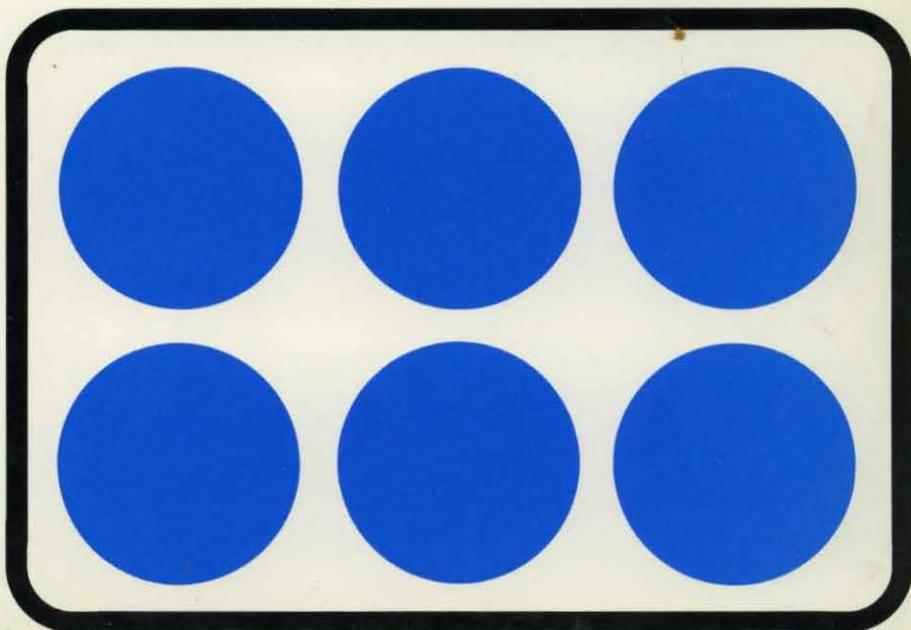


1981 DISK/TREND[®] REPORT

RIGID
DISK
DRIVES



1981 DISK/TREND® REPORT

RIGID DISK DRIVES

August, 1981

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FOREWORD

Now in its fifth year, the DISK/TREND Report continues to reflect the industry's dynamic growth. In the first DISK/TREND Report in 1977, detailed information on 23 manufacturers was provided; this year, the total is 62 manufacturers, 17 of which were added in 1981.

This section of the DISK/TREND Report covers moving head rigid disk drives. Flexible disk drives will be covered in a separate report to be published at the end of September.

The nine product categories you will find in this year's report have been used since 1977, but they will change after this year. The older disk pack drives and data module drives (the original Winchester) are now almost dormant product areas, and these groups will be dropped from next year's report. At the same time, it is clear that the fixed disk drive product groups are expanding at a rate which will justify additional breakdowns into new product groups. Decisions on the new groups will be made before the close of calendar 1981, and your suggestions will be welcome.

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

And your suggestions for improvements in the report are always welcome.

James N. Porter

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INTRODUCTION

New information in this year's report

The basic format for presentation of DISK/TREND information has been retained in the 1981 report, but several features have been added, all of which provide new information not included in previous editions.

- * The summary table of all manufacturers' product lines now shows the disk diameter of all drives, broken down by DISK/TREND groups. Additional data on shipments by disk diameter has been added to the sections on disk cartridge drives less than 12 MB.
- * In the section covering fixed disk drives more than 200 MB, a new table has been added, covering shipments of IBM and PCM drives by individual drive model.
- * In the specification section, information on the generic types of heads, disks and actuators employed in each drive has been added. General information on the type of interfaces available has been given for most drives.

To avoid confusion, please note these points

- * For OEM drives sold in the United States, prices are shown for most drives, usually the 100 unit price. But prices are changed without notice, so please use the information with care.
- * All unit totals are given in spindles. A disk drive containing two spindles is counted in DISK/TREND statistics as two spindles.
- * The value of all leased disk drives is given on an "if sold" basis in all DISK/TREND revenue estimates.
- * Many terms used in the disk drive industry have different meanings for various people. You will find it helpful to refer to the definitions section of the report if in doubt.

SUMMARYIndustry size

Moving head rigid disk drive shipments worldwide were worth \$5,181,200,000 to their manufacturers in 1980, an increase of 35.8% over 1979. For the first time in 1980, fixed disk drives produced more than half of worldwide total revenues.

This year's estimate of 1980 worldwide revenues is 7.8% higher than the forecast included in the 1980 DISK/TREND Report, due primarily to a revised estimate of IBM's shipment level for large fixed disk drives. The total of all non-IBM worldwide revenues for 1980 is now estimated at \$3,466,000,000, 8.9% less than the forecast for 1980 in last year's DISK/TREND Report, but nevertheless an increase of 15.1% over 1979 non-IBM revenues.

1981 will be an exceptionally strong year for total industry sales, with new products, especially in the fixed disk drive groups, providing new revenues for a broad range of captive and OEM manufacturers. And PCM drive revenues for 1981 will also surge, because of IBM's delay in 3380 shipments.

DISK/TREND projections for future years have been raised for all types of fixed disk drives, based on the shifts in product mix now being experienced and the continually expanding growth of the computer industry. Total worldwide revenues are now expected to reach \$14,147,700,000 in 1984, representing average annual growth of 26.4% from 1982 through 1984.

The disk drive industry has maintained an enviable pattern of growth during a relatively troubled period for the major industrialized nations. Only major blunders by the world's politicians can undermine the exceptional outlook for this industry.

1981 DISK/TREND REPORT

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

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1980		-----Forecast-----							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	1,044.8	1,715.2	1,301.7	2,179.1	1,809.4	3,029.2	2,204.0	3,670.5	2,613.0	4,331.4
Other U.S. Captive	986.6	1,627.4	1,433.4	2,283.2	1,840.5	2,906.1	2,280.8	3,569.8	2,652.6	4,101.5
TOTAL U.S. CAPTIVE	2,031.4	3,342.6	2,735.1	4,462.3	3,649.9	5,935.3	4,484.8	7,240.3	5,265.6	8,432.9
PCM	224.0	329.5	371.8	518.8	377.6	522.4	607.8	839.5	825.5	1,140.9
OEM	535.1	747.4	784.7	1,048.6	1,085.4	1,449.2	1,354.9	1,788.8	1,545.1	2,068.7
TOTAL U.S. NON-CAPTIVE	759.1	1,076.9	1,156.5	1,567.4	1,463.0	1,971.6	1,962.7	2,628.3	2,370.6	3,209.6
TOTAL U.S. SHIPMENTS	2,790.5	4,419.5	3,891.6	6,029.7	5,112.9	7,906.9	6,447.5	9,868.6	7,636.2	11,642.5
Non-U.S. Manufacturers										
Captive	--	661.5	--	833.5	47.5	1,224.8	144.9	1,598.8	264.8	1,914.0
PCM	1.1	12.2	1.1	11.1	2.6	14.9	7.2	33.6	12.5	56.5
OEM	14.3	88.0	42.5	163.4	112.3	297.0	174.5	413.0	240.6	534.7
TOTAL NON-U.S. SHIPMENTS	15.4	761.7	43.6	1,008.0	162.4	1,536.7	326.6	2,045.4	517.9	2,505.2
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	2,805.9	5,181.2	3,935.2	7,037.7	5,275.3	9,443.6	6,774.1	11,914.0	8,154.1	14,147.7

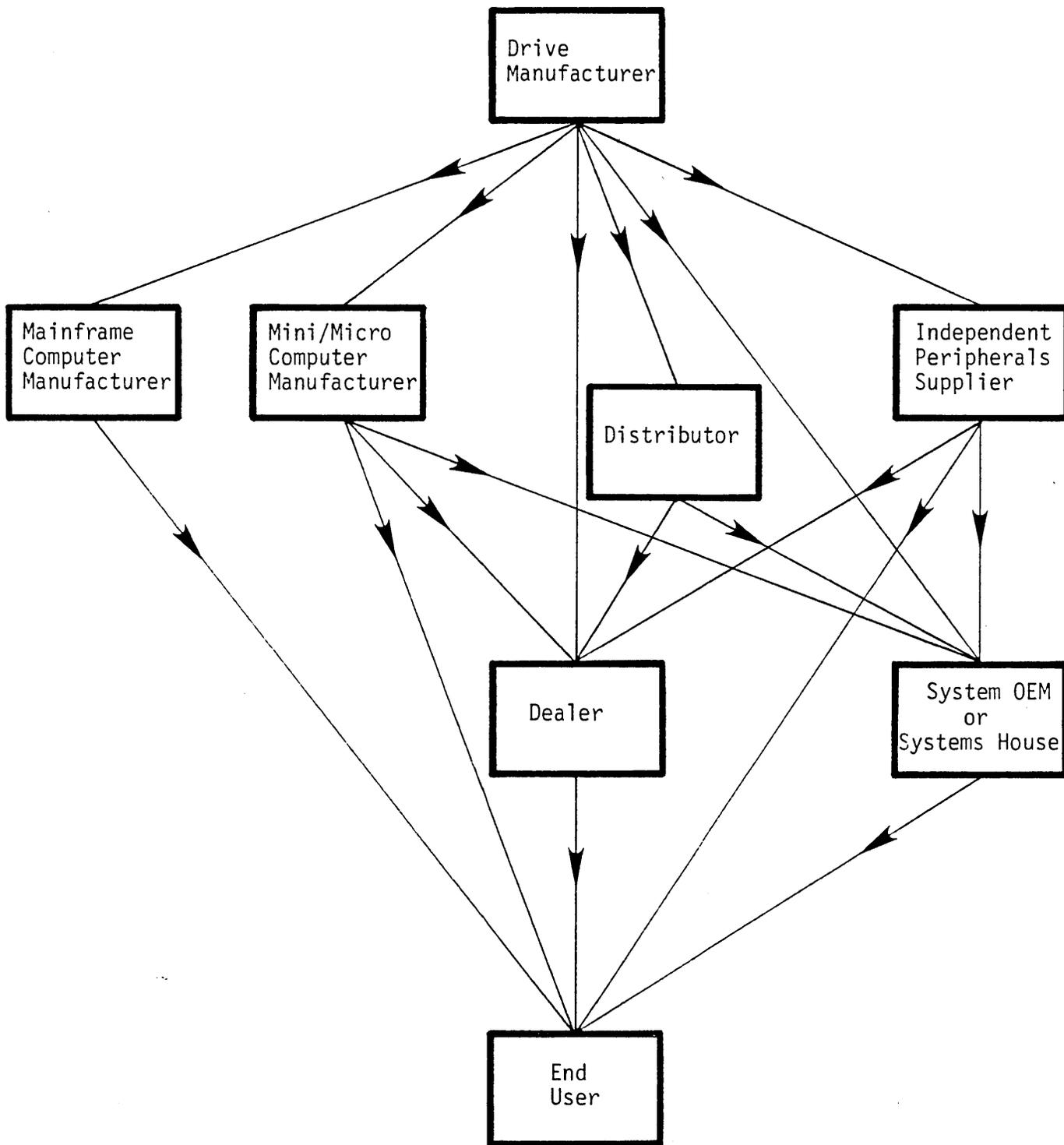
Industry structure

It is a sign of the current vigor of the disk drive industry that the only companies dropped this year from the DISK/TREND list of manufacturers are a couple of firms that never actually got into production on their announced drives. All other manufacturers remain on the list, and 17 additional companies are being added in 1981. Twelve of the additions are U.S. firms; four, European; and one, Japanese. All except four of this group plan to manufacture fixed disk drives as their initial products. And only three of the newcomers plan to make disk drives using 14" disks. The total number of rigid disk drive manufacturers is now 62, of which 43 are U.S. companies; 11, European; eight, Japanese.

The complex distribution pattern for non-captive disk drives is illustrated in Figure 1. Higher value drives are sold primarily to system OEMs and mainframe or minicomputer manufacturers for use with systems these firms market to end users or systems houses. Many smaller system OEMs, and some systems houses and sophisticated end users, buy controllers and/or complete disk subsystems from independent peripherals suppliers, instead of attempting the difficult task of controller design and manufacture themselves. The distribution channel for PCM drives, primarily a direct sale or lease arrangement between drive manufacturer and end user, is not shown in this figure.

With the rapid growth in desktop computers and the wide dispersion of all types of systems, dealer/distributor arrangements have started to emerge. Originally intended to handle personal computers and floppy drives, these channels are now becoming significant in rigid disk drive shipments.

Figure 1
NON-CAPTIVE MARKETING STRUCTURE
Moving Head Disk Drives



Marketing channels

As discussed on page SUM-2, the DISK/TREND estimate for IBM's recent disk drive revenues has been substantially revised from last year's report. IBM's share of worldwide revenues is now placed at 33.1% for 1980. Despite very rapid growth by the rest of the disk drive industry, IBM's share of total revenues is expected to stay above 30% through 1984. 1981 IBM disk drive revenues will double during this period, based on growing production of Piccolo family drives, 3370, 3375 and 3380.

Other captive disk drive manufacturers' share of worldwide revenues will fluctuate around 30% through 1984. During this time, most removable media drive groups will show stagnant growth in revenues, but all fixed disk drive groups will be growing rapidly. The net effect for all other captive product groups combined will be a 24.7% average annual growth in worldwide revenues through 1984.

The expected drop in PCM drives' share of revenues did not occur in 1981, but instead increased slightly as PCM drive shipments grew to exploit the unsatisfied demand for big disk drives on IBM systems. It should dip, however, in 1982, as the independents lag IBM's introduction cycle for new products, then recover to about 8% of total disk drive industry revenues in 1984.

OEM drives continue to achieve rapid growth, although 1980's revenue results are below last year's forecast. In 1981, this market class is tracking very closely to the previous forecast, however, and succeeding years should be even higher than previously anticipated, due to increased forecasts for fixed disk drives.

TABLE 2
 CONSOLIDATED WORLDWIDE SHIPMENTS
 MARKET CLASS REVIEW
 REVENUE SUMMARY

WORLDWIDE REVENUES BY MANUFACTURER TYPE	-----1980-----		-----FORECAST-----							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	\$M	%	\$M	%	\$M	%	\$M	%	\$M	%
U.S. Manufacturers										
IBM	1,715.2	33.1	2,179.1	31.0	3,029.2	32.1	3,670.5	30.8	4,331.4	30.6
Other U.S. Captive	1,627.4	31.4	2,283.2	32.4	2,906.1	30.8	3,569.8	30.0	4,101.5	29.0
PCM	329.5	6.4	518.8	7.4	522.4	5.5	839.5	7.0	1,140.9	8.1
OEM	747.4	14.4	1,048.6	14.9	1,449.2	15.3	1,788.8	15.0	2,068.7	14.6
Total U.S. Mfgr's.	4,419.5	85.3	6,029.7	85.7	7,906.9	83.7	9,868.6	82.8	11,642.5	82.3
Non-U.S. Manufacturers										
Captive	661.5	12.8	833.5	11.8	1,224.8	13.0	1,598.8	13.4	1,914.0	13.5
PCM	12.2	.2	11.1	.2	14.9	.2	33.6	.3	56.5	.4
OEM	88.0	1.7	163.4	2.3	297.0	3.1	413.0	3.5	534.7	3.8
Total Non-U.S. Mfgr's.	761.7	14.7	1,008.0	14.3	1,536.7	16.3	2,045.4	17.2	2,505.2	17.7
Worldwide Total	5,181.2	100.0	7,037.7	100.0	9,443.6	100.0	11,914.0	100.0	14,147.7	100.0

Product mix

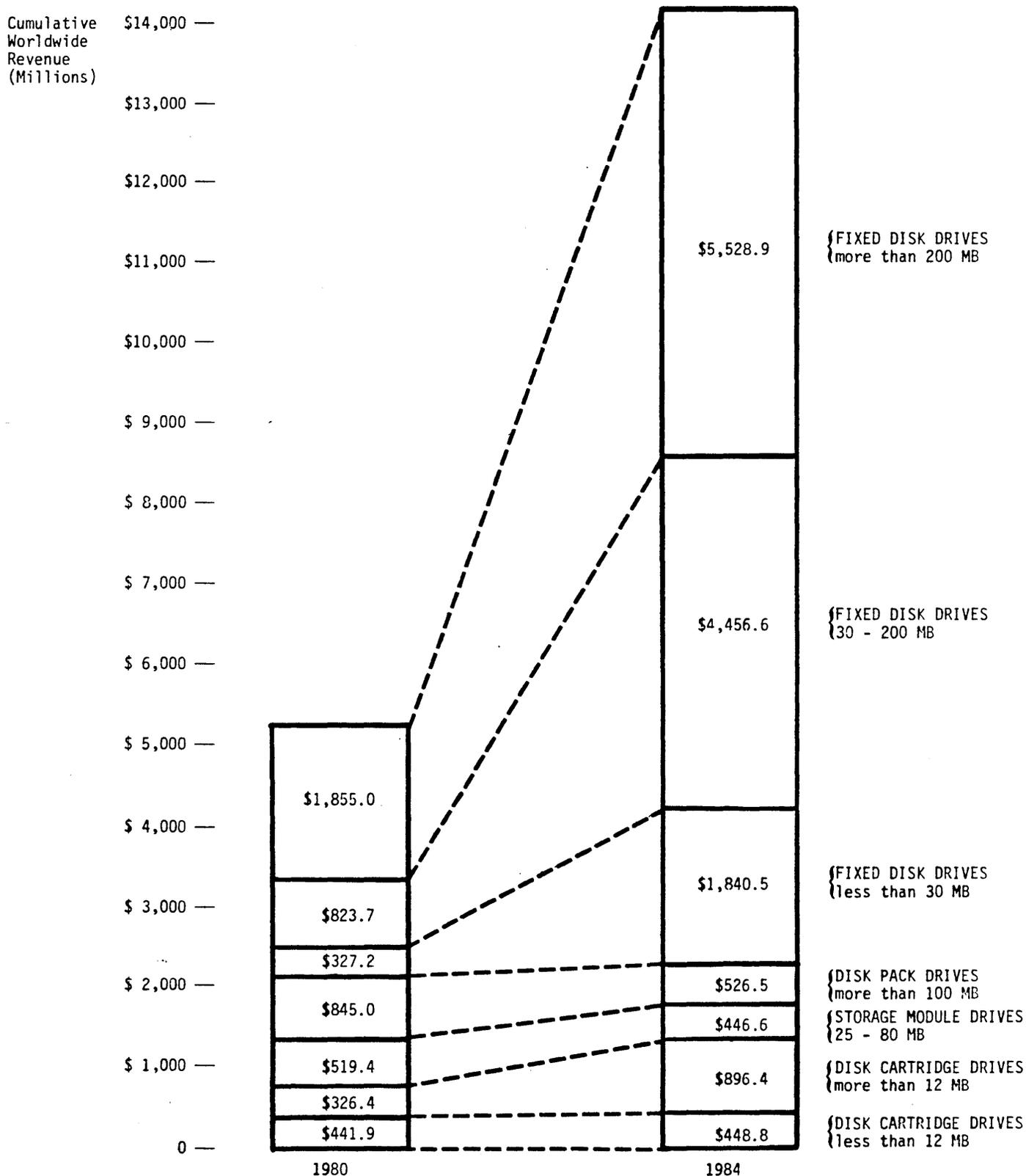
Worldwide revenues for fixed disk drives reached 58.0% of the 1980 total, and are continuing to grow at a rate even faster than envisioned in previous DISK/TREND forecasts. By 1984, fixed disk drives are expected to account for 83.6% of worldwide revenues.

Fixed disk drives over 200 MB have already become the dominant DISK/TREND product group, with worldwide 1980 revenues of \$1,855,000,000. However, this group's 35.8% of the total is expected to grow only to 39.1% in 1984, a much lower growth rate than for fixed disk drives of lower capacity.

The sharpest growth of all will accrue to fixed disk drives in the 30-200 MB range. All market classes will boost shipments of these drives, with captive producers throughout the world, including IBM, contributing the biggest share. In addition, OEM drive shipments in this group, which were relatively minor in 1980, will become the largest for total revenue production of any OEM disk drive group.

Disk cartridge drives more than 12 MB will be the only group of rigid removable disk drives to sustain continuous growth through 1984 -- but they are forecasted to close that period with the same 6.3% of total worldwide disk drive revenues they held in 1980. 8" disk cartridge drives are expected to achieve substantial market penetration, and should hold 50% of 1984 worldwide revenues for disk cartridge drives more than 12 MB. Disk cartridge drives less than 12 MB are projected for minimal growth for the total group during the same period, but major changes in product mix are foreseen, with 8" drives holding 54% of worldwide revenues in 1984.

Figure 2
 CHANGING PRODUCT MIX
 CONSOLIDATED WORLDWIDE DISK DRIVE SHIPMENTS



OEM market

Fixed disk drives will soon constitute the majority of all OEM drives shipped worldwide, but removable disk drives are still the major source of revenue for disk drive manufacturers, and will produce almost half of OEM drive revenues as late as 1983, according to current DISK/TREND projections.

Despite IBM's complete abandonment of rigid removable disks, and a follow-the-leader response by other mainframers producing captive disks, the thousands of system OEMs buying disk drives from independent manufacturers have continued their loyalty to the principal disk cartridge and disk pack configurations. And they are expected to respond enthusiastically to many new, smaller, more cost effective drives yet to be introduced.

Fixed disk drives are nevertheless already growing at a spectacular rate in selected OEM drive market segments, and in 1984 are forecasted to provide 56.9% of worldwide OEM drive revenues. Current unit shipments of OEM 5.25" and 8" fixed disk drives less than 30 MB are growing fastest in response to the booming market for desktop and other small computers. Drives in this group will provide half of all OEM drive unit shipments in 1984, but only 20% of total OEM revenues, due to very low unit selling prices.

Another group of fixed disk drives, those in the 30-200 MB range, will also achieve very strong growth in unit shipments, but the higher value of these drives will produce an even more dramatic growth in revenues -- from 4.5% of worldwide total revenues in 1980 to 27.4% in 1984. 14" and 8" high performance drives in the 160 MB area will make the most important contribution to this increase.

1981 DISK/TREND REPORT

TABLE 3
 CONSOLIDATED WORLDWIDE SHIPMENTS
 PRODUCT CATEGORY REVIEW

REVENUE SUMMARY

	-----1980-----		-----FORECAST-----							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	\$M	%	\$M	%	\$M	%	\$M	%	\$M	%
WORLDWIDE REVENUES ALL MANUFACTURERS										
Disk Cartridge Drives Less than 12 MB	441.9	8.5	487.6	6.9	484.0	5.1	473.6	4.0	448.8	3.2
Disk Cartridge Drives More than 12 MB	326.4	6.3	477.0	6.8	669.2	7.1	809.6	6.8	896.4	6.3
Disk Pack Drives 29-58 MB	26.3	.5	9.8	.1	6.8	.1	5.1	--	3.4	--
Storage Module Drives 25-80 MB	519.4	10.0	531.2	7.5	535.2	5.7	518.5	4.4	446.6	3.2
Disk Pack Drives More than 100 MB	845.0	16.3	802.0	11.4	763.9	8.1	689.3	5.8	526.5	3.7
Data Module Drives	16.3	.3	1.2	--	--	--	--	--	--	--
Fixed Disk Drives Less than 30 MB	327.2	6.3	510.6	7.3	912.5	9.7	1,345.4	11.3	1,840.5	13.0
Fixed Disk Drives 30-200 MB	823.7	15.9	1,482.7	21.1	2,512.9	26.6	3,548.1	29.8	4,456.6	31.5
Fixed Disk Drives More than 200 MB	1,855.0	35.8	2,735.6	38.9	3,559.1	37.7	4,524.4	38.0	5,528.9	39.1
Total Worldwide Revenue	5,181.2	100.0	7,037.7	100.0	9,443.6	100.0	11,914.0	100.0	14,147.7	100.0
% U.S. Mfg.	85.3		85.7		83.7		82.8		82.3	
Annual Growth Rate			+35.8%		+34.2%		+26.2%		+18.7%	

TABLE 4
 OEM WORLDWIDE SHIPMENTS
 PRODUCT CATEGORY REVIEW
 REVENUE SUMMARY

	-----1980-----		-----FORECAST-----							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	\$M	%	\$M	%	\$M	%	\$M	%	\$M	%
WORLDWIDE REVENUES ALL MANUFACTURERS										
Disk Cartridge Drives Less than 12 MB	200.1	24.0	188.0	15.5	179.5	10.3	172.0	7.8	169.1	6.5
Disk Cartridge Drives More than 12 MB	99.1	11.9	193.5	16.0	330.3	18.9	438.9	19.9	560.0	21.5
Disk Pack Drives 29-58 MB	26.3	3.1	9.8	.8	6.8	.4	5.1	.2	3.4	.1
Storage Module Drives 25-80 MB	193.8	23.2	228.5	18.9	234.2	13.4	219.7	10.0	194.4	7.5
Disk Pack Drives More than 100 MB	211.3	25.3	252.9	20.9	260.7	14.9	245.5	11.1	195.7	7.5
Data Module Drives	5.0	.6	--	--	--	--	--	--	--	--
Fixed Disk Drives Less than 30 MB	52.8	6.3	164.4	13.6	325.5	18.6	426.2	19.4	520.2	20.0
Fixed Disk Drives 30-200 MB	37.8	4.5	135.1	11.1	289.3	16.6	509.9	23.2	713.8	27.4
Fixed Disk Drives More than 200 MB	9.2	1.1	39.8	3.3	119.9	6.9	184.5	8.4	246.8	9.5
Total Worldwide Revenue	835.4	100.0	1,212.0	100.0	1,746.2	100.0	2,201.8	100.0	2,603.4	100.0
% U.S. Mfg.	89.5		86.5		83.0		81.2		79.5	
Annual Growth Rate			+45.1%		+44.1%		+26.1%		+18.2%	

TABLE 5
 OEM WORLDWIDE SHIPMENTS
 PRODUCT CATEGORY REVIEW
 UNIT SHIPMENT SUMMARY

WORLDWIDE UNIT SHIPMENTS ALL MANUFACTURERS	-----1980-----		-----FORECAST-----							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	Units	%	Units	%	Units	%	Units	%	Units	%
Disk Cartridge Drives Less than 12 MB	66.6	32.5	62.2	16.4	62.8	10.0	64.6	7.3	73.9	6.7
Disk Cartridge Drives More than 12 MB	24.6	12.0	47.1	12.4	83.5	13.2	116.0	13.1	152.0	13.7
Disk Pack Drives 29-58 MB	3.2	1.6	1.1	.3	.8	.1	.6	.1	.4	
Storage Module Drives 25-80 MB	41.8	20.4	50.3	13.2	51.9	8.2	49.8	5.6	47.3	4.3
Disk Pack Drives More than 100 MB	23.4	11.4	27.5	7.2	28.1	4.5	26.7	3.0	21.5	1.9
Data Module Drives	.5	.2	--	--	--	--	--	--	--	--
Fixed Disk Drives Less than 30 MB	33.3	16.3	145.1	38.2	307.3	48.7	452.7	51.3	548.0	49.5
Fixed Disk Drives 30-200 MB	10.5	5.1	43.1	11.3	85.1	13.5	154.5	17.5	238.0	21.5
Fixed Disk Drives More than 200 MB	.9	.4	3.5	.9	11.3	1.8	18.2	2.1	25.8	2.3
Total Worldwide Units	204.8	100.0	379.9	100.0	630.8	100.0	883.1	100.0	1,106.9	100.0
% U.S. Mfg.	89.5		86.5		83.0		81.2		79.5	
Annual Growth Rate			+85.5%		+66.0%		+40.0%		+25.3%	

TABLE 6

1980 ESTIMATED MARKET SHARES

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

	CAPTIVE		PCM		OEM		TOTAL INDUSTRY	
	\$M	%	\$M	%	\$M	%	\$M	%
<u>U.S. MANUFACTURERS</u>								
Ampex	--	--	--	--	30.5	3.7	30.5	.6
Burroughs	476.1	11.9	--	--	.4	.1	476.5	9.2
Century Data Systems	--	--	--	--	83.2	10.0	83.2	1.6
Control Data	396.4	9.9	69.8	20.4	460.5	55.1	926.7	17.9
Data General	108.0	2.7	--	--	--	--	108.0	2.1
Datapoint	24.6	.6	--	--	--	--	24.6	.5
Digital Equipment	183.1	4.6	--	--	--	--	183.1	3.5
Hewlett-Packard	180.9	4.5	--	--	--	--	180.9	3.5
IBM	1,715.2	42.8	--	--	--	--	1,715.2	33.1
ISS/Univac	190.5	4.8	3.3	1.0	3.8	.4	197.6	3.8
Memorex	--	--	108.4	31.7	59.9	7.2	168.3	3.2
Microdata	28.9	.7	--	--	.5	.1	29.4	.6
Perkin Elmer	3.5	.1	--	--	16.7	2.0	20.2	.4
Pertec	15.7	.4	--	--	20.7	2.5	36.4	.7
Shugart Associates	.8	--	--	--	18.4	2.2	19.2	.4
Storage Technology	--	--	148.0	43.3	3.8	.4	151.8	2.9
Western Dynex	--	--	--	--	18.7	2.2	18.7	.4
Other U.S.	18.9	.5	--	--	30.3	3.6	49.2	.9
U.S. Total	3,342.6	83.5	329.5	96.4	747.4	89.5	4,419.5	85.3
<u>NON-U.S. MANUFACTURERS</u>								
Data Recording Equipment	--	--	--	--	23.3	2.8	23.3	.5
Fujitsu	179.0	4.5	--	--	6.7	.8	185.7	3.6
Hitachi	40.1	1.0	1.1	.3	2.8	.3	44.0	.9
Isotimpex	--	--	--	--	17.6	2.1	17.6	.3
Mitsubishi	59.5	1.5	--	--	9.2	1.1	68.7	1.3
Nippon Electric Company	136.5	3.4	--	--	1.5	.2	138.0	2.7
Philips	48.3	1.2	--	--	--	--	48.3	.9
Siemens	141.4	3.5	--	--	--	--	141.4	2.7
Toshiba	47.5	1.2	--	--	3.5	.4	51.0	1.0
Other Non-U.S.	9.2	.2	11.1	3.3	23.4	2.8	43.7	.8
Non-U.S. Total	661.5	16.5	12.2	3.6	88.0	10.5	761.7	14.7
Worldwide Total	4,004.1	100.0	341.7	100.0	835.4	100.0	5,181.2	100.0

Note: Drives manufactured by ISS, NPL or Hitachi and resold by others in the PCM market are valued at PCM price levels above, to avoid distortion of total PCM market values.

Codes: 5 = 5.25" C = Captive
 8 = 8" P = PCM
 9 = 9" O = OEM
 10 = 10.5"
 14 = 14"

TABLE 7

CURRENT PRODUCT LINES
 MANUFACTURERS OF MOVING HEAD DISK DRIVES

DISK/TREND PRODUCT GROUP:		1	2	4	5	7	8	9
		Disk Cartridge Drives <12 MB	Disk Cartridge Drives >12 MB	Storage Module Drives 25-80 MB	Disk Pack Drives >100 MB	Fixed Disk Drives <30 MB	Fixed Disk Drives 30-200 MB	Fixed Disk Drives >200 MB
U.S. Manufacturers	Type							
Alpha Data	0						14	
Ampex*	0			14	14		14	14
Ball Computer	0			14	14			
Burroughs	C,0	14		14	14	14	14	14
Century Data Systems	0			14	14	14	14	
Computer Memories	0					5		
Control Data	C,P,0	14	8,14	14	14	8,14	14	14
Dastek	0							14
Data General	C	14	14	14	14	14		
Data Peripherals	0	8						
Datapoint	C	14	14					
Digital Equipment	C	14	14			14	14	
Disk Memory Technology	0					9		
DMA Systems	0	5						
Hewlett-Packard	C		14	14	14	8,14		
IBM	C					8,14	8	14
International Memories	C,0					5,8	8	
Irwin International	0					5		
ISS/Univac	C,P,0			14	14		14	14
Kennedy	0					14	8,14	
Memorex	P,0		8		14	8	14	14
Microdata	C	14				14	14	
Micro Peripherals	0					5		
Micropolis	0					8	8	
Miniscribe	0					5		
New World Computer	C,0					5,8		
Northern Telecom	C	14				8,14		
Ohio Scientific	0						14	
Perkin Elmer	C,0	14	14					
Pertec	C,0	14	14			8,14		
Priam	0						8,14	
Quantum	0					8	8	
Rotating Memory Systems	0					5		
Seagate Technology	0					5		
Shugart Associates	C,0					5,8,14	14	
SLI Industries	0					8	8	
Storage Technology	P,0							14
Tandon	0					5		
Tecstor	0						14	
Texas Instruments	0					5		
3M	0					8	8	
Vermont Research	0		14					
Western Dynex	0	14	14			14		
Japanese Manufacturers								
Fujitsu	C,0		14		14	8,14	8,14	10,14
Hitachi	C,P,0				14	8,14	8,14	14
Hokushin	0	14	14			8	8,14	
Mitsubishi	C,0	14	14	14	14	8,14	8,14	
Nippon Electric Company	C,0	14			14	8,14	8,14	14
Nippon Electric Industry	0					5,8	8	
Nippon Peripherals	C,P,0					5	8	14
Toshiba	C,0		14		14	8,14	8,14	
European Manufacturers								
BASF	0					5,8	8	
Cii-Honeywell Bull	C,0	10	10			5	10	
Data Recording Equipment	0	14	14			8		
Hightrack Computer Technik	0					8	8	
Isotimpex*	0	14			14			
Nixdorf	C			14				
Olivetti	C,0					5	8	
Philips	C,0	14	14			14		
Rodime	0					5		
ROM Control Data*	0							
Siemens	C,0				14			14

*Manufactures disk pack drives equivalent to IBM's 2314

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TECHNICAL REVIEW

Competing technologies

Worldwide disk drive shipments are expected to be worth \$7 billion to drive manufacturers this year, and DISK/TREND projections call for that figure to double in the next three years. Any market that size, with such a growth rate, is guaranteed to attract plenty of would-be innovators with a "better" way to do the same thing.

But would-be improved alternatives to magnetic rigid disk recording have been announced on many occasions during the industry's rapid climb to its current position by a number of excellent researchers and sponsored by solid companies. To date, the net result of all the announcements is almost no impact on magnetic disk recording's growth.

The underlying problem for competitive data storage technologies is the continuing advancement in recording densities achieved with magnetic recording. Fewer heads and disks mean lower cost per megabyte and less physical space per disk drive. Higher densities, and the corollary development in head positioning techniques, also provide faster access to data. Improvements in these parameters have been rapid, and the pace is obviously going to be sustained for many years to come.

Furthermore, any alternative to magnetic disk recording will be unattractive to the computer industry if only marginal improvements are offered. Magnetic disk recording is too well entrenched, with tens of thousands of computer industry development personnel familiar with disk drive reliability, availability, prices, interface requirements, and

impact on system software. It will require a major advantage for the competitor to dislodge disk drives from their hold on the data storage market.

Many of the proposed new data storage methods do possess advantages over magnetic disks in individual performance areas. But so far, all of them have also had major disadvantages in certain key areas -- such as unit cost, producibility, or high front-end costs to start manufacturing operations.

As development of alternative storage methods continues, it is becoming clear that most of them will not attract a following, but that a few will co-exist with magnetic disk recording, finding a role in certain data storage requirements in which magnetic disk recording is not particularly cost effective or practical. Here is a review of the probable winners and losers:

- * Optical disk: In the past, various optical memory devices have been developed, but the survivor, at least for computer data storage, is the optical disk. Optical disks hold out the promise of high capacity in a small, removable package, combined with fast access and stable archival storage. The most important limitation to all the optical disk variations in the product development stage today is the lack of a way to revise previously recorded data. These systems are known as "non-reversible".

A non-reversible medium could possibly be used in a variety of data processing applications by providing a means to allow re-writing revised records through a series of new locations on the disk. The idea would be that optical disk capacity would be so cheap that revisions to records could be continually re-written at little additional cost, and the old records would still be available if needed. The problem with this concept is that it would require extensive revision of the software now used in the industry to control auxiliary data storage, and even then would not be suitable for frequently revised data bases.

However, much of the planning for optical disk systems is now more realistic. Rather than being aimed at the mainstream applications which are done so efficiently by magnetic disk drives, optical disk systems now being developed appear to be concentrated

on applications such as backup for large magnetic disk files, storage of infrequently updated files, on line mass storage systems, and document storage in "electronic file cabinet" systems.

The remaining technical questions on optical disks make it difficult to be sure which type of recording media will prevail. The technology has been the beneficiary of major development programs for consumer optical products designed for video and audio recording. But the long-term media stability and error rates required for data storage are considerably more demanding than those of the consumer market. Problems arose with the stability of disks using metallic tellurium in a sandwich with plastics, because of a tendency of tellurium to degrade when exposed to the atmosphere. Several firms have spent a great amount of time and resources to clear up this problem, and many have experimented with other types of optical disk media using dyes, metallic particles suspended in plastic coatings, and coatings in which lasers are used to raise a surface bubble rather than burn a hole. Companies active in development of such media include Eastman Kodak, 3M and Drexler Technology. All of this recent activity among the firms active in optical disk development has created an impression of technical confusion, and certainly lack of a consensus on the media question. But most participants are confident that the several media solutions offered represent not unsolvable problems, but a variety of feasible methods.

Reversibility can be demonstrated only to a severely limited degree with today's optical disk technology. The experimental techniques developed suffer from problems such as slow completion of the reversal cycle, limitations on the number of reversals before degradation, poor archival storage, and low recording density. It seems likely that a truly suitable method of reversible optical disk recording has not yet been invented.

Despite the technical limitations considered above, several firms have advanced optical disk development programs which are likely to result in actual commercial products in the next few years. Toshiba has demonstrated an office document storage system, but commercial deliveries are still in the future. It is probable that a number of firms with an involvement in "office of the future" systems will be active in this area eventually. In the meantime, other image storage applications in the CAD-CAM area and in medicine are considered probable, and systems for use in data processing applications are coming.

Hardware development is underway at several major companies. Philips was an early pioneer in optical disk systems for video and data storage, and recently indicated an intent to offer a system for attachment to computer systems, with prototypes planned for 1982 and production in 1983. Storage Technology acquired the Pasadena-based optical disk development group of

Exxon Enterprises in June, 1981, and now has an extensive program apparently intended to result in a high performance data storage system. Other companies with active development programs include Xerox, Control Data, Burroughs, Hitachi, IBM, Thomson-CSF, McDonnell Douglas and RCA.

- * Magnetic bubbles: 1981 brought both good news and bad news for magnetic bubble fans. The departure from the field of both Rockwell and Texas Instruments was a shock to the industry. Both firms had been pioneers in development of quantity production for bubbles, and the availability of stock commercial chips from Texas Instruments has provided for several years the principal source of actual products for industry consideration. But managements of the two firms apparently grew impatient with the major investments already made in the technology, combined with uncertain timetables for achieving profitability.

Programs from some other bubble manufacturers appear to be in much better shape. Hitachi is presently assumed to be the leader in quantity production, with most shipments going to Nippon Telephone and Telegraph. Western Electric, the captive manufacturing arm of AT&T, is preparing to manufacture bubbles for extensive use in telephone switching systems for Bell system operating companies. Intel Magnetics has moved into the lead among U.S. bubble manufacturers, as a result of successful execution of its plan to proceed directly to quantity production of one megabit chips, combined with early availability of all support circuits needed for system integration. National Semiconductor is producing 256 Kbit chips and support circuits, with one megabit chips expected at the end of 1981. The firm has a second source arrangement with Motorola, which expects to be in production in 1982. Intel Magnetics has also voiced an interest in second sourcing arrangements.

The major captive program is IBM's. Just what IBM's intention for bubbles is, is still obscure. Most speculation involves smart typewriters, cache memories in large systems, various intelligent workstations, and point of sale terminals. From the amount of technical activity, it is clear that IBM's investment in the technology is large, and continuing. It remains unclear when bubble technology will be used in actual IBM products.

The existing manufacturers of bubble chips for the commercial market have found most applications available to them are not the ones for which either rigid or flexible disks are normally used. Bubbles' high price, many times the price per megabyte of all types of disk drives, limits their market to a variety of specialized and harsh environment applications. However, because of the actual availability of one megabit chips and support circuits, with an aggressive commitment by Intel Magnetics to specific lower future prices, some market areas are now opening up for bubbles. Bubbles' non-volatility offers significant advantages over RAM memory for several applications, and they are suitable for capacity ranges too small to be cost effective for

magnetic disk drives. So they are finding their way into portable terminals, industrial control systems, robots, point of sale terminals, medical instrumentation and military systems.

The size of the future market available to magnetic bubbles will be directly dependent upon price. The experience curve will inevitably produce lower prices as shipments increase, but the question is how much lower. At this time, the most optimistic projections for bubbles in the second half of the 1980s are for prices several times the probable prices for magnetic disks. Even then, it seems likely that bubbles will still find their markets in specialized applications, with magnetic disk drives still storing data by the terabyte.

- * High capacity flexible disk drives: Shipments of small fixed Winchester disk drives are now growing at a phenomenal rate, filling a need for more capacity, faster access and better reliability on a variety of small computer systems. This market is largely based on the demand for upgraded versions of small systems previously using only flexible disk drives for auxiliary storage. But it may be possible to provide many of the benefits of Winchester disks with certain types of floppy drives, at lower cost.

Iomega has announced a drive with 10 MB formatted capacity, using a Bernoulli principle floppy. This technology uses a flexible disk revolving at high speed in a rigid plastic cartridge, employing an air bearing between the disk and the cartridge's interior walls to maintain stability and prevent media wear. It is still early to predict whether the founders of this firm, who worked on comparable technology at IBM, will succeed in achieving quantity production of reliable drives, at a cost attractive enough to wean system OEMs away from small Winchester and disk cartridge drives. But the potential is there, and developments in this area bear watching.

It is also possible that refinements in existing floppy drive and media technology could greatly increase the practical capacity range of floppy drives. Most manufacturers have considered it essential to keep the production cost of any new floppy drive low, so there has been a reluctance to use the sophisticated head positioning methods required to double track densities on 8" drives or increase them further on 5.25" drives. But increases in linear density are close at hand. It is considered likely that IBM will introduce a new floppy drive using chromium dioxide magnetic particles instead of iron oxide, providing higher resolution. In an 8" format, this drive could offer 3-4 MB capacity, with only a modest increase in TPI. Such an introduction by IBM would obviously create another industry defacto standard, and general availability of OEM drives using IBM's media standard would follow.

Even without IBM's blessing, there is a considerable appetite in the industry for further exploitation of the potential for floppy technology. One new firm, Amlyn, is ready to provide drives using spin coated oxide coated disks produced by Dysan in a small cartridge holding five 5.25" diskettes. By recording at 170 TPI, 9,500 BPI, Amlyn will offer 8 MB capacity per cartridge, with hardware prices considerably below Winchester drives. The intended market for this drive is for backup of 5.25" Winchesters, but it is conceivable that some system OEMs will find the drive attractive as a basic system disk.

- * Other alternate technologies: No other data storage method is currently considered likely to have any possibility of significant impact on rigid disk drive growth through 1984. EBAM (Electron-beam accessed MOS storage) is still a laboratory curiosity, with only theoretical suitability for very large systems, and a probable requirement to make major software changes for efficient usage. Charge coupled devices were widely discussed as potential disk replacements a few years ago, but CCD projects were shelved by most of the semiconductor manufacturers sponsoring them. It seems that CCDs never could get very far in front of the cost reduction curve achieved by other storage technologies.

Disk drive enhancements

As always, the major technology innovations in the disk drive industry during recent years have come from IBM. Most of the newer generation of thin film heads will be patterned closely after IBM's heads for the 3370, 3375 and 3380. The industry is currently seeing many innovations in disks, head positioning methods and recording methods from other quarters, but the mainstream products continue to be highly influenced by technology introduced by IBM.

- * Recording heads: Although Fujitsu announced drives in 1981 using ferrite heads at densities as high as 12,790 BPI, most ferrite heads today operate in the 4,000 to 8,500 BPI range. Ferrite heads are produced internally by several major disk drive manufacturers and other independent head manufacturers, and used on almost all drives made today. Compared to IBM's newer thin film heads, ferrite heads are available from multiple sources, producible with good manufacturing yields, and are competitively priced. Most of the industry agrees that thin film heads will eventually dominate for the majority of disk drive requirements, but the beginning of that dominance is still several years in the future.

Both IBM and its competition found that achieving efficient quantity production of thin film heads was tough to do. But the movement down the learning curve has started, especially for IBM, the only firm actually producing drives using thin film heads in quantity. The recording densities now used with thin film heads are probably well within the range practical for ferrite heads. But it is agreed that thin film heads will be needed for the next leap forward in linear density. The real significance in the introduction of thin film heads during this period is that the industry will learn how to make them efficiently now, before they are needed.

- * Recording disks: IBM's progression in recording densities through 3340/3350/Piccolo/3370/3375/3380 apparently involves only a refinement in the oxide coating process through each new disk drive model to achieve a continually thinner application of a uniform coating. The newer disks do involve improvements in chemical engineering and coating application which provide technical hurdles for competitors, but most are expected to meet the challenge. The next generation of drives will probably involve thin metallic films, rather than particulate coatings -- but IBM's introductions are believed to be years in the future. In the meantime, a few drive manufacturers are using plated disks in new drives, to provide the potential for future density increases.
- * Head positioning methods: Some high performance disk drives are now operated at densities as high as 960 TPI, but such precision is too costly for use on most drives. The majority of drives are still designed for less than 500 TPI. There is still considerable room for innovation in head positioning, to achieve higher densities and lower cost.
- * Longitudinal vs. perpendicular recording: The digital magnetic recording systems in use today all employ longitudinal recording -- the magnetizing of long, thin particles oriented parallel to the surface of the recording medium. It is theoretically possible to achieve much higher recording density by orienting these particles in a plane vertical to the recording surface. Published research has indicated laboratory demonstrations of at least 100,000 BPI with the theoretical possibility of 500,000 BPI.

Although IBM, Eastman Kodak, Sony and other major companies have conducted advanced research in this area, it is probable that the first practical samples of vertically oriented disks available to the industry will come from two new startup firms organized in 1981. Lanx, in San Jose, plans to provide vertically oriented sputtered rigid disks to existing manufacturers of high performance disk drives, intended for use in upgraded versions of existing disk drives. Vertimag, in Minneapolis, plans to provide vertically oriented flexible media for digital and video applications. Vertimag has already demonstrated media operating at 40,000 BPI. The actions of both firms could be very influential in accelerating the development of magnetic disk drives operating at strikingly higher densities than today's equipment.

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

- * Drives sold by DEC, Hewlett-Packard or Burroughs are considered captive, if internally manufactured.
- * In the case of a joint venture disk drive manufacturer such as Magnetic Peripherals, Inc., a joint venture of Control Data and Honeywell, MPI drives sold by Honeywell are included in captive, and MPI drives sold by CDC are included in captive, PCM or OEM groups, as appropriate.

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

- * Shipments by Shugart Associates are non-captive, except for drives sold by its parent company or other subsidiaries.
- * CDC disk drive sales to NCR are non-captive, in that NCR does not share in ownership of MPI, and are included in OEM totals.

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

- * Storage module drives sold by CDC to users of IBM Series/1 systems.
- * On an arbitrary basis, drives manufactured by ISS, Nippon Peripherals or Hitachi and resold in the PCM market by other companies are included in PCM totals, in order to avoid distortion of total industry PCM activity.

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

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

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

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

- * IBM and Burroughs are considered U.S. manufacturers, even though each firm manufactures some of its disk drives in non-U.S. locations.
- * BASF is considered a non-U.S. manufacturer although the firm manufactures disk drives in the U.S. as well as Germany.

Revenue: Based on sale of disk drives alone, as normally sold by individual manufacturers. Controllers sold as separate units are not included, nor are spare parts or service. When individual disk drive models include integral control functions, such as may be required for the first drive on a string of drives, the actual value of each unit is used. Sale prices are estimated public sale transaction prices, whether at captive end user, PCM or OEM levels. Prices used for leased drives are on an "if sold" basis, at captive or PCM levels, as appropriate. All projected prices are in 1981 constant dollars.

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

- * Enhancements such as double density versions of existing configurations, revised encoding schemes and improved fixed head options 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 computer manufacturers, sometimes popularly known as "mainframers". In the U.S. this group consists of IBM, Sperry Univac, Honeywell, Burroughs, Control Data, and NCR.

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

System OEMs/systems houses: (1) OEMs which manufacture a system requiring disk drives, such as Foxboro, Basic Four or Cromemco. (2) Systems houses, of any size, which combine finished components and custom software to offer users complete systems.

Independent peripherals suppliers: Specialized manufacturers which add controllers, interfaces and other equipment or software, and offer plug compatible subsystems to end users, system OEMs and systems houses. Examples are System Industries, Advanced Electronic Design, Microcomputer Systems, Xylogics and Emulex.

Direct to end user: Sales of plug compatible disk drives with any other necessary hardware directly to end users by disk drive manufacturers, whether or not title to the equipment is to be held by end users themselves or by lessors.

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DISK CARTRIDGE DRIVES, LESS THAN 12 MB

1981 DISK/TREND REPORT

DISK CARTRIDGE DRIVES, LESS THAN 12 MBCoverage

Examples of disk drives in this group include:

14" disk diameter

IBM	2310, 5444, 5447, 5022
Burroughs	9480-22
Control Data	9427H
Data General	6045, 6095
Datapoint	9360
Data Recording Equipment	4044B, D9427H
Digital Equipment	RK05J, RL01, RL02
Hokushin	CD5200S
Isotimpex	ISOT 1370, SM 5400
Mitsubishi	M802F/S
Nippon Electric Company	N7711, N7715
Perkin Elmer	VT-2222
Pertec	D3341, D3441
Philips	X1215
Western Dynex	DD-6121, DD-6222

10.5" disk diameter

Cii-Honeywell Bull	D120, D135
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8" disk diameter

Data Peripherals	DP100
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This product group includes all removable-only or fixed/removable disk drives with a total capacity per spindle of less than 12 MB. Each fixed/removable combination drive is counted as one spindle. 14" disk cartridges may be front loading (patterned after IBM's 2315), top loading (similar to IBM's 5440), or a special design. The special cartridges used with the Cii-Honeywell Bull D120 and D135 use a 10.5" disk. Drives using 8" disks in a special cartridge have been added this year, with the Data Peripherals DP 100 still the only announced product in the group.

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
U.S. manufacturers	360.6	410.9	394.5	378.1	346.8
All manufacturers	441.9	487.6	484.0	473.6	448.8

Total production of this product group has been at its expected peak during 1980 and 1981. Shipments still consist mostly of 14" drives. Net worldwide unit shipments are expected to increase in 1981, up 4.9% over 1980, and total revenues are forecasted to be up by 10.3% in 1981. The major portion of this increase is attributable to DEC's captive production of its RL01/RL02 drive, now being produced in larger quantities than any other drive in this group.

U.S. OEM drive shipments were historically the driving force in this product group, but the peak shipment level by U.S. manufacturers was reached in 1979, with 60,600 spindles. 1981 shipments are estimated at 45,400 14" drives, plus less than 1,000 of the newer 8" drives. Other disk drive configurations have finally halted the decade-long growth of 14" drives in this group.

As shipments by OEM drive manufacturers continue to decline in total, the industry leader, Control Data, has still not peaked. CDC shipped 29,300 OEM drives in 1980, 44% of the worldwide total -- with only Western Dynex among the other U.S. manufacturers increasing its shipments, to 8,500 units. Several of the pioneer disk cartridge drive manufacturers have now completely discontinued manufacture of OEM drives, in each case several years after being acquired by larger firms: Diablo (acquired by Xerox), Caelus (EMM), and Iomec (Data 100, which was subsequently acquired by Northern Telecom). Total OEM shipments by non-U.S.

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manufacturers have also been declining since 1979, led by rapid movement by Japanese manufacturers to small fixed Winchester drives in newer systems.

The huge success of DEC's RL01/RL02 program is entirely responsible for the forecasted increase in U.S. captive drive production for this group, from 42,000 units in 1980, to 51,400 in 1981. Apparently, DEC's major design consideration for this drive was low production cost, which has made it possible for DEC to sell these drives at prices \$2,000 to \$4,000 below other captive drives in this group. Until the introduction of the RL01 and RL02, DEC was losing a significant portion of the disk cartridge drive business available from various types of system integrators using DEC systems. DEC has now recaptured most of this business from independent vendors, and has substantially improved its overall competitive position versus other manufacturers of minicomputer systems. Most other manufacturers of captive drives in this group have concentrated on higher capacity disk cartridge drives or on small Winchester drives. For this reason, production levels for every other manufacturer of captive drives worldwide is either flat or declining.

Marketing status

While this product group's past belonged to the 14" drive, its future will be owned by drives using small diameter disks. DISK/TREND statistics for the group now reflect the forecasted impact of 8" and 10.5" drives, and it is expected that 5.25" disk cartridge drives will be introduced by the time the 1982 DISK/TREND Report is published. European production of 10.5" drives by Cii-Honeywell Bull is well under way, and initial U.S. production of 8" drives by Data Peripherals has commenced, with a cooperative program by Dysan to market the required disk media. The expected

effect of these programs and others yet to come will be to replace the shipments lost to declining 14" sales volume -- with the net result that worldwide unit shipments for this product group will actually grow slightly through 1984.

Initially, most of this growth in smaller disk cartridge drive shipments will come from OEM drives, driven by the many system OEMs now using 14" cartridge drives who would like to transition to drives with a smaller physical size and lower cost, but would also like to continue with removable disk cartridges. It is expected that captive manufacturing programs will be initiated by some of the larger system manufacturers, however, even though it may take a few years for volume shipments.

Technical trends

Higher recording densities will be the hallmark of the newer small drives in this group, but the technology employed will probably be similar to drives already announced: Very thin oxide disk coatings, mostly ferrite heads, well designed air filtration systems, and some use of sophisticated encoding algorithms to enhance effective recording densities.

Forecasting assumptions

1. 14" disk cartridge drives will continue to decline due to competitive pressure from higher capacity disk cartridge drives and small diameter disk drives, both fixed and disk cartridge types, with the exception of continued high level production of DEC's RL01/RL02.
2. OEM price levels will decline, as smaller drive shipments increase.
3. Additional OEM manufacturing programs for 8" drives will be initiated in 1982 and captive programs in 1983/1984.

TABLE 8
DISK CARTRIDGE DRIVES, LESS THAN 12 MB
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1980		Forecast							
	---Shipments---		---1981---		---1982---		---1983---		---1984---	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>U.S. Manufacturers</u>										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	128.3	208.0	169.1	275.1	165.2	270.5	161.3	263.2	143.6	232.2
TOTAL U.S. CAPTIVE	128.3	208.0	169.1	275.1	165.2	270.5	161.3	263.2	143.6	232.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	101.6	152.6	92.2	135.8	86.0	124.0	80.6	114.9	79.0	114.6
TOTAL U.S. NON-CAPTIVE	101.6	152.6	92.2	135.8	86.0	124.0	80.6	114.9	79.0	114.6
TOTAL U.S. SHIPMENTS	229.9	360.6	261.3	410.9	251.2	394.5	241.9	378.1	222.6	346.8
<u>Non-U.S. Manufacturers</u>										
Captive	--	33.8	--	24.5	--	34.0	--	38.4	--	47.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	6.9	47.5	11.4	52.2	15.3	55.5	20.2	57.1	21.8	54.5
TOTAL NON-U.S. SHIPMENTS	6.9	81.3	11.4	76.7	15.3	89.5	20.2	95.5	21.8	102.0
<u>Worldwide Recap</u>										
TOTAL WORLDWIDE SHIPMENTS	236.8	441.9	272.7	487.6	266.5	484.0	262.1	473.6	244.4	448.8
OEM Average Price (\$000)	2.9	3.0	3.0	3.0	2.8	2.9	2.6	2.7	2.3	2.3

TABLE 9
DISK CARTRIDGE DRIVES, LESS THAN 12 MB
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers	-----									
IBM	(5.9)	(8.7)	(5.2)	(7.6)	(4.8)	(7.1)	(4.4)	(6.5)	(4.0)	(6.1)
Other U.S. Captive	25.9	42.0	31.6	51.4	29.5	48.3	28.8	47.0	26.6	43.0
TOTAL U.S. CAPTIVE	20.0	33.3	26.4	43.8	24.7	41.2	24.4	40.5	22.6	36.9
PCM	--	--	--	--	--	--	--	--	--	--
OEM	35.2	52.9	31.3	46.1	30.7	44.3	31.0	44.2	35.9	52.1
TOTAL U.S. NON-CAPTIVE	35.2	52.9	31.3	46.1	30.7	44.3	31.0	44.2	35.9	52.1
TOTAL U.S. SHIPMENTS	55.2	86.2	57.7	89.9	55.4	85.5	55.4	84.7	58.5	89.0
Non-U.S. Manufacturers	-----									
Captive	--	3.5	--	2.5	--	3.5	--	4.0	--	5.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	2.0	13.7	3.5	16.1	5.1	18.5	7.2	20.4	8.7	21.8
TOTAL NON-U.S. SHIPMENTS	2.0	17.2	3.5	18.6	5.1	22.0	7.2	24.4	8.7	26.8
Worldwide Recap	-----									
TOTAL WORLDWIDE SHIPMENTS	57.2	103.4	61.2	108.5	60.5	107.5	62.6	109.1	67.2	115.8
Installed at Year End	-----									
IBM	41.8	62.0	36.6	54.4	31.8	47.3	27.4	40.8	23.4	34.7
Non-IBM	397.2	671.0	463.6	787.1	528.9	901.7	595.9	1,017.3	667.1	1,139.2
WORLDWIDE TOTAL	439.0	733.0	500.2	841.5	560.7	949.0	623.3	1,058.1	690.5	1,173.9

TABLE 10
 DISK CARTRIDGE DRIVES, LESS THAN 12 MB
 WORLDWIDE SHIPMENTS
 14" AND 8" DISK DIAMETERS*

	-----DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		Forecast							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	14"	8"	14"	8"	14"	8"	14"	8"	14"	8"
<u>U.S. Manufacturers</u>										
IBM	(8.7)	--	(7.6)	--	(7.1)	--	(6.5)	--	(6.1)	--
Other U.S. Captive	42.0	--	51.4	--	48.3	--	44.0	3.0	35.0	8.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	52.9	--	45.4	.7	36.3	8.0	27.2	17.0	19.1	33.0
TOTAL U.S. SHIPMENTS	86.2	--	89.2	.7	77.5	8.0	64.7	20.0	48.0	41.0
<u>Non-U.S. Manufacturers</u>										
Captive	3.1	.4	1.0	1.5	1.0	2.5	--	4.0	--	5.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	10.6	3.1	10.3	5.8	9.8	8.7	7.8	12.6	5.4	16.4
TOTAL NON-U.S. SHIPMENTS	13.7	3.5	11.3	7.3	10.8	11.2	7.8	16.6	5.4	21.4
<u>TOTAL WORLDWIDE SHIPMENTS</u>	99.9	3.5	100.5	8.0	88.3	19.2	72.5	36.6	53.4	62.4
14"/8" ANNUAL SHARE	97%	3%	93%	7%	82%	18%	67%	33%	46%	54%

*CII-Honeywell Bull's 10.5" Cynthia drive is grouped with 8" drives in this table.

TABLE 11
DISK CARTRIDGE DRIVES, LESS THAN 12 MB
DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

<u>Distribution Channel</u>	1980 U.S. Net Shipments		FORECAST			
	Units (000)	%	1981 %	1982 %	1983 %	1984 %
Mainframe computer manufacturers	7.1	19.1	16.2	13.8	11.7	10.0
Mini/micro computer manufacturers	14.3	38.4	35.7	33.2	31.6	30.0
System OEMs/systems houses	13.0	35.0	42.0	48.4	53.5	57.5
Independent peripherals suppliers	1.8	4.8	3.4	2.4	1.2	.6
Direct to end user/retail dealers	<u>1.0</u>	2.7	2.4	2.2	2.0	1.9
TOTAL	37.2					

TABLE 12
DISK CARTRIDGE DRIVES, LESS THAN 12 MB
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	1980 Net Shipments			
	<u>To United States Destinations</u>		<u>Worldwide</u>	
	Units (000)	%	Units (000)	%
Control Data	19.3	51.9	29.3	44.0
Western Dynex	5.1	13.7	8.5	12.8
Century Data Systems	7.0	18.8	7.8	11.7
Data Recording Equipment	--	--	6.4	9.6
Perkin Elmer	2.2	5.9	3.8	5.7
Pertec	1.3	3.5	3.2	4.8
CII-Honeywell Bull	2.0	5.4	3.1	4.7
Other U.S.	.3	.8	.3	.4
Other Non-U.S.	<u>--</u>	<u>--</u>	<u>4.2</u>	<u>6.3</u>
TOTAL	37.2	100.0	66.6	100.0

DISK CARTRIDGE DRIVES, MORE THAN 12 MB

DISK CARTRIDGE DRIVES, MORE THAN 12 MBCoverage

Examples of disk drives in this group include:

14" disk diameter

Ampex	DFR-932, DFR-964, DFR-996
Control Data	9448-32, 9448-64, 9448-96 CMD
Data General	6070
Datapoint	9374
Data Recording Equipment	D9448-32, D9448-64, D9448-96
Digital Equipment	RK06, RK07
Fujitsu	M-2201, M-2211
Hewlett-Packard	7906
Hokushin	CD-5200, CD-5400
Mitsubishi	M803
Perkin Elmer	VT-2422
Pertec	D3461, D3481
Philips	X1240
Toshiba	MK-200R, MK-800R-32/64/96
Vermont Research	5017-4
Western Dynex	8420, 8430

10.5" disk diameter

Cii-Honeywell Bull	D 140
--------------------	-------

8" disk diameter

Control Data	9455 Lark I
Memorex	201

All drives in this group use a removable disk cartridge, which is usually, but not always, combined with one or more fixed disks. Drives in the group may be classified as follows:

Conventional fixed/removable cartridge format: Drives which are essentially the same physical configuration as lower capacity 14" cartridge drives, but which use 10 MB removable cartridges combined with 10 MB fixed disks (Data General 6070, Perkin Elmer VT-2422, Mitsubishi M803, Toshiba MK-200R, Western Dynex 8420/8430).

High capacity fixed/removable format: Drives using storage module (6000 BPI) technology to provide 16 MB removable cartridges, combined with up to 80 MB on fixed disks (Control Data 9448 series, Toshiba MK-800R series).

Unique configurations: Drives such as Fujitsu's M-2201 (50 MB removable), Cii-HB's D 140 (10 MB fixed/10 MB removable on 10.5" disks), DEC's RK06 and RK07 (up to 27.5 MB in a special two-disk removable cartridge), Vermont Research's 5017-4 (26 MB fixed/26 MB removable, with embedded servo), and CDC's 9455 Lark I (8 MB fixed/8 MB removable, on 195 mm disks, with embedded servo).

Since last year Century Data System's Hunter drive, comparable to the CDC 9448 CMD series, has been withdrawn from the market, and the Memorex 201 8" fixed/removable drive has been delayed for a redesign intended to provide more capacity. The Perkin-Elmer 8" fixed/removable drive, which has received numerous mentions in the trade press and was privately shown during the 1981 NCC, is expected to be formally announced later in 1981.

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
U.S. manufacturers	265.5	378.0	523.8	613.9	671.6
All manufacturers	326.4	477.0	669.2	809.6	896.4

Control Data's family of "Cartridge Module Drives", the 9448 series, has achieved very rapid growth and now dominates shipments in this product group. CDC's 1979 OEM shipments of 10,000 spindles were increased to 18,300 in 1980, 74.4% of the worldwide OEM market -- and a continued high growth rate is expected for 1981. The total of worldwide shipments for all market classes is expected to reach 72,400 spindles in 1981, an increase of 59.5% over 1980.

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Captive shipments of 14" drives will increase by only a few thousand spindles in 1981. Most captive drives are dead-end products with only 20 MB capacity, and the major system OEMs manufacturing these drives have diverted customers to SMD-type disk pack drives or newer Winchester drives.

It is expected that a major contributor to future growth of this product group will be the 8" fixed/removable cartridge drives now being introduced. The only drive actually available to date, however, is CDC's Lark I, with 8 MB fixed/8 MB removable; quantity production is expected to start in the second half of 1981.

Marketing trends

It is clear that the established momentum of Control Data's CMD drive family will generate continued growth for years, but a part of that growth is expected to be diverted to higher capacity versions of the 8" Lark drive after 1982. It is not yet clear to what extent other manufacturers of OEM drives will participate in the markets CDC is creating for both 14" and 8" drives in this group. Both Memorex and Perkin Elmer's Memory Products Division are currently involved in merger/acquisition discussions, which will have an unknown impact on the products in question, and the 8" cartridge drive projects planned by others are still in early stages of development. Aside from Control Data, only UPL (the CDC/DRE joint venture firm in England), plus Toshiba, manufacture CDC equivalent drives.

At this time, it appears that captive drive manufacturers will not increase their emphasis on 14" drives in this group, and will get off to a relatively slow start with 8" cartridge drives. However, OEM drive

shipments are destined to continue rapid growth, initially in 14" drives, later in 8" drives -- whether or not Control Data's competitors are successful in initiating design and marketing programs. Worldwide shipments of OEM drives are projected at 152,000 spindles in 1984. Growth rates in total worldwide shipments of all OEM and captive drives are expected to average 51% annually during 1982-1984.

Technical trends

It is considered likely that future advances for recording density in this group will bypass 14" drives, and will be concentrated in 8" drives, and eventually 5.25" drives -- in response to the continuing trend toward smaller, quieter, lower cost, more energy-efficient systems.

In order to take advantage of the established market for CMD drives, the new 8" drives will generally be designed for 16 MB removable cartridges, with track capacities and cylinder organization as similar to the CMD as possible. Most such drives are also expected to offer interfaces compatible with Control Data's well-established SMD interface, plus "intelligent" drive options.

Forecasting assumptions

1. The CMD and similar drives will remain the leading OEM disk cartridge drive configuration in this group through 1983.
2. 8 inch disk cartridge drives will be widely accepted, due to integral backup capability, small physical size and competitive pricing, with OEM shipments exceeding those for 14 inch drives in 1984.

TABLE 13
DISK CARTRIDGE DRIVES, MORE THAN 12 MB
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1980		-----Forecast-----							
	---Shipments---		---1981---		---1982---		---1983---		---1984---	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>U.S. Manufacturers</u>										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	110.8	176.5	128.6	207.9	146.9	239.8	149.3	245.3	118.8	198.0
TOTAL U.S. CAPTIVE	110.8	176.5	128.6	207.9	146.9	239.8	149.3	245.3	118.8	198.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	59.2	89.0	109.9	170.1	195.2	284.0	258.8	368.6	337.4	473.6
TOTAL U.S. NON-CAPTIVE	59.2	89.0	109.9	170.1	195.2	284.0	258.8	368.6	337.4	473.6
TOTAL U.S. SHIPMENTS	170.0	265.5	238.5	378.0	342.1	523.8	408.1	613.9	456.2	671.6
<u>Non-U.S. Manufacturers</u>										
Captive	--	50.8	--	75.6	--	99.1	--	125.4	--	138.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	2.4	10.1	4.4	23.4	18.1	46.3	27.8	70.3	33.8	86.4
TOTAL NON-U.S. SHIPMENTS	2.4	60.9	4.4	99.0	18.1	145.4	27.8	195.7	33.8	224.8
<u>Worldwide Recap</u>										
TOTAL WORLDWIDE SHIPMENTS	172.4	326.4	242.9	477.0	360.2	669.2	435.9	809.6	490.0	896.4
OEM Average Price (\$000)	4.0	4.0	4.2	4.1	4.0	4.0	3.8	3.8	3.7	3.7

TABLE 14
DISK CARTRIDGE DRIVES, MORE THAN 12 MB
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers	-----Forecast-----									
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	10.8	17.2	12.0	19.4	13.6	22.2	13.7	22.5	10.8	18.0
TOTAL U.S. CAPTIVE	10.8	17.2	12.0	19.4	13.6	22.2	13.7	22.5	10.8	18.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	14.7	22.1	26.3	40.7	48.8	71.0	68.1	97.0	91.2	128.0
TOTAL U.S. NON-CAPTIVE	14.7	22.1	26.3	40.7	48.8	71.0	68.1	97.0	91.2	128.0
TOTAL U.S. SHIPMENTS	25.5	39.3	38.3	60.1	62.4	93.2	81.8	119.5	102.0	146.0
Non-U.S. Manufacturers	-----									
Captive	--	3.6	--	5.9	--	8.4	--	11.5	--	12.7
PCM	--	--	--	--	--	--	--	--	--	--
OEM	.6	2.5	1.2	6.4	4.9	12.5	7.5	19.0	9.4	24.0
TOTAL NON-U.S. SHIPMENTS	.6	6.1	1.2	12.3	4.9	20.9	7.5	30.5	9.4	36.7
Worldwide Recap	-----									
TOTAL WORLDWIDE SHIPMENTS	26.1	45.4	39.5	72.4	67.3	114.1	89.3	150.0	111.4	182.7
Installed at Year End	-----									
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	59.7	105.6	99.2	178.0	166.5	292.1	255.8	442.1	367.2	624.8
WORLDWIDE TOTAL	59.7	105.6	99.2	178.0	166.5	292.1	255.8	442.1	367.2	624.8

TABLE 15
 DISK CARTRIDGE DRIVES, MORE THAN 12 MB
 WORLDWIDE SHIPMENTS
 14" AND 8" DISK DIAMETERS*

	-----DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		-----Forecast-----							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	14"	8"	14"	8"	14"	8"	14"	8"	14"	8"
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	17.2	--	19.2	.2	20.2	2.0	18.5	4.0	13.0	5.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	22.0	.1	37.7	3.0	55.0	16.0	60.0	37.0	62.0	66.0
TOTAL U.S. SHIPMENTS	39.2	.1	56.9	3.2	75.2	18.0	78.5	41.0	75.0	71.0
Non-U.S. Manufacturers										
Captive	3.5	.1	3.9	2.0	4.2	4.2	4.7	6.8	4.9	7.8
PCM	--	--	--	--	--	--	--	--	--	--
OEM	2.0	.5	3.2	3.2	7.5	5.0	11.0	8.0	12.0	12.0
TOTAL NON-U.S. SHIPMENTS	5.5	.6	7.1	5.2	11.7	9.2	15.7	14.8	16.9	19.8
TOTAL WORLDWIDE SHIPMENTS	44.7	.7	64.0	8.4	86.9	27.2	94.2	55.8	91.9	90.8
14"/8" ANNUAL SHARE	98%	2%	88%	12%	76%	24%	63%	37%	50%	50%

*CII-Honeywell Bull's 10.5" Cynthia drive is grouped with 8" drives in this table.

TABLE 16
 DISK CARTRIDGE DRIVES, MORE THAN 12 MB
 DISTRIBUTION CHANNEL SUMMARY
 U.S. Non-Captive Disk Drives

<u>Distribution Channel</u>	1980 U.S. Net Shipments		FORECAST			
	Units (000)	%	1981 %	1982 %	1983 %	1984 %
Mainframe computer manufacturers	3.3	21.6	20.5	19.3	17.9	16.5
Mini/micro computer manufacturers	5.2	34.0	33.3	32.7	32.0	31.6
System OEMs/systems houses	6.3	41.2	42.4	43.4	44.6	45.3
Independent peripherals suppliers	.5	3.2	3.8	4.6	5.5	6.6
Direct to end user/retail dealers	--	--	--	--	--	--
TOTAL	15.3					

TABLE 17
 DISK CARTRIDGE DRIVES, MORE THAN 12 MB
 MARKET SHARE SUMMARY
 Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	1980 Net Shipments			
	To United States Destinations		Worldwide	
	Units (000)	%	Units (000)	%
Control Data	12.2	79.7	18.4	74.8
Other U.S.	2.5	16.4	3.7	15.0
Other Non-U.S.	.6	3.9	2.5	10.2
TOTAL	15.3	100.0	24.6	100.0

DISK PACK DRIVES, 29-58 MB

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DISK PACK DRIVES, 29-58 MBCoverage

Examples of disk drives in this group include:

IBM	2314, 2319, 5445
Ampex	DM-323
Control Data	9746, 9747
Isotimpex	EC 6061

When IBM introduced the 2314 in 1965, as the basic disk drive for use with System/360, it established a standard configuration for drives and media which was to survive long after production was discontinued by IBM itself. At one time, most of the major disk drive manufacturers throughout the world produced 2314-type drives, but it is believed that actual production of new drives in this group is now limited to three organizations. All drives in the group utilize the same basic technology and physical configuration as IBM's original 2314, but most of the drives now in production are "double density" 58 MB versions.

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
U.S. manufacturers	17.8	1.3	--	--	--
All manufacturers	26.3	9.8	6.8	5.1	3.4

The DISK/TREND units shipment summary, Table 19, shows negative shipments during the 1980-1984 period of this report, due to the continuing retirements of IBM and PCM drives, which have been made obsolete by newer IBM configurations. The worldwide population of

System/360 computers has been declining for years, and the 2314 drives used with them are being replaced along with the computers.

Worldwide shipments of new drives in this group were down to 3,200 spindles in 1980, with the market entirely in Europe. Control Data and Ampex are the last U.S. companies involved in manufacturing such drives, and their involvement in actual manufacturing is again substantially diminished in 1981. The last production of 2314-type drives in Japan was in 1979, and in Western Europe, 1980. In 1981, continuing production is concentrated in Eastern Europe. ROM-Control Data, a joint venture organization in Romania with 45% CDC participation, is still in production, as is a Bulgarian state enterprise represented by Isotimpex.

Western European markets for sophisticated computer products traditionally have developed somewhat later than in the United States, and the final phase in the product life cycle of such products has also lingered on longer than in the U.S. At this time, even the 2314 OEM market is drying up in favor of newer, more cost effective disk drives, and the 1981 market for such drives remaining in Western Europe is expected to be very small.

Marketing trends

With the complete halt of all 2314-type production in the Western industrialized countries, continuation of shipments for these drives will depend entirely on product planning decisions made for the planned economies of Eastern Europe. Since only limited production of 3330 technology drives is yet available in these countries, and they may be

expected to experience considerable difficulty with Winchester technology, it is probable that production of 2314-type drives will continue for several years, but at total production levels considered insignificant in comparison to the world market. For this reason, this product category is included in the DISK/TREND Report this year for the last time -- it will be dropped from the 1982 DISK/TREND Report.

Forecasting assumptions

1. OEM drive production will end in 1981, except in Eastern Europe.
2. In Western countries and Japan, system designers will not use drives in this group on any new systems.

TABLE 18
DISK PACK DRIVES, 29-58 MB
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1980		Forecast							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>U.S. Manufacturers</u>										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. CAPTIVE	--	--	--	--	--	--	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	17.8	--	1.3	--	--	--	--	--	--
TOTAL U.S. NON-CAPTIVE	--	17.8	--	1.3	--	--	--	--	--	--
TOTAL U.S. SHIPMENTS	--	17.8	--	1.3	--	--	--	--	--	--
<u>Non-U.S. Manufacturers</u>										
Captive	--	--	--	--	--	--	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	8.5	--	8.5	--	6.8	--	5.1	--	3.4
TOTAL NON-U.S. SHIPMENTS	--	8.5	--	8.5	--	6.8	--	5.1	--	3.4
<u>Worldwide Recap</u>										
TOTAL WORLDWIDE SHIPMENTS	--	26.3	--	9.8	--	6.8	--	5.1	--	3.4
OEM Average Price (\$000)	--	8.2	--	8.9	--	8.5	--	8.5	--	8.5

TABLE 19
DISK PACK DRIVES, 29-58 MB
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		Forecast							
	Shipments		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>U.S. Manufacturers</u>										
IBM	(2.1)	(3.5)	(2.0)	(3.3)	(1.8)	(3.0)	(1.6)	(2.6)	(1.4)	(2.3)
Other U.S. Captive	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. CAPTIVE	(2.1)	(3.5)	(2.0)	(3.3)	(1.8)	(3.0)	(1.6)	(2.6)	(1.4)	(2.3)
PCM	(.9)	(1.1)	(.9)	(1.0)	(.9)	(1.0)	(.8)	(.9)	(.8)	(.9)
OEM	--	2.2	--	.1	--	--	--	--	--	--
TOTAL U.S. NON-CAPTIVE	(.9)	1.1	(.9)	(.9)	(.9)	(1.0)	(.8)	(.9)	(.8)	(.9)
TOTAL U.S. SHIPMENTS	(3.0)	(2.4)	(2.9)	(4.2)	(2.7)	(4.0)	(2.4)	(3.5)	(2.2)	(3.2)
<u>Non-U.S. Manufacturers</u>										
Captive	--	--	--	--	--	--	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	1.0	--	1.0	--	.8	--	.6	--	.4
TOTAL NON-U.S. SHIPMENTS	--	1.0	--	1.0	--	.8	--	.6	--	.4
<u>Worldwide Recap</u>										
TOTAL WORLDWIDE SHIPMENTS	(3.0)	(1.4)	(2.9)	(3.2)	(2.7)	(3.2)	(2.4)	(2.9)	(2.2)	(2.8)
<u>Installed at Year End</u>										
IBM	20.1	34.7	18.1	31.4	16.3	28.4	14.7	25.8	13.3	23.5
Non-IBM	60.5	124.0	59.6	124.1	58.7	123.9	57.9	123.6	57.1	123.1
WORLDWIDE TOTAL	80.6	158.7	77.7	155.5	75.0	152.3	72.6	149.4	70.4	146.6

STORAGE MODULE DRIVES, 25-80 MB

STORAGE MODULE DRIVES, 25-80 MBCoverage

Examples of disk drives in this group include:

Ampex	DM-940, DM-980
Ball	BD-50, BD-80
Burroughs	9484-5
Century Data Systems	T-50, T-80
Control Data	9760, 9762, 270-10
Data General	6067
Hewlett-Packard	7920
ISS/Univac	8418, 8419
Mitsubishi	M2850F, M2851F

When Control Data introduced its 9760 in 1974, it also introduced the name "Storage Module Drive". The abbreviation SMD is now widely used to describe not only the 9760 and 9762, each with five data surfaces, but also the larger disk pack drives with 19 data surfaces using the SMD standard interface. The term SMD is used throughout the DISK/TREND Report as a generic description for these Control Data drives and competitive equivalents. All SMDs in this product group use packs with five data surfaces, yielding a capacity up to 80 MB. The Univac 8418 and 8419 with seven data surfaces have also been included, arbitrarily, since their capacities and technology are roughly similar to the SMD's.

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
U.S. manufacturers	506.6	510.5	504.3	467.6	388.9
All manufacturers	519.4	531.2	535.2	518.5	446.6

Shipments by manufacturers of U.S. OEM drives are the mainstay of this product group. U.S. OEM unit shipments were 41,600 spindles in 1980, up 36.4% from 1979, and continuing the dynamic growth shown for several years in this key OEM product group. However, the forecast for 1981 of 50,000 spindles represents an increase of only 20.2%, expected to signal the beginning of the product life cycle peak for the 14" OEM disk drives in this group.

Production of captive U.S. drives started into a slight decline in 1980, with this trend now expected to continue through 1981 and beyond. Behind this drop appears to be a transition among users of the systems involved toward higher capacity disk pack drives and the growing availability of fixed disk drives in the SMD's capacity range.

Production of SMD-type drives by non-U.S. manufacturers has remained very small, but it is possible that the initiation of SMD manufacturing operations during 1981 by Nixdorf may increase captive non-U.S. shipments in later years.

Control Data's share of the 1980 worldwide OEM market held up well, at 69.7%, representing 29,500 spindles. Century Data Systems' market share increased slightly, to 21.3%, with 9,000 drives. Shipments of PCM drives to IBM Series/1 customers by Control Data remain small, and are included in CDC's OEM market share above.

Marketing trends

Even the most successful of disk drive configurations must reach a production peak eventually, and it is now expected that the peak for SMDs in this group will occur in 1982, with a gentle decline thereafter through 1984. Newer drives using Winchester technology promise higher reliability

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and better prices per megabyte than the 80 MB SMD. A pronounced movement toward these drives is underway in 1981, and expected to be stronger in future years. However, the SMD still has great momentum and solid acceptance among many types of OEMs and the decline will not be rapid. Continual decline for total captive production is also forecasted, as several manufacturers initiate their own Winchester drive programs.

Technical trends

The introduction of 160 MB drives by Ampex and Ball, using double track density, has been ignored by Control Data, and without the market-leader's blessing, little impact on the 80 MB SMD has been noted in the marketplace.

The expected introduction of 8" versions of the 80 MB SMD is another matter, however, since the industry expects Control Data itself to make such a move next year. The impact of an 8" SMD is not yet included in DISK/TREND forecasts, and it is likely that such a product would materially extend the product life cycle for the 80 MB SMD, with a significant shift in product mix occurring in 1983 and 1984.

Forecasting assumptions

1. OEM sales of 14" SMDs will peak in 1982, due to competition from other removable media drives and from fixed disk drives.
2. If 8" SMD-type drives are introduced in 1982, it will be necessary to modify the existing forecast for 1983-1984.
3. OEM average prices will decline slightly, representing the continued growth in cumulative industry production.
4. Captive production will continue to decline through the forecast period, due to competition from other disk drive configurations.

TABLE 20
STORAGE MODULE DRIVES, 25-80 MB
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1980		-----Forecast-----							
	Shipments		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	177.9	307.5	165.7	276.1	158.1	262.4	146.0	242.7	113.6	188.8
TOTAL U.S. CAPTIVE	177.9	307.5	165.7	276.1	158.1	262.4	146.0	242.7	113.6	188.8
PCM	6.5	6.5	6.4	7.7	7.6	10.1	6.3	7.5	6.2	7.4
OEM	145.4	192.6	173.2	226.7	173.7	231.8	163.2	217.4	144.7	192.7
TOTAL U.S. NON-CAPTIVE	151.9	199.1	179.6	234.4	181.3	241.9	169.5	224.9	150.9	200.1
TOTAL U.S. SHIPMENTS	329.8	506.6	345.3	510.5	339.4	504.3	315.5	467.6	264.5	388.9
Non-U.S. Manufacturers										
Captive	--	11.6	--	18.9	--	28.5	--	48.6	--	56.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	1.2	--	1.8	--	2.4	--	2.3	--	1.7
TOTAL NON-U.S. SHIPMENTS	--	12.8	--	20.7	--	30.9	--	50.9	--	57.7
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	329.8	519.4	345.3	531.2	339.4	535.2	315.5	518.5	264.5	446.6
OEM Average Price (\$000)	4.6	4.6	4.5	4.5	4.5	4.5	4.4	4.4	4.1	4.1

TABLE 21
STORAGE MODULE DRIVES, 25-80 MB
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		-----1981-----		-----1982-----		-----Forecast-----		-----1984-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	11.4	19.7	10.2	17.0	9.7	16.1	8.9	14.8	7.1	11.8
TOTAL U.S. CAPTIVE	11.4	19.7	10.2	17.0	9.7	16.1	8.9	14.8	7.1	11.8
PCM	.5	.5	.5	.6	.6	.8	.5	.6	.5	.6
OEM	31.4	41.6	38.2	50.0	38.6	51.5	37.1	49.4	35.3	47.0
TOTAL U.S. NON-CAPTIVE	31.9	42.1	38.7	50.6	39.2	52.3	37.6	50.0	35.8	47.6
TOTAL U.S. SHIPMENTS	43.3	61.8	48.9	67.6	48.9	68.4	46.5	64.8	42.9	59.4
Non-U.S. Manufacturers										
Captive	--	.6	--	.9	--	1.5	--	2.7	--	3.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	.2	--	.3	--	.4	--	.4	--	.3
TOTAL NON-U.S. SHIPMENTS	--	.8	--	1.2	--	1.9	--	3.1	--	3.5
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	43.3	62.6	48.9	68.8	48.9	70.3	46.5	67.9	42.9	62.9
Installed at Year End										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	115.6	165.2	164.5	234.0	213.4	304.3	259.9	372.2	302.8	435.1
WORLDWIDE TOTAL	115.6	165.2	164.5	234.0	213.4	304.3	259.9	372.2	302.8	435.1

TABLE 22
 STORAGE MODULE DRIVES, 25-80 MB
 DISTRIBUTION CHANNEL SUMMARY
 U.S. Non-Captive Disk Drives

<u>Distribution Channel</u>	1980 U.S. Net Shipments		FORECAST			
	Units (000)	%	1981 %	1982 %	1983 %	1984 %
Mainframe computer manufacturers	.5	1.6	2.2	2.1	1.9	1.6
Mini/micro computer manufacturers	22.6	70.9	66.1	60.5	53.7	45.5
System OEMs/systems houses	5.3	16.6	19.9	24.9	31.1	38.9
Independent peripherals suppliers	2.5	7.8	8.6	9.3	10.0	10.6
Direct to end user/retail dealers	<u>1.0</u>	3.1	3.2	3.2	3.3	3.4
TOTAL	31.9					

TABLE 23
 STORAGE MODULE DRIVES, 25-80 MB
 MARKET SHARE SUMMARY
 Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	1980 Net Shipments			
	<u>To United States Destinations</u>		<u>Worldwide</u>	
	Units (000)	%	Units (000)	%
Control Data	23.7	74.3	29.5	69.7
Century Data Systems	7.2	22.6	9.0	21.3
Other U.S.	1.0	3.1	3.6	8.5
Other Non-U.S.	<u>--</u>	<u>--</u>	<u>.2</u>	<u>.5</u>
TOTAL	31.9	100.0	42.3	100.0

DISK PACK DRIVES, MORE THAN 100 MB

DISK PACK DRIVES, MORE THAN 100 MBCoverage

Examples of disk drives in this group include:

IBM	3330-1, 3330-11
Ampex	DM-9100, DM-9160, DM-9300, 331
Ball	BD-100, BD-160
Burroughs	9383-16, 9484-8
Century Data Systems	T-200, T-300
Control Data	9764, 9766, 270-30, 33302
Data General	6061, 6122
Fujitsu	F479
Hewlett-Packard	7925
Hitachi	H-8589-1, H-8589-11
Isotimpex	ES-5066, ES-5067
ISS/Univac	7330-10, 7330-11, 7330-12
Memorex	3670, 3675, 677
Mitsubishi	M2838F, M2839F
Nippon Electric Company	N277
Siemens	3465, 3468
Toshiba	DSU-450

Most of the large disk pack drives now in production use 19 data surfaces and are equivalent to the IBM 3330 family introduced in 1971, except as noted below. IBM discontinued production of 3330 drives years ago, in favor of fixed disk drives. Today, the major product in the group is the Control Data 300 MB SMD, which offers 50% greater capacity than IBM's 3330-11, with a 50% increase in linear recording density (BPI).

Other disk pack drives with unique physical configurations in this group include: Ampex DM-9160 and Ball BD-160 (160 MB on five surfaces), Hewlett-Packard 7925 (120 MB on nine surfaces), Burroughs 9383-16 (174 MB on 20 surfaces, Siemens 3465 (143 MB on nine surfaces), and ISS 7330-12 (317.5 MB, the equivalent to IBM's 3350, with a 19 surface removable disk pack).

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
U.S. manufacturers	645.2	655.9	639.4	590.4	452.8
All manufacturers	845.0	802.0	763.9	689.3	526.5

Net worldwide total shipments of large disk pack drives peaked in 1980 and started into a decline in 1981. It should be noted, however, that DISK/TREND worldwide shipments are shown as net totals in Table 25, reflecting the effect of continuing retirements of IBM and PCM 3330 drives. It is expected that actual worldwide shipments of new drives in this group will not peak until 1981, at 51,500 spindles.

Worldwide shipments of OEM drives grew vigorously in 1979, to 23,400 spindles, an increase of 72.9% over the previous year. Continued growth will occur in 1981, but at a lower rate: Up 16.5%, to 26,800 spindles. The appetite for higher capacity disks among users of mainframes, superminis and larger small business systems has continued to expand this market, despite increasing competition from fixed disk drives.

Control Data obtained most of the growth for OEM drives in 1980 with 14,000 spindles -- a 59.8% share of the worldwide market. Memorex held a 24.8% share with 5,800 spindles, representing continued heavy purchases by its major OEM customer, DEC.

Worldwide shipments of captive drives in this group reached a peak in 1980, and the total is expected to be down starting in 1981, and thereafter.

Marketing trends

It now appears that the shipment peak for OEM drives in this group will not occur until 1982, but DISK/TREND forecasts for that year anticipate

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only a slight increase over 1981. It is clear that many major OEMs which have represented the core of this market are now adding a variety of the more reliable and lower cost Winchester technology drives. After 1982, nothing but a steady decline is in sight.

Worldwide captive shipments will also continue their gradual decline. The large mainframers with captive disk drive production were first to shift emphasis to fixed disk drives at the expense of disk pack drives. But the minicomputer manufacturers producing large disk pack drives will also soon add fixed Winchester drives competitive with their existing disk pack drives, which will tend to further lower shipments in this product group.

Although the existing population of IBM and PCM drives is still quite large, annual retirements will increase during the next few years, as IBM's new systems and new disk drives enter the market in increasing shipment levels.

Technical trends

The 768 TPI introduced by Ampex and Ball on 160 MB drives with five data surfaces is probably not feasible on larger 19 surface drives without employing embedded servo techniques. Century Data Systems originally announced such a drive, which has now been withdrawn. Meanwhile, the Ampex and Ball 160 MB drives are rather lonely pioneers, with CDC pursuing different plans.

Forecasting assumptions

1. IBM will not introduce any other large removable disk drive.
2. The population of IBM and PCM 3330 drives will continue to decline, due to obsolescence caused by newer systems and disk drives.
3. Other captive drives will decline after 1980, and OEM drives after 1982, due to the impact of large fixed disk drives.

TABLE 24
DISK PACK DRIVES, MORE THAN 100 MB
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1980		-----Forecast-----							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>U.S. Manufacturers</u>										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	252.3	438.7	237.3	411.1	226.8	390.1	207.8	358.3	156.9	269.2
TOTAL U.S. CAPTIVE	252.3	438.7	237.3	411.1	226.8	390.1	207.8	358.3	156.9	269.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	148.1	206.5	175.4	244.8	179.4	249.3	167.4	232.1	132.3	183.6
TOTAL U.S. NON-CAPTIVE	148.1	206.5	175.4	244.8	179.4	249.3	167.4	232.1	132.3	183.6
TOTAL U.S. SHIPMENTS	400.4	645.2	412.7	655.9	406.2	639.4	375.2	590.4	289.2	452.8
<u>Non-U.S. Manufacturers</u>										
Captive	--	195.0	--	138.0	--	113.1	--	85.5	--	61.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	4.8	--	8.1	--	11.4	--	13.4	--	12.1
TOTAL NON-U.S. SHIPMENTS	--	199.8	--	146.1	--	124.5	--	98.9	--	73.7
<u>Worldwide Recap</u>										
TOTAL WORLDWIDE SHIPMENTS	400.4	845.0	412.7	802.0	406.2	763.9	375.2	689.3	289.2	526.5
OEM Average Price (\$000)	9.0	9.0	9.1	9.2	9.2	9.3	9.1	9.2	9.0	9.1

TABLE 25
DISK PACK DRIVES, MORE THAN 100 MB
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		-----Forecast-----							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	(2.3)	(4.2)	(3.5)	(6.3)	(3.6)	(6.6)	(3.8)	(6.9)	(3.5)	(6.4)
Other U.S. Captive	11.5	20.0	11.2	19.4	10.7	18.4	9.8	16.9	7.4	12.7
TOTAL U.S. CAPTIVE	9.2	15.8	7.7	13.1	7.1	11.8	6.0	10.0	3.9	6.3
PCM	(1.3)	(1.7)	(1.9)	(2.4)	(2.4)	(3.0)	(3.1)	(3.9)	(2.8)	(3.5)
OEM	16.5	23.0	19.2	26.8	19.5	27.1	18.4	25.5	14.7	20.4
TOTAL U.S. NON-CAPTIVE	15.2	21.3	17.3	24.4	17.1	24.1	15.3	21.6	11.9	16.9
TOTAL U.S. SHIPMENTS	24.4	37.1	25.0	37.5	24.2	35.9	21.3	31.6	15.8	23.2
Non-U.S. Manufacturers										
Captive	--	6.5	--	4.6	--	3.9	--	3.0	--	2.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	.4	--	.7	--	1.0	--	1.2	--	1.1
TOTAL NON-U.S. SHIPMENTS	--	6.9	--	5.3	--	4.9	--	4.2	--	3.3
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	24.4	44.0	25.0	42.8	24.2	40.8	21.3	35.8	15.8	26.5
Installed at Year End										
IBM	38.5	64.4	35.0	58.1	31.4	51.5	27.6	44.6	24.1	38.2
Non-IBM	133.2	237.4	161.7	286.5	189.5	333.9	214.6	376.6	233.9	409.5
WORLDWIDE TOTAL	171.7	301.8	196.7	344.6	220.9	385.4	242.2	421.2	258.0	447.7

TABLE 26
DISK PACK DRIVES, MORE THAN 100 MB
DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

<u>Distribution Channel</u>	1980 U.S. Net Shipments		FORECAST			
	Units (000)	%	1981 %	1982 %	1983 %	1984 %
Mainframe computer manufacturers	2.5	15.2	13.7	12.6	11.7	10.8
Mini/micro computer manufacturers	12.2	73.9	72.2	68.6	63.1	57.4
System OEMs/systems houses	1.7	10.3	14.1	18.8	25.2	31.8
Independent peripherals suppliers	--	--	--	--	--	--
Direct to end user/retail dealers	<u>.1</u>	.6	--	--	--	--
TOTAL	16.5					

TABLE 27
DISK PACK DRIVES, MORE THAN 100 MB
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	1980 Net Shipments			
	To United States Destinations		Worldwide	
	Units (000)	%	Units (000)	%
Control Data	8.4	50.9	14.0	59.8
Memorex	5.7	34.5	5.8	24.8
Other U.S.	2.4	14.6	3.2	13.7
Other Non-U.S.	<u>--</u>	<u>--</u>	<u>.4</u>	<u>1.7</u>
TOTAL	16.5	100.0	23.4	100.0

NOTE: Based on shipments of new drives, before deduction for retirements of PCM drives.

DATA MODULE DRIVES, 35-70 MB

1981 DISK/TREND REPORT

DATA MODULE DRIVES, 35-70 MBCoverage

Examples of disk drives in this group include:

IBM	3340
Control Data	9770
Nippon Peripherals, Ltd.	NP20

IBM's 3340 was developed under the internal code name of "Winchester". Except for IBM's own substantial production of 3340 drives, worldwide production of copies of the 3340 configuration were small, due the judgement by IBM's competitors that the 3348 data module used with the 3340 was too costly as a removable media unit. The two competitive drives listed above were the only media compatible drives ever to be produced. Both were compatible with all versions of the IBM 3348 and data modules from other media suppliers. Despite the lack of a competitive following for the 3340 itself, Winchester technology has exerted a profound influence on the design direction for new disk drives, with its basic elements (closed environment, low mass heads, lubricated disks) now in use with scores of the industry's major products.

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
U.S. manufacturers	13.5	--	--	--	--
All manufacturers	16.3	1.2	--	--	--

IBM production of 3340s dropped sharply in 1979, and ceased completely in early 1980, with the last manufacture of new A2 configurations. It is probable that the only reason the A2 continued in new production so long was that it was needed to provide control functions for the attachment of 280 MB 3344 drives, using 3350 technology, to the still significant System/3 population.

Because the System/3 installed population is now being impacted by heavy deliveries of the newer System/34, System/38, 4331 and 4341, using the newer 8" Piccolo and/or 14" 3370 drives, 3340 retirements are producing a negative shipment number for IBM's 3340 in 1981 for the first time.

U.S. production by Control Data, primarily for NCR, reached its conclusion in 1980 as NCR turned to more cost-effective disk drives for its mainframes. Japanese production by Nippon Peripherals, Ltd., in cooperation with Fujitsu and Hitachi, its parent companies, has now slowed to a trickle, also in favor of other drive configurations.

Marketing trends

IBM's 3340 drive retirements are expected to accelerate, as the System/3 population dwindles, and as 3340s used with the low-end System/370 systems are also put out to pasture along with their host systems.

Japanese production will probably be ended this year, with the last movement of PCM drives manufactured by NPL into the European market. Following the usual pattern, the PCM market for this drive has dried up following the end of IBM's own shipments of 3340 drives.

Because of the close of new production activity for this product group, this is the last year it will be included in the DISK/TREND Report.

Technical trends

No further IBM product introductions are expected in this group of disk drives. IBM's current generation of fixed disk drives all employ head-disk assemblies intended to be removed only by customer engineers, not by customers. The day of the removable "data module" has come to an end.

Forecasting assumptions

1. IBM will not extend the 3340 class of products with new introductions, and will not reinstitute new production for the 3340.
2. OEM and PCM markets for drives in this group will not exist after 1981, due to lower drive and media costs for alternative disk drives.

TABLE 28
DATA MODULE DRIVES
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1980		Forecast							
	---Shipments---		---1981---		---1982---		---1983---		---1984---	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>U.S. Manufacturers</u>										
IBM	5.1	8.5	--	--	--	--	--	--	--	--
Other U.S. Captive	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. CAPTIVE	5.1	8.5	--	--	--	--	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	5.0	5.0	--	--	--	--	--	--	--	--
TOTAL U.S. NON-CAPTIVE	5.0	5.0	--	--	--	--	--	--	--	--
TOTAL U.S. SHIPMENTS	10.1	13.5	--	--	--	--	--	--	--	--
<u>Non-U.S. Manufacturers</u>										
Captive	--	1.6	--	--	--	--	--	--	--	--
PCM	--	1.2	--	1.2	--	--	--	--	--	--
OEM	--	--	--	--	--	--	--	--	--	--
TOTAL NON-U.S. SHIPMENTS	--	2.8	--	1.2	--	--	--	--	--	--
<u>Worldwide Recap</u>										
TOTAL WORLDWIDE SHIPMENTS	10.1	16.3	--	1.2	--	--	--	--	--	--
OEM Average Price (\$000)	10.0	10.0	--	--	--	--	--	--	--	--

TABLE 29
DATA MODULE DRIVES
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		Forecast							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	.3	.5	(.7)	(1.1)	(3.7)	(5.7)	(3.9)	(6.0)	(4.9)	(7.5)
Other U.S. Captive	--	--	--	--	--	--	--	--	--	--
TOTAL U.S. CAPTIVE	.3	.5	(.7)	(1.1)	(3.7)	(5.7)	(3.9)	(6.0)	(4.9)	(7.5)
PCM	--	--	--	--	--	--	--	--	--	--
OEM	.5	.5	--	--	--	--	--	--	--	--
TOTAL U.S. NON-CAPTIVE	.5	.5	--	--	--	--	--	--	--	--
TOTAL U.S. SHIPMENTS	.8	1.0	(.7)	(1.1)	(3.7)	(5.7)	(3.9)	(6.0)	(4.9)	(7.5)
Non-U.S. Manufacturers										
Captive	--	.1	--	--	--	--	--	--	--	--
PCM	--	.1	--	.1	--	--	--	--	--	--
OEM	--	--	--	--	--	--	--	--	--	--
TOTAL NON-U.S. SHIPMENTS	--	.2	--	.1	--	--	--	--	--	--
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	.8	1.2	(.7)	(1.0)	(3.7)	(5.7)	(3.9)	(6.0)	(4.9)	(7.5)
Installed at Year End										
IBM	42.5	65.5	41.8	64.4	38.1	58.7	34.2	52.7	29.3	45.2
Non-IBM	3.4	9.2	3.4	9.3	3.4	9.3	3.4	9.3	3.4	9.3
WORLDWIDE TOTAL	45.9	74.7	45.2	73.7	41.5	68.0	37.6	62.0	32.7	54.5

TABLE 30
 DATA MODULE DRIVES
 DISTRIBUTION CHANNEL SUMMARY
 U.S. Non-Captive Disk Drives

<u>Distribution Channel</u>	1980 U.S. Net Shipments		FORECAST			
	<u>Units (000)</u>	<u>%</u>	<u>1981 %</u>	<u>1982 %</u>	<u>1983 %</u>	<u>1984 %</u>
Mainframe computer manufacturers	.5	100.0	--	--	--	--
Mini/micro computer manufacturers	--	--	--	--	--	--
System OEMs/systems houses	--	--	--	--	--	--
Independent peripherals suppliers	--	--	--	--	--	--
Direct to end user/retail dealers	--	--	--	--	--	--
TOTAL	.5					

FIXED DISK DRIVES, LESS THAN 30 MB

1981 DISK/TREND REPORT

FIXED DISK DRIVES, LESS THAN 30 MBCoverage

Examples of disk drives in this group include:

14" disk diameter

IBM	System 32-34, 4962, 5448
Burroughs	9493-9, FD 211
Century Data Systems	Marksman M-20
Control Data	9414, 9730-12, 230-20
Data General	6102, 6104
Digital Equipment	RK05F
Fujitsu	M-2251, M-2252
Hewlett-Packard	7910
Hitachi	MFD 90/135, DK 62-20
Kennedy	5301-14
Microdata	Reflex 7501
Mitsubishi	M 2883-10/20
Nippon Electric Company	N 7721, D 1210
Northern Telecom	4518, 4510
Pertec	D1451
Philips	X1250, X1220
Shugart Associates	SA 4004, SA 4008
Toshiba	MK-100F
Western Dynex	DD-4222

8" disk diameter

IBM	4963-29, 8100 system, 5520 system
BASF	6171, 6172
Control Data	9410-8, 9410-24
Data Recording Equipment	3120
Fujitsu	M-2301, M-2302
Hewlett-Packard	7908
Hightrack Computer Technik	HT-24
Hitachi	DK 801, DK 811-2
Hokushin	CD-8005, CD-8010
International Memories	7710, 7720
Memorex	102
Micropolis	1201-I, 1222-I
Mitsubishi	M 2860-1
New World Computer	Mikro-Disc VIII-1, VIII-1TF
Nippon Electric Company	D 2220
Nippon Electric Industry	RD-8074, RD-8223
Northern Telecom	Aspen I, Aspen II
Pertec	D 8000
Priam	Diskos 1070
Quantum	Q2010, Q2020
Shugart Associates	SA 1002, SA 1004
SLI Industries	Cheyenne
3M	8431, 8432
Toshiba	MK80F-10/20

5.25" disk diameter

BASF	6181, 6182, 6183
Cii-Honeywell Bull	D505
Computer Memories	CM5205, CM5410, CM5616
International Memories	5006, 5007
Irwin International	510
Micro Peripherals	10
Miniscribe	1-006, 1-012
New World Computer	Mikro-Disc V 2/0, 4/0
Nippon Electric Industry	RD-5055
Nippon Peripherals, Ltd.	NP05-6, NP05-10
Olivetti	HD513, HD561, HD512
Rodime	RO 101, RO 102, RO 103, RO 104
Rotating Memory Systems	RMS 503, RMS 506, RMS 512
Seagate Technology	ST 506, ST 512
Shugart Associates	SA602, SA604, SA606
Tandon	602, 602E, 603, 603E
Texas Instruments	5¼" Winchester

IBM's drive in this group are the 14" Gulliver, a single platter drive using 3340 technology, and the 8" Piccolo, using a higher density version of 3350 technology. All of the Piccolos in this group use three disks, with five data surfaces. While a majority of the 14" drives use 3340/3350 recording technology, several still use pre-Winchester technology, including the listed drives from Burroughs, DEC, Northern Telecom, Pertec, Western Dynex, and the Control Data 9414.

All of the 8" and 5.25" drives use variations of 3340/3350 head technology except the New World Computer drives, which use special multiple head sliders. All use oxide coated disks of conventional Winchester type except the drives by Hightrack Computer Technik, Irwin International, New World Computer and International Memories (5.25") which use plated disks. Most of the 5.25" drives and some of the 8" and 14" drives use head positioning systems driven by stepping motors with relatively slow average access times, but low costs. Most of the other drives use voice coil actuators, rotary or linear, to produce access times suitable for multiple workstation systems.

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
U.S. manufacturers	265.8	403.3	674.0	957.6	1,290.5
All manufacturers	327.2	510.6	912.5	1,345.4	1,840.5

This is now the fastest growing of all DISK/TREND product groups, in terms of unit shipments. Although shipments of 14" drives with less than 30 MB are declining for all market classes, business for 8" and 5.25" drives is booming. Worldwide unit shipments increased a relatively modest 25.3% in 1980, to 66,400 spindles, but are projected to reach 190,300 spindles in 1981, up 186.6%. Worldwide revenues for 1981 are estimated at \$510.6 million, up 56.1% over 1980.

The low-cost stepping motor 14" Winchester drives pioneered by Century Data Systems and Shugart Associates in 1978 successfully demonstrated a product concept -- which was soon to be adapted to smaller drives better suited to the booming small systems market. Worldwide unit shipments of 14" drives in this group reached their peak in 1979, including drives using pre-Winchester technologies. 1980 worldwide shipments of 14" drives were down 11.7%, and 1981 shipments are expected to decline another 23.8%, to 34,000 spindles.

The big growth in both 8" and 5.25" drives in this group involves OEM products. 1981 worldwide shipments of OEM drives are projected at 71,500 8" units and 59,300 5.25" units, staggering increases over the unit shipments of 16,400 8" drives and 1,200 5.25" drives in 1980. There are now 21 announced manufacturers of 8" OEM drives in this group, and 17 announced manufacturers of 5.25" OEM drives.

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Shugart Associates held a 43.9% share of non-captive drives shipped in 1980, including all disk diameters, with 14,700 spindles. International Memories, the first firm with an 8" OEM drive, held 14.9%.

Significant captive shipments are really just getting started in 1981. IBM's 3 platter version of the Piccolo is now used on several systems, and is estimated at 10,200 spindles for 1981. Four other U.S. firms and five non-U.S. firms are also expected to ship 8" and 5.25" captive drives in 1981, but most at very low levels. Seven U.S. and five non-U.S. firms will ship captive 14" drives in 1981.

Several manufacturers of 14" drives in this group, including both captive and OEM drives, achieved disappointing results with their programs because of the inadequate backup devices offered with systems using these drives. The majority of such systems, using drives with formatted capacities from 10 to 30 MB, offered only floppy drives for backup, with capacities of 1.2 MB or less. While such arrangements are suitable for most word processing backup, they are marginal in meeting the needs of small business systems in this capacity range.

This problem has not provided the same braking effect on growth of the markets for smaller disk drives because the ubiquitous floppies are a more tolerable backup solution for 5 to 10 MB, even with a capacity limit in the 1 MB range. Most of the files found on today's 5 to 10 MB fixed disks can be stored on individual .5 or 1 MB floppies. And many system OEMs with the functional requirement to back up the entire content of disks in this capacity range or higher are finding the $\frac{1}{4}$ " tape cartridge, with capacities in the 10 to 20 MB range to be a satisfactory answer.

Marketing trends

IBM's system requirements for the smaller Piccolo drives are expected to continue to grow, for the existing applications and others to come -- but the big growth for Piccolo will come in the larger capacity versions not included in this group. The 14" Gulliver drive appears to be on the way out.

14" drive production for both captive and OEM requirements will continue to fade, but shipments of smaller fixed disks for both market classes is definitely pointed sharply upward. DISK/TREND projections show another year or two of good growth for 8" drives in this group, but only modest growth in 1984. In the meantime, 5.25" drives are forecasted to surpass 8" drive shipments in 1982, and reach an annual worldwide shipment level of 644,000 units in 1984, representing an average annual increase in shipments of 127%.

Rapid growth in the market for small business systems is driving the sharp increase in 8" drive shipments, with an assist from smaller shared resource word processing systems. The even sharper anticipated increase in 5.25" drive shipments will be driven by the spectacular increase in desktop systems used for business data processing and other office applications. In the classic computer industry pattern, many business users with floppy-only desktop systems are now hungry for more data storage and higher performance. The 5.25" Winchester is already available to answer this appetite, with several drive manufacturers now in production, and about a dozen expected to be shipping by the end of 1981.

OEM drive manufacturers have created most of the initial market for 8" and 5.25" drives, but they will undoubtedly lose part of it to captive manufacturing programs. Captive production is already underway or will

start soon by Cii-Honeywell Bull, International Memories, Olivetti, Shugart Associates and Texas Instruments. It is believed to be inevitable that some of the major manufacturers of personal computers and other computer manufacturers about to enter the desktop computer market will eventually initiate internal manufacturing programs for 5.25" Winchester drives.

Technical trends

With the exception of the unorthodox New World Computer drives, all small Winchester drives now in production use conventional 3340/3350 head and disk technology, plus a small complement of plated disks. Seagate Technology is the first to announce the use of thin film heads, enabling the firm to double the capacity of its initial drive without increasing the number of disks. It is predictable that others will follow, but not until quantities of thin film heads actually become available to independent drive manufacturers, a delay of at least a year.

Forecasting assumptions

1. IBM's system requirements for fixed disk drives less than 30 MB will grow at a steady but modest rate through 1984, due to a greater emphasis on applications requiring larger disks.
2. Other captive 8" and 5.25" manufacturing programs will reach substantial production levels in 1982 and will divert a significant portion of the shipments otherwise available to the OEM market. Captive 14" drive production will continue to decline.
3. 14" OEM drives will continue their decline through 1984. 8" drives will slow to minor growth in 1984. 5.25" drives will achieve and maintain very high growth rates through 1984, as a result of continued dynamic growth in the desktop computer market.
4. PCM drives will grow at a minimal rate, due to high selling costs and effective competition from IBM.

TABLE 31
FIXED DISK DRIVES, LESS THAN 30 MB
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1980		-----Forecast-----							
	---Shipments---		---1981---		---1982---		---1983---		---1984---	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>U.S. Manufacturers</u>										
IBM	74.7	110.1	81.4	119.6	99.0	138.6	133.4	185.8	173.0	265.1
Other U.S. Captive	64.8	106.8	123.5	150.7	236.3	287.3	359.1	446.0	519.9	650.1
TOTAL U.S. CAPTIVE	139.5	216.9	204.9	270.3	335.3	425.9	492.5	631.8	692.9	915.2
PCM	1.6	1.6	1.6	1.6	1.5	1.5	2.3	3.0	2.2	3.6
OEM	42.4	47.3	110.9	131.4	197.9	246.6	258.8	322.8	297.7	371.7
TOTAL U.S. NON-CAPTIVE	44.0	48.9	112.5	133.0	199.4	248.1	261.1	325.8	299.9	375.3
TOTAL U.S. SHIPMENTS	183.5	265.8	317.4	403.3	534.7	674.0	753.6	957.6	992.8	1,290.5
<u>Non-U.S. Manufacturers</u>										
Captive	--	55.9	--	74.3	14.0	159.6	60.8	284.4	118.4	401.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	1.2	5.5	12.3	33.0	33.9	78.9	48.1	103.4	76.6	148.5
TOTAL NON-U.S. SHIPMENTS	1.2	61.4	12.3	107.3	47.9	238.5	108.9	387.8	195.0	550.0
<u>Worldwide Recap</u>										
TOTAL WORLDWIDE SHIPMENTS	184.7	327.2	329.7	510.6	582.6	912.5	862.5	1,345.4	1,187.8	1,840.5
OEM Average Price (\$000)	1.6	1.6	1.1	1.1	1.0	1.1	.9	.9	.9	.9

TABLE 32
FIXED DISK DRIVES, LESS THAN 30 MB
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		-----Forecast-----							
	Shipments		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>U.S. Manufacturers</u>										
IBM	9.9	14.6	9.8	14.4	11.0	15.4	14.5	20.2	18.6	28.5
Other U.S. Captive	7.1	11.7	16.8	20.5	42.2	51.3	85.5	106.2	173.3	216.7
TOTAL U.S. CAPTIVE	17.0	26.3	26.6	34.9	53.2	66.7	100.0	126.4	191.9	245.2
PCM	.2	.2	.2	.2	.2	.2	.3	.4	.3	.5
OEM	27.4	30.6	101.6	120.4	197.9	246.6	287.5	358.7	330.8	413.0
TOTAL U.S. NON-CAPTIVE	27.6	30.8	101.8	120.6	198.1	246.8	287.8	359.1	331.1	413.5
TOTAL U.S. SHIPMENTS	44.6	57.1	128.4	155.5	251.3	313.5	387.8	485.5	523.0	658.7
<u>Non-U.S. Manufacturers</u>										
Captive	--	6.6	--	10.1	2.5	28.5	13.5	63.2	32.0	108.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	.6	2.7	9.2	24.7	26.1	60.7	43.7	94.0	69.6	135.0
TOTAL NON-U.S. SHIPMENTS	.6	9.3	9.2	34.8	28.6	89.2	57.2	157.2	101.6	243.5
<u>Worldwide Recap</u>										
TOTAL WORLDWIDE SHIPMENTS	45.2	66.4	137.6	190.3	279.9	402.7	445.0	642.7	624.6	902.2
<u>Installed at Year End</u>										
IBM	71.1	101.0	80.9	115.4	91.9	130.8	106.4	151.0	125.0	179.5
Non-IBM	74.3	115.2	202.1	291.1	471.0	678.4	901.5	1,300.9	1,507.5	2,174.6
WORLDWIDE TOTAL	145.4	216.2	283.0	406.5	562.9	809.2	1,007.9	1,451.9	1,632.5	2,354.1

TABLE 33
 FIXED DISK DRIVES, LESS THAN 30 MB
 WORLDWIDE SHIPMENTS
 14", 8" AND 5.25" DISK DIAMETERS

	-----DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)-----														
	1980			Forecast											
	Shipments			1981			1982			1983			1984		
	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"
U.S. Manufacturers															
IBM	10.8	3.8	--	4.2	10.2	--	(1.9)	17.3	--	(5.0)	25.2	--	(4.0)	32.5	--
Other U.S. Captive	11.7	--	--	9.8	7.7	3.0	8.3	19.0	24.0	6.2	28.0	72.0	3.7	33.0	180.0
PCM	.2	--	--	.2	--	--	.2	--	--	.1	.3	--	--	.5	--
OEM	15.1	14.3	1.2	14.0	49.1	57.3	12.6	88.0	146.0	10.7	105.0	243.0	8.0	110.0	295.0
TOTAL U.S. SHIPMENTS	37.8	18.1	1.2	28.2	67.0	60.3	19.2	124.3	170.0	12.0	158.5	315.0	7.7	176.0	475.0
Non-U.S. Manufacturers															
Captive	6.2	.4	--	5.5	3.6	1.0	5.0	8.5	15.0	4.2	13.0	46.0	3.0	18.5	87.0
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	.6	2.1	--	.3	22.4	2.0	.2	38.5	22.0	--	46.0	48.0	--	53.0	82.0
TOTAL NON-U.S. SHIPMENTS	6.8	2.5	--	5.8	26.0	3.0	5.2	47.0	37.0	4.2	59.0	94.0	3.0	71.5	169.0
TOTAL WORLDWIDE SHIPMENTS	44.6	20.6	1.2	34.0	93.0	63.3	24.4	171.3	207.0	16.2	217.5	409.0	10.7	247.5	644.0
14"/8"/5.25" ANNUAL SHARE	67%	31%	2%	18%	49%	33%	6%	43%	51%	2%	34%	64%	1%	28%	71%

TABLE 34
 FIXED DISK DRIVES, LESS THAN 30 MB
 DISTRIBUTION CHANNEL SUMMARY
 U.S. Non-Captive Disk Drives

<u>Distribution Channel</u>	1980 U.S. Net Shipments		FORECAST			
	<u>Units (000)</u>	<u>%</u>	<u>1981 %</u>	<u>1982 %</u>	<u>1983 %</u>	<u>1984 %</u>
Mainframe computer manufacturers	2.3	8.2	6.9	6.6	6.3	6.0
Mini/micro computer manufacturers	1.5	5.3	5.1	4.9	4.5	3.8
System OEMs/systems houses	17.8	63.1	67.8	71.8	73.0	74.1
Independent peripherals suppliers	6.3	22.3	18.9	15.1	14.1	13.5
Direct to end user/retail dealers	<u>.3</u>	1.1	1.3	1.6	2.1	2.6
TOTAL	28.2					

TABLE 35
 FIXED DISK DRIVES, LESS THAN 30 MB
 MARKET SHARE SUMMARY
 Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	1980 Net Shipments			
	<u>To United States Destinations</u>		<u>Worldwide</u>	
	<u>Units (000)</u>	<u>%</u>	<u>Units (000)</u>	<u>%</u>
Shugart Associates	12.9	45.7	14.7	43.9
International Memories	4.5	16.0	5.0	14.9
Control Data	3.5	12.4	3.6	10.8
Century Data Systems	3.2	11.4	3.5	10.5
Other U.S.	3.5	12.4	4.0	11.9
Other Non-U.S.	<u>.6</u>	<u>2.1</u>	<u>2.7</u>	<u>8.0</u>
TOTAL	28.2	100.0	33.5	100.0

FIXED DISK DRIVES, 30-200 MB

1981 DISK/TREND REPORT

FIXED DISK DRIVES, 30-200 MBCoverage

Examples of disk drives in this group include:

14" disk diameter

Ampex	Capricorn 165
Burroughs	FD 214
Century Data Systems	Marksman M-40, M-80
Control Data	9730-80/160, 230-30
Digital Equipment	RM80
Fujitsu	F436, M2284
Hitachi	DK 62-80
Hokushin	CD-6030
ISS/Univac	717, 8402, 8417
Kennedy	5830
Memorex	601, 612
Microdata	Reflex I 7503, Reflex II 4722
Mitsubishi	M-2883-60, M-2884
Nippon Electric Company	N 7723, D 1240
Ohio Scientific	3303, 3306
Priam	Diskos 3350, 15450
Tecstor	Sapphire 160
Toshiba	MK-300F

10.5" disk diameter

Cii-Honeywell Bull	D160
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8" disk diameter

IBM	3310, 4963-64, System/34-38, 8100 system
BASF	6173
Fujitsu	M2311, M2312
Hightrack Computer Technik	HT40, HT80
Hitachi	DK811-4
Hokushin	CD-8030
International Memories	7740
Kennedy	7300
Micropolis	1203-I, 1223-I
Mitsubishi	M2860-2
Nippon Electric Company	D2230
Nippon Electric Industry	RD-8371, RD-8520
Nippon Peripherals, Ltd.	NP30, NP31
Olivetti	HD 830
Priam	Diskos 3450, 7050
Quantum	Q2030, Q2040
SLI Industries	Cheyenne
3M	8533
Toshiba	MK80F-30

The several IBM drives and systems listed above all use the same basic 6 platter Piccolo drive, using 11 data surfaces to provide 64.5 MB in the versions without fixed head option. All other drives use normal Winchester technology except the Cii-Honeywell Bull drive, with thin film heads, and the Hightrack Computer Technik drive, with plated disks.

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
U.S. manufacturers	672.1	1,190.5	1,964.4	2,791.5	3,522.2
All manufacturers	823.7	1,482.7	2,512.9	3,548.1	4,456.6

This product group is now growing very rapidly, and the product mix is changing just as fast. In 1980, IBM's Piccolo drive accounted for an estimated 70.6% of worldwide unit shipments, but IBM's share will drop to an estimated 48.5% of the 1981 worldwide total, with 74,900 spindles. However, other captive and OEM shipments are growing even faster. Total worldwide unit shipments for all market classes were 80,000 spindles in 1980, up 188.9% from the previous year, and 1981 is forecasted at 154,300 spindles, up 92.9%.

The sharp increase in other captive drive shipments involves mostly 14" drives to date, manufactured by seven U.S. and five non-U.S. companies. The worldwide 14" captive unit shipment total is expected to climb from 12,800 spindles in 1980 to 32,300 in 1981. No U.S. production of captive 8" drives in this group has started yet, but five Japanese manufacturers are expected to make shipments before the end of 1981.

OEM drive growth has been led by 14" drives during 1981. The original OEM drives in this group, the Memorex and Okidata drives introduced in 1977, are now in decline, but the Control Data 80 MB and 160 MB drives introduced in 1979 are now growing fast. These CDC drives use the SMD interface employed on other high performance OEM drives from the same firm, and have attracted a flock of plug compatible equivalent drives from Ampex, Fujitsu, Kennedy, Priam, NEC and the new startup, Tecstor. Most of the U.S. 8" drives shipped so far are in the 30 to 40 MB range, except for the Fujitsu high performance 8" drive with capacity up to 84 MB. Market shares of individual companies in 1980 reflected a market which has since changed greatly; Memorex held a 23.4%, with 2,500 spindles, while Control Data was at 18.7%, with 2,000 spindles.

Marketing trends

IBM's Piccolo is currently used on six different systems, and the use of this drive and enhanced versions is expected to expand. Shipments are forecasted to reach 145,600 spindles in 1984.

Worldwide shipments of OEM drives will grow faster than other captive drives, in response to heavy demand for additional storage capacity on superminis, small business systems and shared logic word processing systems. System designers now have a tendency to use Winchester drives for these systems, rather than removable media drives, responding to lower prices and higher reliability. Shipments of 14" drives will remain strong, but the expected emergence of 160 MB 8" drives with the SMD interface, as early as 1982, will also stimulate fast growth for the smaller drives. 8" drive shipments are forecasted to exceed those for 14" drives in 1984. Shipments of 5.25" drives in the 30 to 50 MB range, are expected by 1983.

Young captive drive programs by firms such as Burroughs, DEC, ISS/Univac and several Japanese manufacturers are clearly destined for steady growth, including existing 14" drives and numerous 8" drives to come. Total captive shipments for 1984 are projected at 135,000 spindles, 60% of which will be 14" drives in 1984.

PCM drives will be more competitive against IBM's Piccolo when PCM 8" drives are available, but overall penetration of this market probably will remain low, with Series/1 the only target.

Technical trends

Increased density versions of IBM's Piccolo are considered imminent. IBM will probably have to choose between a double density version of the existing drive or a complete new design with higher capacity. The latter is considered the better bet.

Technology advances by independent manufacturers are expected to concentrate first on OEM drives. Expected next year are announcements of 160 MB 8" drives, the first 5.25" drives in the group, expanded use of thin film heads, and introduction of intelligent drive options.

Forecasting assumptions

1. IBM's heavy shipments of systems using the Piccolo drive will necessitate extremely large production levels for this drive.
2. Heavy growth in captive production will continue through 1984, with 14" drives retaining their lead in unit shipments.
3. Existing sharp growth for 14" OEM drives will continue through 1984, supplemented by rapid increases for 8" drives, especially after quantity production of 160 MB 8" drives becomes available in 1983. 5.25" drive production will start in 1983.
4. PCM shipments will remain modest through 1984.

TABLE 36
FIXED DISK DRIVES, 30-200 MB
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1980		Forecast							
	---Shipments---		-----1981-----		-----1982-----		-----1983-----		-----1984-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	381.1	582.0	497.7	786.5	734.7	1,161.9	944.2	1,481.3	1,146.4	1,790.9
Other U.S. Captive	46.5	59.8	196.7	299.3	386.4	588.0	604.5	926.3	779.0	1,195.2
TOTAL U.S. CAPTIVE	427.6	641.8	694.4	1,085.8	1,121.1	1,749.9	1,548.7	2,407.6	1,925.4	2,986.1
PCM	1.8	1.8	2.9	3.8	4.9	6.8	9.0	12.6	11.1	17.0
OEM	25.3	28.5	90.1	100.9	176.5	207.7	312.8	371.3	415.3	519.1
TOTAL U.S. NON-CAPTIVE	27.1	30.3	93.0	104.7	181.4	214.5	321.8	383.9	426.4	536.1
TOTAL U.S. SHIPMENTS	454.7	672.1	787.4	1,190.5	1,302.5	1,964.4	1,870.5	2,791.5	2,351.8	3,522.2
Non-U.S. Manufacturers										
Captive	--	142.3	--	258.0	30.0	465.0	73.0	613.2	126.9	733.2
PCM	--	--	--	--	--	1.9	--	4.8	--	6.5
OEM	2.7	9.3	13.3	34.2	34.7	81.6	62.0	138.6	85.5	194.7
TOTAL NON-U.S. SHIPMENTS	2.7	151.6	13.3	292.2	64.7	548.5	135.0	756.6	212.4	934.4
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	457.4	823.7	800.7	1,482.7	1,367.2	2,512.9	2,005.5	3,548.1	2,564.2	4,456.6
OEM Average Price (\$000)	3.5	3.6	3.1	3.1	3.4	3.4	3.3	3.3	3.0	3.0

TABLE 37
FIXED DISK DRIVES, 30-200 MB
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
	-----Forecast-----									
U.S. Manufacturers										
IBM	37.0	56.5	47.4	74.9	67.4	106.6	81.4	127.7	93.2	145.6
Other U.S. Captive	2.8	3.6	11.5	17.5	23.0	35.0	38.5	59.0	54.1	83.0
TOTAL U.S. CAPTIVE	39.8	60.1	58.9	92.4	90.4	141.6	119.9	186.7	147.3	228.6
PCM	.2	.2	.3	.4	.5	.7	1.0	1.4	1.3	2.0
OEM	7.2	8.1	29.1	32.6	51.9	61.1	94.8	112.5	143.2	179.0
TOTAL U.S. NON-CAPTIVE	7.4	8.3	29.4	33.0	52.4	61.8	95.8	113.9	144.5	181.0
TOTAL U.S. SHIPMENTS	47.2	68.4	88.3	125.4	142.8	203.4	215.7	300.6	291.8	409.6
Non-U.S. Manufacturers										
Captive	--	9.2	--	18.4	2.0	31.0	5.0	42.0	9.0	52.0
PCM	--	--	--	--	--	.2	--	.5	--	.7
OEM	.7	2.4	4.1	10.5	10.2	24.0	18.8	42.0	25.9	59.0
TOTAL NON-U.S. SHIPMENTS	.7	11.6	4.1	28.9	12.2	55.2	23.8	84.5	34.9	111.7
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	47.9	80.0	92.4	154.3	155.0	258.6	239.5	385.1	326.7	521.3
Installed at Year End										
IBM	46.2	69.8	93.6	144.7	161.0	251.3	242.4	379.0	335.6	524.6
Non-IBM	19.9	42.9	64.9	122.3	152.5	274.3	310.6	531.7	544.1	907.4
WORLDWIDE TOTAL	66.1	112.7	158.5	267.0	313.5	525.6	553.0	910.7	879.7	1,432.0

TABLE 38
 FIXED DISK DRIVES, 30-200 MB
 WORLDWIDE SHIPMENTS
 14", 8" AND 5.25" DISK DIAMETERS

	DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)											
	1980		1981		1982		Forecast			1984		5.25"
	14"	8"	14"	8"	14"	8"	14"	8"	14"	8"		
U.S. Manufacturers												
IBM	--	56.5	--	74.9	--	106.6	--	127.7	--	--	145.6	--
Other U.S. Captive	3.6	--	17.5	--	31.0	4.0	44.0	13.0	2.0	53.0	21.0	9.0
PCM	.2	--	.4	--	.7	--	.9	.5	--	.8	1.2	--
OEM	7.4	.7	25.0	7.6	45.1	16.0	67.5	39.0	6.0	78.0	85.0	16.0
TOTAL U.S. SHIPMENTS	11.2	57.2	42.9	82.5	76.8	126.6	112.4	180.2	8.0	131.8	252.8	25.0
Non-U.S. Manufacturers												
Captive	9.2	--	14.8	3.6	22.0	9.0	26.0	16.0	--	28.0	24.0	--
PCM	--	--	--	--	--	.2	--	.5	--	--	.7	--
OEM	2.4	--	5.4	5.1	12.0	12.0	17.0	23.0	2.0	19.0	36.0	4.0
TOTAL NON-U.S. SHIPMENTS	11.6	--	20.2	8.7	34.0	21.2	43.0	39.5	2.0	47.0	60.7	4.0
TOTAL WORLDWIDE SHIPMENTS	22.8	57.2	63.1	91.2	110.8	147.8	155.4	219.7	10.0	178.8	313.5	29.0
14"/8"/5.25" ANNUAL SHARE	29%	71%	41%	59%	43%	57%	40%	57%	3%	34%	60%	6%

TABLE 39
 FIXED DISK DRIVES, 30-200 MB
 DISTRIBUTION CHANNEL SUMMARY
 U.S. Non-Captive Disk Drives

<u>Distribution Channel</u>	1980 U.S. Net Shipments		FORECAST			
	<u>Units (000)</u>	<u>%</u>	<u>1981 %</u>	<u>1982 %</u>	<u>1983 %</u>	<u>1984 %</u>
Mainframe computer manufacturers	.2	2.5	2.8	3.4	4.0	4.8
Mini/micro computer manufacturers	3.3	40.7	42.7	47.0	49.4	50.8
System OEMs/systems houses	4.1	50.6	47.3	40.9	36.6	32.9
Independent peripherals suppliers	.3	3.7	4.6	5.8	6.9	8.0
Direct to end user/retail dealers	<u>.2</u>	2.5	2.6	2.9	3.1	3.5
TOTAL	8.1					

TABLE 40
 FIXED DISK DRIVES, 30-200 MB
 MARKET SHARE SUMMARY
 Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	1980 Net Shipments			
	<u>To United States Destinations</u>		<u>Worldwide</u>	
	<u>Units (000)</u>	<u>%</u>	<u>Units (000)</u>	<u>%</u>
Memorex	2.5	30.9	2.5	23.4
Control Data	1.7	21.0	2.0	18.7
Other U.S.	3.2	39.5	3.8	35.5
Other Non-U.S.	<u>.7</u>	<u>8.6</u>	<u>2.4</u>	<u>22.4</u>
TOTAL	8.1	100.0	10.7	100.0

FIXED DISK DRIVES, MORE THAN 200 MB

1981 DISK/TREND REPORT

FIXED DISK DRIVES, MORE THAN 200 MBCoverage

Examples of disk drives in this group include:

14" disk diameter

IBM	3344, 3350, 3370, 3375, 3380
Ampex	Capricorn 330
Burroughs	9494-2, 9494-4
Control Data	885, 9775, 819-21, 33502
Dastek	4830, 4835
Fujitsu	F493, F496
Hitachi	H-8595, H-8587, H-8598
ISS/Univac	7350, 8450, 8470
Memorex	3644, 3650, 3652, 659
Nippon Electric Company	D1510, N7751, N7755
Nippon Peripherals, Ltd.	NP24, NP25, NP37
Siemens	3470
Storage Technology	8350, 8650, 8360, 8370, 8380

10.5" disk diameter

Fujitsu	M2351A, F6421, F6425
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Most of the above drives are IBM's 3350 or PCM equivalent in both standard and double density versions, IBM's newer 3370/75/80 thin film head drives, or captive drives using variations of the same technologies. The exceptions are Burroughs drives (201 MB, using 3330 technology on 8 surfaces), Control Data's several 22-surface drives, Univac's 8470 (16 surfaces), Dastek's 483X (200-400 MB OEM drives using thin film heads at 12,772 BPI), and the new Fujitsu Eagle series (initially, ferrite heads and 10.5" coated disks; later, thin film heads and 10.5" sputtered disks).

Market status

DISK/TREND estimate of total market size:

<u>Worldwide sales (\$M)</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
U.S. manufacturers	1,672.4	2,479.3	3,206.5	4,069.5	4,969.7
All manufacturers	1,855.0	2,735.6	3,559.1	4,524.4	5,528.9

1981 DISK/TREND REPORT

Shipment levels for all types of drives in this group are running substantially ahead of the projections in last year's DISK/TREND Report for U.S. manufacturers, while unit shipments by non-U.S. manufacturers are close to the forecast. Worldwide unit shipments of all drives are now projected to grow from 89,000 spindles in 1980 to 120,900 spindles in 1981, an increase of 35.8%. Worldwide revenues for all drives are expected to reach \$2,735.6 million in 1981, up 47.5%.

The largest increases involve IBM's 3350 and 3370 drives, for which DISK/TREND estimates of 1980 and 1981 shipments have been revised sharply upward, as noted in Table 43, a detailed review of IBM and PCM shipments. IBM's 3350 shipments are now estimated at 41,000 spindles worldwide in 1980, with 43,000 in 1981. Because of IBM's failure to start 3380 shipments in first quarter of 1981, as planned, IBM's 3350 shipment level is actually increasing, and PCM drives are enjoying an unearned period of excellent growth, extending for at least a year. IBM still has the 3370 all to itself, with heavy demand for the systems on which it is used. Apparently, early production problems have been overcome, and 1980's 8,000 spindles are expected to grow to 12,500 spindles shipped in 1981.

PCM worldwide shipments were 21,900 spindles in 1980, projected to grow to 30,600 spindles in 1981. During this period of unsatisfied user demand for more storage capacity, manufacturers of PCM drives were able to shift their product mix from 31.5% 635 MB double density versions of IBM's 3350 in 1980 to an estimated 61.1% in 1981. The 1980 competitive positions of the major PCM drive manufacturers were roughly the same as the previous year: Storage Technology, 45.2%; Memorex, 31.1%; Control Data, 17.1%.

Shipments of other U.S. captive drives are also increasing rapidly in 1981, to an estimated 22,500 spindles, as Burroughs, Honeywell and

Univac use their large fixed disk drives on systems competitive with IBM's new offerings. U.S. shipments of OEM drives are still small at 3,300 spindles, but starting on a sharp curve upward, with a strong 675 MB drive with SMD interface from Control Data, and the beginnings of major DEC purchases from ISS/Univac and Storage Technology.

Marketing trends

The key assumption made for this year's DISK/TREND forecast of future IBM and PCM drive shipments is a fourth quarter 1981 start for IBM's 3380 shipments and a third quarter 1981 start for the 3375. These are still IBM's announced dates for the two drives. DISK/TREND projections also assume that PCM 3370 and 3375 drives will not be shipped before 1982, and 3380s before 1983.

If all of these events follow the above schedule, IBM and PCM 317.5 MB drive shipments will dry up quickly, with last shipments in 1983, and 635 MB PCM drives following in about a year. Another major variable in these forecasts is IBM's actual (and still obscure) intention for the relative roles of the 3370 and 3375. The DISK/TREND 1984 forecast sees both drives being shipped at approximately the same rate, with 3380 at a substantially higher level. The total annual disk capacity represented by these annual shipment projections, as expressed in terabytes, will probably not change greatly even if the product mix should be altered by IBM sales policies. PCM revenues are expected to be flat for 1982, then move ahead well in later years, as the transition to new products is accomplished.

The customer base for OEM drives in this group is being expanded rapidly by the dynamic growth in supermini systems, and will be further boosted by the availability next year from several manufacturers of lower

cost rack mounted drives. Worldwide 1984 OEM drive shipments are projected at 25,800 spindles. Relatively slow, but steady growth in other captive shipments through 1984 is expected, with no new manufacturers, and gradual conversion to newer technologies.

Technical trends

The key technical details on IBM's new drives not yet announced are the track density of the 3375 (estimated by the competition at about 790 TPI) and the track and linear densities of the 3380 (estimated at about 760 TPI and 10,000 FRPI, yielding approximately 15,000 effective BPI). The 3370, 3375 and 3380 are extremely tough technical challenges to the competition, but the handful of disk drive manufacturers left in the business of making big high performance drives will be able to match them -- although some will take longer than others. And others may elect to achieve similar capacities with unique configurations, such as the Fujitsu Eagle drives. It is probable that IBM's next big wave of technical innovation will not break until 1984 or 1985.

Forecasting assumptions

1. IBM first commercial shipments of 3375 in third quarter of 1981 and 3380 in fourth quarter of 1981, per current schedule. Last IBM 3350 new production in 1983. No other major new disk through 1984.
2. First commercial shipment of PCM 3370 and 3375 in second quarter, 1982; 3380, second quarter, 1983. 3350 product mix continues shift to 635 MB versions.
3. Moderate, but steady continuing growth in other captive shipments.
4. Major growth in OEM drive shipments, tied to supermini market.

TABLE 41
FIXED DISK DRIVES, MORE THAN 200 MB
REVENUE SUMMARY

	-----DISK DRIVE REVENUES, BY SHIPMENT DESTINATION (\$M)-----									
	1980		-----Forecast-----							
	Shipments		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>U.S. Manufacturers</u>										
IBM	583.9	1,014.6	722.6	1,273.0	975.7	1,728.7	1,126.4	2,003.4	1,293.6	2,275.4
Other U.S. Captive	206.0	330.1	412.5	663.0	520.8	868.0	652.8	1,088.0	820.8	1,368.0
TOTAL U.S. CAPTIVE	789.9	1,344.7	1,135.1	1,936.0	1,496.5	2,596.7	1,779.2	3,091.4	2,114.4	3,643.4
PCM	214.1	319.6	360.9	505.7	363.6	504.0	590.2	816.4	806.0	1,112.9
OEM	8.1	8.1	33.0	37.6	76.7	105.8	113.3	161.7	138.7	213.4
TOTAL U.S. NON-CAPTIVE	222.2	327.7	393.9	543.3	440.3	609.8	703.5	978.1	944.7	1,326.3
TOTAL U.S. SHIPMENTS	1,012.1	1,672.4	1,529.0	2,479.3	1,936.8	3,206.5	2,482.7	4,069.5	3,059.1	4,969.7
<u>Non-U.S. Manufacturers</u>										
Captive	--	170.5	--	244.2	3.5	325.5	11.1	403.3	19.5	475.8
PCM	1.1	11.0	1.1	9.9	2.6	13.0	7.2	28.8	12.5	50.0
OEM	1.1	1.1	1.1	2.2	10.3	14.1	16.4	22.8	22.9	33.4
TOTAL NON-U.S. SHIPMENTS	2.2	182.6	2.2	256.3	16.4	352.6	34.7	454.9	54.9	559.2
<u>Worldwide Recap</u>										
TOTAL WORLDWIDE SHIPMENTS	1,014.3	1,855.0	1,531.2	2,735.6	1,953.2	3,559.1	2,517.4	4,524.4	3,114.0	5,528.9
OEM Average Price (\$000)	10.2	10.2	11.4	11.4	10.6	10.6	10.1	10.1	9.6	9.6

TABLE 42
FIXED DISK DRIVES, MORE THAN 200 MB
UNIT SHIPMENT SUMMARY

	-----DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers	-----									
IBM	28.2	49.0	32.3	56.9	33.3	59.0	29.8	53.0	33.6	59.1
Other U.S. Captive	7.3	11.7	14.0	22.5	16.8	28.0	19.2	32.0	21.6	36.0
TOTAL U.S. CAPTIVE	35.5	60.7	46.3	79.4	50.1	87.0	49.0	85.0	55.2	95.1
PCM	14.0	20.9	21.2	29.7	20.2	28.0	22.7	31.4	26.0	35.9
OEM	.8	.8	2.9	3.3	7.1	9.8	11.0	15.7	14.3	22.0
TOTAL U.S. NON-CAPTIVE	14.8	21.7	24.1	33.0	27.3	37.8	33.7	47.1	40.3	57.9
TOTAL U.S. SHIPMENTS	50.3	82.4	70.4	112.4	77.4	124.8	82.7	132.1	95.5	153.0
Non-U.S. Manufacturers	-----									
Captive	--	5.5	--	7.4	.1	9.3	.3	10.9	.5	12.2
PCM	.1	1.0	.1	.9	.2	1.0	.4	1.6	.5	2.0
OEM	.1	.1	.1	.2	1.1	1.5	1.8	2.5	2.6	3.8
TOTAL NON-U.S. SHIPMENTS	.2	6.6	.2	8.5	1.4	11.8	2.5	15.0	3.6	18.0
Worldwide Recap	-----									
TOTAL WORLDWIDE SHIPMENTS	50.5	89.0	70.6	120.9	78.8	136.6	85.2	147.1	99.1	171.0
Installed at Year End	-----									
IBM	84.3	142.4	116.6	199.3	149.9	258.3	179.7	311.3	213.3	370.4
Non-IBM	46.4	80.1	84.7	144.1	130.2	221.7	185.6	315.8	251.1	427.7
WORLDWIDE TOTAL	130.7	222.5	201.3	343.4	280.1	480.0	365.3	627.1	464.4	798.1

TABLE 43
 FIXED DISK DRIVES, MORE THAN 200 MB
 WORLDWIDE SHIPMENTS OF IBM AND PCM DISK DRIVES
 PRODUCT MIX ANALYSIS

	-----DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)-----									
	1980		-----Forecast-----							
	Shipments		1981		1982		1983		1984	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
<u>3344/3350 Type</u>										
IBM 317/280 MB	24.6	41.0	25.8	43.0	16.2	27.0	3.0	5.0	--	--
PCM 317 MB	9.4	15.0	8.3	11.9	3.3	4.7	1.4	2.0	--	--
PCM 635 MB	<u>4.7</u>	<u>6.9</u>	<u>13.0</u>	<u>18.7</u>	<u>13.2</u>	<u>18.8</u>	<u>7.0</u>	<u>10.0</u>	<u>2.1</u>	<u>3.0</u>
TOTAL	38.7	62.9	47.1	73.6	32.7	50.5	11.4	17.0	2.1	3.0
<u>3370 Type (571 MB)</u>										
IBM	3.6	8.0	5.6	12.5	6.8	15.0	7.2	16.0	7.7	17.1
PCM	--	--	--	--	<u>1.8</u>	<u>2.5</u>	<u>4.2</u>	<u>6.0</u>	<u>6.3</u>	<u>9.0</u>
TOTAL	3.6	8.0	5.6	12.5	8.6	17.5	11.4	22.0	14.0	26.1
<u>3375 Type (819 MB)</u>										
IBM	--	--	.6	1.0	4.4	8.0	6.6	12.0	7.7	14.0
PCM	--	--	--	--	<u>2.1</u>	<u>3.0</u>	<u>6.3</u>	<u>9.0</u>	<u>7.6</u>	<u>10.9</u>
TOTAL			.6	1.0	6.5	11.0	12.9	21.0	15.3	24.9
<u>3380 Type (1260 MB)</u>										
IBM	--	--	.3	.4	5.9	9.0	13.0	20.0	18.2	28.0
PCM	--	--	--	--	--	--	<u>4.2</u>	<u>6.0</u>	<u>10.5</u>	<u>15.0</u>
TOTAL			.3	.4	5.9	9.0	17.2	26.0	28.7	43.0
TOTAL SPINDLES	42.3	70.9	53.6	87.5	53.7	88.0	52.9	86.0	60.1	97.0
TOTAL TERABYTES	15.8	26.7	23.1	37.7	32.2	52.3	44.6	71.1	58.0	91.4
			+46%	+41%	+39%	+39%	+38%	+36%	+30%	+29%

TABLE 44
 FIXED DISK DRIVES, MORE THAN 200 MB
 DISTRIBUTION CHANNEL SUMMARY
 U.S. Non-Captive Disk Drives

<u>Distribution Channel</u>	1980 U.S. Net Shipments		FORECAST			
	Units (000)	%	1981 %	1982 %	1983 %	1984 %
Mainframe computer manufacturers	--	--	2.0	5.5	6.5	7.4
Mini/micro computer manufacturers	.7	4.7	7.6	18.6	22.1	22.6
System OEMs/systems houses	.2	1.3	2.2	3.5	5.3	6.9
Independent peripherals suppliers	--	--	.5	1.1	1.7	2.0
Direct to end user/retail dealers	<u>14.1</u>	94.0	87.7	71.3	64.4	61.1
TOTAL	15.0					

TABLE 45
 FIXED DISK DRIVES, MORE THAN 200 MB
 MARKET SHARE SUMMARY
 Worldwide Shipments of Non-Captive Disk Drives

<u>Drive Manufacturers</u>	1980 Net Shipments			
	<u>To United States Destinations</u>		<u>Worldwide</u>	
	Units (000)	%	Units (000)	%
Storage Technology	8.1	54.0	10.3	45.2
Memorex	3.3	22.0	7.1	31.1
Control Data	3.0	20.0	3.9	17.1
Other U.S.	.4	2.7	.4	1.8
Other Non-U.S.	<u>.2</u>	<u>1.3</u>	<u>1.1</u>	<u>4.8</u>
TOTAL	15.0	100.0	22.8	100.0

NOTE: Includes drives manufactured by ISS, NPL or Hitachi and resold by others in the PCM market.

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DISK DRIVE SPECIFICATIONS

Changes for 1981

Several additions have been made this year to the information included in the specification section of this report. Every drive is now identified as to its normal market class: Captive, OEM or PCM. The technology employed in each drive is identified by general information on the types of heads and disks employed, and the type of actuator. For most drives, a capsule description of the type of interface available is given.

Coverage

This listing includes most disk drives now in new production or announced. Also included are a number of IBM drives no longer in new production, but listed for reference.

Generally, no attempt has been made to include specifications on drive models sold by computer system manufacturers but purchased on an OEM basis from others. Also not listed in most cases are captive drives which are similar to OEM models made by the same manufacturer. In some cases, drives made by one drive manufacturer and resold by another drive manufacturer have been included for identification purposes.

Generic type

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

require media with a variety of special characteristics, such as non-standard recording disks, sectors, initialization, etc.

Technology type

The IBM drive model numbers used are intended as a general guide to the type of heads and recording disks employed. This identification is based on a much broader interpretation than the original IBM specifications, since other drives frequently use greater densities.

The term "Gulliver" is used to describe IBM's family of single disk fixed 14" disk drives using essentially 3340 technology, and "Piccolo" identifies the 8530 BPI, 450 TPI technology used with IBM's 210 mm drives.

Capacities

Capacities are listed as "U" for unformatted or "F" for formatted.

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 disk drive groups

- | | |
|------------------|---|
| Removable media: | 1. Disk cartridge drives, less than 12 MB |
| | 2. Disk cartridge drives, more than 12 MB |
| | 3. Disk pack drives, 29-58 MB |
| | 4. Storage module drives, 25-80 MB |
| | 5. Disk pack drives, more than 100 MB |
| | 6. Data module drives, 35-70 MB |
| Fixed media: | 7. Fixed disk drives, less than 30 MB |
| | 8. Fixed disk drives, 30-200 MB |
| | 9. Fixed disk drives, more than 200 MB |

MANUFACTURER	AMPEX	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE					
	DM-440	DM-441	DM-442	DM-443	DM-445
DISK/TREND GROUP	1	1	1	1	1
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	2315	2315	2315	2315	5440
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	2314	2314	2314	2314	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options				
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 3.125	--	U: 6.25	--
REMOVABLE	U: 3.125	U: 3.125	U: 6.25	U: 6.25	U: 3.125
Capacity per track (Bytes)	U: 7,812				
Data surfaces per spindle	2	4	2	4	2
Heads per data surface	1	1	1	1	1
Tracks per surface	200	200	400	400	200
TPI	100	100	200	200	100
BPI	2200	2200	2200	2200	2200
RPM	1500/2400	1500/2400	1500/2400	1500/2400	1500/2400
Actuator type	Linear, Voice Coil				
Average positioning time (msec)	35	35	35	35	35
Average rotational delay (msec)	20/12.5	20/12.5	20/12.5	20/12.5	20/12.5
Average access time (msec)	55/47.5	55/47.5	55/47.5	55/47.5	55/47.5
Data transfer rate (KByte/sec)	195/312.5	195/312.5	195/312.5	195/312.5	195/312.5
FIRST CUSTOMER SHIPMENT	1975	1975	1975	1975	1975
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Mfg. by Western Dynex				

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MANUFACTURER	AMPEX	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE					
	DM-446	DM-447	DM-448 DM-548	DFR-932	DFR-964
DISK/TREND GROUP	1	1	1	2	2
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	CDC 91204	CDC 91204
Generic type	5440	5440	5440	CMD	CMD
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	2314	2314	2314	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options	Various Options	Various Options	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 3.125	--	U: 6.25	U: 16.289	U: 48.868
REMOVABLE	U: 3.125	U: 6.25	U: 6.25	U: 16.289	U: 16.289
Capacity per track (Bytes)	U: 7,812	U: 7,812	U: 7,812	U: 20,160	U: 20,160
Data surfaces per spindle	4	2	4	1 Fixed 1 Removable	3 Fixed 1 Removable
Heads per data surface	1	1	1	2 Fixed 1 Removable	2 Fixed 1 Removable
Tracks per surface	200	400	400	823	823
TPI	100	200	200	367 Fixed 384 Removable	367 Fixed 384 Removable
BPI	2200	2200	2200	6274 Fixed 6038 Removable	6274 Fixed 6038 Removable
RPM	1500/2400	1500/2400	1500/2400	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Fix: Rotary VC Rem: Linear VC	Fix: Rotary VC Rem: Linear VC
Average positioning time (msec)	35	35	35	30	30
Average rotational delay (msec)	20/12.5	20/12.5	20/12.5	8.3	8.3
Average access time (msec)	55/47.5	55/47.5	55/47.5	38.3	38.3
Data transfer rate (KByte/sec)	195/312.5	195/312.5	195/312.5	1209	1209
FIRST CUSTOMER SHIPMENT	1975	1975	1975	4Q79	4Q79
U.S. OEM PRICE FOR 100 UNITS	--	--	\$2,950	\$4,625	\$5,280
COMMENTS	Mfg. by Western Dynex	Mfg. by Western Dynex	Mfg. by Western Dynex	Mfg. by Toshiba	Mfg. by Toshiba

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MANUFACTURER	AMPEX	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE	DFR-996	DM-323	DM-940	DM-980	DM-9160
DISK/TREND GROUP	2	3	4	4	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	CDC 91204	--	--	--	--
Generic type	CMD	2316	SMD	SMD	SMD
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	2314	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD		SMD	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 81.446	--	--	--	--
REMOVABLE	U: 16.289	F: 58.4	U: 41.4	U: 82.8	U: 165.8
Capacity per track (Bytes)	U: 20,160	F: 7,294	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	5 Fixed 1 Removable	20	5	5	5
Heads per data surface	2 Fixed 1 Removable	2 Fixed 1 Removable	2 Fixed 1 Removable	2 Fixed 1 Removable	2 Fixed 1 Removable
Tracks per surface	823	406	411	822	1645
TPI	367 Fixed 384 Removable	200	192	384	768
BPI	6274 Fixed 6038 Removable	2200	6038	6038	6038
RPM	3600	2400	3600	3600	3600
Actuator type	Fix: Rotary VC Rem: Linear VC	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear Voice Coil
Average positioning time (msec)	30	32	30	30	28
Average rotational delay (msec)	8.3	12.5	8.3	8.3	8.3
Average access time (msec)	38.3	44.5	38.3	38.3	36.3
Data transfer rate (KByte/sec)	1209	312.5	1209	1209	1209
FIRST CUSTOMER SHIPMENT	4Q79	1973	10/75	1/76	1980
U.S. OEM PRICE FOR 100 UNITS	\$5,855	\$8,200	\$5,540	\$5,540	\$6,250
COMMENTS	Mfg. by Toshiba				

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MANUFACTURER	AMPEX	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE					
	DM-9100	DM-9200	DM-9300	DM-9300A	DM-331
DISK/TREND GROUP	5	5	5	5	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	CDC 9883-91	--
Generic type	3336-1	3336-11	3336-11	3336-11	3336-11
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3330-1	3336-11	3336-11	3336-11	3336-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	SMD	SMD	
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	U: 103.17	U: 206.3	U: 309.5	U: 309.5	U: 206.3
Capacity per track (Bytes)	U: 13,440	U: 13,440	U: 20,160	U: 20,160	U: 13,440
Data surfaces per spindle	19	19	19	19	19
Heads per data surface	1	1	1	1	1
Tracks per surface	411	815	815	823	815
TPI	192	370	370	384	370
BPI	4040	4040	6038	6038	4040
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil				
Average positioning time (msec)	28	28	28	28	28
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	36.3	36.3	36.3	36.3	36.3
Data transfer rate (KByte/sec)	806	806	1209	1209	806
FIRST CUSTOMER SHIPMENT	11/75	11/75	5/76	3Q80	11/74
U.S. OEM PRICE FOR 100 UNITS	\$9,775	\$9,775	\$9,775	\$9,775	\$10,150
COMMENTS					

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MANUFACTURER	AMPEX	AMPEX	AMPEX	AMPEX	BALL COMPUTER PRODUCTS
DRIVE	PTD-930X Parallel Transfer Drive	DM-404	Capricorn 165	Capricorn 330	BD-50
DISK/TREND GROUP	5	7	8	9	4
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	3336-11	Fixed	Fixed	Fixed	SMD
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	2314	3350	3350	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Special	Various Options	SMD	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 12.5	U: 165.9	U: 330.3	--
REMOVABLE	U: 312.177	--	--	--	U: 54.7
Capacity per track (Bytes)	U: 20,160	U: 7,812	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	19	4	5	8	5
Heads per data surface	1	1	2	2	1
Tracks per surface	815	406	1646	2048	815
TPI	384	200	960	960	370/384
BPI	6038	2200	6370	6370	4040
RPM	3600	1500/2400	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	28	70	30	30	30
Average rotational delay (msec)	8.3	20/12.5	8.3	8.3	8.3
Average access time (msec)	36.3	90/82.5	38.3	38.3	38.3
Data transfer rate (KByte/sec)	1209	195/312.5	1209	1209	1209
FIRST CUSTOMER SHIPMENT	11/78	1980	3Q81	3Q81	8/76
U.S. OEM PRICE FOR 100 UNITS	\$55,000	--	\$5,750	\$7,455	\$4,795
COMMENTS	Up to 9 track parallel data transfer	Mfg. by Western Dynex			

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MANUFACTURER	BALL COMPUTER PRODUCTS	BALL COMPUTER PRODUCTS	BALL COMPUTER PRODUCTS	BASF	BASF
DRIVE	BD-80	BD-100	BD-160	6240 6242	6243
DISK/TREND GROUP	4	5	5	6	6
MARKET	OEM	OEM	OEM	PCM	PCM
MEDIA: Manufacturer's number	--	--	--	1370	1370
Generic type	SMD	SMD	SMD	3348 Data Module 14"	3348 Data Module 14"
Nominal disk diameter	14"	14"	14"	Oxide Coated	Oxide Coated
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	3330-11	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	SMD	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	U: 82.1	U: 103.2	U: 164.2	F: 35/70	F: 50.6
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	F: 16,736	F: 16,736
Data surfaces per spindle	5	5	5	3/6	6
Heads per data surface	1	1	1	2	2
Tracks per surface	815	1024	1645	348/696	696
TPI	370/384	465	768	300	300
BPI	6060	6060	6060	5636	5636
RPM	3600	3600	3600	2964	2964
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	30	20	20
Average rotational delay (msec)	8.3	8.3	8.3	10.1	10.1
Average access time (msec)	38.3	38.3	38.3	30.1	30.1
Data transfer rate (KByte/sec)	1209	1209	1209	885	885
FIRST CUSTOMER SHIPMENT	4/77	8/79	1Q82	1977	1979
U.S. OEM PRICE FOR 100 UNITS	\$5,950	\$6,300	\$6,650	--	--
COMMENTS				PCM 3340 Mfg. by Nippon Peripherals	PCM 3340 Mfg. by Nippon Peripherals

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MANUFACTURER	BASF	BASF	BASF	BASF	BASF
DRIVE					
	6171	6172	6173	6181	6182
DISK/TREND GROUP	7	7	8	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	3340	3340	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	BASF, SMD, ANSI X3T9.3	BASF, SMD, ANSI X3T9.3	BASF, SMD, ANSI X3T9.3	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 8.0	U: 24.0	U: 40.0	U: 3.19	U: 6.38
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 13,344	U: 13,344	U: 13,344	U: 10,416	U: 10,416
Data surfaces per spindle	1	3	5	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	600	600	600	153	153
TPI	500	500	500	254	254
BPI	6542	6542	6542	7690	7690
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	27	27	27	115 (Including Settling)	115 (Including Settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	35.3	35.3	35.3	123.3	123.3
Data transfer rate (KByte/sec)	800	800	800	625	625
FIRST CUSTOMER SHIPMENT	4Q79	4Q79	4Q81	11/81	11/81
U.S. OEM PRICE FOR 100 UNITS	\$1,600	\$1,900	\$2,200	--	\$1,150
COMMENTS					

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SPEC-11

MANUFACTURER	BASF	BASF	BASF	BASF	BURROUGHS
DRIVE	6183	6410 6411	6244	6250 6252 6253	9480-22
DISK/TREND GROUP	7	8	9	9	1
MARKET	OEM	PCM	PCM	PCM	End User
MEDIA: Manufacturer's number	--	--	--	--	9985
Generic type	Fixed	Fixed	Fixed	Fixed	2315
Nominal disk diameter	130 mm OD 40 mm ID	210 mm OD 100 mm ID	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	Piccolo	3350	3350	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	IBM	IBM	IBM	Burroughs
CAPACITY/PERFORMANCE			1.004 MB Fixed Head Option	1.44 MB Fixed Head Option	
Total capacity (MBytes) FIXED	U: 9.57	F: 64.5	F: 279.558	F: 317.5	--
REMOVABLE	--	--	--	--	F: 4.68
Capacity per track (Bytes)	U: 10,416	F: 16,384	F: 16,736	F: 19,069	F: 11,520
Data surfaces per spindle	6	11	15	15	2
Heads per data surface	1	1	2	2	1
Tracks per surface	153	360	1114	1110	203
TPI	254	465	480	480	100
BPI	7690	8530	5636	6425	4400
RPM	3600	3125	2964	3600	1500
Actuator type	Band, Stepping Motor	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	115 (Including Settling)	27	20	20	60
Average rotational delay (msec)	8.3	9.6	10.1	8.3	20
Average access time (msec)	123.3	36.6	30.1	28.3	80
Data transfer rate (KByte/sec)	625	1031	885	1198	193
FIRST CUSTOMER SHIPMENT	11/81	4Q80	1978	1978	1973
U.S. OEM PRICE FOR 100 UNITS	\$1,435	--	--	--	--
COMMENTS		PCM 3310 Mfg. by Nippon Peripherals	PCM 3344 Mfg. by Nippon Peripherals	PCM 3350 Mfg. by Nippon Peripherals	

1981 DISK/TREND REPORT

MANUFACTURER	BURROUGHS	BURROUGHS	BURROUGHS	BURROUGHS	BURROUGHS
DRIVE	9484-5	9383-16 9383-17 9383-18 9484-8	9493-9	9493-18	9493-28
DISK/TREND GROUP	4	5	7	7	7
MARKET	End User	End User	End User	End User	End User
MEDIA: Manufacturer's number	9974-5	9974-4	--	--	--
Generic type	Trident	2316	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	3330-1	3330-1	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Burroughs	Burroughs	Burroughs	Burroughs	Burroughs
CAPACITY/PERFORMANCE					Drive consists of 2 spindles
Total capacity (MBytes) FIXED	--	--	F: 9.4	F: 18.8	F: 28.2
REMOVABLE	F: 65.2	F: 174.4	--	--	--
Capacity per track (Bytes)	F: 16,200	F: 10,800	F: 11,520	F: 11,520	F: 11,520
Data surfaces per spindle	5	20	2	4	2
Heads per data surface	1	1	1	1	1
Tracks per surface	815	808	400	400	400
TPI	370	400	200	200	200
BPI	6039	4400	4000	4000	4000
RPM	3672	2400	1500	1500	1500
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	25	30	35	35	35
Average rotational delay (msec)	8.3	12.5	20	20	20
Average access time (msec)	33.3	42.5	55	55	55
Data transfer rate (KByte/sec)	1210	625	348	348	348
FIRST CUSTOMER SHIPMENT	1977	1976	1/77	1/77	1/77
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS		Embedded Servo			

1981 DISK/TREND REPORT

SPEC-13

MANUFACTURER	BURROUGHS	BURROUGHS	BURROUGHS	BURROUGHS	BURROUGHS
DRIVE					
	9493-37	FD 211	FD 214	9494-2	9494-4
DISK/TREND GROUP	8	7	8	9	9
MARKET	End User	OEM	OEM	End User	End User
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-1	3340	3340	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Burroughs	Intelligent Parallel 1/F	Intelligent Parallel 1/F	Burroughs	Burroughs
CAPACITY/PERFORMANCE	Drive consists of 2 spindles				Drive consists of 2 spindles
Total capacity (MBytes) FIXED	F: 37.6	F: 19.955	F: 79.822	F: 201	F: 402
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 11,520	F: 14,848	F: 14,848	F: 16,060	F: 16,060
Data surfaces per spindle	4	2	8	8	8
Heads per data surface	1	2	2	1	1
Tracks per surface	400	672	672	1564	1564
TPI	200	300	300	714	714
BPI	4000	5500	5500	6551	6551
RPM	1500	3000	3000	3672	3672
Actuator type	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	35	35	35	28	28
Average rotational delay (msec)	20	10	10	8	8
Average access time (msec)	55	45	45	36	36
Data transfer rate (KByte/sec)	348	888	888	1300	1300
FIRST CUSTOMER SHIPMENT	1/77	12/79	12/79	4Q78	4Q78
U.S. OEM PRICE FOR 100 UNITS	--	\$3,357	\$4,352	--	--
COMMENTS		Equivalent to B9493-19 and B9493-20	Equivalent to B9493-76 and B9493-80	B1800-B7800 Embedded Servo	B1800-B7800 Embedded Servo

1981 DISK/TREND REPORT

	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS
MANUFACTURER					
DRIVE	Trident T50	Trident T80 T82	Trident T200	Trident T300 T302	Marksman M20
DISK/TREND GROUP	4	4	5	5	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Trident	Trident	3330-11	3330-11	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	3330-11	3330-11	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Trident	T80: Trident T82: SMD	Trident	T300: Trident T302: SMD	Marksman
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	U: 20.16
REMOVABLE	U: 54.7	U: T80: 82.1 U: T82: 82.9	U: 208.1	U: T300: 312.1 T: T302: 315.2	--
Capacity per track (Bytes)	U: 13,440	U: 20,160	U: 13,440	U: 20,160	U: 24,000
Data surfaces per spindle	5	5	19	19	2
Heads per data surface	1	1	1	1	2
Tracks per surface	815	T80: 815 T82: 823	815	T300: 815 T302: 823	210
TPI	370	T80: 370 T82: 384	370	T300: 370 T302: 384	182
BPI	4040	6060	4040	6060	7545
RPM	3600	3600	3600	3600	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	30	30	30	30	65
Average rotational delay (msec)	8.3	8.3	8.3	8.3	12.5
Average access time (msec)	38.3	38.3	38.3	38.3	77.5
Data transfer rate (KByte/sec)	806	1209	806	1209	960
FIRST CUSTOMER SHIPMENT	5/75	8/75	6/76	8/76	3Q78
U.S. OEM PRICE FOR 100 UNITS	\$5,200	\$5,935	\$9,375	\$10,515	\$1,780
COMMENTS					

1981 DISK/TREND REPORT

SPEC-15

MANUFACTURER	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL
DRIVE	Marksman M40	Marksman M80	Cynthia D120 D122	Cynthia D135 D137	Cynthia D140 D142
DISK/TREND GROUP	8	8	1	1	2
MARKET	OEM	OEM	Captive, OEM	OEM	Captive, OEM
MEDIA: Manufacturer's number	--	--	M4120	M4120	M4120
Generic type	Fixed	Fixed	Special Cartridge 10.5" OD	Special Cartridge 10.5" OD	Special Cartridge 10.5" OD
Nominal disk diameter	14"	14"			
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Marksman	Marksman	Cynthia	Cynthia	Cynthia
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 40.32	U: 80.64	--	F: 5.0	F: 10.0
REMOVABLE	--	--	F: 10.0	F: 5.0	F: 10.0
Capacity per track (Bytes)	U: 24,000	U: 24,000	F: 12,800	F: 12,800	F: 12,800
Data surfaces per spindle	4	3	2	2	4
Heads per data surface	2	2	1	1	1
Tracks per surface	210	560	392	392	392
TPI	182	480	500	500	500
BPI	7545	7545	4750	4750	4750
RPM	2400	2400	3600	3600	3600
Actuator type	Band, Stepping Motor	Band, Torque Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	65	50	65	100	65
Average rotational delay (msec)	12.5	12.5	8.3	8.3	8.3
Average access time (msec)	77.5	62.5	73.3	108.3	73.3
Data transfer rate (KByte/sec)	960	960	920	920	920
FIRST CUSTOMER SHIPMENT	3Q78	4Q81	7/78	1Q81	4Q79
U.S. OEM PRICE FOR 100 UNITS	\$2,235	--	\$2,380	\$3,090	\$3,085
COMMENTS			Embedded Servo	Embedded Servo	Embedded Servo

1981 DISK/TREND REPORT

MANUFACTURER	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL	COMPUTER MEMORIES, INC.
DRIVE	Cynthia D505	Cynthia D160/4 D162/4	Cynthia D160/6 D162/6	Cynthia D160/8 D162/8	CM5205
DISK/TREND GROUP	7	8	8	8	7
MARKET	Captive, OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	10.5" OD	10.5" OD	10.5" OD	130 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3370	3370	3370	3350
Heads	Ferrite	Thin Film	Thin Film	Thin Film	Ferrite
Interface	ST 506	Cynthia	Cynthia	Cynthia	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.38	F: 60.21	F: 90.31	F: 120.42	U: 5.33
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,417	F: 12,800	F: 12,800	F: 12,800	U: 10,400
Data surfaces per spindle	4	4	6	8	2
Heads per data surface	1	1	1	1	1
Tracks per surface	153	1176	1176	1176	256
TPI	255	900	900	900	345
BPI	7690	4850	4850	4850	8650
RPM	3600	3600	3600	3600	3600
Actuator type	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Stepping Motor
Average positioning time (msec)	170 (Including Settling)	40	40	40	105 (Including Settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	178.3	48.3	48.3	48.3	113.3
Data transfer rate (KByte/sec)	625	920	920	920	625
FIRST CUSTOMER SHIPMENT	4Q81	3Q81	3Q81	3Q81	2Q81
U.S. OEM PRICE FOR 100 UNITS	--	\$3,085	\$3,355	\$3,625	\$975
COMMENTS	Mfg. under Seagate license	Embedded Servo			

SPEC-17

MANUFACTURER	COMPUTER MEMORIES, INC.	COMPUTER MEMORIES, INC.	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	CM5410	CM5616	9427H "Hawk"	9455 "Lark I"	9448-32 "Phoenix" or "CMD"
DISK/TREND GROUP	7	7	1	2	2
MARKET	OEM	OEM	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	9848	91208	91204
Generic type	Fixed	Fixed	5440	Lark Module Drive	Cartridge Module Drive
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"	195 mm OD 100 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	2314	LMD	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	Various Options	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 10.67	U: 16.0	U: 6.25	U: 8.35	U: 16.289
REMOVABLE	--	--	U: 6.25	U: 8.35	U: 16.289
Capacity per track (Bytes)	U: 10,400	U: 10,400	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	4	6	4	4	1 Fixed 1 Removable
Heads per data surface	1	1	1	1	1
Tracks per surface	256	256	406	202/4	823
TPI	345	345	200	237	384
BPI	8650	8650	2200	6774 FRPI 10161 BPI	6038
RPM	3600	3600	2400/1500	3510	3600
Actuator type	Rotary, Stepping Motor	Rotary, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	105 (Including Settling)	105 (Including Settling)	35	50	30
Average rotational delay (msec)	8.3	8.3	12.5/20	8.55	8.3
Average access time (msec)	113.3	113.3	47.5/55	58.55	38.3
Data transfer rate (KByte/sec)	625	625	312.5/195	1209	1209
FIRST CUSTOMER SHIPMENT	2Q81	2Q81	8/74	1Q81	9/78
U.S. OEM PRICE FOR 100 UNITS	\$1,220	\$1,475	\$4,230	\$3,160	\$5,315
COMMENTS				Embedded Servo	Separate Servo surface for fixed and removable disks

1981 DISK/TREND REPORT

	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
MANUFACTURER					
DRIVE	9448-64 "Phoenix" or "CMD"	9448-96 "Phoenix" or "CMD"	9746 9747	9760 "SMD"	9762 "SMD"
DISK/TREND GROUP	2	2	3	4	4
MARKET	OEM, Captive	OEM, Captive	OEM	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	91204	91204	9873	9876	9877
Generic type	Cartridge Module Drive	Cartridge Module Drive	2316	Storage Module Drive	Storage Module Drive
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	2314	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	Various Options	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 48.869	U: 81.446	--	--	--
REMOVABLE	U: 16.289	U: 16.289	U: 62.5	U: 40.7	U: 81.5
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 7,812	U: 20,160	U: 20,160
Data surfaces per spindle	3 Fixed 1 Removable	5 Fixed 1 Removable	20	5	5
Heads per data surface	1	1	1	1	1
Tracks per surface	823	823	406	411	823
TPI	384	834	200	192	384
BPI	6038	6038	2220	6038	6038
RPM	3600	3600	2400	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	35	30	30
Average rotational delay (msec)	8.3	8.3	12.5	8.3	8.3
Average access time (msec)	38.3	38.3	47.5	38.3	38.3
Data transfer rate (KByte/sec)	1209	1209	312.5	1209	1209
FIRST CUSTOMER SHIPMENT	9/78	9/78	1974	3/74	3/75
U.S. OEM PRICE FOR 100 UNITS	\$6,005	\$6,695	--	\$6,500	\$6,715
COMMENTS	Separate Servo surface for fixed and removable disks	Separate Servo surface for fixed and removable disks			

1981 DISK/TREND REPORT

SPEC-19

	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
MANUFACTURER					
DRIVE	270-10	9764 "SMD"	9766 "SMD"	270-30	9780
DISK/TREND GROUP	4	5	5	5	5
MARKET	PCM	OEM, Captive	OEM, Captive	PCM	OEM, Captive
MEDIA: Manufacturer's number	9877	9883-91	9883-91	9883-91	9883
Generic type	Storage Module Drive	3336-11	3336-11	3336-11	3336-11
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM Series 1	SMD	SMD	IBM Series 1	CDC
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	F: 63	U: 154.8	U: 309.5	F: 240	F: 200
Capacity per track (Bytes)	F: 15,360	U: 20,160	U: 20,160	F: 15,360	F: 13,030
Data surfaces per spindle	5	19	19	19	19
Heads per data surface	1	1	1	1	1
Tracks per surface	823	411	823	823	822
TPI	384	192	384	384	384
BPI	6038	6038	6038	6038	4040
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	30	30	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	38.3	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	1209	1209	1209	1209	806
FIRST CUSTOMER SHIPMENT	1978	3/76	3/76	1978	1974
U.S. OEM PRICE FOR 100 UNITS	--	--	\$12,355	--	--
COMMENTS					PCM version is 33302

1981 DISK/TREND REPORT

	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
MANUFACTURER					
DRIVE	9770	9414 "Falcon"	9410-8 "Finch"	9410-24 "Finch"	9730-12 "MMD"
DISK/TREND GROUP	6	7	7	7	7
MARKET	OEM	OEM	OEM, Captive	OEM, Captive	OEM
MEDIA: Manufacturer's number	9778	--	--	--	--
Generic type	3348	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	195 mm OD 100 mm ID	195 mm OD 100 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	2314	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	Various Options	Modified Floppy Disk Type	Modified Floppy Disk Type	SMD
CAPACITY/PERFORMANCE					0.96 MB Fixed Head Option
Total capacity (MBytes) FIXED	--	U: 12.5/6.25	U: 8.13	U: 24.39	U: 12.9
REMOVABLE	F: 35/70	--	--	--	--
Capacity per track (Bytes)	F: 16,736	U: 7,812	U: 13,440	U: 13,440	U: 20,160
Data surfaces per spindle	3/6	4/2	1	3	1
Heads per data surface	2	1	1	1	2
Tracks per surface	696/2	408	605	605	640
TPI	300	200/100	554	554	296
BPI	5636	2200	6800	6800	6220
RPM	2964	2400/1500	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	25	65	50	50	40
Average rotational delay (msec)	10.1	12.5/20	8.3	8.3	8.3
Average access time (msec)	35.1	77.5/85	58.3	58.3	48.3
Data transfer rate (KByte/sec)	885	312.5/195	806	806	1209
FIRST CUSTOMER SHIPMENT	1976	9/76	6/81	6/81	5/77
U.S. OEM PRICE FOR 100 UNITS	--	--	250 Units: \$1,420	250 Units: \$1,710	\$4,025
COMMENTS					

1981 DISK/TREND REPORT

	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
MANUFACTURER					
DRIVE	9730-24 "MMD"	230-10 240-10*	230-20 240-20*	230-23 240-23*	230-26 240-26*
DISK/TREND GROUP	7	7	7	8	8
MARKET	OEM	PCM	PCM	PCM	PCM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	IBM Series 1	IBM Series 1	IBM Series 1	IBM Series 1
CAPACITY/PERFORMANCE	0.96 MB Fixed Head Option	0.74 or 1.48 MB Fixed Head Option			
Total capacity (MBytes) FIXED	U: 25.8	F: 9.3	F: 25.3	F: 37.9	F: 50.6
REMOVABLE	--	--	--	--	
Capacity per track (Bytes)	U: 20,160	F: 15,360	F: 15,360	F: 15,360	F: 15,360
Data surfaces per spindle	2	1	2	3	4
Heads per data surface	2	2	2	2	2
Tracks per surface	640	606	823	823	823
TPI	296	296	340	340	340
BPI	6220	6220	6220	6220	6220
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	40	30	30	30	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	48.3	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	1209	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT	5/77	1Q79	2Q79	2Q79	2Q79
U.S. OEM PRICE FOR 100 UNITS	\$4425	--	--	--	--
COMMENTS					

*240 Series includes a flexible disk drive

	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
MANUFACTURER					
DRIVE	230-30 240-30*	9730-80 "MMD"	9730-160 "MMD"	33801-A2 33801-B2 33801-C2 (3330 Format)	33501-A2 33501-B2 33501-C2 (3350 Format)
DISK/TREND GROUP	8	8	8	9	9
MARKET	PCM	OEM, Captive	OEM, Captive	PCM	PCM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM Series 1	SMD	SMD	IBM	IBM
CAPACITY/PERFORMANCE	0.74 or 1.48 MB Fixed Head Option F: 63.2	0.96 or 1.93 MB Fixed Head Option U: 82.9	0.96 or 1.93 MB Fixed Head Option U: 165.9	1.24 MB Fixed Head Option F: 400	1.72 MB Fixed Head Option F: 317.5
Total capacity (MBytes) FIXED					
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 15,360	U: 20,160	U: 20,160	F: 13,030	F: 19,069
Data surfaces per spindle	5	5	5	20	20
Heads per data surface	2	2	2	2	2
Tracks per surface	823	823	1646	1686	843
TPI	340	340	680	660	660
BPI	6220	6220	6220	6350	6350
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	30	25	19
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	38.3	38.3	38.3	33.3	27.3
Data transfer rate (KByte/sec)	1209	1209	1209	1198	1198
FIRST CUSTOMER SHIPMENT	2Q79	1Q79	2Q79	1978	1978
U.S. OEM PRICE FOR 100 UNITS	--	\$5,600	\$6,980	--	--
COMMENTS					

*240 Series includes a flexible disk drive

1981 DISK/TREND REPORT

SPEC-23

	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
MANUFACTURER					
DRIVE	33502-A2 33502-B2 33502-C2	9776-A2 9776-B2 9776-C2	819-11	819-21	9775 "FMD"
DISK/TREND GROUP	9	9	9	9	9
MARKET	PCM	OEM, Captive	Captive	Captive	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed Module Drive
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3330-11	3330-11	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	CDC	CDC	SMD
CAPACITY/PERFORMANCE	1.72 MB Fixed Head Option	1.72 MB Fixed Head Option			1.9 MB Fixed Head Option
Total capacity (MBytes) FIXED	F: 635	F: 635	U: 325.8	U: 651.6	U: 675
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 19,069	F: 19,069	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	20	20	40	40	20
Heads per data surface	2	2	1	1	2
Tracks per surface	1686	1686	411	823	1686
TPI	660	660	192	384	660
BPI	6350	6350	600	600	6350
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	25	25	50	50	25
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	33.3	33.3	58.3	58.3	33.3
Data transfer rate (KByte/sec)	1198	1198	4840	4840	1209
FIRST CUSTOMER SHIPMENT	1Q79	1978	1978	1978	4/80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	\$16,690
COMMENTS	CDC Model 885		4 track parallel data transfer	4 track parallel data transfer	

1981 DISK/TREND REPORT

MANUFACTURER	CONTROL DATA	DASTEK	DASTEK	DASTEK	DASTEK
DRIVE	9797	4830-1	4830-2	4830-3	4835-1
DISK/TREND GROUP	9	9	9	9	9
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3370	3370	3370	3370
Heads	Ferrite	Thin Film	Thin Film	Thin Film	Thin Film
Interface	Special	SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 651.6	U: 203.5	U: 339.2	U: 407.0	U: 203.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 40,960	U: 40,960	U: 40,960	U: 40,960
Data surfaces per spindle	40	3	5	6	3
Heads per data surface	1	2	2	2	2
Tracks per surface	822	1656	1656	1656	1656
TPI	384	694	694	694	694
BPI	6000	12772	12772	12772	12772
RPM	3600	1785	1785	1785	2964
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	50	25	25	25	25
Average rotational delay (msec)	8.3	16.8	16.8	16.8	10.1
Average access time (msec)	58.3	41.8	41.8	41.8	35.1
Data transfer rate (KByte/sec)	4840	1200	1200	1200	2000
FIRST CUSTOMER SHIPMENT	1977	10/81	10/81	10/81	10/81
U.S. OEM PRICE FOR 100 UNITS	--	\$7,620	\$8,480	\$9,020	\$7,620
COMMENTS	4 track parallel data transfer				

1981 DISK/TREND REPORT

SPEC-25

MANUFACTURER	DASTEK	DASTEK	DATA GENERAL	DATA GENERAL	DATA GENERAL
DRIVE	4835-2	4835-3	6045 6046 6047 6048 6050	6095	6070
DISK/TREND GROUP	9	9	1	1	2
MARKET	OEM	OEM	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	1121	1121	1145
Generic type	Fixed	Fixed	5440	5440	5440
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3370	3370	2314	2314	3330-1
Heads	Thin Film	Thin Film	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	Data General	Data General	Data General
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 339.2	U: 407.0	F: 5.014	F: 5.014	F: 10.027
REMOVABLE	--	--	F: 5.014	F: 5.014	F: 10.027
Capacity per track (Bytes)	U: 40,960	U: 40,960	F: 6,144	F: 6,144	F: 12,288
Data surfaces per spindle	5	6	4	4	4
Heads per data surface	2	2	1	1	1
Tracks per surface	1656	1656	408	408	408
TPI	694	694	200	200	200
BPI	12772	12772	2200	2200	4400
RPM	2964	2964	2400	2400	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	25	25	38	38	38
Average rotational delay (msec)	10.1	10.1	12.5	12.5	12.5
Average access time (msec)	35.1	35.1	50.5	50.5	50.5
Data transfer rate (KByte/sec)	2000	2000	312.5	312.5	625
FIRST CUSTOMER SHIPMENT	10/81	10/81	1976	1978	1978
U.S. OEM PRICE FOR 100 UNITS	\$8,480	\$9,020	--	--	--
COMMENTS					

1981 DISK/TREND REPORT

	DATA GENERAL				
MANUFACTURER					
DRIVE	6067	6060	6061	6122	6098 6099 6101 6102
DISK/TREND GROUP	4	5	5	5	7
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	1143	1122	1123	1163	--
Generic type	SMD	3336-1	3336-11	3336-11	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3330-11	3330-1	3330-11	3330-11	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Data General				
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	F: 12.58
REMOVABLE	F: 50.074	F: 95.957	F: 190.280	F: 277.491	--
Capacity per track (Bytes)	F: 12,288	F: 12,288	F: 12,288	F: 17,920	F: 16,384
Data surfaces per spindle	5	19	19	19	2
Heads per data surface	1	1	1	1	2
Tracks per surface	815	411	815	815	384
TPI	370	192	370	370	166
BPI	4040	4040	4040	6060	5760
RPM	3600	3600	3600	3600	2964
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	35	35	35	35	60 (Including Settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	10.1
Average access time (msec)	43.3	43.3	43.3	43.3	70.1
Data transfer rate (KByte/sec)	806	806	806	1209	910.6
FIRST CUSTOMER SHIPMENT	1978	1976	1976	1Q80	3Q79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

1981 DISK/TREND REPORT

SPEC-27

MANUFACTURER	DATA GENERAL	DATA PERIPHERALS	DATAPPOINT	DATAPPOINT	DATA RECORDING EQUIPMENT, LTD.
DRIVE	6100 6103 6104 6105	DP100	9360	9374	4041B
DISK/TREND GROUP	7	1	1	2	1
MARKET	Captive	OEM	Captive	Captive	OEM
MEDIA: Manufacturer's number	--	DP10	80362	80428	--
Generic type	Fixed		2315	5440	5440
Nominal disk diameter	14"	200 mm OD 63.5 mm ID	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	Modified 3350	2314	3330-1	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Data General	Modified SA1000	Datapoint	Datapoint	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 25.16	--	F: 2.49	F: 10.027	--
REMOVABLE	--	U: 11.02	F: 2.49	F: 10.027	U: 3.125
Capacity per track (Bytes)	F: 16,384	U: 13,440	F: 6,144	F: 12,288	U: 7,812
Data surfaces per spindle	4	2	4	4	2
Heads per data surface	2	1	1	1	1
Tracks per surface	384	415	203	408	204
TPI	166	478	100	200	100
BPI	5760	6866	2200	4400	2200
RPM	2964	3600	1500	2400	2400
Actuator type	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	60 (Including Settling)	60	70	35	38
Average rotational delay (msec)	10.1	8.3	20	12.5	12.5
Average access time (msec)	70.1	68.3	90	47.5	50.5
Data transfer rate (KByte/sec)	910.6	874	195	625	312.5
FIRST CUSTOMER SHIPMENT	4Q79	4/81	1978	1978	6/77
U.S. OEM PRICE FOR 100 UNITS	--	\$1,960	--	--	--
COMMENTS		Embedded Servo			

1981 DISK/TREND REPORT

	DATA RECORDING EQUIPMENT, LTD.				
MANUFACTURER					
DRIVE					
	4042B	4043B	4044B	D9427H	D9448-32
DISK/TREND GROUP	1	1	1	1	2
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	CDC 91204
Generic type	5440	5440	5440	5440	CMD
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	2314	2314	2314	2314	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options	Various Options	Various Options	Various Options	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 3.125	U: 6.25	U: 6.25	U: 16.289
REMOVABLE	U: 6.25	U: 3.125	U: 6.25	U: 6.25	U: 16.289
Capacity per track (Bytes)	U: 7,812	U: 7,812	U: 7,812	U: 7,812	U: 20,160
Data surfaces per spindle	2	4	4	4	1 Fixed 1 Removable
Heads per data surface	1	1	1	1	1
Tracks per surface	408	204	408	406	823
TPI	200	100	200	200	384
BPI	2200	2200	2200	2200	6038
RPM	2400	2400	2400	2400	3600
Actuator type	Linear, Voice Coil				
Average positioning time (msec)	38	38	38	35	30
Average rotational delay (msec)	12.5	12.5	12.5	12.5	8.3
Average access time (msec)	50.5	50.5	50.5	47.5	38.3
Data transfer rate (KByte/sec)	312.5	312.5	312.5	312.5	1209
FIRST CUSTOMER SHIPMENT	6/77	6/77	6/77	1Q80	2Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

1981 DISK/TREND REPORT

	DATA RECORDING EQUIPMENT, LTD.	DATA RECORDING EQUIPMENT, LTD.	DATA RECORDING EQUIPMENT, LTD.	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION
MANUFACTURER					
DRIVE	D9448-64	D9448-96	3120	RK05J	RL01
DISK/TREND GROUP	2	2	7	1	1
MARKET	OEM	OEM	OEM	Captive	Captive
MEDIA: Manufacturer's number	CDC 91204	CDC 91204	--	RK05K	RL01K
Generic type	CMD	CMD	Fixed	2315	5440
Nominal disk diameter	14"	14"	200 mm OD 63.5 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	3340	2314	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	Bidirectional	Unibus	Unibus, LSI-11
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 48.869	U: 81.446	U: 19.5	--	--
REMOVABLE	U: 16.289	U: 16.289	--	F: 2.49	F: 5.24
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 10,880	F: 6,144	F: 10,240
Data surfaces per spindle	3 Fixed 1 Removable	5 Fixed 1 Removable	5	2	2
Heads per data surface	1	1	1	1	1
Tracks per surface	823	823	360	203	256
TPI	384	384	300	100	125
BPI	6038	6038	5800	2040	3725
RPM	3600	3600	4430	1500	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	35	50	55
Average rotational delay (msec)	8.3	8.3	6.77	20	12.5
Average access time (msec)	38.3	38.3	41.77	70	67.5
Data transfer rate (KByte/sec)	1209	1209	800	180	512.5
FIRST CUSTOMER SHIPMENT	2Q81	2Q81	1980	1975	4/78
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS				Original RK05 FCS 1972	Embedded Servo

MANUFACTURER	DIGITAL EQUIPMENT CORPORATION				
DRIVE	RL02	RK06	RK07	RM02	RM03
DISK/TREND GROUP	1	2	2	4	4
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	RL02K	RK06K	RK07K	--	--
Generic type	5440	Special Cartridge	Special Cartridge	SMD	SMD
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3330-1	3330-1	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Unibus, LSI-11	Unibus	Unibus	Unibus, Massbus	Unibus, Massbus
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	F: 10.48	F: 13.89	F: 27.54	F: 67.42	F: 67.42
Capacity per track (Bytes)	F: 10,240	F: 11,264	F: 11,264	F: 16,384	F: 16,384
Data surfaces per spindle	2	3	3	5	5
Heads per data surface	1	1	1	1	1
Tracks per surface	512	411	815	823	823
TPI	250	192.3	384.6	384	384
BPI	3725	4040	4040	6038	6038
RPM	2400	2400	2400	2400	3600
Actuator type	Linear, Voice Coil				
Average positioning time (msec)	55	38	36.5	30	30
Average rotational delay (msec)	12.5	12.5	12.5	12.5	8.3
Average access time (msec)	67.5	50.5	49	42.5	38.3
Data transfer rate (KByte/sec)	512.5	538	538	806	1209
FIRST CUSTOMER SHIPMENT	1979	12/76	4/78	4/78	4Q77
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Embedded Servo			Manufactured by CDC	Manufactured by CDC

1981 DISK/TREND REPORT

	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION
MANUFACTURER					
DRIVE					
	RM05	RP06	RK05F	RM80	RP07
DISK/TREND GROUP	5	5	7	8	9
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	RP06P	--	--	--
Generic type	3330-11	3330-11	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3330-11	3330-11	2314	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Massbus	Unibus, Massbus	Unibus	Massbus	Massbus
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	F: 4.99	F: 124	F: 516
REMOVABLE	F: 256	F: 176	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 11,264	F: 6,144	F: 16,384	F: 25,600
Data surfaces per spindle	19	19	2	7	16
Heads per data surface	1	1	1	2	2
Tracks per surface	823	815	406	1122	1260
TPI	384	384	200	478	537
BPI	6038	4040	2040	6339	11139*
RPM	3600	3600	1500	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	56	25	23
Average rotational delay (msec)	8.3	8.3	20	8.3	8.3
Average access time (msec)	38.3	38.3	76	33.3	31.3
Data transfer rate (KByte/sec)	1209	806	180	1200	2160
FIRST CUSTOMER SHIPMENT	3Q80	4Q76	7/76	1981	7/81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Manufactured by CDC	Manufactured by Memorex			*Effective BPI Manufactured by ISS/Univac

MANUFACTURER	DIGITAL EQUIPMENT CORPORATION	DISK MEMORY TECHNOLOGY	DISK MEMORY TECHNOLOGY	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE	RP20	601A	601B	M2201	F451
DISK/TREND GROUP	9	7	7	2	2
MARKET	Captive	OEM	OEM	OEM	Captive
MEDIA: Manufacturer's number	--	--	--	M2951	F922P
Generic type	Fixed	Fixed	Fixed	Special Cartridge 14"	Special Cartridge 14"
Nominal disk diameter	14"	9"	9"		
Magnetic surface	Oxide Coated	Nickel-Cobalt Plated	Nickel-Cobalt Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	Special	Special	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Massbus	Unique	Unique	SMD	Fujitsu
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 483.4	U: 2.8	U: 5.5	--	--
REMOVABLE	--	--	--	U: 50.56	F: 19.86
Capacity per track (Bytes)	F: 14,400	U: 6,750	U: 13,500	U: 20,480	F: 16,384
Data surfaces per spindle	15	2	2	3	3
Heads per data surface	2	2	2	1	1
Tracks per surface	2238	408	408	823	404
TPI	957	256	256	370	370
BPI	6425	3750	7500	6135	6135
RPM	3600	1800	1800	2400	2400
Actuator type	Linear, Voice Coil	Lead Screw Stepping Motor	Lead Screw Stepping Motor	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	25	130	130	30	30
Average rotational delay (msec)	8.3	16.7	16.7	12.5	12.5
Average access time (msec)	33.3	146.7	146.7	42.5	42.5
Data transfer rate (KByte/sec)	1198	219	438	819	819
FIRST CUSTOMER SHIPMENT	4Q80	9/80	9/80	4Q77	3Q77
U.S. OEM PRICE FOR 100 UNITS	--	Varies*	Varies*	--	--
COMMENTS	2 spindles per drive Manufactured by Storage Technology	*Normally sold only as subsys- tem, with price dependent on specific system	*Normally sold only as subsys- tem, with price dependent on specific system		

MANUFACTURER	FUJITSU, LTD.				
DRIVE	F452	M2211	F6417	F479	M2301B/K
DISK/TREND GROUP	2	2	2	5	7
MARKET	Captive	OEM	Captive	Captive	OEM
MEDIA: Manufacturer's number	F922P	M2952	F924P	F949P	--
Generic type	Special Cartridge	Special Cartridge	Special Cartridge	3336-11	Fixed
Nominal disk diameter	14"	14"	14"	14"	200 mm OD 100 mm ID Oxide Coated
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3330-11	3330-11	3330-11	3330-11	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Fujitsu	SMD	Fujitsu	Fujitsu	B=SA 4000 K=Bidirectional
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	U: 11.712
REMOVABLE	F: 39.7	U: 84.27	F: 67.6	F: 200	--
Capacity per track (Bytes)	F: 16,384	U: 20,480	F: 16,736	F: 13,030	U: 12,000
Data surfaces per spindle	3	5	5	19	4
Heads per data surface	1	1	1	1	1
Tracks per surface	808	823	808	815	244
TPI	370	370	370	370	195
BPI	6135	6135	5636	4040	6100
RPM	2400	2400	2400	3600	2964
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	30	30	30	25	70 (Including Settling)
Average rotational delay (msec)	12.5	12.5	12.5	8.4	10.1
Average access time (msec)	42.5	42.5	42.5	33.4	80.1
Data transfer rate (KByte/sec)	819	819	717	806	593
FIRST CUSTOMER SHIPMENT	3Q77	4Q79	4Q79	3Q75	7/80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	\$1,610
COMMENTS					

MANUFACTURER	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE	M2302B/K	M2311K	M2312K	M2251	M2252
DISK/TREND GROUP	7	8	8	7	7
MARKET	OEM	OEM	OEM	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	200 mm OD 100 mm ID	200 mm OD 100 mm ID	200 mm OD 100 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	2 x 3350	2 x 3350	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	B=SA 4000 K=Bidirectional	SMD	SMD	Fujitsu	Fujitsu
CAPACITY/PERFORMANCE				.3277 or .6554 Fixed Head Option U: 12.7	.3277 or .6554 Fixed Head Option U: 25.4
Total capacity (MBytes) FIXED	U: 23.424	U: 48.250	U: 84.439		
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 12,000	U: 20,480	U: 20,480	U: 20, 480	U: 20,480
Data surfaces per spindle	8	4	7	1	2
Heads per data surface	1	1	1	2	2
Tracks per surface	244	589	589	630	630
TPI	195	720	720	300	300
BPI	6100	9550	9550	6230	6230
RPM	2964	3600	3600	2400	2400
Actuator type	Band, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	70 (Including Settling)	20	20	40	40
Average rotational delay (msec)	10.1	8.3	8.3	12.5	12.5
Average access time (msec)	80.1	28.3	28.3	52.5	52.5
Data transfer rate (KByte/sec)	593	1229	1229	819	819
FIRST CUSTOMER SHIPMENT	7/80	4/81	4/81	2Q78	2Q78
U.S. OEM PRICE FOR 100 UNITS	\$2,090	\$3,195	\$3,795	--	--
COMMENTS					

MANUFACTURER	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE					
	M2253	M2280	M2284	F436	F6411
DISK/TREND GROUP	8	8	8	8	8
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Fujitsu	SMD	SMD	Fujitsu	Fujitsu
CAPACITY/PERFORMANCE	.3277 or .6554 Fixed Head Option	.65536 MB Fixed Head Option	.65536 MB Fixed Head Option		
Total capacity (MBytes) FIXED	U: 50.8	U: 84.275	U: 168.55	F: 100	F: 135
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,480	U: 20,480	U: 20,480		F: 16,736
Data surfaces per spindle	4	3	5	5	5
Heads per data surface	2	2/1	2	2	2
Tracks per surface	630	1646	1646	1630	1630
TPI	300	680	680	668	668
BPI	6230	6475	6475	6580	5694
RPM	2400	2964	2964	2400	2964
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	40	27	27	27	27
Average rotational delay (msec)	12.5	10.12	10.12	12.5	10.1
Average access time (msec)	52.5	37.12	37.12	39.5	37.1
Data transfer rate (KByte/sec)	819	1012	1012	819	885
FIRST CUSTOMER SHIPMENT	2Q78	4Q79	4Q79	4Q79	4Q79
U.S. OEM PRICE FOR 100 UNITS	--	\$3,817	\$4,787	--	--
COMMENTS					

1981 DISK/TREND REPORT

MANUFACTURER	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE	M2351A	F6421	F6425	F493	F496
DISK/TREND GROUP	9	9	9	9	9
MARKET	OEM	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	10.5" OD 4" ID	10.5" OD 4" ID	10.5" OD 4" ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Sputtered	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Special	3350	2 x 3350
Heads	Ferrite	Ferrite	Thin Film	Ferrite	Ferrite
Interface	Modified SMD	Fujitsu	Fujitsu	Fujitsu	Fujitsu
CAPACITY/PERFORMANCE	1.69 MB Fixed Head Option	1.607 or 1.144 MB Fixed Head Option	1.4 MB Fixed Head Option	1.144 MB Fixed Head Option	1.144 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 474.214	F: 446/317.5	F: 630	F: 317.5	F: 635
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 28,160	F: 26,793/ 19,069	*	F: 19,069	F: 19,069
Data surfaces per spindle	10	10	*	15	20
Heads per data surface	2	2	*	2	2
Tracks per surface	1684	1680	*	1110	1660
TPI	880	880	*	480	668
BPI	12790	12790	*	6362	6426
RPM	3961	3961	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	18	18	15	20	20
Average rotational delay (msec)	7.5	7.5	8.3	8.3	8.3
Average access time (msec)	25.5	25.5	23.3	28.3	28.3
Data transfer rate (KByte/sec)	1859	1859	3000	1198	1198
FIRST CUSTOMER SHIPMENT	4/82	3Q81	1982	4Q79	2Q80
U.S. OEM PRICE FOR 100 UNITS	\$8,500 (250 units)	--	--	--	--
COMMENTS		Drive has four spindles	*Not Announced Drive has four spindles	Drive has two spindles	Drive has two spindles

1981 DISK/TREND REPORT

	HEWLETT- PACKARD	HEWLETT- PACKARD	HEWLETT- PACKARD	HEWLETT- PACKARD	HEWLETT- PACKARD
MANUFACTURER					
DRIVE					
	7906	7920	7925	7908	7910
DISK/TREND GROUP	2	4	5	7	
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	12940A	13394A	13356A	--	--
Generic type	2315	Special SMD	Special Pack	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	200 mm OD 63.5 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-1	3330-11	--	3350	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	HP1B	HP1B	HP1B	HP1B	HP1B
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.68	--	--	F: 16.5	F: 12.04
REMOVABLE	U: 12.68	U: 63.67	F: 120.18	--	--
Capacity per track (Bytes)	U: 15,625	U: 15,625	F: 16,384	F: 8,960	F: 8,192
Data surfaces per spindle	3	5	9	5	2
Heads per data surface	1	1	1	1	1
Tracks per surface	812 Fixed 406 Removable	815	815	370	738
TPI	384 Fixed 192 Removable	384	384	300	300
BPI	4680	4680	6250	6000	3225
RPM	3600	3600	2700	3600	3000
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	25	25	25	41.6	70
Average rotational delay (msec)	8.3	8.3	11.1	8.3	10
Average access time (msec)	33.3	33.3	36.1	49.9	80
Data transfer rate (KByte/sec)	937.5	937.5	937.5	537.6	526
FIRST CUSTOMER SHIPMENT	3/78	3/77	6/78	9/81	1Q79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS				Drive manufactured by International Memories	

MANUFACTURER	HIGHTRACK COMPUTER TECHNIK GmbH	HIGHTRACK COMPUTER TECHNIK GmbH	HIGHTRACK COMPUTER TECHNIK GmbH	HITACHI, LTD.	HITACHI, LTD.
DRIVE	HT 24	HT 40	HT 80	H-8593	H-8589-1
DISK/TREND GROUP	7	8	8	5	5
MARKET	OEM	OEM	OEM	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	H-8583	H-8581-1
Generic type	Fixed	Fixed	Fixed	Special Disk Pack 14"	3336-1
Nominal disk diameter	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	14"	14"
Magnetic surface	Plated	Plated	Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	3330-11	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD, ANSI X3T9.3	SMD, ANSI X3T9.3	SMD, ANSI X3T9.3	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 25.905	U: 41.425	U: 82.958	--	--
REMOVABLE	--	--	--	F: 100	F: 100
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	F: 13,030	F: 13,030
Data surfaces per spindle	5	5	5	12	19
Heads per data surface	1	1	1	1	1
Tracks per surface	257	411	823	815	411
TPI	286	286	572	370	192
BPI	9290	11286	11286	4040	4040
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	24	30	30	30	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	32.3	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	1209	1209	1209	806	806
FIRST CUSTOMER SHIPMENT	12/80	12/80	1981	1979	
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS				Two 50 MB disk packs on a single spindle	

1981 DISK/TREND REPORT

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	H-8589-11	H-8586-12 H-8586-22	MFD 90-1	MFD 90-2	MFD 90-F
DISK/TREND GROUP	5	6	7	7	7
MARKET	Captive	Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	H-8581-11	H-8584-35/70	--	--	--
Generic type	3336-11	3348-35/70	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3340	3340	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	Floppy Type	Floppy Type	Floppy Type
CAPACITY/PERFORMANCE					0.061 MB Fixed Head Option
Total capacity (MBytes) FIXED	--	--	F: 1.3	F: 2.6	F: 1.95
REMOVABLE	F: 200	F: 35/70	--	--	--
Capacity per track (Bytes)	F: 13,030	F: 16,736	F: 10,200	F: 10,200	F: 10,200
Data surfaces per spindle	19	3/6	1	2	2
Heads per data surface	1	2	2	2	2/1
Tracks per surface	815	696/2	129	129	129/65
TPI	370	300	48	48	48
BPI	4040	5636	3706	3706	3706
RPM	3600	2964	3425	3425	3425
Actuator type	Linear, Voice Coil	Rotary, Voice Coil	Stepping Motor	Stepping Motor	Stepping Motor
Average positioning time (msec)	25	20	190	190	190
Average rotational delay (msec)	8.3	10.1	8.8	8.8	8.8
Average access time (msec)	33.3	30.1	198.8	198.8	198.8
Data transfer rate (KByte/sec)	806	885	618	618	618
FIRST CUSTOMER SHIPMENT		1976	1976	1976	1976
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE					
	MFD 90-F2	MFD 135-4	MFD 135-8	MFD 135-F	DK801-1
DISK/TREND GROUP	7	7	7	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	210 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	3340	3340	3340	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Floppy Type	Floppy Type	Floppy Type	Floppy Type	Modified SMD
CAPACITY/PERFORMANCE	0.143 MB Fixed Head Option			0.21 MB Fixed Head Option	
Total capacity (MBytes) FIXED	F: 1.95	F: 3.7	F: 7.4	F: 6.5	U: 6.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 10,200	F: 14,500	F: 14,500	F: 14,500	F: 13,300
Data surfaces per spindle	2	2	4	4	2
Heads per data surface	2/1	2	2	2/2/2/1	1
Tracks per surface	129/65	129/128	129/128	129/128	231
TPI	48	48	48	48	200
BPI	3706	5241	5241	5241	7300
RPM	3425	3450	3450	3450	3521
Actuator type	Stepping Motor	Stepping Motor	Stepping Motor	Stepping Motor	Rotary, Stepping Motor 70
Average positioning time (msec)	190	100	100	100	
Average rotational delay (msec)	8.8	8.7	8.7	8.7	8.5
Average access time (msec)	198.8	108.7	108.7	108.7	78.5
Data transfer rate (KByte/sec)	618	875	875	875	889
FIRST CUSTOMER SHIPMENT	1976	1979	1979	1979	4/80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	DK801-2	DK811-2	DK811-4	DK 62-10	DK 62-20
DISK/TREND GROUP	7	7	8	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Modified SMD	Modified SMD	Modified SMD		
CAPACITY/PERFORMANCE				0.144 MB Fixed Head Option	0.144 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 13.9	U: 24.0	U: 48.0	U: 10.8 F: 9.2	U: 21.7 F: 18.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 13,300	F: 12,800	F: 12,800	F: 15,360	F: 15,360
Data surfaces per spindle	4	3	6	1	2
Heads per data surface	1	1	1	2	2
Tracks per surface	231	522	522	604	604
TPI	200	480	480	300	300
BPI	7300	7495	7495	5570	5570
RPM	3521	3521	3521	2964	2964
Actuator type	Rotary, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	70	25	25	40	40
Average rotational delay (msec)	8.5	8.5	8.5	10.1	10.1
Average access time (msec)	78.5	33.5	33.5	50.1	50.1
Data transfer rate (KByte/sec)	889	904	904	889	889
FIRST CUSTOMER SHIPMENT	4/80	10/80	10/80	1977	1977
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	DK 62-40	DK 62-80	H-8594-22	DKU-95 H-8595-12 H-8595-22 H-8595-32	H-8597-12 H-8597-22
DISK/TREND GROUP	8	8	9	9	9
MARKET	OEM	OEM	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	3340	3350	3350	2 x 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface			IBM	IBM	IBM
CAPACITY/PERFORMANCE	0.144 MB Fixed Head Option U: 43.3 F: 36.9	0.144 MB Fixed Head Option U: 86.6 F: 73.9	1.004 MB Fixed Head Option F: 280	1.144 MB Fixed Head Option F: 317.5	F: 635
Total capacity (MBytes) FIXED					
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 15,360	F: 15,360	F: 16,736	F: 19,069	F: 19,069
Data surfaces per spindle	4	8	15	15	20
Heads per data surface	2	2	2	2	2
Tracks per surface	604	604	1114	1110	1666
TPI	300	300	478	478	720
BPI	5570	5570	5636	6425	6425
RPM	2964	2964	2964	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Dual Rotary, Voice Coil
Average positioning time (msec)	37	37	20	20	20
Average rotational delay (msec)	10.1	10.1	10.1	8.3	8.3
Average access time (msec)	47.1	47.1	30.1	28.3	28.3
Data transfer rate (KByte/sec)	889	889	885	1198	1198
FIRST CUSTOMER SHIPMENT	1979	1979	1979	1979	4Q80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			Drive has two spindles	Drive has two spindles	Drive has two spindles

1981 DISK/TREND REPORT

SPEC-43

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HOKUSHIN ELECTRIC WORKS, LTD.	HOKUSHIN ELECTRIC WORKS, LTD.	HOKUSHIN ELECTRIC WORKS, LTD.
DRIVE	DKU-97I	DKU-98I H-8598	CD-5200S	CD-5400S	CD-5200
DISK/TREND GROUP	9	9	1	2	2
MARKET	OEM	OEM, Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	5440	5440	5440
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	2 x 3350	Special 3350	2314	2314	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	Various Options	Various Options	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 635	F: 1260	U: 6.0	U: 18.0	U: 13.26
REMOVABLE	--	--	U: 6.0	U: 6.0	U: 13.26
Capacity per track (Bytes)	F: 19,069	*	U: 7,500	U: 7,500	U: 16,250
Data surfaces per spindle	20	20	4	8	4
Heads per data surface	2	2	1	1	1
Tracks per surface	1666	1770	408	408	408
TPI	720	762	200	200	200
BPI	6425	15240**	2200	2200	4580
RPM	3600	3600	2400	2400	2400
Actuator type	Dual Rotary, Voice Coil	Dual Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	20/18	16	40	40	40
Average rotational delay (msec)	8.3	8.3	12.5	12.5	12.5
Average access time (msec)	28.3/26.3	24.3	52.5	52.5	52.5
Data transfer rate (KByte/sec)	1198	3000	312.5	312.5	650
FIRST CUSTOMER SHIPMENT	1981	--	1979	1979	1979
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Drive has two spindles	*Not Announced **Effective BPI Drive has two spindles			

1981 DISK/TREND REPORT

	HOKUSHIN ELECTRIC WORKS, LTD.				
MANUFACTURER					
DRIVE	CD-5400	CD-8005	CD-8010	CD-8010P	CD-8030
DISK/TREND GROUP	2	7	7	7	8
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	5440	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	210 mm OD 100 mm ID	210 mm OD 100 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3330-11	3340	3340	3340	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options	Priam	Priam	Priam	Priam
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 39.78	U: 6.6	U: 13.2	U: 11.5	U: 35.28
REMOVABLE	U: 13.26	--	--	--	--
Capacity per track (Bytes)	U: 16,250	U: 15,000	--	U: 15,151	U: 13,440
Data surfaces per spindle	8	2	4	4	5
Heads per data surface	1	1	1	1	1
Tracks per surface	408	221	221	190	525
TPI	200	180	180	180	480
BPI	2200	7475	7475	7475	6670
RPM	2400	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil
Average positioning time (msec)	40	78 (Including Settling)	78 (Including Settling)	73 (Including Settling)	42
Average rotational delay (msec)	12.5	8.3	8.3	8.3	8.3
Average access time (msec)	52.5	86.3	86.3	81.3	50.3
Data transfer rate (KByte/sec)	312.5	900	900	900	800
FIRST CUSTOMER SHIPMENT	1979	3/80	3/80	11/80	1982
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS				SA 800 Dimensions	Priam License: DISKOS 3450

1981 DISK/TREND REPORT

SPEC-45

MANUFACTURER	HOKUSHIN ELECTRIC WORKS, LTD.	HOKUSHIN ELECTRIC WORKS, LTD.	HOKUSHIN ELECTRIC WORKS, LTD.	HOKUSHIN ELECTRIC WORKS, LTD.	IBM
DRIVE	CD-8070	CD-6030	CD-6060	CD-6150	1131 2310
DISK/TREND GROUP	8	8	8	8	1
MARKET	OEM	OEM	OEM	OEM	Captive
MEDIA: Manufacturer's number	--	--	--	--	2315
Generic type	Fixed	Fixed	Fixed	Fixed	2315
Nominal disk diameter	200 mm OD 63.5 mm ID	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	2310
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Priam	Priam	Priam	Priam	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 70.49	U: 33.9	U: 67.9	U: 158.5	--
REMOVABLE	--	--	--	--	F: 1.024
Capacity per track (Bytes)	U: 13,440	U: 20,160	U: 20,160	U: 20,160	F: 2,560
Data surfaces per spindle	5	2	2	4	2
Heads per data surface	1	2/1	2/1	2/1	1
Tracks per surface	1049	1122	2246	2246	200
TPI	960	480	960	960	100
BPI	6670	6430	6430	6430	1100
RPM	3600	3125	3125	3125	1500
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Step- ping Voice Coil
Average positioning time (msec)	42	45	45	40	520
Average rotational delay (msec)	8.3	9.7	9.7	9.7	20
Average access time (msec)	50.3	54.7	54.7	49.7	540
Data transfer rate (KByte/sec)	800	1040	1040	1040	97.5
FIRST CUSTOMER SHIPMENT	1982	1982	1982	1982	11/65
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Priam License: DISKOS 7050	Priam License: DISKOS 3350	Priam License: DISKOS 6650	Priam License: DISKOS 15450	1130

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MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE					
	5444-1	5444-A1	5444-2/3	5444-A2	5022-1
DISK/TREND GROUP	1	1	1	1	1
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	5440	5440	5440	5440	5440
Generic type	5440	5440	5440	5440	5440
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	5444	5444	5444	5444	5444
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 1.22	F: 1.22	F: 2.45	F: 2.45	F: 2.45
REMOVABLE	F: 1.22	F: 1.22	F: 2.45	F: 2.45	F: 2.45
Capacity per track (Bytes)	F: 6,144				
Data surfaces per spindle	4	4	4	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	100	100	200	200	200
TPI	100	100	100	100	100
BPI	2200	2200	2200	2200	2200
RPM	1500	1500	1500	1500	1500
Actuator type	Lead Screw, Friction Drive	Lead Screw, Stepping Motor	Lead Screw, Friction Drive	Lead Screw, Stepping Motor	Lead Screw, Friction Drive
Average positioning time (msec)	153	86	269	126	269
Average rotational delay (msec)	20	20	20	20	20
Average access time (msec)	173	106	289	146	289
Data transfer rate (KByte/sec)	199	199	199	199	199
FIRST CUSTOMER SHIPMENT	9/70	1971	1970	1971	1971
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/3	System/3	System/3	System/3	System/7

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MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5022-2	5447-A1	5447-A2	2311-1	2311-11
DISK/TREND GROUP	1	1	1	--	--
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	5440	5440	5440	1316	1316
Generic type	5440	5440	5440	1316	1316
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	5444	5444	5444	2311	2311
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 2.45	F: 2.45	F: 7.35	--	--
REMOVABLE	F: 2.45	F: 2.45	F: 2.45	F: 7.45	F: 5.4
Capacity per track (Bytes)	F: 6,144	F: 6,144	F: 6,144	F: 3,625	F: 2,700
Data surfaces per spindle	4	4	8	10	10
Heads per data surface	1	1	1	1	1
Tracks per surface	200	200	200	203	203
TPI	100	100	100	100	100
BPI	2200	2200	2200	1100	1100
RPM	1500	1500	1500	2400	2400
Actuator type	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Lead Screw, Stepping Motor	Linear, Hydraulic	Linear, Hydraulic
Average positioning time (msec)	126	126	126	75	75
Average rotational delay (msec)	20	20	20	12.5	12.5
Average access time (msec)	146	146	146	87.5	87.5
Data transfer rate (KByte/sec)	199	199	199	156	156
FIRST CUSTOMER SHIPMENT	1972	1976	1976	6/65	11/70
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/7	System/3	System/3	System/360	System/360

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MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	2311-12	2314-1	2314-A 2314-B 2312 2319	5445	3330-1
DISK/TREND GROUP	--	3	3	3	5
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	1316	2316	2316	2316	3336-1
Generic type	1316	2316	2316	2316	3336-1
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	2311	2314	2314	2314	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	F: 2.7	F: 29.176	F: 29.176	F: 20.48	F: 100.018
Capacity per track (Bytes)	F: 2,700	F: 7,294	F: 7,294	F: 5,120	F: 13,030
Data surfaces per spindle	10	20	20	20	19
Heads per data surface	1	1	1	1	1
Tracks per surface	103	203	203	203	411
TPI	100	100	100	100	192
BPI	1100	2200	2200	2200	4040
RPM	2400	2400	2400	2400	3600
Actuator type	Linear, Hydraulic	Linear, Hydraulic	Linear, Hydraulic	Linear, Hydraulic	Linear, Voice Coil
Average positioning time (msec)	60	75	60	60	30
Average rotational delay (msec)	12.5	12.5	12.5	12.5	8.3
Average access time (msec)	72.5	87.5	72.5	72.5	38.3
Data transfer rate (KByte/sec)	156	312.5	312.5	312.5	806
FIRST CUSTOMER SHIPMENT	11/70	4/65	A-8/69 B, 2319-12/70	6/72	8/71
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/360	System/360 System/370	System/360 System/370	System/3	System/370 303X Series 43XX

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MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	3330-11	3340-A2 3340-B1 3340-B2	3340-C2	5022-3	5022-4
DISK/TREND GROUP	5	6	6	7	7
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	3336-11	3348-35/70/70F	3348-70	--	--
Generic type	3336-11	3348	3348	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3340	3340	2314	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	F: 2.45	F: 2.45
REMOVABLE	F: 200.036	F: 34.9/69.8	F: 50.872	--	--
Capacity per track (Bytes)	F: 13,030	F: 16,736	F: 16,736	F: 6,144	F: 6,144
Data surfaces per spindle	19	3/6	6	2	2
Heads per data surface	1	2	2	1	1
Tracks per surface	815	696	696	200	200
TPI	370	300	300	100	100
BPI	4040	5636	5636	2200	2200
RPM	3600	2964	2964	1500	1500
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Hydraulic	Linear, Hydraulic
Average positioning time (msec)	30	25	25	269	126
Average rotational delay (msec)	8.3	10.1	10.1	20	20
Average access time (msec)	38.3	35.1	35.1	289	146
Data transfer rate (KByte/sec)	806	885	885	199	199
FIRST CUSTOMER SHIPMENT	1973	11/73	11/73	1971	1971
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/370 303X Series 43XX	System/370 System/3 System/7 303X, 43XX .502 Fixed Head with 3348-70F	System/3-12	System/7	System/7

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5448	5320-XX1	5320-XX2	5320-XX3	5320-XX4
DISK/TREND GROUP	7	7	7	7	7
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	2314	Gulliver	Gulliver	Gulliver	Gulliver
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 9.8	F: 3.210	F: 5.053	F: 9.170	F: 13.778
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 6,144	F: 15,360	F: 15,360	F: 15,360	F: 15,360
Data surfaces per spindle	8	1	1	1	2
Heads per data surface	1	2	2	2	2/1
Tracks per surface	200	209	329	597	598/299
TPI	100	300	300	300	300
BPI	2200	5636	5636	5636	5636
RPM	1500	2964	2964	2964	2964
Actuator type	Linear, Hydraulic	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	126	50.4	70	72.5	40
Average rotational delay (msec)	20	10.1	10.1	10.1	10.1
Average access time (msec)	146	60.5	80.1	82.6	50.1
Data transfer rate (KByte/sec)	199	889	889	889	889
FIRST CUSTOMER SHIPMENT	1977	4Q76	1/75	1/75	2Q76
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/3	System/32	System/32	System/32	System/32

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MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	4962-1 4962-2	4962-3 4962-4	5340-XX1	5340-XX2	5340-XX3
DISK/TREND GROUP	7	7	7	7	7
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Gulliver	Gulliver	Gulliver	Gulliver	Gulliver
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE	0.122 MB Fixed Head Option				(2 Spindles)
Total capacity (MBytes) FIXED	F: 9.308	F: 13.962240	F: 8.616960	F: 13.271040	F: 27.156840
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 15,360	F: 15,360	F: 15,360	F: 15,360	F: 15,360
Data surfaces per spindle	1	2	2	2	2
Heads per data surface	2	2/1	2/1	2/1	2/1
Tracks per surface	606	606	402/201	604/302	604/302
TPI	300	300	300	300	300
BPI	5636	5636	5636	5636	5636
RPM	2964	2964	2964	2964	2964
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	40	40	35	40	40
Average rotational delay (msec)	10.1	10.1	10.1	10.1	10.1
Average access time (msec)	50.1	50.1	45.1	50.1	50.1
Data transfer rate (KByte/sec)	889	889	889	889	889
FIRST CUSTOMER SHIPMENT	4Q76		1/78	1/78	1/78
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Series/1	Series/1	System/34	System/34	System/34

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MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	4963-29A 4963-29B	4963-23A 4963-23B	4963-64A 4963-64B	4963-58A 4963-58B	5340-XX4
DISK/TREND GROUP	7	7	8	8	8
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Piccolo	Piccolo	Piccolo	Piccolo	Piccolo
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE		0.131 MB Fixed Heads		0.131 MB Fixed Heads	
Total capacity (MBytes) FIXED	F: 29.327360	F: 23.461888	F: 64.520192	F: 58.654720	F: 63.905792
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 16,384	F: 16,384	F: 16,384	F: 16,384
Data surfaces per spindle	5	5	11	11	11
Heads per data surface	1	1	1	1	1
Tracks per surface	359	359	359	359	359
TPI	450	450	450	450	450
BPI	8530	8530	8530	8530	8530
RPM	3125	3125	3125	3125	3125
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	27	27	27	27	27
Average rotational delay (msec)	9.6	9.6	9.6	9.6	9.6
Average access time (msec)	36.6	36.6	36.6	36.6	36.6
Data transfer rate (KByte/sec)	1031	1031	1031	1031	1031
FIRST CUSTOMER SHIPMENT	2/79	2/79	2/79	2/79	1/79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Series/1	Series/1	Series/1	Series/1	System/34

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MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5340-XX5	5381- All Models	8130-A21 8130-A31 A41, A51 A61, A71	8130-A22 8140-A32 A42, A52 A62, A72	8130-A23 8140-A33 A43, A53 A63, A73
DISK/TREND GROUP	8	8	7	7	8
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Piccolo	Piccolo	Piccolo	Piccolo	Piccolo
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE	(2 Spindles)			.131072 MB Fixed Heads	
Total capacity (MBytes) FIXED	F: 128.425984	F: 64.520192	F: 29.327360	F: 23.461888	F: 64.520192
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 16,384	F: 16,384	F: 16,384	F: 16,384
Data surfaces per spindle	11	11	5	5	11
Heads per data surface	1	1	1	1	1
Tracks per surface	359	359	359	359	359
TPI	450	450	450	450	450
BPI	8530	8530	8530	8530	8530
RPM	3125	3125	3125	3125	3125
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	27	27	27	27	27
Average rotational delay (msec)	9.6	9.6	9.6	9.6	9.6
Average access time (msec)	36.6	36.6	36.6	36.6	36.6
Data transfer rate (KByte/sec)	1031	1031	1031	1031	1031
FIRST CUSTOMER SHIPMENT	1/79	8/79	3Q79	3Q79	3Q79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/34	System/38 5381 Processor available with up to six disk spindles	8100 System	8100 System	8100 System

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	8130-A24 8140-A34 A44, A54 A64, A74	8140-B51 B61 B71	8140-B52 B62 B72	8101-A11	8101-A13
DISK/TREND GROUP	8	8	8	7	8
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD	210 mm OD	210 mm OD	210 mm OD	210 mm OD
	100 mm ID	100 mm ID	100 mm ID	100 mm ID	100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Piccolo	Piccolo	Piccolo	Piccolo	Piccolo
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE	.131072 MB Fixed Heads	.131072 MB Fixed Heads	.131072 MB Fixed Heads (2 Spindles)		
Total capacity (MBytes) FIXED	F: 58.654720	F: 58.654720	F: 123.174912	F: 29.327360	F: 64.520192
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 16,384	F: 16,384	F: 16,384	F: 16,384
Data surfaces per spindle	11	11	11	5	11
Heads per data surface	1	1	1	1	1
Tracks per surface	359	359	359	359	359
TPI	450	450	450	450	450
BPI	8530	8530	8530	8530	8530
RPM	3125	3125	3125	3125	3125
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	27	27	27	27	27
Average rotational delay (msec)	9.6	9.6	9.6	9.6	9.6
Average access time (msec)	36.6	36.6	36.6	36.6	36.6
Data transfer rate (KByte/sec)	1031	1031	1031	1031	1031
FIRST CUSTOMER SHIPMENT	3Q79	4Q80	4Q80	3Q79	3Q79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	8100 System	8100 System	8100 System	8100 System	8100 System

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MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	3310-A1 3310-A2 3310-B1 3310-B2	5525-020 5525-030	5525-040 5525-050	3344-B2 3344-B2F	3350-A2 3350-B2 3350-C2
DISK/TREND GROUP	8	7	8	9	9
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Piccolo	Piccolo	Piccolo	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE				1.004 MB Fixed Head Option	1.144 MB Fixed Head Option
Total capacity (MBytes) FIXED	F: 64.520192	F: 29.327360	F: 64.520192	F: 279.558	F: 317.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 16,384	F: 16,384	F: 16,736	F: 19,069
Data surfaces per spindle	11	5	11	15	15
Heads per data surface	1	1	1	2	2
Tracks per surface	359	359	359	1114	1110
TPI	450	450	450	478	478
BPI	8530	8530	8530	5636	6425
RPM	3125	3125	3125	2964	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	27	27	27	25	25
Average rotational delay (msec)	9.6	9.6	9.6	10.1	8.4
Average access time (msec)	36.6	36.6	36.6	35.1	33.4
Data transfer rate (KByte/sec)	1031	1031	1031	885	1198
FIRST CUSTOMER SHIPMENT	3/79	2/80	11/80	2Q76	1Q76
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	4331	5520 Admin. System	5520 Admin. System -050 Model is Dual Spindle	System/370 System/3 303X Series 4341 Drive has two spindles	System/370 303X Series 43XX Drive has two spindles

MANUFACTURER	IBM	IBM	IBM	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.
DRIVE	3370-A1 3370-A11 3370-B1 3370-B11	3375-A01 3375-B01 3375-D01	3380-A4 3380-A4F 3380-AA4 3380-AAF 3380-B4 3380-B4F	5007	5006
DISK/TREND GROUP	9	9	9	7	7
MARKET	Captive	Captive	Captive	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	133 mm OD 63.5 mm ID	133 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3370	3370	3380	3350	3350
Heads	Thin Film	Thin Film	Thin Film	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IMI	ST506
CAPACITY/PERFORMANCE	1.144 MB Fixed Head Option		2.8 MB Fixed Head Option		
Total capacity (MBytes) FIXED	F: 571.392	F: 819.7	F: 1260.4878	U: 6.72	U: 6.38
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 31,744	*	F: 47,476	U: 12,000	U: 10,417
Data surfaces per spindle	12	12	15	4	4
Heads per data surface	2	2	2	1	1
Tracks per surface	1500	*	1770	140	153
TPI	635	*	*	200	200
BPI	8128 FRPI 12134 BPI	8128 FRPI 12134 BPI	*	8800	7690
RPM	2964	2964	3600	4800	3600
Actuator type	Dual, Linear, Voice Coil	Dual, Linear, Voice Coil	Dual, Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	20	19	16	165 (Including Settling)	192 (Including Settling)
Average rotational delay (msec)	10.1	10.1	8.3	6.25	8.3
Average access time (msec)	30.1	29.1	24.3	171.25	200.3
Data transfer rate (KByte/sec)	1859	1859	3000	960	625
FIRST CUSTOMER SHIPMENT	10/79	3Q81	4Q81	1Q81	9/81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	\$1,170	\$1,100
COMMENTS	43X1 Series System/38	4331 4341 303X Series *Not Announced	303X Series 370/158, 158-3 370/168, 168-3 *Not Announced Drive has two spindles		

1981 DISK/TREND REPORT

SPEC-57

MANUFACTURER	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	IRWIN INTERNATIONAL	ISOTIMPEX
DRIVE	7710	7720	7740	510	ISOT 1370
DISK/TREND GROUP	7	7	8	7	1
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	ES 5269
Generic type	Fixed	Fixed	Fixed	Fixed	5440
Nominal disk diameter	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	130 mm OD 40 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Plated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	Modified 3350	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IMI	IMI	IMI	Irwin	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 11.12	U: 20.5	U: 40.0	U: 12.3	F: 3.125
REMOVABLE	--	--	--	--	F: 3.125
Capacity per track (Bytes)	U: 10,800	U: 10,800	U: 10,800	U: 10,080	F: 7,812
Data surfaces per spindle	3	5	5	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	380	380	760	612	203
TPI	300	300	600	900	100
BPI	6200	6200	6200	9124	2200
RPM	3600	3600	3600	3605	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	35	35	50	25	40
Average rotational delay (msec)	8.3	8.3	8.3	8.32	12.5
Average access time (msec)	43.3	43.3	58.3	33.32	57.5
Data transfer rate (KByte/sec)	648	648	648	675	312
FIRST CUSTOMER SHIPMENT	1/79	1/80	2Q81	3Q81	1976
U.S. OEM PRICE FOR 100 UNITS	\$1,900	\$2,290	\$2,850	\$1,800	--
COMMENTS				Subsystem, with tape cartridge; Embedded Servo	

1981 DISK/TREND REPORT

MANUFACTURER	ISOTIMPEX	ISOTIMPEX	ISOTIMPEX	ISOTIMPEX	ISOTIMPEX
DRIVE	ES 5052	SM 5400-02 SM 5400-03	SM 5400-00 SM 5400-01	ES 5061	ES 5066 ES 5067.01 ES 5067.02
DISK/TREND GROUP	--	1	1	3	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	ES 5053	ES 5269	ES 5269	ES 5261	ES 5266
Generic type	1316	5440	5440	2316	3336-1
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	2311	2314	2314	2314	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options	Various Options	Various Options		
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	U: 3.125	--	--
REMOVABLE	F: 7.25	U: 3.125	U: 3.125	F: 29	F: 100
Capacity per track (Bytes)	F: 3,625	U: 7,812	U: 7,812	F: 7,294	F: 13,030
Data surfaces per spindle	10	4	4	20	19
Heads per data surface	1	1	1	1	1
Tracks per surface	203	204	204	203	411
TPI	100	100	100	100	192
BPI	1100	2200	2200	2200	4040
RPM	2400	2400/1500	2400/1500	2400	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	70	50	50	50	30
Average rotational delay (msec)	12.5	12.5/20	12.5/20	12.5	8.3
Average access time (msec)	82.5	62.5/70	62.5/70	62.5	38.3
Data transfer rate (KByte/sec)	156	312/195	312/195	312	806
FIRST CUSTOMER SHIPMENT	1971	1979	1979	1976	1980
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

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SPEC-59

MANUFACTURER	ISOTIMPEX	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC
DRIVE	ES 5067	Univac 8418-92	Univac 8418-94	Univac 8419	733-10 7330-10
DISK/TREND GROUP	5	4	4	4	5
MARKET	OEM	Captive	Captive	Captive	OEM, PCM, Captive
MEDIA: Manufacturer's number	ES 5267	F 1216-01	F 1216-02	--	--
Generic type	3336-11	SMD	SMD	SMD	3336-1
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3330-11	3330-11	3330-11	3330-11	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface		Univac	Univac	Univac	IBM, Univac
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	F: 200	F: 28.9	F: 57.9	F: 72.3	F: 100
Capacity per track (Bytes)	F: 13,030	F: 10,240	F: 10,240	F: 16,800	F: 13,030
Data surfaces per spindle	19	7	7	7	19
Heads per data surface	1	1	1	1	1
Tracks per surface	815	411	815	815	411
TPI	370	370	370	370	192
BPI	4040	4040	4040	5050	4040
RPM	3600	2800	2800	2800	3600
Actuator type	Linear, Voice Coil				
Average positioning time (msec)	30	27	33	33	27
Average rotational delay (msec)	8.3	10.7	10.7	10.7	8.3
Average access time (msec)	38.3	37.7	43.7	43.7	35.3
Data transfer rate (KByte/sec)	806	625	625	784	806
FIRST CUSTOMER SHIPMENT	1980	11/75	3/76	12/80	5/75
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS				System 80	Equivalent to Univac 8430

1981 DISK/TREND REPORT

MANUFACTURER	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC
DRIVE	733-11 7330-11	7330-12	717	Univac 8402-50	Univac 8402-75
DISK/TREND GROUP	5	5	8	8	8
MARKET	OEM, PCM, Captive	PCM, Captive	OEM	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	3336-11	3336 (Spec.)	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM, Univac	IBM, Univac	SMD	Univac	Univac
CAPACITY/PERFORMANCE			1.2 MB Fixed Head Option		
Total capacity (MBytes) FIXED	--	--	U: 154	F: 50.7	F: 76.0
REMOVABLE	F: 200	F: 317.5	--	--	--
Capacity per track (Bytes)	F: 13,030	F: 19,069	U: 19,968	F: 13,312	F: 13,312
Data surfaces per spindle	19	19	7	7	7
Heads per data surface	1	1	2	2	2
Tracks per surface	815	887	1120	544	816
TPI	370	402	476	476	476
BPI	4040	6965*	6366	6366	6366
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	27	30	35	35	35
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	35.3	38.3	43.3	43.3	43.3
Data transfer rate (KByte/sec)	806	1260	1198	1198	1198
FIRST CUSTOMER SHIPMENT	2/75	1977	1979	3/81	3/81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Equivalent to Univac 8433	Equivalent to Univac 8434 *Effective BPI (uses 3 PM code)		BC/7-900	BC/7-900

1981 DISK/TREND REPORT

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MANUFACTURER	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC
DRIVE	Univac 8402-100	Univac 8417	7350	Univac 8450	Univac 8470
DISK/TREND GROUP	8	8	9	9	9
MARKET	Captive	Captive	PCM	Captive, OEM	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Univac	Univac	IBM	Univac	Univac
CAPACITY/PERFORMANCE		.86 MB Fixed Head Option			1.524 MB Fixed Head Option
Total capacity (MBytes) FIXED	F: 101.4	F: 118.2	F: 317.5	F: 336.3	F: 564.48
REMOVABLE	--	--	--		
Capacity per track (Bytes)	F: 13,312	F: 19,900	F: 19,069	F: 21,060	F: 28,224
Data surfaces per spindle	7	7	15	15	16
Heads per data surface	2	2	2	2	2
Tracks per surface	1088	1100	1110	1110	1250
TPI	476	476	478	478	538
BPI	6366	6366	6366	6695	11134*
RPM	3600	3400	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	35	35	23	23	23
Average rotational delay (msec)	8.3	8.82	8.3	8.3	8.3
Average access time (msec)	43.3	43.82	31.3	31.3	31.3
Data transfer rate (KByte/sec)	1198	1130	1198	1198	2097
FIRST CUSTOMER SHIPMENT	3/81	12/80	4Q77	2Q78	6/80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	BC/7-900	System 80			Univac 1100/60 *Effective BPI (uses 3 PM code)

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MANUFACTURER	KENNEDY	KENNEDY	KENNEDY	KENNEDY	KENNEDY
DRIVE	5301-14	5302-42	5303-72	5830	7300
DISK/TREND GROUP	7	8	8	8	8
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	200 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3340	3340	3340	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Kennedy	Kennedy	Kennedy	SMD	SMD, Kennedy, ANSI X3T9.3
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 14.112	U: 42.336	U: 70.56	U: 80	U: 41.4
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160				
Data surfaces per spindle	1	3	5	5	5
Heads per data surface	2	2	2	2	1
Tracks per surface	700	700	700	823	411
TPI	300	300	300	429	480
BPI	6000	6000	6000	6330	9420
RPM	3000	3000	3000	3600	3600
Actuator type	Rotary, Voice Coil				
Average positioning time (msec)	45	45	45	35	30
Average rotational delay (msec)	10	10	10	8.3	8.3
Average access time (msec)	55	55	55	43.3	38.3
Data transfer rate (KByte/sec)	1000	1000	1000	1290	967
FIRST CUSTOMER SHIPMENT	1Q78	1Q78	1Q78	3Q81	3Q81
U.S. OEM PRICE FOR 100 UNITS	\$2,800	\$3,200	\$3,600	\$4,320	\$2,560
COMMENTS					

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	MEMOREX	MEMOREX	MEMOREX	MEMOREX	MEMOREX
MANUFACTURER					
DRIVE					
	201	3670-1/2	3675	677-0X	677-30
DISK/TREND GROUP	2	5	5	5	5
MARKET	OEM	PCM	PCM	OEM	OEM
MEDIA: Manufacturer's number	2001	Mark X	Mark XI	Mark XI	Mark XIII
Generic type	Special Cartridge	3336-1	3336-11	3336-11	3336-11
Nominal disk diameter	200 mm OD 100 mm ID	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3330-1	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD, Memorex	IBM	IBM	IBM	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.5	--	--	--	--
REMOVABLE	U: 12.5	F: 100	F: 200	U: 208.18	U: 309.5
Capacity per track (Bytes)	U: 20,672	F: 13,030	F: 13,030	U: 13,440	U: 20,160
Data surfaces per spindle	4	19	19	19	19
Heads per data surface	1	1	1	1	1
Tracks per surface	312	411	815	815	823
TPI	480	192	384	370	384
BPI	8450	4040	4040	4040	6060
RPM	3510	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	27	27	28.5	28.5
Average rotational delay (msec)	8.5	8.3	8.3	8.3	8.3
Average access time (msec)	38.5	35.3	35.3	36.8	36.8
Data transfer rate (KByte/sec)	1209	806	806	806	1209
FIRST CUSTOMER SHIPMENT	--	10/74	1976	1977	3Q80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	\$8,830	\$9,450
COMMENTS	Embedded Servo Note: Specs expected to be revised	PCM 3330-1	PCM 3330-11		

MANUFACTURER	MEMOREX	MEMOREX	MEMOREX	MEMOREX	MEMOREX
DRIVE	101	102	601-50	612-56	601-75
DISK/TREND GROUP	7	7	8	8	8
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	200 mm OD 100 mm ID	200 mm OD 100 mm ID	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	3340	3340	3350	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA 4000	SA 4000	Memorex	SMD, Memorex	SMD, Memorex
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 11.7	U: 23.4	U: 50.288	U: 56	U: 75.432
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 12,000	U: 12,000	U: 17,920	U: 20,160	U: 17,920
Data surfaces per spindle	4	8	4	4	6
Heads per data surface	1	1	2	2	2
Tracks per surface	244	244	700	700	700
TPI	195	195	300	300	300
BPI	6120	6120	5636	6350	5636
RPM	2983	2983	2964	3600	2964
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	103 (Including Settling)	103 (Including Settling)	32	32	32
Average rotational delay (msec)	10.06	10.06	10.1	8.3	10.1
Average access time (msec)	113.06	113.06	42.1	40.3	42.1
Data transfer rate (KByte/sec)	596.6	596.6	885	1209	885
FIRST CUSTOMER SHIPMENT	2Q80	1Q81	1977	1/80	1977
U.S. OEM PRICE FOR 100 UNITS	\$1,560	\$1,870	\$4,175	\$4,175	\$4,740
COMMENTS					

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MANUFACTURER	MEMOREX	MEMOREX	MEMOREX	MEMOREX	MEMOREX
DRIVE	612-84	3644	3650-A2 3650-B2 3650-C2	3652-A2 3652-B2 3652-C2	659
DISK/TREND GROUP	8	9	9	9	9
MARKET	OEM	PCM	PCM	PCM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD, Memorex	IBM	IBM	IBM	SMD
CAPACITY/PERFORMANCE		1.004 MB Fixed Head Option	1.144 MB Fixed Head Option	1.144 MB Fixed Head Option	
Total capacity (MBytes) FIXED	U: 84	F: 279.558	F: 317.5	F: 635	U: 677.8
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	F: 16,736	F: 19,069	F: 19,069	U: 20,160
Data surfaces per spindle	6	15	15	15	15
Heads per data surface	2	2	2	2	2
Tracks per surface	700	1114	1110	2220	2240
TPI	300	480	480	960	935
BPI	6350	5636	6425	6425	6350
RPM	3600	2964	3600	3600	3600
Actuator type	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	32	25	25	25	22
Average rotational delay (msec)	8.3	10.1	8.3	8.3	8.3
Average access time (msec)	40.3	35.1	33.3	33.3	30.3
Data transfer rate (KByte/sec)	1209	885	1198	1198	1207
FIRST CUSTOMER SHIPMENT	1/80	7/78	4Q77	3Q79	1981
U.S. OEM PRICE FOR 100 UNITS	\$4,740	--	--	--	\$13,500
COMMENTS		PCM 3344	PCM 3350	PCM 3350 Double Density	

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	MICRODATA	MICRODATA	MICRODATA	MICRODATA	MICRODATA
MANUFACTURER					
DRIVE					
	Reflex I 7501	Reflex I 7502	Reflex I 7503	Reflex II 4721	Reflex II 4722
DISK/TREND GROUP	7	8	8	8	8
MARKET	Captive, OEM				
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3340	3340	3340	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE	.54 MB Fixed Head Option	.54 MB Fixed Head Option	.54 MB Fixed Head Option	1.2 MB Fixed Head Option	1.2 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 12.5	U: 37.6	U: 62.7	U: 113.1	U: 158.3
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 17,920	U: 17,920	U: 17,920	U: 20,160	U: 20,160
Data surfaces per spindle	1	3	5	5	7
Heads per data surface	2	2	2	2	2
Tracks per surface	700	700	700	1122	1122
TPI	300	300	300	478	478
BPI	5636	5636	5636	6427	6427
RPM	2964	2964	2964	3530	3530
Actuator type	Linear, Voice Coil				
Average positioning time (msec)	30	30	30	30	30
Average rotational delay (msec)	10.1	10.1	10.1	8.5	8.5
Average access time (msec)	40.1	40.1	40.1	38.5	38.5
Data transfer rate (KByte/sec)	885	885	885	1175	1175
FIRST CUSTOMER SHIPMENT	1977	1977	1977	1979	1979
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	\$5,600
COMMENTS					

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MANUFACTURER	MICRO PERIPHERALS, INC.	MICROPOLIS	MICROPOLIS	MICROPOLIS	MINISCRIBE
DRIVE	10	1221-I 1201-I	1222-I 1202-I	1223-I 1203-I	Miniscribe 1-006
DISK/TREND GROUP	7	7	7	8	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	130 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA 1000	Micropolis or ANSI	Micropolis or ANSI	Micropolis or ANSI	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.06	U: 8.911	U: 26.73	U: 44.56	U: 6.4
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 8,900	U: 15,364	U: 15,364	U: 15,364	U: 10,417
Data surfaces per spindle	4	1	3	5	2
Heads per data surface	1	1	1	1	1
Tracks per surface	337.5	580	580	580	306
TPI	371	478	478	478	402
BPI	8000	5749 FCI 8623 BPI*	5749 FCI 8623 BPI*	5749 FCI 8623 BPI*	8605
RPM	4000	3600	3600	3600	3600
Actuator type	Rotary, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rack & Pinion, Stepping Motor
Average positioning time (msec)	27 (Including Settling)	42	42	42	194 (Including Settling)
Average rotational delay (msec)	7.5	8.3	8.3	8.3	8.3
Average access time (msec)	34.5	50.3	50.3	50.3	202.3
Data transfer rate (KByte/sec)	625	922	922	922	625
FIRST CUSTOMER SHIPMENT	2/82	11/79	11/79	11/79	8/81
U.S. OEM PRICE FOR 100 UNITS	\$1,575	1221-I: \$2,048 1201-I: \$1,642	1222-I: \$2,481 1202-I: \$2,075	1223-I: \$2,896 1203-I: \$2,490	
COMMENTS		*Uses modified 3 PM encoding	*Uses modified 3 PM encoding	*Uses modified 3 PM encoding	

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MANUFACTURER	MINISCRIBE	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION
DRIVE	Miniscribe 1-012	M802F M802S	M803F M803S	M2850F	2851F
DISK/TREND GROUP	7	1	2	4	4
MARKET	OEM	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	370111	802029	50-802282	80-802282
Generic type	Fixed	5440	5440	Trident	Trident
Nominal disk diameter	130 mm OD 40 mm ID	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	2314	3330-1	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	Mitsubishi, Hawk, Diablo	Mitsubishi	Trident	Trident
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.8	U: 6.375	U: 12.75	--	--
REMOVABLE	--	U: 6.375	U: 12.75	U: 54.7	U: 82.1
Capacity per track (Bytes)	U: 10,417	U: 7,812	U: 15,624	U: 13,440	U: 20,160
Data surfaces per spindle	4	4	4	5	5
Heads per data surface	1	1	1	1	1
Tracks per surface	306	408	408	815	815
TPI	402	200	200	370	370
BPI	8605	2211	4420	4040	6060
RPM	3600	2400	2400	3600	3600
Actuator type	Rack & Pinion, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	194 (Including Settling)	45	45	30	30
Average rotational delay (msec)	8.3	12.5	12.5	8.3	8.3
Average access time (msec)	202.3	57.5	57.5	38.3	38.3
Data transfer rate (KByte/sec)	625	312.5	625	806	1209
FIRST CUSTOMER SHIPMENT	8/81	1974	1976	1977	1978
U.S. OEM PRICE FOR 100 UNITS		--	--	--	--
COMMENTS					

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	mitsubishi electric corporation				
MANUFACTURER					
DRIVE					
	M2853F	M2854F	M2838F	2839F	M2860-1
DISK/TREND GROUP	4	4	5	5	7
MARKET	OEM	OEM	OEM, Captive	OEM	OEM
MEDIA: Manufacturer's number	--	--	J20789	--	--
Generic type	SMD	SMD		SMD	Fixed
Nominal disk diameter	14"	14"	14"	14"	200 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3330-11	3330-11	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	Trident	SMD	Trident, SMD, SA-1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	U: 21.73
REMOVABLE	U: 55.3	U: 82.9	U: 312.1	U: 315	--
Capacity per track (Bytes)	U: 13,440	U: 20,160	U: 20,160	U: 20,160	U: 13,440
Data surfaces per spindle	5	5	19	19	3
Heads per data surface	1	1	1	1	1
Tracks per surface	823	823	815	823	548
TPI	384	384	370	384	480
BPI	4040	6060	6060	6060	7300
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil				
Average positioning time (msec)	30	30	30	30	35
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	38.3	38.3	38.3	38.3	43.3
Data transfer rate (KByte/sec)	806	1209	1209	1209	806
FIRST CUSTOMER SHIPMENT	1980	1980	1979	4/81	1981
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

1981 DISK/TREND REPORT

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION
DRIVE					
	M2860-2	M2883-10	M2883-20	M2883-40	M2883-60
DISK/TREND GROUP	8	7	7	8	8
MARKET	OEM	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	200 mm OD 63.5 mm ID	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3330-11	3340	3340	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Trident, SMD, SA-1000	Trident, SMD	Trident, SMD	Trident, SMD	Trident, SMD
CAPACITY/PERFORMANCE		0.81 MB Fixed Head Option	0.81/2.42 MB Fixed Head Option	0.81/2.42 MB Fixed Head Option	0.81 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 50.71	U: 13.47	U: 26.93	U: 53.86	U: 80.8
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 13,440	U: 20,160	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	7	1	2	4	6
Heads per data surface	1	2	2	2	2
Tracks per surface	548	678	678	678	678
TPI	480	286	286	286	286
BPI	7300	6060	6060	6060	6060
RPM	3600	3000	3000	3000	3000
Actuator type	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	35	38	38	38	38
Average rotational delay (msec)	8.3	10	10	10	10
Average access time (msec)	43.3	48	48	48	48
Data transfer rate (KByte/sec)	806	996	996	996	996
FIRST CUSTOMER SHIPMENT	1981	4Q78	4Q78	4Q78	4Q78
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

1981 DISK/TREND REPORT

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MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	NEW WORLD COMPUTER CO., INC.	NEW WORLD COMPUTER CO., INC.	NEW WORLD COMPUTER CO., INC.	NEW WORLD COMPUTER CO., INC.
DRIVE	M2884	Mikro-Disc V 2/0	Mikro-Disc V 4/0	Mikro-Disc V 2/2	Mikro-Disc V 4/2
DISK/TREND GROUP	8	7	7	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--			
Generic type	Fixed	Fixed	Fixed	Fixed, with Removable HDA	Fixed, with Removable HDA
Nominal disk diameter	14"	130 mm OD 40 mm ID			
Magnetic surface	Oxide Coated	Plated	Plated	Plated	Plated
DRIVE: Technology type	3350	Special	Special	Special	Special
Heads	Ferrite	8 Ferrite Heads Per Assembly			
Interface	Trident, SMD	New World, ST 506, SA-1000			
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 129.18	U: 2	U: 4	U: 2	U: 4
REMOVABLE	--	--	--	U: 2	U: 2
Capacity per track (Bytes)	U: 20,160	U: 13,000	U: 13,000	U: 13,000	U: 13,000
Data surfaces per spindle	6	1	2	2	3
Heads per data surface	2	8	8	8	8
Tracks per surface	1068	160	160	160	160
TPI	480	250	250	250	250
BPI	6122	9000	9000	9000	9000
RPM	2964	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Stepping Motor	Stepping Motor	Stepping Motor	Stepping Motor
Average positioning time (msec)	38	28.3	28.3	28.3	28.3
Average rotational delay (msec)	10.12	8.3	8.3	8.3	8.3
Average access time (msec)	48.12	36.6	36.6	36.6	36.6
Data transfer rate (KByte/sec)	996	782	782	782	782
FIRST CUSTOMER SHIPMENT	4/81	3Q81	3Q81	3Q81	3Q81
U.S. OEM PRICE FOR 100 UNITS	--	\$596	\$856	\$936	\$1,096
COMMENTS					

MANUFACTURER	NEW WORLD COMPUTER CO., INC.	NEW WORLD COMPUTER CO., INC.	NEW WORLD COMPUTER CO., INC.	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY
DRIVE	Mikro-Disc V 4/4	Mikro-Disc VIII-1	Mikro-Disc VIII-1TF	N7711	N7715
DISK/TREND GROUP	7	7	7	1	1
MARKET	OEM	OEM	OEM	Captive	Captive
MEDIA: Manufacturer's number		--	--	N9710	N9715
Generic type	Fixed, with Removable HDA	Fixed	Fixed	5440	5440
Nominal disk diameter	130 mm OD 40 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	14"	14"
Magnetic surface	Plated	Oxide Coated	Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Special	Special	Special	2314	2314
Heads	8 Ferrite Heads Per Assembly	20 Ferrite Heads Per Ass'y	16 Ferrite Heads Per Ass'y	Ferrite	Ferrite
Interface	New World, ST 506, SA-1000	New World, ST 506, SA-1000	New World, ST 506, SA-1000	NEC	NEC
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 4	U: 1.8	U: 5.0	F: 2.45	F: 4.9
REMOVABLE	U: 4	--	--	F: 2.45	F: 4.9
Capacity per track (Bytes)	U: 13,000	U: 11,300	U: 16,500	F: 6,144	F: 6,144
Data surfaces per spindle	4	1	1	4	4
Heads per data surface	8	20	16	1	1
Tracks per surface	160	160	320	204	407
TPI	250	100	200	100	200
BPI	9000	7200	9000	2200	2200
RPM	3600	3600	3600	2400	2400
Actuator type	Stepping Motor	Stepping Motor	Stepping Motor	Linear, Voice Coil 30	Linear, Voice Coil 30
Average positioning time (msec)	28.3	18.3	28.3		
Average rotational delay (msec)	8.3	8.3	8.3	12.5	12.5
Average access time (msec)	36.6	26.6	36.6	42.5	42.5
Data transfer rate (KByte/sec)	782	675	988	312.5	312.5
FIRST CUSTOMER SHIPMENT	3Q81	1980	1980	4/74	8/75
U.S. OEM PRICE FOR 100 UNITS	\$1,296	\$1,100	\$1,300	--	--
COMMENTS					

1981 DISK/TREND REPORT

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MANUFACTURER	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY
DRIVE	N277 N7745	D-1210 N7721	D-1220 N7722	D-1240 N7723	D2220 N7724
DISK/TREND GROUP	5	7	8	8	7
MARKET	Captive	Captive, OEM	Captive, OEM	Captive, OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	3336-11	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	210 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	NEC	SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE		0.48/0.96 MB Fixed Head Option U: 20.8	0.48/0.96 MB Fixed Head Option U: 41.5	0.48/0.96 MB Fixed Head Option U: 83.1	
Total capacity (MBytes) FIXED	--				U: 25.49
REMOVABLE	F: 200	--	--	--	--
Capacity per track (Bytes)	F: 13,030	U: 19,968	U: 19,968	U: 19,968	U: 20,480
Data surfaces per spindle	19	1	2	4	3
Heads per data surface	1	2	2	2	1
Tracks per surface	815	1040	1040	1040	415
TPI	370	480	480	480	480
BPI	4040	6370	6370	6370	8824
RPM	3600	3600	3600	3600	3510
Actuator type	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	30	40	40	40	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.55
Average access time (msec)	38.3	48.3	48.3	48.3	38.55
Data transfer rate (KByte/sec)	806	1198	1198	1198	1198
FIRST CUSTOMER SHIPMENT	11/75	9/78	9/78	9/78	3/81
U.S. OEM PRICE FOR 100 UNITS	--	\$3,050	\$3,300	\$3,870	\$2,365
COMMENTS					

1981 DISK/TREND REPORT

	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC INDUSTRY CO., LTD.
MANUFACTURER					
DRIVE	D2230 N7725	N7751	D-1510	N7755	RD-5055
DISK/TREND GROUP	8	9	9	9	7
MARKET	OEM	Captive	OEM	Captive	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	14"	14"	14"	130 mm OD 40 mm ID
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3350	3350	3350	2 x 3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	NEC	SMD	NEC	
CAPACITY/PERFORMANCE		1.144 MB Fixed Head Option	1.19 MB Fixed Head Option		
Total capacity (MBytes) FIXED	U: 42.49	F: 317.5	U: 331.5	F: 635	U: 5.55
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,480	F: 19,069	U: 19,968	F: 19,069	U: 9,250
Data surfaces per spindle	5	15	15	15	4
Heads per data surface	1	2	2	2	1
Tracks per surface	415	1122	1122	2244	150
TPI	480	480	480	960	200
BPI	8824	6400	6400	6400	7500
RPM	3510	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	30	20	20	20	195 (Including Settling)
Average rotational delay (msec)	8.55	8.3	8.3	8.3	8.3
Average access time (msec)	38.55	28.3	28.3	28.3	203.3
Data transfer rate (KByte/sec)	1198	1198	1198	1198	555
FIRST CUSTOMER SHIPMENT	3/81	12/77	5/78	1979	1982
U.S. OEM PRICE FOR 100 UNITS	\$2,590	--	\$9,800	--	--
COMMENTS					

1981 DISK/TREND REPORT

SPEC-75

MANUFACTURER	NIPPON ELECTRIC INDUSTRY CO., LTD.	NIPPON PERIPHERALS LIMITED			
DRIVE	RD-8074	RD-8223	RD-8371	RD-8520	NP05-6
DISK/TREND GROUP	7	7	8	8	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	200 mm OD	200 mm OD	200 mm OD	200 mm OD	130 mm OD
Magnetic surface	63.5 mm ID Oxide Coated	40 mm ID Oxide Coated			
DRIVE: Technology type	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	SMD	SMD	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 7.4	U: 22.3	U: 37.1	U: 52.0	U: 6.66
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 11,340	U: 11,340	U: 11,340	U: 11,340	U: 10,400
Data surfaces per spindle	1	3	5	7	4
Heads per data surface	1	1	1	1	1
Tracks per surface	656	656	656	656	160
TPI	478	478	478	478	254
BPI	6424	6424	6424	6424	8261
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	45	45	45	45	90 (Including Settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	53.3	53.3	53.3	53.3	98.3
Data transfer rate (KByte/sec)	680	680	680	680	625
FIRST CUSTOMER SHIPMENT	1982	1982	1982	1982	4Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

1981 DISK/TREND REPORT

MANUFACTURER	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED
DRIVE	NP05-10	NP31-A1 NP31-A2 NP31-B1 NP31-B2	NP30-40	NP30-80	NP30-120
DISK/TREND GROUP	7	8	8	8	8
MARKET	OEM	PCM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	Piccolo	Piccolo	Piccolo	Piccolo
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	IBM	SMD	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 10	F: 64.5	U: 36.6	U: 80.6	U: 120.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,400	F: 16,384	U: 19,800	U: 19,800	U: 19,800
Data surfaces per spindle	6	11	5	11	11
Heads per data surface	1	1	1	1	1
Tracks per surface	160	360	370	370	555
TPI	254	465	479	479	719
BPI	8261	8530	8530	8530	8530
RPM	3600	3125	3125	3125	3125
Actuator type	Band, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	90 (Including Settling)	27	27	27	27
Average rotational delay (msec)	8.3	9.6	9.6	9.6	9.6
Average access time (msec)	98.3	36.6	36.6	36.6	36.6
Data transfer rate (KByte/sec)	625	1031	1031	1031	1031
FIRST CUSTOMER SHIPMENT	4Q81	1Q81	1Q81	1Q81	1Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS		PCM 3310			

1981 DISK/TREND REPORT

SPEC-77

MANUFACTURER	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NORTHERN TELECOM
DRIVE	NP20	NP24	NP25-A2 NP25-B2 NP25-C2	NP37-A01 NP37-B01	4518
DISK/TREND GROUP	6	9	9	9	7
MARKET	PCM	PCM	PCM	OEM	Captive
MEDIA: Manufacturer's number	NP21-35/70	--	--	--	--
Generic type	3348 Data Module	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	3350	3350	3370	2314
Heads	Ferrite	Ferrite	Ferrite	Thin Film	Ferrite
Interface	IBM	IBM	IBM	--	Northern Telecom
CAPACITY/PERFORMANCE		1.004 MB Fixed Head Option	1.144 MB Fixed Head Option		
Total capacity (MBytes) FIXED	--	F: 279.558	F: 317.499	U: 680.988	F: 5.3
REMOVABLE	F: 35/70	--	--	--	--
Capacity per track (Bytes)	F: 16,736	F: 16,736	F: 19,069	*	F: 6,656
Data surfaces per spindle	3/6	15	15	12	2
Heads per data surface	2	2	2	2	1
Tracks per surface	696/2	1114	1110	1500	400
TPI	300	480	480	*	200
BPI	5636	5636	6425	*	2200
RPM	2964	2964	3600	2964	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Dual Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	20	20	20	20	50
Average rotational delay (msec)	10.1	10.1	8.3	10.12	12.5
Average access time (msec)	30.1	30.1	28.3	30.12	62.5
Data transfer rate (KByte/sec)	885	885	1198	1859	312.5
FIRST CUSTOMER SHIPMENT	1976	1977	1977	1982	1975
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	PCM 3340	PCM 3344	PCM 3350	*Not Announced	

1981 DISK/TREND REPORT

MANUFACTURER	NORTHERN TELECOM	NORTHERN TELECOM	NORTHERN TELECOM	OHIO SCIENTIFIC	OHIO SCIENTIFIC
DRIVE	4520 4521	Aspen I	Aspen II	3303	3306
DISK/TREND GROUP	7	7	7	8	8
MARKET	Captive	Captive	Captive	Captive, OEM	Captive, OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	210 mm OD 100 mm ID	210 mm OD 100 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	2314	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Northern Telecom	Northern Telecom	Northern Telecom	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 10.7	F: 11.0 U: 13.2	F: 22.0 U: 26.4	U: 40.39	U: 80.8
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 13,312	U: 14,700	U: 14,700	U: 20,160	U: 20,160
Data surfaces per spindle	2	2	4	3	6
Heads per data surface	1	1	1	2	2
Tracks per surface	400	1	1	678	678
TPI	200	447	447	286	286
BPI	4400	480	480	6122	6122
RPM	2400	6250	6250	2964	2964
Actuator type	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	50	22	27	38	38
Average rotational delay (msec)	12.5	8.3	8.3	10.12	10.12
Average access time (msec)	62.5	30.3	35.3	48.12	48.12
Data transfer rate (KByte/sec)	625	869	869	1000	1000
FIRST CUSTOMER SHIPMENT	1978	1981	1981	7/77	7/77
U.S. OEM PRICE FOR 100 UNITS	--	--	--	\$3,550	\$4,150
COMMENTS		Embedded Servo	Embedded Servo		

1981 DISK/TREND REPORT

MANUFACTURER	OLIVETTI	OLIVETTI	OLIVETTI	OLIVETTI	OLIVETTI
DRIVE					
	HD 513	HD 561/1	HD 561/2	HD 561/3	HD 512/1
DISK/TREND GROUP	7	7	7	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID
Magnetic surface	Plated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Special	ST 506	ST 506	ST 506	Bidirectional
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.3	U: 3.75	U: 7.50	U: 11.25	U: 13
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,080	U: 10,417	U: 10,417	U: 10,417	U: 10,080
Data surfaces per spindle	2	2	4	6	3
Heads per data surface	1	1	1	1	1
Tracks per surface	612	180	180	180	430
TPI	900	254	254	254	600
BPI	9124	7690	7690	7690	8166
RPM	3605	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil
Average positioning time (msec)	25	86 (Including Settling)	86 (Including Settling)	86 (Including Settling)	30 (Including Settling)
Average rotational delay (msec)	8.32	8.3	8.3	8.3	8.3
Average access time (msec)	33.32	94.3	94.3	94.3	38.3
Data transfer rate (KByte/sec)	675	625	625	625	690
FIRST CUSTOMER SHIPMENT	1981	8/81 9/81	8/81 9/81	8/81 9/81	3/82
U.S. OEM PRICE FOR 100 UNITS	\$1,800	--	\$1,020	--	--
COMMENTS	Embedded Servo; Subsystem with tape cartridge; Licensed by Irwin International				

MANUFACTURER	OLIVETTI	OLIVETTI	OLIVETTI	PERKIN-ELMER	PERKIN-ELMER
DRIVE	HD 512/2	HD 830/1	HD 830/2	VF-2221 VT-2221	VF-2222 VT-2222
DISK/TREND GROUP	7	8	8	1	1
MARKET	OEM	OEM	OEM	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	2315/5440	2315/5440
Nominal disk diameter	130 mm OD 40 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	2314	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Bidirectional	Bidirectional, ANSI X3T9.3	Bidirectional, ANSI X3T9.3	Various Options	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 21.7	U: 34.75	U: 57.92	U: 6.25	U: 6.25
REMOVABLE	--	--	--	U: 6.25	U: 6.25
Capacity per track (Bytes)	U: 10,080	U: 17,850	U: 17,850	U: 7,812	U: 7,812
Data surfaces per spindle	5	3	5	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	430	649	649	408	408
TPI	600	600	600	200	200
BPI	8166	8500	8500	200	200
RPM	3600	3600	3600	1500	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30 (Including Settling)	40	40	35	35
Average rotational delay (msec)	8.3	8.3	8.3	20	12.5
Average access time (msec)	38.3	48.3	48.3	55	47.5
Data transfer rate (KByte/sec)	690	800	800	195	312.5
FIRST CUSTOMER SHIPMENT	3/82	11/81	11/81	2Q80	2Q80
U.S. OEM PRICE FOR 100 UNITS	--	\$2,130	\$2,310	F-\$3,837 T-\$3,773	F-\$3,837 T-\$3,775
COMMENTS					

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MANUFACTURER	PERKIN-ELMER	PERTEC	PERTEC	PERTEC	PERTEC
DRIVE	VT-2422	D3311/D3312	D3321/D3322	D3331/D3332	D3341/D3342
DISK/TREND GROUP	2	1	1	1	1
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	5440	5440	5440	2315	2315
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	2314	2314	2314	2314	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options				
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.5	--	U: 3.17	--	U: 3.17
REMOVABLE	U: 12.5	U: 3.17	U: 3.17	U: 3.17	U: 3.17
Capacity per track (Bytes)	U: 15,625	U: 7,812	U: 7,812	U: 7,812	U: 7,812
Data surfaces per spindle	4	2	4	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	408	203	203	203	203
TPI	200	100	100	100	100
BPI	4400	2200	2200	2200	2200
RPM	2400	1500/2400	1500/2400	1500/2400	1500/2400
Actuator type	Linear, Voice Coil				
Average positioning time (msec)	35	35	35	35	35
Average rotational delay (msec)	12.5	20/12.5	20/12.5	20/12.5	20/12.5
Average access time (msec)	47.5	55/47.5	55/47.5	55/47.5	55/47.5
Data transfer rate (KByte/sec)	625	195/312.5	195/312.5	195/312.5	195/312.5
FIRST CUSTOMER SHIPMENT	2Q80				
U.S. OEM PRICE FOR 100 UNITS	\$4,213	--	\$3,660	--	\$3,660
COMMENTS					

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MANUFACTURER	PERTEC	PERTEC	PERTEC	PERTEC	PERTEC
DRIVE					
	D3421/D3422	D3441/D3442	D3461/D3462	D3481/D3482	D1451/D1452
DISK/TREND GROUP	1	1	2	2	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	5440	2315	5440	2315	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated				
DRIVE: Technology type	2314	2314	2314	2314	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options				
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.34	U: 6.34	U: 19.03	U: 19.03	U: 6.34
REMOVABLE	U: 6.34	U: 6.34	U: 6.34	U: 6.34	--
Capacity per track (Bytes)	U: 7,812				
Data surfaces per spindle	4	4	8	8	2
Heads per data surface	1	1	1	1	1
Tracks per surface	406	406	406	406	406
TPI	200	200	200	200	200
BPI	2200	2200	2200	2200	2200
RPM	1500/2400	1500/2400	1500/2400	1500/2400	1500/2400
Actuator type	Linear, Voice Coil				
Average positioning time (msec)	40	40	40	40	70
Average rotational delay (msec)	20/125	20/12.5	20/12.5	20/12.5	20/12.5
Average access time (msec)	60/52.5	60/52.5	60/52.5	60/52.5	90/82.5
Data transfer rate (KByte/sec)	195/312.5	195/312.5	195/312.5	195/312.5	195/312.5
FIRST CUSTOMER SHIPMENT		1977	1977		
U.S. OEM PRICE FOR 100 UNITS	\$3,900	\$3,900	\$4,680	\$4,680	--
COMMENTS					Also available as 12.68 MB: D1461/D1462 (4 surfaces)

MANUFACTURER	PERTEC	PHILIPS DATA SYSTEMS	PHILIPS DATA SYSTEMS	PHILIPS DATA SYSTEMS	PHILIPS DATA SYSTEMS
DRIVE					
	D8000	X1215	X1616	X1240	X1250
DISK/TREND GROUP	7	1	1	2	7
MARKET	OEM	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	5440	5440	CMD-Type Cartridge	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	2314	2314	3330-11	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ANSI X3T9.3	Philips	Philips	Philips	Philips, FD Interface
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 20.33	F: 2.5	F: 5.0	F: 20.02	U: 9.62
REMOVABLE	--	F: 2.5	F: 5.0	F: 20.02	--
Capacity per track (Bytes)	U: 14,400	F: 5,632	F: 5,632	F: 14,592	U: 20,830
Data surfaces per spindle	3	4	4	4	2
Heads per data surface	1	1	1	1	1
Tracks per surface	466	204	407	700	231
TPI	476	100	200	300	100
BPI	6688	2200	2200	8175	6356
RPM	3600	2400	2400	3000	720
Actuator type	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Stepping Motor
Average positioning time (msec)	50	35	35	35	144
Average rotational delay (msec)	8.3	12.5	12.5	10.0	41.67
Average access time (msec)	58.3	47.5	47.5	45.0	185.67
Data transfer rate (KByte/sec)	870	312.5	312.5	1305	250
FIRST CUSTOMER SHIPMENT	1981	1974	1976	1980	1979
U.S. OEM PRICE FOR 100 UNITS	\$1,980	--	--	--	--
COMMENTS				Embedded Servo	

MANUFACTURER	PHILIPS DATA SYSTEMS	PRIAM	PRIAM	PRIAM	PRIAM
DRIVE	X1220	Diskos 1070	Diskos 3450	Diskos 7050	Diskos 3350
DISK/TREND GROUP	7	7	8	8	8
MARKET	Captive	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Philips, SMD		Priam, SMD	Priam, SMD	Priam, SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 20.02	U: 10.8	U: 35.28	U: 70.49	U: 33.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 14,592	U: 15,151	U: 13,440	U: 13,440	U: 20,160
Data surfaces per spindle	2	4	5	5	2
Heads per data surface	2	1	1	1	2/1
Tracks per surface	700	190	525	1049	1122
TPI	300	180	480	960	480
BPI	8175	7475	6670	6670	6430
RPM	3000	3564	3600	3600	3125
Actuator type	Rotary, Voice Coil	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	35	73 (Including Settling)	42	42	45
Average rotational delay (msec)	10	8.4	8.3	8.3	9.7
Average access time (msec)	45	81.4	50.3	50.3	54.7
Data transfer rate (KByte/sec)	1305	900	800	800	1040
FIRST CUSTOMER SHIPMENT	1979		4Q80	4Q81	8/79
U.S. OEM PRICE FOR 100 UNITS	--	\$1,555	\$2,700	\$3,600	\$2,300
COMMENTS	Embedded Servo				

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MANUFACTURER	PRIAM	PRIAM	QUANTUM	QUANTUM	QUANTUM
DRIVE	Diskos 6650	Diskos 15450	Q2010	Q2020	Q2030
DISK/TREND GROUP	8	8	7	7	8
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Priam, SMD	Priam, SMD	SA 1000	SA 1000	SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 67.9	U: 158.5	U: 10.66	U: 21.33	U: 32.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 10,400	U: 10,400	U: 10,400
Data surfaces per spindle	2	4	2	4	6
Heads per data surface	2/1	2/1	1	1	1
Tracks per surface	2246	2246	512	512	512
TPI	960	960	345	345	345
BPI	6430	6430	6600	6600	6600
RPM	3125	3125	3000	3000	3000
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Torque Motor	Rotary, Torque Motor	Rotary, Torque Motor
Average positioning time (msec)	45	40	50	55	60
Average rotational delay (msec)	9.7	9.7	10	10	10
Average access time (msec)	54.7	49.7	60	65	70
Data transfer rate (KByte/sec)	1040	1040	543	543	543
FIRST CUSTOMER SHIPMENT	3Q80	3Q81	1Q81	1Q81	1Q81
U.S. OEM PRICE FOR 100 UNITS	\$2,950	\$4,200	\$1,400	\$1,750	\$2,100
COMMENTS					

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MANUFACTURER	QUANTUM	RODIME	RODIME	RODIME	RODIME
DRIVE	Q2040	RO 101	RO 102	RO 103	RO 104
DISK/TREND GROUP	8	7	7	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	200 mm OD 63.5 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA 1000	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 42.66	U: 4.0	U: 8.0	U: 12.0	U: 16.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,400	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	8	2	4	6	8
Heads per data surface	1	1	1	1	1
Tracks per surface	512	192	192	192	192
TPI	345	260	260	260	260
BPI	6600	8060	8060	8060	8060
RPM	3000	3600	3600	3600	3600
Actuator type	Rotary, Torque Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	65	85 (Including Settling)	85 (Including Settling)	85 (Including Settling)	85 (Including Settling)
Average rotational delay (msec)	10	8.3	8.3	8.3	8.3
Average access time (msec)	75	93.3	93.3	93.3	93.3
Data transfer rate (KByte/sec)	543	625	625	625	625
FIRST CUSTOMER SHIPMENT	1Q81	6/81	6/81	6/81	6/81
U.S. OEM PRICE FOR 100 UNITS	\$2,450	\$850	\$1,115	\$1,380	\$1,645
COMMENTS					

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MANUFACTURER	ROTATING MEMORY SYSTEMS	ROTATING MEMORY SYSTEMS	ROTATING MEMORY SYSTEMS	SEAGATE TECHNOLOGY	SEAGATE TECHNOLOGY
DRIVE	RMS 503	RMS 506	RMS 512	ST 506	ST 512
DISK/TREND GROUP	7	7	7	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID
Magnetic surface	Oxide	Oxide	Oxide	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	3370
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Thin Film
Interface	SA 1000	SA 1000	SA 1000	SA 1000	SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 3.18	U: 6.38	U: 12.72	U: 6.38	U: 12.76
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,417	U: 10,417	U: 10,417	U: 10,417	U: 10,417
Data surfaces per spindle	2	4	8	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	153	153	153	153	306
TPI	255	255	255	255	270
BPI	7700	7700	7700	7690	10202
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Driven by Stepper	Rotary, Driven by Stepper	Rotary, Driven by Stepper	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	85 (Including Settling)	85 (Including Settling)	85 (Including Settling)	170 (Including Settling)	170 (Including Settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	93.3	93.3	93.3	178.3	178.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	2Q81	2Q81	2Q81	7/80	10/81
U.S. OEM PRICE FOR 100 UNITS	\$905	\$1,140	\$1,460	\$1,100	\$1,450
COMMENTS					

MANUFACTURER	SHUGART ASSOCIATES				
DRIVE	SA 602	SA 604	SA 606	SA 1002	SA 1004
DISK/TREND GROUP	7	7	7	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated				
DRIVE: Technology type	3350	3350	3350	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA 1000 Type	SA 1000 Type	SA 1000 Type	SA 1000	SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 3.33	U: 6.66	U: 10.0	U: 5.33	U: 10.67
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,400				
Data surfaces per spindle	2	4	6	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	160	160	160	256	256
TPI	256	256	256	172	172
BPI	7900	7900	7900	6270	6270
RPM	3125	3125	3125	3125	3125
Actuator type	Band, Stepping Motor				
Average positioning time (msec)	75 (Including Settling)	75 (Including Settling)	75 (Including Settling)	70 (Including Settling)	70 (Including Settling)
Average rotational delay (msec)	9.6	9.6	9.6	9.6	9.6
Average access time (msec)	84.6	84.6	84.6	79.6	79.6
Data transfer rate (KByte/sec)	542.5	542.5	542.5	542.5	542.5
FIRST CUSTOMER SHIPMENT	3Q81	3Q81	3Q81	4Q79	4Q79
U.S. OEM PRICE FOR 100 UNITS	\$870	\$1,125	\$1,380	\$1,140	\$1,400
COMMENTS					

MANUFACTURER	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SIEMENS	SIEMENS
DRIVE	SA 4004	SA 4008	SA 4104	3455	3465
DISK/TREND GROUP	7	7	8	5	5
MARKET	OEM	OEM	OEM	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	V26374-Q7	V26374-Q9
Generic type	Fixed	Fixed	Fixed	Special	Special
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	3340	3340	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA 4000	SA 4000	SA 4000	Siemens	Siemens
CAPACITY/PERFORMANCE	0.144 MB Fixed Head Option	0.144 MB Fixed Head Option	0.144 MB Fixed Head Option		
Total capacity (MBytes) FIXED	U: 14.5	U: 29.0	U: 58.0	--	--
REMOVABLE	--	--	--	F: 71.8	F: 143.6
Capacity per track (Bytes)	U: 18,000	U: 18,000	U: 18,000	F: 19,750	F: 19,750
Data surfaces per spindle	2	4	8	9	9
Heads per data surface	2	2	2	1	1
Tracks per surface	404	404	404	404	808
TPI	172	172	172	192	384
BPI	5534	5534	5534	6060	6060
RPM	2964	2964	2964	2400	2400
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	65 (Including Settling)	65 (Including Settling)	65 (Including Settling)	25	25
Average rotational delay (msec)	10.1	10.1	10.1	12.5	12.5
Average access time (msec)	75.1	75.1	75.1	37.5	37.5
Data transfer rate (KByte/sec)	887.5	887.5	887.5	806	806
FIRST CUSTOMER SHIPMENT	3Q78	3Q78	1981	9/75	12/76
U.S. OEM PRICE FOR 100 UNITS	\$1,600	\$2,000	\$2,650	--	--
COMMENTS					

MANUFACTURER	SIEMENS	SIEMENS	SLI INDUSTRIES	SLI INDUSTRIES	SLI INDUSTRIES
DRIVE	3468	3470	Cheyenne	Cheyenne	Cheyenne
DISK/TREND GROUP	5	9	7	7	8
MARKET	Captive	Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	3336-11	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Siemens	Siemens	SMD, SA 1000, ANSI X3T9.3	SMD, SA 1000, ANSI X3T9.3	SMD, SA 1000, ANSI X3T9.3
CAPACITY/PERFORMANCE		1.115 MB Fixed Head Option			
Total capacity (MBytes) FIXED	--	F: 420.25	U: 7.44	U: 22.3	U: 37.2
REMOVABLE	F: 303.2	--	--	--	--
Capacity per track (Bytes)	F: 19,750	F: 16,384	U: 11,340	U: 11,340	U: 11,340
Data surfaces per spindle	19	19	1	3	5
Heads per data surface	1	2	1	1	1
Tracks per surface	808	1350	656	656	656
TPI	384	590	478	478	478
BPI	6060	6060	6500	6500	6500
RPM	2400	2400	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	25	20	40	40	40
Average rotational delay (msec)	12.5	12.5	8.3	8.3	8.3
Average access time (msec)	37.5	32.5	48.3	48.3	48.3
Data transfer rate (KByte/sec)	806	806	602	602	602
FIRST CUSTOMER SHIPMENT	1977	10/78	4Q80	4Q80	4Q80
U.S. OEM PRICE FOR 100 UNITS	--	--	\$1,815	\$2,020	\$2,200
COMMENTS					

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	SLI INDUSTRIES	SLI INDUSTRIES	STORAGE TECHNOLOGY CORPORATION	STORAGE TECHNOLOGY CORPORATION	STORAGE TECHNOLOGY CORPORATION
MANUFACTURER					
DRIVE	Cheyenne	Cheyenne	8350-A2 8350-B2 8350-C2	8650-A2 8650-B2	8360-A2 8360-B2
DISK/TREND GROUP	8	8	9	9	9
MARKET	OEM	OEM	PCM	PCM	PCM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	2 x 3350	2 x 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD, SA 1000, ANSI X3T9.3	SMD, SA 1000, ANSI X3T9.3	IBM	IBM	IBM
CAPACITY/PERFORMANCE			1.144 MB Fixed Head Option	1.144 MB Fixed Head Option	1.144 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 52.07	U: 83.0	F: 317.5	F: 635	F: 317.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 11,340	U: 20,160	F: 19,069	F: 19,069	F: 19,069
Data surfaces per spindle	7	5	15	15	15
Heads per data surface	1	1	2	2	2
Tracks per surface	656	808	1110	2220	1110
TPI	478	588	480	957	957
BPI	6500	11200	6425	6425	6425
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	40	40	25	18	23
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	48.3	48.3	33.3	26.3	31.3
Data transfer rate (KByte/sec)	602	1200	1198	1198	1198
FIRST CUSTOMER SHIPMENT	4Q80	2Q82	4/77	5/79	2Q81
U.S. OEM PRICE FOR 100 UNITS	\$2,400	\$3,900	--	--	--
COMMENTS			PCM 3350	PCM 3350	PCM 3350

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MANUFACTURER	STORAGE TECHNOLOGY CORPORATION	STORAGE TECHNOLOGY CORPORATION	TANDON	TANDON	TANDON
DRIVE	8370-A1 8370-AA1 8370-B1 8370-BB1	3380-A4 3380-A4F 3380-AA4 3380-AAF 3380-B4 3380-B4F	602	603	602E
DISK/TREND GROUP	9	9	7	7	7
MARKET	PCM	PCM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3370	3380	3350	3350	3350
Heads	Thin Film	Thin Film	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	SA 1000, ST 506	SA 1000, ST 506	SA 1000, ST 506
CAPACITY/PERFORMANCE		2.8 MB Fixed Head Option			
Total capacity (MBytes) FIXED	F: 571	F: 1260	U: 6.38	U: 9.57	U: 7.66
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 31,744	F: 47,476	U: 10,400	U: 10,400	U: 8,300
Data surfaces per spindle	12	15	4	6	4
Heads per data surface	2	2	1	1	1
Tracks per surface	1500	1770	153	153	230
TPI	*	*	254	254	254
BPI	*	*	7690	7690	7690
RPM	2964	3600	3600	3600	3600
Actuator type	Dual, Linear, Voice Coil	Dual, Linear, Voice Coil	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	20	16	168 (Including Settling)	168 (Including Settling)	225 (Including Settling)
Average rotational delay (msec)	10.1	8.3	8.3	8.3	8.3
Average access time (msec)	30.1	24.3	176.3	176.3	233.3
Data transfer rate (KByte/sec)	1859	3000	625	625	500
FIRST CUSTOMER SHIPMENT			12/80	12/80	12/80
U.S. OEM PRICE FOR 100 UNITS	--	--	\$865	\$998	\$915
COMMENTS	PCM 3370 *Not Announced	PCM 3380 *Not Announced			

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MANUFACTURER	TANDON	TECSTOR	TEXAS INSTRUMENTS	3M COMPANY	3M COMPANY
DRIVE	603E	Sapphire 160	5¼" Winchester Disk	8431	8432
DISK/TREND GROUP	7	8	7	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	14"	130 mm OD 40 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA 1000, ST 506	SMD	SA 1000, ST 506	ANSI X3T9.3	ANSI X3T9.3
CAPACITY/PERFORMANCE		0.967 MB Fixed Head Option			
Total capacity (MBytes) FIXED	U: 11.5	U: 169.344	U: 6.38	U: 10.03	U: 20.07
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 8,300	U: 20,160	U: 10,417	U: 17,920	U: 17,920
Data surfaces per spindle	6	6	4	2	4
Heads per data surface	1	2	1	1	1
Tracks per surface	230	1400	153	280	280
TPI	254	600	254	219	219
BPI	7690	6370	7690	8649	8649
RPM	3600	2976	3600	3125	3125
Actuator type	Rotary, Stepping Motor	Rotary, Voice Coil	Band, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	275 (Including Settling)	35	170 (Including Settling)	65	65
Average rotational delay (msec)	8.3	10.0	8.3	9.6	9.6
Average access time (msec)	233.3	45.0	178.3	74.6	74.6
Data transfer rate (KByte/sec)	500	1000	625	933.3	933.3
FIRST CUSTOMER SHIPMENT	12/80	11/81	3Q81	4/81	4/81
U.S. OEM PRICE FOR 100 UNITS	\$1,055	\$5,450	\$1,087	\$1,695 (50 units)	\$1,925 (50 units)
COMMENTS			Mfg. under Seagate license		

MANUFACTURER	3M COMPANY	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION
DRIVE	8533	MK-800R-32	MK-800R-64	MK-800R-96	MK-200R
DISK/TREND GROUP	8	2	2	2	2
MARKET	OEM	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	CMD	CMD	CMD	5440
Nominal disk diameter	210 mm OD 100 mm ID	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3330-11	3330-11	3330-11	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ANSI X3T9.3	SMD	SMD	SMD	Toshiba
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 60	U: 16.289	U: 48.868	U: 80.446	F: 10
REMOVABLE	--	U: 16.289	U: 16.289	U: 16.289	F: 10
Capacity per track (Bytes)	U: 17,920	U: 20,160	U: 20,160	U: 20,160	F: 13,030
Data surfaces per spindle	4	1 Fixed 1 Removable	3 Fixed 1 Removable	5 Fixed 1 Removable	4
Heads per data surface	1	2 Fixed 1 Removable	2 Fixed 1 Removable	2 Fixed 1 Removable	1
Tracks per surface	838	823	823	823	417
TPI	693	367 Fixed 384 Removable	367 Fixed 384 Removable	367 Fixed 384 Removable	188
BPI	8555	6274 Fixed 6038 Removable	6274 Fixed 6038 Removable	6274 Fixed 6038 Removable	4040
RPM	3125	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Fix: Rotary VC Rem: Linear VC	Fix: Rotary VC Rem: Linear VC	Fix: Rotary VC Rem: Linear VC	Linear, Voice Coil
Average positioning time (msec)	29	30	30	30	30
Average rotational delay (msec)	9.6	8.3	8.3	8.3	8.3
Average access time (msec)	38.6	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	933.3	1209	1209	1209	806
FIRST CUSTOMER SHIPMENT	1/82	2Q80	2Q80	2Q80	1977
U.S. OEM PRICE FOR 100 UNITS	\$3,745 (50 units)	--	--	--	--
COMMENTS					

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MANUFACTURER	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION
DRIVE					
	DSU-450	MK80F-10	MK80F-20	MK80F-30	MK-100F
DISK/TREND GROUP	5	7	7	8	7
MARKET	Captive	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	3336-11	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	Piccolo	Piccolo	Piccolo	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Toshiba	SMD	SMD	SMD	Toshiba
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 15.32	U: 22.98	U: 38.3	U: 12.0 F: 10.2
REMOVABLE	F: 200	--	--	--	--
Capacity per track (Bytes)	F: 13,030	U: 20,160	U: 20,160	U: 20,160	F: 16,384
Data surfaces per spindle	19	2	3	5	1
Heads per data surface	1	1	1	1	630
Tracks per surface	815	380	380	380	318
TPI	370	450	450	450	5940
BPI	4040	8700	8700	8700	2800
RPM	3600	3600	3600	3600	40
Actuator type	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	30	40	40	40	40
Average rotational delay (msec)	8.3	8.3	8.3	8.3	10.8
Average access time (msec)	38.3	48.3	48.3	48.3	50.8
Data transfer rate (KByte/sec)	806	1210	1210	1210	896
FIRST CUSTOMER SHIPMENT	1975	7/81	7/81	7/81	1977
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

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MANUFACTURER	TOSHIBA CORPORATION	VERMONT RESEARCH	WESTERN DYNEX	WESTERN DYNEX	WESTERN DYNEX
DRIVE	MK-300F	5017-4	DD-6121	DD-6221	DD-6122
DISK/TREND GROUP	8	2	1	1	1
MARKET	OEM, Captive	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	VRC5517	--	--	--
Generic type	Fixed	5440	2315/5440	2315/5440	2315/5440
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	3330-11	2314	2314	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Toshiba	VRC, ANSI X3T9.3	Various Options	Various Options	Various Options
CAPACITY/PERFORMANCE	.262 MB Fixed Head Option U: 36.0 F: 30.6				
Total capacity (MBytes) FIXED		F: 26.2	--	U: 3.13	--
REMOVABLE	--	F: 26.2	U: 3.13	U: 3.13	U: 6.25
Capacity per track (Bytes)	F: 16,384	F: 12,800	U: 7,812	U: 7,812	U: 7,812
Data surfaces per spindle	3	4	2	4	2
Heads per data surface	630	1	1	1	1
Tracks per surface	318	1024	203	203	406
TPI	5940	500	100	100	200
BPI	2800	4000	2200	2200	2200
RPM	40	3165	1500/2400	1500/2400	1500/2400
Actuator type	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	40	45	35	35	35
Average rotational delay (msec)	10.8	9.5	20/12.5	20/12.5	20/12.5
Average access time (msec)	50.8	54.5	55/47.5	55/47.5	55/47.5
Data transfer rate (KByte/sec)	896	673	195/312.5	195/312.5	195/312.5
FIRST CUSTOMER SHIPMENT	1977	1975	1972	1972	1973
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS		Embedded Servo			

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MANUFACTURER	WESTERN DYNEX	WESTERN DYNEX	WESTERN DYNEX	WESTERN DYNEX	
DRIVE	DD-6222	DD-8420	DD-8430	DD-4222	
DISK/TREND GROUP	1	2	2	7	
MARKET	OEM	OEM	OEM	OEM	
MEDIA: Manufacturer's number	--	--	--	--	
Generic type	2315/5440	5440	5440	Fixed	
Nominal disk diameter	14"	14"	14"	14"	
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	
DRIVE: Technology type	2314	3330-1	3330-1	2314	
Heads	Ferrite	Ferrite	Ferrite	Ferrite	
Interface	Various Options	Various Options	Various Options	Various Options	
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.25	F: 11.0	F: 12.3	U: 12.5	
REMOVABLE	U: 6.25	F: 11.0	F: 12.3	--	
Capacity per track (Bytes)	U: 7,812	F: 13,488	F: 16,667	U: 7,812	
Data surfaces per spindle	4	4	4	4	
Heads per data surface	1	1	1	1	
Tracks per surface	406	408	428	406	
TPI	200	200	210	200	
BPI	2200	4400	4800	2200	
RPM	1500/2400	2400	2400	1500/2400	
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	
Average positioning time (msec)	35	35	35	75	
Average rotational delay (msec)	20/12.5	12.5	12.5	20/12.5	
Average access time (msec)	55/47.5	47.5	47.5	95/87.5	
Data transfer rate (KByte/sec)	195/312.5	625	666	195/312.5	
FIRST CUSTOMER SHIPMENT	1973	1981	1981	1980	
U.S. OEM PRICE FOR 100 UNITS	F-\$2,533 T-\$2,458	\$2,704	\$2,704	\$1,930	
COMMENTS					

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MANUFACTURER PROFILES

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

U.S. Manufacturers

ALPHA DATA, INC.
20750 Marilla Street
Chatsworth, CA 91311

213/882-6500

1980 disk sales: None

Alpha Data has reannounced a moving head fixed disk drive using 14" plated disks, following the withdrawal from the market of a family of similar products announced two years previously. Specifications for the new drive are not yet final, but it is expected to have 80 MB capacity with a rotary actuator. Alpha Data is a privately held manufacturer of head-per-track disk drives.

AMPEX CORPORATION
Subsidiary of Signal Companies, Inc.
Memory Products Division
10435 North Tantau Avenue
Cupertino, CA 95014

408/255-4800

1980 disk sales: \$30,500,000
1980 total net sales: \$4,285,300,000

Net income: \$167,700,000

Ampex was acquired by Signal in early 1981, after an earlier acquisition by the same firm was announced the year before, then dropped. In recent years, Ampex' disk drive operation has specialized completely in the OEM

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market. Internally manufactured 80 MB and 300 MB SMDs have provided the majority of revenues, supplemented with resale of disk drives manufactured by other firms. Ampex disk drives are positioned to compete in the high performance drive markets dominated by Control Data, but the firm has achieved only a modest penetration of these markets, with a strong European sales organization the bright spot. With new management and engineering talent installed in the past year, Ampex' disk drive activity is now in a growth phase, with high hopes for new 165 MB and 330 MB 14" Winchester drives scheduled to ship for the first time in the second half of 1981.

ATASI CORPORATION

505 West Olive
Sunnyvale, CA 94086

408/730-2574

1980 disk sales: None

Atasi is a newly formed company, staffed by veterans of the Santa Clara valley disk drive business, with plans to manufacture a 5.25" Winchester drive offering high performance and relatively high capacity. The firm has not yet announced specific products or delivery dates.

BALL COMPUTER PRODUCTS

Division of Ball Corporation
P.O. Box 589
Westminster, CO 80020

303/469-5511

1980 disk sales: \$7,000,000

1980 total net sales: \$698,794,000

Net income: \$24,402,000

Ball corporate management grew impatient with the profitability of its Ball Computer Products, Inc., subsidiary in early 1981, and cut the business back to a family of SMD drives originally introduced in 1976. Other computer industry products were sold off, the Sunnyvale facility was closed down in June, 1981, and the 165 MB and 333 MB 14" Winchester disk drives previously announced were discontinued before start of actual shipments. Marketing for the SMD drives was moved to Boulder, Colorado, near the facility where the drives are manufactured. The firm continues to serve its OEM customer base, with major sales activity in Europe.

BURROUGHS CORPORATION

Burroughs Place
Detroit, MI 48232

313/972-7000

1980 disk sales: \$476,500,000

1980 total net sales: \$1,613,668,000

Net income: \$81,972,000

Burroughs remains the world's second largest manufacturer of captive disk drives, with disk production facilities in California, Scotland, Canada, Mexico and Brazil. In early August, 1981, the company announced

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it had reach an agreement in principle to acquire Memorex. If this acquisition is consummated, the impact on Burroughs' disk drive programs will obviously be profound, but the firm has not defined any plans, except the usual statements that the acquired organization will continue to serve its normal markets with the same products. Burroughs has lagged the industry in usage of Winchester technology in large disk drives, and it is assumed that Memorex' established capabilities in this area would provide a boost to Burroughs' system disk drive offerings. The effect wouldn't be short-term, however, since substantial changes in controllers and software would be required to utilize Memorex IBM compatible disk drives on Burroughs systems. Burroughs has a negligible OEM disk drive business, and it is probably too early to speculate whether this activity would be combined with the Memorex OEM disk drive activities.

CENTURY DATA SYSTEMS, INC.
 Subsidiary of Xerox Corporation
 1270 North Kraemer Boulevard
 Anaheim, CA 92806

714/632-0400

1980 disk sales: \$83,200,000

1980 total net sales: \$8,196,500,000

Net income: \$619,200,000

Century was one of the pioneer manufacturers of PCM drives, which was shifted gradually to an exclusively OEM-oriented product line under its period of Calcomp management. The organization was sold to Xerox in 1979. Today, Century's main products are the Trident SMD-type drives, followed by the Marksman 14" Winchester. The Hunter drive family, equivalent to the Control Data CMD, has been dropped, as has the disk cartridge line inherited from Diablo Systems, another Xerox acquisition. Extensive changes have been made in management, and an attempt is being made to develop products suitable to strengthen Century's position in the high performance OEM disk drive market.

COMPUTER MEMORIES, INC.
 9233 Eton Avenue
 Chatsworth, CA 91311

213/709-6445

1980 disk sales: None

CMI was started in late 1980, with venture capital funding, to manufacture a family of 5.25" Winchester disk drives with capacities ranging from 5 MB to 16 MB. The firm is staffed with industry veterans, most with recent Pertec experience, and started shipments in mid-1981.

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

612/853-8100

1980 disk sales: \$926,700,000
1980 total net sales: \$2,790,500,000

Net income: \$150,600,000

Control Data has long been regarded as the dominant manufacturer of OEM disk drives, and the degree of that dominance is increasing. In 1980, CDC collected 55.1% of worldwide revenues for OEM rigid disk drives, with increases in all currently significant disk drive categories: Disk cartridges, SMD, CMD, large disk pack drives, and mid and large capacity fixed disk drives. Disk drives sold by Control Data are designed and manufactured by Magnetic Peripherals, Inc., a joint venture with ownership shared by CDC and Honeywell. 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 either CDC or Honeywell systems are considered CDC captive drives for the purposes of DISK/TREND statistics. Annual production of captive drives for both parents is also growing every year, with increasing markets for large fixed disk drives. CDC is also active in the PCM market for large fixed disk drives and held 20.1% of worldwide PCM revenues in 1980. But it is expected that OEM disk drives will continue to be CDC's most important product area, and that the firm will retain its leadership in the high performance rigid disk drive area. New product introductions are expected in the coming year, for important OEM drives of several types. These new drives will probably be the basis for Control Data's market leadership in high performance rigid disk drives for years.

DASTEK CORPORATION
Subsidiary of Dysan Corporation
141 Albright Way
Los Gatos, CA 95030

408/866-0550

1980 disk sales: None
1980 total net sales: \$62,871,000

Net income: \$7,993,000

Since Dastek's founding in 1978 by key technical personnel from IBM's San Jose disk drive operation, the firm has actively carried out a program to establish manufacturing capability for thin film heads, plus an eventual introduction of an OEM disk drive, with capacities ranging from 200 to 400 MB. In 1980, two of the founders moved to OMAC, another Dysan-funded organization involved in advanced disk drive development. The remaining founders departed at the beginning of May, 1981, apparently as the result of the parent company's interest in pressing for positive financial results. Dastek continues in the race to establish a position in the formative market for thin film heads, and has indicated it will also stay in the struggle to obtain a share of the future market for large fixed disk drives.

DATA GENERAL CORPORATION
 4400 Computer Drive
 Westboro, MA 01581

617/366-8911

1980 disk sales: \$108,000,000
 1980 total net sales: \$653,887,000

Net income: \$54,690,000

The internal disk drive program at Data General continues in mid-1981 to provide all of the rigid disk drives sold with Data General systems. Disk cartridge drives, SMDs, 3330 type drives, and low end 14" Winchester drives are currently the captive drives manufactured. Data General has had its problems in maintaining a desirable margin of profitability during the last few years, as the company has responded to changes in its markets. It is still considered probable, as the firm rations its resources among competing internal programs, that disk drive manufacturing activities may be supplemented by outside purchases of OEM drives.

DATA PERIPHERALS CORPORATION
 Subsidiary of Computer & Communications
 Technology Corporation
 965 Stewart Drive
 Sunnyvale, CA 94086

408/745-6500

1980 disk sales: None
 1980 total net sales: \$46,253,000

Net income: \$3,423,000

Data Peripherals is still substantially on schedule in its ambitious program to develop and manufacture an 11 MB removable-only 8" disk cartridge drive. The firm is owned by CCT, the parent company of Information Magnetics, one of the industry's major manufacturers of magnetic recording heads. The firm has been providing evaluation units of its cartridge drive since spring of 1981, and plans to be in production later in the year. Cartridges for the drive are to be made by both Data Peripherals and Dysan, with distribution handled separately by each firm. The firm also has indicated it will introduce an 8" fixed disk drive in the 40 MB range by the end of 1981.

DATAPoint CORPORATION
 Peripheral Products Division
 686 Maude Avenue
 Sunnyvale, CA 94086

408/732-7330

1980 disk sales: \$24,600,000
 1980 total net sales: \$318,826,000

Net income: \$33,478,000

The principal captive rigid disk drive manufacturing program by Datapoint continues to be the production of disk cartridge drives, under a manufacturing license originally obtained from Wangco. The firm has also indicated in technical literature that it is involved in preparing a new plated disk drive for production, presumably also for captive usage on Datapoint systems.

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DIGITAL EQUIPMENT CORPORATION
146 Main Street
Maynard, MA 01754

617/897-5111

1980 disk sales: \$183,100,000

1980 total net sales: \$2,368,045,000

Net income: \$249,861,000

All of DEC's 1980 rigid disk drive revenues were still provided by disk cartridge drives, manufactured principally at the Colorado Springs plant. The RLO1/RLO2 family of low cost removable-only disk cartridge drives is the big revenue producer -- and DEC now makes more disk drives in this group, by far, than any other manufacturer. The firm finally introduced its 124 MB 14" Winchester drive in 1981, with the expectation of eventual high production levels. In the meantime, disk pack drives and high capacity fixed disk drives are still purchased for resale from others: Control Data, Memorex, ISS/Univac, and Storage Technology.

DISK MEMORY TECHNOLOGY, INC.
8066 Southwest Nimbus
Beaverton, OR 97005

503/643-6383

DMT is a small Northwest manufacturer offering a specialized disk drive using plated 9" disks. The principal configurations offer capacity up to the 5 MB range and employ stepping motor actuators. An OEM version is offered, but the drive is normally sold as a subsystem equipped to be plug compatible with various small computer systems.

DMA SYSTEMS
325 Chapala Street
Santa Barbara, CA 93101

805/965-7059

This firm was organized in 1980 to manufacture a fixed/removable drive using 5.25" disks. The four founders are industry veterans, with backgrounds including experience at Information Magnetics and PerSci. The initial product will offer formatted capacities of 5 MB fixed and 5 MB removable, with a formal announcement expected in the second half of 1981. DMA Systems, in cooperation with Dysan and Seagate Technology, will promote the removable cartridge used with this drive, as an industry standard.

DORADO MICRO SYSTEMS
10381 Bandley Drive
Cupertino, CA 95014

408/446-9779

1980 disk sales: \$9,700,000

1980 total net sales: \$14,478,000

Net income: \$473,000

Dorado Micro Systems assumed its present name in October, 1980, as the successor to International Memories, Inc., the pioneer manufacturer of OEM 8" Winchester disk drives which was formed in July, 1977. The firm

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now makes IMI drives, and is the parent company of Onyx Systems, a manufacturer of small computer systems using the IMI disk drives, and Dataflux, a manufacturer of head per track drives. The IMI 8" drive family was broadened in 1981 to include a 40 MB drive, and the firm also added 5.25" Winchester drives to the product line. The 8" drives continue to be produced at the company's Cupertino headquarters, but 5.25" drives are manufactured at a new facility in White City, Oregon.

EVOTEK CORPORATION
2589 Scott Boulevard
Santa Clara, CA 95052

408/727-2333

Evotek was formed in mid-1981 to manufacture 5.25" Winchester disk drives with capacities of 12.5 MB and 20.5 MB. The company, whose founders' disk industry experience includes tours at Memorex and Data General, is now starting the design phase of its program and does not plan to announce its product until late 1982, with production in the first half of 1983. Evotek's drives will use conventional ferrite heads, but will rely on plated disks to be obtained from IBIS.

HEWLETT-PACKARD COMPANY
Disk Memory Division
11403 Chinden Boulevard
Boise, ID 83707

208/376-6000

1980 disk sales: \$180,900,000

1980 total net sales: \$3,099,000,000

Net income: \$269,000,000

H-P's Boise facility has become a major disk drive design and manufacturing operation since its establishment in 1977. Disk drives manufactured internally for use with Hewlett-Packard systems include disk cartridge drives, disk pack drives and a 14" small Winchester drive. The firm has recently introduced a new disk subsystem using a basic 8" Winchester drive manufactured by International Memories, with electronics added by H-P. The main thrust of H-P's future disk drive development is expected to be in higher recording densities and in fixed disk drives larger than those now offered.

IBIS SYSTEMS, INC.
1850 Evergreen Drive
Duarte, CA 91010

213/357-2180

1980 disk sales: None

IBIS has taken on the extremely ambitious project of developing and manufacturing a disk drive with capacity and performance matching IBM's 3380. The firm plans to place 4 spindles in each cabinet, for a total capacity per drive of 5 gigabytes. IBIS was started in 1980, with founders from Memorex, Burroughs and Exxon's Star optical disk operation. The firm is establishing its own facilities to manufacture plated disks

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and will use these disks and ferrite heads in the new drive. It is planned to have a prototype in operation by the beginning of 1982, with first production by the end of that year. The initial target market is a small group of major system manufacturers, followed by the PCM market.

INTERNATIONAL BUSINESS MACHINES CORPORATION

Route 22

Armonk, NY 10504

914/765-1900

1980 disk sales: \$1,715,200,000

1980 total net sales: \$26,213,000,000

Net income: \$3,562,000,000

While its competitors are scrambling to develop recording technology matching IBM's, as introduced in new generation large disk files such as 3370, 3375 and 3380, IBM has had its own problems in getting the new drives into quantity production. Starting with the first 3370 shipment in October, 1979, and the subsequent 6-9 months of very limited deliveries, these start-up activities have been below expectations. The 3370 is now shipping, but in quantities sufficiently below demand level to force IBM to severely limit deliveries to individual customers. While the 3375, which is very similar to the 3370, is still planned for first shipment third quarter, 1981, the most important of all these new drives, the 3380, has been delayed from the originally promised delivery in first quarter, 1981. IBM has indicated the delay will extend to fourth quarter, 1981, resulting in a major realignment of competitive strategies among the PCM drive manufacturers. The independents are thus able to realize another major growth year for 3350 equivalent drives, especially double density versions, rather than the shrunken market which would have resulted if IBM had met its original plan for the more cost-effective 3380. The underlying cause for the delay remains obscure, with a multitude of industry rumors naming various unconfirmed technical failings.

In the meantime, production is at high levels for the 8" Piccolo drive, now manufactured at Rochester, Minnesota; Hursley, England; and Vimercate, Italy. It is believed that IBM is overdue for a higher capacity version of the Piccolo, for use with such systems as the 4331, 8100 and System/38. The new drive may be introduced soon, and will probably combine higher transfer rates with two to four times increase in capacity. IBM also has an obvious need for even smaller disk drives for upgraded versions of the floppy based desktop systems being introduced in 1981. However, the company seems to be planning to buy such drives from outside manufacturers, at least for the near future.

IRWIN INTERNATIONAL INDUSTRIES, INC.

2000 Green Road

Ann Arbor, MI 48105

313/663-3600

1980 disk sales: None

Irwin International's announced product, a subsystem combining a 5.25" Winchester and a tape backup device using 3M DC-100A cartridges, has

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attracted considerable attention in the disk drive industry because of the ambitious specifications for both disk and tape drives. The firm now plans production deliveries in third quarter, 1981. A license to make this subsystem has been granted to Olivetti, but initial shipments by that firm will probably be manufactured by Irwin International.

ISS/UNIVAC

Operating Unit of Sperry Univac Division
Sperry Corporation
3333 Scott Boulevard
Santa Clara, CA 95051

408/496-3333

1980 disk sales: \$197,600,000

1980 total net sales: \$4,785,425,000

Net income: \$277,092,000

Total revenues generated by drives manufactured by ISS have been flat for the last few years, but shipments of captive drives for use with Univac systems continue to increase. After years of being a major factor in the PCM market through drives distributed by IteI, production of such drives is now at a nominal level following the acquisition of IteI's computer industry business by National Advanced Systems. OEM drive business also has been nominal, but with an outlook for increases due to DEC's use of a large ISS fixed disk drive. Following the industry trend, the ISS product mix is shifting rapidly from removable disk drives to Winchester technology products.

KENNEDY COMPANY

Subsidiary of Magnetics & Electronics, Inc.
a subsidiary of Allegheny International, Inc.
1600 South Shamrock Avenue
Monrovia, CA 91001

213/357-8831

1980 disk sales: \$1,300,000

1980 total net sales: \$923,528,000

Net income: \$45,895,000

Kennedy Company remains a leading manufacturer of small tape drives, acquired in 1979 by Allegheny International. The firm attempted to enter the disk drive business in 1977 with a 14" Winchester, but experienced classic Winchester start-up problems, delaying shipments for a few years. The firm has announced two additional disk drives for delivery in third quarter, 1981: A 41.4 MB 8" Winchester drive and an 80 MB version of the existing 14" product line, with SMD interface.

MEMOREX CORPORATION

San Tomas and Central Expressways
Santa Clara, CA 95052

408/987-1000

1980 disk sales: \$168,300,000

1980 total net sales: \$768,661,000

Net income: (\$28,978,000)

Because Memorex has continued to lose money during a period of great prosperity for the disk drive industry, it is apparently about to be acquired. In mid-1981, Burroughs offered \$105 million for Memorex, outbidding a previous offer by Storage Technology worth about \$85 million. Once one of the industry's brightest growth companies, Memorex has suffered through a series of poorly executed product expansions and management attempts to apply short-term solutions to long-term problems. After years of internal turmoil, the firm has lost large numbers of its most capable managers and engineers. In disk drives, poor manufacturing yields for 3350 equivalent drives have contributed to Memorex' current losses and limit the firm's ability to take advantage of a boom year for these products -- as well as raise questions about the company's ability to transition successfully to 3380 PCM products. Most of the Memorex OEM disk drive revenues are produced by sales to DEC, now expected to start declining, as DEC has added large disk files from Memorex' competitors. Memorex recently announced it will "deemphasize" some of the 8" OEM Winchester drives it unsuccessfully introduced during the last few years. It is expected that the Burroughs acquisition, which is subject to various conditions, will require two to three months of negotiations before any possible consummation.

MICRODATA CORPORATION

Subsidiary of McDonnell Douglas Corporation
17481 Red Hill Avenue
Irvine, CA 92714

714/540-1113

1980 disk sales: \$29,400,000

1980 total net sales: \$6,066,300,000

Net income: \$144,600,000

Microdata's efforts have been concentrated on expansion of its computer systems business, since its acquisition by McDonnell Douglas in late 1979. Disk drive manufacturing is now solely in support of captive system requirements, and revenues are generated primarily by the firm's Reflex family of 14" Winchester drives.

MICRO PERIPHERALS, INC.

9754 Deering Avenue
Chatsworth, CA 91311

213/709-1213

1980 disk sales: None

Micro Peripherals is a privately held manufacturer which has achieved a position among the leaders in shipments of 5.25" flexible disk drives. The firm announced at the 1981 NCC a 5.25" Winchester drive with average access time of 27 ms, unusually fast for drives in its class. Deliveries are planned for first quarter, 1982.

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MICROPOLIS CORPORATION
21329 Nordhoff Avenue
Chatsworth, CA 91311

213/709-3300

1980 disk sales: \$2,000,000

After pioneering in development of the double track density 5.25" floppy, Micropolis announced an 8" Winchester drive in 1979, with capacities up to 44 MB. Micropolis had the difficulties common to new Winchester drive manufacturers in establishing quantity production but has since achieved some success in the OEM market. In addition to the OEM drive, a subsystem designed for the S-100 bus is also offered.

MINISCRIBE CORPORATION
410 South Sunset Street
Longmont, CO 80501

303/656-6000

1980 disk sales: None

Miniscribe was formed in 1980 to develop and manufacture 5.25" Winchester disk drives. Key personnel are disk drive industry veterans with extensive experience with high performance disk drives at Storage Technology Corporation. The initial products are 6 MB and 12 MB drives with an unusual rack and pinion head positioning system driven by a stepping motor. Deliveries are planned to occur at the time of product announcement, in third quarter, 1981.

NEW WORLD COMPUTER COMPANY, INC.
3176 Pullman Street
Costa Mesa, CA 92626

714/556-9320

1980 disk sales: None

1980 total net sales: \$14,983

Net income: (\$484,883)

At the 1979 NCC, New World Computer displayed an unconventional 8" fixed disk drive using a moving head array of 20 ferrite transducers on a single slider. At the 1980 NCC, the firm showed a 5.25" drive, also with multiple heads per surface, and announced availability of both drives with plated disks. At the 1981 NCC, the company showed a revised product line which also now includes versions of the 5.25" drives using a removable cartridge containing disks, heads and actuator -- reminiscent of a miniature IBM 3348 Data Module. The firm now hopes to initiate quantity production in third quarter, 1981.

NORTHERN TELECOM, INC.

Subsidiary of Northern Telecom, Ltd. (Canada)

Data Park

Minnetonka, MN 55343

612/932-8000

1980 disk sales: \$12,400,000

1980 total net sales: \$1,643,649,000

Net income: (\$148,124,000)

The electronic office systems operation of Northern Telecom was carved from the Data 100 and Sycor firms acquired by the Canadian company two years ago. Since that time, these operations have at least 2,000 fewer employees, a reduced product line, and have been blamed by the parent company for huge losses. Previously active in marketing OEM disk drives in addition to the captive disk drives produced by both predecessor companies, Northern Telecom is now producing only captive disk drives for use with the firm's terminal systems. Products include older small disk drives using 2314 technology, and a new pair of 8" Winchester drives with 11 MB and 22 MB formatted capacities.

OHIO SCIENTIFIC MEMORY PRODUCTS, INC.

Subsidiary of M/A-COM, Inc.

5740 Thornwood Drive

Goleta, CA 93117

805/964-3535

1980 disk sales: \$3,300,000

1980 total net sales: \$322,480,000

Net income: \$24,905,000

Within the past year Ohio Scientific, a pioneer manufacturer of personal and small business computers, acquired the disk drive operation of Okidata and was itself acquired by M/A-COM, an electronics industry conglomerate of moderate size. The products are still the same 14" Winchesters, but the product line has been shrunk to two models of 40 MB and 80 MB capacities. Ohio Scientific was the largest OEM customer for the Okidata drives in recent years, and this usage now continues on a captive basis, plus the remaining OEM business.

PERKIN-ELMER CORPORATION

Memory Products Division

7301 Orangewood Avenue

Garden Grove, CA 92641

714/891-3711

1980 disk sales: \$20,200,000

1980 total net sales: \$996,149,000

Net income: \$68,245,000

Perkin-Elmer's Memory Products Division manufactures the old Wangco tape and disk drives, which were acquired in 1976. It now appears that Perkin-Elmer has tired of the game, and has been entertaining prospective buyers for the division in mid-1981. At this time, the disk products involved are captive and OEM 14" disk cartridge drives, which are soon to be obsolete, and a new family of 8" fixed/removable disk drives which are yet to

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be formally announced. Depending on the ownership status of the operation, the new drives could be announced in late 1981, with production starting in first half of 1982.

PERTEC COMPUTER CORPORATION
 Subsidiary of Triumph Werke Nurnberg AG
 9600 Irondale Avenue
 Chatsworth, CA 91311

213/882-0030

1980 disk sales: \$36,400,000

Triumph Adler's United States expansion, which included acquisition of Pertec in early 1980, had gone badly so far. The Pertec operations ran in the red in 1980, as did the parent company. It is expected to take a year or two for Triumph Adler's strategies, as part of the worldwide Volkswagen holdings, to be revised adequately to cope with the rapid collapse of the market for its main products, mechanical and electric typewriters. Pertec's disk drives may not be in a position to help much with the overall recovery plan. Revenue produced by the Pertec 14" disk cartridge drives is now in decline, and the firm's 8" Winchester program is just getting into production.

PRIAM CORPORATION
 3096 Orchard Drive
 San Jose, CA 95134

408/946-4600

1980 disk sales: \$2,700,000

Priam got its manufacturing program for 14" Winchester disk drives underway in 1980, and will apparently achieve substantial production levels with these products in 1981. The firm's internally manufactured 8" drives are now in production, and a low-end stepping motor Winchester 8" drive manufactured by Hokushin is also being distributed in the United States. Priam and Hokushin have a cross licensing arrangement under which Priam has rights to sell and make the Hokushin Winchester drive, and Hokushin may make and sell the Priam higher performance drives in Japan.

QUANTUM CORPORATION
 1804 McCarthy Boulevard
 Milpitas, CA 95035

408/262-1100

1980 disk sales: None

Quantum was started in the first half of 1980, with an ambitious plan to confront Shugart Associates' SA1000 8" Winchester drives head-on with a competitive family of drives offering capacities up to 40 MB, using a compatible interface. The backgrounds of the founders, including success stories at Shugart Associates, Memorex and IBM, enabled the new firm to obtain a heavy venture capital commitment, which has since been expanded with second round financing. Quantum's plan is working well, to date.

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The disk drives have been designed and are in production without extensive delays, OEM customers have been signed, and Shugart Associates has not yet responded with a counterattack product.

ROTATING MEMORY SYSTEMS, INC.
1031-A East Duane Avenue
Sunnyvale, CA 94086

408/730-1346

1980 disk sales: None

RMS provided evaluation units for its family of 5.25" Winchester drives in less than a year after the firm's start in mid-1980, and is now in production. Founders of RMS bring extensive Winchester design and manufacturing experience acquired at IBM, Shugart Associates, and Memorex to the company. In addition to industry standard interfaces for its drives, RMS also offers a proprietary data separator which can increase the capacity of its largest drive from 12 MB to 18 MB through use of a run-length limited code.

SEAGATE TECHNOLOGY
360 El Pueblo Road
Scotts Valley, CA 95066

408/438-6550

1980 disk sales: \$1,000,000

Seagate Technology is on its way to become the definitive model for disk drive start-up companies. The founders were among the most seasoned people in the industry, combining leadership backgrounds in the required functional areas with previous start-up experience. The product concept involved usage of conventional, predictable Winchester technology, reconfigured into a package size new to the industry, but a physical match to the booming 5.25" floppy disk. The timing for introduction of a 5.25" Winchester was perfect, catching the wave of desktop computers now being used for business applications, but with a need for more storage capacity. The initial commitment to a production facility capable of extremely high volume levels made it possible to press for a large market share from the beginning. The establishment of an extensive marketing campaign and the early success in obtaining licensing agreements from such major firms as Texas Instruments and Cii-Honeywell Bull created a stampede in the industry to recognize the Seagate drive and interface as defacto standards. And the company secured the essential aura of credibility by delivering according to its announced schedule -- 1,200 drives by the end of 1980, 12,000 drives by the end of the Seagate fiscal year, June 30, 1981. Seagate is now the dominant company in one of the fastest growing segments of the disk drive industry.

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

408/733-0100

1980 disk sales: \$19,200,000

1980 total net sales: \$8,196,500,000

Net income: \$619,000,000

Shugart Associates is the worldwide leader in total shipments of flexible disk drives and a pioneer in development of OEM markets for low cost Winchester disk drives. Introduction of the 14" SA4000 in 1979 proved the existence of a market, and the introduction of the 8" SA1000 in 1980 proved that the market could be sizable. Shugart Associates is now enjoying a high growth rate for the SA1000, but future growth of the market for the existing drives is expected to be limited, due to tough competition at the 5 MB and 10 MB levels offered by 5.25" Winchesters. The company will have its own 5.25" Winchester, but initial production will be a year behind Seagate, the industry leader. There is expected to be a good market for 8" Winchester drives above the 10 MB level of the existing SA1000, and Shugart Associates will undoubtedly offer drives in that range soon.

SLI INDUSTRIES
 21040 Victory Boulevard
 Woodland Hills, CA 91367

213/884-7300

1980 disk sales: None

Having been involved in the disk drive industry for years as a supplier of voice coil actuators and other disk drive components, SLI has been trying to find an effective point of entry into manufacture of complete disk drives. After a few years of looking for customers for a 14" Winchester drive "kit" consisting of deck plate, spindle, rotary actuator, cover and related parts, the firm began offering a kit for an 8" drive with more success. Both Texas Instruments and Nippon Electric Industries now have agreements to build drives using the SLI 8" kit. And since late 1980, SLI has also had available for the OEM market a series of complete disk drives ranging from 7 MB to 52 MB, based on its own 8" kit. An 82 MB version of this drive, with SMD interface, has been announced, for initial delivery in second quarter, 1982.

STORAGE TECHNOLOGY CORPORATION
 2270 South 88th Street
 Louisville, CO 80027

303/673-5151

1980 disk sales: \$151,800,000

1980 total net sales: \$603,493,000

Net income: \$45,400,000

STC continues to be the successful survivor of the high risk environment in IBM's shadow -- first with IBM compatible tape drives, then with 3350 equivalent disk drives. STC will find it necessary soon to completely

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replace these product lines with new ones compatible with IBM's latest generations of magnetic storage devices. And now the firm is embarked on a venture with risks equal to all those faced in the past: A plan to enter the high-end PCM mainframe business by 1984. However, the short-term challenge in the disk drive segment of STC's product line is challenging enough for most, involving a large-scale increase in existing product shipments, just before the predictable decline of these products. The firm is trying to double production of 3350 equivalent disk drives in 1981, and to shift a major portion of its product mix to double density versions. Parallel programs to complete development of 3370 and 3380 compatible drives are underway, and will have to result in hardware ready for production phase-in immediately behind the existing drive models. There is plenty of room for debilitating delays in these activities, with major loss of revenue, but STC has retained its early vigor and might just make it. Oddly, the firm has not duplicated its PCM market successes in OEM disk drives. STC gave up on its 14" family of intelligent OEM drives in late 1980 and withdrew from further marketing of the drives. However, it is expected that the company will re-enter the OEM area, either through acquisition or internal development. In the meantime, it is starting to receive OEM orders for large disk files similar to its standard PCM drives.

TANDON CORPORATION
20320 Prairie Street
Chatsworth, CA 91311

213/993-6644

1980 disk sales: None

1980 total net sales: \$22,761,000

Net income: \$1,507,000

Tandon has transitioned from its status as the leading independent floppy head manufacturer a few years ago to a new role as the leading manufacturer of two sided 5.25" floppy drives. Quick to realize the potential of the 5.25" Winchester format originated by Seagate Technology, Tandon has been supplying evaluation units of its own 5.25" Winchester for several months and hopes to ship a substantial quantity by the end of 1981. The orders are already there: At the 1981 NCC, Tandon announced a contract with Commodore, one of the big three in personal computers.

TECSTOR, INC.
16161 Gothard Street
Huntington Beach, CA 92647

714/842-0077

1980 disk sales: None

Tecstor started operations in March, 1981, having acquired rights to a 14" Winchester disk drive developed by BASF in Europe, but never placed in quantity production. The new company expects to have a 160 MB version of the drive, with SMD interface, ready for production at the new California facility by November, 1981. The founding team is considered to have a good chance of meeting this objective, since their key technical personnel managed development of the similar Reflex I and Reflex II drives

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at Microdata. Founders' experience in disk drive organizations includes Microdata, Century Data Systems, Memorex, and Pertec.

TEXAS INSTRUMENTS INCORPORATED
Terminals and Peripherals Division
P.O. Box 1444
Houston, TX 77040

713/937-2000

1980 disk sales: None

1980 total net sales: \$4,074,700,000

Net income: \$212,200,000

TI acquired a license from Seagate Technology in July, 1980, to make and sell 5.25" Winchester drives using the Seagate design, and also acquired a license in November, 1980, covering the SLI 8" Winchester drives. The usual TI curtain of silence now extends over the firm's long-range intentions for both areas, with the exception of an announced effort to sell the 5.25" drive in the OEM market. However, it is considered probable that both types of drives will eventually be used in TI computer systems as captive drives.

3M COMPANY
Data Recording Products Division
3M Center
St. Paul, MN 55144

612/733-1110

1980 disk sales: None

1980 total net sales: \$6,079,540,000

Net income: \$678,029,000

3M finally announced its 8" Winchester disk drives in April, 1981. The stepping motor versions, with 10 MB and 20 MB capacities, are in production in mid-1981, and the 60 MB drive with voice coil actuator is scheduled for delivery in first quarter, 1981. Both drive types offer the ANSI X3T9.3 interface exclusively.

VERMONT RESEARCH CORPORATION
Precision Park
North Springfield, VT 05156

802/886-2256

1980 disk sales: \$1,200,000

1980 total net sales: \$16,085,000

Net income: \$2,796,000

The head-per-track disk drives is VRC's primary business. The firm continues to produce small quantities of its high capacity disk cartridge drive with embedded servo, and has introduced advanced models, which are used in European military systems.

WESTERN DYNEX CORPORATION
3536 West Osborn Road
Phoenix, AZ 85019

602/269-6401

1980 disk sales: \$18,700,000

Disk cartridge drives, at least those below 12 MB, are starting to decline in the OEM market, and Western Dynex is going through a period of flat sales. The firm has risen to second place in the OEM segment of this market, but even the low overhead and low prices which have kept Western Dynex in the running aren't enough for the future. Unless a transition is made to newer disk recording technologies, the future is clouded.

Japanese Manufacturers

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

FUJITSU LIMITED

6-1, Marunouchi 2-chome
Chiyoda-ku, Tokyo 100

(03)216-3211

1980 disk sales: \$185,700,000

1980 total net sales: \$2,854,471,000

Net income: \$84,095,000

Fujitsu's share of the Japanese domestic computer market has now exceeded that of IBM for two years in a row, lending emphasis to the firm's position as leading Japanese computer manufacturer. Fujitsu is becoming known in the United States as an OEM disk drive manufacturer, but OEM drives still constitute a small part of the firm's total disk drive business. Removable media captive drives have now given way to a variety of fixed disk drives as the major revenue producers for Fujitsu. In addition to 317.5 MB and 635 MB 3350 drives, Fujitsu expects to ship 446 MB versions of its Eagle 10.5" fixed drive with 1.859 MB/second transfer rate during 1981, and an enhanced Eagle equivalent to IBM's 3380 during 1982. In the OEM worldwide market, Fujitsu 80 MB and 160 MB 14" fixed drives are starting to be well accepted, and 48 MB and 84 MB 8" fixed drives are being evaluated by many potential OEM buyers. The 11 MB and 23 MB stepping motor 8" fixed drives are already being shipped in quantity. Eventually, the OEM versions of the 10.5" Eagle are also expected to have significant markets, with the emerging supermini systems offered by many manufacturers.

HITACHI, LTD.

6-2, Otemachi, 2-chome
Chiyoda-ku, Tokyo 100

(03)270-2111

1980 disk sales: \$44,000,000

1980 total net sales: \$14,025,638,000

Net income: \$548,529,000

Hitachi is Japan's largest manufacturer of electrical and electronic equipment, but less than a fifth of the company's sales are provided by the computer industry. With the exception of relatively minor shipments to PCM and OEM markets, Hitachi's internally manufactured disk drives are sold on a captive basis with Hitachi systems. The firm makes 3350 equivalent drives, a 635 MB version with dual actuator, and has announced that it will produce a drive equivalent to IBM's 3380.

HOKUSHIN ELECTRIC WORKS, LTD.

30-1, Shimomaruko, 3-chome
Ohta-ku, Tokyo 146

(03)759-4141

1980 disk sales: \$3,200,000

1980 total net sales: \$171,533,000

Net income: \$2,895,000

Hokushin is a major manufacturer of industrial, marine and aircraft instruments. After years of production of disk cartridge drives as the Diablo licensee for Japan, the company is now transitioning from the

declining disk cartridge product lines to OEM Winchester drives. A licensing arrangement between Priam and Hokushin has resulted in sales by Priam in the U.S. of 8" Winchester stepping motor drives manufactured by Hokushin. Hokushin, in turn has acquired rights to make and sell the Priam line of voice coil actuator Priam Winchester drives in Japan, and plans to start production in 1982.

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

(03)218-2111

1980 disk sales: \$68,700,000

1980 total net sales: \$5,664,114,000

Net income: \$155,338,000

Mitsubishi Electric is one of Japan's major electronic and electrical products companies, and remains a leader in the domestic small business system markets. The company manufactures disk drives for its wide variety of computer systems, on a captive basis, and also is a significant factor in OEM disk drive sales in Japan. Disk cartridge and disk pack drives are still a major part of the firm's product shipments, but 14" and 8" Winchester drives are growing fast.

NIPPON ELECTRIC COMPANY, LTD.
33-1, Shiba Gochome
Minato-ku, Tokyo 108

(03)454-1111

1980 disk sales: \$138,000,000

1980 total net sales: \$4,105,071,000

Net income: \$69,629,000

NEC is a diversified manufacturer of communications, data processing and other electronic equipment. The company's computer systems span the range from mainframes to minicomputers, and the firm's internally manufactured disk drives are used with a wide range of these systems. While large disk pack drives are still produced, NEC has moved decisively into Winchester technology drives in both high and low capacity areas -- and these products now provide the bulk of the firm's disk drive revenues.

NIPPON ELECTRIC INDUSTRY CO., LTD.
19-18, Tsutsumi-dori 1-chome
Sumida-ku, Tokyo 131

(03)613-1111

1980 disk sales: None

1980 total net sales: \$79,562,000

Net income: \$1,771,000

This firm, which is known in Japan by its Densei brand name, is a major producer of power supplies for communications and computer equipment, automatic control systems and other electronic equipment. The company is a manufacturer of magnetic drum memories. Densei made its entry into the OEM disk drive field this spring, with the announcement of 8" Winchester drives based on the SLI Mini Fox kit and a 5.25" Winchester

internally developed by the company. These programs are independent of the disk drive programs of NEC, which owns 34.6% of Densei.

NIPPON PERIPHERALS LIMITED
660 Miyamae, Fujisawa-shi
Kanagawa-ken 251

(0466)26-8211

1980 disk sales: \$15,800,000

NPL is a joint venture organization, owned equally by Fujitsu and Hitachi, which carries the responsibility to develop advanced disk drives and other magnetic peripherals. The initial product developed by the firm was a duplication of the IBM 3340, and NPL has designed disk drives equivalent to every IBM drive introduced since that time: the 3350, 3344, 3310 -- and is expected to continue with the newer generation of IBM thin film head drives. Drives developed by NPL may be sold by that firm, or the designs may be adapted to the specific requirements of the parent companies, and produced by those firms as captive drives. NPL's existing direct sales to outside firms are primarily to BASF, which markets PCM versions of the 3350, 3344 and 3310 in Europe. These shipments are treated as PCM shipments by NPL in DISK/TREND statistics to avoid distortion of PCM market totals.

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

(03)501-5411

1980 disk sales: \$51,000,000

1980 total net sales: \$9,074,362,000

Net income: \$215,833,000

Although a major factor in the Japanese office computer market, Toshiba's computer industry sales are a relatively small part of the company's total revenues. The firm is a major factor in consumer electric and electronic products, plus heavy electric power equipment and numerous industrial electronic products. Captive disk drives constitute most of Toshiba's production, with current growth occurring primarily in 14" and 8" Winchester drives.

European Manufacturers

(Exchange basis indicated for each firm)

BASF AG

D-6700 Ludwigshafen

West Germany

(0621) 4 00 81

1980 disk sales: \$4,100,000

1980 total net sales: \$16,479,000,000

Net income: \$213,000,000

(Basis: DM 1.82 = U.S.\$1)

Although BASF is one of the world's largest chemical companies, it is known primarily in the computer industry as a broad-line manufacturer of magnetic media products. In addition, the firm has been a manufacturer of disk drives since the early 1970s, originally as a result of a manufacturing license from the old Century Data Systems for 2314 type drives. Although the BASF 2314 production is now phasing out, the firm has continued as a factor in the European PCM market, reselling 3340, 3350, 3344 and 3310 drives manufactured by Nippon Peripherals, Ltd. BASF 8" Winchester drives are made at the firm's plant at Los Gatos, California. A 14" Winchester originally planned for production in Germany, has been licensed instead to Tecstor, a new California company which will manufacture the drive.

CII-HONEYWELL BULL

94, Avenue Gambetta

75960 Paris Cedex 20

France

(1)360 02 22

1980 disk sales: \$13,400,000

1980 total net sales: \$1,480,848,000

Net income: \$42,393,000

(Basis: FF 4.25 = U.S.\$1)

Cii-Honeywell Bull will undoubtedly continue to be France's principal flag-carrier in the European computer industry, but major changes seem to be in store following the complete socialist victory in 1981's French elections. At present, 53% of the company is controlled by Saint-Gobain-Pont-a-Mousson, a major French conglomerate which also controls a significant minority interest in Olivetti. France's new government has indicated an interest in nationalizing both Cii-HB and Saint-Gobain, but the timetable still appears uncertain. The status of Honeywell's 47% of Cii-HB is also not clear. In the meantime, Cii-HB has been busily expanding production of its Cynthia 10.5" disk drive family, with captive shipments for Cii-HB systems, plus a healthy OEM business in both Europe and the United States. The 5.25" Winchester to be made under license from Seagate Technology, and also dubbed Cynthia, is expected to be in production by the end of 1981. In mid-1981 the firm established a U.S. subsidiary named Cynthia Peripheral Corporation, based in California, to push U.S. OEM and end user subsystem sales.

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

(0784) 61141

1980 disk sales: \$23,300,000
 1980 total net sales: \$63,111,000 Net income: (\$22,978,000)
 (Basis: .45 Pound = U.S.\$1)

DRE now markets disk drives manufactured by a joint venture company established by DRI, its parent firm, and Magnetic Peripherals, Inc., the U.S. disk drive development and manufacturing firm owned primarily by Control Data and Honeywell. The joint venture, named United Peripherals, Ltd., was formed in 1979, and now produces selected products from the old DRE line, plus MPI disk drives such as the Hawk disk cartridge drive and the Phoenix cartridge module drive. Included in the DRE products now made by UPL is a 19.5 MB 8" Winchester drive.

HIGHTRACK COMPUTER TECHNIK GMBH
 Bundesallee 36/37
 D-1000 Berlin 31
 West Germany

(030) 86 04 97

1980 disk sales: None

Hightrack Computer Technik, previously known as Computer Peripherie Technik, has been developing a high performance 8" OEM drive using plated disks. The announced product line now consists of 25 MB, 41 MB and 82 MB drives, with specifications for interface, track capacity and cylinder organization compatible with standard SMD products.

ISOTIMPEX
 51, Chapaev St.
 Sofia, Bulgaria

1980 disk sales: \$17,600,000

Isotimpex is the foreign trade organization for Bulgarian computer equipment and other electronic products. Disk drives manufactured by ISOT, the Bulgarian state computer organization, are exported throughout Eastern Bloc countries. Currently manufactured are disk cartridge drives, developed under a Wangco license, and disk pack drives compatible with standard IBM designs now out of production. Isotimpex is currently marketing 2314 and 3330 compatible drives.

NIXDORF COMPUTER AG
 Furstenallee 7
 4790 Paderborn
 West Germany

(05251) 2 00 1

1980 disk sales: None

1980 total net sales: \$855,495,000 Net income: \$23,255,000
 (Basis: DM 1.82 = U.S.\$1)

Nixdorf Computer continues to be the European computer company with the highest growth rate, and has a chance to become the largest in Europe in the next few years. In addition to numerous product line expansions currently underway, Nixdorf has started to manufacture storage module drives in Germany, under a Control Data license. Nixdorf has long been one of CDC's largest customers for the SMD, and the firm's growth will assure substantial captive production.

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

(0125) 525

1980 disk sales: None

1980 total net sales: \$2,550,840,000

Olivetti is a major factor in the worldwide market for office equipment and data processing systems, with operations in numerous countries around the world. In recent years, the company's new management has arranged a number of acquisitions and reorganizations of the organization and product lines. A major investment was obtained from Saint-Gobain-Pont-a-Mousson, in exchange for a minority equity position. In 1980, the printer and disk memory activities were placed in a new subsidiary, Olivetti Peripheral Equipment, creating an operation with 1,700 employees and more the 400,000 square feet of manufacturing space. OPE is planning an aggressive entry into a new generation of rigid disk drives, with several 5.25" and 8" Winchester drives scheduled for initial production during 1981 and 1982, intended for both captive requirements and the worldwide OEM market. In addition, the parent company has acquired a license for the sale and manufacture of the Irwin International subsystem incorporating a 5.25" Winchester drive and a tape cartridge unit.

PHILIPS DATA SYSTEMS

Subsidiary of N. V. Philips Gloeilampenfabrieken

Postbus 245

7300 AE Apeldoorn

The Netherlands

(055) 330123

1980 disk sales: \$48,300,000

1980 total net sales: \$18,359,798,000

Net income: \$164,824,000

(Basis: Fl 1.99 = U.S.\$1)

Philips is one of the giants of the worldwide electrical and electronic equipment industry, with product lines spanning consumer, commercial and industrial markets. Computer industry revenues contribute less than 5% of total company sales, but the firm's extensive minicomputer, terminal and office computer lines are a factor in most European countries. Rigid disk drives produced include several 14" disk cartridge drives and low capacity Winchester drives, all sold as captive drives with Philips systems. Philips' varied activities to promote industry adoption of optical disk systems for data storage have not yet resulted in introduction of optical disks in connection with the company's own computer systems.

RODIME LIMITED

12-14 Edison House, Fullerton Road

Glenrothes, Fife KY7 5QR

Scotland

(0592) 757498

1980 disk sales: None

Rodime was formed in late 1980 to design and manufacture a family of 5.25" Winchester drives with capacities from 4 MB to 16 MB. The founders include several individuals who played a key role in development of the Winchester drive now in production at Burroughs' Glenrothes plant. The Rodime drive is scheduled for initial shipment during 1981 and is intended for the European and U.S. OEM markets.

ROM CONTROL DATA S.R.L.

Bucharest

Romania

1980 disk sales: \$2,600,000

ROM-CD is a peripherals manufacturing organization established as a joint venture by Control Data and the Romanian government. Control Data owns 45% of ROM-CD, which manufactures double density versions of 2314 type drives, using technology provided by CDC. Disk drives manufactured by this joint venture are marketed both in Eastern Bloc countries and in Western Europe.

SIEMENS AG
Data and Information Systems Group
Otto-Hahn-Ring 6
D-8000 Munchen 83
West Germany

1980 disk sales: \$141,400,000
1980 total net sales: \$17,560,673,000 Net income: \$347,540,000
(Basis: DM 1.82 = U.S.\$1)

Siemens is a major factor in the European general purpose computer market, but the firm's overall electrical and electronic product lines are so extensive that computers account for only about 5% of the company's total revenues. The company does not attempt any significant OEM marketing activity for disk drives, and all disk production is committed to Siemens system marketing activities. Existing products include several disk pack drives and a large fixed disk drive.