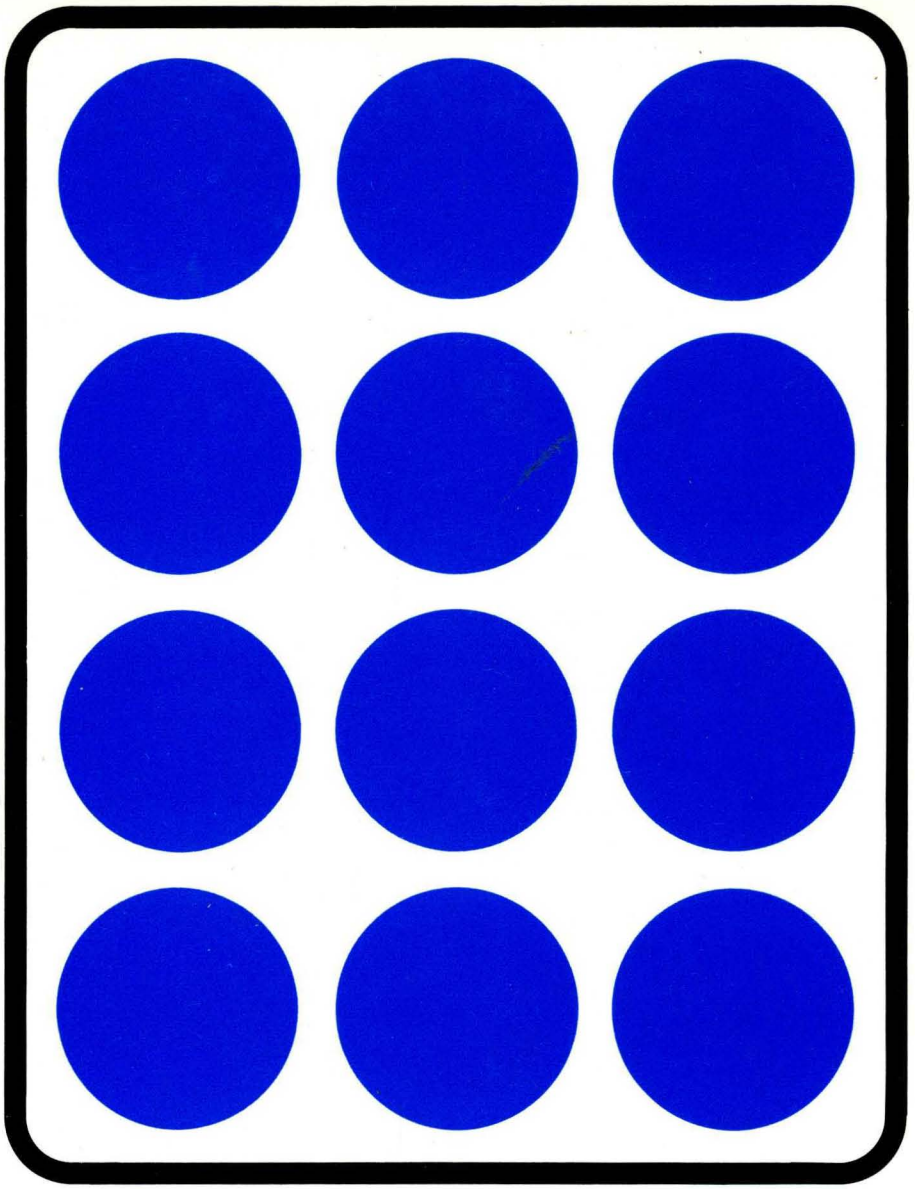
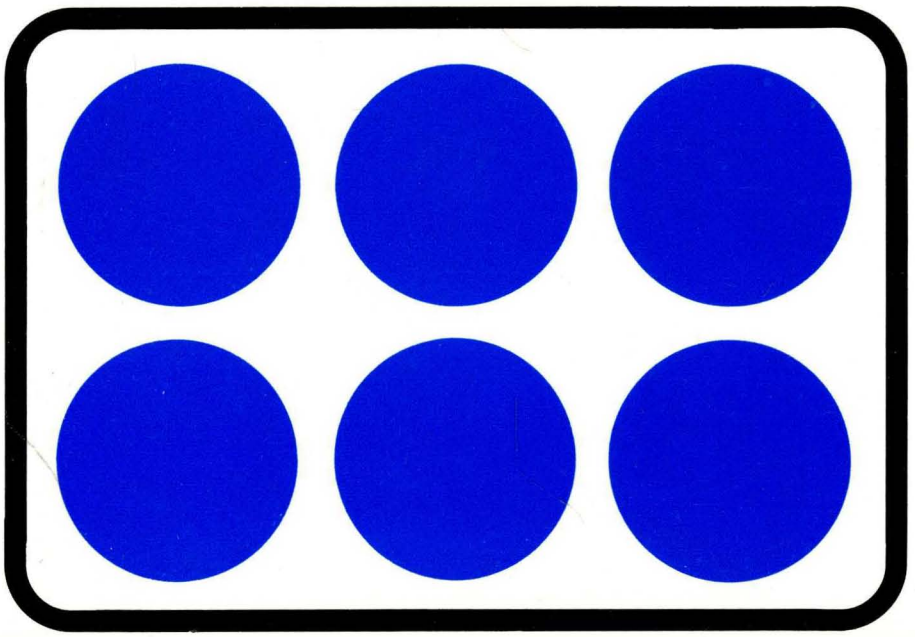


1982 DISK/TREND® REPORT

RIGID DISK DRIVES



1982 DISK/TREND® REPORT

RIGID DISK DRIVES

September, 1982

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

FOREWORD

The disk drive industry is showing no signs of slowing down, despite the recession and the decline of several older product configurations. As disk drives continually become more capable and more cost effective, the market just keeps expanding. This year's DISK/TREND Report on rigid disk drives now includes detailed information on 70 drive manufacturers and 590 individual drive models.

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 October.

I am always willing to help you at any time by providing 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.

As always, your suggestions for improvements in the report are always welcome.

James N. Porter

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INTRODUCTION

Major changes in this year's DISK/TREND Report

For several years the rigid disk drive industry has been in the midst of a transition -- from mostly removable disk formats to predominantly fixed disk formats. An attempt is made to maintain consistency in DISK/TREND formats and organization from year to year, but it has finally become necessary to change the basic groups in which data is organized.

* Two removable disk drive product groups which have become relatively inactive have been dropped from this year's report: Disk pack drives 29-58 MB and data module drives. Fixed disk drives have been arranged in five product groups instead of the three groups previously used. Here are the nine product groups used for rigid disk drives this year:

Removable media:	1.	Disk cartridge drives, less than 12 MB
	2.	Disk cartridge drives, more than 12 MB
	3.	Storage module drives, 25-80 MB
	4.	Disk pack drives, more than 100 MB
Fixed media:	5.	Fixed disk drives, less than 30 MB
	6.	Fixed disk drives, 30-100 MB
	7.	Fixed disk drives, 100-300 MB
	8.	Fixed disk drives, 300-500 MB
	9.	Fixed disk drives, more than 500 MB

* Additional breakdowns by disk diameter have been added. The product groups for disk cartridge drives now include 5.25" drives, and the storage module drive group now includes 8" drives. The newly reorganized fixed disk drive groups include 14"/8"/5.25" breakdowns for the three groups covering capacities below 300 MB.

This information will help you use the report

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

* Prices for most OEM drives sold in the United States are shown, usually at the 100 unit level. Please remember that prices may be changed without notice by the manufacturers.

* The value of all leased disk drives is given on an "if sold" basis in all DISK/TREND estimates.

SUMMARY

Industry size

Total moving head disk drive shipments produced $6,370,600,000 in worldwide revenue for 1981, up 23% over 1980. Basic changes in industry product mix are underway, and revenues for fixed disk drives were two thirds of the 1981 worldwide total.

Although the industry continues to sustain an impressive overall growth rate, worldwide revenues for both 1981 and 1982 are running below the levels anticipated in the 1981 DISK/TREND Report, by 9.5% and 16.1%, respectively. The reason is believed to be (1) several of the older disk drive configurations are declining faster than expected, and (2) the persistence of the worldwide economic recession has affected the new system introduction plans of many manufacturers and has dampened sales of existing systems, especially in the mid-size and larger groups.

Nevertheless, the future outlook, especially for the many newer disk drive configurations is excellent. 1982's estimated total worldwide revenue level of $7,925,300,000 is forecasted to reach $15,415,000,000 in 1985, an average annual increase of 25% for the three year period.

All DISK/TREND market classes are expected to share in the forecasted industry increases. IBM is now in a high-growth phase, created by demand for the 3370, 3375 and 3380, but PCM drive shipments will divert a share of this market in 1984 and 1985. Other captive and OEM drive shipments will hold their own in revenue growth, but the overall totals hide major product mix changes. The main themes are dominance of fixed over removable drive configurations and the ascendancy of smaller disk formats.

TABLE 1

CONSOLIDATED WORLDWIDE SHIPMENTS

ALL EXISTING MOVING HEAD DISK DRIVE GROUPS

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1981		Forecast							
	---Shipments---		------1982-----		------1983-----		------1984-----		------1985-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	1,283.5	2,232.2	1,800.2	3,042.6	2,560.8	4,248.9	2,980.9	4,898.6	2,945.3	4,957.3
Other U.S. Captive	1,000.0	1,624.6	1,135.7	1,802.9	1,453.1	2,186.8	1,993.1	2,928.6	2,534.7	3,764.5
TOTAL U.S. CAPTIVE	2,283.5	3,856.8	2,935.9	4,845.5	4,013.9	6,435.7	4,974.0	7,827.2	5,480.0	8,721.8
PCM	350.2	514.2	376.8	563.1	429.9	634.9	866.9	1,270.9	1,247.4	1,884.3
OEM	638.7	914.2	844.8	1,167.9	1,103.3	1,527.1	1,354.3	1,863.0	1,532.8	2,133.1
TOTAL U.S. NON-CAPTIVE	988.9	1,428.4	1,221.6	1,731.0	1,533.2	2,162.0	2,221.2	3,133.9	2,780.2	4,017.4
TOTAL U.S. SHIPMENTS	3,272.4	5,285.2	4,157.5	6,576.5	5,547.1	8,597.7	7,195.2	10,961.1	8,260.2	12,739.2
Non-U.S. Manufacturers										
Captive	30.4	871.1	31.9	1,023.8	73.7	1,259.4	149.2	1,605.3	232.1	1,984.5
PCM	--	17.6	--	20.8	--	20.2	--	15.8	--	21.1
OEM	55.1	196.7	88.1	304.2	147.7	423.5	201.8	539.8	256.7	670.2
TOTAL NON-U.S. SHIPMENTS	85.5	1,085.4	120.0	1,348.8	221.4	1,703.1	351.0	2,160.9	488.8	2,675.8
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	3,357.9	6,370.6	4,277.5	7,925.3	5,768.5	10,300.8	7,546.2	13,122.0	8,749.0	15,415.0

Marketing channels

There are now 70 manufacturers of moving head rigid disk drives, counting only those companies with specifically announced products. The geographical distribution of these firms is United States, 45; Japan, 13; Europe, 12. Two manufacturers have dropped their rigid disk drive products since last year, and five have either changed their names voluntarily or been involved in acquisitions.

Because of the relatively high price per unit for captive drives compared to OEM drives, captive revenue totals can give an exaggerated impression of captive drives' share of the industry's unit production. IBM and other captive drives held 74.2% of the industry's total worldwide revenues in 1981, for $4,727,900,000. If produced as OEM products, these drives would have produced revenues at 20-25% of that figure.

Total worldwide PCM revenues are now growing, but are actually declining as a percentage of the total industry, as manufacturers of PCM drives transition from 3350 technology to 3370/3380 technology. Sharp growth in both share of industry and absolute revenues are expected for 1984 and 1985, with 1985 worldwide revenues forecasted at $1,884,300,000.

Although IBM has pioneered most of the basic recording technology used in the industry's mainstream products, the manufacturers of OEM rigid disk drives have engineered the proliferation of product configurations now produced. Responsiveness to varied market needs has continually revitalized the range of OEM products offered and produced dynamic growth for several start up firms. OEM drives are expected to hold 18.1% of industry revenues in 1985, for $2,803,300,000 worldwide.

TABLE 2

CONSOLIDATED WORLDWIDE SHIPMENTS

MARKET CLASS REVIEW

REVENUE SUMMARY

WORLDWIDE REVENUES BY MANUFACTURER TYPE	1981 Shipments $M	1981 Shipments %	FORECAST 1982 $M	1982 %	1983 $M	1983 %	1984 $M	1984 %	1985 $M	1985 %
U.S. Manufacturers										
IBM	2,232.2	35.0	3,042.6	38.4	4,248.9	41.2	4,898.6	37.3	4,957.3	32.2
Other U.S. Captive	1,624.6	25.5	1,802.9	22.7	2,186.8	21.2	2,928.6	22.3	3,764.5	24.4
PCM	514.2	8.1	563.1	7.1	634.9	6.2	1,270.9	9.7	1,884.3	12.2
OEM	914.2	14.4	1,167.9	14.7	1,527.1	14.8	1,863.0	14.2	2,133.1	13.8
Total U.S. Mfgr's.	5,285.2	83.0	6,576.5	83.0	8,597.7	83.5	10,961.1	83.5	12,739.2	82.6
Non-U.S. Manufacturers										
Captive	871.1	13.7	1,023.8	12.9	1,259.4	12.2	1,605.3	12.2	1,984.5	12.9
PCM	17.6	.3	20.8	.3	20.2	.2	15.8	.1	21.1	.1
OEM	196.7	3.1	304.2	3.8	423.5	4.1	539.8	4.1	670.2	4.3
Total Non-U.S. Mfgr's.	1,085.4	17.0	1,348.8	17.0	1,703.1	16.5	2,160.9	16.5	2,675.8	17.4
Worldwide Total	6,370.6	100.0	7,925.3	100.0	10,300.8	100.0	13,122.0	100.0	15,415.0	100.0

Product mix

The steady transition to fixed disk drives continues, on a worldwide basis. Even though three DISK/TREND removable disk drive product groups are expected to start growing again by 1984 as new small diameter disk drives reach high production levels, the current trend for removable disk drives is down, for all groups.

In contrast, four of the five DISK/TREND fixed disk drive product groups are maintaining a high growth level year after year. In 1981, 67.8% of estimated worldwide revenues for all rigid disk drives came from fixed disk drives; in 1985, the estimate for fixed disk drive revenues is 89.4% of the total.

The large high performance drives used with mainframes, fixed disk drives over 500 MB, were the largest revenue producers in 1981 with 20.9% of the worldwide total. The 1985 revenue forecast for this group is $6,875,300,000, which will be 44.6% of total industry revenues, with IBM and the PCM manufacturers dominating shipments. Fixed disk drives in the 300-500 MB group are expected to decline for the next two years, as IBM's 3350 and equivalent PCM drives are phased out.

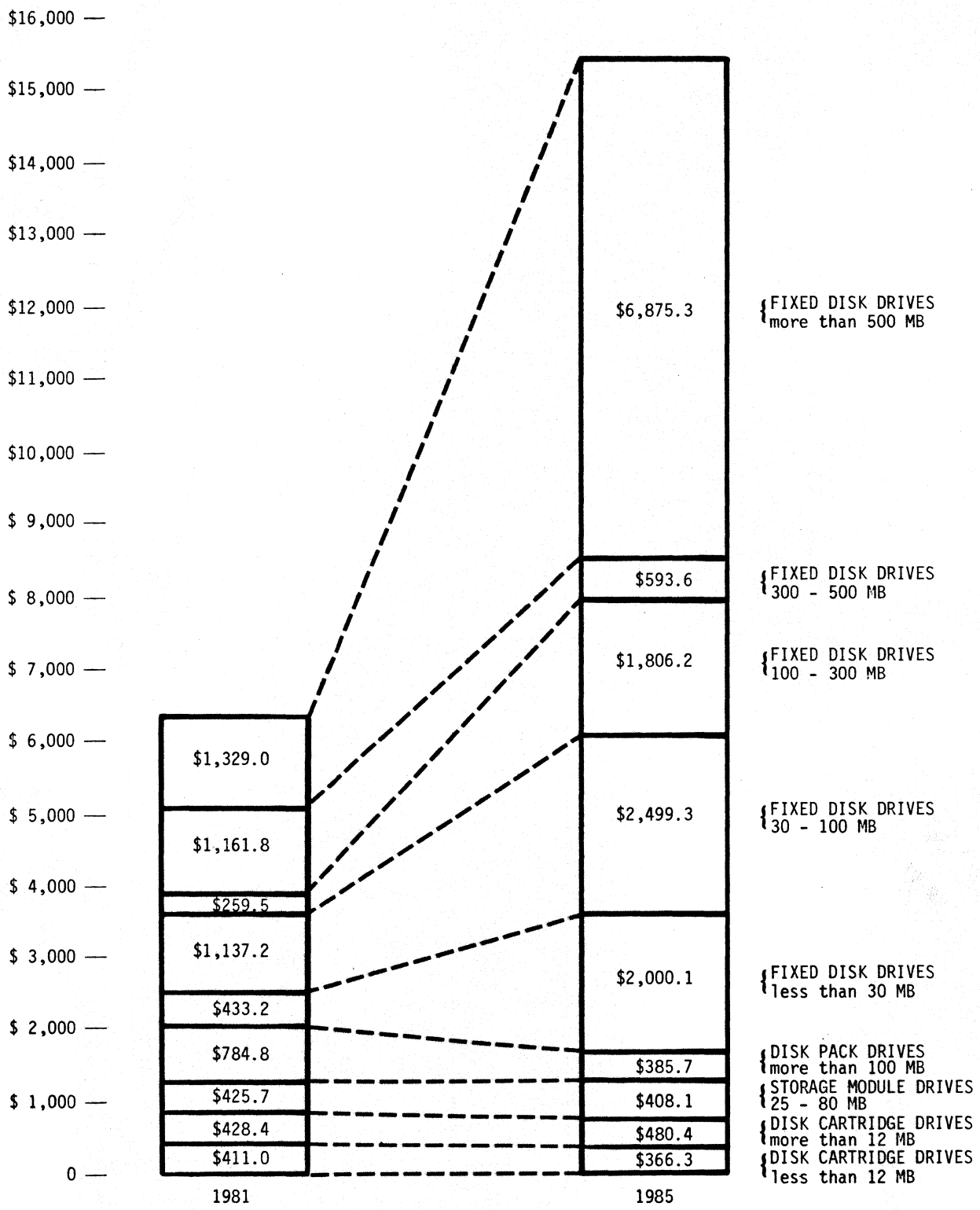
Fixed disk drives less than 30 MB will lead every other product group in unit shipments because of continuing spectacular growth for 5.25" Winchesters, and even though average prices will be low, 1985 revenues for the group are projected at $2,000,100,000 for 13% of the industry total.

However, fixed disk drives 30-100 MB are expected to generate even more revenue, with $2,499,300,000 in 1985, 16.2% of the industry total. This group will benefit from heavy IBM activity, plus major growth for other captive and OEM shipments, primarily in 8" and 5.25" drives.

Figure 1

CHANGING PRODUCT MIX

CONSOLIDATED WORLDWIDE DISK DRIVE SHIPMENTS



OEM market

In 1981 every DISK/TREND OEM removable disk drive product group generated higher revenues than every OEM fixed disk drive group. But the tide has turned in 1982, and for the first time OEM fixed disk drives in total will produce more revenue than OEM removable disk drives. By 1985 the balance in favor of fixed disk drive is expected to be 77.6%.

Although OEM removable disk drives are now producing mixed results, the long term outlook for disk cartridge drives and storage module drives is good, as new drives with small disk diameters replace older 14" disk versions. Disk pack drives more than 100 MB produced 23.0% of worldwide OEM revenues in 1981, more than any other group, but are forecasted at 3.5% of worldwide OEM revenues in 1985, making them the smallest group.

The largest fixed disk drive product group in OEM revenues during the last few years has been fixed disk drives less than 30 MB, on the strength of early growth for 8" Winchester drives, and more recently the boom in 5.25" Winchesters. 1982's worldwide shipments of OEM fixed disk drives less than 30 MB are estimated at a startling 356,900 units, or 57.3% of all OEM worldwide unit shipments. That quantity is forecasted to increase to 752,600 drives in 1985, but by that year this group will no longer be the leading revenue producer.

Manufacturers of OEM fixed disk drives 100-300 MB produced revenues of only $45,000,000 in 1981, but unit shipments of drives in this group doubled in 1982, and somewhat higher unit shipment growth rates are expected in 1983 and 1984. Worldwide OEM revenues for this group are forecasted at $603,000,000 for 1985, making it the largest OEM product group of all, with 21.5% of the total.

TABLE 3

CONSOLIDATED WORLDWIDE SHIPMENTS
PRODUCT CATEGORY REVIEW

REVENUE SUMMARY

WORLDWIDE REVENUES ALL MANUFACTURERS	1981 Shipments $M	1981 Shipments %	FORECAST 1982 $M	1982 %	1983 $M	1983 %	1984 $M	1984 %	1985 $M	1985 %
DISK CARTRIDGE DRIVES Less than 12 MB	411.0	6.5	268.0	3.4	268.5	2.6	310.6	2.4	366.3	2.4
DISK CARTRIDGE DRIVES More than 12 MB	428.4	6.7	362.3	4.6	361.5	3.5	402.4	3.1	480.4	3.1
STORAGE MODULE DRIVES 25-80 MB	425.7	6.7	336.5	4.2	299.9	2.9	357.0	2.7	408.1	2.6
DISK PACK DRIVES More than 100 MB	784.8	12.3	642.3	8.1	573.7	5.6	461.0	3.5	385.7	2.5
FIXED DISK DRIVES Less than 30 MB	433.2	6.8	764.9	9.7	1,155.6	11.2	1,680.7	12.8	2,000.1	13.0
FIXED DISK DRIVES 30-100 MB	1,137.2	17.9	1,495.8	18.9	1,918.6	18.6	2,335.7	17.8	2,499.3	16.2
FIXED DISK DRIVES 100-300 MB	259.5	4.1	358.5	4.5	689.0	6.7	1,236.4	9.4	1,806.2	11.7
FIXED DISK DRIVES 300-500 MB	1,161.8	18.2	1,166.3	14.7	801.9	7.8	534.7	4.1	593.6	3.9
FIXED DISK DRIVES More than 500 MB	1,329.0	20.9	2,530.7	31.9	4,232.1	41.1	5,803.5	44.2	6,875.3	44.6
Total Worldwide Revenue	6,370.6	100.0	7,925.3	100.0	10,300.8	100.0	13,122.0	100.0	15,415.0	100.0
% U.S. Mfg.	83.0	--	83.0	--	83.5	--	83.5	--	82.6	--
Annual Growth Rate	--	--	+24.4%	--	+30.0%	--	+27.4%	--	+17.5%	--

TABLE 4

OEM WORLDWIDE SHIPMENTS
PRODUCT CATEGORY REVIEW

REVENUE SUMMARY

	1981		FORECAST							
	Shipments		1982		1983		1984		1985	
WORLDWIDE REVENUES ALL MANUFACTURERS	$M	%	$M	%	$M	%	$M	%	$M	%
DISK CARTRIDGE DRIVES Less than 12 MB	156.1	14.1	86.4	5.9	114.5	5.9	143.6	6.0	162.3	5.8
DISK CARTRIDGE DRIVES More than 12 MB	169.2	15.2	174.0	11.8	174.4	8.9	171.8	7.1	191.4	6.8
STORAGE MODULE DRIVES 25-80 MB	188.6	17.0	148.2	10.1	132.8	6.8	149.4	6.2	176.0	6.3
DISK PACK DRIVES More than 100 MB	255.4	23.0	293.2	19.9	263.2	13.5	174.8	7.3	98.4	3.5
FIXED DISK DRIVES Less than 30 MB	171.2	15.4	332.9	22.6	438.7	22.5	471.6	19.6	471.0	16.8
FIXED DISK DRIVES 30-100 MB	75.3	6.8	216.5	14.7	336.2	17.2	432.9	18.0	461.2	16.5
FIXED DISK DRIVES 100-300 MB	45.0	4.1	87.5	5.9	224.6	11.5	427.1	17.8	603.0	21.5
FIXED DISK DRIVES 300-500 MB	13.0	1.2	29.9	2.0	68.9	3.5	119.8	5.0	193.5	6.9
FIXED DISK DRIVES More than 500 MB	37.1	3.3	103.5	7.0	197.3	10.1	311.8	13.0	446.5	15.9
Total Worldwide Revenue	1,110.9	100.0	1,472.1	100.0	1,950.6	100.0	2,402.8	100.0	2,803.3	100.0
% U.S. Mfg.	82.3	--	79.3	--	78.3	--	77.5	--	76.1	--
Annual Growth Rate	--	--	+32.5%	--	+32.5%	--	+23.2%	--	+16.7%	--

TABLE 5

OEM WORLDWIDE SHIPMENTS
PRODUCT CATEGORY REVIEW

UNIT SHIPMENT SUMMARY

WORLDWIDE UNIT SHIPMENTS ALL MANUFACTURERS	1981 Shipments Units	1981 Shipments %	FORECAST (000 UNITS) 1982 Units	1982 %	1983 Units	1983 %	1984 Units	1984 %	1985 Units	1985 %
DISK CARTRIDGE DRIVES Less than 12 MB	51.7	15.3	31.5	5.1	78.5	7.9	139.1	10.7	221.5	14.0
DISK CARTRIDGE DRIVES More than 12 MB	41.4	12.3	44.4	7.1	49.8	5.0	58.0	4.5	82.0	5.2
STORAGE MODULE DRIVES 25-80 MB	40.7	12.1	31.0	5.0	28.2	2.8	33.9	2.6	43.5	2.8
DISK PACK DRIVES More than 100 MB	28.1	8.3	33.5	5.4	30.4	3.1	20.3	1.6	11.5	.7
FIXED DISK DRIVES Less than 30 MB	133.3	39.5	356.9	57.3	576.0	57.9	695.5	53.5	752.6	47.7
FIXED DISK DRIVES 30-100 MB	27.7	8.2	94.1	15.1	153.4	15.4	194.4	15.0	219.6	13.9
FIXED DISK DRIVES 100-300 MB	10.4	3.1	20.4	3.3	52.7	5.3	114.8	8.8	181.3	11.5
FIXED DISK DRIVES 300-500 MB	1.2	.4	3.6	.6	10.5	1.1	20.8	1.6	37.4	2.4
FIXED DISK DRIVES More than 500 MB	2.6	.8	7.9	1.3	15.7	1.6	23.2	1.8	30.0	1.9
Total Worldwide Shipments	337.1	100.0	623.3	100.0	995.2	100.0	1,300.0	100.0	1,579.4	100.0
% U.S. Mfg.	82.3	--	79.3	--	78.3	--	77.5	--	76.1	--
Annual Growth Rate	--	--	+84.9%	--	+59.7%	--	+30.6%	--	+21.5%	--

TABLE 6

1981 ESTIMATED MARKET SHARES

WORLDWIDE SHIPMENTS OF ALL MOVING HEAD DISK DRIVES
(Value of non-U.S. currencies estimated at July, 1982, rates)

	CAPTIVE		PCM		OEM		TOTAL INDUSTRY	
	$M	%	$M	%	$M	%	$M	%
U.S. MANUFACTURERS								
Ampex	--	--	--	--	35.0	3.2	35.0	.6
Burroughs	181.7	3.8	--	--	1.4	.1	183.1	2.9
Century Data Systems	--	--	--	--	81.7	7.4	81.7	1.3
Control Data	456.2	9.7	67.0	12.6	568.5	51.2	1,091.7	17.2
Data General	123.4	2.6	--	--	--	--	123.4	1.9
Datapoint	27.5	.6	--	--	--	--	27.5	.4
Digital Equipment	308.1	6.5	--	--	--	--	308.1	4.9
Hewlett-Packard	198.7	4.2	--	--	--	--	198.7	3.1
IBM	2,232.2	47.2	--	--	--	--	2,232.2	35.0
International Memories	27.7	.6	--	--	25.6	2.3	53.3	.8
ISS/Univac	231.5	4.9	1.9	.4	8.2	.7	241.6	3.8
Memorex	--	--	124.7	23.4	62.5	5.6	187.2	2.9
Microdata	33.6	.7	--	--	--	--	33.6	.5
Seagate Technology	--	--	--	--	24.5	2.2	24.5	.4
Shugart Associates	24.4	.5	--	--	23.7	2.1	48.1	.8
Storage Technology	--	--	320.6	60.3	3.3	.3	323.9	5.1
Other U.S.	11.8	.3	--	--	79.8	7.2	91.6	1.4
U.S. Total	3,856.8	81.6	514.2	96.7	914.2	82.3	5,285.2	83.0
NON-U.S. MANUFACTURERS								
Cii-Honeywell Bull	19.6	.4	--	--	12.4	1.1	32.0	.5
Data Recording Equipment	--	--	--	--	28.3	2.5	28.3	.4
Fujitsu	256.2	5.4	--	--	47.7	4.3	303.9	4.8
Hitachi	93.7	2.0	--	--	42.3	3.8	136.0	2.1
Mitsubishi	61.9	1.3	--	--	7.8	.7	69.7	1.1
Nippon Electric Company	181.8	3.9	--	--	2.8	.3	184.6	2.9
Nixdorf	34.0	.7	--	--	--	--	34.0	.5
Siemens	119.6	2.5	--	--	--	--	119.6	1.9
Toshiba	75.0	1.6	--	--	7.4	.7	82.4	1.3
Other Non-U.S.	29.3	.6	17.6	3.3	48.0	4.3	94.9	1.5
Non-U.S. Total	871.1	18.4	17.6	3.3	196.7	17.7	1,085.4	17.0
Worldwide Total	4,727.9	100.0	531.8	100.0	1,110.9	100.0	6,370.6	100.0

NOTE: Drives sold in the PCM market by other than the original manufacturer are valued at PCM price levels above, to avoid distortion of total PCM market values.

Codes: 3 = 3"-3.9" C = Captive
5 = 5.25" P = PCM
8 = 8"-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	3	4	5	6	7	8	9
U.S. Manufacturers	Type	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 30-100 MB	Fixed Disk Drives 100-300 MB	Fixed Disk Drives 300-500 MB	Fixed Disk Drives >500 MB
Alpha Data	O							14		
Ampex*	O			14	14	5	8	14	14	
Applied Peripheral Systems	O							14	14	
Atasi	O					5	5			
Ball Computer	O			14	14					
Burroughs	C,O	14		14	14	14	14	14		
Century Data Systems	O		8	14	14	14	14	14	14	
Cipher	O	14	14							
Computer Memories	O					5	5			
Control Data	C,O,P	14	8,14	8,14	14	5,8,14	5,8,14	8,14	14	14
Data General	C	14	14	14	14	14				
Data Peripherals	O	8					8			
Datapoint	C	14	14			5				
Digital Equipment	C	14	14		14	14		14	14	
Disc Tech One	O						14	14	14	
Disk Memory Technology	O					9				
DMA Systems	O	5								
Evotek	O					5	5			
Hewlett-Packard	C		14	14	14	14	14		14	
Ibis	O,P									14
IBM	C					8	8		14	14
International Memories	C,O					5,8				
Irwin Olivetti	O					5				
ISS/Univac	C,O			14	14		14	14	14	14
Kennedy	O					8,14	14			
Megavault	O					8	8	8		
Memorex	C,O,P				14			14	14	14
Microdata	C							14		
Micropolis	O					5,8	5,8	8		
Miniscribe	O					5				
New World	O	5				5				
Northern Telecom	C					8,14				
Priam	O						5,8,14	8,14		
Quantum	O					8	8			
Rotating Memory Systems	O					5				
Seagate Technology	O	5				5				
Shugart Associates	C,O					5,8,14	8			
Storage Technology	O,P								14	14
Syquest	O	3				3				
Tandon	O					5	5			
Tecstor	O						14	14	14	
Texas Instruments	C,O					5,8	8			
3M	O					8	8			
Vermont Research	O	8	8,14							
Western Dynex	O	5,14								
Japanese Manufacturers										
Fujitsu	C,O		14		14	5,8,14	8,14	14	10,14	10,14
Hitachi	C,O				14	5,8,14	8	14	14	14
Hokushin	O	14	14			8				
Matsushita Com. Ind.	O					5,8	8			
Mitsubishi	C,O	14	14	14	14	5,8,14	8,14			
Nipponcoinco	O	5								
Nippon Electric Company	C,O				14	5,8,14	8,14	14	8,14	14
Nippon Electric Industry	O					5,8	8			
Nippon Peripherals	C,O,P					5	8	8,14	14	14
Otari	O					5				
TEAC	O					5				
Tokico	O					5				
Toshiba	C,O		14		14	8,14	8,14	8		
European Manufacturers										
BASF	O					5				
Cii-Honeywell Bull	C,O	10	10			5	10	10		
Data Recording Equipment	O	14	14							
Hightrack Computer Technik	O					8	8			
Isotimpex*	O	14			14					
Nixdorf	C			14						
Olivetti	C,O					5,8	8			
Olympia	C	5				5				
Pertec	C,O	14	14				8			
Rodime	O					5	5			
ROM Control Data*	O									
Siemens	C				14				14	

* Manufactures disk drives of 2314 type.

TECHNICAL REVIEW

Competing technologies

The rigid disk drive market continues to be an ever more attractive target for a variety of potential competitors, as it approaches $8 billion in worldwide revenues in 1982.

Two perennial candidates for serious penetration of the data storage market are showing promise: Magnetic bubbles and optical disks. Bubbles are now used in many harsh environment applications and are being designed into selected data processing systems, such as portable computers. Optical disks are approaching a new status as actual commercial products, as several manufacturers are close to product introductions. Both technologies will be discussed in more detail later in this section.

Other would-be alternates to magnetic rigid disk recording have found the competition tougher than expected. Magnetic disk technology is frequently described as a "moving target." And as the target moves it becomes continually more cost effective.

The history of magnetic disk recording is one of continually improving recording densities, and this advancement translates directly into lower cost for data storage. Higher density means fewer heads and disks for a given capacity, thus reduced physical size, smaller motors, less heat, lower power, etc. And as densities have been improved, continual development in head positioning techniques provided faster access to data.

Great competitive strength is now derived from the size of the worldwide magnetic disk drive industry, with scores of well established

manufacturers, and amazing diversity of products. System manufacturers, and the thousands of engineers making their data storage selection decisions, are familiar with the magnetic disk drive industry, know the system integration requirements for disk drives, and have well established opinions on the credibility of specific manufacturers, based on extensive actual experience. These factors provide a level of momentum for magnetic disk drives which will not be undercut by any potential alternative products soon, or without very good reason.

Rather than assume major displacement of mainstream existing data storage products by technological newcomers, it is more reasonable to expect those with outstanding strengths for specific applications to be successful in gradually developing selected niche markets. Today's leading candidates among the alternative data storage technologies are:

* Optical disk: After many years of costly development programs by a number of manufacturers in the United States, Europe and Japan, optical disks are gradually beginning to look like actual products. Although there are several planned application areas for optical disks, all hold out the promise of high capacity in a small, removable package, combined with moderately fast access and stable archival storage.

  The most important issue to be addressed in developing potential markets for optical disk subsystems is the matter of determining which markets can live with the nonreversible character of the products to be introduced during the next two years. The "ablative" recording methods of these units burns a pit in the disk's recording surface which cannot be restored to its original condition. The experimental techniques developed to date to modify these recording methods for reversibility 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. The only optical disk programs with apparent promise of success in achieving reversibility use magneto-optical techniques, actually a different recording technology, which will be discussed later in this section.

  However, there is probably a market of acceptable size for the non-reversible optical disks expected to reach the market first. Product introductions are being prepared for large capacity storage subsystems intended for use with mainframes, for smaller subsystems

to be used with mincomputers, workstation clusters and local area networks, and for optical disk memories to be used with document storage systems.

Storage Technology's optical disk program is probably the most ambitious program to date with the objective of developing the mainframe market. STC is covering part of the development cost with a limited research and development partnership formed in the fall of 1981, and funded with $40 million. STC intends to position its initial optical disk drives, with four gigabyte capacity, as complementary products to its existing magnetic disk and tape drives, using its existing 8880 controller. Applications envisioned are large on line data bases, back up for magnetic disk, and long term archival storage. First deliveries are planned by the end of 1983, and the product line is projected by STC to eventually become a larger revenue producer than all of its existing products.

Other programs underway by firms such as Control Data and Xerox are expected to result in mid-range products with more modest capacities and price tags. Both captive and OEM drives are expected to be introduced, with the general intention to provide bulk direct access data storage at cost/megabyte ratios lower than magnetic disk drives can provide. Applications involving infrequently revised historical data bases and magnetic disk back up are envisioned, but these products will be offering drastically different features from existing data storage subsystems -- and observers will be well advised to expect the unexpected, since system manufacturers and computer users can be quite inventive in finding uses for new tools.

Document storage systems, to be introduced by Burroughs, Toshiba and others, reduce system demands in one critical technical area, that of error rates. Data stored for machine-readable applications require excellent error rates, but data for human-readable applications can tolerate lower standards. The test for products in this area will be whether they can provide cost/image ratios comparable to those of the various microfilm formats. So far the microfilm industry still seems confident they can hold their markets, but the potential versatility and convenience of use for the "electronic file cabinet" systems hasn't yet had its trial.

The advocates of optical disk recording understandably forget sometimes to point out the major problems to commercialization of the technology. Foremost among optical disk technical problems is media -- its form, producibility, long-term stability and cost. The main technical problem involves finding a successful way to keep air away from the tellurium used in most optical disks, since tellurium degrades when exposed to the atmosphere. The systems expected to come to market will use a variety of disk surface structures, representing several different philosophies, and all subject to being proven reliable by real-world users. A joint technical development program by Philips and Control Data has been

established to provide a joint media standard for the two firms. A related problem is the very poor raw error rates experienced by most developmental optical disk systems. Most optical disk advocates take the position that media quality will be improved for actual production products and that error correction techniques can solve their problems even if better media doesn't.

The market for optical disks subsystems will be limited to the niches which can tolerate nonreversability, until that feature becomes practical. Until then, major impact on mainstream magnetic disk drive markets is considered unlikely. At this time the leading technology candidate for reversible optical disks seems to be variations on magneto-optical technology. Most magneto-optical development programs involve using a low powered laser to change the magnetic state of an amorphous gadolinium coating on a disk, by raising surface temperatures to the coating's Curie point. These changes are apparent during reading, as the Kerr effect creates a rotation in the polarized light reflected from the surface. Work underway in Europe, Japan and the United States has shown promising results, but it is apparently too early to be certain of the producibility of adequate media.

* Magnetic bubbles: Magnetic bubbles are alive and well, and being shipped regularly in actual products, despite a serious loss of credibility after the 1981 departure of National Semiconductor, Texas Instruments and Rockwell International from the field. The rate at which the market for magnetic bubbles has developed was clearly not acceptable for the drop-outs, which had plans for much more immediate returns on their investments.

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

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

The successful bubble program of Intel Magnetics has been instrumental in developing a wide variety of applications. Intel led the market with 1 Mbit chips, the introduction of support circuits and a guaranteed future price reduction policy. The company has attracted a variety of customers in specialized and

harsh environment applications -- at least sufficient to establish quantity production, and start down the learning curve. The hottest new market area for bubbles is potentially the largest one: Portable computers. Several of the new portable computer manufacturers have incorporated bubble memories as basic auxiliary memory devices, because of bubbles' advantages of physical size and durability while being transported.

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

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

* High capacity flexible disk drives: Ironically, the most likely type of product to displace certain rigid disk drives is the high capacity flexible disk drive. Some new floppy drives, and others to be announced, have the potential to do just that.

The market for very small computer systems is growing at a rapid rate, and shipments of small Winchester disk drives are keeping pace. However, this market is based on the demand for upgraded versions of small systems which previously used only floppy drives for auxiliary storage. Now that there is the promise of much larger capacity for floppies, there may be a real opportunity for floppies to capture a portion of the small Winchester market.

The 2 MB 5.25" floppies now starting to appear are only the beginning of the potential expansion of capabilities for floppies. Two other more significant rival technologies are waiting in the wings to boost floppy capacity.

Perpendicular recording for flexible disks has received considerable attention in the last year, and has the potential to increase capacity for a 5.25" drive to 5-10 MB without significant increases in track density. By using a sputtered thin film on a Mylar substrate, disks for perpendicular recording could achieve linear densities of at least 50,000 BPI. Vertimag, a Minneapolis firm, expects to announce such a drive for 1983 delivery. It is likely that the largest limitation to the development of markets for such a drive will be media availability. Any large scale success would require that media be produced by the millions of units, which would be difficult with today's batch sputtering processes. Anelva, a Japanese joint venture of Nippon Electric

Company and Varian Associates, has announced a continuous sputtering process designed to produce 5.25" floppy media, which may have the long term result of improving media producibility.

The other technology with real promise for improving floppy capacities involves use of very small magnetic particles, very little longer than they are wide. Use of such particles in coatings with conventional binder systems could result in "isotropic" magnetic recording, in which many more flux changes per inch could be obtained than with conventional recording. The big advantage for this technique may be producibility of the media, with little to change in existing floppies but the magnetic particles. Presumably, existing coating lines operated by the several major floppy media suppliers could be used. Currently, the Spin Physics subsidiary of Eastman Kodak is the principal advocate for this technology, and has provided media samples to manufacturers for evaluation.

Disk drive enhancements

As always, the industry freely adapts new disk recording technology developments by IBM to the specific requirements of new drives, whatever the physical size or density requirements. However, the industry is past the point of complete reliance on IBM for new recording technologies, as evidenced by independent development in several areas.

* Recording heads: Winchester heads patterned after IBM's 3340/3350 designs still dominate in new fixed media disk drives, except for PCM drives designed to compete against IBM's 3370, 3375 and 3380. The conventional ferrite heads are available from multiple sources, are routinely produced with good manufacturing yields, and are competitively priced. And they will continue to be used for most other captive and OEM drives until thin film heads are widely available and are price competitive with Winchester heads.

  The new PCM 3370, 3375 and 3380 equivalent drives may be expected to use thin film heads, however, despite limited current availability. Drive manufacturers have established either joint ventures or internal development programs for thin film heads, and are continuing to maintain close liaison with outside head manufacturers until availability becomes more routine.

* Recording disks: As IBM progressed through succeeding generations of disk drives, the disk media employed underwent only a refinement of the basic process of applying an oxide coating, to achieve a continually thinner application of a uniform coating, plus improvements in surface lubricants. The disks used in most Winchester drives today are derived from IBM's process improvements.

However, there is considerable activity in 1982 in plated disks, for the first time, with emphasis on 5.25" drives Things got started in 1981, with adoption of plated media by Irwin International, IMI, New World, Evotek and Texas Instruments, all for 5.25" fixed drives, and Ibis, for 14" drives. More recently, Seagate Technology has decided to use plated disks for its 5.25" disk cartridge drive, and SyQuest has announced an internal manufacturing program for plated disks to be used with its 3.9" fixed and removable disk drives. Ampex has supplied most of the plated disks used to date, except for the internal Ibis and Evotek programs. Ampex has recently licensed CCT, which plans to establish a new production facility for disks, and Tandon is preparing to produce plated disks for internal requirements. All of this activity has been generated not because of the higher density potential of plated disks (few of the above drives need more density than oxide disks offer), but because of plated disks' better physical durability.

* Head positioning methods: The industry is not moving forward rapidly with TPI improvements. Several of the highest performance drives operate at about 960 TPI, but such precision is too costly for most drives. The industry still has plenty of room for innovation in this area -- the majority of disk drives still operate below 500 TPI.

* Perpendicular recording: Today's disk drives all use longitudinal recording, making use of long, thin magnetic particles oriented parallel to the surface of the recording medium. Many more flux changes per inch could theoretically be resolved by recording heads if magneticization were oriented in a plane perpendicular to the recording surface. The potential appears to be at least 100,000 BPI.

  A very large amount of development activity in perpendicular recording is currently underway in Japan, with application objectives in video and audio recording, as well as for data storage. In the United States, IBM and other established manufacturers have development programs, but it appears that the earliest products may come from small firms. Lanx is preparing to supply sputtered small diameter disks to manufacturers of existing high performance small drives, with the objective of making significant increases in capacity possible for existing drive mechanisms at modest cost increases. Applied Information Memories has been organized to manufacture small diameter drives using perpendicular recording, and employing sputtered disks manufactured internally. Because of the current activity level, it is expected that drives using this technology may actually be shipped in 1983, with a fairly rapid development of the market if production bugs can be kept to a minimum.

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 of 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:

* Cartridge module drives sold by CDC to users of IBM Series/1 systems.

* On an arbitrary basis, drives manufactured by ISS or Nippon Peripherals 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 shipments: Shipments are classified U.S. or worldwide depending on the shipment destination of a drive's first public sale. Examples:

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

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

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

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

* Pertec is considered a non-U.S. manufacturer, since it is a subsidiary of Triumph Adler, a German firm.

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 1982 constant dollars.

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

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

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

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.

DISK CARTRIDGE DRIVES, LESS THAN 12 MB

1982 DISK/TREND REPORT

DISK CARTRIDGE DRIVES, LESS THAN 12 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

IBM	2310, 5444, 5022
Cipher Data Products	VT-2222, VF 2221
Control Data	9427H
Data General	6045, 6095
Datapoint	9360
Data Recording Equipment	4044B, D9427H
Digital Equipment	RK05J, RL01, RL02
Hokushin	CD-5200S
Isotimpex	SM 5400, ISOT 1370
Mitsubishi	M802
Pertec	D3321, D3442
Western Dynex	DD-6222

10.5" disk diameter

Cii-Honeywell Bull	D120

8" disk diameter

Data Peripherals	DP100
Vermont Research	8010

5.25" disk diameter

DMA Systems	Micro-magnum 5/5, 5
Memorex	410
New World Computer	Mikro-disc V 2/2, 4/2, 4/4
Olympia	Mikro-disc 2/2, 4/2, 4/4
Seagate Technology	ST 706
Western Dynex	WD505

3.9" disk diameter

SyQuest Technology	SQ-306R

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.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1981	1982	1983	1984	1985
U.S. manufacturers	336.1	214.3	206.1	239.5	278.3
All manufacturers	411.0	268.0	268.5	310.6	366.3

After continuous growth since the late 1960's, disk cartridge drives in this group finally started to decline in shipments during 1981. Worldwide unit shipments were down 7.5% in 1981 and are expected to drop by 34.4% in 1982, to 62,800 spindles. Worldwide revenues are forecasted to decline from $441.9 million in 1980 to $268 million in 1982.

The reduction in 1981 shipments of OEM drives was greater than expected, with the sharpest drop produced by 14" OEM drives shipped by U.S. manufacturers. Worldwide shipments of U.S. manufactured 14" OEM drives were down to 35,400 units in 1981, reflecting a severe decline in monthly shipping rates during the second half of 1981. DISK/TREND forecasts indicate an even sharper drop in 1982, to 12,000 drives, down 66%. Start-up of 8" OEM disk cartridge drive shipments in this group has been slower than expected, and may even be exceeded during 1982, at least in the U.S., by early shipments of 5.25" and smaller drives.

Control Data continued to dominate 1981 shipments of OEM drives, with 48.1% of the worldwide total, although the firm's shipments declined for the first year, to 24,900 units. In 1981 Century Data Systems shipped the last of the Diablo model drives, ending the shipment history of one of the pioneers in the OEM disk drive field. The only other remaining U.S. manufacturers of 14" OEM disk cartridge drives in this group are Western Dynex and Cipher.

Digital Equipment Corporation's production of RL01/RL02 drives continues to dominate captive shipments, with all other captive disk cartridge programs in this group now at minimal levels or already phased out. However, DEC's production is starting to decline, despite the most aggressive pricing offered for any captive disk cartridge drive. Worldwide shipments of all new captive drives is expected to decline from 51,600 units in 1981 to 38,700 units in 1982.

Marketing trends

Continued market acceptance of small fixed disk drives, combined with availability of newer small disk cartridge drives, will assure the end of the product life for 14" disk cartridge drives. It is expected that the last production year for OEM 14" disk cartridge drives will be 1984, with limited captive drive production lingering on until 1985.

Market penetration by 8" disk cartridge drives in this capacity range has been relatively slight to date, with only a few manufacturers in the field. With the passage of time, it now appears that various types of disk cartridge drives using 5.25" and smaller disks have the potential for a much larger future.

Although current shipments of 5.25" disk cartridge drives have been limited to date, DISK/TREND forecasts assume that a substantial available market in small business system applications will exist in 1983 and later years. The 5.25" disk cartrige product lines of DMA Systems, Seagate Technology and Western Dynex all appear have an assured market opportunity. And the plans of SyQuest Technology for a 3.9" disk cartridge drive are even more ambitious. So far, there are no announced plans by non-U.S.

firms for small disk cartridge drives in this capacity group, except for licensees of U.S. companies.

It is expected that continued explosive growth in very small business systems will turn around the current slump in total shipments of drives in this group, with 5.25" and smaller drives being the big winner. The DISK/TREND forecast for 1985 total worldwide shipments is 276,400 drives, 77% of which are expected to be 5.25" or smaller drives -- a striking recovery from 1982's overall total of 62,800 units.

Technical trends

Heads used with the new small disk cartridge drives are a variety of adaptations from older 3330 and 3350 designs, in some cases combined with smaller sliders. Disks include variations on existing Winchester media, with at least two manufacturers using plated disks, chosen primarily for physical durability.

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.

2. Shipments of 8" disk cartridge drives in this group will start to top out in 1984, due to competition from smaller drives.

3. The 5.25" disk cartridge drives announced to date will achieve normal production status by early 1983.

4. OEM price levels will decline, as shipments of smaller drives become predominant and quantities increase.

TABLE 8

DISK CARTRIDGE DRIVES, LESS THAN 12 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	141.8	232.8	102.3	168.8	83.4	138.9	87.5	141.8	103.5	165.0
TOTAL U.S. CAPTIVE	141.8	232.8	102.3	168.8	83.4	138.9	87.5	141.8	103.5	165.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	67.7	103.3	28.4	45.5	46.2	67.2	69.6	97.7	80.3	113.3
TOTAL U.S. NON-CAPTIVE	67.7	103.3	28.4	45.5	46.2	67.2	69.6	97.7	80.3	113.3
TOTAL U.S. SHIPMENTS	209.5	336.1	130.7	214.3	129.6	206.1	157.1	239.5	183.8	278.3
Non-U.S. Manufacturers										
Captive	6.2	22.1	.9	12.8	--	15.1	--	25.2	3.1	39.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	7.4	52.8	7.5	40.9	11.8	47.3	14.0	45.9	15.8	49.0
TOTAL NON-U.S. SHIPMENTS	13.6	74.9	8.4	53.7	11.8	62.4	14.0	71.1	18.9	88.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	223.1	411.0	139.1	268.0	141.4	268.5	171.1	310.6	202.7	366.3
OEM Average Price ($000)	2.9	3.0	2.5	2.7	1.3	1.5	1.0	1.0	.7	.7

TABLE 9

DISK CARTRIDGE DRIVES, LESS THAN 12 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	(5.2)	(7.6)	(5.0)	(7.4)	(4.8)	(7.1)	(4.6)	(6.9)	(4.4)	(6.5)
Other U.S. Captive	29.9	49.1	22.6	37.3	19.4	32.3	25.0	40.5	34.5	55.0
TOTAL U.S. CAPTIVE	24.7	41.5	17.6	29.9	14.6	25.2	20.4	33.6	30.1	48.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	23.6	36.0	11.8	18.9	38.5	56.0	77.3	108.5	125.4	177.0
TOTAL U.S. NON-CAPTIVE	23.6	36.0	11.8	18.9	38.5	56.0	77.3	108.5	125.4	177.0
TOTAL U.S. SHIPMENTS	48.3	77.5	29.4	48.8	53.1	81.2	97.7	142.1	155.5	225.5
Non-U.S. Manufacturers										
Captive	.7	2.5	.1	1.4	--	1.7	--	3.6	.5	6.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	2.2	15.7	2.3	12.6	5.6	22.5	9.3	30.6	14.4	44.5
TOTAL NON-U.S. SHIPMENTS	2.9	18.2	2.4	14.0	5.6	24.2	9.3	34.2	14.9	50.9
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	51.2	95.7	31.8	62.8	58.7	105.4	107.0	176.3	170.4	276.4
Installed at Year End										
IBM	36.6	54.4	31.6	47.0	26.8	39.9	22.2	33.0	17.8	26.5
Non-IBM	453.1	774.7	489.9	844.9	553.4	957.4	665.0	1,140.6	839.8	1,423.5
WORLDWIDE TOTAL	489.7	829.1	521.5	891.9	580.2	997.3	687.2	1,173.6	857.6	1,450.0

TABLE 10

DISK CARTRIDGE DRIVES, LESS THAN 12 MB

WORLDWIDE SHIPMENTS

BREAKDOWN BY DISK DIAMETER

	DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)													
	1981		Forecast											
	--Shipments--		1982			1983			1984			1985		
	14"	8"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"
U.S. Manufacturers														
IBM	(7.6)	--	(7.4)	--	--	(7.1)	--	--	(6.9)	--	--	(6.5)	--	--
Other U.S. Captive	49.1	--	37.3	--	--	24.3	8.0	--	14.5	19.0	7.0	4.0	36.0	15.0
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	35.4	.6	12.0	3.0	3.9	5.0	9.0	42.0	1.5	15.0	92.0	--	17.0	160.0
TOTAL U.S. SHIPMENTS	76.9	.6	41.9	3.0	3.9	22.2	17.0	42.0	9.1	34.0	99.0	(2.5)	53.0	175.0
Non-U.S. Manufacturers														
Captive	1.6	.9	.5	.9	--	.2	1.5	--	--	2.1	1.5	--	2.4	4.0
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	13.3	2.4	9.8	2.8	--	6.0	4.5	12.0	2.0	7.6	21.0	--	8.5	36.0
TOTAL NON-U.S. SHIPMENTS	14.9	3.3	10.3	3.7	--	6.2	6.0	12.0	2.0	9.7	22.5	--	10.9	40.0
TOTAL WORLDWIDE SHIPMENTS	91.8	3.9	52.2	6.7	3.9	28.4	23.0	54.0	11.1	43.7	121.5	(2.5)	63.9	215.0
ANNUAL SHARE, BY DIAMETER	96%	4%	83%	11%	6%	27%	22%	51%	6%	25%	69%	--	23%	77%

NOTE: In this table, 10.5" drives are grouped with 8" drives, and drives less than 5.25" in diameter are grouped with 5.25" drives.

TABLE 11

DISK CARTRIDGE DRIVES, LESS THAN 12 MEGABYTES

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

Distribution Channel	1981 U.S. Net Shipments Units (000)	%	FORECAST 1982 %	1983 %	1984 %	1985 %
Mainframe computer manufacturers	6.0	23.3	19.8	16.8	15.2	13.6
Mini/micro computer manufacturers	9.7	37.6	30.1	25.6	21.7	18.5
System OEMs/systems houses	8.4	32.6	43.1	49.7	54.7	58.9
Independent peripherals suppliers	1.2	4.6	5.3	6.4	7.0	7.7
Direct to end user/retail dealers	.5	1.9	1.7	1.5	1.4	1.3
TOTAL	25.8					

TABLE 12

DISK CARTRIDGE DRIVES, LESS THAN 12 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1981 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Control Data	16.4	63.6	24.9	48.1
Data Recording Equipment	--	--	7.7	14.9
Western Dynex	3.0	11.6	5.0	9.7
Century Data Systems	2.5	9.7	3.5	6.8
Other U.S.	1.7	6.6	2.6	5.0
Other Non-U.S.	2.2	8.5	8.0	15.5
TOTAL	25.8	100.0	51.7	100.0

DISK CARTRIDGE DRIVES, MORE THAN 12 MB

1982 DISK/TREND REPORT

DISK CARTRIDGE DRIVES, MORE THAN 12 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

Ampex	DFR-932, DFR-964, DFR-996
Cipher	VT-2422
Control Data	9448-32, 9448-64, 9448-96,
Data General	6070
Datapoint	9374
Data Recording Equipment	D9448-32, D9448-64, D9448-96
Digital Equipment	RK06, RK07
Fujitsu	M2201, F451
Hewlett-Packard	7906
Hokushin	CD-5200, CD-5400
Mitsubishi	M803
Pertec	D3461, D3482
Toshiba	MK-800R-32, 64, 96
Vermont Research	5017-4

10.5" disk diameter

Cii-Honeywell Bull	D140, D145

8" disk diameter

Century Data Systems	C 2048
Control Data	9454, 9455, 9457
Vermont Research	8520

This is a diverse group of drives, all of which use a removable disk cartridge, which is usually, but not always, combined with one or more fixed disk drives. There are three main types of drives in the group:

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, Cipher VT-2422, Mitsubishi M803).

14" 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 D140 (10 MB fixed/10MB removable on 10.5" disks), DEC's RK06 and RK07 (up to 27.5 MB in a special two-disk 14" removable cartridge), Vermont Research's 5017-4 (14" 26 MB fixed/26 MB removable, with embedded servo), plus the newer 8" disk cartridge drives: Control Data's Lark 9454/9455 (8 MB fixed/8 MB removable) and Lark 9457 (25 MB fixed/25 MB removable), both with embedded servo, Vermont Research's 8520 (9.7 MB fixed/9.7 MB removable, with embedded servo), and Century Data System's C 2048 (33.46 MB fixed/16.73 MB removable, with embedded servo).

The list of 8" disk cartridge drives offered by manufacturers has been unsettled during the last year. Memorex has withdrawn the 201 two years after its original announcement, and Cipher has decided not to introduce the 8" cartridge drive acquired with the rest of Perkin Elmer's memory products business. However, at least one additional 8" drive in this group is expected to be announced later this year.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1981	1982	1983	1984	1985
U.S. manufacturers	337.4	260.9	253.1	260.9	302.2
All manufacturers	428.4	362.3	361.5	402.4	480.4

In 1981, Control Data's large shipments of 9448 "Phoenix" cartridge module drives overshadowed other activity in this product group. Worldwide OEM shipments by Control Data totaled 33,800 drives in 1981, for 81.6% market share -- with the 9448 series constituting most of this total. However, 14" drives of this type are now topping out and 1982's worldwide total for OEM 14" drives is expected to be down a few thousand.

Despite the announcement of the original Lark 8" drive in 1980, shipments through 1981 remained nominal, due to a combination of problems: A relatively high price, technical problems which prevented a smooth

production startup, and a desire of many Control Data customers for more capacity in a drive of this type than the 8 MB fixed/8 MB removable offered. However, it now appears that reasonable shipments are underway in 1982, with the start of normal production for the original Lark and the first release of evaluation units for the 50 MB Lark.

Worldwide captive shipments of all drives in this group increased in 1981 to 23,500 units, up 13% from the previous year, but 1982 shipments are expected to decline to 16,900 drives, down 28%. All of this decline is being caused by lower production of older 14" drive formats, which are being displaced by small Winchester drives.

Marketing trends

The future for this product group belongs to the smaller diameter disk cartridge drives, with 14" captive and OEM drives expected to gradually decline in shipments through 1985.

1983 should see the first year of major growth for 8" drives, which are forecasted to become the dominant format, with worldwide shipments of 54,800 units in 1983, and 82,000 in 1984. 5.25" disk cartridge drives with capacities over 12 MB are expected by 1984, with forecasted shipments of 24,000 units in 1985, for 21% of the total in that year.

OEM manufacturers will provide the leadership in the transition to smaller disk diameters. OEM 8" drives are forecasted at 40,400 units worldwide in 1984, 73.7% of the total for all 8" drives, with the majority expected to be drives in the Control Data Lark family. It is also expected that early 5.25" disk cartridge drives in this group will also be OEM drives exclusively.

Technical trends

The basic recording technologies now in use for products in this group will continue to predominate for years. Most of the 14" drives use variations of SMD technology, itself a higher density variation to the older 3330 technology.

The 8" drives introduced to date incorporate elements of the older technologies, but utilize head designs similar to the Winchester heads in wide use on many fixed disk drives. All of the existing 8" drives use oxide coated disks, and all use embedded servo techniques in order to maximize the disk surface area available for recording.

The major difference in the potential for high density recording between disk cartridge drives and fixed disk drives, of course, is higher probability of particulate contamination in removable disk drives. At existing linear recording densities removability appears to be completely practical. But at densities well above 10,000 BPI, expected to be widely used in future fixed disk drives, heads will have to fly at lower altitutes, increasing the need to lower contamination even more. So it will be possible to increase density in removable disk drives even more, but the degree of engineering difficulty may be high. Changes in heads, filtration systems and seals may be necessary, and plated disks may be used because their surfaces seem to be more durable than oxide coated disks.

Forecasting assumptions

1. 8" 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" drives in 1984.

2. First shipments of 5.25" drives in this group will occur in 1983.

TABLE 13

DISK CARTRIDGE DRIVES, MORE THAN 12 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	118.7	192.3	78.3	128.4	73.7	118.3	77.4	121.5	83.9	134.8
TOTAL U.S. CAPTIVE	118.7	192.3	78.3	128.4	73.7	118.3	77.4	121.5	83.9	134.8
PCM	--	--	1.2	1.2	2.3	3.5	4.2	6.3	7.0	11.0
OEM	94.9	145.1	86.1	131.3	79.8	131.3	83.2	133.1	98.4	156.4
TOTAL U.S. NON-CAPTIVE	94.9	145.1	87.3	132.5	82.1	134.8	87.4	139.4	105.4	167.4
TOTAL U.S. SHIPMENTS	213.6	337.4	165.6	260.9	155.8	253.1	164.8	260.9	189.3	302.2
Non-U.S. Manufacturers										
Captive	7.7	66.9	5.1	58.7	7.3	65.3	15.9	102.8	20.5	143.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	10.4	24.1	14.0	42.7	15.8	43.1	17.9	38.7	17.5	35.0
TOTAL NON-U.S. SHIPMENTS	18.1	91.0	19.1	101.4	23.1	108.4	33.8	141.5	38.0	178.2
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	231.7	428.4	184.7	362.3	178.9	361.5	198.6	402.4	227.3	480.4
OEM Average Price ($000)	4.1	4.1	4.0	3.9	3.5	3.5	2.9	3.0	2.3	2.3

TABLE 14

DISK CARTRIDGE DRIVES, MORE THAN 12 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1981 Shipments		Forecast 1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	11.3	18.3	7.5	12.3	7.6	12.2	8.6	13.5	10.9	17.5
TOTAL U.S. CAPTIVE	11.3	18.3	7.5	12.3	7.6	12.2	8.6	13.5	10.9	17.5
PCM	--	--	.1	.1	.2	.3	.4	.6	.7	1.1
OEM	22.7	34.7	21.5	32.8	22.8	37.5	28.7	45.9	42.8	68.0
TOTAL U.S. NON-CAPTIVE	22.7	34.7	21.6	32.9	23.0	37.8	29.1	46.5	43.5	69.1
TOTAL U.S. SHIPMENTS	34.0	53.0	29.1	45.2	30.6	50.0	37.7	60.0	54.4	86.6
Non-U.S. Manufacturers										
Captive	.6	5.2	.4	4.6	.6	5.4	1.5	9.7	2.2	15.4
PCM	--	--	--	--	--	--	--	--	--	--
OEM	2.9	6.7	3.8	11.6	4.5	12.3	5.6	12.1	7.0	14.0
TOTAL NON-U.S. SHIPMENTS	3.5	11.9	4.2	16.2	5.1	17.7	7.1	21.8	9.2	29.4
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	37.5	64.9	33.3	61.4	35.7	67.7	44.8	81.8	63.6	116.0
Installed at Year End										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	97.1	170.5	130.4	231.9	166.1	299.6	210.9	381.4	274.5	497.4
WORLDWIDE TOTAL	97.1	170.5	130.4	231.9	166.1	299.6	210.9	381.4	274.5	497.4

TABLE 15

DISK CARTRIDGE DRIVES, MORE THAN 12 MB

WORLDWIDE SHIPMENTS

BREAKDOWN BY DISK DIAMETER

	DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)											
	1981		Forecast									
	Shipments		1982		1983		1984			1985		
	14"	8"	14"	8"	14"	8"	14"	8"	5.25"	14"	8"	5.25"
U.S. Manufacturers												
IBM	--	--	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	18.3	--	12.3	--	9.2	3.0	6.5	7.0	--	2.5	12.0	3.0
PCM	--	--	.1	--	.3	--	.5	.1	--	.6	.5	--
OEM	33.8	.9	27.6	5.2	19.5	18.0	9.5	32.4	4.0	4.0	47.0	17.0
TOTAL U.S. SHIPMENTS	52.1	.9	40.0	5.2	29.0	21.0	16.5	39.5	4.0	7.1	59.5	20.0
Non-U.S. Manufacturers												
Captive	4.2	1.0	3.5	1.1	3.0	2.4	2.4	7.3	--	1.4	13.0	1.0
PCM	--	--	--	--	--	--	--	--	--	--	--	--
OEM	4.0	2.7	7.6	4.0	6.5	5.8	4.1	8.0	--	1.5	9.5	3.0
TOTAL NON-U.S. SHIPMENTS	8.2	3.7	11.1	5.1	9.5	8.2	6.5	15.3	--	2.9	22.5	4.0
TOTAL WORLDWIDE SHIPMENTS	60.3	4.6	51.1	10.3	38.5	29.2	23.0	54.8	4.0	10.0	82.0	24.0
ANNUAL SHARE, BY DIAMETER	93%	7%	83%	17%	57%	43%	28%	67%	5%	8%	71%	21%

NOTE: In this table, 10.5" drives are grouped with 8" drives, and drives less than 5.25" in diameter are grouped with 5.25" drives.

TABLE 16

DISK CARTRIDGE DRIVES, MORE THAN 12 MEGABYTES

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

Distribution Channel	1981 U.S. Net Shipments Units (000)	%	FORECAST 1982 %	1983 %	1984 %	1985 %
Mainframe computer manufacturers	6.0	23.4	19.8	16.9	14.4	12.9
Mini/micro computer manufacturers	8.8	34.4	32.7	31.1	29.5	28.0
System OEMs/systems houses	9.8	38.3	43.0	46.8	50.2	52.6
Independent peripherals suppliers	1.0	3.9	4.5	5.2	5.9	6.5
Direct to end user/retail dealers	--	--	--	--	--	--
TOTAL	25.6					

TABLE 17

DISK CARTRIDGE DRIVES, MORE THAN 12 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1981 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Control Data	22.3	87.1	33.8	81.6
Cii-Honeywell Bull	1.4	5.5	2.7	6.5
Other U.S.	.4	1.5	.9	2.2
Other Non-U.S.	1.5	5.9	4.0	9.7
TOTAL	25.6	100.0	41.4	100.0

STORAGE MODULE DRIVES, 25-80 MB

1982 DISK/TREND REPORT

STORAGE MODULE DRIVES, 25-80 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

Ampex	DM-980
Ball	BD-50, BD-80
Burroughs	9484-5
Century Data Systems	T50, T80
Control Data	9760, 9762, 270-10
Data General	6067
Hewlett-Packard	7920
ISS/Univac	8419
Mitsubishi	M2850, M2851, M2853, M2854

9" disk diameter

Control Data	9710

In the years since its introduction in 1974, the Control Data "Storage Module Drive" became not only the leader in this segment of the industry, but a widely used industry interface standard. "SMD" also became the generally used term for this class of drives using five data surfaces, as well as the larger 19 data surface disk pack drives which use the SMD interface. The term SMD is used throughout the DISK/TREND Report as a generic description for these 14" Control Data drives and competitive equivalents. 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.

Control Data's new 9" "Removable Storage Drive", the RSD, or 9710, is functionally similar to the 80 MB SMD in every way except for smaller size and lower price. Its physical size is matched to the 160 MB "Fixed Storage Drive", or FSD, which was also introduced at the 1982 NCC.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1981	1982	1983	1984	1985
U.S. manufacturers	379.0	281.9	233.3	277.1	316.6
All manufacturers	425.7	336.5	299.9	357.0	408.1

Shipments in this product group have always been dominated by U.S. OEM drives, with Control Data's 80 MB SMD the major portion of those shipments. Control Data's worldwide shipment of non-captive drives totaled 30,900 in 1981, for 74.8% of the total -- but these shipments were only slightly ahead of 1980's 29,500 drives.

The 14" SMD is now declining from its 1981 worldwide peak for all OEM drives of 41,800 drives in 1980 and 40,700 drives in 1981, and 1982 shipments are estimated at only 31,000 units. While the 9" RSD is expected to replace the 14" SMD in time, only minimal shipments of evaluation units are likely before the end of 1982.

Worldwide captive shipments peaked during 1979/1980, and 1981 shipments were down to 16,800 spindles, with the level expected to drop further, to 12,800 units in 1982. The U.S. shipments are declining somewhat faster than these totals would indicate, since there is currently growth in non-U.S. shipments underway, due to the initiation of an internal manufacturing program by Nixdorf.

Marketing trends

Despite its landmark role in the development of OEM disk drives, the SMD will be surpassed by smaller diameter drives in worldwide OEM shipments by the end of 1984, according to DISK/TREND forecasts. Total worldwide shipments of all 14" OEM drives in 1985 is expected to decline

to 6,500 spindles. In that year, worldwide shipments of 8" (and 9") OEM drives are forecasted at 37,000 units. Shipments of 14" SMD OEM drives by non-U.S. companies have been minimal, and there is so far no sign of any serious plans by non-U.S. firms to compete with Control Data's RSD.

A major question is whether other manufacturers will develop their own versions of the Control Data RSD. So far nothing has been heard from Century Data Systems or Ampex, CDC's traditional competitors in the SMD field. These firms, as well as most of the rest of the industry, are now primarily active in product development for fixed disk drive products and may be reluctant to invest in another major disk drive program. Indeed, it is reasonable to expect that the future for a given removable disk pack drive will not approach that of a fixed disk drive of equivalent capacity and performance.

The decline of captive 14" drive shipments is expected to continue gradually, with 1985 probably to be the last year of production. No captive programs for small diameter disk drives in this group are expected in the near future, with the probable exception of Honeywell and Control Data, the parent companies of Magnetic Peripherals, Inc., the disk drive development and manufacturing firm managed by CDC.

Technical trends

Control Data has used a conservative approach in designing the RSD. Recording density is higher than the SMD, but well below the most advanced drives of today -- leaving adequate design margins for the double density version the firm has told its customers to expect later. Today's RSD is well designed to take advantage of the existing SMD customer base,

providing exactly the same capacity, performance, file organization and interface, but in half the space, at a significant price reduction. The drive is also one of the several new products on which the ISI intelligent interface is being made available.

The 160 MB versions of the 14" five surface SMD-type drives offered by Ampex and Ball are not included in this product group, but have been covered in the disk pack over 100 MB product group. In any event, Control Data chose not to offer a product of this type when it might have been appropriate a few years ago, and has apparently no reason to do so now, with the RSD announced, and higher capacity versions expected in future years.

Forecasting assumptions

1. Captive and OEM shipments of 14" drives in this group will continue to decline through 1985, displaced by smaller disk pack drives and a variety of fixed disk drives.

2. The RSD drives introduced in 1982 will dominate shipments by the end of 1984.

3. The changing product mix in OEM drives in favor of the RSD will cause average OEM prices to continually decline through 1985.

TABLE 19

STORAGE MODULE DRIVES, 25-80 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1981		Forecast							
	---Shipments--		-----1982-----		-----1983-----		-----1984-----		-----1985-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	6.9	14.2	4.7	9.7	4.1	7.3	6.5	10.5	9.1	14.0
TOTAL U.S. CAPTIVE	6.9	14.2	4.7	9.7	4.1	7.3	6.5	10.5	9.1	14.0
PCM	.5	.6	.6	.8	.7	.9	.8	1.1	.8	1.1
OEM	26.7	40.4	20.6	30.8	18.2	28.0	21.8	33.5	25.7	39.5
TOTAL U.S. NON-CAPTIVE	27.2	41.0	21.2	31.6	18.9	28.9	22.6	34.6	26.5	40.6
TOTAL U.S. SHIPMENTS	34.1	55.2	25.9	41.3	23.0	36.2	29.1	45.1	35.6	54.6
Non-U.S. Manufacturers										
Captive	--	2.6	--	3.1	--	3.8	--	4.9	.5	5.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	.3	--	.2	--	.2	--	.4	.5	4.0
TOTAL NON-U.S. SHIPMENTS	--	2.9	--	3.3	--	4.0	--	5.3	1.0	9.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	34.1	58.1	25.9	44.6	23.0	40.2	29.1	50.4	36.6	63.6
Installed at Year End										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	149.7	223.3	175.6	267.9	198.6	308.1	227.7	358.5	264.3	422.1
WORLDWIDE TOTAL	149.7	223.3	175.6	267.9	198.6	308.1	227.7	358.5	264.3	422.1

TABLE 20

STORAGE MODULE DRIVES, 25-80 MB

WORLDWIDE SHIPMENTS

BREAKDOWN BY DISK DIAMETER

	DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)							
	1981	Forecast						
	Shipments	1982	1983		1984		1985	
	14"	14"	14"	8"	14"	8"	14"	8"
U.S. Manufacturers								
IBM	--	--	--	--	--	--	--	--
Other U.S. Captive	14.2	9.7	6.3	1.0	3.5	7.0	1.0	13.0
PCM	.6	.8	.6	.3	.5	.6	.4	.7
OEM	40.4	30.8	24.5	3.5	16.0	17.5	6.5	33.0
TOTAL U.S. SHIPMENTS	55.2	41.3	31.4	4.8	20.0	25.1	7.9	46.7
Non-U.S. Manufacturers								
Captive	2.6	3.1	3.8	--	3.4	1.5	2.0	3.0
PCM	--	--	--	--	--	--	--	--
OEM	.3	.2	.2	--	.1	.3	--	4.0
TOTAL NON-U.S. SHIPMENTS	2.9	3.3	4.0	--	3.5	1.8	2.0	7.0
TOTAL WORLDWIDE SHIPMENTS	58.1	44.6	35.4	4.8	23.5	26.9	9.9	53.7
ANNUAL SHARE, BY DIAMETER	100%	100%	88%	12%	47%	53%	16%	84%

NOTE: 9" drives are grouped with 8" drives in this table.

TABLE 21

STORAGE MODULE DRIVES, 25-80 MEGABYTES

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

Distribution Channel	1981 U.S. Net Shipments Units (000)	%	FORECAST 1982 %	1983 %	1984 %	1985 %
Mainframe computer manufacturers	.2	.7	1.1	1.5	1.2	.9
Mini/micro computer manufacturers	12.4	45.6	43.3	41.2	39.1	37.1
System OEMs/systems houses	9.3	34.2	35.1	35.9	37.6	39.2
Independent peripherals suppliers	4.8	17.7	18.2	18.6	18.9	19.2
Direct to end user/retail dealers	.5	1.8	2.3	2.8	3.2	3.6
TOTAL	27.2					

TABLE 22

STORAGE MODULE DRIVES, 25-80 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1981 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Control Data	20.1	73.9	30.9	74.8
Century Data Systems	6.2	22.8	7.0	17.0
Other U.S.	.9	3.3	3.1	7.5
Other Non-U.S.	--	--	.3	.7
TOTAL	27.2	100.0	41.3	100.0

DISK PACK DRIVES, MORE THAN 100 MB

1982 DISK/TREND REPORT

DISK PACK DRIVES, MORE THAN 100 MEGABYTES

Coverage

Examples of disk drives in this group include:

IBM	3330-1, 3330-11
Ampex	DM-9160, DM-9300
Ball	BD-100, BD-160
Century Data Systems	T200, T300
Control Data	9764, 9766, 270-30
Data General	6060, 6061, 6122
Digital Equipment	RA60
Fujitsu	F479
Hewlett-Packard	7925, 7935H
Hitachi	H-8589-11, H-8593
Isotimpex	ES 5066, ES 5067
ISS/Univac	7330-11
Memorex	3675, 677
Mitsubishi	M2838, M2839
Nippon Electric Company	N277, N7745
Siemens	3455, 3465, 3468
Toshiba	DSU-450

IBM's introduction of the 3330, with 19 data surfaces, in 1971 set the model for the physical configuration now in predominant use, even though the initial IBM drive had only 100 MB capacity. The major product still in new production today is the Control Data 300 MB SMD.

The only new products in this group are the Digital Equipment RA60 (14" 205 MB using 6 data surfaces) and the Hewlett-Packard 7935H (14" 404 MB using 13 data surfaces). The RA60 is expected to become a major DEC product, replacing disk pack drives of various sizes previously purchased from Control Data and Memorex and resold.

Other disk pack drives with unique physical configurations in this group include: Ampex DM-9160 and Ball BD-160 (both with 160 MB on five surfaces), Hewlett-Packard 7925 (120 MB on nine surfaces), and Siemens 3465 (143 MB on nine surfaces).

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1981	1982	1983	1984	1985
U.S. manufacturers	639.1	559.8	515.3	432.6	375.5
All manufacturers	784.8	642.3	573.7	461.0	385.7

Production and shipment of large disk pack drives is now almost exclusively a United States and European affair, with the once extensive production by most Japanese manufacturers of high performance disk drives almost at an end.

Worldwide total production continues to decline from the 1980 peak. 1981 actual shipments of all new drives totaled 52,200 spindles, dropping almost 5%, to 49,700 spindles in 1982. During this period, however, OEM shipments were actually increasing, while captive shipments declined.

OEM worldwide shipments increased almost 20% in 1981, and the 1982 total is expected to grow another 19%, to 33,500 spindles in 1982. Almost all of this growth is coming from 300 MB drives shipped by U.S. manufacturers, led by Control Data. In 1981 CDC had worldwide shipments of OEM drives totaling 17,000 spindles, for a 60.5% share of the market.

Captive shipments of existing drives in this group are declining fast, however. The worldwide captive total went down 9% to 24,100 spindles in 1981, and 1982 is seeing an even sharper decline. The 1982 worldwide captive total is expected to be 16,200 spindles, down 33%, with reductions in every existing captive program except the new DEC RA60.

Marketing trends

As forecasted in last year's DISK/TREND Report, it is expected that the peak for OEM drives in this group will be 1982. The availability of

more cost effective rack mounted fixed disk drives from several manufacturers will displace the disk pack drives in this group on a gradual basis. 1985's shipments of OEM drives are expected to be only about one third of 1982's shipments.

Captive shipments of the older disk pack drives is now drying up rapidly, but total worldwide shipments are expected to increase because of DEC's introduction of the RA60 and Hewlett-Packard's introduction of the 1935H. DEC has been shipping very large quantities of disk pack drives on a resale basis, and the firm may be expected to push its own drive vigorously in the same markets.

Retirements of IBM and PCM drives will remain high for several years, as IBM and PCM shipments of new high capacity drives grows.

Technical trends

DEC's RA60 (779 TPI, 9668 net BPI) and the HP 7935H (625 TPI, 8320 net BPI) achieve higher effective areal densities than previous disk pack drives, partially through run length limited data encoding. The advance in actual recording densities is modest, however, and has been rivaled by the Ampex and Ball 160 MB SMD drives shipped during the last few years.

The drive which could potentially extend the life of this product group more than anything else would be one using smaller diameter disks. CDC has indicated to customers that this is a possibility, with a 160 MB version of its RSD planned for the future.

Forecasting assumptions

1. The population of IBM and PCM 3330 drives will continue to decline, due to displacement by newer systems and disk drives.

2. New captive drives will cause growth through 1985, but OEM drives will decline after 1982, displaced by large fixed disk drives.

TABLE 23

DISK PACK DRIVES, MORE THAN 100 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	210.9	390.3	128.6	275.0	132.0	262.5	142.8	270.2	154.7	287.3
TOTAL U.S. CAPTIVE	210.9	390.3	128.6	275.0	132.0	262.5	142.8	270.2	154.7	287.3
PCM	--	--	--	--	--	--	--	--	--	--
OEM	163.7	248.8	175.9	284.8	151.4	252.8	97.8	162.4	52.9	88.2
TOTAL U.S. NON-CAPTIVE	163.7	248.8	175.9	284.8	151.4	252.8	97.8	162.4	52.9	88.2
TOTAL U.S. SHIPMENTS	374.6	639.1	304.5	559.8	283.4	515.3	240.6	432.6	207.6	375.5
Non-U.S. Manufacturers										
Captive	--	139.1	--	74.1	--	48.0	--	16.0	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	6.6	--	8.4	--	10.4	--	12.4	--	10.2
TOTAL NON-U.S. SHIPMENTS	--	145.7	--	82.5	--	58.4	--	28.4	--	10.2
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	374.6	784.8	304.5	642.3	283.4	573.7	240.6	461.0	207.6	385.7
OEM Average Price ($000)	9.0	9.1	8.7	8.8	8.6	8.7	8.5	8.6	8.4	8.6

TABLE 24

DISK PACK DRIVES, MORE THAN 100 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	(3.8)	(6.9)	(4.1)	(7.5)	(4.7)	(8.5)	(5.0)	(9.0)	(4.8)	(8.7)
Other U.S. Captive	10.7	19.8	6.5	13.9	8.8	17.5	10.2	19.3	11.9	22.1
TOTAL U.S. CAPTIVE	6.9	12.9	2.4	6.4	4.1	9.0	5.2	10.3	7.1	13.4
PCM	(1.9)	(2.4)	(2.8)	(3.5)	(4.0)	(5.0)	(4.0)	(5.0)	(3.2)	(4.0)
OEM	18.1	27.5	20.2	32.7	17.6	29.4	11.5	19.1	6.3	10.5
TOTAL U.S. NON-CAPTIVE	16.2	25.1	17.4	29.2	13.6	24.4	7.5	14.1	3.1	6.5
TOTAL U.S. SHIPMENTS	23.1	38.0	19.8	35.6	17.7	33.4	12.7	24.4	10.2	19.9
Non-U.S. Manufacturers										
Captive	--	4.3	--	2.3	--	1.5	--	.5	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	.6	--	.8	--	1.0	--	1.2	--	1.0
TOTAL NON-U.S. SHIPMENTS	--	4.9	--	3.1	--	2.5	--	1.7	--	1.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	23.1	42.9	19.8	38.7	17.7	35.9	12.7	26.1	10.2	20.9
Installed at Year End										
IBM	33.5	55.4	29.4	47.9	24.7	39.4	19.7	30.4	14.9	21.7
Non-IBM	160.2	287.2	184.1	333.4	206.5	377.8	224.2	412.9	239.2	442.5
WORLDWIDE TOTAL	193.7	342.6	213.5	381.3	231.2	417.2	243.9	443.3	254.1	464.2

TABLE 25

DISK PACK DRIVES, MORE THAN 100 MEGABYTES

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

Distribution Channel	1981 U.S. Net Shipments Units (000)	1981 U.S. Net Shipments %	FORECAST 1982 %	1983 %	1984 %	1985 %
Mainframe computer manufacturers	.2	1.1	.5	--	--	--
Mini/micro computer manufacturers	13.1	72.4	68.8	65.3	61.4	58.4
System OEMs/systems houses	3.6	19.9	25.4	30.5	33.2	36.1
Independent peripherals suppliers	1.2	6.6	5.3	4.2	2.9	2.0
Direct to end user/retail dealers	--	--	--	--	2.5	3.5
TOTAL	18.1					

TABLE 26

DISK PACK DRIVES, MORE THAN 100 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1981 Net Shipments To United States Destinations Units (000)	To United States Destinations %	Worldwide Units (000)	Worldwide %
Control Data	9.0	49.7	17.0	60.5
Memorex	4.4	24.3	4.9	17.5
Ampex	2.2	12.2	2.7	9.6
Century Data Systems	2.2	12.2	2.5	8.9
Other U.S.	.3	1.6	.4	1.4
Other Non-U.S.	--	--	.6	2.1
TOTAL	18.1	100.0	28.1	100.0

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

FIXED DISK DRIVES, LESS THAN 30 MB

1982 DISK/TREND REPORT

FIXED DISK DRIVES, LESS THAN 30 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

IBM	4962, 5448
Burroughs	FD 211
Century Data Systems	M20
Control Data	230-10, 230-20
Data General	6098, 6100
Fujitsu	M2251, M2252
Hewlett-Packard	7910, 7911, 7912
Hitachi	MFD 135-4/8
Kennedy	5301-14
Mitsubishi	M2883-10, M2883-20
Nippon Electric Company	D-1240, N7721
Northern Telecom	4518, 4520
Shugart Associates	SA 4004, SA 4008
Toshiba	MK-100F

8" disk diameter

IBM	4963-29, 5247-011
Control Data	9410-8, 9410-24
Data Peripherals	DP400
Fujitsu	M2301, 2302
Hewlett-Packard	7908
Hightrack Computer Technik	HT 24
Hitachi	DK 801-1/2, DK 811-2
Hokushin	CD-8010
International Memories	7710, 7720
Kennedy	6172
Matsushita Communication Ind.	JA-900, JA-902
Megavault	MV20L, MV26
Micropolis	1202SA, 1222MII
Mitsubishi	M2860-1
Nippon Electric Company	D2220, N7724
Nippon Electric Industry	RD-8074, RD-8223
Northern Telecom	Aspen I, Aspen II
Olivetti	HD860/10
Quantum	Q2010, Q2020
Shugart Associates	SA 1002, SA 1004, SA 1104
Texas Instruments	WD 800-18
3M Company	8431, 8432
Toshiba	MK-80F-10/20

5.25" disk diameter

Ampex	Pyxis 7, 13, 20, 27
Atasi	3020
BASF	6182, 6183
Cii-Honeywell Bull	D505, D510
Computer Memories	CM 5206, CM 5212, CM5219
Control Data	9415-19
Datapoint	9301
Evotek	ET-5510, ET-5820
Fujitsu	M2231, M2232
Hitachi	DK 501-1, DK 501-2, DK 501-3
International Memories	5007, 5006, 5012, 5019
Irwin Olivetti	510, 416, 516
Matsushita Communication Ind.	SA-602, SA-604, SA-606
Micropolis	1302
Miniscribe	1006, 2012, 3010, 4020
Mitsubishi	M 4863-1, M 4863-2, M 4863-3
New World Computer	Mikro-disc V 2/0, 4/0
Nippon Electric Company	D5210
Nippon Electric Industry	RD-5033, RD-5133
Nippon Peripherals Ltd.	NP05-6, NP05-10
Olivetti	HD 512/1,HD 513K, HD 561
Olympia	Mikro-disc 2/0, 4/0
Rodime	RO 101, RO 201, RO 204
Rotating Memory Systems	RMS-507, RMS-525
Seagate Technology	ST 506, ST 406, ST 412, ST 419
Shugart Associates	SA 604, SA 606
Tandon	TM 602, TM 503
TEAC	SD 506, SD 412
Texas Instruments	525/62, 525/122
Tokico	DK 501-1/2/3

3.9" disk diameter

SyQuest Technology	SQ-306F

IBM introduced the earliest Winchester 14" and 8" drives in this group, the 14" Gulliver in 1975 and the 8" Piccolo in 1979. IBM also announced a new 15 MB linear voice coil 8" drive in 1982, as an upgrade for the previously floppy-only System 23 Datamaster small business system.

With the exception of a single 14" drive still using 2314 technology and the New World Computer drives using a special multiple head slider, all drives in this group use variations of IBM's 3340/3350 head technology. Most use oxide coated disks of the convential Winchester type,

but a growing number have adopted plated disks, including Hightrack Computer Technik, Evotek, International Memories, Irwin Olivetti, New World Computer, Olympia, SyQuest Technology, and Texas Instruments.

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:

Worldwide sales ($M)	1981	1982	1983	1984	1985
U.S. manufacturers	291.5	501.7	749.7	1,087.3	1,271.2
All manufacturers	433.2	764.9	1,155.6	1,680.7	2,000.1

The well-established trend to smaller diameter disks, combined with explosive growth in unit shipments, keynote this product group. 1981's 155.7% growth in total worldwide shipments, to 169,800 spindles, is almost being equalled in 1982, with an estimated 150.6% increase, to 425,500 spindles.

After peaking in 1979, total shipments of 14" drives in this group have continued to decline, despite the fact that a few individual manufacturers' shipments are actually still increasing in 1982. Worldwide 14" drive shipments in 1981 were 34,400 spindles, and the 19.8% drop in 1982 will result in an estimated 23,100 units this year.

The growth in 5.25" drives is unprecedented in the industry's history. Starting in 1980 with 1,200 drives worldwide, shipments rose to 51,500 in 1981 and are estimated at 269,000 for 1982. So far, most of

these shipments are OEM drives, and most have been used in desktop systems designed as upgrades to previously available floppy-only systems.

The continued growth in shipments of 8" drives less than 30 MB may surprise many in the industry who assumed that 5.25" drives would quickly destroy the 8" market. The 5.25" drives in this group surely will displace low-end 8" drives, but not quite yet. 8" drive shipments will reach an estimated worldwide total of 133,400 units in 1982, up 59% over 1981. OEM drives accounted for 70% of the worldwide total.

Seagate Technology was the leader in worldwide non-captive unit shipments of all disk drive diameters for 1981, with 35,000 drives (all 6.38 MB 5.25"), for 26.2% of the total. Shugart Associates held 23% of the worldwide total, with 30,700 drives (8" predominately, with some 14").

Although captive shipments of drives in this group have been overshadowed by the dynamic OEM market, the seeds have been planted for future captive manufacturing programs which are expected to become quite large. Numerous captive manufacturers have now acquired production experience with 14", 8" and 5.25" drives -- and this experience may be expected to result in a significant level of future 5.25" drive production.

Marketing trends

Although IBM's shipments of the small Piccolo drive in this product group(up to 29 MB on five data surfaces) have remained relatively modest compared to the large shipments for the basic 64 MB drive, the firm's new 15.4 MB single platter 8" drive will probably have a larger role in IBM's plans. This drive, along with a 30.8 MB two platter version, has so far been announced for use with only one IBM system, the System/23 Datamaster.

It is going to be widely used with the successful Datamaster system, and will probably show up in future IBM small system and terminal applications. DISK/TREND forecasts indicate a 1985 shipment level for IBM 8" drives of 36,000 units, compared to 10,200 for 1981.

It is too early to guess intelligently at the prospects for an internally developed IBM drive in the 5.25" range or smaller. It is believed that such a drive is inevitable. But such a drive is probably several years in the future. In the meantime, it appears that IBM will soon become a customer for one or more 5.25" OEM drives, in order to supply a Winchester disk upgrade for the very successful Personal Computer program, and for other requirements.

Overall, DISK/TREND forecasts for this product group envision that most 14" drives will be produced for the last time in 1984, that 1984 will also see 8" drives peaking in overall shipments, and that 5.25" and smaller drives will completely prevail for these capacities. The forecasted worldwide shipment total for 8" drives in 1985 is 160,000 units, compared to 1,009,000 for 5.25" drives.

While the 5.25" Winchester boom has been mostly an OEM drive phenomenon to date, more substantial captive programs are expected to appear by 1983. For 1985, the forecast is for 342,000 captive drive shipments worldwide, almost 34% of total shipments for this product group. This forecast assumes that several of the major U.S. and non-U.S. manufacturers of personal computers and desktop small business systems will initiate internal manufacturing programs for 5.25" low-end Winchester drives. If the expected internal programs fail to materialize, the worldwide total shipment level will probably not change significantly -- the manufacturers of OEM drives may be expected to rise to the opportunity.

Technical trends

The Seagate Technology announcement last year of an increased capacity version of their 5.25" drive using thin film heads was withdrawn due to availability and technical reasons. The increased capacity models have appeared from Seagate and their competitors, but using mostly manganese zinc ferrite heads. Thin film heads will be used, but when availability and price are competitive with conventional heads, since higher density recording is not immediately needed for 5.25" drives in this group.

In the meantime, plated disks are making inroads, because of apparently improved durability -- their potential for higher density is not needed now, and they are priced the same as oxide disks. Considerably increased plated disk production capacity will be available during 1983, further strengthening this trend.

The product innovation to watch will be 1/2 high 5.25" drives and drives using smaller diameter disks, such as the SyQuest 3.9" (100 mm) disk, and others to come. It's too early to be definitive, but smaller, cheaper drives like these could expand the market even further and provide an effective counterattack to high capacity floppies.

Forecasting assumptions

1. IBM's shipments in this group will increase for 8" drives, due to expanded system requirements.
2. Other captive programs, especially for 5.25" drives, will increase to significant levels, starting in 1983.
3. Growth in the desktop computer market will create very high growth for 5.25" drives, and a peak for 8" drives in 1984.
4. PCM drives will grow at a minimal rate, due to high selling costs and effective competition from IBM.

TABLE 27

FIXED DISK DRIVES, LESS THAN 30 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	65.5	95.2	74.4	104.0	115.5	159.6	122.6	168.6	112.7	170.1
Other U.S. Captive	74.5	84.2	153.1	165.1	246.5	281.4	484.2	592.5	620.8	785.6
TOTAL U.S. CAPTIVE	140.0	179.4	227.5	269.1	362.0	441.0	606.8	761.1	733.5	955.7
PCM	1.6	1.6	1.5	1.5	2.2	2.9	3.2	4.5	4.6	6.4
OEM	96.1	110.5	191.6	231.1	252.2	305.8	264.3	321.7	249.1	309.1
TOTAL U.S. NON-CAPTIVE	97.7	112.1	193.1	232.6	254.4	308.7	267.5	326.2	253.7	315.5
TOTAL U.S. SHIPMENTS	237.7	291.5	420.6	501.7	616.4	749.7	874.3	1,087.3	987.2	1,271.2
Non-U.S. Manufacturers										
Captive	8.1	81.0	17.9	161.4	51.4	273.0	106.1	443.5	164.2	567.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	18.0	60.7	19.2	101.8	27.2	132.9	33.7	149.9	39.3	161.9
TOTAL NON-U.S. SHIPMENTS	26.1	141.7	37.1	263.2	78.6	405.9	139.8	593.4	203.5	728.9
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	263.8	433.2	457.7	764.9	695.0	1,155.6	1,014.1	1,680.7	1,190.7	2,000.1
OEM Average Price ($000)	1.2	1.3	.9	.9	.7	.8	.7	.7	.6	.6

TABLE 28

FIXED DISK DRIVES, LESS THAN 30 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	7.7	11.2	9.3	13.0	15.2	21.0	16.8	23.1	16.1	24.3
Other U.S. Captive	11.6	13.1	25.5	27.5	46.5	53.1	112.6	137.8	194.0	245.5
TOTAL U.S. CAPTIVE	19.3	24.3	34.8	40.5	61.7	74.1	129.4	160.9	210.1	269.8
PCM	.2	.2	.2	.2	.3	.4	.5	.7	.8	1.1
OEM	84.9	97.6	221.6	267.2	355.2	430.7	411.1	500.3	415.2	515.2
TOTAL U.S. NON-CAPTIVE	85.1	97.8	221.8	267.4	355.5	431.1	411.6	501.0	416.0	516.3
TOTAL U.S. SHIPMENTS	104.4	122.1	256.6	307.9	417.2	505.2	541.0	661.9	626.1	786.1
Non-U.S. Manufacturers										
Captive	1.2	12.0	3.1	27.9	9.7	51.5	22.1	92.4	39.1	135.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	10.6	35.7	16.9	89.7	29.7	145.3	43.9	195.2	57.6	237.4
TOTAL NON-U.S. SHIPMENTS	11.8	47.7	20.0	117.6	39.4	196.8	66.0	287.6	96.7	372.4
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	116.2	169.8	276.6	425.5	456.6	702.0	607.0	949.5	722.8	1,158.5
Installed at Year End										
IBM	91.4	124.8	100.7	137.8	115.9	158.8	132.7	181.9	148.8	206.2
Non-IBM	182.8	277.9	450.1	690.4	891.5	1,371.4	1,481.7	2,297.8	2,188.4	3,432.0
WORLDWIDE TOTAL	274.2	402.7	550.8	828.2	1,007.4	1,530.2	1,614.4	2,479.7	2,337.2	3,638.2

TABLE 29

FIXED DISK DRIVES, LESS THAN 30 MB

WORLDWIDE SHIPMENTS

BREAKDOWN BY DISK DIAMETER

	DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)														
	1981 Shipments			Forecast 1982			1983			1984			1985		
	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"
U.S. Manufacturers															
IBM	1.0	10.2	--	(4.5)	17.5	--	(10.2)	31.2	--	(11.5)	34.6	--	(11.7)	36.0	--
Other U.S. Captive	5.8	6.2	1.1	7.6	14.2	5.7	6.8	20.0	26.3	4.2	25.0	108.6	--	24.5	221.0
PCM	.2	--	--	.2	--	--	.1	.3	--	--	.4	.3	--	.3	.8
OEM	12.8	38.5	46.3	6.5	66.9	193.8	3.2	70.5	357.0	--	65.8	434.5	--	51.0	464.2
TOTAL U.S. SHIPMENTS	19.8	54.9	47.4	9.8	98.6	199.5	(0.1)	122.0	383.3	(7.3)	125.8	543.4	(11.7)	111.8	686.0
Non-U.S. Manufacturers															
Captive	8.4	3.6	--	4.3	8.6	15.0	2.8	12.0	36.7	1.2	14.2	77.0	--	14.0	121.0
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	6.2	25.4	4.1	9.0	26.2	54.5	7.3	33.0	105.0	3.1	37.0	155.1	1.2	34.2	202.0
TOTAL NON-U.S. SHIPMENTS	14.6	29.0	4.1	13.3	34.8	69.5	10.1	45.0	141.7	4.3	51.2	232.1	1.2	48.2	323.0
TOTAL WORLDWIDE SHIPMENTS	34.4	83.9	51.5	23.1	133.4	269.0	10.0	167.0	525.0	(3.0)	177.0	775.5	(10.5)	160.0	1,009.0
ANNUAL SHARE, BY DIAMETER	20%	50%	30%	6%	31%	63%	1%	24%	75%	--	19%	81%	--	14%	86%

NOTE: Drives less than 5.25" in diameter are grouped with 5.25" drives in this table.

TABLE 30

FIXED DISK DRIVES, LESS THAN 30 MEGABYTES

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

Distribution Channel	1981 U.S. Net Shipments Units (000)	%	FORECAST 1982 %	1983 %	1984 %	1985 %
Mainframe computer manufacturers	2.5	2.6	2.9	7.3	8.5	9.4
Mini/micro computer manufacturers	2.0	2.1	4.1	6.4	7.5	8.6
System OEMs/systems houses	61.9	64.7	64.8	62.9	63.1	63.7
Independent peripherals suppliers	25.8	27.0	24.5	19.6	16.9	14.1
Direct to end user/retail dealers	3.5	3.6	3.7	3.8	4.0	4.2
TOTAL	95.7					

TABLE 31

FIXED DISK DRIVES, LESS THAN 30 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1981 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Seagate Technology	28.0	29.3	35.0	26.2
Shugart Associates	28.9	30.2	30.7	23.0
International Memories	12.2	12.7	14.1	10.6
Hitachi	--	--	14.0	10.5
Fujitsu	4.0	4.2	8.9	6.7
Hokushin	3.0	3.1	5.0	3.7
Century Data Systems	4.0	4.2	4.5	3.4
Other U.S.	12.0	12.5	13.5	10.1
Other Non-U.S.	3.6	3.8	7.8	5.8
TOTAL	95.7	100.0	133.5	100.0

FIXED DISK DRIVES, 30-100 MB

1982 DISK/TREND REPORT

FIXED DISK DRIVES, 30-100 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

Alpha Data	Atlas
Burroughs	FD 214
Century Data Systems	M40, M80
Control Data	9730-80, 230-30
Disc Tech One	3303, 3306
Fujitsu	M2253, M2280
ISS/Univac	8402-50/75
Kennedy	5303-42, 5303-70, 5380
Mitsubishi	M2883-40, M2883-60
Priam	3350, 6650
Tecstor	Sapphire 85
Toshiba	MK-300F

10.5" disk diameter

Cii-Honeywell Bull	D160/4,6

8" disk diameter

IBM	3310, 4963-64, 5247-012, 676, 680
Ampex	Scorpio 40, Scorpio 80
Control Data	9410-32, 9410-40
Fujitsu	M2303
Hightrack Computer Technik	HT 40, HT 80
Hitachi	DK 811-4, DK 811-8
International Memories	7740, 8740, 8757
Kennedy	7340, 7380, 7173
Matsushita Communication Ind.	JA-901, JA-903
Megavault	MV34L, MV52
Micropolis	1203ANSI, 1404SMD
Mitsubishi	M2860-2
Nippon Electric Company	D2230, N 7726
Nippon Electric Industry	RD-8371, RD-8520
Nippon Peripherals Ltd.	NP30-80
Olivetti	HD 860/20, HD 860/30
Pertec	D8035, D8067, D8084
Priam	3470, 7050
Quantum	Q2030, Q2040
Shugart Associates	SA 1106
Texas Instruments	WD 800-43
3M Company	8533
Toshiba	MK-80F-30, MK-182

5.25 disk diameter

Atasi	3033, 3046
Computer Memories	CM 5640
Control Data	9415-32
Evotek	ET-5840, ET-5540
Micropolis	1303, 1304
Rodime	RO 206, RO 208
Tandon	TM 703
Priam	502

Except as noted below, the drives in this group make use of IBM's 3350 Winchester head and disk technology, with a variety of enhancements in track and linear densities. Most use voice coil head positioning systems comparable to IBM's Piccolo (rotary) or new 30.8 MB 8" drive (linear), but a few use other techniques, such as stepping motors or torque motors.

The exceptions are the Alpha Data Atlas 14" with 8 heads per surface, in a unique configuration. That drive uses plated disks, as do the 8" Hightrack Computer Technik drives and the 5.25" Evotek drives.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1981	1982	1983	1984	1985
U.S. manufacturers	930.9	1,249.9	1,617.8	1,946.6	2,018.7
All manufacturers	1,137.2	1,495.8	1,918.6	2,335.7	2,499.3

Shipments of IBM's 64 MB Piccolo 8" drive dominate this product group, but that dominance is becoming less noticeable each year, as other captive and OEM drives grow rapidly. The Piccolo constituted an estimated 61.2% of worldwide shipments for this group in 1981, but that share is falling to 46.9% in 1982, even though Piccolo shipments rose to an estimated worldwide total of 107,500 spindles.

During 1982 most DISK/TREND market classes in this product category

are growing except non-U.S. captive drives -- but the major growth is being achieved by 8" OEM drives, led by U.S. manufacturers. U.S. 8" OEM shipments to worldwide destinations are estimated at 51,600 spindles for 1982, up from 8,800 drives in 1981.

1982's sharp increase in OEM 8" unit shipments is being led by several very successful disk drives: Quantum's 30 and 40 MB drives, Priam's 35 and 70 MB drives, Micropolis' 40 MB drives, and the high performance Fujitsu 48 and 84 MB drives.

In 1981, 27,900 non-captive drives were shipped worldwide, with no manufacturer the dominant leader. Priam held 22.6% of the worldwide total with 6,300 drives; Micropolis, 18.6% with 5,200 drives; Century Data Systems, 10.7% with 3,000 drives.

Compared to the current rapid growth for OEM drives, non-IBM captive drives are achieving only modest growth. 1981's worldwide other captive total was 20,800 drives, expected to climb in 1982 to 27,300 spindles. In 1982 the majority of these drives will be shipped by non-U.S. manufacturers, with 8" drives in the lead. During 1982, only two U.S. firms are expected to ship captive 8" drives, compared to five Japanese companies and one European company.

Marketing trends

This product group is expected to see a continual swing to drives with smaller disk diameters. 1982 probably will have been the peak production year for captive 14" drives, and 1983 is forecasted as the top year for OEM 14" drives. Even 8" drive shipments, now in a fast-growth stage, will be affected by high capacity 5.25" disk drives now being introduced. 1984 is forecasted as the peak production year for OEM 8"

drives, and 1985 the peak for captive 8" drives. The early 5.25" drive shipments expected in late 1982 are expected to reach a worldwide total of 164,000 units in 1985, providing more than a serious rival to the 305,200 8" drives forecasted for that year.

IBM's 8" drive shipments are currently forecasted to peak at 159,100 units in 1984, based on the assumption that the company will be placing greater emphasis on systems requiring disk drives above and below this capacity.

Technical trends

Increased density drives continue to be expected from IBM, which will fall in product categories for higher capacity drives. In the meantime, the 64 MB Piccolo looks like it has several more years of production.

The highest level of innovation in this product group will probably involve 5.25" drives, as manufacturers of OEM drives scramble for competitive functional and cost advantages. Programs to utilize half-size packaging, plated disks, sputtered disks, vertical recording and faster access are underway by numerous manufacturers. Flexibility in interface strategies and usage of the several intelligent drive standards will be common strategies.

Forecasting assumptions

1. IBM will continue to rely on the existing Piccolo drives for coverage of this product area.

2. 8" OEM drives will peak in 1984 and 8" captive drives will peak in 1985, as a result of displacement due to rapid growth of 5.25" OEM and captive drives.

TABLE 32

FIXED DISK DRIVES, 30-100 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	509.3	805.4	612.9	967.5	751.6	1,167.0	847.1	1,304.6	702.4	1,067.2
Other U.S. Captive	46.3	61.7	79.9	119.3	141.1	198.0	224.4	321.6	395.3	612.0
TOTAL U.S. CAPTIVE	555.6	867.1	692.8	1,086.8	892.7	1,365.0	1,071.5	1,626.2	1,097.7	1,679.2
PCM	1.8	1.8	1.9	2.8	3.7	4.6	4.3	6.0	4.8	6.4
OEM	49.2	62.0	135.6	160.3	198.7	248.2	244.2	314.4	248.4	333.1
TOTAL U.S. NON-CAPTIVE	51.0	63.8	137.5	163.1	202.4	252.8	248.5	320.4	253.2	339.5
TOTAL U.S. SHIPMENTS	606.6	930.9	830.3	1,249.9	1,095.1	1,617.8	1,320.0	1,946.6	1,350.9	2,018.7
Non-U.S. Manufacturers										
Captive	3.7	193.0	3.4	189.7	4.8	212.8	8.3	270.6	12.0	352.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	1.1	13.3	24.2	56.2	40.0	88.0	55.7	118.5	62.8	128.1
TOTAL NON-U.S. SHIPMENTS	4.8	206.3	27.6	245.9	44.8	300.8	64.0	389.1	74.8	480.6
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	611.4	1,137.2	857.9	1,495.8	1,139.9	1,918.6	1,384.0	2,335.7	1,425.7	2,499.3
OEM Average Price ($000)	2.7	2.7	2.3	2.3	2.2	2.2	2.2	2.2	2.1	2.1

TABLE 33

FIXED DISK DRIVES, 30-100 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	48.5	76.7	68.1	107.5	87.4	135.7	103.3	159.1	87.8	133.4
Other U.S. Captive	3.9	5.2	7.1	10.6	14.4	20.2	27.7	39.7	54.9	85.0
TOTAL U.S. CAPTIVE	52.4	81.9	75.2	118.1	101.8	155.9	131.0	198.8	142.7	218.4
PCM	.2	.2	.2	.3	.4	.5	.5	.7	.6	.8
OEM	18.1	22.8	61.5	72.7	94.6	118.2	111.0	142.9	118.3	158.6
TOTAL U.S. NON-CAPTIVE	18.3	23.0	61.7	73.0	95.0	118.7	111.5	143.6	118.9	159.4
TOTAL U.S. SHIPMENTS	70.7	104.9	136.9	191.1	196.8	274.6	242.5	342.4	261.6	377.8
Non-U.S. Manufacturers										
Captive	.3	15.6	.3	16.7	.5	22.4	1.0	32.6	1.6	47.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	.4	4.9	9.2	21.4	16.0	35.2	24.2	51.5	29.9	61.0
TOTAL NON-U.S. SHIPMENTS	.7	20.5	9.5	38.1	16.5	57.6	25.2	84.1	31.5	108.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	71.4	125.4	146.4	229.2	213.3	332.2	267.7	426.5	293.1	485.8
Installed at Year End										
IBM	94.7	146.5	162.8	254.0	250.2	389.7	353.5	548.8	441.3	682.2
Non-IBM	40.1	83.5	118.4	205.2	244.3	401.7	408.7	669.1	614.0	1,021.5
WORLDWIDE TOTAL	134.8	230.0	281.2	459.2	494.5	791.4	762.2	1,217.9	1,055.3	1,703.7

TABLE 35

FIXED DISK DRIVES, 30-100 MEGABYTES

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

Distribution Channel	1981 U.S. Net Shipments Units (000)	1981 U.S. Net Shipments %	FORECAST 1982 %	1983 %	1984 %	1985 %
Mainframe computer manufacturers	1.3	7.0	6.3	5.9	5.5	5.2
Mini/micro computer manufacturers	3.0	16.0	18.4	20.6	22.7	24.5
System OEMs/systems houses	13.8	73.8	71.9	69.8	67.6	65.7
Independent peripherals suppliers	.3	1.6	1.9	2.3	2.8	3.3
Direct to end user/retail dealers	.3	1.6	1.5	1.4	1.4	1.3
TOTAL	18.7					

TABLE 36

FIXED DISK DRIVES, 30-100 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1981 Net Shipments To United States Destinations Units (000)	To United States Destinations %	Worldwide Units (000)	Worldwide %
Priam	5.8	31.0	6.3	22.6
Micropolis	2.3	12.3	5.2	18.6
Century Data Systems	2.6	13.9	3.0	10.7
Other U.S.	7.6	40.7	8.5	30.5
Other Non-U.S.	.4	2.1	4.9	17.6
TOTAL	18.7	100.0	27.9	100.0

TABLE 34

FIXED DISK DRIVES, 30-100 MB

WORLDWIDE SHIPMENTS

BREAKDOWN BY DISK DIAMETER

	DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)													
	1981		Forecast											
	--Shipments--		1982			1983			1984			1985		
	14"	8"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"
U.S. Manufacturers														
IBM	--	76.7	--	107.5	--	--	135.7	--	--	159.1	--	--	133.4	--
Other U.S. Captive	5.0	.2	8.6	2.0	--	10.4	4.8	5.0	9.2	12.0	18.5	7.5	28.5	49.0
PCM	.2	--	.3	--	--	.4	.1	--	.4	.3	--	.4	.4	--
OEM	14.0	8.8	19.2	51.6	1.9	24.0	72.2	22.0	14.4	86.7	41.8	7.2	82.4	69.0
TOTAL U.S. SHIPMENTS	19.2	85.7	28.1	161.1	1.9	34.8	212.8	27.0	24.0	258.1	60.3	15.1	244.7	118.0
Non-U.S. Manufacturers														
Captive	12.3	3.3	8.1	8.6	--	6.0	15.4	1.0	3.1	22.0	7.5	1.5	27.5	18.0
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	.4	4.5	.4	21.0	--	.2	29.0	6.0	--	35.0	16.5	--	33.0	28.0
TOTAL NON-U.S. SHIPMENTS	12.7	7.8	8.5	29.6	--	6.2	44.4	7.0	3.1	57.0	24.0	1.5	60.5	46.0
TOTAL WORLDWIDE SHIPMENTS	31.9	93.5	36.6	190.7	1.9	41.0	257.2	34.0	27.1	315.1	84.3	16.6	305.2	164.0
ANNUAL SHARE, BY DIAMETER	25%	75%	16%	83%	1%	12%	78%	10%	6%	74%	20%	3%	63%	34%

NOTE: 10.5" drives are grouped with 8" drives in this table.

FIXED DISK DRIVES, 100-300 MB

1982 DISK/TREND REPORT

FIXED DISK DRIVES, 100-300 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

IBM	3344
Ampex	Capricorn 165
Applied Peripheral Systems	4830-1, 4835-1
Burroughs	9494-2, 9494-4
Century Data Systems	M160, AMS 190
Control Data	9730-160
Digital Equipment	RM80, RA80
Disc Tech One	4160
Fujitsu	M2284, F436
Hitachi	H-8594
ISS/Univac	717, 8402-100, 8417
Kennedy	53160
Memorex	3644
Microdata	Reflex II
Nippon Electric Company	N7728
Nippon Peripherals Ltd	NP24
Priam	15450
Tecstor	Sapphire 165, 200

10.5" disk diameter

Cii-Honeywell Bull	D160/8

9" disk diameter

Control Data	9715

8 disk diameter

Megavault	MVA116
Micropolis	1405ANSI, 1406SMD
Nippon Peripherals Ltd	NP30-120
Priam	804
Toshiba	MK184F

The pioneer disk drive in this group was the IBM 3344, which uses recording technology identical to the landmark 3350, but formatted to 280 MB in order to provide logical multiples of the 70 MB 3340. The 3344's last year of new production was 1981.

All other drives in this group also use basic head and disk technology based on the 3350, with modifications to enhance track and linear density in many cases, with two exceptions. Applied Peripheral Systems (previously known as Dastek) uses thin film heads of its own manufacture with its 14" drives, as does Cii-Honeywell Bull, with its 10.5" drives.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1981	1982	1983	1984	1985
U.S. manufacturers	202.0	288.1	563.6	990.2	1,422.3
All manufacturers	259.5	358.5	689.0	1,236.4	1,806.2

In 1981, captive manufacturing programs for 14" drives by Digital Equipment, Burroughs, ISS/Univac, Microdata and Fujitsu accounted for most of the 15,000 non-IBM captive drives shipped that year.

The non-captive worldwide total for 1981 was 10,600 drives. Control Data shipped 53.8% of that total with 5,700 spindles, and Fujitsu shipped most of the balance, with 4,600 spindles for 43.4% share.

Worldwide shipments of all drives in 1982 are expected to be up sharply, reaching 41,300 spindles for a 58.2% increase -- with 98% still 14" disk drives. U.S. manufacturers are generating most of the growth in both captive and OEM drives. DEC's RA80 and RM80 drives are causing most of the captive increase, and the OEM increase is attributed to Control Data's 9730-160, with an assist from several competitors.

Marketing trends

The history of this product group has largely been confined to 14" drives, but the future will not be. Several 8" drives already announced may be expected to ship in volume in 1983, including the Control Data Fixed Storage Disk (the "FSD", actually 9" disk diameter, but grouped with 8" drives in DISK/TREND statistics). The FSD, because of CDC's leadership in drives at this capacity range, is a foregone choice as a major product. And the first 5.25" drives with capacities over 100 MB are expected to also be in production before the end of 1983.

IBM has not yet announced an 8" drive in this capacity range, but it is definitely overdue. It's a good bet for use with the also long overdue System/36, and could be put to good use with the Series/1 minicomputer, the 5520 shared resource word processing and administrative system, and the smaller System/38s. It might even appear as the 3320, the unused number in IBM's disk drive model sequence for mainframe computers. The current DISK/TREND forecasts assume first shipments of such an 8" drive in 1983, growing to 35,600 spindles in 1985.

The worldwide shipment peak for captive 14" drives is expected in 1985, with the peak for OEM 14" drives occuring one year earlier, in 1984. By that time, 8" drives offering equivalent capacity and performance will be winning out for most of the new system requirements, with one exception. Digital Equipment, which often marches to the beat of its own drummer, will probably still be using 14" drives.

Also in 1984, 5.25" OEM drives will start to win a growing share of new systems, but probably in the range below 200 MB. By 1985, 5.25" worldwide total shipments are forecasted at 53,500 units, with the lead

held by 8" drives, at 149,800 spindles. The 1985 worldwide total for 14" drives is expected to be slightly below the previous year, with 78,700 spindles.

Technical trends

Because it combines requirements for small physical size and high performance, this product group is likely to be an early proving ground for new recording technologies with the potential to provide drastic increases in linear recording density.

When thin film heads become a commercial practicality as a result of efforts by IBM and the manufacturers of plug compatible drives, this product group will promptly see them in new drives. And efforts to introduce OEM 8" and 5.25" drives using vertical recording will probably involve pioneer products in this product group. The Control Data FSD will clearly be a leader in establishing widespread use of intelligent drives, and other intelligent interface standards will also be widely available with drives in this group.

Forecasting assumptions

1. IBM will start shipments of a new 8" drive in this group during 1983.
2. PCM shipments aimed at IBM's minicomputer market will start in 1984 but will remain small.
3. 8" drives will become the leading format in this group for most applications by 1985.
4. 5.25" drives will be successfully introduced in 1983, with growth to significant levels within two years.

TABLE 37

FIXED DISK DRIVES, 100-300 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1981 Shipments		Forecast							
			1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	4.7	7.9	--	--	50.0	75.0	148.8	233.8	265.0	435.0
Other U.S. Captive	107.7	164.8	142.7	220.8	198.9	305.0	271.3	416.5	346.2	532.5
TOTAL U.S. CAPTIVE	112.4	172.7	142.7	220.8	248.9	380.0	420.1	650.3	611.2	967.5
PCM	--	2.7	--	--	--	--	2.1	3.2	7.4	10.6
OEM	19.7	26.6	51.0	67.3	138.0	183.6	252.7	336.7	333.3	444.2
TOTAL U.S. NON-CAPTIVE	19.7	29.3	51.0	67.3	138.0	183.6	254.8	339.9	340.7	454.8
TOTAL U.S. SHIPMENTS	132.1	202.0	193.7	288.1	386.9	563.6	674.9	990.2	951.9	1,422.3
Non-U.S. Manufacturers										
Captive	1.7	39.1	1.6	50.2	4.4	84.4	6.6	155.8	6.1	225.1
PCM	--	--	--	--	--	--	--	--	--	--
OEM	12.8	18.4	14.3	20.2	23.0	41.0	36.9	90.4	56.4	158.8
TOTAL NON-U.S. SHIPMENTS	14.5	57.5	15.9	70.4	27.4	125.4	43.5	246.2	62.5	383.9
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	146.6	259.5	209.6	358.5	414.3	689.0	718.4	1,236.4	1,014.4	1,806.2
OEM Average Price ($000)	4.3	4.3	4.3	4.3	4.3	4.3	3.7	3.7	3.3	3.3

TABLE 38

FIXED DISK DRIVES, 100-300 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	.3	.5	--	--	4.0	6.0	11.9	18.7	21.2	34.8
Other U.S. Captive	8.3	12.7	11.5	17.8	16.3	25.0	22.8	35.0	30.1	46.3
TOTAL U.S. CAPTIVE	8.6	13.2	11.5	17.8	20.3	31.0	34.7	53.7	51.3	81.1
PCM	--	.2	--	--	--	--	.2	.3	.7	1.0
OEM	4.3	5.8	11.6	15.3	32.1	42.7	68.3	91.0	101.0	134.6
TOTAL U.S. NON-CAPTIVE	4.3	6.0	11.6	15.3	32.1	42.7	68.5	91.3	101.7	135.6
TOTAL U.S. SHIPMENTS	12.9	19.2	23.1	33.1	52.4	73.7	103.2	145.0	153.0	216.7
Non-U.S. Manufacturers										
Captive	.1	2.3	.1	3.1	.3	5.7	.5	11.8	.5	18.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	3.2	4.6	3.6	5.1	5.6	10.0	9.7	23.8	16.6	46.7
TOTAL NON-U.S. SHIPMENTS	3.3	6.9	3.7	8.2	5.9	15.7	10.2	35.6	17.1	65.3
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	16.2	26.1	26.8	41.3	58.3	89.4	113.4	180.6	170.1	282.0
Installed at Year End										
IBM	4.8	8.0	4.8	8.0	8.8	14.0	20.7	32.7	41.9	67.5
Non-IBM	21.8	37.2	48.6	78.5	102.9	161.9	204.4	323.8	353.3	571.0
WORLDWIDE TOTAL	26.6	45.2	53.4	86.5	111.7	175.9	225.1	356.5	395.2	638.5

TABLE 39

FIXED DISK DRIVES, 100-300 MB

WORLDWIDE SHIPMENTS

BREAKDOWN BY DISK DIAMETER

	DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)											
	1981	Forecast										
		1982		1983			1984			1985		
	Shipments 14"	14"	8"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"
U.S. Manufacturers												
IBM	.5	--	--	--	6.0	--	(.5)	19.2	--	(.8)	35.6	--
Other U.S. Captive	12.7	17.8	--	25.0	--	--	31.0	4.0	--	35.8	8.5	2.0
PCM	.2	--	--	--	--	--	(.2)	.5	--	(.2)	1.2	--
OEM	5.8	15.3	--	33.7	8.0	1.0	39.0	34.0	18.0	35.6	61.0	38.0
TOTAL U.S. SHIPMENTS	19.2	33.1	--	58.7	14.0	1.0	69.3	57.7	18.0	70.4	106.3	40.0
Non-U.S. Manufacturers												
Captive	2.3	2.6	.5	3.2	2.5	--	2.8	9.0	--	1.1	16.5	1.0
PCM	--	--	--	--	--	--	--	--	--	--	--	--
OEM	4.6	4.7	.4	6.5	3.5	--	7.8	12.0	4.0	7.2	27.0	12.5
TOTAL NON-U.S. SHIPMENTS	6.9	7.3	.9	9.7	6.0	--	10.6	21.0	4.0	8.3	43.5	13.5
TOTAL WORLDWIDE SHIPMENTS	26.1	40.4	.9	68.4	20.0	1.0	79.9	78.7	22.0	78.7	149.8	53.5
ANNUAL SHARE, BY DIAMETER	100%	98%	2%	77%	22%	1%	44%	44%	12%	28%	53%	19%

NOTE: 9" and 10.5" drives are grouped with 8" drives in this table.

TABLE 40

FIXED DISK DRIVES, 100-300 MEGABYTES

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

Distribution Channel	1981 U.S. Net Shipments Units (000)	1981 U.S. Net Shipments %	FORECAST 1982 %	1983 %	1984 %	1985 %
Mainframe computer manufacturers	1.2	16.0	15.7	15.5	15.2	4.9
Mini/micro computer manufacturers	2.7	36.0	38.8	42.0	44.9	47.2
System OEMs/systems houses	2.6	34.7	32.1	28.9	26.2	24.1
Independent peripherals suppliers	1.0	13.3	13.4	13.6	13.7	13.8
Direct to end user/retail dealers	--	--	--	--	--	--
TOTAL	7.5					

TABLE 41

FIXED DISK DRIVES, 100-300 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1981 Net Shipments To United States Destinations Units (000)	To United States Destinations %	Worldwide Units (000)	Worldwide %
Control Data	4.2	56.0	5.7	53.8
Fujitsu	3.2	42.7	4.6	43.4
Other U.S.	.1	1.3	.3	2.8
TOTAL	7.5	100.0	10.6	100.0

FIXED DISK DRIVES, 300-500 MB

1982 DISK/TREND REPORT

FIXED DISK DRIVES, 300-500 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

IBM	3350
Ampex	Capricorn 330
Applied Peripheral Systems	4830-2/3, 4835-2/3
Century Data Systems	AMS 380
Control Data	33801, 33501, 819-11
Digital Equipment	RA81
Disc Tech One	4300
Fujitsu	F493, M2294
Hewlett-Packard	7933H
Hitachi	DKU-95, H-8595
ISS/Univac	7350, 8450
Memorex	3650
Nippon Electric Company	N7751, D-1510
Nippon Peripherals Ltd	NP25
Siemens	3470
Storage Technology	8350, 8360
Tecstor	Sapphire 315, 330

10.5" disk diameter

Fujitsu	M2351, F6421

8" disk diameter

Nippon Electric Company	JS4380-N

IBM's 3350 is the classic product in this group, and several other drives in the group are patterned directly after the 3350 -- all 317 MB floor-standing drives intended for use with mainframes, including both PCM and other captive applications.

With two exceptions, all of the other drives employ 3350 recording technolory or refinements of it. Many of the newer 14" drives are smaller, rack mounted units designed for quieter operation, less power and lower costs -- with supermini applications in mind. Two drives use

modified recording technologies: Applied Peripheral Systems' 14" 4830 series and 4835 series (thin film heads with oxide disks), and Nippon Electric Company's JS4380-N (402 MB per spindle 8" drive using ferrite heads and plated disks, produced for Nippon Telephone and Telegraph).

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1981	1982	1983	1984	1985
U.S. manufacturers	972.2	874.4	492.2	307.1	409.2
All manufacturers	1,161.8	1,166.3	801.9	534.7	593.6

We are seeing the last of the high production levels for IBM 3350 and PCM equivalent drives during the 1981-82 period. After a difficult birth, IBM's 3380 is now well into its production growth ramp and is displacing more 3350's and competitive PCM drives each month, with assistance from the 3370 and 3375, IBM's other new-generation mainframe drives. PCM emphasis has switched to 635 MB versions of the 3350, and older 317 MB PCM drives in this product group are sinking fast. For an overall view of the disk drive market created by IBM's mainframes, see Table 48, page DT9-8.

In contrast, other new captive and OEM drives are positioned for excellent future growth. Drives introduced in 1982 by Digital Equipment, Hewlett-Packard and Fujitsu may be expected to generate substantial growth in captive shipments. And new rack mounted OEM drives from firms such as Ampex, Tecstor, Century Data Systems and Fujitsu are designed to provide a cost effective upgrade to Control Data's leading 160 MB Winchester drives.

In 1981, most of the non-captive shipments in this group were PCM drives: STC produced worldwide shipments of 9,800 spindles, for 60.1%. Memorex had 12.3% with 2,000 spindles, and CDC 9.2% with 1,500 spindles.

Marketing trends

1983 is expected to be the last production year for IBM 3350 and PCM 317 MB drives. Any future IBM product in the group would need a higher density, smaller, lower cost design, but no near term plans are known.

The new other captive and OEM drives mentioned above, plus others to come, will provide renewed growth for this group. Other captive drives are forecasted to reach 22,400 spindles in 1985, primarily to growth in U.S. shipments. OEM drives are expected to increase from very modest current levels to 37,400 spindles in 1985, as OEM drives in this group become essential to growth by supermini manufacturers without internal disk drive programs.

Technical trends

Just as the currently new OEM 14" rack mounted drives in the 300 MB range are extensions of drives in the 160 MB group, it is reasonable to expect higher capacity versions of 8" and 9" drives now appearing in the 100-200 MB range. No specific forecast has been included in this year's DISK/TREND Report for such drives, as product plans are not yet clear.

Meantime, expect to see widespread early use of thin film heads and disks, vertical recording, and intelligent interfaces in this group.

Forecasting assumptions

1. IBM will introduce no new drives in this group through 1985, and IBM/PCM 317 MB drive production will end in 1983.
2. Sustained growth for superminicomputers, large workstation clusters and small mainframes will create significant growth for both captive and OEM drives in this group.

TABLE 42

FIXED DISK DRIVES, 300-500 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1981		Forecast							
	---Shipments--		-----1982-----		-----1983-----		-----1984-----		-----1985-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	440.8	753.3	346.9	601.8	125.3	226.5	--	--	--	--
Other U.S. Captive	21.0	31.5	87.9	148.7	121.6	186.2	146.2	232.9	165.9	275.9
TOTAL U.S. CAPTIVE	461.8	784.8	434.8	750.5	246.9	412.7	146.2	232.9	165.9	275.9
PCM	127.7	187.4	78.3	116.3	28.3	42.9	--	--	--	--
OEM	--	--	6.9	7.6	27.7	36.6	53.5	74.2	93.1	133.3
TOTAL U.S. NON-CAPTIVE	127.7	187.4	85.2	123.9	56.0	79.5	53.5	74.2	93.1	133.3
TOTAL U.S. SHIPMENTS	589.5	972.2	520.0	874.4	302.9	492.2	199.7	307.1	259.0	409.2
Non-U.S. Manufacturers										
Captive	3.0	159.0	3.0	252.0	5.8	269.7	8.4	182.0	10.8	124.2
PCM	--	17.6	--	17.6	--	7.7	--	--	--	--
OEM	5.4	13.0	8.9	22.3	14.3	32.3	22.8	45.6	36.0	60.2
TOTAL NON-U.S. SHIPMENTS	8.4	189.6	11.9	291.9	20.1	309.7	31.2	227.6	46.8	184.4
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	597.9	1,161.8	531.9	1,166.3	323.0	801.9	230.9	534.7	305.8	593.6
OEM Average Price ($000)	10.8	10.8	7.9	8.3	6.4	6.6	5.7	5.8	5.1	5.2

TABLE 43

FIXED DISK DRIVES, 300-500 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	23.7	40.5	19.6	34.0	8.3	15.0	--	--	--	--
Other U.S. Captive	.6	.9	3.9	6.6	6.4	9.8	8.6	13.7	10.7	17.8
TOTAL U.S. CAPTIVE	24.3	41.4	23.5	40.6	14.7	24.8	8.6	13.7	10.7	17.8
PCM	9.2	13.5	6.4	9.5	2.5	3.8	--	--	--	--
OEM	--	--	1.0	1.1	4.7	6.2	10.1	14.0	19.0	27.2
TOTAL U.S. NON-CAPTIVE	9.2	13.5	7.4	10.6	7.2	10.0	10.1	14.0	19.0	27.2
TOTAL U.S. SHIPMENTS	33.5	54.9	30.9	51.2	21.9	34.8	18.7	27.7	29.7	45.0
Non-U.S. Manufacturers										
Captive	.1	5.3	.1	8.4	.2	9.3	.3	6.5	.4	4.6
PCM	--	1.6	--	1.6	--	.7	--	--	--	--
OEM	.5	1.2	1.0	2.5	1.9	4.3	3.4	6.8	6.1	10.2
TOTAL NON-U.S. SHIPMENTS	.6	8.1	1.1	12.5	2.1	14.3	3.7	13.3	6.5	14.8
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	34.1	63.0	32.0	63.7	24.0	49.1	22.4	41.0	36.2	59.8
Installed at Year End										
IBM	99.8	167.3	119.4	201.3	127.7	216.3	127.7	216.3	127.7	216.3
Non-IBM	43.0	79.6	55.4	109.3	71.1	143.4	93.5	184.4	129.7	244.2
WORLDWIDE TOTAL	142.8	246.9	174.8	310.6	198.8	359.7	221.2	400.7	257.4	460.5

TABLE 44

FIXED DISK DRIVES, 300-500 MEGABYTES

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

Distribution Channel	1981 U.S. Net Shipments Units (000)	%	FORECAST 1982 %	1983 %	1984 %	1985 %
Mainframe computer manufacturers	--	--	--	--	--	--
Mini/micro computer manufacturers	.1	1.0	12.0	39.0	37.1	34.1
System OEMs/systems houses	--	--	8.0	28.0	60.5	63.3
Independent peripherals suppliers	--	--	--	2.0	2.4	2.6
Direct to end user/retail dealers	9.6	99.0	80.0	31.0	--	--
TOTAL	9.7					

TABLE 45

FIXED DISK DRIVES, 300-500 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1981 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Storage Technology	6.9	71.1	9.8	60.1
Memorex	1.0	10.3	2.0	12.3
Control Data	1.1	11.3	1.5	9.2
Other U.S.	.2	2.1	.2	1.2
Other Non-U.S.	.5	5.2	2.8	17.2
TOTAL	9.7	100.0	16.3	100.0

NOTE: Includes drives sold in the PCM market by other than the original manufacturer.

FIXED DISK DRIVES, MORE THAN 500 MB

1982 DISK/TREND REPORT

FIXED DISK DRIVES, MORE THAN 500 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

IBM	3370, 3375, 3380
Control Data	9775, 885-42, 33800
Fujitsu	F496
Hitachi	DKU-97I, H-8597, H-8598
Ibis	1250, 2500, 5000, 5380
ISS/Univac	8470
Memorex	3652
Nippon Electric Company	D1550, N7761, N7755
Nippon Peripherals Ltd	NP37
Storage Technology	8650, 8775, 8370, 8380

10.5" disk diameter

Fujitsu	F6425

The newest drives in this group are IBM's 3370 (571 MB), 3375 (819 MB) and 3380 (1260 MB) -- plus various announced but so far undelivered PCM and other captive drives intended to be equivalent to IBM's new generation. Most of these drives, plus additional models to be announced by Memorex and Control Data, will follow IBM's example and use thin film heads with oxide coated disks. But Ibis's 14" drives will use composite ferrite heads with plated disks, and Fujitsu's 10.5" drive, with 630 MB per spindle, is planned for thin film heads with sputtered disks.

Also included in this group are a number of captive, PCM and OEM drives using double track density 3350 technology, providing capacities of 635 MB formatted or about 675 unformatted. All double density 3350 type drives are floor standing models.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1981	1982	1983	1984	1985
U.S. manufacturers	1,197.0	2,345.5	3,966.6	5,419.8	6,345.2
All manufacturers	1,329.0	2,530.7	4,232.1	5,803.5	6,875.3

The key fact in 1982 for those who manufacture (and those who buy) big disk drives is that the IBM 3380 is alive and well, and shipments are growing fast. Current DISK/TREND estimates now indicate worldwide 3380 shipments in 1982 of 11,000 spindles.

To fully appreciate the market impact of IBM's new disk drive generation, consider that the company will also ship an estimated 14,500 3370's and 9,000 3375's in 1982 -- for a grand total of 34,500 spindles of 3370, 3375 and 3380. All of this on top of 34,000 spindles of 3350. Total 1982 revenues for IBM (including leased drives on an if-sold basis) are forecasted at $1,369 million.

During 1982, manufacturers of PCM drives will not make significant shipments of any IBM compatible drives except 317 and 635 MB 3350 equivalent drives. The mix between these two types is more heavily weighted toward 635 MB drives in 1982 than previously expected. The 1982 estimated worldwide shipments for 635 MB PCM drives of 24,800 spindles are 69% of the 35,900 total 317/635 MB spindles for the year. In 1981, 635 MB drives were barely in the majority of all PCM shipments.

1981 market shares for non-captive drives, consisting mostly of PCM models, continue to show Storage Technology with a dominant lead. STC shipped 9,700 spindles for 53.3% of the worldwide total, while Memorex shipped 4,000 spindles for 22.0% and Control Data had shipments of 3,500 spindles for 19.2%.

While worldwide shipments of OEM drives were only 2,600 spindles in 1981, the total is expected to be 7,900 spindles in in 1982. Underlying the current growth are increasing shipments by Control Data, ISS/Univac and STC for supermini and other applications.

Other captive drives are also in a growth mode, from 12,100 spindles in 1981 to 18,500 spindles in 1982. Captive shipments by Control Data (for use with CDC's own mainframes, plus those of its disk drive partner, Honeywell), ISS/Univac, Fujitsu, Hitachi and Nippon Electric Company are all growing in 1982.

Marketing trends

As noted in Table 48, IBM's 3370, 3375 and (most importantly) 3380 shipments are due to get into high gear in 1983, with an estimated 63,000 spindles for the three models, in total. The forecast for the three drives in 1985 is 90,000 spindles. IBM's revenues for this product group are forecasted at a 1985 worldwide (if-sold basis) total of $3,285 million.

If the manufacturers of PCM drives manage to start-up their production of drives equivalent to IBM's new models in 1983 as forecasted, they should be able to head off annihilation by a narrow margin. The DISK/TREND estimate for 1985 worldwide shipments of PCM spindles is 60,000, worth $1,859.4 million. There is no room for slippage on this production ramp, since it is expected that all existing PCM drives will be out of production by 1984.

The outlook for OEM drives in this group is considered to be excellent, especially as OEM versions of the new thin film head high density drives are phased in during the next few years. The DISK/TREND

forecast for 1985 worldwide OEM drive shipments is 30,000 spindles, valued at $446.5 million.

Captive drive shipments are expected to increase at a slower rate, but should reach 34,400 spindles worldwide in 1985, with an estimated total value of $1,284.4 million.

Technical trends

It is considered unlikely that IBM will introduce any new recording technology for large disk drives in the next year or two. IBM may find it appropriate for systems market development purposes to introduce a fixed block architecture version of the 3380, but such a drive shouldn't involve any fundamental changes in recording technology.

During the next few years, innovation by other firms active in this group will probably not go beyond evolutionary changes such as the thin film disks used by Ibis and Fujitsu. It is likely that perpendicular recording will find use first on drives with capacities below those in this product group.

Forecasting assumptions

1. IBM will have no further significant technical problems with 3370, 3375 or 3380 drives which will limit production growth. No new IBM drives in this group through 1985, except possibly an FBA version of 3380.

2. PCM production of 3370, 3375 and 3380 will start in mid-1983, with rapid growth in 1984.

3. Moderate, but steady growth in other captive shipments.

4. Major growth in OEM drive shipments, tied to supermini market.

TABLE 46

FIXED DISK DRIVES, MORE THAN 500 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1981		Forecast							
	Shipments		1982		1983		1984		1985	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	263.2	570.4	766.0	1,369.3	1,518.4	2,620.8	1,862.4	3,191.6	1,865.2	3,285.0
Other U.S. Captive	189.4	282.5	302.4	452.0	404.6	605.2	486.5	714.0	568.8	824.4
TOTAL U.S. CAPTIVE	452.6	852.9	1,068.4	1,821.3	1,923.0	3,226.0	2,348.9	3,905.6	2,434.0	4,109.4
PCM	212.7	313.0	286.3	431.2	385.3	570.6	844.3	1,238.8	1,215.2	1,838.3
OEM	24.0	31.1	71.0	93.0	123.8	170.0	193.1	275.4	274.5	397.5
TOTAL U.S. NON-CAPTIVE	236.7	344.1	357.3	524.2	509.1	740.6	1,037.4	1,514.2	1,489.7	2,235.8
TOTAL U.S. SHIPMENTS	689.3	1,197.0	1,425.7	2,345.5	2,432.1	3,966.6	3,386.3	5,419.8	3,923.7	6,345.2
Non-U.S. Manufacturers										
Captive	--	126.0	--	171.5	--	225.7	3.9	331.5	8.0	460.0
PCM	--	--	--	3.2	--	12.5	--	15.8	--	21.1
OEM	--	6.0	--	10.5	15.6	27.3	20.8	36.4	26.6	49.0
TOTAL NON-U.S. SHIPMENTS	--	132.0	--	185.2	15.6	265.5	24.7	383.7	34.6	530.1
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	689.3	1,329.0	1,425.7	2,530.7	2,447.7	4,232.1	3,411.0	5,803.5	3,958.3	6,875.3
OEM Average Price ($000)	14.1	14.3	12.9	13.1	12.6	12.6	13.5	13.4	14.9	14.9

TABLE 47

FIXED DISK DRIVES, MORE THAN 500 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1981 Shipments		Forecast							
	1982		1983		1984		1985			
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	7.8	16.9	19.3	34.5	36.5	63.0	46.1	79.0	51.1	90.0
Other U.S. Captive	5.7	8.5	9.1	13.6	11.9	17.8	13.9	20.4	15.8	22.9
TOTAL U.S. CAPTIVE	13.5	25.4	28.4	48.1	48.4	80.8	60.0	99.4	66.9	112.9
PCM	10.6	15.6	16.4	24.7	15.6	23.1	25.9	38.0	39.2	59.3
OEM	1.7	2.2	5.5	7.2	9.9	13.6	14.3	20.4	18.3	26.5
TOTAL U.S. NON-CAPTIVE	12.3	17.8	21.9	31.9	25.5	36.7	40.2	58.4	57.5	85.8
TOTAL U.S. SHIPMENTS	25.8	43.2	50.3	80.0	73.9	117.5	100.2	157.8	124.4	198.7
Non-U.S. Manufacturers										
Captive	--	3.6	--	4.9	--	6.1	.1	8.5	.2	11.5
PCM	--	--	--	.1	--	.4	--	.5	--	.7
OEM	--	.4	--	.7	1.2	2.1	1.6	2.8	1.9	3.5
TOTAL NON-U.S. SHIPMENTS	--	4.0	--	5.7	1.2	8.6	1.7	11.8	2.1	15.7
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	25.8	47.2	50.3	85.7	75.1	126.1	101.9	169.6	126.5	214.4
Installed at Year End										
IBM	11.5	25.0	30.8	59.5	67.3	122.5	113.4	201.5	164.5	291.5
Non-IBM	27.5	45.7	58.5	96.9	97.1	160.0	152.9	250.6	228.3	375.0
WORLDWIDE TOTAL	39.0	70.7	89.3	156.4	164.4	282.5	266.3	452.1	392.8	666.5

TABLE 48

WORLDWIDE SHIPMENTS OF IBM AND PCM 14 INCH FIXED DISK DRIVES

PRODUCT MIX ANALYSIS

	DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1981		Forecast							
	---Shipments--		-----1982-----		-----1983-----		-----1984-----		-----1985-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
3344/3350 Type										
IBM 317/280 MB	24.0	41.0	19.6	34.0	8.3	15.0	--	--	--	--
PCM 317 MB	9.2	15.1	6.4	11.1	2.5	4.5	--	--	--	--
PCM 635 MB	10.6	15.6	16.4	24.8	9.4	14.0	2.7	4.0	--	--
TOTAL	43.8	71.7	42.4	69.9	20.2	33.5	2.7	4.0	--	--
3370 Type (571 MB)										
IBM	7.2	16.0	6.5	14.5	8.1	18.0	9.5	21.0	9.9	22.0
PCM	--	--	--	--	1.4	2.5	4.1	7.5	7.7	14.0
TOTAL	7.2	16.0	6.5	14.5	9.5	20.5	13.6	28.5	17.6	36.0
3375 Type (819 MB)										
IBM	.3	.5	5.0	9.0	9.4	17.0	9.9	18.0	11.0	20.0
PCM	--	--	--	--	2.0	3.0	6.5	10.0	9.8	15.0
TOTAL	.3	.5	5.0	9.0	11.4	20.0	16.4	28.0	20.8	35.0
3380 Type (1260 MB)										
IBM	.3	.4	7.8	11.0	19.0	28.0	26.7	40.0	30.2	48.0
PCM	--	--	--	--	2.8	4.0	12.6	17.0	21.7	31.0
TOTAL	.3	.4	7.8	11.0	21.8	32.0	39.3	57.0	51.9	79.0
TOTAL SPINDLES	51.6	88.6	61.7	104.4	62.9	106.0	72.0	117.5	90.3	150.0
TOTAL TERABYTES		37.7 +41%		59.6 +58%		83.5 +40%		113.6 +36%		148.8 +31%

TABLE 49

FIXED DISK DRIVES, MORE THAN 500 MEGABYTES

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

Distribution Channel	1981 U.S. Net Shipments Units (000)	%	FORECAST 1982 %	1983 %	1984 %	1985 %
Mainframe computer manufacturers	.6	4.9	5.5	6.1	6.2	6.2
Mini/micro computer manufacturers	.9	7.3	11.7	16.4	15.3	14.5
System OEMs/systems houses	.1	.8	6.7	17.7	15.0	11.8
Independent peripherals suppliers	.1	.8	1.2	1.4	1.5	1.5
Direct to end user/retail dealers	10.6	86.2	74.9	58.4	62.0	66.0
TOTAL	12.3					

TABLE 50

FIXED DISK DRIVES, MORE THAN 500 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1981 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Storage Technology	7.3	59.3	9.7	53.3
Memorex	2.0	16.3	4.0	22.0
Control Data	2.4	19.5	3.5	19.2
Other U.S.	.6	4.9	.6	3.3
Other Non-U.S.	--	--	.4	2.2
TOTAL	12.3	100.0	18.2	100.0

DISK DRIVE SPECIFICATIONS

1982 DISK/TREND REPORT

DISK DRIVE SPECIFICATIONS

Coverage

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

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

Generic type

Where applicable, 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, due to variations in head technology, media, recording formats and interfaces.

Technology type

IBM drive model numbers are also used as a general guide to type of heads and recording disks employed, using a broad interpretation of IBM specifications, since later drives frequently use higher track and linear densities. The term "Gulliver" is used to describe IBM's family of single disk fixed 14" disk drives using 3340 technology, and "Piccolo" identifies the 8530 BPI, 450 TPI technology used with IBM's original 210 mm drives.

Capacities

Capacities are listed as "U" for unformatted or "F" for formatted. In general unformatted capacities are shown for OEM drives, and formatted capacities for given for captive and PCM drives.

Interfaces

Specific interfaces available are indicated for most drives, using references to manufacturers' own unique interfaces or to defacto industry standards where applicable. However, this is a rapidly changing area for OEM drives, so please be alert to the need to check for manufacturers' latest information if you need precise data.

OEM prices

The 100 unit price is given for most OEM drives sold in the United States. These prices may be changed by manufacturers without notice, so please use them with the appropriate caution.

Accuracy

All information in this section 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 have been required.

1982 DISK/TREND product groups

DISK/TREND product groups have been revised for 1982:

REMOVABLE MEDIA:	1.	Disk cartridge drives, less than 12 MB
	2.	Disk cartridge drives, more than 12 MB
	3.	Storage module drives, 25-80 MB
	4.	Disk pack drives, more than 100 MB
FIXED MEDIA:	5.	Fixed disk drives, less than 30 MB
	6.	Fixed disk drives, 30-100 MB
	7.	Fixed disk drives, 100-300 MB
	8.	Fixed disk drives, 300-500 MB
	9.	Fixed disk drives, more than 500 MB

MANUFACTURER	ALPHA DATA	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE	Atlas	DM-440	DM-441	DM-442	DM-443
DISK/TREND GROUP	6	1	1	1	1
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	2315	2315	2315	2315
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Plated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Special	2314	2314	2314	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD, ANSI	Various Options	Various Options	Various Options	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 128.0	--	U: 3.125	--	U: 6.25
REMOVABLE	--	U: 3.125	U: 3.125	U: 6.25	U: 6.25
Capacity per track (Bytes)	U: 20,160	U: 7,812	U: 7,812	U: 7,812	U: 7,812
Data surfaces per spindle	6	2	4	2	4
Heads per data surface	8	1	1	1	1
Tracks per surface	*	200	200	400	400
TPI	*	100	100	200	200
BPI	*	2200	2200	2200	2200
RPM	3600	1500/2400	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)	18	35	35	35	35
Average rotational delay (msec)	8.3	20/12.5	20/12.5	20/12.5	20/12.5
Average access time (msec)	26.3	55/47.5	55/47.5	55/47.5	55/47.5
Data transfer rate (KByte/sec)	1209	195/312.5	195/312.5	195/312.5	195/312.5
FIRST CUSTOMER SHIPMENT	4Q82	1975	1975	1975	1975
U.S. OEM PRICE FOR 100 UNITS	$5,995	--	--	--	--
COMMENTS	*Not Announced	Mfg. by Western Dynex	Mfg. by Western Dynex	Mfg. by Western Dynex	Mfg. by Western Dynex

MANUFACTURER	AMPEX	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE	DM-445	DM-446	DM-447	DM-448 DM-548	DFR-932
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	Oxide Coated	Oxide Coated	Oxide Coated	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: 16.289
REMOVABLE	U: 3.125	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	2	4	1 Fixed 1 Removable
Heads per data surface	1	1	1	1	2 Fixed 1 Removable
Tracks per surface	200	200	400	400	823
TPI	100	100	200	200	367 Fixed 384 Removable
BPI	2200	2200	2200	2200	6274 Fixed 6038 Removable
RPM	1500/2400	1500/2400	1500/2400	1500/2400	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Fix: Rotary VC Rem: Linear VC
Average positioning time (msec)	35	35	35	35	30
Average rotational delay (msec)	20/12.5	20/12.5	20/12.5	20/12.5	8.3
Average access time (msec)	55/47.5	55/47.5	55/47.5	55/47.5	38.3
Data transfer rate (KByte/sec)	195/312.5	195/312.5	195/312.5	195/312.5	1209
FIRST CUSTOMER SHIPMENT	1975	1975	1975	1975	4Q79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	$4,525
COMMENTS	Mfg. by Western Dynex	Mfg. by Western Dynex	Mfg. by Western Dynex	Mfg. by Western Dynex	Mfg. by Toshiba

MANUFACTURER		AMPEX	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE		DFR-964	DFR-996	DM-980	DM-9160	DM-9300
DISK/TREND GROUP		2	2	3	4	4
MARKET		OEM	OEM	OEM	OEM	OEM
MEDIA:	Manufacturer's number	CDC 91204	CDC 91204	--	--	--
	Generic type	CMD	CMD	SMD	SMD	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	3336-11
	Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
	Interface	SMD	SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE						
Total capacity (MBytes)	FIXED	U: 48.868	U: 81.446	--	--	--
	REMOVABLE	U: 16.289	U: 16.289	U: 82.8	U: 165.8	U: 312
Capacity per track (Bytes)		U: 20,160	U: 20,160	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle		3 Fixed 1 Removable	5 Fixed 1 Removable	5	5	19
Heads per data surface		2 Fixed 1 Removable	2 Fixed 1 Removable	1	1	1
Tracks per surface		823	823	823	1645	815
TPI		367 Fixed 384 Removable	367 Fixed 384 Removable	384	768	370
BPI		6274 Fixed 6038 Removable	6274 Fixed 6038 Removable	6038	6038	6038
RPM		3600	3600	3600	3600	3600
Actuator type		Fix: Rotary VC Rem: Linear VC	Fix: Rotary VC Rem: Linear VC	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)		30	30	30	28	28
Average rotational delay (msec)		8.3	8.3	8.3	8.3	8.3
Average access time (msec)		38.3	38.3	38.3	36.3	36.3
Data transfer rate (KByte/sec)		1209	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT		4Q79	4Q79	1/76	1980	5/76
U.S. OEM PRICE FOR 100 UNITS		$5,145	$5,700	$5,605	$6,605	$9,870
COMMENTS		Mfg. by Toshiba	Mfg. by Toshiba			

MANUFACTURER	AMPEX	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE	Scorpio 48	Scorpio 80	PTD-930X Parallel Transfer Drive	Capricorn 165 Capricorn 165E	Capricorn 330
DISK/TREND GROUP	6	6	4	7	8
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	3336-11	Fixed	Fixed
Nominal disk diameter	200 mm OD	200 mm OD	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	3330-11	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	Special	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 49.7	U: 82.9	--	U: 165.9	U: 330.3
REMOVABLE	--	--	U: 312.177	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	3	5	19	5	8
Heads per data surface	1	1	1	2	2
Tracks per surface	823	823	815	1646	2048
TPI	826	826	384	960	960
BPI	6736 FRPI 10104 BPI	6736 FRPI 10104 BPI	6038	5950	6250
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)	32	32	28	30	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	40.3	40.3	36.3	38.3	38.3
Data transfer rate (KByte/sec)	1209	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT	6/82	6/82	11/78	3Q81	3Q81
U.S. OEM PRICE FOR 100 UNITS	$3,050	$3,350	$55,000	$5,200	$7,400
COMMENTS			Up to 9 track parallel data transfer	165E emulates DM-9160	

MANUFACTURER	AMPEX	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE	DM-9300A	PYXIS 7	PYXIS 13	PYXIS 20	PYXIS 27
DISK/TREND GROUP	4	5	5	5	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	CDC 9883-91	--	--	--	--
Generic type	3336-11	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	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 Caoted	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3336-11	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 6.67	U: 13.33	U: 20	U: 26.67
REMOVABLE	U: 315	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 10,417	U: 10,417	U: 10,417	U: 10,417
Data surfaces per spindle	19	2	4	6	8
Heads per data surface	1	1	1	1	1
Tracks per surface	823	320	320	320	320
TPI	384	360	360	360	360
BPI	6038	8720	8720	8720	8720
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	28	90 (including settling)	90 (including settling)	90 (including settling)	90 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	36.3	98.3	98.3	98.3	98.3
Data transfer rate (KByte/sec)	1209	625	625	625	625
FIRST CUSTOMER SHIPMENT	3Q80	5/82	5/82	5/82	5/82
U.S. OEM PRICE FOR 100 UNITS	$9,870	$695	$895	$1,090	$1,290
COMMENTS		Manufactured under Rodime license	Manufactured under Rodime license	Manufactured under Rodime license	Manufactured under Rodime license

MANUFACTURER	APPLIED PERIPHERAL SYSTEMS	APPLIED PERIPHERAL SYSTEMS	APPLIED PERIPHERAL SYSTEMS	APPLIED PERIPHERAL SYSTEMS	APPLIED PERIPHERAL SYSTEMS
DRIVE	4830-1	4830-2	4830-3	4835-1	4835-2
DISK/TREND GROUP	7	8	8	7	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"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3370	3370	3370	3370	3370
Heads	Thin Film	Thin Film	Thin Film	Thin Film	Thin Film
Interface	SMD	SMD	SMD	Modified SMD	Modified SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 202.2	U: 337.1	U: 404.5	U: 202.2	U: 337.1
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 40,960	U: 40,960	U: 40,960	U: 40,960	U: 40,960
Data surfaces per spindle	3	5	6	3	5
Heads per data surface	2	2	2	2	2
Tracks per surface	1646	1646	1646	1646	1646
TPI	694	694	694	694	694
BPI	12877* BPI	12877* BPI	12877* BPI	12877* BPI	12877* BPI
RPM	1785	1785	1785	2964	2964
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	25	25	25	25	25
Average rotational delay (msec)	16.8	16.8	16.8	10.1	10.1
Average access time (msec)	41.8	41.8	41.8	35.1	35.1
Data transfer rate (KByte/sec)	1200	1200	1200	2000	2000
FIRST CUSTOMER SHIPMENT	3/82	3/82	3/82	8/82	8/82
U.S. OEM PRICE FOR 100 UNITS	$7,600	$8,500	$9,000	$7,600	$8,500
COMMENTS	*RLL Code	*RLL Code	*RLL Code	*RLL Code	*RLL Code

MANUFACTURER	APPLIED PERIPHERAL SYSTEMS	ATASI	ATASI	ATASI	BALL COMPUTER PRODUCTS
DRIVE	4835-3	3020	3033	3046	BD-50
DISK/TREND GROUP	8	5	6	6	3
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	SMD
Nominal disk diameter	14"	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3370	Modified 3350	Moddified 3350	Modified 3350	3330-11
Heads	Thin Film	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Modified SMD	ST 506	ST 506	ST 506	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 404.5	U: 19.84	U: 33.07	U: 46.3	--
REMOVABLE	--	--	--	--	U: 54.7
Capacity per track (Bytes)	U: 40,960	U: 10,416	U: 10,416	U: 10,416	U: 13,440
Data surfaces per spindle	6	3	5	7	5
Heads per data surface	2	1	1	1	1
Tracks per surface	1646	635	635	635	815
TPI	694	800	800	800	370/384
BPI	12877* BPI	8780	8780	8780	4040
RPM	2964	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	33 (including settling)	33 (including settling)	33 (including settling)	30
Average rotational delay (msec)	10.1	8.3	8.3	8.3	8.3
Average access time (msec)	35.1	41.3	41.3	41.3	38.3
Data transfer rate (KByte/sec)	2000	625	625	625	806
FIRST CUSTOMER SHIPMENT	8/82	9/82	9/82	1Q83	8/76
U.S. OEM PRICE FOR 100 UNITS	$9,000	$1,920	$2,300	--	$4,795
COMMENTS	*RLL Code				

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	3	4	4	--	--
MARKET	OEM	OEM	OEM	PCM	PCM
MEDIA: Manufacturer's number	--	--	--	1370	1370
Generic type	SMD	SMD	SMD	3348 Data Module	3348 Data Module
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	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

MANUFACTURER	BASF	BASF	BASF	BASF	BASF
DRIVE	6182	6183	6410 6411	6244	6250 6252 6253
DISK/TREND GROUP	5	5	6	7	8
MARKET	OEM	OEM	PCM	PCM	PCM
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	210 mm OD 100 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Piccolo	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	IBM	IBM	IBM
CAPACITY/PERFORMANCE				1.004 MB Fixed Head Option	1.44 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 6.38	U: 9.57	F: 64.5	F: 279.558	F: 317.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	F: 16,384	F: 16,736	F: 19,069
Data surfaces per spindle	4	6	11	15	15
Heads per data surface	1	1	1	2	2
Tracks per surface	153	153	360	1114	1110
TPI	254	254	465	480	480
BPI	7690	7690	8530	5636	6425
RPM	3600	3600	3125	2964	3600
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	115 (including settling)	115 (including settling)	27	20	20
Average rotational delay (msec)	8.3	8.3	9.6	10.1	8.3
Average access time (msec)	123.3	123.3	36.6	30.1	28.3
Data transfer rate (KByte/sec)	625	625	1031	885	1198
FIRST CUSTOMER SHIPMENT	1Q82	1Q82	4Q80	1978	1978
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			PCM 3310 Mfg. by Nippon Peripherals	PCM 3344 Mfg. by Nippon Peripherals	PCM 3350 Mfg. by Nippon Peripherals

MANUFACTURER	BURROUGHS	BURROUGHS	BURROUGHS	BURROUGHS	BURROUGHS
DRIVE	9480-22	9484-5	9383-16 9383-17 9383-18 9484-8	9493-9	9493-18
DISK/TREND GROUP	1	3	4	5	5
MARKET	End User	End User	End User	End User	End User
MEDIA: Manufacturer's number	9985	9974-5	9974-4	--	--
Generic type	2315	Trident	2316	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	3330-11	3330-11	3330-1	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Burroughs	Burroughs	Burroughs	Burroughs	Burroughs
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	F: 9.4	F: 18.8
REMOVABLE	F: 4.68	F: 65.2	F: 174.4	--	--
Capacity per track (Bytes)	F: 11,520	F: 16,200	F: 10,800	F: 11,520	F: 11,520
Data surfaces per spindle	2	5	20	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	203	815	808	400	400
TPI	100	370	400	200	200
BPI	4400	6039	4400	4000	4000
RPM	1500	3672	2400	1500	1500
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	60	25	30	35	35
Average rotational delay (msec)	20	8.3	12.5	20	20
Average access time (msec)	80	33.3	42.5	55	55
Data transfer rate (KByte/sec)	193	1210	625	348	348
FIRST CUSTOMER SHIPMENT	1973	1977	1976	1/77	1/77
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			Embedded Servo		

MANUFACTURER	BURROUGHS	BURROUGHS	BURROUGHS	BURROUGHS	BURROUGHS
DRIVE	9493-28	9493-37	FD 211	FD 214	9494-2
DISK/TREND GROUP	5	5	5	6	7
MARKET	End User	End User	OEM, Captive	OEM, Captive	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	3330-1	3340	3340	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Burroughs	Burroughs	Intelligent Parallel 1/F	Intelligent Parallel 1/F	Burroughs
CAPACITY/PERFORMANCE	(2 spindles)	(2 spindles)			
Total capacity (MBytes) FIXED	F: 28.2	F: 37.6	F: 19.955	F: 79.822	F: 201
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 11,520	F: 11,520	F: 14,848	F: 14,848	F: 16,060
Data surfaces per spindle	2	4	2	8	8
Heads per data surface	1	1	2	2	1
Tracks per surface	400	400	672	672	1564
TPI	200	200	300	300	714
BPI	4000	4000	5500	5500	6551
RPM	1500	1500	3000	3000	3672
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	35	35	35	35	28
Average rotational delay (msec)	20	20	10	10	8
Average access time (msec)	55	55	45	45	36
Data transfer rate (KByte/sec)	348	348	888	888	1300
FIRST CUSTOMER SHIPMENT	1/77	1/77	12/79	12/79	4Q78
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			Equivalent to B9493-19 and B9493-20	Equivalent to B9493-76 and B9493-80	B1800-B7800 Embedded Servo

MANUFACTURER	BURROUGHS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS
DRIVE	9494-4	C2048	Trident T50	Trident T80 T82	Trident T200 T202
DISK/TREND GROUP	7	2	3	3	4
MARKET	End User	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	8" Cartridge	Trident	Trident	3330-11
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	3330-11	Modified 3350	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Burroughs	SMD, ANSI X3T9/1226	Trident	T80: Trident T82: SMD	T200: Trident T202: SMD
CAPACITY/PERFORMANCE	(2 spindles)				
Total capacity (MBytes) FIXED	F: 402	U: 33.46	--	--	--
REMOVABLE	--	U: 16.73	U: 54.7	U: T80: 82.1 U: T82: 82.9	U: T200: 208.1 U: T202: 210.1
Capacity per track (Bytes)	F: 16,060	U: 20,160	U: 13,440	U: 20,160	U: 13,440
Data surfaces per spindle	8	4 Fixed 2 Removable	5	5	19
Heads per data surface	1	1	1	1	1
Tracks per surface	1564	415	815	T80: 815 T82: 823	T200: 815 T202: 823
TPI	714	480	370	T80: 370 T82: 384	T200: 370 T202: 384
BPI	6551	9873 BPI	4040	6060	4040
RPM	3672	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)	28	30	30	30	30
Average rotational delay (msec)	8	8.3	8.3	8.3	8.3
Average access time (msec)	36	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	1300	1209	806	1209	806
FIRST CUSTOMER SHIPMENT	4Q78	1Q83	5/75	8/75	6/76
U.S. OEM PRICE FOR 100 UNITS	--	$2,920	$5,200	$5,935	$9,055
COMMENTS	B1800-B7800 Embedded Servo	Embedded Servo			

MANUFACTURER	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS
DRIVE	Trident T300 T302 T306	Marksman M20	Marksman M40	Marksman M80	Marksman M160
DISK/TREND GROUP	4	5	6	6	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	3330-11	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	3350	3350	3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	T300: Trident T302/6: SMD	Marksman	Marksman	Marksman, SMD	Marksman, SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 20.16	U: 40.32	U: 80.64	--
REMOVABLE	U:T300:312.1 U:T302/6:315.2	--	--	--	U: 160.7
Capacity per track (Bytes)	U: 20,160	U: 24,000	U: 24,000	U: 24,000	U: 32,000
Data surfaces per spindle	19	2	4	3	3
Heads per data surface	1	2	2	2	2
Tracks per surface	T300: 815 T302/6: 823	426	426	1138	1690
TPI	T300: 370 T302/6: 384	182	182	480	712
BPI	6060	7545	7545	7545	10000
RPM	3600	2400	2400	2400	2400
Actuator type	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Torque Motor	Band, Torque Motor
Average positioning time (msec)	30	65	65	50	50
Average rotational delay (msec)	8.3	12.5	12.5	12.5	12.5
Average access time (msec)	38.3	77.5	77.5	62.5	62.5
Data transfer rate (KByte/sec)	1209	960	960	960	1280
FIRST CUSTOMER SHIPMENT	8/76	3Q78	3Q78	4Q81	1Q82
U.S. OEM PRICE FOR 100 UNITS	$10,255	$1,780	$2,235	$3,265	$4,050
COMMENTS					

MANUFACTURER	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL
DRIVE	Marksman AMS 190	Marksman AMS 380	Cynthia D120 D122	Cynthia D140 D142	Cynthia D145
DISK/TREND GROUP	7	8	1	2	2
MARKET	OEM	OEM	Captive, OEM	Captive, OEM	OEM
MEDIA: Manufacturer's number	--	--	M4120	M4120	M4120
Generic type	Fixed	Fixed	Special Cartridge	Special Cartridge	Special Cartridge
Nominal disk diameter	14"	14"	10.5" OD 6.6" ID	10.5" OD 6.6" ID	14.0" OD 6.6" ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Marksman, SMD	Marksman, SMD	Cynthia	Cynthia	SASI
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 191	U: 378.5	--	F: 10.0	F: 10.0
REMOVABLE	--	--	F: 10.0	F: 10.0	F: 10.0
Capacity per track (Bytes)	U: 24,000	U: 32,000	F: 12,800	F: 12,800	F: 12,800
Data surfaces per spindle	7	7	2	4	4
Heads per data surface	2	2	1	1	1
Tracks per surface	1138	1690	392	392	392
TPI	480	712	500	500	500
BPI	7545	10000	4750	4750	4750
RPM	2400	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)	25	25	50	50	50
Average rotational delay (msec)	12.5	12.5	8.3	8.3	8.3
Average access time (msec)	37.5	37.5	58.3	58.3	58.3
Data transfer rate (KByte/sec)	960	1280	920	920	920
FIRST CUSTOMER SHIPMENT	2Q82	2Q82	7/78	4Q79	8/82
U.S. OEM PRICE FOR 100 UNITS	$5,920	$7,760	$2,100	$2,970	$3,390
COMMENTS			Embedded Servo	Embedded Servo	Embedded Servo

MANUFACTURER	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL
DRIVE	Cynthia D505	Cynthia D510	Cynthia D160/4 D162/4	Cynthia D160/6 D162/6	Cynthia D160/8 D162/8
DISK/TREND GROUP	5	5	6	6	7
MARKET	Captive, OEM	Captive, 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	10.5" OD 6.6" ID	10.5" OD 6.6" ID	10.5" OD 6.6" ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	3370	3370	3370
Heads	Ferrite	Ferrite	Thin Film	Thin Film	Thin Film
Interface	ST 506	ST 506	Cynthia	Cynthia	Cynthia
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.38	U: 12.76	F: 60.21	F: 90.31	F: 120.42
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	F: 12,800	F: 12,800	F: 12,800
Data surfaces per spindle	4	4	4	6	8
Heads per data surface	1	1	1	1	1
Tracks per surface	153	306	1176	1176	1176
TPI	255	345	900	900	900
BPI	7690	9074	4850	4850	4850
RPM	3600	3600	3600	3600	3600
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	170 (including settling)	170 (including settling)	40	40	40
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	178.3	178.3	48.3	48.3	48.3
Data transfer rate (KByte/sec)	625	625	920	920	920
FIRST CUSTOMER SHIPMENT	1982	1983	3Q81	3Q81	3Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	$3,160	$3,440	$3,720
COMMENTS	Mfg. under Seagate license	Mfg. under Seagate license	Embedded Servo	Embedded Servo	Embedded Servo

MANUFACTURER	CIPHER	CIPHER	CIPHER	COMPUTER MEMORIES, INC.	COMPUTER MEMORIES, INC.
DRIVE	VF-2221 VT-2221	VF-2222 VT-2222	VT-2422	CM 5206	CM 5412
DISK/TREND GROUP	1	1	2	5	5
MARKET	OEM, Captive	OEM, Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	2315/5440	2315/5440	5440	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	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	2314	2314	2314	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options	Various Options	Various Options	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.25	U: 6.25	U: 12.5	U: 6.38	U: 12.76
REMOVABLE	U: 6.25	U: 6.25	U: 12.5	--	--
Capacity per track (Bytes)	U: 7,812	U: 7,812	U: 15,625	U: 10,416	U: 10,416
Data surfaces per spindle	4	4	4	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	408	408	408	306	306
TPI	200	200	200	345	345
BPI	200	200	4400	8650	8650
RPM	1500	2400	2400	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	35	35	35	130 (including settling)	130 (including settling)
Average rotational delay (msec)	20	12.5	12.5	8.3	8.3
Average access time (msec)	55	47.5	47.5	138.3	138.3
Data transfer rate (KByte/sec)	195	312.5	625	625	625
FIRST CUSTOMER SHIPMENT	2Q80	2Q80	2Q80	1Q82	1Q82
U.S. OEM PRICE FOR 100 UNITS	F-$3,660 T-$3,600	F-$3,660 T-$3,600	$4,320	$800	$940
COMMENTS					

MANUFACTURER	COMPUTER MEMORIES, INC.	COMPUTER MEMORIES, INC.	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	CM 5619	CM 5640	9427H "Hawk"	9448-32 "Phoenix" or "CMD"	9448-64 "Phoenix" or "CMD"
DISK/TREND GROUP	5	6	1	2	2
MARKET	OEM	OEM	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	9848	91204	91204
Generic type	Fixed	Fixed	5440	Cartridge Module Drive	Cartridge Module Drive
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	2314	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	Various Options	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 19.14	U: 40	U: 6.25	U: 16.289	U: 48.869
REMOVABLE	--		U: 6.25	U: 16.289	U: 16.289
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 7,812	U: 20,160	U: 20,160
Data surfaces per spindle	6	6	4	1 Fixed 1 Removable	3 Fixed 1 Removable
Heads per data surface	1	1	1	1	1
Tracks per surface	306	640	406	823	823
TPI	345	690	200	384	384
BPI	8650	9650	2200	6038	6038
RPM	3600	3600	2400/1500	3600	3600
Actuator type	Rotary, Stepping Motor	Rotary, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	130 (including settling)	40 (including settling)	35	30	30
Average rotational delay (msec)	8.3	8.3	12.5/20	8.3	8.3
Average access time (msec)	138.3	48.3	47.5/55	38.3	38.3
Data transfer rate (KByte/sec)	625	625	312.5/195	1209	1209
FIRST CUSTOMER SHIPMENT	1Q82	4Q82	8/74	9/78	9/78
U.S. OEM PRICE FOR 100 UNITS	$1,190	$1,680	$4,230	$5,315	$6,005
COMMENTS				Separate Servo surface for fixed and removable disks	Separate Servo surface for fixed and removable disks

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	9448-96 "Phoenix" or "CMD"	280-10 280-20	9454 "Lark"	9455 "Lark"	9457 "Lark"
DISK/TREND GROUP	2	2	2	2	2
MARKET	OEM, Captive	PCM	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	91204	91204	91208	91208	
Generic type	Cartridge Module Drive	Cartridge Module Drive	Lark Module Drive	Lark Module Drive	Lark Module Drive
Nominal disk diameter	14"	14"	195 mm OD 100 mm ID	195 mm OD 100 mm ID	195 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	IBM Series 1	LDI	LDI, SMD, ISI	LDI, SMD, ISI
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 81.446	F: 64.5	U: 8.35	U: 8.35	U: 25
REMOVABLE	U: 16.289	F: 13.3	U: 8.35	U: 8.35	U: 25
Capacity per track (Bytes)	U: 20,160	F: 16,384	U: 20,672	U: 20,672	U: 20,672
Data surfaces per spindle	5 Fixed 1 Removable	5 Fixed 1 Removable	4	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	823	814	202	202	606
TPI	384	384	237	237	715
BPI	6038	6038	6774 FRPI 10161 BPI	6774 FRPI 10161 BPI	6774 FPRI 10161 BPI
RPM	3600	3600	3510	3510	3510
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	50	50	35
Average rotational delay (msec)	8.3	8.3	8.55	8.55	8.55
Average access time (msec)	38.3	38.3	58.55	58.55	43.55
Data transfer rate (KByte/sec)	1209	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT	9/78	4/82	1Q82	1Q81	4Q82
U.S. OEM PRICE FOR 100 UNITS	$6,695	--	--	$2,600	$3,440
COMMENTS	Separate Servo surface for fixed and removable disks		Embedded Servo	Embedded Servo	Embedded Servo

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	9710 "RSD"	9746 9747	9760 "SMD"	9762 "SMD"	270-10
DISK/TREND GROUP	3	--	3	3	3
MARKET	OEM	OEM	OEM, Captive	OEM, Captive	PCM
MEDIA: Manufacturer's number		9873	9876	9877	9877
Generic type	Removable Storage Drive	2316	Storage Module Drive	Storage Module Drive	Storage Module Drive
Nominal disk diameter	230 mm OD 100 mm ID	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	2314	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD, ISI	Various Options	SMD	SMD	IBM Series 1
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	U: 82.9	U: 62.5	U: 40.7	U: 81.5	F: 63
Capacity per track (Bytes)	U: 20,160	U: 7,812	U: 20,160	U: 20,160	F: 15,360
Data surfaces per spindle	5	20	5	5	5
Heads per data surface	1	1	1	1	1
Tracks per surface	823	406	411	823	823
TPI	550	200	192	384	384
BPI	10000*	2220	6038	6038	6038
RPM	3600	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)	30	35	30	30	30
Average rotational delay (msec)	8.3	12.5	8.3	8.3	8.3
Average access time (msec)	38.3	47.5	38.3	38.3	38.3
Data transfer rate (KByte/sec)	1209	312.5	1209	1209	1209
FIRST CUSTOMER SHIPMENT	1Q83	1974	3/74	3/75	1978
U.S. OEM PRICE FOR 100 UNITS	$4,915	--	$6,500	$6,715	--
COMMENTS	*RLL Code				

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	9764 "SMD"	9766 "SMD"	270-30	9780	9770
DISK/TREND GROUP	4	4	4	4	--
MARKET	OEM, Captive	OEM, Captive	PCM	OEM, Captive	OEM
MEDIA: Manufacturer's number	9883-91	9883-91	9883-91	9883	9778
Generic type	3336-11	3336-11	3336-11	3336-11	3348
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	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	IBM Series 1	CDC	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	U: 154.8	U: 309.5	F: 240	F: 200	F: 35/70
Capacity per track (Bytes)	U: 20,160	U: 20,160	F: 15,360	F: 13,030	F: 16,736
Data surfaces per spindle	19	19	19	19	3/6
Heads per data surface	1	1	1	1	2
Tracks per surface	411	823	823	822	696/2
TPI	192	384	384	384	300
BPI	6038	6038	6038	4040	5636
RPM	3600	3600	3600	3600	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	30	25
Average rotational delay (msec)	8.3	8.3	8.3	8.3	10.1
Average access time (msec)	38.3	38.3	38.3	38.3	35.1
Data transfer rate (KByte/sec)	1209	1209	1209	806	885
FIRST CUSTOMER SHIPMENT	3/76	3/76	1978	1974	1976
U.S. OEM PRICE FOR 100 UNITS	--	$12,355	--	--	--
COMMENTS				PCM version is 33302	

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	9415-19 "Wren"	9415-32 "Wren"	9410-8 "Finch"	9410-24 "Finch"	9410-32 "Finch"
DISK/TREND GROUP	5	6	5	5	6
MARKET	Captive, OEM	Captive, OEM	OEM, Captive	OEM, Captive	OEM, Captive
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	195 mm OD 100 mm ID	195 mm OD 100 mm ID	195 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Finch, ST 506	Finch, ST 506	Finch, LDI, SMD, SA 1000	Finch, LDI, SMD, SA 1000	Finch, LDI, SMD, SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 19	U: 32	U: 8.13	U: 24.39	U: 32.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,080	U: 10,080	U: 13,440	U: 13,440	U: 13,440
Data surfaces per spindle	3	5	1	3	4
Heads per data surface	1	1	1	1	1
Tracks per surface	635	635	605	605	605
TPI	800	800	554	554	554
BPI	8730	8730	6800	6800	6800
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)	50	50	50	50	50
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	58.3	58.3	58.3	58.3	58.3
Data transfer rate (KByte/sec)	605	605	806	806	806
FIRST CUSTOMER SHIPMENT	2Q83	2Q83	6/81	6/81	12/81
U.S. OEM PRICE FOR 100 UNITS	$1,620	$1,965	$1,510	$1,820	$2,150
COMMENTS					

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	9410-40 "Finch"	230-10 240-10*	230-20 240-20*	230-23 240-23*	230-26 240-26*
DISK/TREND GROUP	6	5	5	6	6
MARKET	OEM, Captive	PCM	PCM	PCM	PCM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	195 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	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Finch, LDI, SMD, SA 1000	IBM Series 1	IBM Series 1	IBM Series 1	IBM Series 1
CAPACITY/PERFORMANCE		0.74 or 1.48 MB Fixed Head Option	0.74 or 1.48 MB Fixed Head Option	0.74 or 1.48 MB Fixed Head Option	0.74 or 1.48 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 40.67	F: 9.3	F: 25.3	F: 37.9	F: 50.6
REMOVABLE	--	--	--	--	
Capacity per track (Bytes)	U: 13,440	F: 15,360	F: 15,360	F: 15,360	F: 15,360
Data surfaces per spindle	5	1	2	3	4
Heads per data surface	1	2	2	2	2
Tracks per surface	605	606	823	823	823
TPI	554	296	340	340	340
BPI	6800	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)	50	30	30	30	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	58.3	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	806	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT	8/82	1Q79	2Q79	2Q79	2Q79
U.S. OEM PRICE FOR 100 UNITS	$2,280	--	--	--	--
COMMENTS					

*240 Series includes a flexible disk drive

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	230-30 240-30*	9730-80 "MMD"	9730-160 "MMD"	9715 "FSD"	33801-A2 33801-B2 33801-C2 (3330 Format)
DISK/TREND GROUP	6	6	7	7	8
MARKET	PCM	OEM, Captive	OEM, Captive	OEM	PCM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	230 mm OD 100 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM Series 1	SMD	SMD	SMD, ISI	IBM
CAPACITY/PERFORMANCE	0.74 or 1.48 MB Fixed Head Option	0.96 or 1.93 MB Fixed Head Option	0.96 or 1.93 MB Fixed Head Option		1.24 MB Fixed Head Option
Total capacity (MBytes) FIXED	F: 63.2	U: 82.9	U: 165.9	U: 165.9	F: 400
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 15,360	U: 20,160	U: 20,160	U: 20,160	F: 13,030
Data surfaces per spindle	5	5	5	10	20
Heads per data surface	2	2	2	1	2
Tracks per surface	823	823	1646	823	1686
TPI	340	340	680	550	660
BPI	6220	6220	6220	10000*	6350
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	30	30	25
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	33.3
Data transfer rate (KByte/sec)	1209	1209	1209	1209	1198
FIRST CUSTOMER SHIPMENT	2Q79	1Q79	2Q79	4Q82	1978
U.S. OEM PRICE FOR 100 UNITS	--	$5,040	$5,785	$4,960	--
COMMENTS				*RLL Code	

*240 Series includes a flexible disk drive

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	33501-A2 33501-B2 33501-C2 (3550 Format)	33502-A2 33502-B2 33502-C2	9776-A2 9776-B2 9776-C2	819-11	819-21
DISK/TREND GROUP	8	9	9	8	9
MARKET	PCM	PCM	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	Modified 3350	Modified 3350	Modified 3350	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	CDC	CDC
CAPACITY/PERFORMANCE	1.72 MB Fixed Head Option	1.72 MB Fixed Head Option	1.72 MB Fixed Head Option		
Total capacity (MBytes) FIXED	F: 317.5	F: 635	F: 635	U: 325.8	U: 651.6
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 19,069	F: 19,069	F: 19,069	U: 20,160	U: 20,160
Data surfaces per spindle	20	20	20	40	40
Heads per data surface	2	2	2	1	1
Tracks per surface	843	1686	1686	411	823
TPI	660	660	660	192	384
BPI	6350	6350	6350	6000	6000
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)	19	25	25	50	50
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	27.3	33.3	33.3	58.3	58.3
Data transfer rate (KByte/sec)	1198	1198	1198	4840	4840
FIRST CUSTOMER SHIPMENT	1978	1Q79	1978	1978	1978
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS		CDC Model 885		4 track parallel data transfer	4 track parallel data transfer

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	DATA GENERAL
DRIVE	9775 "FMD"	9797	885-42	33800-A4 33800-B4 33800-AA4	6045 6046 6047 6048 6050
DISK/TREND GROUP	9	9	9	9	1
MARKET	OEM	OEM	Captive	PCM	Captive
MEDIA: Manufacturer's number	--	--	--	--	1121
Generic type	Fixed Module Drive	Fixed	Fixed	Fixed	5440
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	3330-11	Modified 3350	3380	2314
Heads	Ferrite	Ferrite	Ferrite	Thin Film	Ferrite
Interface	SMD	Special	CDC	IBM	Data General
CAPACITY/PERFORMANCE	1.9 MB Fixed Head Option				
Total capacity (MBytes) FIXED	U: 675	U: 651.6	U: 673	F: 630	F: 5.014
REMOVABLE	--	--	--	--	F: 5.014
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	F: 47,476	F: 6,144
Data surfaces per spindle	20	40	20	*	4
Heads per data surface	2	1	2	2	1
Tracks per surface	1686	822	1686	*	408
TPI	660	384	660	*	200
BPI	6350	6000	6350	*	2200
RPM	3600	3600	3600	3600	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	25	50	25	16	38
Average rotational delay (msec)	8.3	8.3	8.3	8.3	12.5
Average access time (msec)	33.3	58.3	33.3	24.3	50.5
Data transfer rate (KByte/sec)	1209	4840	4788	3000	312.5
FIRST CUSTOMER SHIPMENT	4/80	1977	1982	1983	1976
U.S. OEM PRICE FOR 100 UNITS	$16,690	--	--	--	--
COMMENTS		4 track parallel data transfer	Cyber 865 & 875 4 track parallel data transfer. Drive has two spindles.	*Not Announced Drive has four spindles	

MANUFACTURER	DATA GENERAL	DATA GENERAL	DATA GENERAL	DATA GENERAL	DATA GENERAL
DRIVE	6095	6070	6067	6060	6061
DISK/TREND GROUP	1	2	3	4	4
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	1121	1145	1143	1122	1123
Generic type	5440	5440	SMD	3336-1	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	2314	3330-1	3330-11	3330-1	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Data General	Data General	Data General	Data General	Data General
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 5.014	F: 10.027	--	--	--
REMOVABLE	F: 5.014	F: 10.027	F: 50.074	F: 95.957	F: 190.280
Capacity per track (Bytes)	F: 6,144	F: 12,288	F: 12,288	F: 12,288	F: 12,288
Data surfaces per spindle	4	4	5	19	19
Heads per data surface	1	1	1	1	1
Tracks per surface	408	408	815	411	815
TPI	200	200	370	192	370
BPI	2200	4400	4040	4040	4040
RPM	2400	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)	38	38	35	35	35
Average rotational delay (msec)	12.5	12.5	8.3	8.3	8.3
Average access time (msec)	50.5	50.5	43.3	43.3	43.3
Data transfer rate (KByte/sec)	312.5	625	806	806	806
FIRST CUSTOMER SHIPMENT	1978	1978	1978	1976	1976
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	DATA GENERAL	DATA GENERAL	DATA GENERAL	DATA PERIPHERALS	DATA PERIPHERALS
DRIVE	6122	6098 6099 6101 6102	6100 6103 6104 6105	DP 100	Puma DP 400
DISK/TREND GROUP	4	5	5	1	5
MARKET	Captive	Captive	Captive	OEM	OEM
MEDIA: Manufacturer's number	1163	--	--	DP 10	--
Generic type	3336-11	Fixed	Fixed	8" Cartridge	Fixed
Nominal disk diameter	14"	14"	14"	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	3340	3340	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Data General	Data General	Data General	Modified SA 1000	Modified SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	F: 12.58	F: 25.16	--	U: 46.4
REMOVABLE	F: 277.491	--	--	U: 11.02	--
Capacity per track (Bytes)	F: 17,920	F: 16,384	F: 16,384	U: 13,440	U: 13,440
Data surfaces per spindle	19	2	4	2	4
Heads per data surface	1	2	2	1	1
Tracks per surface	815	384	384	415	864
TPI	370	166	166	478	640
BPI	6060	5760	5760	6866	8335
RPM	3600	2964	2964	3600	3600
Actuator type	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	35	60 (including settling)	60 (including settling)	60	60
Average rotational delay (msec)	8.3	10.1	10.1	8.3	8.3
Average access time (msec)	43.3	70.1	70.1	68.3	68.3
Data transfer rate (KByte/sec)	1209	910.6	910.6	874	875
FIRST CUSTOMER SHIPMENT	1Q80	3Q79	4Q79	4/81	2/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	$1,710	$1,925
COMMENTS				Embedded Servo	Embedded Servo

MANUFACTURER	DATAPOINT	DATAPOINT	DATAPOINT	DATA RECORDING EQUIPMENT, LTD.	DATA RECORDING EQUIPMENT, LTD.
DRIVE	9360	9374	9301 9302 9303	4041B	4042B
DISK/TREND GROUP	1	2	5	1	1
MARKET	Captive	Captive	Captive	OEM	OEM
MEDIA: Manufacturer's number	80362	80428	--	--	--
Generic type	2315	5440	Fixed	5440	5440
Nominal disk diameter	14"	14"	130 mm OD 25 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	2314	3330-1	Modified 3350	2314	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Datapoint	Datapoint	Datapoint	Various Options	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 2.49	F: 10.027	F: 20.24	--	--
REMOVABLE	F: 2.49	F: 10.027	--	U: 3.125	U: 6.25
Capacity per track (Bytes)	F: 6,144	F: 12,288	F: 6,144	U: 7,812	U: 7,812
Data surfaces per spindle	4	4	6	2	2
Heads per data surface	1	1	1	1	1
Tracks per surface	203	408	549	204	408
TPI	100	200	500	100	200
BPI	2200	4400	8000	2200	2200
RPM	1500	2400	5520	2400	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	70	35	75 (without settling)	38	38
Average rotational delay (msec)	20	12.5	5.4	12.5	12.5
Average access time (msec)	90	47.5	80.4	50.5	50.5
Data transfer rate (KByte/sec)	195	625	725	312.5	312.5
FIRST CUSTOMER SHIPMENT	1978	1978	1981	6/77	6/77
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			9301 includes 20 MB tape		

MANUFACTURER	DATA RECORDING EQUIPMENT, LTD.	DATA RECORDING EQUIPMENT, LTD.	DATA RECORDING EQUIPMENT, LTD.	DATA RECORDING EQUIPMENT, LTD.	DATA RECORDING EQUIPMENT, LTD.
DRIVE	4043B	4044B	D9427H	D9448-32	D9448-64
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: 6.25	U: 16.289	U: 48.869
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	4	4	1 Fixed 1 Removable	3 Fixed 1 Removable
Heads per data surface	1	1	1	1	1
Tracks per surface	204	408	406	823	823
TPI	100	200	200	384	384
BPI	2200	2200	2200	6038	6038
RPM	2400	2400	2400	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	38	38	35	30	30
Average rotational delay (msec)	12.5	12.5	12.5	8.3	8.3
Average access time (msec)	50.5	50.5	47.5	38.3	38.3
Data transfer rate (KByte/sec)	312.5	312.5	312.5	1209	1209
FIRST CUSTOMER SHIPMENT	6/77	6/77	1Q80	2Q81	2Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	DATA RECORDING EQUIPMENT, LTD.	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION
DRIVE	D9448-96	RK05J	RL01	RL02	RK06
DISK/TREND GROUP	2	1	1	1	2
MARKET	OEM	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	CDC 91204	RK05K	RL01K	RL02K	RK06K
Generic type	CMD	2315	5440	5440	Special Cartridge
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	3330-1	3330-1	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	Unibus	Unibus, LSI-11	Unibus, LSI-11	Unibus
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 81.446	--	--	--	--
REMOVABLE	U: 16.289	F: 2.49	F: 5.24	F: 10.48	F: 13.89
Capacity per track (Bytes)	U: 20,160	F: 6,144	F: 10,240	F: 10,240	F: 11,264
Data surfaces per spindle	5 Fixed 1 Removable	2	2	2	3
Heads per data surface	1	1	1	1	1
Tracks per surface	823	203	256	512	411
TPI	384	100	125	250	192.3
BPI	6038	2040	3725	3725	4040
RPM	3600	1500	2400	2400	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	50	55	55	38
Average rotational delay (msec)	8.3	20	12.5	12.5	12.5
Average access time (msec)	38.3	70	67.5	67.5	50.5
Data transfer rate (KByte/sec)	1209	180	512.5	512.5	538
FIRST CUSTOMER SHIPMENT	2Q81	1975	4/78	1979	12/76
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS		Original RK05 FCS 1972	Embedded Servo	Embedded Servo	

MANUFACTURER	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION
DRIVE	RK07	RM02	RM03	RM05	RP06
DISK/TREND GROUP	2	3	3	4	4
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	RK07K	--	--	--	RP06P
Generic type	Special Cartridge	SMD	SMD	3330-11	3330-11
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	Unibus	Unibus, Massbus	Unibus, Massbus	Massbus	Unibus, Massbus
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	F: 27.54	F: 67.42	F: 67.42	F: 256	F: 176
Capacity per track (Bytes)	F: 11,264	F: 16,384	F: 16,384	F: 16,384	F: 11,264
Data surfaces per spindle	3	5	5	19	19
Heads per data surface	1	1	1	1	1
Tracks per surface	815	823	823	823	815
TPI	384.6	384	384	384	384
BPI	4040	6038	6038	6038	4040
RPM	2400	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)	36.5	30	30	30	30
Average rotational delay (msec)	12.5	12.5	8.3	8.3	8.3
Average access time (msec)	49	42.5	38.3	38.3	38.3
Data transfer rate (KByte/sec)	538	806	1209	1209	806
FIRST CUSTOMER SHIPMENT	4/78	4/78	4Q77	3Q80	4Q76
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS		Manufactured by CDC	Manufactured by CDC	Manufactured by CDC	Manufactured by Memorex

MANUFACTURER	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION
DRIVE	RA60	RK05F	RP07	RM80	RA80
DISK/TREND GROUP	4	5	8	7	7
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	RA 60P	--	--	--	--
Generic type	Special Disk Pack	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	Modified 3330	2314	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Unibus	Unibus	Massbus	Massbus	Unibus
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	F: 4.99	F: 516	F: 124	F: 121
REMOVABLE	F: 205	--	--	--	--
Capacity per track (Bytes)	F: 21,504	F: 6,144	F: 25,600	F: 16,384	F: 15,872
Data surfaces per spindle	6	2	16	7	7
Heads per data surface	1	1	2	2	2
Tracks per surface	1600	406	1260	1122	1092
TPI	779	200	537	478	478
BPI	7251 FRPI 9668 BPI	2040	11139*	6339	6339
RPM	3600	1500	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	41.7	56	23	25	25
Average rotational delay (msec)	8.3	20	8.3	8.3	8.3
Average access time (msec)	50.0	76	31.3	33.3	33.3
Data transfer rate (KByte/sec)	1980	180	2160	1200	1200
FIRST CUSTOMER SHIPMENT	4Q82	7/76	7/81	1981	1/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Embedded Servo		*Effective BPI Manufactured by ISS/Univac		

MANUFACTURER	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DISK MEMORY TECHNOLOGY	DISK MEMORY TECHNOLOGY	DISK TECH ONE
DRIVE	RA81	RP20	601A	601B	3303
DISK/TREND GROUP	8	8	5	5	6
MARKET	Captive	Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	9"	9"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Nickel-Cobalt Plated	Nickel-Cobalt Plated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Special	Special	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Unibus	Massbus	Unique	Unique	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 456	F: 483.4	U: 2.8	U: 5.5	U: 40.39
REMOVABLE		--	--	--	--
Capacity per track (Bytes)	F: 26,112	F: 14,400	U: 6,750	U: 13,500	U: 20,160
Data surfaces per spindle	7	15	2	2	3
Heads per data surface	2	2	2	2	2
Tracks per surface	2496	2238	408	408	678
TPI	960	957	256	256	286
BPI	8550 FRPI 11400 BPI	6425	3750	7500	6122
RPM	3600	3600	1800	1800	2964
Actuator type	Rotary, Voice Coil	Linear, Voice Coil	Lead Screw Stepping Motor	Lead Screw Stepping Motor	Rotary, Voice Coil
Average positioning time (msec)	28	25	130	130	38
Average rotational delay (msec)	8.3	8.3	16.7	16.7	10.12
Average access time (msec)	36.3	33.3	146.7	146.7	48.12
Data transfer rate (KByte/sec)	2200	1198	219	438	1000
FIRST CUSTOMER SHIPMENT	9/82	4Q80	9/80	9/80	7/77
U.S. OEM PRICE FOR 100 UNITS	--	--	Varies*	Varies*	$3,550
COMMENTS	Embedded Servo	2 spindles per drive Manufactured by Storage Technology	*Normally sold only as subsystem, with price dependent on specific system	*Normally sold only as subsystem, with price dependent on specific system	

MANUFACTURER	DISK TECH ONE	DISK TECH ONE	DISK TECH ONE	DMA SYSTEMS	DMA SYSTEMS
DRIVE	3306	4160	4300	Micro-Magnum 5/5	Micro-Magnum 5
DISK/TREND GROUP	6	7	8	1	1
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	"Micro-Magnum"	"Micro-Magnum"
Generic type	Fixed	Fixed	Fixed	5.25" Cartridge	5.25" Cartridge
Nominal disk diameter	14"	14"	14"	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	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	SMD	Modified SA 1000	Modified SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 80.8	U: 165.9	U: 301.0	U: 6.75	--
REMOVABLE	--	--	--	U: 6.75	U: 6.75
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 25,872	U: 10,890	U: 10,890
Data surfaces per spindle	6	5	7	4	2
Heads per data surface	2	2	2	1	1
Tracks per surface	678	1646	1664	311	311
TPI	286	706	706	454	454
BPI	6122	6270	8072	8617	8617
RPM	2964	3600	2964	3443	3443
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	38	35	35	50 (including settling)	50 (including settling)
Average rotational delay (msec)	10.12	8.3	10.1	8.7	8.7
Average access time (msec)	48.12	43.3	45.1	58.7	58.7
Data transfer rate (KByte/sec)	1000	1209	1278	625	625
FIRST CUSTOMER SHIPMENT	7/77	4Q82	4Q82	9/82	9/82
U.S. OEM PRICE FOR 100 UNITS	$4,150	--	$5,500	$1,800	$1,625
COMMENTS				Embedded Servo	Embedded Servo

MANUFACTURER	EVOTEK	EVOTEK	EVOTEK	EVOTEK	EVOTEK
DRIVE	ET-5510	ET-5520	ET-5530	ET-5540	ET-5810
DISK/TREND GROUP	5	5	5	6	5
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	Plated	Plated	Plated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 7.81	U: 15.62	U: 23.43	U: 31.24	U: 12.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 17,220
Data surfaces per spindle	2	4	6	8	2
Heads per data surface	1	1	1	1	1
Tracks per surface	375	375	375	375	375
TPI	367	367	367	367	367
BPI	9825	9825	9825	9825	16,250
RPM	3600	3600	3600	3600	3600
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	49 (including settling)	49 (including settling)	49 (including settling)	49 (including settling)	49 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	57.3	57.3	57.3	57.3	57.3
Data transfer rate (KByte/sec)	625	625	625	625	1025
FIRST CUSTOMER SHIPMENT	4Q82	4Q82	4Q82	4Q82	4Q82
U.S. OEM PRICE FOR 100 UNITS	$1,275	$1,475	$1,975	$2,375	$1,375
COMMENTS					

MANUFACTURER	EVOTEK	EVOTEK	EVOTEK	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE	ET-5820	ET-5830	ET-5840	M2201	F451
DISK/TREND GROUP	5	6	6	2	2
MARKET	OEM	OEM	OEM	OEM	Captive
MEDIA: Manufacturer's number	--	--	--	M2951	F922P
Generic type	Fixed	Fixed	Fixed	Special Cartridge	Special Cartridge
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"	14"
Magnetic surface	Plated	Plated	Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	ST 506	SMD	Fujitsu
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 25.83	U: 38.75	U: 51.68	--	--
REMOVABLE	--	--	--	U: 50.56	F: 19.86
Capacity per track (Bytes)	U: 17,220	U: 17,220	U: 17,220	U: 20,480	F: 16,384
Data surfaces per spindle	4	6	8	3	3
Heads per data surface	1	1	1	1	1
Tracks per surface	375	375	375	823	404
TPI	367	367	367	370	370
BPI	16250	16250	16250	6135	6135
RPM	3600	3600	3600	2400	2400
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	49 (including settling)	49 (including settling)	49 (including settling)	30	30
Average rotational delay (msec)	8.3	8.3	8.3	12.5	12.5
Average access time (msec)	57.3	57.3	57.3	42.5	42.5
Data transfer rate (KByte/sec)	1025	1025	1025	819	819
FIRST CUSTOMER SHIPMENT	4Q82	4Q82	4Q82	4Q77	3Q77
U.S. OEM PRICE FOR 100 UNITS	$2,075	$2,375	$2,675	--	--
COMMENTS					

MANUFACTURER	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE	F452	M2211	F6417	F479	M2231A/B
DISK/TREND GROUP	2	2	2	4	5
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"	130 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	3330-11	3330-11	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Fujitsu	SMD	Fujitsu	Fujitsu	A = ST 506 B = SA 4000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	U: 6.66
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: 10,416
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	160
TPI	370	370	370	370	254
BPI	6135	6135	5636	4040	8020
RPM	2400	2400	2400	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Stepping Motor
Average positioning time (msec)	30	30	30	25	95 (including settling)
Average rotational delay (msec)	12.5	12.5	12.5	8.4	8.3
Average access time (msec)	42.5	42.5	42.5	33.4	103.3
Data transfer rate (KByte/sec)	819	819	717	806	625
FIRST CUSTOMER SHIPMENT	3Q77	4Q79	4Q79	3Q75	7/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE	M2232A/B	M2301B/K	M2302B/K	M2301BE/KE	M2302BE/KE
DISK/TREND GROUP	5	5	5	5	5
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 100 mm ID	200 mm OD 100 mm ID	200 mm OD 100 mm ID	200 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	3340	3340	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	A = ST 506 B = SA 4000	B=SA 4000 K=Bidirectional	B=SA 4000 K=Bidirectional	BE=SA 4000, KE= Bidirectional	BE=SA 4000, KE= Bidirectional
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 10.0	U: 11.712	U: 23.424	U: 11.87	U: 23.74
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 12,000	U: 12,000	U: 24,320	U: 24,320
Data surfaces per spindle	6	4	8	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	160	244	244	244	244
TPI	254	195	195	195	195
BPI	8020	6100	6100	12360	12360
RPM	3600	2964	2964	2964	2964
Actuator type	Rotary, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	95 (including settling)	70 (including settling)	70 (including settling)	70 (including settling)	70 (including settling)
Average rotational delay (msec)	8.3	10.1	10.1	10.1	10.1
Average access time (msec)	103.3	80.1	80.1	80.1	80.1
Data transfer rate (KByte/sec)	625	593	593	1200	1200
FIRST CUSTOMER SHIPMENT	7/82	7/80	7/80	9/82	9/82
U.S. OEM PRICE FOR 100 UNITS	$1,050	$1,610 (B)	$2,090 (B)	--	--
COMMENTS					

MANUFACTURER	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE	M2303BE/KE	M2311K	M2312K	M2251	M2252
DISK/TREND GROUP	6	6	6	5	5
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	Modified 3350	Modified 3350	Modified 3350	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	BE=SA 4000, KE= Bidirectional	SMD	SMD	Fujitsu	Fujitsu
CAPACITY/PERFORMANCE				.3277 or .6554 Fixed Head Option	.3277 or .6554 Fixed Head Option
Total capacity (MBytes) FIXED	U: 47.47	U: 48.250	U: 84.439	U: 12.7	U: 25.4
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 24,320	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	12360	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)	1200	1229	1229	819	819
FIRST CUSTOMER SHIPMENT	9/82	4/81	4/81	2Q78	2Q78
U.S. OEM PRICE FOR 100 UNITS	$2,250 (BE)	$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	6	6	7	7	7
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	Modified 3350	Modified 3350	Modified 3350	Modified 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	6580	6580	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					

MANUFACTURER	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE	M2294K/N	M2351A	F6421	F6425	F493
DISK/TREND GROUP	8	8	8	9	8
MARKET	OEM	OEM	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	10.5" OD 4" ID	10.5" OD 4" ID	10.5" OD 4" ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Sputtered	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Special	3350
Heads	Ferrite	Ferrite	Ferrite	Thin Film	Ferrite
Interface	SMD	Modified SMD	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
Total capacity (MBytes) FIXED	U: 335.544	U: 474.214	F: 446/317.5	F: 630	F: 317.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,480	U: 28,160	F: 26,793/ 19,069	*	F: 19,069
Data surfaces per spindle	8	10	10	*	15
Heads per data surface	2	2	2	*	2
Tracks per surface	2048	1684	1680	*	1110
TPI	850	880	880	*	480
BPI	6500	12790	12790	*	6362
RPM	2964	3961	3961	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	27	18	18	15	20
Average rotational delay (msec)	10.12	7.5	7.5	8.3	8.3
Average access time (msec)	37.12	25.5	25.5	23.3	28.3
Data transfer rate (KByte/sec)	1012	1859	1859	3000	1198
FIRST CUSTOMER SHIPMENT	3/83	3/82	3Q81	1983	4Q79
U.S. OEM PRICE FOR 100 UNITS	--	$8,800	--	--	--
COMMENTS			Drive has four spindles	*Not Announced Drive has four spindles	Drive has two spindles

MANUFACTURER	FUJITSU, LTD.	HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD
DRIVE	F496	7906	7920	7925	7910
DISK/TREND GROUP	9	2	3	4	5
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	12940A	13394A	13356A	--
Generic type	Fixed	2315	Special SMD	Special Pack	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	3330-1	3330-11	--	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Fujitsu	HPIB	HPIB	HPIB	HPIB
CAPACITY/PERFORMANCE	1.144 MB Fixed Head Option				
Total capacity (MBytes) FIXED	F: 635	U: 12.68	--	--	F: 12.04
REMOVABLE	--	U: 12.68	U: 63.67	F: 120.18	--
Capacity per track (Bytes)	F: 19,069	U: 15,625	U: 15,625	F: 16,384	F: 8,192
Data surfaces per spindle	20	3	5	9	2
Heads per data surface	2	1	1	1	1
Tracks per surface	1660	812 Fixed 406 Removable	815	815	738
TPI	668	384 Fixed 192 Removable	384	384	300
BPI	6426	4680	4680	6250	3225
RPM	3600	3600	3600	2700	3000
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	20	25	25	25	70
Average rotational delay (msec)	8.3	8.3	8.3	11.1	10
Average access time (msec)	28.3	33.3	33.3	36.1	80
Data transfer rate (KByte/sec)	1198	937.5	937.5	937.5	526
FIRST CUSTOMER SHIPMENT	2Q80	3/78	3/77	6/78	1Q79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Drive has two spindles				

MANUFACTURER		HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD
DRIVE		7908	7911	7912	7935H	7933H
DISK/TREND GROUP		5	5	6	4	8
MARKET		Captive	Captive	Captive	Captive	Captive
MEDIA:	Manufacturer's number	--	--	--	97935	--
	Generic type	Fixed	Fixed	Fixed	Special Disk Pack	Fixed
	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	Modified 3330	Modified 3330
	Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
	Interface	HPIB	HPIB	HPIB	HPIB	HPIB
CAPACITY/PERFORMANCE						
Total capacity (MBytes)	FIXED	F: 16.5	F: 28.1	F: 65.6	--	F: 404.4
	REMOVABLE	--	--	--	F: 404.4	--
Capacity per track (Bytes)		F: 8,960	F: 16,384	F: 16,384	F: 23,552	F: 23,552
Data surfaces per spindle		5	1.5	3.5	13	13
Heads per data surface		1	2	2	2	2
Tracks per surface		370	1144	1144	1321	1321
TPI		300	478	478	625	625
BPI		6000	6161	6161	8320 Net*	8320 Net*
RPM		3600	3600	3600	2700	2700
Actuator type		Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)		41.6	26.7	26.7	24.0	24.0
Average rotational delay (msec)		8.3	8.3	8.3	11.1	11.1
Average access time (msec)		49.9	35.0	35.0	35.1	35.1
Data transfer rate (KByte/sec)		537.6	983	983	1000	1000
FIRST CUSTOMER SHIPMENT		9/81	10/81	10/81	12/82	12/81
U.S. OEM PRICE FOR 100 UNITS		--	--	--	--	--
COMMENTS		Drive manufactured by International Memories			*Uses RLL Code	*Uses RLL Code

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-8589-11
DISK/TREND GROUP	5	6	6	4	4
MARKET	OEM	OEM	OEM	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	H-8583	H-8581-11
Generic type	Fixed	Fixed	Fixed	Special Disk Pack	3336-11
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	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD, ANSI X3T9/1226	SMD, ANSI X3T9/1226	SMD, ANSI X3T9/1226	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 25.905	U: 41.425	U: 82.958	--	--
REMOVABLE	--	--	--	F: 100	F: 200
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	815
TPI	286	286	572	370	370
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	25
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	33.3
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	

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	H-8586-12 H-8586-22	DK 501-1	DK 501-2	DK 501-3	MFD 135-4
DISK/TREND GROUP	--	5	5	5	5
MARKET	Captive	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	H-8584-35/70	--	--	--	--
Generic type	3348-35/70	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	Modified 3350	Modified 3350	Modified 3350	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	ST 506	ST 506	ST 506	Floppy Type
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 6.7	U: 10.0	U: 13.3	F: 3.7
REMOVABLE	F: 35/70	--	--	--	--
Capacity per track (Bytes)	F: 16,736	U: 10,416	U: 10,416	U: 10,416	F: 14,500
Data surfaces per spindle	3/6	4	6	8	2
Heads per data surface	2	1	1	1	2
Tracks per surface	696/2	160	160	160	129/128
TPI	300	254	254	254	48
BPI	5636	7800	7800	7800	5241
RPM	2964	3600	3600	3600	3450
Actuator type	Rotary, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Stepping Motor
Average positioning time (msec)	20	78 (including settling)	78 (including	78 (including	100
Average rotational delay (msec)	10.1	8.3	8.3	8.3	8.7
Average access time (msec)	30.1	86.3	86.3	86.3	108.7
Data transfer rate (KByte/sec)	885	625	625	625	875
FIRST CUSTOMER SHIPMENT	1976	4Q82	4Q82	4Q82	1979
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS		Mfg. by Tokico	Mfg. by Tokico	Mfg. by Tokico	

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	H-8586-12 H-8586-22	DK 501-1	DK 501-2	DK 501-3	MFD 135-4
DISK/TREND GROUP	--	5	5	5	5
MARKET	Captive	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	H-8584-35/70	--	--	--	--
Generic type	3348-35/70	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3340	Modified 3350	Modified 3350	Modified 3350	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	ST 506	ST 506	ST 506	Floppy Type
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 6.7	U: 10.0	U: 13.3	F: 3.7
REMOVABLE	F: 35/70	--	--	--	--
Capacity per track (Bytes)	F: 16,736	U: 10,416	U: 10,416	U: 10,416	F: 14,500
Data surfaces per spindle	3/6	4	6	8	2
Heads per data surface	2	1	1	1	2
Tracks per surface	696/2	160	160	160	129/128
TPI	300	254	254	254	48
BPI	5636	7800	7800	7800	5241
RPM	2964	3600	3600	3600	3450
Actuator type	Rotary, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Stepping Motor
Average positioning time (msec)	20	78 (including settling)	78 (including	78 (including	100
Average rotational delay (msec)	10.1	8.3	8.3	8.3	8.7
Average access time (msec)	30.1	86.3	86.3	86.3	108.7
Data transfer rate (KByte/sec)	885	625	625	625	875
FIRST CUSTOMER SHIPMENT	1976	4Q82	4Q82	4Q82	1979
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS		Mfg. by Tokico	Mfg. by Tokico	Mfg. by Tokico	

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	MFD 135-8	MFD 135-F	DK 801-1	DK 801-2	DK 811-2
DISK/TREND GROUP	5	5	5	5	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	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	3340	3340	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Floppy Type	Floppy Type	Modified SMD	Modified SMD	Modified SMD
CAPACITY/PERFORMANCE		0.21 MB Fixed Head Option			
Total capacity (MBytes) FIXED	F: 7.4	F: 6.5	U: 6.9	U: 13.9	U: 24.0 F: 20.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 14,500	F: 14,500	F: 13,300	F: 13,300	F: 12,800
Data surfaces per spindle	4	4	2	4	3
Heads per data surface	2	2/2/2/1	1	1	1
Tracks per surface	129/128	129/128	230	230	521
TPI	48	48	200	200	480
BPI	5241	5241	7300	7300	7495
RPM	3450	3450	3521	3521	3521
Actuator type	Stepping Motor	Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Voice Coil
Average positioning time (msec)	100	100	70	70	25
Average rotational delay (msec)	8.7	8.7	8.5	8.5	8.5
Average access time (msec)	108.7	108.7	78.5	78.5	33.5
Data transfer rate (KByte/sec)	875	875	889	889	904
FIRST CUSTOMER SHIPMENT	1979	1979	4/80	4/80	10/80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	DK 811-4	DK 811-8	H-8594-22	DKU-95 H-8595-12 H-8595-22 H-8595-32	H-8597-12 H-8597-22
DISK/TREND GROUP	6	6	7	8	9
MARKET	OEM	OEM	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	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Modified SMD	Modified SMD	IBM	IBM	IBM
CAPACITY/PERFORMANCE			1.004 MB Fixed Head Option	1.144 MB Fixed Head Option	
Total capacity (MBytes) FIXED	U: 48.0 F: 40.0	U: 89.1 F: 71.1	F: 280	F: 317.5	F: 635
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 12,800	F: 12,800	F: 16,736	F: 19,069	F: 19,069
Data surfaces per spindle	6	11	15	15	20
Heads per data surface	1	1	2	2	2
Tracks per surface	521	526	1114	1110	1666
TPI	480	480	478	478	720
BPI	7495	7495	5636	6425	6425
RPM	3521	3521	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)	25	25	20	20	20
Average rotational delay (msec)	8.5	8.5	10.1	8.3	8.3
Average access time (msec)	33.5	33.5	30.1	28.3	28.3
Data transfer rate (KByte/sec)	904	904	885	1198	1198
FIRST CUSTOMER SHIPMENT	10/80	3/82	1979	1979	4Q80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			Drive has two spindles	Drive has two spindles	Drive has two spindles

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	Modified 3350	3380	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 **RLL Code Drive has two spindles			

MANUFACTURER	HOKUSHIN ELECTRIC WORKS, LTD.	HOKUSHIN ELECTRIC WORKS, LTD.	HOKUSHIN ELECTRIC WORKS, LTD.	IBIS	IBIS
DRIVE	CD-5400	CD-8010	CD-8010P	1250	2500
DISK/TREND GROUP	2	5	5	9	9
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	200 mm OD 63.5 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Plated	Plated
DRIVE: Technology type	3330-11	3340	3340	Special	Special
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options	Priam	Priam	SMD, IBM	SMD, IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 39.78	U: 13.2	U: 11.5	U: 1,409	U: 1,409
REMOVABLE	U: 13.26	--	--	--	--
Capacity per track (Bytes)	U: 16,250	--	U: 15,151	U: 49,728	U: 49,728
Data surfaces per spindle	8	4	4	16	16
Heads per data surface	1	1	1	2	2
Tracks per surface	408	221	190	1782	1782
TPI	200	180	180	769	769
BPI	2200	7475	7475	15294	15294
RPM	2400	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	40	78 (including settling)	73 (including settling)	16	16
Average rotational delay (msec)	12.5	8.3	8.3	8.3	8.3
Average access time (msec)	52.5	86.3	81.3	24.3	24.3
Data transfer rate (KByte/sec)	312.5	900	900	3000	3000
FIRST CUSTOMER SHIPMENT	1979	3/80	11/80	1Q83	1Q83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			SA 800 dimensions		Drive has two spindles

MANUFACTURER	IBIS	IBIS	IBM	IBM	IBM
DRIVE	5000	5380-A4 5380-AA4 5380-B4 5380-BB4	1131 2310	5444-1	5444-A1
DISK/TREND GROUP	9	9	1	1	1
MARKET	OEM	PCM	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	2315	5440	5440
Generic type	Fixed	Fixed	2315	5440	5440
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Plated	Plated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Special	Special	2310	5444	5444
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD, IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 1,409	F: 1,260	--	F: 1.22	F: 1.22
REMOVABLE	--	--	F: 1.024	F: 1.22	F: 1.22
Capacity per track (Bytes)	U: 49,728	F: 47,476	F: 2,560	F: 6,144	F: 6,144
Data surfaces per spindle	16	16	2	4	4
Heads per data surface	2	2	1	1	1
Tracks per surface	1782	1772	200	100	100
TPI	769	769	100	100	100
BPI	15294	15294*	1100	2200	2200
RPM	3600	3600	1500	1500	1500
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Stepping Voice Coil	Lead Screw, Friction Drive	Lead Screw, Stepping Motor
Average positioning time (msec)	16	16	520	153	86
Average rotational delay (msec)	8.3	8.3	20	20	20
Average access time (msec)	24.3	24.3	540	173	106
Data transfer rate (KByte/sec)	3000	3000	97.5	199	199
FIRST CUSTOMER SHIPMENT	1Q83	1Q83	11/65	9/70	1971
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Drive has four spindles	Drive has two spindles *RLL Code	1130	System/3	System/3

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5444-2/3	5444-A2	5022-1	5022-2	5447-A1
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	Oxide Coated	Oxide Coated	Oxide Coated	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: 2.45	F: 2.45	F: 2.45	F: 2.45	F: 2.45
REMOVABLE	F: 2.45	F: 2.45	F: 2.45	F: 2.45	F: 2.45
Capacity per track (Bytes)	F: 6,144	F: 6,144	F: 6,144	F: 6,144	F: 6,144
Data surfaces per spindle	4	4	4	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	200	200	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, Stepping Motor
Average positioning time (msec)	269	126	269	126	126
Average rotational delay (msec)	20	20	20	20	20
Average access time (msec)	289	146	289	146	146
Data transfer rate (KByte/sec)	199	199	199	199	199
FIRST CUSTOMER SHIPMENT	1970	1971	1971	1972	1976
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/3	System/3	System/7	System/7	System/3

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5447-A2	2311-1	2311-11	2311-12	2314-1
DISK/TREND GROUP	1	--	--	--	--
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	5440	1316	1316	1316	2316
Generic type	5440	1316	1316	1316	2316
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	5444	2311	2311	2311	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 7.35	--	--	--	--
REMOVABLE	F: 2.45	F: 7.45	F: 5.4	F: 2.7	F: 29.176
Capacity per track (Bytes)	F: 6,144	F: 3,625	F: 2,700	F: 2,700	F: 7,294
Data surfaces per spindle	8	10	10	10	20
Heads per data surface	1	1	1	1	1
Tracks per surface	200	203	203	103	203
TPI	100	100	100	100	100
BPI	2200	1100	1100	1100	2200
RPM	1500	2400	2400	2400	2400
Actuator type	Lead Screw, Stepping Motor	Linear, Hydraulic	Linear, Hydraulic	Linear, Hydraulic	Linear, Hydraulic
Average positioning time (msec)	126	75	75	60	75
Average rotational delay (msec)	20	12.5	12.5	12.5	12.5
Average access time (msec)	146	87.5	87.5	72.5	87.5
Data transfer rate (KByte/sec)	199	156	156	156	312.5
FIRST CUSTOMER SHIPMENT	1976	6/65	11/70	11/70	4/65
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/3	System/360	System/360	System/360	System/360 System/370

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	2314-A 2314-B 2312 2319	5445	3330-1	3330-11	3340-A2 3340-B1 3340-B2
DISK/TREND GROUP	--	--	4	4	--
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	2316	2316	3336-1	3336-11	3348-35/70/70F
Generic type	2316	2316	3336-1	3336-11	3348
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	3330-1	3330-11	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	F: 29.176	F: 20.48	F: 100.018	F: 200.036	F: 34.9/69.8
Capacity per track (Bytes)	F: 7,294	F: 5,120	F: 13,030	F: 13,030	F: 16,736
Data surfaces per spindle	20	20	19	19	3/6
Heads per data surface	1	1	1	1	2
Tracks per surface	203	203	411	815	696
TPI	100	100	192	370	300
BPI	2200	2200	4040	4040	5636
RPM	2400	2400	3600	3600	2964
Actuator type	Linear, Hydraulic	Linear, Hydraulic	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	60	60	30	30	25
Average rotational delay (msec)	12.5	12.5	8.3	8.3	10.1
Average access time (msec)	72.5	72.5	38.3	38.3	35.1
Data transfer rate (KByte/sec)	312.5	312.5	806	806	885
FIRST CUSTOMER SHIPMENT	A-8/69 B. 2319-12/70	6/72	8/71	1973	11/73
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/360 System/370	System/3	System/370 303X Series 43XX	System/370 303X Series 43XX	System/370 System/3 System/7 303X, 43XX .502 Fixed Head with 3348-70F

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	3340-C2	5022-3	5022-4	5448	5320-XX1
DISK/TREND GROUP	--	5	5	5	5
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	3348-70	--	--	--	--
Generic type	3348	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	2314	2314	2314	Gulliver
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: 9.8	F: 3.210
REMOVABLE	F: 50.872	--	--	--	--
Capacity per track (Bytes)	F: 16,736	F: 6,144	F: 6,144	F: 6,144	F: 15,360
Data surfaces per spindle	6	2	2	8	1
Heads per data surface	2	1	1	1	2
Tracks per surface	696	200	200	200	209
TPI	300	100	100	100	300
BPI	5636	2200	2200	2200	5636
RPM	2964	1500	1500	1500	2964
Actuator type	Linear, Voice Coil	Linear, Hydraulic	Linear, Hydraulic	Linear, Hydraulic	Rotary, Voice Coil
Average positioning time (msec)	25	269	126	126	50.4
Average rotational delay (msec)	10.1	20	20	20	10.1
Average access time (msec)	35.1	289	146	146	60.5
Data transfer rate (KByte/sec)	885	199	199	199	889
FIRST CUSTOMER SHIPMENT	11/73	19/71	1971	1977	4Q76
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/3-12	System/7	System/7	System/3	System/32

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5320-XX2	5320-XX3	5320-XX4	4962-1 4962-2	4962-3 4962-4
DISK/TREND GROUP	5	5	5	5	5
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	
Total capacity (MBytes) FIXED	F: 5.053	F: 9.170	F: 13.778	F: 9.308	F: 13.962240
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	1	2	1	2
Heads per data surface	2	2	2/1	2	2/1
Tracks per surface	329	597	598/299	606	606
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)	70	72.5	40	40	40
Average rotational delay (msec)	10.1	10.1	10.1	10.1	10.1
Average access time (msec)	80.1	82.6	50.1	50.1	50.1
Data transfer rate (KByte/sec)	889	889	889	889	889
FIRST CUSTOMER SHIPMENT	1/75	1/75	2Q76	4Q76	
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/32	System/32	System/32	Series/1	Series/1

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5340-XX1	5340-XX2	5340-XX3	5247-011	5247-012
DISK/TREND GROUP	5	5	5	5	6
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	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	Gulliver	Gulliver	Gulliver	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE			(2 spindles)		
Total capacity (MBytes) FIXED	F: 8.616960	F: 13.271040	F: 27.156840	F: 15.4	F: 30.8
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 15,360	F: 15,360	F: 15,360	F: 17,408	F: 17,408
Data surfaces per spindle	2	2	2	2	4
Heads per data surface	2/1	2/1	2/1	1	1
Tracks per surface	402/201	604/302	604/302	443	443
TPI	300	300	300	523	523
BPI	5636	5636	5636	6875 FRPI 10312 BPI	6875 FRPI 10312 BPI
RPM	2964	2964	2964	3151	3151
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	35	40	40	40	40
Average rotational delay (msec)	10.1	10.1	10.1	9.52	9.52
Average access time (msec)	45.1	50.1	50.1	49.52	49.52
Data transfer rate (KByte/sec)	889	889	889	1250	1250
FIRST CUSTOMER SHIPMENT	1/78	1/78	1/78	9/82	9/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/34	System/34	System/34	Embedded Servo Shared storage for Datamaster	Embedded Servo Shared storage for Datamaster

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	676	680	4963-29A 4963-29B	4963-23A 4963-23B	4963-64A 4963-64B
DISK/TREND GROUP	6	6	5	5	6
MARKET	OEM	OEM	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	Modified 3350	Piccolo	Piccolo	Piccolo	Piccolo
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE				0.131 MB Fixed Heads	
Total capacity (MBytes) FIXED	F: 31.8 U: 38.6	F: 64.5	F: 29.327360	F: 23.461888	F: 64.520192
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 17,920 U: 21,700	F: 16,384	F: 16,384	F: 16,384	F: 16,384
Data surfaces per spindle	4	11	5	5	11
Heads per data surface	1	1	1	1	1
Tracks per surface	445	358	359	359	359
TPI	523	450	450	450	450
BPI	6875 FRPI 10312 BPI	8530	8530	8530	8530
RPM	3151	3125	3125	3125	3125
Actuator type	Linear, 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)	9.52	9.6	9.6	9.6	9.6
Average access time (msec)	49.52	36.6	36.6	36.6	36.6
Data transfer rate (KByte/sec)	1250	1031	1031	1031	1031
FIRST CUSTOMER SHIPMENT	12/82	1/82	2/79	2/79	2/79
U.S. OEM PRICE FOR 100 UNITS	$2,750	$4,375	--	--	--
COMMENTS	Embedded Servo	Embedded Servo	Series/1	Series/1	Series/1

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	4963-58A 4963-58B	5340-XX4	5340-XX5	5381- All Models	8130-A21 8130-A31 A41, A51 A61, A71
DISK/TREND GROUP	6	6	6	6	5
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		(2 spindles)		
Total capacity (MBytes) FIXED	F: 58.654720	F: 63.905792	F: 128.425984	F: 64.520192	F: 29.327360
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	11	5
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	1/79	1/79	8/79	3Q79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Series/1	System/34	System/34	System/38 5381 Processor available with up to six disk spindles	8100 System

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	8130-A22 8140-A32 A42, A52 A62, A72	8130-A23 8140-A33 A43, A53 A63, A73	8130-A24 8140-A34 A44, A54 A64, A74	8140-B51 B61 B71	8140-B52 B62 B72
DISK/TREND GROUP	5	6	6	6	6
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	.131072 MB Fixed Heads		.131072 MB Fixed Heads	.131072 MB Fixed Heads	.131072 MB Fixed Heads (2 spindles)
Total capacity (MBytes) FIXED	F: 23.461888	F: 64.520192	F: 58.654720	F: 58.654720	F: 123.174912
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	11	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	3Q79	3Q79	3Q79	4Q80	4Q80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	8100 System	8100 System	8100 System	8100 System	8100 System

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	8101-A11	8101-A13	3310-A1 3310-A2 3310-B1 3310-B2	5525-020 5525-030	5525-040 5525-050
DISK/TREND GROUP	5	6	6	5	6
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					
Total capacity (MBytes) FIXED	F: 29.327360	F: 64.520192	F: 64.520192	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	5	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	3Q79	3/79	2/80	11/80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	8100 System	8100 System	4331	5520 Admin. System	5520 Admin. System -050 Model is Dual Spindle

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	3344-B2 3344-B2F	3350-A2 3350-B2 3350-C2	3370-A1 3370-A11 3370-B1 3370-B11	3375-A1 3375-B1 3375-D1	3380-A4 3380-AA4 3380-B4
DISK/TREND GROUP	7	8	9	9	9
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	3350	3350	3370	3370	3380
Heads	Ferrite	Ferrite	Thin Film	Thin Film	Thin Film
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE	1.004 MB Fixed Head Option	1.144 MB Fixed Head Option	1.144 MB Fixed Head Option		
Total capacity (MBytes) FIXED	F: 279.558	F: 317.5	F: 571.392	F: 819.7	F: 1,260.4878
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,736	F: 19,069	F: 31,744	F: 35,616	F: 47,476
Data surfaces per spindle	15	15	12	12	15
Heads per data surface	2	2	2	2	2
Tracks per surface	1114	1110	1500	1918	1770
TPI	478	478	635	*	800
BPI	5636	6425	8128 FRPI 12134 BPI	8128 FRPI 12134 BPI	10160 FRPI 15240 BPI
RPM	2964	3600	2964	2964	3620
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Dual, Linear, Voice Coil	Dual, Linear, Voice Coil	Dual, Linear, Voice Coil
Average positioning time (msec)	25	25	20	19	16
Average rotational delay (msec)	10.1	8.4	10.1	10.1	8.3
Average access time (msec)	35.1	33.4	30.1	29.1	24.3
Data transfer rate (KByte/sec)	885	1198	1859	1859	3000
FIRST CUSTOMER SHIPMENT	2Q76	1Q76	10/79	3Q81	4Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/370 System/3 303X Series 4341 Drive has two spindles	System/370 303X Series 43XX Drive has two spindles	43X1 Series System/38	4331 4341 303X Series *Not Announced	303X Series 370/158, 158-3 370/168, 168-3 Drive has two spindles

MANUFACTURER	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.
DRIVE	5007	5006	5006H	5012H	5018H
DISK/TREND GROUP	5	5	5	5	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	133 mm OD 63.5 mm ID	133 mm OD 63.5 mm ID	133 mm OD 63.5 mm ID	133 mm OD 63.5 mm ID	133 mm OD 63.5 mm ID
Magnetic surface	Plated	Plated	Plated	Plated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IMI	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.91	U: 6.38	U: 6.38	U: 12.76	U: 19.14
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 12,000	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	4	4	2	4	6
Heads per data surface	1	1	1	1	1
Tracks per surface	144	153	306	306	306
TPI	200	200	303	303	303
BPI	8800	7800	9706	9706	9706
RPM	4800	3600	3600	3600	3600
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	165 (including settling)	167 (including settling)	100 (including settling)	100 (including settling)	100 (including settling)
Average rotational delay (msec)	6.25	8.3	8.3	8.3	8.3
Average access time (msec)	171.25	175.3	108.3	108.3	108.3
Data transfer rate (KByte/sec)	960	625	625	625	625
FIRST CUSTOMER SHIPMENT	1Q81	9/81	6/82	6/82	6/82
U.S. OEM PRICE FOR 100 UNITS	--	--	$870	$965	$1,060
COMMENTS					

MANUFACTURER	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.
DRIVE	7710	7720	7740	8740	8757
DISK/TREND GROUP	5	5	6	6	6
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	200 mm OD 63.5 mm ID	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	IMI, ANSI X3T9/1226	IMI, ANSI X3T9/1226	IMI, ANSI X3T9/1226	IMI, ANSI X3T9/1226	IMI, ANSI X3T9/1226
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.57	U: 20.95	U: 41.9	U: 41.9	U: 58.7
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,800	U: 10,800	U: 10,800	U: 10,800	U: 10,800
Data surfaces per spindle	3	5	5	5	7
Heads per data surface	1	1	1	1	1
Tracks per surface	388	388	776	776	776
TPI	300	300	600	600	600
BPI	6200	6200	6200	6200	6200
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)	35	35	50	50	50
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	43.3	43.3	58.3	58.3	58.3
Data transfer rate (KByte/sec)	648	648	648	648	648
FIRST CUSTOMER SHIPMENT	1/79	1/80	2Q81	11/82	11/82
U.S. OEM PRICE FOR 100 UNITS	$1,900	$2,290	$2,850	$2,850	$3,050
COMMENTS					

MANUFACTURER	IRWIN OLIVETTI, INC.	IRWIN OLIVETTI, INC.	IRWIN OLIVETTI, INC.	ISOTIMPEX	ISOTIMPEX
DRIVE	510	416	516	ISOT 1370	ES 5052
DISK/TREND GROUP	5	5	5	1	--
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	ES 5269	ES 5053
Generic type	Fixed	Fixed	Fixed	5440	1316
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"	14"
Magnetic surface	Plated	Plated	Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	2314	2311
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Irwin	Irwin	Irwin	Various Options	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.5	U: 16.0	U: 16.0	F: 3.125	--
REMOVABLE	--	--	--	F: 3.125	F: 7.25
Capacity per track (Bytes)	U: 9,952	U: 9,952	U: 9,952	F: 7,812	F: 3,625
Data surfaces per spindle	2	2	2	4	10
Heads per data surface	1	1	1	1	1
Tracks per surface	628	819	819	203	203
TPI	900	900	900	100	100
BPI	9124	9950	9950	2200	1100
RPM	3605	3605	3605	2400	2400
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	33	34	34	40	70
Average rotational delay (msec)	8.3	8.3	8.3	12.5	12.5
Average access time (msec)	41.3	42.3	42.3	52.5	82.5
Data transfer rate (KByte/sec)	675	675	675	312	156
FIRST CUSTOMER SHIPMENT	12/81	6/82	6/82	1976	1971
U.S. OEM PRICE FOR 100 UNITS	$2,035	$1,406	$2,212	--	--
COMMENTS	Embedded Servo Includes 6.38 MB tape cartridge drive	Embedded Servo	Embedded Servo Includes 6.38 MB tape cartridge drive		

MANUFACTURER	ISOTIMPEX	ISOTIMPEX	ISOTIMPEX	ISOTIMPEX	ISOTIMPEX
DRIVE	SM 5400-02 SM 5400-03	SM 5400-00 SM 5400-01	ES 5061	ES 5066 ES 5067.01 ES 5067.02	ES 5067
DISK/TREND GROUP	1	1	--	4	--
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	ES 5269	ES 5269	ES 5261	ES 5266	ES 5267
Generic type	5440	5440	2316	3336-1	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	2314	2314	2314	3330-1	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options	Various Options			
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 3.125	--	--	--
REMOVABLE	U: 3.125	U: 3.125	F: 29	F: 100	F: 200
Capacity per track (Bytes)	U: 7,812	U: 7,812	F: 7,294	F: 13,030	F: 13,030
Data surfaces per spindle	4	4	20	19	19
Heads per data surface	1	1	1	1	1
Tracks per surface	204	204	203	411	815
TPI	100	100	100	192	370
BPI	2200	2200	2200	4040	4040
RPM	2400/1500	2400/1500	2400	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	50	50	50	30	30
Average rotational delay (msec)	12.5/20	12.5/20	12.5	8.3	8.3
Average access time (msec)	62.5/70	62.5/70	62.5	38.3	38.3
Data transfer rate (KByte/sec)	312/195	312/195	312	806	806
FIRST CUSTOMER SHIPMENT	1979	1979	1976	1980	1980
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC	ISS/UNIVAC
DRIVE	Univac 8419	7330-11	717	Univac 8402-50	Univac 8402-75
DISK/TREND GROUP	3	4	7	6	6
MARKET	Captive	OEM, PCM, Captive	OEM	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	SMD	3336-11	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	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: 72.3	F: 200	--	--	--
Capacity per track (Bytes)	F: 16,800	F: 13,030	U: 19,968	F: 13,312	F: 13,312
Data surfaces per spindle	7	19	7	7	7
Heads per data surface	1	1	2	2	2
Tracks per surface	815	815	1120	544	816
TPI	370	370	476	476	476
BPI	5050	4040	6366	6366	6366
RPM	2800	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)	33	27	35	35	35
Average rotational delay (msec)	10.7	8.3	8.3	8.3	8.3
Average access time (msec)	43.7	35.3	43.3	43.3	43.3
Data transfer rate (KByte/sec)	784	806	1198	1198	1198
FIRST CUSTOMER SHIPMENT	12/80	2/75	1979	3/81	3/81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System 80	Equivalent to Univac 8433	Equivalent to Univac 8417	BC/7-900	BC/7-900

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	7	7	8	8	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)

MANUFACTURER	KENNEDY	KENNEDY	KENNEDY	KENNEDY	KENNEDY
DRIVE	5301-14	5303-42	5305-70	5380	53160
DISK/TREND GROUP	5	6	6	6	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"	14"
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	Kennedy	Kennedy	Kennedy	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 14.112	U: 42.336	U: 70.56	U: 82.9	U: 165.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	1	3	5	5	5
Heads per data surface	2	2	2	2	2
Tracks per surface	700	700	700	823	1646
TPI	300	300	300	430	680
BPI	6000	6000	6000	6330	6330
RPM	3000	3000	3000	3000	3000
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	45	45	45	30	35
Average rotational delay (msec)	10	10	10	10	10
Average access time (msec)	55	55	55	40	45
Data transfer rate (KByte/sec)	1000	1000	1000	1000	1000
FIRST CUSTOMER SHIPMENT	1Q78	1Q78	1Q78	3Q81	4Q82
U.S. OEM PRICE FOR 100 UNITS	$2,800	$3,200	$3,600	$3,700	$4,625
COMMENTS					

MANUFACTURER	KENNEDY	KENNEDY	KENNEDY	KENNEDY	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.
DRIVE	7340	7380	6172	6173	SA-602
DISK/TREND GROUP	6	6	5	6	5
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	200 mm OD 63.5 mm ID	210 mm OD 100 mm ID	210 mm OD 100 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	SMD, PICO, ANSI X3T9/1226	SMD, PICO, ANSI X3T9/1226	SMD, DISK BUS, ANSI X3T9/1226	SMD, DISK BUS, ANSI X3T9/1226	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 41.4	U: 82.9	U: 24.0	U: 40.0	U: 3.33
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 13,444	U: 13,444	U: 10,416
Data surfaces per spindle	5	5	3	5	2
Heads per data surface	1	1	1	1	1
Tracks per surface	411	823	600	600	160
TPI	560	960	500	500	256
BPI	9420	9420	6542	6542	7900
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Band, Rotary, Stepping Motor
Average positioning time (msec)	30	30	40	40	75 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	38.3	38.3	48.3	48.3	83.3
Data transfer rate (KByte/sec)	1209	1209	800	800	625
FIRST CUSTOMER SHIPMENT	2Q82	4Q82	4Q79	4Q81	1982
U.S. OEM PRICE FOR 100 UNITS	$2,560	$3,195	$1,895	$2,195	--
COMMENTS			Product acquired from BASF	Product acquired from BASF	Shugart Associates license

MANUFACTURER	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.
DRIVE	SA-604	SA-606	JA-900	JA-901	JA-902
DISK/TREND GROUP	5	5	5	6	5
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	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	ST 506	ST 506	SA 1000	SA 1000	SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.66	U: 10.0	U: 20.0	U: 33.3	U: 24.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 12,600
Data surfaces per spindle	4	6	3	5	3
Heads per data surface	1	1	1	1	1
Tracks per surface	160	160	640	640	640
TPI	256	256	508	508	508
BPI	7900	7900	5500	5500	6790
RPM	3600	3600	3125	3125	3125
Actuator type	Band, Rotary, Stepping Motor	Band, Rotary, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	75 (including settling)	75 (including settling)	40	40	40
Average rotational delay (msec)	8.3	8.3	9.6	9.6	9.6
Average access time (msec)	83.3	83.3	49.6	49.6	49.6
Data transfer rate (KByte/sec)	625	625	542.5	542.5	656.25
FIRST CUSTOMER SHIPMENT	1982	1982	1982	1982	1982
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Shugart Associates license	Shugart Associates license			

MANUFACTURER	MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.	MEGAVAULT	MEGAVAULT	MEGAVAULT	MEGAVAULT
DRIVE	JA-903	MV20L	MV34L	MV48L	MV22
DISK/TREND GROUP	6	5	6	6	5
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	200 mm OD 63.5 mm ID	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	SA 1000	SA 1000/ST 506	SA 1000/ST 506	SA 1000/ST 506	SMD/ANSI
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 40.0	U: 20.5	U: 34.16	U: 47.83	U: 22.3
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 12,600	U: 10,416	U: 10,416	U: 10,416	U: 11,340
Data surfaces per spindle	5	3	5	7	3
Heads per data surface	1	1	1	1	1
Tracks per surface	640	656	656	656	656
TPI	508	478	478	478	478
BPI	6790	6000	6000	6000	6500
RPM	3125	3125/3600	3125/3600	3125/3600	3600
Actuator type	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	40	45	45	45	40
Average rotational delay (msec)	9.6	8.3	8.3	8.3	8.3
Average access time (msec)	49.6	53.5	53.5	53.5	48.3
Data transfer rate (KByte/sec)	656.25	542.5/625	542.5/625	542.5/625	602
FIRST CUSTOMER SHIPMENT	1982	3/82	3/82	3/82	4Q80
U.S. OEM PRICE FOR 100 UNITS	--	$2,020	$2,200	$2,410	$2,390/$2,290
COMMENTS					

MANUFACTURER	MEGAVAULT	MEGAVAULT	MEGAVAULT	MEGAVAULT	MEGAVAULT
DRIVE	MV37	MV52	MV26	MV44	MV62
DISK/TREND GROUP	6	6	5	6	6
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	200 mm OD 63.5 mm ID	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	SMD/ANSI	SMD/ANSI	SMD/ANSI	SMD/ANSI	SMD/ANSI
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 37.2	U: 52.07	U: 26.65	U: 44.42	U: 62.19
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 11,340	U: 11,340	U: 13,545	U: 13,545	U: 13,545
Data surfaces per spindle	5	7	3	5	7
Heads per data surface	1	1	1	1	1
Tracks per surface	656	656	656	656	656
TPI	478	478	478	478	478
BPI	6500	6500	7750	7750	7750
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	40	45	45	45
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	48.3	48.3	53.3	53.3	53.3
Data transfer rate (KByte/sec)	602	602	812.5	812.5	812.5
FIRST CUSTOMER SHIPMENT	4Q80	4Q80	2/82	2/82	2/82
U.S. OEM PRICE FOR 100 UNITS	$2,600/$2,500	$2,820/$2,690	$2,390/$2,290	$2,600/$2,500	$2,820/$2,690
COMMENTS					

MANUFACTURER	MEGAVAULT	MEGAVAULT	MEGAVAULT	MEMOREX	MEMOREX
DRIVE	MV48	MV83	MV116	410	3670-1/2
DISK/TREND GROUP	6	6	7	1	4
MARKET	OEM	OEM	OEM	OEM	PCM
MEDIA: Manufacturer's number	--	--	--	--	Mark X
Generic type	Fixed	Fixed	Fixed	5.25" Cartridge	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	130 mm ID 40 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	Modified 3350	3330-1
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD/ANSI	SMD/ANSI	SMD/ANSI	Modified SA 1000	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 49.77	U: 82.95	U: 116.14	U: 6.75	--
REMOVABLE	--	--	--	U: 6.75	F: 100
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	U: 10,890	F: 13,030
Data surfaces per spindle	3	5	7	4	19
Heads per data surface	1	1	1	1	1
Tracks per surface	823	823	823	311	411
TPI	600	600	600	454	192
BPI	8850 FRPI 11500 BPI	8850 FRPI 11500 BPI	8850 FRPI 11500 BPI	8617	4040
RPM	3600	3600	3600	3443	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	45	45	45	50 (including settling)	27
Average rotational delay (msec)	8.3	8.3	8.3	8.7	8.3
Average access time (msec)	53.3	53.3	53.3	58.7	35.3
Data transfer rate (KByte/sec)	1209	1209	1209	625	806
FIRST CUSTOMER SHIPMENT	4/82	4/82	4/82	1982	10/74
U.S. OEM PRICE FOR 100 UNITS	$2,930/$2,750	$3,190/$3,020	$3,450/$3,290	--	--
COMMENTS				Licensed by DMA Systems Embedded Servo	PCM 3330-1

MANUFACTURER	MEMOREX	MEMOREX	MEMOREX	MEMOREX	MEMOREX
DRIVE	3675	677-70	677-30	101	102
DISK/TREND GROUP	4	4	4	5	5
MARKET	PCM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	Mark XI	Mark XI	Mark XIII	--	--
Generic type	3336-11	3336-11	3336-11	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	200 mm OD 100 mm ID	200 mm OD 100 mm ID
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	IBM	SMD	SMD	SA 4000	SA 4000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	U: 11.7	U: 23.4
REMOVABLE	F: 200	U: 206.0	U: 309.5	--	--
Capacity per track (Bytes)	F: 13,030	U: 13,440	U: 20,160	U: 12,000	U: 12,000
Data surfaces per spindle	19	19	19	4	8
Heads per data surface	1	1	1	1	1
Tracks per surface	815	815	823	244	244
TPI	384	370	384	195	195
BPI	4040	4040	6038	6100	6100
RPM	3600	3600	3600	2964	2964
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	27	28.5	28.5	70 (including settling)	70 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	10.1	10.1
Average access time (msec)	35.3	36.8	36.8	80.1	80.1
Data transfer rate (KByte/sec)	806	806	1209	593	593
FIRST CUSTOMER SHIPMENT	1976	1977	3Q80	2Q80	1Q81
U.S. OEM PRICE FOR 100 UNITS	--	$10,500	$9,450 $10,500	$1,450	$1,700
COMMENTS	PCM 3330-11			Manufactured by Fujitsu	Manufactured by Fujitsu

MANUFACTURER	MEMOREX	MEMOREX	MEMOREX	MEMOREX	MEMOREX
DRIVE	213	214	306	310	3644
DISK/TREND GROUP	6	6	5	5	9
MARKET	OEM	OEM	OEM	OEM	PCM
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	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	ST 506	ST 506	IBM
CAPACITY/PERFORMANCE					1.004 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 48.25	U: 84.439	U: 6.66	U: 10.0	F: 279.558
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,480	U: 20,480	U: 10,416	U: 10,416	F: 16,736
Data surfaces per spindle	4	7	4	6	15
Heads per data surface	1	1	1	1	2
Tracks per surface	589	589	160	160	1114
TPI	720	720	254	254	480
BPI	9550	9550	8020	8020	5636
RPM	3600	3600	3600	3600	2964
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Stepping Motor	Rotary, Stepping Motor	Linear, Voice Coil
Average positioning time (msec)	20	20	95 (including settling)	95 (including settling)	25
Average rotational delay (msec)	8.3	8.3	8.3	8.3	10.1
Average access time (msec)	28.3	28.3	103.3	103.3	35.1
Data transfer rate (KByte/sec)	1229	1229	625	625	885
FIRST CUSTOMER SHIPMENT	7/82	7/82	1Q82	1Q82	7/78
U.S. OEM PRICE FOR 100 UNITS	$3,550	$3,675	$750	$920	--
COMMENTS	Manufactured by Fujitsu	Manufactured by Fujitsu	Manufactured by Fujitsu	Manufactured by Fujitsu	PCM 3344

MANUFACTURER	MEMOREX	MEMOREX	MICRODATA	MICRODATA	MICROPOLIS
DRIVE	3650-A2 3650-B2 3650-C2	3652-A2 3652-B2 3652-C2	Reflex II 4721	Reflex II 4722	1302
DISK/TREND GROUP	9	9	7	7	5
MARKET	PCM	PCM	Captive, OEM	Captive, OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	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	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	SMD	SMD	ST 506
CAPACITY/PERFORMANCE	1.144 MB Fixed Head Option	1.144 MB Fixed Head Option	1.2 MB Fixed Head Option	1.2 MB Fixed Head Option	
Total capacity (MBytes) FIXED	F: 317.5	F: 635	U: 113.1	U: 158.3	U: 17.3
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 19,069	F: 19,069	U: 20,160	U: 20,160	U: 10,416
Data surfaces per spindle	15	15	5	7	2
Heads per data surface	2	2	2	2	1
Tracks per surface	1110	2220	1122	1122	830
TPI	480	960	478	478	960
BPI	6425	6425	6427	6427	9400
RPM	3600	3600	3530	3530	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	25	25	30	30	38
Average rotational delay (msec)	8.3	8.3	8.5	8.5	8.3
Average access time (msec)	33.3	33.3	38.5	38.5	46.3
Data transfer rate (KByte/sec)	1198	1198	1175	1175	625
FIRST CUSTOMER SHIPMENT	4Q77	3Q79	1979	1979	1Q83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	PCM 3350	PCM 3350 Double Density			

MANUFACTURER	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE	1303	1304	1202 ANSI	1202 SA	1203 ANSI
DISK/TREND GROUP	6	6	5	5	6
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	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	Modified 3350	Modified 3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	ANSI X3T9/1226	SA 1000	ANSI X3T9/1226
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 34.6	U: 51.9	U: 26.8	U: 20.6	U: 44.56
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 15,364	U: 10,416	U: 15,364
Data surfaces per spindle	4	6	3	3	5
Heads per data surface	1	1	1	1	1
Tracks per surface	830	830	580	660	580
TPI	960	960	478	478	478
BPI	9400	9400	5749 FRPI 8623 BPI	6154	5749 FRPI 8623 BPI
RPM	3600	3600	3600	3125	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	38	38	42	45	42
Average rotational delay (msec)	8.3	8.3	8.3	9.6	8.3
Average access time (msec)	46.3	46.3	50.3	54.6	50.3
Data transfer rate (KByte/sec)	625	625	922	542.5	922
FIRST CUSTOMER SHIPMENT	1Q83	1Q83	7/82	5/82	7/82
U.S. OEM PRICE FOR 100 UNITS	--	--	$2,192	$1,975	$2,607
COMMENTS					

MANUFACTURER		MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE		1203 SA	1221-MII	1222-MII	1223-MII	1423-MII
DISK/TREND GROUP		6	5	5	6	6
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	200 mm OD 63.5 mm ID	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	Modified 3350
	Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
	Interface	SA 1000	Micropolis Intelligent	Micropolis Intelligent	Micropolis Intelligent	Micropolis Intelligent
CAPACITY/PERFORMANCE						
Total capacity (MBytes)	FIXED	U: 34.3	U: 8.911	U: 26.73	U: 44.56	U: 74
	REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)		U: 10,416	U: 15,360	U: 15,360	U: 15,360	U: 15,364
Data surfaces per spindle		5	1	3	5	4
Heads per data surface		1	1	1	1	1
Tracks per surface		660	580	580	580	1200
TPI		478	478	478	478	960
BPI		6154	5749 FRPI 8623 BPI	5749 FRPI 8623 BPI	5749 FRPI 8623 BPI	5600 FRPI 8400 BPI
RPM		3125	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)		45	42	42	42	28
Average rotational delay (msec)		9.6	8.3	8.3	8.3	8.3
Average access time (msec)		54.6	50.3	50.3	50.3	36.3
Data transfer rate (KByte/sec)		542.5	922	922	922	922
FIRST CUSTOMER SHIPMENT		5/82	11/79	11/79	11/79	2Q83
U.S. OEM PRICE FOR 100 UNITS		$2,390	$2,048	$2,481	$2,896	--
COMMENTS						

MANUFACTURER	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE	1423-MII	1404 SMD	1406 SMD	1403 ANSI	1405 ANSI
DISK/TREND GROUP	7	6	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	200 mm OD 63.5 mm ID	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	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Micropolis Intelligent	SMD	SMD	ANSI X3T9/1226	ANSI X359/1226
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 148	U: 80	U: 160	U: 100	U: 200
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 15,364	U: 20,160	U: 20,160	U: 20,800	U: 20,800
Data surfaces per spindle	8	5	10	4	8
Heads per data surface	1	1	1	1	1
Tracks per surface	1200	823	823	1200	1200
TPI	960	960	960	960	960
BPI	5600 FRPI 8400 BPI	9287	9287	7587 FRPI 11380 BPI	7587 FRPI 11380 BPI
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)	28	26	26	28	28
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	36.3	34.3	34.3	36.3	36.3
Data transfer rate (KByte/sec)	922	1209	1209	1248	1248
FIRST CUSTOMER SHIPMENT	2Q83	2Q83	2Q83	2Q83	2Q83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	MICROPOLIS	MICROPOLIS	MINISCRIBE	MINISCRIBE	MINISCRIBE
DRIVE	1403 SA	1405 SA	Miniscribe 1006	Miniscribe 1012	Miniscribe II 2006
DISK/TREND GROUP	6	7	5	5	5
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	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
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA 1000	SA 1000	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 50	U: 100	U: 6.4	U: 12.8	U: 6.4
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	4	8	2	4	2
Heads per data surface	1	1	1	1	1
Tracks per surface	1200	1200	306	306	306
TPI	960	960	402	402	402
BPI	5690	5690	8605	8605	8280
RPM	3125	3125	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor
Average positioning time (msec)	28	28	194 (including settling)	194 (including settling)	85 (including settling)
Average rotational delay (msec)	9.6	9.6	8.3	8.3	8.3
Average access time (msec)	37.6	37.6	202.3	202.3	93.3
Data transfer rate (KByte/sec)	542.5	542.5	625	625	625
FIRST CUSTOMER SHIPMENT	2Q83	2Q83	10/81	10/81	7/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	MINISCRIBE	MINISCRIBE	MINISCRIBE	MINISCRIBE	MINISCRIBE
DRIVE	Miniscribe II 2012	Miniscribe III 3006	Miniscribe III 3010	Miniscribe IV 4010	Miniscribe IV 4020
DISK/TREND GROUP	5	5	5	5	5
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 Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.8	U: 6.4	U: 10.0	U: 10.0	U: 20.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	4	2	2	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	306	306	480	480	480
TPI	402	402	588	588	588
BPI	8280	8280	8575	8575	8575
RPM	3600	3600	3600	3600	3600
Actuator type	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor
Average positioning time (msec)	85 (including settling)	85 (including settling)	120 (including settling)	120 (including settling)	120 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	93.3	93.3	128.3	128.3	128.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	7/82	4Q82	4Q82	8/82	8/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION
DRIVE	M802F M802S	M803F M803S	M2850F	2851F	M2853F
DISK/TREND GROUP	1	2	3	3	3
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive	OEM
MEDIA: Manufacturer's number	370111	802029	50-802282	80-802282	--
Generic type	5440	5440	Trident	Trident	SMD
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	2314	3330-1	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Mitsubishi, Hawk, Diablo	Mitsubishi	Trident	Trident	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.375	U: 12.75	--	--	--
REMOVABLE	U: 6.375	U: 12.75	U: 54.7	U: 82.1	U: 55.3
Capacity per track (Bytes)	U: 7,812	U: 15,624	U: 13,440	U: 20,160	U: 13,440
Data surfaces per spindle	4	4	5	5	5
Heads per data surface	1	1	1	1	1
Tracks per surface	408	408	815	815	823
TPI	200	200	370	370	384
BPI	2211	4420	4040	6060	4040
RPM	2400	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)	45	45	30	30	30
Average rotational delay (msec)	12.5	12.5	8.3	8.3	8.3
Average access time (msec)	57.5	57.5	38.3	38.3	38.3
Data transfer rate (KByte/sec)	312.5	625	806	1209	806
FIRST CUSTOMER SHIPMENT	1974	1976	1977	1978	1980
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION
DRIVE	M2854F	M2838F	2839F	M4863-1	M4863-2
DISK/TREND GROUP	3	4	4	5	5
MARKET	OEM	OEM, Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	J20789	--	--	--
Generic type	SMD		SMD	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	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	3330-11	3330-11	3330-11	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	Trident	SMD	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	U: 3.33	U: 6.66
REMOVABLE	U: 82.9	U: 312.1	U: 315	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	U: 10,416	U: 10,416
Data surfaces per spindle	5	19	19	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	823	815	823	160	160
TPI	384	370	384	256	256
BPI	6060	6060	6060	7900	7900
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	30	30	30	75	75
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	38.3	38.3	38.3	83.3	83.3
Data transfer rate (KByte/sec)	1209	1209	1209	625	625
FIRST CUSTOMER SHIPMENT	1980	1979	4/81	2/82	2/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	$800
COMMENTS					

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION
DRIVE	M4863-3	M2860-1	M2860-2	M2883-10	M2883-20
DISK/TREND GROUP	5	5	6	5	5
MARKET	OEM	OEM	OEM	OEM, Captive	OEM, Captive
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	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3330-11	3330-11	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	Trident, SMD, SA 1000	Trident, SMD, SA 1000	Trident, SMD	Trident, SMD
CAPACITY/PERFORMANCE				0.81 MB Fixed Head Option	0.81/2.42 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 10.0	U: 21.73	U: 50.71	U: 13.47	U: 26.93
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 13,440	U: 13,440	U: 20,160	U: 20,160
Data surfaces per spindle	6	3	7	1	2
Heads per data surface	1	1	1	2	2
Tracks per surface	160	548	548	678	678
TPI	256	480	480	286	286
BPI	7900	7300	7300	6060	6060
RPM	3600	3600	3600	3000	3000
Actuator type	Rotary, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	75	35	35	38	38
Average rotational delay (msec)	8.3	8.3	8.3	10	10
Average access time (msec)	83.3	43.3	43.3	48	48
Data transfer rate (KByte/sec)	625	806	806	996	996
FIRST CUSTOMER SHIPMENT	2/82	1981	1981	4Q78	4Q78
U.S. OEM PRICE FOR 100 UNITS	$950	$2,200	$2,650	--	--
COMMENTS					

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	NEW WORLD COMPUTER CO., INC.	NEW WORLD COMPUTER CO., INC.	NEW WORLD COMPUTER CO., INC.
DRIVE	M2883-40	M2883-60	Mikro-Disc V 2/0	Mikro-Disc V 4/0	Mikro-Disc V 2/2
DISK/TREND GROUP	6	6	5	5	1
MARKET	OEM, Captive	OEM, Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--		
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed, with Removable HDA
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	Plated	Plated	Plated
DRIVE: Technology type	3340	3340	Special	Special	Special
Heads	Ferrite	Ferrite	8 Ferrite Heads Per Assembly	8 Ferrite Heads Per Assembly	8 Ferrite Heads Per Assembly
Interface	Trident, SMD	Trident, SMD	New World, ST 506, SA 1000	New World, ST 506, SA 1000	New World, ST 506, SA 1000
CAPACITY/PERFORMANCE	0.81/2.42 MB Fixed Head Option	0.81 MB Fixed Head Option			
Total capacity (MBytes) FIXED	U: 53.86	U: 80.8	U: 2	U: 4	U: 2
REMOVABLE	--	--	--	--	U: 2
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 13,000	U: 13,000	U: 13,000
Data surfaces per spindle	4	6	1	2	2
Heads per data surface	2	2	8	8	8
Tracks per surface	678	678	160	160	160
TPI	286	286	250	250	250
BPI	6060	6060	9000	9000	9000
RPM	3000	3000	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Stepping Motor	Stepping Motor	Stepping Motor
Average positioning time (msec)	38	38	28.3	28.3	28.3
Average rotational delay (msec)	10	10	8.3	8.3	8.3
Average access time (msec)	48	48	36.6	36.6	36.6
Data transfer rate (KByte/sec)	996	996	782	782	782
FIRST CUSTOMER SHIPMENT	4Q78	4Q78	3Q82	3Q82	3Q82
U.S. OEM PRICE FOR 100 UNITS	--	--	$596	$906	$1,006
COMMENTS					

MANUFACTURER	NEW WORLD COMPUTER CO., INC.	NEW WORLD COMPUTER CO., INC.	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY
DRIVE	Mikro-Disc V 4/2	Mikro-Disc V 4/4	N277 N7745	D-1210 N7721	D-1220 N7722
DISK/TREND GROUP	1	1	4	5	6
MARKET	OEM	OEM	Captive	Captive, OEM	Captive, OEM
MEDIA: Manufacturer's number			--	--	--
Generic type	Fixed, with Removable HDA	Fixed, with Removable HDA	3336-11	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"	14"	14"
Magnetic surface	Plated	Plated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Special	Special	3330-11	3350	3350
Heads	8 Ferrite Heads Per Assembly	8 Ferrite Heads Per Assembly	Ferrite	Ferrite	Ferrite
Interface	New World, ST 506, SA 1000	New World, ST 506, SA 1000	NEC	SMD	SMD
CAPACITY/PERFORMANCE				0.48/0.96 MB Fixed Head Option	0.48/0.96 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 4	U: 4	--	U: 20.8	U: 41.5
REMOVABLE	U: 2	U: 4	F: 200	--	--
Capacity per track (Bytes)	U: 13,000	U: 13,000	F: 13,030	U: 19,968	U: 19,968
Data surfaces per spindle	3	4	19	1	2
Heads per data surface	8	8	1	2	2
Tracks per surface	160	160	815	1040	1040
TPI	250	250	370	480	480
BPI	9000	9000	4040	6370	6370
RPM	3600	3600	3600	3600	3600
Actuator type	Stepping Motor	Stepping Motor	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	28.3	28.3	30	40	40
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	36.6	36.6	38.3	48.3	48.3
Data transfer rate (KByte/sec)	782	782	806	1198	1198
FIRST CUSTOMER SHIPMENT	3Q82	3Q82	11/75	9/78	9/78
U.S. OEM PRICE FOR 100 UNITS	$1,196	$1,436	--	--	--
COMMENTS					

MANUFACTURER	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY
DRIVE	D-1240 N7723	D5210	D2220 N7724	D2230 N7725	N7726 D2246
DISK/TREND GROUP	6	5	5	6	6
MARKET	Captive, OEM	OEM	OEM	OEM	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	130 mm OD 40 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	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	ST 506	SMD	SMD	SMD
CAPACITY/PERFORMANCE	0.48/0.96 MB Fixed Head Option				
Total capacity (MBytes) FIXED	U: 83.1	U: 6.38	U: 25.5	U: 42.5	U: 85
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 19,968	U: 10,416	U: 20,480	U: 20,480	U: 20,480
Data surfaces per spindle	4	4	3	5	6
Heads per data surface	2	1	1	1	1
Tracks per surface	1040	153	415	415	692
TPI	480	200	480	480	720
BPI	6370	8935	8800	8800	9040
RPM	3600	3600	3510	3510	3510
Actuator type	Rotary, Voice Coil	Rotary, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	40	102 (including settling)	30	30	26
Average rotational delay (msec)	8.3	8.3	8.55	8.55	8.55
Average access time (msec)	48.3	110.3	38.55	38.55	34.55
Data transfer rate (KByte/sec)	1198	625	1198	1198	1198
FIRST CUSTOMER SHIPMENT	9/78	7/82	3/81	3/81	5/82
U.S. OEM PRICE FOR 100 UNITS	--	--	$2,375	$2,850	$3,300
COMMENTS					

MANUFACTURER	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY
DRIVE	N7751	D-1510	N7728	JS4380N	N7755
DISK/TREND GROUP	8	8	7	8	9
MARKET	Captive	OEM	Captive	OEM	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	210 mm OD 100 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Plated	Oxide Coated
DRIVE: Technology type	3350	3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	NEC	SMD	SMD	Special NTT	NEC
CAPACITY/PERFORMANCE	1.144 MB Fixed Head Option	1.19 MB Fixed Head Option		U: 402 Per Spindle	
Total capacity (MBytes) FIXED	F: 317.5	U: 331.5	F: 170	U: 3,200 Total	F: 635
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 19,069	U: 19,968	U: 19,968 F: 19,069	U: 25,520	F: 19,069
Data surfaces per spindle	15	15	6	13	15
Heads per data surface	2	2	2	2	2
Tracks per surface	1122	1122	1508	1226	2244
TPI	480	480	680	1080	960
BPI	6400	6400	6400	13840	6400
RPM	3600	3600	3600	3000	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	20	20	25	18	20
Average rotational delay (msec)	8.3	8.3	8.3	10	8.3
Average access time (msec)	28.3	28.3	33.3	28	28.3
Data transfer rate (KByte/sec)	1198	1200	1198	1344	1198
FIRST CUSTOMER SHIPMENT	12/77	5/78	3/82	3/82	1979
U.S. OEM PRICE FOR 100 UNITS	--	$9,800	--	--	--
COMMENTS				"Patty" Drive produced for NTT. 8 spindles per drive.	

MANUFACTURER	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC COMPANY	NIPPON ELECTRIC INDUSTRY CO., LTD.	NIPPON ELECTRIC INDUSTRY CO., LTD.	NIPPON ELECTRIC INDUSTRY CO., LTD.
DRIVE	D1550	N7761	RD-5033	RD-5067	RD-5100
DISK/TREND GROUP	9	9	5	5	5
MARKET	OEM	Captive	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	Modified 3350	3380	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Thin Film	Ferrite	Ferrite	Ferrite
Interface	SMD	NEC	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE	1.19 MB Fixed Head Option				
Total capacity (MBytes) FIXED	U: 663	F: 630	U: 3.3	U: 6.7	U: 10.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 19,968	F: 49,950	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	15	7	2	4	6
Heads per data surface	2	2	1	1	1
Tracks per surface	2242	1800	160	160	160
TPI	960	820	254	254	254
BPI	6400	10133 FRPI 15200 BPI	8200	8200	8200
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	20	16	95 (including settling)	95 (including settling)	95 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	28.3	24.3	103.3	103.3	103.3
Data transfer rate (KByte/sec)	1200	3000	625	625	625
FIRST CUSTOMER SHIPMENT	1982	1983	6/82	6/82	6/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS		4 spindles per drive			

MANUFACTURER	NIPPON ELECTRIC INDUSTRY CO., LTD.	NIPPON ELECTRIC INDUSTRY CO., LTD.	NIPPON ELECTRIC INDUSTRY CO., LTD.	NIPPON ELECTRIC INDUSTRY CO., LTD.	NIPPON ELECTRIC INDUSTRY CO., LTD.
DRIVE	RD-5133	RD-8074	RD-8223	RD-8371	RD-8520
DISK/TREND GROUP	5	5	5	6	6
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	200 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 13.3	U: 7.4	U: 22.3	U: 37.1	U: 52.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 11,340	U: 11,340	U: 11,340	U: 11,340
Data surfaces per spindle	8	1	3	5	7
Heads per data surface	1	1	1	1	1
Tracks per surface	160	656	656	656	656
TPI	254	478	478	478	478
BPI	8200	6424	6424	6424	6424
RPM	3600	3600	3600	3600	3600
Actuator type	Band, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	95 (including settling)	45	45	45	45
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	103.3	53.3	53.3	53.3	53.3
Data transfer rate (KByte/sec)	625	680	680	680	680
FIRST CUSTOMER SHIPMENT	6/82	10/81	10/81	10/81	10/81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED
DRIVE	NP05-6	NP05-10	NP31-A1 NP31-A2 NP31-B1 NP31-B2	NP30-80	NP30-120
DISK/TREND GROUP	5	5	--	6	7
MARKET	OEM	OEM	PCM	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	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	Modified 3350	Modified 3350	Piccolo	Piccolo	Piccolo
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	IBM	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.66	U: 10	F: 64.5	U: 80.6	U: 120.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	F: 16,384	U: 19,800	U: 19,800
Data surfaces per spindle	4	6	11	11	11
Heads per data surface	1	1	1	1	1
Tracks per surface	160	160	360	370	555
TPI	254	254	465	479	719
BPI	8020	8020	8530	8530	8530
RPM	3600	3600	3125	3125	3125
Actuator type	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	175 (including settling)	175 (including settling)	27	27	27
Average rotational delay (msec)	8.3	8.3	9.6	9.6	9.6
Average access time (msec)	183.3	183.3	36.6	36.6	36.6
Data transfer rate (KByte/sec)	625	625	1031	1031	1031
FIRST CUSTOMER SHIPMENT	4Q81	4Q81	1Q81	1Q81	1Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			PCM 3310		

MANUFACTURER	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NIPPON PERIPHERALS LIMITED	NORTHERN TELECOM	NORTHERN TELECOM
DRIVE	NP24	NP25-A2 NP25-B2 NP25-C2	NP37-A01 NP37-B01	4518	4520 4521
DISK/TREND GROUP	7	8	9	5	5
MARKET	PCM	PCM	OEM, PCM	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	3350	3350	3370	2314	2314
Heads	Ferrite	Ferrite	Thin Film/ Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM, Special	Northern Telecom	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	F: 571.392	F: 5.3	F: 10.7
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,736	F: 19,069	F: 31,744	F: 6,656	F: 13,312
Data surfaces per spindle	15	15	12	2	2
Heads per data surface	2	2	2	1	1
Tracks per surface	1114	1110	1500	400	400
TPI	480	480	635	200	200
BPI	5636	6425	12000*	2200	4400
RPM	2964	3600	2964	2400	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Dual Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	20	20	20	50	50
Average rotational delay (msec)	10.1	8.3	10.12	12.5	12.5
Average access time (msec)	30.1	28.3	30.12	62.5	62.5
Data transfer rate (KByte/sec)	885	1198	1859	312.5	625
FIRST CUSTOMER SHIPMENT	1977	1977	1982	1975	1978
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	PCM 3344	PCM 3350	*RLL Code		

MANUFACTURER	NORTHERN TELECOM	NORTHERN TELECOM	OLIVETTI	OLIVETTI	OLIVETTI
DRIVE	Aspen I	Aspen II	HD 512/1	HD 512/2	HD 512/3
DISK/TREND GROUP	5	5	5	5	5
MARKET	Captive	Captive	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	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	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Northern Telecom	Northern Telecom	Bidirectional	Bidirectional	Bidirectional
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 11.0 U: 13.2	F: 22.0 U: 26.4	U: 4.3	U: 13.0	U: 21.7
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 14,700	U: 14,700	U: 10,080	U: 10,080	U: 10,080
Data surfaces per spindle	2	4	1	3	5
Heads per data surface	1	1	1	1	1
Tracks per surface	447	447	430	430	430
TPI	480	480	605	605	605
BPI	6250	6250	8166	8166	8166
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Torque Motor	Rotary, Torque Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	22	27	30 (including settling)	30 (including settling)	30 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	30.3	35.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	869	869	605	605	605
FIRST CUSTOMER SHIPMENT	1981	1981	1982	1982	1982
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Embedded Servo	Embedded Servo			

MANUFACTURER	OLIVETTI	OLIVETTI	OLIVETTI	OLIVETTI	OLIVETTI
DRIVE	HD 513	HD 561/2	562/11	562/12	562/13
DISK/TREND GROUP	5	5	5	5	5
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	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Special	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.2	U: 7.50	U: 3.75	U: 7.5	U: 11.25
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 9,952	U: 10,417	U: 10,417	U: 10,417	U: 10,417
Data surfaces per spindle	2	4	2	4	6
Heads per data surface	1	1	1	1	1
Tracks per surface	628	180	180	180	180
TPI	900	254	254	254	254
BPI	9124	7820	7820	7820	7820
RPM	3605	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	33	138 (including settling)	84 (including settling)	84 (including settling)	84 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	41.3	146.3	92.3	92.3	92.3
Data transfer rate (KByte/sec)	675	625	625	625	625
FIRST CUSTOMER SHIPMENT	1982	9/81	6/82	6/82	6/82
U.S. OEM PRICE FOR 100 UNITS	--	$790	$750	$880	$1,075
COMMENTS	Embedded Servo; Subsystem with tape cartridge; Licensed by Irwin International				

MANUFACTURER	OLIVETTI	OLIVETTI	OLIVETTI	OLYMPIA INTERNATIONAL	OLYMPIA INTERNATIONAL
DRIVE	HD 860/10	HD 860/20	HD 860/30	Mikro-Disc 2/0	Mikro-Disc 4/0
DISK/TREND GROUP	5	6	6	5	5
MARKET	OEM	OEM	OEM	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	130 mm OD 40 mm ID	130 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Plated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Special	Special
Heads	Ferrite	Ferrite	Ferrite	8 Ferrite Heads Per Assembly	8 Ferrite Heads Per Assembly
Interface	Bidirectional, ANSI X3T9/1226	Bidirectional, ANSI X3T9/1226	Bidirectional, ANSI X3T9/1226	Olympia	Olympia
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 11.1	U: 33.4	U: 55.7	U: 2	U: 4
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 17,800	U: 17,800	U: 17,800	U: 13,000	U: 13,000
Data surfaces per spindle	1	3	5	1	2
Heads per data surface	1	1	1	8	8
Tracks per surface	627	627	627	160	160
TPI	605	605	605	250	250
BPI	8284	8284	8284	9000	9000
RPM	3125	3125	3125	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Stepping Motor	Stepping Motor
Average positioning time (msec)	44 (including settling)	44 (including settling)	44 (including settling)	28.3	28.3
Average rotational delay (msec)	9.6	9.6	9.6	8.3	8.3
Average access time (msec)	53.6	53.6	53.6	36.6	36.6
Data transfer rate (KByte/sec)	925	925	925	782	782
FIRST CUSTOMER SHIPMENT	1982	1982	1982	1983	1983
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS				Mfg. under New World Computer license	Mfg. under New World Computer license

MANUFACTURER	OLYMPIA INTERNATIONAL	OLYMPIA INTERNATIONAL	OLYMPIA INTERNATIONAL	PERTEC	PERTEC
DRIVE	Mikro-Disc 2/2	Mikro-Disc 4/2	Mikro-Disc 4/4	D3311/D3312	D3321/D3322
DISK/TREND GROUP	1	1	1	1	1
MARKET	Captive	Captive	Captive	OEM	OEM
MEDIA: Manufacturer's number				--	--
Generic type	Fixed, with Removable HDA	Fixed, with Removable HDA	Fixed, with Removable HDA	5440	5440
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"	14"
Magnetic surface	Plated	Plated	Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Special	Special	Special	2314	2314
Heads	8 Ferrite Heads Per Assembly	8 Ferrite Heads Per Assembly	8 Ferrite Heads Per Assembly	Ferrite	Ferrite
Interface	Olympia	Olympia	Olympia	Various Options	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 2	U: 4	U: 4	--	U: 3.17
REMOVABLE	U: 2	U: 2	U: 4	U: 3.17	U: 3.17
Capacity per track (Bytes)	U: 13,000	U: 13,000	U: 13,000	U: 7,812	U: 7,812
Data surfaces per spindle	2	3	4	2	4
Heads per data surface	8	8	8	1	1
Tracks per surface	160	160	160	203	203
TPI	250	250	250	100	100
BPI	9000	9000	9000	2200	2200
RPM	3600	3600	3600	1500/2400	1500/2400
Actuator type	Stepping Motor	Stepping Motor	Stepping Motor	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	28.3	28.3	28.3	35	35
Average rotational delay (msec)	8.3	8.3	8.3	20/12.5	20/12.5
Average access time (msec)	36.6	36.6	36.6	55/47.5	55/47.5
Data transfer rate (KByte/sec)	782	782	782	195/312.5	195/312.5
FIRST CUSTOMER SHIPMENT	1983	1983	1983		
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	$3,975
COMMENTS	Mfg. under New World Computer license	Mfg. under New World Computer license	Mfg. under New World Computer license		

MANUFACTURER	PERTEC	PERTEC	PERTEC	PERTEC	PERTEC
DRIVE	D3331/D3332	D3341/D3342	D3421/D3422	D3441/D3442	D3461/D3462
DISK/TREND GROUP	1	1	1	1	2
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	2315	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	2314	2314	2314	2314	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options	Various Options	Various Options	Various Options	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 3.17	U: 6.34	U: 6.34	U: 19.03
REMOVABLE	U: 3.17	U: 3.17	U: 6.34	U: 6.34	U: 6.34
Capacity per track (Bytes)	U: 7,812	U: 7,812	U: 7,812	U: 7,812	U: 7,812
Data surfaces per spindle	2	4	4	4	8
Heads per data surface	1	1	1	1	1
Tracks per surface	203	203	406	406	406
TPI	100	100	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	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	35	35	40	40	40
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	60/52.5	60/52.5	60/52.5
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	--	$3,975	$3,975	$3,975	$4,720
COMMENTS					

MANUFACTURER	PERTEC	PERTEC	PERTEC	PERTEC	PRIAM
DRIVE	D3481/D3482	D8035	D8067	D8084	Diskos 502
DISK/TREND GROUP	2	6	6	6	6
MARKET	OEM	OEM, Captive	OEM, Captive	OEM, Captive	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	2315	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	130 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	*
DRIVE: Technology type	2314	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options	ANSI X3T9/1226	ANSI X3T9/1226	ANSI X3T9/1226	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 19.03	U: 35.56	U: 67.29	U: 84.11	U: 55.04
REMOVABLE	U: 6.34	--	--	--	--
Capacity per track (Bytes)	U: 7,812	U: 17,708	U: 17,708	U: 17,708	U: 10,416
Data surfaces per spindle	8	4	4	5	7
Heads per data surface	1	1	1	1	1
Tracks per surface	406	502	950	950	755
TPI	200	476	952	952	960
BPI	2200	8204	8204	8204	9000
RPM	1500/2400	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	40	45	45	45	35
Average rotational delay (msec)	20/12.5	8.3	8.3	8.3	8.3
Average access time (msec)	60/52.5	53.3	53.3	53.3	43.3
Data transfer rate (KByte/sec)	195/312.5	1063	1063	1063	625
FIRST CUSTOMER SHIPMENT		3/82	6/82	8/82	2Q82
U.S. OEM PRICE FOR 100 UNITS	$4,720	$2,545	$2,985	$3,250	--
COMMENTS					*Not Announced

MANUFACTURER	PRIAM	PRIAM	PRIAM	PRIAM	PRIAM
DRIVE	Diskos 1070	Diskos 3450	Diskos 7050	Diskos 804	Diskos 3350
DISK/TREND GROUP	5	6	6	7	6
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	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
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface		Priam, SMD	Priam, SMD	Priam, SMD, ANSI X3T9/1226	Priam, SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 10.8	U: 35.28	U: 70.49	U: 105.7	U: 33.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 15,151	U: 13,440	U: 13,440	U: 20,160	U: 20,160
Data surfaces per spindle	4	5	5	5	2
Heads per data surface	1	1	1	1	2/1
Tracks per surface	190	525	1049	1049	1122
TPI	180	480	960	960	480
BPI	7475	6670	6670	10000	6430
RPM	3564	3600	3600	3600	3125
Actuator type	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	73 (including settling)	42	42	40	45
Average rotational delay (msec)	8.4	8.3	8.3	8.3	9.7
Average access time (msec)	81.4	50.3	50.3	48.3	54.7
Data transfer rate (KByte/sec)	900	800	800	1209	1040
FIRST CUSTOMER SHIPMENT		4Q80	4Q81	1Q82	8/79
U.S. OEM PRICE FOR 100 UNITS	$1,515	$2,325	$3,240	--	$2,000
COMMENTS	Mfg. by Hokushin			*Not Announced	

MANUFACTURER	PRIAM	PRIAM	QUANTUM	QUANTUM	QUANTUM
DRIVE	Diskos 6650	Diskos 15450	Q2010	Q2020	Q2030
DISK/TREND GROUP	6	7	5	5	6
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	Modified 3350	Modified 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	$2,660	$4,095	$1,400	$1,750	$2,100
COMMENTS					

MANUFACTURER	QUANTUM	RODIME	RODIME	RODIME	RODIME
DRIVE	Q2040	RO 101	RO 201	RO 202	RO 203
DISK/TREND GROUP	6	5	5	5	5
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	Modified 3350	Modified 3350	Modified 3350	Modified 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: 6.67	U: 13.33	U: 20.0
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	2	4	6
Heads per data surface	1	1	1	1	1
Tracks per surface	512	192	320	320	320
TPI	345	260	360	360	360
BPI	6600	8060	8720	8720	8720
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)	90 (including settling)	90 (including settling)	90 (including settling)
Average rotational delay (msec)	10	8.3	8.3	8.3	8.3
Average access time (msec)	75	93.3	98.3	98.3	98.3
Data transfer rate (KByte/sec)	543	625	625	625	625
FIRST CUSTOMER SHIPMENT	1Q81	6/81	3Q82	3Q82	3Q82
U.S. OEM PRICE FOR 100 UNITS	$2,450	$850	$720	$890	$1,060
COMMENTS					

MANUFACTURER	RODIME	RODIME	RODIME	ROTATING MEMORY SYSTEMS	ROTATING MEMORY SYSTEMS
DRIVE	RO 204	RO 206	RO 208	RMS 504	RMS 509
DISK/TREND GROUP	5	6	6	5	5
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 Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 26.67	U: 40.0	U: 53.34	U: 4.5	U: 9.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,417	U: 10,417
Data surfaces per spindle	8	6	8	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	320	640	640	216	216
TPI	360	600	600	270	270
BPI	8720	10200	10200	8944	8944
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	90 (including settling)	90 (including settling)	90 (including settling)	83 (including settling)	83 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	98.3	98.3	98.3	91.3	91.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	3Q82	4Q82	4Q82	10/81	10/81
U.S. OEM PRICE FOR 100 UNITS	$1,285	--	--	$905	$1,140
COMMENTS					

MANUFACTURER	ROTATING MEMORY SYSTEMS	ROTATING MEMORY SYSTEMS	ROTATING MEMORY SYSTEMS	ROTATING MEMORY SYSTEMS	ROTATING MEMORY SYSTEMS
DRIVE	RMS 513	RMS 518	RMS 507	RMS 514	RMS 519
DISK/TREND GROUP	5	5	5	5	5
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 Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 13.5	U: 18.0	U: 6.38	U: 12.75	U: 19.13
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,417	U: 10,417	U: 10,417	U: 10,417	U: 10,417
Data surfaces per spindle	6	8	2	4	6
Heads per data surface	1	1	1	1	1
Tracks per surface	216	216	306	306	306
TPI	270	270	383	383	383
BPI	8944	8944	8944	8944	8944
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	83 (including settling)	83 (including settling)	90 (including settling)	90 (including settling)	90 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	91.3	91.3	98.3	98.3	98.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	10/81	10/81	9/82	9/82	9/82
U.S. OEM PRICE FOR 100 UNITS	$1,305	$1,460	$935	$1,165	$1,330
COMMENTS					

MANUFACTURER	ROTATING MEMORY SYSTEMS	SEAGATE TECHNOLOGY	SEAGATE TECHNOLOGY	SEAGATE TECHNOLOGY	SEAGATE TECHNOLOGY
DRIVE	RMS 526	ST 706	ST 506	ST 406	ST 412
DISK/TREND GROUP	5	1	5	5	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	5.25" Cartridge	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 Coated	Plated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3370	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Thin Film	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 25.5	--	U: 6.38	U: 6.38	U: 12.76
REMOVABLE	--	U: 6.38	--	--	--
Capacity per track (Bytes)	U: 10,417	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	8	2	4	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	306	306	153	306	306
TPI	383	270	255	345	345
BPI	8944	10202	7690	9074	9074
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	90 (including settling)	100 (including settling)	170 (including settling)	100 (including settling)	100 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	98.3	108.3	178.3	108.3	108.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	9/82	1Q83	7/80	3Q82	2/82
U.S. OEM PRICE FOR 100 UNITS	$1,485	--	$1,000	$850	$1,030
COMMENTS					

MANUFACTURER	SEAGATE TECHNOLOGY	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SHUGART ASSOCIATES
DRIVE	ST 419	SA 604	SA 606	SA 1002	SA 1004
DISK/TREND GROUP	5	5	5	5	5
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	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	SA 1000 Type	SA 1000 Type	SA 1000	SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 19	U: 6.66	U: 10.0	U: 5.33	U: 10,67
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,400	U: 10,400	U: 10,400	U: 10,400
Data surfaces per spindle	6	4	6	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	306	160	160	256	256
TPI	345	256	256	172	172
BPI	9074	7900	7900	6270	6270
RPM	3600	3600	3600	3125	3125
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	100 (including settling)	99 (including settling)	99 (including settling)	70 (including settling)	70 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	9.6	9.6
Average access time (msec)	108.3	107.3	107.3	79.6	79.6
Data transfer rate (KByte/sec)	625	625	625	542.5	542.5
FIRST CUSTOMER SHIPMENT	3Q82			4Q79	4Q79
U.S. OEM PRICE FOR 100 UNITS	$1,250	$1,090	$1,275	$1,140	$1,400
COMMENTS					

MANUFACTURER	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SHUGART ASSOCIATES	SIEMENS
DRIVE	SA 1104	SA 1106	SA 4004	SA 4008	3455
DISK/TREND GROUP	5	6	5	5	4
MARKET	OEM	OEM	OEM	OEM	Captive
MEDIA: Manufacturer's number	--	--	--	--	V26374-Q7
Generic type	Fixed	Fixed	Fixed	Fixed	Special
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	3340	3340	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA 1000	SA 1000	SA 4000	SA 4000	Siemens
CAPACITY/PERFORMANCE			0.144 MB Fixed Head Option	0.144 MB Fixed Head Option	
Total capacity (MBytes) FIXED	U: 20.3	U: 33.9	U: 14.5	U: 29.0	--
REMOVABLE	--	--	--	--	F: 71.8
Capacity per track (Bytes)	U: 10,400	U: 10,400	U: 18,000	U: 18,000	F: 19,750
Data surfaces per spindle	3	5	2	4	9
Heads per data surface	1	1	2	2	1
Tracks per surface	650	650	404	404	404
TPI	500	500	172	172	192
BPI	6006	6006	5534	5534	6060
RPM	3125	3125	2964	2964	2400
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil
Average positioning time (msec)	35	35	65 (including settling)	65 (including settling)	25
Average rotational delay (msec)	9.6	9.6	10.1	10.1	12.5
Average access time (msec)	44.6	44.6	75.1	75.1	37.5
Data transfer rate (KByte/sec)	542.5	542.5	887.5	887.5	806
FIRST CUSTOMER SHIPMENT	11/81	11/80	3Q78	3Q78	9/75
U.S. OEM PRICE FOR 100 UNITS	$1,920	$2,300	$1,600	$2,000	--
COMMENTS					

MANUFACTURER	SIEMENS	SIEMENS	SIEMENS	STORAGE TECHNOLOGY CORPORATION	STORAGE TECHNOLOGY CORPORATION
DRIVE	3465	3468	3470 3472	8350-A2 8350-B2 8350-C2	8650-A2 8650-B2
DISK/TREND GROUP	4	4	8	8	9
MARKET	Captive	Captive	Captive	PCM	PCM
MEDIA: Manufacturer's number	V26374-Q9	--	--	--	--
Generic type	Special	3336-11	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	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Siemens	Siemens	Siemens	IBM	IBM
CAPACITY/PERFORMANCE			1.115 MB Fixed Head Option	1.144 MB Fixed Head Option	1.144 MB Fixed Head Option
Total capacity (MBytes) FIXED	--	--	F: 420.25	F: 317.5	F: 635
REMOVABLE	F: 143.6	F: 303.2	--	--	--
Capacity per track (Bytes)	F: 19,750	F: 19,750	F: 16,384	F: 19,069	F: 19,069
Data surfaces per spindle	9	19	19	15	15
Heads per data surface	1	1	2	2	2
Tracks per surface	808	808	1350	1110	2220
TPI	384	384	590	480	957
BPI	6060	6060	6060	6425	6425
RPM	2400	2400	2400	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	20	25	18
Average rotational delay (msec)	12.5	12.5	12.5	8.3	8.3
Average access time (msec)	37.5	37.5	32.5	33.3	26.3
Data transfer rate (KByte/sec)	806	806	806	1198	1198
FIRST CUSTOMER SHIPMENT	12/76	1977	10/78	4/77	5/79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			3472 is dual spindle drive with 840 MB total capacity	PCM 3350 Drive has two spindles	PCM 3350 Drive has two spindles

MANUFACTURER	STORAGE TECHNOLOGY CORPORATION	STORAGE TECHNOLOGY CORPORATION	STORAGE TECHNOLOGY CORPORATION	STORAGE TECHNOLOGY CORPORATION	SYQUEST TECHNOLOGY
DRIVE	8360-A2 8360-B2	8775	8370-A1 8370-AA1 8370-B1 8370-BB1	3380-A4 8380-AA4 3380-B4	SQ-306F
DISK/TREND GROUP	9	9	9	9	5
MARKET	PCM	OEM	PCM	PCM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	100 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	3370	3380	Special
Heads	Ferrite	Ferrite	Thin Film	Thin Film	Ferrite
Interface	IBM	SMD	IBM	IBM	ST 506
CAPACITY/PERFORMANCE	1.144 MB Fixed Head Option				
Total capacity (MBytes) FIXED	F: 317.5	U: 673.95	F: 571	F: 1,260	U: 6.38
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 19,069	U: 19,969	U: 31,744	F: 47,476	U: 10,416
Data surfaces per spindle	15	15	12	15	2
Heads per data surface	2	2	2	2	1
Tracks per surface	1110	2250	1500	1770	306
TPI	957	957	635	*	435
BPI	6425	6425	8128 FRPI 12134 BPI	*	12000
RPM	3600	3600	2964	3620	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Dual, Linear, Voice Coil	Dual, Linear, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	23	23	20	16	90 (including settling)
Average rotational delay (msec)	8.3	8.3	10.1	8.3	8.3
Average access time (msec)	31.3	31.3	30.1	24.3	98.3
Data transfer rate (KByte/sec)	1198	1198	1859	3000	625
FIRST CUSTOMER SHIPMENT	2Q81	9/82	1982	1983	7/82
U.S. OEM PRICE FOR 100 UNITS	--	$13,750	--	--	$600
COMMENTS	PCM 3350 Drive has two spindles		PCM 3370	PCM 3380 Drive has two spindles *Not Announced	Embedded Servo 1.625" high

MANUFACTURER	SYQUEST TECHNOLOGY	TANDON	TANDON	TANDON	TANDON
DRIVE	SQ-306R	TM 501	TM 502	TM 503	TM 703
DISK/TREND GROUP	1	5	5	5	6
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Unique Cartridge	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	100 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	Special	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 6.38	U: 12.75	U: 19.14	U: 31.25
REMOVABLE	U: 6.38	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	2	2	4	6	5
Heads per data surface	1	1	1	1	1
Tracks per surface	306	306	306	306	600
TPI	435	345	345	345	600
BPI	12000	9074	9074	9074	10000
RPM	3600	3600	3600	3600	3600
Actuator type	Band, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Voice Coil
Average positioning time (msec)	90 (including settling)	206 (including settling)	206 (including settling)	206 (including settling)	39 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	98.3	214.3	214.3	214.3	47.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	7/82	1/83	1/83	1/83	1/83
U.S. OEM PRICE FOR 100 UNITS	$600	$705	$890	$1,055	$1,950 (1 unit)
COMMENTS	Embedded Servo 1.625" high				

MANUFACTURER	TANDON	TANDON	TANDON	TEAC	TEAC
DRIVE	TM 602	TM 603	TM 603E	SD 506	SD 412
DISK/TREND GROUP	5	5	5	5	5
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 Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	ST 506	ST 506	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.4	U: 9.6	U: 14.3	U: 6.38	U: 12.76
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,417	U: 10,417
Data surfaces per spindle	4	6	6	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	153	153	230	153	306
TPI	255	255	255	255	345
BPI	7690	7690	9625	7690	9074
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	168 (including settling)	168 (including settling)	225 (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)	176.3	176.3	233.3	178.3	178.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	12/80	12/80	12/80	3Q82	3Q82
U.S. OEM PRICE FOR 100 UNITS	$915	$1,060	$1,200	--	--
COMMENTS				Licensed by Seagate	Licensed by Seagate

MANUFACTURER	TECSTOR	TECSTOR	TECSTOR	TECSTOR	TECSTOR
DRIVE	Sapphire 85	Sapphire 165	Sapphire 200	Sapphire 315	Sapphire 330
DISK/TREND GROUP	7	8	8	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	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 82.9	U: 165.9	U: 199.1	U: 315.2	U: 331.8
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	2.5	5	6	9.5	10
Heads per data surface	2	2	2	2	2
Tracks per surface	1646	1646	1646	1646	1646
TPI	680	680	680	680	680
BPI	6450	6450	6450	6450	6450
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)	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	1209
FIRST CUSTOMER SHIPMENT	2/82	12/81	6/82	11/82	11/82
U.S. OEM PRICE FOR 100 UNITS	$4,899	$5,450	$6,000	$6,551	$6,551
COMMENTS					

MANUFACTURER	TEXAS INSTRUMENTS	TEXAS INSTRUMENTS	TEXAS INSTRUMENTS	TEXAS INSTRUMENTS	TEXAS INSTRUMENTS
DRIVE	525/62	525/61	525/122	WD 800-18	WD 800-43
DISK/TREND GROUP	5	5	5	5	6
MARKET	OEM, Captive	OEM	OEM	Captive	Captive
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	Plated	Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA 1000, ST 506	SA 1000, ST 506	SA 1000, ST 506	T.I.	T.I.
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.38	U: 6.38	U: 12.75	F: 18	F: 43
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	F: 9,288	F: 9,288
Data surfaces per spindle	4	2	4	3	7
Heads per data surface	1	1	1	1	1
Tracks per surface	153	306	306	656	656
TPI	254	400	400	478	478
BPI	7690	9200	9200	6500	6500
RPM	3600	3600	3600	3600	3600
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	170 (including settling)	115 (including settling)	115 (including settling)	40	40
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	178.3	123.3	123.3	48.3	48.3
Data transfer rate (KByte/sec)	625	625	625	602	602
FIRST CUSTOMER SHIPMENT	3Q81	3Q82	3Q82	4/82	4/82
U.S. OEM PRICE FOR 100 UNITS	$820	$820	$1,055	--	--
COMMENTS	Mfg. under Seagate license			DS990 Models Mfg. under Megavault license	DS990 Models Mfg. under Megavault license

MANUFACTURER	3M COMPANY	3M COMPANY	3M COMPANY	TOKICO	TOKICO
DRIVE	8431	8432	8533	DK 501-1	DK 501-2
DISK/TREND GROUP	5	5	6	5	5
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	3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ANSI X3T9/1226	ANSI X3T9/1226	ANSI X3T9/1226	ST 506	ST 506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 10.03	U: 20.07	U: 60	U: 6.66	U: 10.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 17,920	U: 17,920	U: 17,920	U: 10,416	U: 10,416
Data surfaces per spindle	2	4	4	4	6
Heads per data surface	1	1	1	1	1
Tracks per surface	280	280	838	160	160
TPI	219	219	693	254	254
BPI	8649	8649	8555	7800	7800
RPM	3125	3125	3125	3600	3600
Actuator type	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Voice Coil	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	65	65	29	78 (including settling)	78 (including settling)
Average rotational delay (msec)	9.6	9.6	9.6	8.3	8.3
Average access time (msec)	74.6	74.6	38.6	86.3	86.3
Data transfer rate (KByte/sec)	933.3	933.3	933.3	625	625
FIRST CUSTOMER SHIPMENT	4/81	4/81	1/82	4Q82	4Q82
U.S. OEM PRICE FOR 100 UNITS	$1,525	$1,735	$3,380	$750	$850
COMMENTS					

MANUFACTURER	TOKICO	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION
DRIVE	DK 501-3	MK-800R-32	MK-800R-64	MK-800R-96	DSU-450
DISK/TREND GROUP	5	2	2	2	4
MARKET	OEM	OEM, Captive	OEM, Captive	OEM, Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	CMD	CMD	CMD	3336-11
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	Modified 3350	3330-11	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST 506	SMD	SMD	SMD	Toshiba
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 13.3	U: 16.289	U: 48.868	U: 80.446	--
REMOVABLE	--	U: 16.289	U: 16.289	U: 16.289	F: 200
Capacity per track (Bytes)	U: 10,416	U: 20,160	U: 20,160	U: 20,160	F: 13,030
Data surfaces per spindle	8	1 Fixed 1 Removable	3 Fixed 1 Removable	5 Fixed 1 Removable	19
Heads per data surface	1	2 Fixed 1 Removable	2 Fixed 1 Removable	2 Fixed 1 Removable	1 1
Tracks per surface	160	823	823	823	815
TPI	254	367 Fixed 384 Removable	367 Fixed 384 Removable	367 Fixed 384 Removable	370
BPI	7800	6274 Fixed 6038 Removable	6274 Fixed 6038 Removable	6274 Fixed 6038 Removable	4040
RPM	3600	3600	3600	3600	3600
Actuator type	Band, Stepping Motor	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)	78 (including settling)	30	30	30	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	86.3	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	625	1209	1209	1209	806
FIRST CUSTOMER SHIPMENT	4Q82	2Q80	2Q80	2Q80	1975
U.S. OEM PRICE FOR 100 UNITS	$1,000	--	--	--	--
COMMENTS					

MANUFACTURER	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION
DRIVE	MK-100F	MK-300F	MK80F-10	MK80F-20	MK80F-30
DISK/TREND GROUP	5	6	5	5	6
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	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	3340	3340	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Toshiba	Toshiba	SMD	SMD	SMD
CAPACITY/PERFORMANCE		.262 MB Fixed Head Option			
Total capacity (MBytes) FIXED	U: 12.0 F: 10.2	U: 36.0 F: 30.6	U: 15.3	U: 23.0	U: 38.3
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 16,384	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	1	3	2	3	5
Heads per data surface	630	630	1	1	1
Tracks per surface	318	318	380	380	380
TPI	5940	5940	450	450	450
BPI	2800	2800	8824	8824	8824
RPM	40	40	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	40	40	40	40
Average rotational delay (msec)	10.8	10.8	8.3	8.3	8.3
Average access time (msec)	50.8	50.8	48.3	48.3	48.3
Data transfer rate (KByte/sec)	896	896	1210	1210	1210
FIRST CUSTOMER SHIPMENT	1977	1977	2Q81	2Q81	2Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	TOSHIBA	TOSHIBA	VERMONT RESEARCH	VERMONT RESEARCH	VERMONT RESEARCH
DRIVE	MK182-F	MK184-F	8010	8520	5017-4
DISK/TREND GROUP	6	7	1	2	2
MARKET	OEM, Captive	OEM, Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	8610	8610	VRC 5517
Generic type	Fixed	Fixed	8" Cartridge	8" Cartridge	5440
Nominal disk diameter	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	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	VRL, SASI, ANSI X3T9/1226	VRL, SASI, ANSI X3T9/1226	VRL, ANSI X3T9/1226
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 83.0	U: 116.1	--	F: 9.7	F: 26.2
REMOVABLE	--	--	F: 9.7	F: 9.7	F: 26.2
Capacity per track (Bytes)	U: 20,160	U: 20,160	F: 8,192	F: 8,192	F: 12,800
Data surfaces per spindle	5	7	2	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	823	823	596	596	1024
TPI	900	900	500	500	500
BPI	6000 FRPI 9000 BPI	6000 FRPI 9000 BPI	6000	6000	4000
RPM	3600	3600	3600	3600	3165
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	40	40	33	42	45
Average rotational delay (msec)	8.3	8.3	8.3	8.3	9.5
Average access time (msec)	48.3	48.3	41.3	50.3	54.5
Data transfer rate (KByte/sec)	1210	1210	500	500	673
FIRST CUSTOMER SHIPMENT	2Q83	2Q83	3Q82	3Q82	1975
U.S. OEM PRICE FOR 100 UNITS	--	--	$2,850	$3,850	$13,065
COMMENTS			Embedded Servo	Embedded Servo	Embedded Servo

MANUFACTURER		WESTERN DYNEX	WESTERN DYNEX	WESTERN DYNEX	WESTERN DYNEX	WESTERN DYNEX
DRIVE		WD-505	DD-6121	DD-6221	DD-6122	DD-6222
DISK/TREND GROUP		1	1	1	1	1
MARKET		OEM	OEM	OEM	OEM	OEM
MEDIA:	Manufacturer's number	--	--	--	--	--
	Generic type	5.25" Cartridge	2315/5440	2315/5440	2315/5440	2315/5440
	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	Modified 3350	2314	2314	2314	2314
	Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
	Interface	ST 506	Various Options	Various Options	Various Options	Various Options
CAPACITY/PERFORMANCE						
Total capacity (MBytes)	FIXED	--	--	U: 3.13	--	U: 6.25
	REMOVABLE	U: 6.38	U: 3.13	U: 3.13	U: 6.25	U: 6.25
Capacity per track (Bytes)		U: 10,416	U: 7,812	U: 7,812	U: 7,812	U: 7,812
Data surfaces per spindle		2	2	4	2	4
Heads per data surface		1	1	1	1	1
Tracks per surface		306	203	203	406	406
TPI		345	100	100	200	200
BPI		9022	2200	2200	2200	2200
RPM		3600	1500/2400	1500/2400	1500/2400	1500/2400
Actuator type		Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)		45 (including settling)	35	35	35	35
Average rotational delay (msec)		8.3	20/12.5	20/12.5	20/12.5	20/12.5
Average access time (msec)		53.3	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		4Q82	1972	1972	1973	1973
U.S. OEM PRICE FOR 100 UNITS		$875	--	--	--	F-$2,533 T-$2,458
COMMENTS						

MANUFACTURER PROFILES

1982 DISK/TREND REPORT

MANUFACTURER PROFILES

All manufacturers now producing moving head disk drives, or which have indicated specific plans to enter the market, are listed in this section. The heading "1981 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. "1981 total net sales" covers the fiscal year ending in 1981 for each firm unless noted otherwise, or for the parent company if the disk drive manufacturer is a subsidiary. Northern Telecom is listed with the U.S. firms for convenience.

U.S. Manufacturers

ALPHA DATA, INC.
20750 Marilla Street
Chatsworth, CA 91311 213/882-6500

1981 disk sales: None

Alpha Data is a privately held manufacturer of head-per-track disk drives. The firm has announced several variations of a 14" moving head drive to use plated disks, but each of the drives announced during the last few years has been changed before shipments actually began. In 1982, Alpha Data announced another version of the drive, this time with 128 MB and 18 ms average access time.

AMPEX CORPORATION
Subsidiary of Signal Companies, Inc.
401 Broadway
Redwood City, CA 94063 415/367-2011

1981 disk sales: $35,000,000
1981 total net sales: $5,342,600,000 Net income: $214,000,000

Following Signal's acquisition of Ampex in early 1981, the firm has continued to invest in development of the existing Ampex disk drive operations, in an attempt to position the company for future growth. Most Ampex disk drive revenues continue to be derived from its older OEM 80 MB and 300 MB SMD 14" disk pack drives. The company sees its future in 14",

8" and 5.25" fixed Winchester drives, with an emphasis on higher performance OEM markets. Internally developed 14" and 8" fixed drives have already been introduced, and a license secured from Rodime for 5.25" Winchesters which will initially be resold, then internally manufactured.

APPLIED INFORMATION MEMORIES
776 Sycamore Drive
Milpitas, CA 95035 408/263-9321

1981 disk sales: None

AIM was started in mid-1982 to develop high capacity 5.25" fixed disk drives using perpendicular recording technology. Key founders are from Ibis and Memorex. The firm plans to manufacture its own recording disks using sputtering techniques of its own design.

APPLIED PERIPHERAL SYSTEMS
Subsidiary of Dysan Corporation
555 East Brokaw Road
San Jose, CA 95112 408/995-6700

1981 disk sales: None
1981 total net sales: $104,202,000 Net income: $5,158,000

Applied Peripheral Systems was established in 1982, when Dysan split Dastek into two entities: Development and manufacture of thin film heads stayed with Dastek, and the previously announced disk drives became the responsibility of APS. The firm's OEM 14" fixed disk drives offer 200 to 400 MB capacities, using thin film heads with oxide coated Dysan disks, and with transfer rates up to 2 MB/second. Evaluation units are in the field, but orders have not yet been announced.

ATASI CORPORATION
2075 Zanker Road
San Jose, CA 95131 408/995-0335

1981 disk sales: None

Atasi is a privately held firm started in 1981 by disk industry veterans to manufacture high capacity 5.25" Winchester fixed drives. Products with capacities from 19 to 46 MB were announced in mid-1982 for 1982 delivery. Atasi's drives are aimed at the high performance end of the 5.25" market, with 33 ms average access times, using linear voice coil actuators.

BALL COMPUTER PRODUCTS
Division of Ball Corporation
P.O. Box 589
Broomfield, CO 80020 303/469-5511

1981 disk sales: $7,700,000
1981 total net sales: $815,182,000 Net income: $29,246,000

After Ball dropped its development program for 14" OEM Winchester disk drives in early 1981, operations were consolidated in Boulder, Colorado. The company now manufactures 50 and 80 MB SMD type drives, supplemented by 100 and 160 MB versions using the same five data surface configuration. Ball's major sales successes have been in Europe.

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

1981 disk sales: $183,100,000
1981 total net sales: $3,318,491,000 Net income: $615,794,000

After many years of captive disk drive production, Burroughs acquired Memorex in late 1981, thus becoming a major participant in the PCM market. Specific Memorex disk drive operations are covered separately in this DISK/TREND Report. Burroughs' 1981 disk declined sharply, as production for several older captive drives dropped to low levels. Sales in the OEM market consisted of very small shipments of an 80 MB 14" fixed disk drive, Burroughs' only Winchester technology drive prior to the Memorex acquisition. Following the acquisition, Burroughs disk drive operations at Westlake Village, California, and Winnipeg, Canada, were consolidated with Memorex, and the Glenrothes, Scotland, facility is being closed down. Future Burroughs large disk drives will come from the Memorex product lines, and controller development programs are underway to make possible the attachment of Memorex IBM compatible drives to Burroughs systems.

CENTURY DATA SYSTEMS, INC.
Subsidiary of Xerox Corporation
1270 North Kraemer Boulevard
Anaheim, CA 92806 714/632-0400

1981 disk sales: $81,700,000
1981 total net sales: $8,691,000,000 Net income: $598,200,000

Century's total sales have been static in the last few years, with products in production before the acquisition by Xerox in 1979 still providing most of the revenue. The 80 and 300 MB Trident drives (SMD type) are the main products, followed by the 14" Marksman Winchester series. Disk cartridge drives, inherited from Xerox' Diablo subsidiary, were phased out last year. Century is pinning its future hopes on the 190 and 380 MB 14" Winchester drives introduced last year, plus the 48 MB 8" disk cartridge drive announced in mid-1982.

CIPHER DATA PRODUCTS,INC.
10225 Willow Creek Road
San Diego, CA 92131 714/578-9100

1981 disk sales: $9,300,000
1981 total net sales: $22,815,000 Net income: $75,000

The 14" disk cartridge product line acquired by Cipher in late 1981 from Perkin-Elmer is now a mere shadow of the original product group, originally developed by Wangco several years earlier. These products are late in their product life cycle, and the 8" disk cartridge drives under development during Perkin-Elmer's ownership have not been brought to the market. Cipher has indicated that it does not intend to invest further in the 8" disk cartridge program.

COMPUTER MEMORIES, INC.
9233 Eton Avenue
Chatsworth, CA 91311 213/709-6445

1981 disk sales: $900,000
1981 total net sales: None (FY end 3/31/81) Net income: ($28,000)

CMI started shipments of 5.25" fixed Winchester drives in 1981, and in early 1981 brought its product line into conformance with the Seagate specifications. A 40 MB version has been announced for delivery in late 1982. CMI has been successful in obtaining a stable customer base, and one of those customers, Intel Corporation, has purchased 20% of the company, along with rights to manufacture CMI products.

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

1981 disk sales: $1,091,700,000
1981 total net sales: $3,101,300,000 Net income: $170,600,000

In 1981 Control Data was the worldwide revenue leader for OEM disk drives in six of the nine DISK/TREND rigid disk product groups, and captured over half of all worldwide OEM revenue for rigid disk drives. Building on successful product lines in 14" disk cartridges, storage module drives, large disk pack drives, plus mid-range and large fixed disk drives, CDC has now introduced smaller diameter drives in most of the same product areas. Currently, many of the older OEM drives have peaked in shipments because of competition from newer configurations and the recession's effects on many of Control Data's key minicomputer based OEM customers. However, most of the new CDC drives will be in production by early next year and are being well received by the firm's large, loyal customer base -- so 1983 is expected to be a good growth year. Disk drives sold by Control Data are designed and manufactured by Magnetic Peripherals, Inc., a joint venture with ownership shared primarily 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 captive CDC drives for the purposes of DISK/TREND statistics. Captive drives for both parents are a significant portion of MPI shipments. Control Data is also a major participant in the PCM market, but 1981 revenue growth was flat, presumably the result of internal decisions to place emphasis on OEM and captive requirements during a year when production capacity was completely utilized.

DATA GENERAL CORPORATION
4400 Computer Drive
Westboro, MA 01581 617/366-8911

1981 disk sales: $123,400,000
1981 total net sales: $736,872,000 Net income: $50,663,000

Data General manufactured all disk drive requirements internally for years, covering its requirements with several captive disk cartridge, disk pack and small 14" Winchester drives. In late 1981, however, the company added a higher capacity Control Data OEM 14" Winchester to its product line, perhaps signalling a change in philosophy toward internal disk drive manufacture.

DATA PERIPHERALS CORPORATION
Subsidiary of Computer & Communications
Technology Corporation
965 Stewart Drive
Sunnyvale, CA 94086 408/745-6500

1981 disk sales: $1,200,000
1981 total net sales: $61,711,000 Net income: $6,208,000

Data Peripherals, a pioneer in developing the market for OEM 8" disk cartridge drives, has been shipping since mid 1981, and in late 1981 added a 46 MB 8" fixed disk drive as a companion product. The firm is owned by CCT, the parent company of Information Magnetics, a leading magnetic recording head manufacturer. As this edition of DISK/TREND is being prepared for release, CCT has announced that Data Peripherals and Rotating Memory Systems, a recently acquired manufacturer of 5.25" Winchester drives, will be consolidated, with the new organization to be known as Disctron, Inc., and that the new firm will be located at the RMS facilities in Milpitas, California.

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

1981 disk sales: $27,500,000
1981 total net sales: $396,220,000 Net income: $48,761,000

For several years, Datapoint has manufactured captive 14" disk cartridge drives at its Magnetic Storage Division in Sunnyvale, California, under a manufacturing license originally obtained from Wangco. During the last half of 1981 the firm announced and started deliveries of a 5.25" Winchester drive using internally manufactured plated disks. This drive is combined with a 1/4" tape cartridge drive in a Datapoint subsystem.

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

1981 disk sales: $308,100,000
1981 total net sales: $3,198,099,000 Net income: $343,297,000

In recent years DEC's rigid disk drive revenues for internally manufactured captive products have been derived from disk cartridge drives, notably the high volume RL02. However, in 1981 a new 124 MB 14" Winchester also contributed significant volume, and two major new drives were introduced at the 1982 NCC. The RA81 is a 14" rack mounted Winchester drive with a formatted capacity of 456 MB, and the RA60 is a rack mounted disk pack drive with 205 MB formatted capacity. DEC's new drives will replace older drives purchased externally on an OEM basis, and all are expected to reach large production quantities. DEC also continues to be one of the largest OEM disk drive buyers -- from Seagate for 5.25" Winchesters, from STC and ISS/Univac for large fixed disk drives, and temporarily from Memorex and Control Data, until the newly introduced drives completely fill DEC requirements for mid-range drives.

DISC TECH ONE
849 Ward Drive
Santa Barbara, CA 93111 805/964-3535

1981 disk sales: $13,500,000

Disc Tech One is the new name for the Ohio Scientific disk drive operation (previously owned by Okidata) which was sold in mid-1982 to a group of independent investors by M/A-Com. Most of 1981's revenues were generated by captive shipments of 14" 40 and 80 MB drives with Ohio Scientific systems. New 165 and 301 MB versions for the OEM market have been announced, for late 1982 delivery.

DISCTRON, INC.
Subsidiary of Computer & Communications
Technology Corporation
1701 McCarthy Boulevard
Milpitas, CA 95035 408/946-6692

1981 total net sales: $61,771,000 Net income: $6,208,000

CCT established Disctron from the combination of Data Peripherals and Rotating Memory Systems, following the acquisition of RMS in mid-1982. Discussion of the Data Peripherals and RMS products is included in separate listings for the two firms in this edition of DISK/TREND Report.

DISK MEMORY TECHNOLOGY, INC.
155 B Avenue
Lake Oswego, OR 97034 503/636-7675

DMT produces a specialized 9" drive using plated disks. The drives offer up to 5 MB capacity, and use stepping motor head positioning systems. These drives are normally sold as subsystems equipped to be plug compatible with various small computer systems.

DMA SYSTEMS
601 Pine Avenue
Goleta, CA 93117 805/683-3811

1981 disk sales: None

DMA Systems has successfully started shipments of its 5.25" 5/5 MB fixed/removable disk cartridge drive in 1982, and has announced a removable-only version. In February, 1982, DMA sold a manufacturing license to Nipponcoinco, a leading Japanese manufacturer of coin vending machines which plans an expansion into computer peripherals. DMA occupied its new manufacturing facility in June, 1982, and expects to have substantial production capability by the end of 1982.

EVOTEK CORPORATION
1220 Page Avenue
Fremont, CA 94538 415/490-3100

1981 disk sales: None

Evotek is an ambitious start up company formed in 1981 to manufacture 5.25" fixed disk drives, with assistance from Ibis. The two firms intend to cooperate in plated disk development and presumably will be able to mutually second source each other, even though Ibis will use 14" disks. Evotek announced a family of 5.25" fixed drives with capacities ranging from 7 to 51 MB at the 1982 NCC. The 51 MB capacity is attained by increasing linear density to 16,250 BPI. Production deliveries are scheduled for late 1982.

HEWLETT-PACKARD COMPANY
Disc Memory Division
11403 Chinden Boulevard
Boise, ID 83707 208/376-6000

1981 disk sales: $198,700,000
1981 total net sales: $3,578,000,000 Net income: $312,000,000

Hewlett-Packard has an extensive manufacturing operation for captive disk drives at Boise, established in 1977 and since expanded, to be supplemented in mid-1983 with a new $50 million facility for disk drive development and manufacturing in Bristol, England. H-P makes disk cartridge, disk pack, and small fixed Winchester disk drives, all using 14" oxide coated disks. The newest products are 404 MB drives using 3330 technology, first shipped at a fixed drive in late 1981 and scheduled to be released as a removable disk pack drive in late 1982.

IBIS SYSTEMS, INC.
1850 Evergreen Drive
Duarte, CA 91010 213/357-2180

1981 disk sales: None

Ibis is one of the most ambitious of the industry's many start up companies, due to the technical complexity of the planned product and the degree of difficulty in successfully introducing the product. The products are OEM and PCM versions of a 3380 equivalent drive which will use composite manganese zinc heads and plated disks instead of the thin film heads and oxide coated disks used by IBM. Availability of the planned heads is assured, from established sources, and internal manufacture of the disks uses known technology. Market development may be a tougher problem. Prospective OEM customers are interested in the product, but the market for drives in this class will take a lengthy period of development. The PCM market can respond rapidly to availability of a desired disk drive from established PCM vendors, with adequate service capabilities -- but Ibis has no track record yet, and little ability to provide service on the scale its PCM competitors offer. Ibis' chances of establishing a toe-hold in either market will probably depend on the usual factors: Excellent product performance, competitive pricing, inventive marketing and persistent service follow-up.

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

1981 disk sales: $2,232,200,000
1981 total net sales: $29,070,000,000 Net income: $3,308,000,000

After an embarrassing and expensive period in which IBM had difficulty in establishing quantity production for its new generation of thin film head drives, things are now going much better. The 3370, 3375 and 3380 are

being shipped in large quantities from plants in the U.S., Europe and Japan; the DISK/TREND estimate for worldwide 1982 total shipments for the three drives is 34,500 spindles -- in addition to 34,000 spindles of 3350. Except for a serious explosion at the firm's San Jose disk substrate finishing facility (which did not cause a major disruption in disk drive production), IBM's recent performance in large disk drives has been excellent. Production of the high volume 8" Piccolo drives is also increasing, and new 15 and 30 MB 8" drives using a linear actuator have been introduced for use with the successful System/23 Datamaster small business system. The new 30 MB drive and the 64 MB Piccolo are being offered by IBM as OEM products -- so far, with no noticeable impact. The products offered to date by IBM in the OEM market do not have industry standard defacto interfaces, are rather bulky for the capacity offered, and are not aggressively priced. It may be very difficult for IBM to set competitive OEM prices, since the company can't afford to undercut the end user pricing established for the same drives when sold in detachable plug in configurations.

INTERNATIONAL MEMORIES, INC.
Subsidiary of Onyx+IMI, Inc.
10381 Bandley Drive
Cupertino, CA 95014 408/446-9779

1981 disk sales: $53,300,000
1981 total net sales: $40,940,000 (FY end 9/81) Net income: $4,455,000

IMI's parent changed its name again in early 1982 to the odd-sounding Onyx+IMI, Inc., a name which is at least distinctive enough to avoid confusion with others. Meanwhile, IMI revenues from 8" and 5.25" Winchester drives are growing rapidly, in both captive and OEM applications. In DISK/TREND statistics, shipments by Onyx or Dataflux, both subsidiaries of IMI's parent firm, are considered captive, while sales to Corvus Systems, a related company with several common investors and directors, are considered to be OEM sales.

IRWIN OLIVETTI, INC.
2000 Green Road
Ann Arbor, MI 48105 313/663-3600

1981 disk sales: $500,000

During August, 1982, Irwin International and the U.S. operations of Olivetti OPE were merged into a new entity known as Irwin Olivetti, Inc., with Irwin's shareholders owning 65% and Olivetti the balance. Initially, the new operation will manufacture the Irwin 5.25" OEM disk drives and disk/tape cartridge subsystems, and will market the Olivetti rigid disk drives, flexible disk drives and printers. The Irwin 5.25" Winchester line, with its high density recording technology, actually got into production in late 1981, despite the skeptics. Changes this year include cutting the capacity of the tape cartridge drive, offering the disk drive as a separate product and announcing a higher capacity disk drive.

ISS/Univac
Operating unit of Sperry Univac Division
Sperry Corporation
3333 Scott Boulevard
Santa Clara, CA 95051 408/496-3333

1981 disk sales: $241,600,000
1981 total net sales: $5,427,178,000 Net income: $312,998,000

Sperry Univac captive disk drive revenues are growing modestly, as the transition from the old ISS disk pack product lines to the newer mid-range and large Winchester drives continues. The formerly large ISS shipments of PCM and OEM drives slowed to a trickle in 1981, but OEM shipments of large fixed disk drives to DEC are now on the increase.

KENNEDY COMPANY
Subsidiary of Magnetics & Electronics, Inc.
a subsidiary of Allegheny International, Inc.
1600 South Shamrock Avenue
Monrovia, CA 91001 213/357-8831

1981 disk sales: $3,100,000
1981 total net sales: $1,908,000,000 Net income: $82,600,000

Kennedy entered the OEM 14" Winchester disk drive business in 1978 with unspectacular results, as the company gradually acquired the production expertise needed to make the products it had announced. An 82 MB drive in this product line is now the main revenue producer, and a 165 MB version is due to ship before the end of 1982. Previously announced 8" fixed drives have been replaced with 40 and 80 MB models, on the same timetable. Demonstrating the company's serious intentions for the disk drive industry, in mid-1982 Kennedy acquired the BASF 8" Winchester product line and facilities in Los Gatos, California. These products are now being sold under the Kennedy name. Also part of the BASF deal was the acquisition of rights to manufacture and market the BASF 5.25" Winchester drive developed in West Germany.

MAXTOR CORPORATION
5201 Lafayette Street
Santa Clara, CA 95050 408/748-7740

Maxtor was formed in 1982 to develop and manufacture high capacity 5.25" Winchester disk drives for the OEM market, and probably will announce specific products in late 1982. Founders are veterans of previous Santa Clara valley disk drive start up companies.

MEGAVAULT
Subsidiary of SLI Industries
6431 Independence Avenue
Woodland Hills, CA 91367 213/884-7300

1981 disk sales: $1,200,000

SLI, a veteran industry supplier of voice coil actuators and other disk drive components, changed its name in 1982 to reflect its new emphasis on complete disk drives. The firm had previously offered a kit of all the mechanical parts required to make a 14" Winchester disk drive, and later an 8" version. The 8" kit is used by both Texas Instruments and Nippon Electric Industry in their existing 8" Winchesters. Megavault's own 8" Winchester product line covers a capacity range from 20 to 116 MB, with choice of SA 1000, SMD or ANSI interfaces.

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

1981 disk sales: $187,200,000
1981 total net sales: $3,318,491,000 Net income: $615,794,000

Memorex was acquired by Burroughs in late 1981, ending a ten year period of management quick-fix responses to long term problems and an extended series of poorly executed product expansions. Currently, the Memorex operation faces declining PCM markets for 3350 type drives, its major product line, and the need to initiate quantity production for 3370 and 3380 equivalent drives. The Memorex OEM disk drive product line really consists only of 200 MB disk pack drives sold mostly to DEC, plus the resale of smaller diameter drives manufactured by others. The DEC purchases of disk pack drives will decline in favor of large fixed disk drives purchased from Memorex' competitors. One of the major current projects at Memorex is development of controllers to make possible the use of large Memorex disk drives with Burroughs systems -- thus creating another large market for Memorex drives, a captive one.

MICRODATA CORPORATION
Subsidiary of McDonnell Douglas Corporation
17481 Red Hill Avenue
Irvine, CA 92714 714/540-1113

1981 disk sales: $33,600,000
1981 total net sales: $7,385,000,000 Net income: $177,000,000

Microdata's disk drive activity is now completely a captive operation in support of the firm's computer systems business. The 14" Reflex line of Winchester drives has been converted to the 3350 technology Reflex II version.

MICROPOLIS CORPORATION
21123 Nordhoff Street
Chatsworth, CA 91311 213/709-3300

1981 disk sales: $14,500,000

Known as the originator of high capacity 5.25" flexible disk drives, Micropolis entered the 8" Winchester disk drive market in 1979, and has become a factor in the marketplace, after the usual Winchester early production problems. The company has embarked on the most ambitious 8" Winchester development program to date, with announced products offering up to 200 MB capacities, and optional SMD, SA 1000 and ANSI interfaces, in addition to Micropolis' own intelligent interface. Also announced was a family of high performance 5.25" Winchesters with capacities up to 52 MB.

MINISCRIBE CORPORATION
410 South Sunset Street
Longmont, CO 80501 303/656-6000

Production of Miniscribe's 5.25" Winchester drives started in late 1981, and the firm has apparently achieved its initial market entry goals. Miniscribe's drives use an unusual rack and pinion head positioning system driven by a stepping motor. Additional models with capacities up to 20 MB were added in 1982.

NEW WORLD COMPUTER COMPANY, INC.
2805 McGaw Avenue
Irvine, CA 92714 714/556-9320

1981 total net sales: $229,000 Net income: ($775,000)

New World is now engaged in the production start up phase for its unique product line of 5.25" drives, offered in various fixed and removable configurations. New World's drives used plated disks with a special head array of 8 ferrite transducers per slider -- achieving very fast access times, but with a maximum capacity of 8 MB. The firm has granted a license to Olympia Werke AG, the West German subsidiary of AEG Telefunken, under which Olympia intends to manufacture the drives for use with new small systems to be introduced.

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

1981 disk sales: $6,500,000
1981 total net sales: $2,090,000,000 Net income: $111,000
(Basis: C$ 1.23 = U.S.$1)

Northern Telecom manufactures captive fixed disk drives in the United States in support of the system products organized around the Data 100 and

Sycor product lines acquired three years ago. Products now in production include older 14" drives using 2314 technology, plus a pair of 8" fixed Winchester technology drives with 11 and 22 MB formatted capacities.

PRIAM CORPORATION
20 West Montague Expressway
San Jose, CA 95134 408/946-4600

1981 disk sales: $15,400,000

Priam became a significant supplier of OEM Winchester disk drives in 1981, as volume production was achieved for the firm's original line of mid-range 14" drives and shipments of 8" drives got underway. In 1982 Priam announced a 105 MB 8" drive and a 55 MB 5.25" drive for early 1983 shipment. Priam also continues to sell in the United States a low-end 8" stepping motor drive manufactured by Hokushin.

QUANTUM CORPORATION
1804 McCarthy Boulevard
Milpitas, CA 95035 408/262-1100

1981 disk sales: $6,800,000

Quantum's game plan, from the start of the company in the first half of 1980, has been to provide a low-cost capacity upgrade for the market created by Shugart Associates' SA 1000 8" Winchester drives. The 10 MB SA 1000 has been a major product, and its small business system manufacturer base has welcomed the 20, 30 and 40 MB 8" Quantum drives, which provided badly needed additional capacity with the same interface and file organization. In 1982, Quantum has benefitted from Shugart Assocates' late start for its own upgrade product, and revenues are increasing sharply.

ROTATING MEMORY SYSTEMS, INC.
Subsidiary of Computer & Communications
Technology Corporation
1701 McCarthy Boulevard
Milpitas, CA 95035 408/946-6692

1981 disk sales: $2,000,000
1981 total net sales: $61,771,000 Net income: $6,208,000

CCT completed its acquisition of RMS in early August, 1982, and the process of combining its operation with that of Data Peripherals, the other CCT disk drive manufacturing subsidiary, is now underway. The combined operation will be known as Disctron, Inc., and will be located in the existing RMS facility. Although shaken by the departure of several founders in 1982, RMS has been in production for its 5.25" Winchesters since mid-1981, and now offers drives with 4.5 to 25.5 MB capacity.

SEAGATE TECHNOLOGY
360 El Pueblo Road
Scotts Valley, CA 95066 408/438-6550

1981 disk sales: $24,500,000
1981 total net sales: $9,792,000 (FY end 6/81) Net income: $1,802,000

The term "Seagate compatible" has become part of the industry's language, as most of the other 5.25" Winchester drive manufacturers swing into line on interfaces and file organization. In 1981, Seagate shipped two thirds of the 5.25" drives produced worldwide, with 35,000 units -- and another defacto standard was created. The current Seagate product line consists of the original 6.38 MB drive, now offered in a single disk version, plus 12.76 and 19 MB fixed disk drives. The 6.38 MB disk cartridge drive should be in production by the start of 1983, using a plated disk. Due to its resounding success, Seagate now faces new challenges: The need to acquire major increases in production capacity, and the need to make the right choices on additional products. The company has started to add the capacity, with a new manufacturing subsidiary in Singapore, and new construction planned near its existing plant. And Seagate has opportunistically arranged a license with Sony for that firm's 3.5" floppy drive, which could be the companion product for a smaller Winchester drive. The firm has these and other good options for new products -- some of which will probably appear before long.

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

1981 disk sales: $48,100,000
1981 total net sales: $8,691,000,000 Net income: $598,200,000

Shugart Associates took advantage of its leadership in flexible disk drives with its 1979 introduction of an early low-end 14" Winchester drive with stepping motor actuator, the SA 4000. This drive proved the market's appetite, but the SA 1000 8" Winchester, which first shipped in volume in 1980, was the real winner. The SA 1000, with 5 and 10 MB versions, is still growing in shipments in 1982, despite competition at the same capacities from 5.25" drives. Unfortunately, Shugart Associates' performance with newer rigid disk drives has not been as good. Delays in effective product introduction for the SA 1100 capacity upgrade for the SA 1000 have enabled Quantum to dominate that market segment, and similar delays for the SA 600 5.25" Winchester have prevented Shugart Associates from securing a significant share of the booming 5.25" market.

STORAGE TECHNOLOGY CORPORATION
2270 South 88th Street
Louisville, CO 80027 303/673-5151

1981 disk sales: $323,900,000
1981 total net sales: $921,963,000 Net income: $82,400,000

STC doubled its PCM drive shipments in 1981, and did even better with its PCM drive revenues, because of the transition to double density 3350 type drives. STC captured 60.3% of worldwide PCM disk drive revenues for 1981, almost three times the share of its nearest rival. However, things have slowed down in 1982 for 3350 type drives in the PCM market, due to the recession and IBM's growing shipments of 3380 drives. After an increase in shipments in early 1982, STC has been faced with the need to scale back production. Until the firm is able to start volume shipments of its own version of the 3380, presumably in mid-1983, STC's PCM disk drive business will be lucky to hold its own.

SYQUEST TECHNOLOGY
44160 Warm Springs Boulevard
Fremont, CA 94538 415/490-7511

SyQuest was started in early 1982 to design and manufacture disk drives using 3.9" (100 mm) plated disks, in both fixed and removable disk configurations. The principal founder was also a founder of Seagate Technology. SyQuest's plan is extremely ambitious, with a production start up scheduled before the end of 1982 and very large quantities planned for 1983. The drives will have the same capacity, interface and file organization as Seagate's 6.38 MB basic 5.25" drive.

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

1981 disk sales: $2,200,000
1981 total net sales: $54,200,000 Net income: $4,505,000

Tandon's growth rate in flexible disk drives exceeds other U.S. manufacturers, and the firm is making a successful bid to become a major supplier of 5.25" Winchester drives. Consistent with the firm's philosophy of maximum practical vertical integration, Tandon internally manufacturers a very high proportion of it drives' content, and has exploited it low costs with an aggressive pricing policy. The original drives have now been supplemented with Seagate compatible models, and a 31 MB model is planned for shipment in early 1983.

TECSTOR, INC.
16161 Gothard Street
Huntington Beach, CA 92647 213/842-0077

1981 disk sales: None

Tecstor acquired rights in 1981 to a 14" Winchester drive developed by BASF in Europe, but never placed in quantity production. Tecstor founders have technical backgounds in similar products stemming from their Microdata experience, which involved design of the Reflex I and Reflex II Winchester drives. Tecstor's production started at the end of 1981, and the firm now offers a family of high performance 14" fixed disk drives with capacities from 82.9 to 331.8 MB. These drives offer interface and file compatibility with several of the Control Data drives in the SMD interface family, and will be competing in the same marketplace.

TEXAS INSTRUMENTS INCORPORATED
Terminals and Peripherals Division
P.O. Box 1444
Houston, TX 77040 713/937-2000

1981 disk sales: None
1981 total net sales: $4,206,000,000 Net income: $108,500,000

TI is assembling 8" Winchesters for captive use with TI computer systems, under a license from Megavault (SLI), and is making 5.25" Winchesters for the OEM market, under a Seagate Technology license. TI announced additional models of the 5.25" drives in late 1981, using plated disks and offering improved access times.

3M COMPANY
Data Recording Products Division
3M Center
St. Paul, MN 55144 612/733-1110

1981 disk sales: $200,000
1981 total net sales: $6,079,540,000 Net income: $678,029,000

3M's 8" Winchester drives for the OEM market were announced in April, 1981, with the 10 and 20 MB versions using stepping motor actuators starting into production at that time. The 60 MB voice coil actuator drive went into production in early 1982. 3M has taken on the role of pioneer, by choosing to offer the drives only with the ANSI X3T9/1226 interface.

VERMONT RESEARCH CORPORATION
Precision Park
North Springfield, VT 05156 802/886-2256

1981 disk sales: $1,300,000
1981 total net sales: $16,298,000 Net income: $2,689,000

VRC is primarily a manufacturer of head-per-track disk drives and magnetic drum memories, with manufacturing both in Vermont and England. A 14" high capacity disk cartridge drive with embedded servo has been in production for several years in England, with application primarily in militarized computer systems. VRC has also announced fixed/removable and removable-only disk cartridge drives using the Dysan 8" disk cartridge, with shipments at the end of 1982.

VERTEX PERIPHERALS
2150 Bering Drive
San Jose, CA 95131 408/942-0606

Vertex was started in 1982, with founders primarily from Shugart Associates, to manufacture high capacity 5.25" Winchester disk drives. Specific products are expected to be announced late in 1982.

WESTERN DYNEX CORPORATION
3536 West Osborn Road
Phoenix, AZ 85019 602/269-6401

1981 disk sales: $12,000,000

Western Dynex managed to stay profitable in the 14" disk cartridge drive business longer than most others, because of its highly efficient, low cost manufacturing operation. But OEM shipments of disk cartridge drives below 12 MB capacity are falling off fast, and Western Dynex has elected to enter the 5.25" disk cartridge race. Its drive will use the Dysan 5.25" cartridge and will be Seagate compatible. First shipments are planned for late 1982.

Japanese Manufacturers (Exchange basis: 225 Yen = $1)

FUJITSU LIMITED
6-1, Marunouchi 2-chome
Chiyoda-ku, Tokyo 100 (03)216-3211

1981 disk sales: $303,900,000
1981 total net sales: $3,087,267,000 Net income: $119,920,000

Fujitsu is known as the leading manufacturer of computers for the Japanese domestic market and a worldwide factor in computer export markets. But the extent of Fujitsu's disk drive business is less well appreciated. In 1981 the firm was in fifth place worldwide in total disk drive revenues; its total captive and OEM disk drive revenues were each in fourth place worldwide. Fujitsu has transitioned from heavy reliance on removable disk drives to a product line consisting mainly of fixed disk drives in all capacity ranges, and in several disk diameters. The company's most impressive captive drives are 10.5" models which provide the Fujitsu answer to IBM's 3370 and 3380 drives. Fujitsu has also offered most of its captive drives in OEM versions, using industry standard OEM interfaces, and is now the only non-U.S. firm to achieve any significant penetration of the U.S. market for OEM rigid disk drives. Particularly effective as OEM drives have been several fixed disk drives: The high performance 14" 84/168 MB and 8" 48/84 MB drives, low end 8" 11/23 MB drives, and the 10.5" 474 MB "Eagle" high performance drive with 1.8 MB/sec transfer rate.

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

1981 disk sales: $136,000,000
1981 total net sales: $14,929,690,000 Net income: $573,700,000

While Hitachi is Japan's largest manufacturer of electrical and electronic equipment, it is only the third largest Japanese manufacturer of computer systems. While the firm no longer manufactures removable disk drives, it currently makes a wide range of Winchester technology fixed disk drives which are sold as captive drives with Hitachi computer systems and, in several cases, as OEM drives. In addition to significant OEM sales of smaller capacity fixed disk drives, Hitachi also sells large IBM compatible drives to National Advanced Systems for distribution with NAS systems in the U.S.

HOKUSHIN ELECTRIC WORKS, LTD.
30-1, Shimomaruko, 3-chome
Ohta-ku, Tokyo 146 (03) 759-4141

1981 disk sales: $9,300,000
1981 total net sales: $186,929,000 Net income: $2,107,000

A diversified product line of industrial, marine and aircraft instruments is manufactured by Hokushin, with computer peripherals one of the firm's smaller operations. As the Japanese licensee for Diablo disk drives, Hokushin was forced to explore new disk product opportunities when Diablo's product development progress stopped and disk cartridge drives began to decline. An 8" low end Winchester drive is resold in the U.S. by Priam, and Hokushin has a license to sell and manufacture Priam's drives in Japan, but is not yet in production with these products.

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

1981 disk sales: None
1981 total net sales: $880,000,000 Net income: 40,000,000

Matsushita Communication Industrial is a member of the Matsushita Electric industrial group, which is a worldwide giant in appliances and electronics. MCI has been the licensee for Shugart Associates' flexible disk drives in Japan for many years, and currently manufactures most of the Shugart Associates floppy models for the Japanese OEM market. MCI has announced that it will start shipments of several Winchester technology fixed disk drives during 1982, including 5.25" drives equivalent to the Shugart SA 600 series, plus a family of 8" Winchester drives of its own design, using linear voice coil actuators, with capacities ranging from 20 to 40 MB.

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

1981 disk sales: $69,700,000
1981 total net sales: $5,949,933,000 Net income: $152,191,000

In addition to being one of Japan's leading electronic and electrical products manufacturers, Mitsubishi Electric is a leader in the domestic small business systems market. The company makes disk drives in all of the removable disk types, plus small and mid-range Winchester technology drives. Captive shipments are the major portion of Mitsubishi's disk drive shipments, but the firm has a growing OEM business in 14", 8" and 5.25" Winchester drives.

NIPPONCOINCO CO., LTD.
2-2, Uchisaiwaicho 2-chome
Chiyoda-ku, Tokyo 100 (03) 502-1811

Nipponcoinco, a leader in manufacturing coin vending equipment, has acquired a manufacturing license for the DMA Systems 5.25" disk cartridge drive as part of an expansion into the computer peripherals area. The firm is putting resources behind this project and intends to add other disk drive products.

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

1981 disk sales: $184,600,000
1981 total net sales: $4,669,151,000 Net income: $98,422,000

NEC has defined its product area as communications and computers, with computer products currently accounting for about one fourth of the firm's total revenues. Except for continuing production of large disk pack drives, all current disk drive production involves fixed disk drives, from large to small configurations, for both captive and OEM markets. Fixed disk drives include 14", 8" and 5.25" disk diameters.

NIPPON ELECTRIC INDUSTRY CO., LTD.
19-18, Tsutsumi-dori 1-chome
Sumida-ku, Tokyo 131 (03) 613-1111

1981 disk sales: None
1981 total net sales: $84,373,000 Net income: $1,911,000

Nippon Electric Industry (NEC owns 34.6% of the firm) is known in Japan by its tradename Densei. The company produces power supplies for communications and computer equipment, automatic control systems and other electronic equipment. It has manufactured magnetic drum memories for several years. Densei has entered the OEM disk drive market with an 8" Winchester drive, using the Megavault (SLI) mechanical assembly kit, and with a 5.25" Winchester of its own design.

NIPPON PERIPHERALS LIMITED
660 Miyamae, Fujisawa-shi
Kanagawa-ken 251 (0466) 26-8211

1981 disk sales: $18,800,000

Fujitsu and Hitachi own NPL equally as a joint venture. NPL has the charter to develop advanced disk drives and other magnetic peripherals, and has developed its own versions of most IBM new disk drives introduced since the 3340. 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. Currently, the major portion of NPL's independent sales are to BASF, which markets PCM drives in Europe. These shipments are treated as PCM shipments by NPL in DISK/TREND statistics to avoid distortion of PCM market totals.

OTARI ELECTRIC CO., LTD.
29-18, Minami Ogikubo 4-chome
Suginami-ku, Tokyo 167 (03) 333-9631

Otari is specialized manufacturer of professional audio tape decks and high speed tape duplicating systems. Shortly before its acquisition by CCT, Rotating Memory Systems entered into a manufacturing agreement with Otari to produce the RMS 5.25" Winchester drives for sale in Japan by the RMS Japanese distributor, Teijin Advanced Products. Otari is expected to be in production by the end of 1982.

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

1981 disk sales: None
1981 total net sales: $165,760,000 Net income: $3,396,000

TEAC has taken steps in recent years to expand into computer peripherals, in recognition of slow growth in the worldwide market for quality audio tape decks, its major product area. TEAC has shipped 5.25" flexible disk drives since 1978, with rapid growth. In 1982, TEAC acquired a manufacturing license from Seagate Technology for its 5.25" Winchester disk drives, with rights to market the drives in Japan and the Far East. The firm will resell Seagate-manufactured drives until production is established in Japan.

TOKICO, LTD
1-6-3, Fujimi
Kawasakiku, Kawasaki 210 (044) 244-3111

1981 disk sales: None
1981 total net sales: $369,049,000 Net income: $10,729,000

Tokico, a member of the Hitachi group, is a manufacturer of automotive equipment, including shock absorbers, brakes and air compressors. The company is manufacturing a 5.25" Winchester fixed disk drive similar to the NPL NP05, with versions of the Tokico drive sold separately by Hitachi and by the Hitachi group trading company, Nissei Sangyo.

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

1981 disk sales: $82,400,000
1981 total net sales: $9,331,538,000 Net income: $222,969,000

Toshiba is a major factor in consumer electric and electronic products, plus a wide range of industrial electronic products and heavy electric power equipment. The company also has a leading position in the Japanese office computer market. Rigid disk drive production is concentrated in captive products, including disk cartridge and disk pack drives, plus newer Winchester technology fixed disk drives in low- and mid-range capacities, in both 14" and 8" disk diameters. Selected drives are also sold in the Japanese OEM disk drive market.

European Manufacturers (Exchange basis indicated for each firm)

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

1981 disk sales: $6,600,000
1981 total net sales: $15,078,000,000 Net income: $179,000,000
(Basis: DM 2.27 = U.S.$1)

BASF is one of the world's chemical giants, and a pioneer manufacturer of magnetic recording media. Since the early 1970's, BASF has been a disk drive manufacturer, starting with a license from the old Century Data Systems to make 2314 type drives. Today, BASF's internally manufactured rigid disk drive products consist only of a relatively new 5.25" Winchester technology drive made in Germany. The firm has sold a 14" Winchester product line to Tecstor, and in 1982 sold the product line and facilities for an 8" Winchester product line in Los Gatos, California. The company continues to be a significant factor in the European PCM market, reselling several Winchester technology drives manufactured in Japan by Nippon Peripherals, Ltd.

CII-HONEYWELL BULL
94, Avenue Gambetta
75960 Paris Cedex 20
France (1) 360 02 22

1981 disk sales: $32,000,000
1981 total net sales: $1,184,995,000 Net income: ($72,454,000)
(Basis: FF 6.20 = U.S.$1)

Cii-Honeywell Bull's management has a new boss in 1982, France's socialist government. The government established control of Cii-HB by taking over Compagnie de Saint-Gobain, which held a majority interest. Honeywell Information Systems' previous 47% share of Cii-HB has been reduced to 19.9%. Cii-HB's production of its unusual 10.5" "Cynthia" rigid disk drives is continuing to grow. The disk cartridge versions are actively sold as captive and OEM drives, with a U.S. subsidiary specifically dedicated to developing the American market. Production in France of 5.25" Winchester drives started in 1982, for captive and OEM distribution in Europe.

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

1981 disk sales: $28,300,000

Disk drive products now sold by DRE are manufactured by a joint venture company owned by DRI, its parent firm (which in turn is controlled by an agency of the British government), and Magnetic Peripherals, Inc., the U.S. disk drive development and manufacturing firm owned principally by Control Data and Honeywell. The joint venture, called United Peripherals, Ltd., was formed in 1979, and now manufactures primarily MPI products such as Hawk and Phoenix disk cartridge drives.

HIGHTRACK COMPUTER TECHNIK GMBH
Bundesallee 36/37
D-1000 Berlin 31
West Germany (030) 86 04 97

Hightrack is now in production on its line of 25, 41 and 82 MB OEM fixed disk drives using 8" plated disks. Specifications for interface, track capacity and cylinder organization are compatible with Control Data's SMD standards.

ISOTIMPEX
51, Chapaev St.
Sofia, Bulgaria

1981 disk sales: $18,600,000

Disk drives manufactured by ISOT, the Bulgarian state computer organization, are exported throughout Eastern Bloc countries by Isotimpex, the foreign trade organization for Bulgarian computer equipment and other electronic products. Isotimpex is currently marketing drives compatible with IBM 2314 and 3330 disk pack drives, plus disk cartridge drives which were originally developed under a Wangco license.

NIXDORF COMPUTER AG
Furstenallee 7
4790 Paderborn
West Germany (05251) 2 00 1

1981 disk sales: $34,000,000
1981 total net sales: $651,651,000 Net income: $17,792,000
(Basis: DM 2.27 = U.S.$1)

Nixdorf's business has grown by an average 23% per year during the past five years, and the firm has undertaken various programs to control costs through internal manufacturing programs. Nixdorf now manufactures storage module drives in Germany, under a license from Control Data, for captive shipment with Nixdorf systems. The firm had previous been using SMD's from CDC for several years.

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

1981 disk sales: $2,700,000
1981 total net sales: $2,569,919,000

Under Olivetti's current management, the firm has undertaken numerous changes to modernize the company's product lines, drop out of older lines, and acquire investments in growth firms with the potential to provide the products and technologies Olivetti will need to stay vigorous in the future. The Olivetti Peripheral Equipment organization represented a consolidation of the firm's printer and disk memory activities in 1980. This organization has established production for 5.25" and 8" Winchester disk drives at Ivrea, with both captive and OEM markets in mind. Recently, Olivetti expanded its investment in Irwin International to 35% of the firm, which was renamed Irwin Olivetti, Inc., and which will have marketing responsibility for Olivetti's peripherals in the U.S.

OLYMPIA WERKE AG
Subsidiary of AEG Telefunken
D-2940 Wilhelmshaven
West Germany (04421) 781

1981 disk sales: None

Olympia is midstream in a program to convert from electric typewriters and other office equipment products to a new group of electronic products, including computer based systems. The firm has purchased a manufacturing license from New World Computer, and intends to manufacture the unique New World 5.25" fixed disk drives, using plated disks.

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

1981 disk sales: $19,300,000

Pertec, a pioneer manufacturer of OEM 14" disk cartridge drives, was acquired by Triumph Adler in early 1980, as a diversification move. While the parent is struggling to enter the electronic age for typewriters and other office equipment, Pertec has been struggling to bring its disk drive line up to date. The initial 8" Winchester drives, announced a few years ago, have been dropped in favor of a new group, with a range of capacities up to 84 MB. Meanwhile, the old disk cartridge line, although declining, provides monthly cash flow.

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

1981 disk sales: $12,300,000
1981 total net sales: $17,069,155,000 Net income: $143,682,000

Philips is a worldwide electrical and electronics manufacturing giant, but the firm's computer business is less than 5% of the firm's total revenues. Philips had manufactured 14" disk cartridge and low end fixed disk drives for several years, but last year discontinued all production of rigid disk drives, because of the firm's relatively small requirements. Philips will now be an OEM customer for disk drives.

RODIME LIMITED
12-14 Edison House, Fullerton Road
Glenrothes, Fife KY7 5QR
Scotland (0592) 757498

1981 disk sales: $1,400,000

Rodime looks like a rare European phenomenon: A successful 5.25" OEM disk drive start up company. After being formed in late 1980 by key personnel from the Burroughs facility in Glenrothes, Rodime has met its schedule for shipments in 1981, and is achieving a healthy growth rate in 1982. Ampex has acquired a license to sell and manufacture the Rodime drives in the United States, and Rodime has expanded its product line to include models with as much as 53 MB capacity.

ROM CONTROL DATA S.R.L.
Bucharest
Romania

The Romanian government and Control Data jointly own ROM-CD, with CDC holding 45%. The organization manufactures double density versions of 2314 type drives, using technology provided by CDC. Drives manufactured are marketed in both Eastern Bloc countries and in Western Europe.

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

1981 disk sales: $119,600,000
1981 total net sales: $15,225,202,000 Net income: $197,708,000
(Basis: DM 2.27 = U.S.$1)

Siemens manufactures rigid disk drives of its own design for captive use with its mainframe systems, which continue to be a major factor in the European computer market, even though a small part of Siemens total revenue. Existing products include several disk pack drives and a large fixed disk drive using 3350 technology.