetti withdrew from Irwin Olivetti, the Ann Arbor, Michigan, firm which was to have had marketing responsibility for Olivetti peripherals in the United States, and is re-establishing its own marketing organization.

PHILIPS DATA SYSTEMS

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

(0271) 3 85 01

1982 total net sales: \$15,366,304,000 Net income: \$129,348,000
(Basis: Fl 2.76 = U.S.\$1)

Although Philips' computer industry revenues contribute less than 5% of total company revenues, the firm's minicomputer, terminal and office computer products are sold throughout Europe. Despite the fact that the firm has phased out production of rigid disk drives, which were manufactured in Holland for several years, a new floppy drive program in Germany is growing rapidly. Shipments of a family of two thirds high 5.25 inch drives in both one and two sided models, including 96 TPI versions, were initiated in late 1980, supplemented in 1983 with half high models. These drives are used as captive products on a variety of Philips systems and as OEM products for worldwide sale. Microfloppy drives are expected in 1984.

ROBOTRON

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

The Robotron group is the East German organization responsible for manufacture of computing and office equipment, communication equipment, electronic instruments and consumer electronics devices. The Robotron facility for peripheral equipment initiated manufacture of 5.25 inch one sided floppy drives during 1983, after several years of buying similar drives from outside sources for Robotron equipment.

SIEMENS AG
Hofmannstrasse 51
D-8000 Munchen 70
West Germany

In early 1983, Siemens sold its California flexible disk drive manufacturing operations to a company funded by Hong Kong investors, and now known as World Storage Technology. Siemens is no longer active in manufacturing flexible disk drives.

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

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