1983 DISK/TREND® REPORT

RIGID DISK DRIVES

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

FOREWORD

As always, this year's DISK/TREND Report reflects the continuous growth of the disk drive industry -- more sales, more companies, more products, more people. While some firms have dropped out, more have entered the industry, led by eight new U.S. companies with 5.25 inch Winchester disk drives. There are 72 manufacturers of moving head rigid disk drives and 604 disk drive models included in this edition.

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 in November.

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.

Your suggestions for improvements in the report are always welcome.

James N. Porter

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INTRODUCTION

Only minor changes in DISK/TREND Report format this year

A continuous attempt is made to maintain consistency in DISK/TREND formats and organization from year to year, and this year only very minor changes have been made.

* The product group previously labeled "Storage Module Drives" is now called "Disk Pack Drives, Less Than 100 Megabytes", in recognition of new disk drive configurations.

* Worldwide unit shipment breakdowns by disk diameter have now been added for for all product groups, and data on drives with less than 5.25 inch diameter have been added to three product groups.

* The tables on non-captive market shares now include breakdowns by disk diameter for the three fixed disk drive groups below 300 MB.

To avoid confusion, please note these points

* 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

The industry's worldwide revenues from shipments of moving head disk drives were $7,403,400,000 in 1982, an increase of 16.2% over 1981. Following a long-term trend toward fixed disk drive configurations, the 1982 revenues derived from sale of removable disk drives dropped to 22.1% of the worldwide total.

1983 is another very strong year in sales growth for the industry, with revenues expected to be up 26.0%, to $9,331,100,000. Even though PCM revenues are depressed for 1983, as old products die before new ones are ready to take their place, other product areas are stronger than ever. IBM's immense increase in shipments of large fixed disk drives is providing the biggest boost, but the booming desktop computer market is also responsible for sharp increases in shipments of OEM small fixed disk drives.

Longer term, average annual growth in worldwide revenues through 1986 is projected at 23.1%, with the total for 1986 set at $16,943,000,000. Changes in product mix will continue existing trends and by 1986 fixed disk drives will be even more dominant. The share of industry revenues held by removable disk drives is estimated at 10.7% for 1986. The largest increases in revenue will go to IBM, as higher capacity large disk drives for the mainframe market are introduced. But the big increases in unit shipments will go to 5.25 inch and smaller fixed disk drives, with 1986 worldwide shipments over four million drives.

TABLE 1

CONSOLIDATED WORLDWIDE SHIPMENTS

ALL EXISTING MOVING HEAD DISK DRIVE GROUPS

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1982 Shipments		Forecast 1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	1,541.7	2,825.5	2,113.4	3,636.6	2,525.5	4,245.4	2,842.6	4,892.8	3,139.2	5,371.1
Other U.S. Captive	951.3	1,603.1	1,174.0	1,894.6	1,487.5	2,444.8	1,984.2	3,309.9	2,594.7	4,328.9
TOTAL U.S. CAPTIVE	2,493.0	4,428.6	3,287.4	5,531.2	4,013.0	6,690.2	4,826.8	8,202.7	5,733.9	9,700.0
PCM	345.5	503.8	127.2	229.6	354.0	547.4	460.8	720.7	604.9	926.3
OEM	853.9	1,090.1	1,290.8	1,606.2	1,628.8	2,055.1	1,846.5	2,377.4	1,930.1	2,551.9
TOTAL U.S. NON-CAPTIVE	1,199.4	1,593.9	1,418.0	1,835.8	1,982.8	2,602.5	2,307.3	3,098.1	2,535.0	3,478.2
TOTAL U.S. SHIPMENTS	3,692.4	6,022.5	4,705.4	7,367.0	5,995.8	9,292.7	7,134.1	11,300.8	8,268.9	13,178.2
Non-U.S. Manufacturers										
Captive	20.8	1,101.2	25.0	1,363.1	59.2	1,845.5	108.1	2,045.9	174.7	2,221.7
PCM	17.4	57.2	79.4	169.2	137.3	294.8	137.1	319.3	152.3	366.1
OEM	57.6	222.5	190.0	431.8	305.0	639.5	452.2	891.8	574.8	1,177.0
TOTAL NON-U.S. SHIPMENTS	95.8	1,380.9	294.4	1,964.1	501.5	2,779.8	697.4	3,257.0	901.8	3,764.8
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	3,788.2	7,403.4	4,999.8	9,331.1	6,497.3	12,072.5	7,831.5	14,557.8	9,170.7	16,943.0

Marketing channels

Counting only companies with specifically announced products, there are now 72 manufacturers of moving head rigid disk drives. 50 firms are headquartered in the United States, 11 in Japan, and 12 in Europe. In the past year ten new companies have entered the market, of which eight are U.S. firms with 5.25 inch disk drives. Nine companies have dropped out of the industry, changed their names voluntarily or been involved in acquisitions. It is known that additional rigid disk drive manufacturing programs are being started in the United States, Japan, Brazil and USSR.

Captive drives are sold at high prices per unit compared to OEM drives. An exaggerated impression of the share of the industry's total unit shipments held by captive drives can be given by looking only at total industry revenues. IBM and other captive drives held 74.8% of worldwide revenues in 1982, for $5,529,800,000, but if produced as OEM products these drives would have generated revenues at 20-25% of that figure.

The share of total worldwide revenues held by OEM drives is affected by the production surges which accompany the introduction of successful new product formats. Explosive growth by small diameter fixed disk drives has driven 1982's 17.7% OEM share of total worldwide revenues up to 21.8% in 1983. The expectation through 1986 is that the OEM share will stay about the same, but with a small shift to non-U.S. manufacturers.

While IBM's share of the industry revenue total is expected to decline following this year's splurge of 3380 production, the portion of other captive revenues held by U.S. manufacturers should increase in 1985-86, as captive production of many of the new drive formats starts.

TABLE 2

CONSOLIDATED WORLDWIDE SHIPMENTS

MARKET CLASS REVIEW

REVENUE SUMMARY

WORLDWIDE REVENUES BY MANUFACTURER TYPE	1982 Shipments $M	1982 Shipments %	FORECAST 1983 $M	1983 %	1984 $M	1984 %	1985 $M	1985 %	1986 $M	1986 %
U.S. Manufacturers										
IBM	2,825.5	38.2	3,636.6	39.0	4,245.4	35.2	4,892.8	33.6	5,371.1	31.7
Other U.S. Captive	1,603.1	21.7	1,894.6	20.3	2,444.8	20.3	3,309.9	22.7	4,328.9	25.5
PCM	503.8	6.8	229.6	2.5	547.4	4.5	720.7	5.0	926.3	5.5
OEM	1,090.1	14.7	1,606.2	17.2	2,055.1	17.0	2,377.4	16.3	2,551.9	15.1
Total U.S. Mfgr's.	6,022.5	81.3	7,367.0	79.0	9,292.7	77.0	11,300.8	77.6	13,178.2	77.8
Non-U.S. Manufacturers										
Captive	1,101.2	14.9	1,363.1	14.6	1,845.5	15.3	2,045.9	14.1	2,221.7	13.1
PCM	57.2	.8	169.2	1.8	294.8	2.4	319.3	2.2	366.1	2.2
OEM	222.5	3.0	431.8	4.6	639.5	5.3	891.8	6.1	1,177.0	6.9
Total Non-U.S. Mfgr's.	1,380.9	18.7	1,964.1	21.0	2,779.8	23.0	3,257.0	22.4	3,764.8	22.2
Worldwide Total	7,403.4	100.0	9,331.1	100.0	12,072.5	100.0	14,557.8	100.0	16,943.0	100.0

Product mix

Scores of new fixed disk drives have been introduced in the last year, but only a handful of new removable disk drives have been offered. This imbalance has now continued for several years, and the future for most removable disk drive configurations looks bleak.

Many observers have cited IBM's movement away from removable disk formats during the last ten years as the reason why fixed disk drives have taken over so much of the market. But that's only a contributing factor. More important are two practical considerations: (1) The higher recording densities now used in many drives would be impractical with removable disks because the lower head flying height required would be impossible with the particulate contamination introduced by interchanging disks, and (2) The mechanical engineering tasks associated with designing and making a drive on which removable disks can be reliably interchanged are much more difficult than with fixed disk drives.

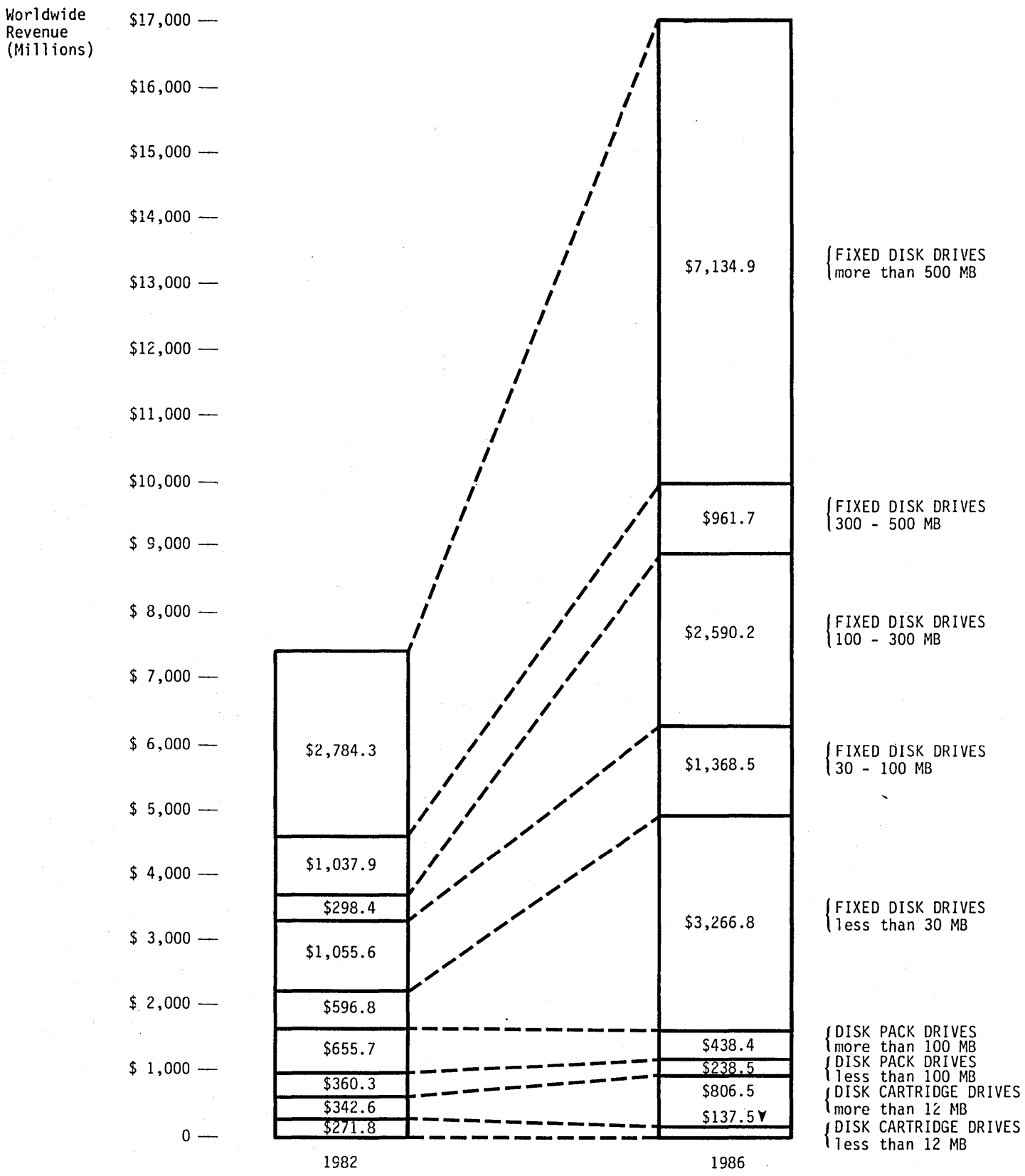
The only DISK/TREND removable disk drive group projected to increase in total revenues through 1986 is disk cartridge drives, more than 12 megabytes -- the type of removable drive which will be most in demand for desktop systems used in the general office and specialized applications.

While large fixed disk drives, those over 500 megabyte capacity, will continue to generate higher revenues than any other product group, faster growth rates are expected from certain smaller fixed disk drives. Drives less than 30 megabytes will certainly see sharp growth, as a higher percentage of desktop and personal computers each year are shipped with 5.25 and 3.5 inch drives. Fixed disk drives with 100-300 megabyte capacity will also see rapid gains, driven by multiple user systems.

Figure 1

CHANGING PRODUCT MIX

CONSOLIDATED WORLDWIDE DISK DRIVE SHIPMENTS



OEM market

1982 was the last year for OEM removable disk drives to generate higher worldwide revenues than fixed disk drives. Shipments in the four DISK/TREND removable disk drive groups produced 54.4% of worldwide OEM revenues, but the estimate for 1983 is 32.2% of revenues, going down to 14.4% in 1986.

Nevertheless, the two disk cartridge product groups are expected to experience healthy increases in unit shipments through 1986, despite a projection for little change in revenues. The reason for this dichotomy is to be found in the almost complete displacement of older 14 inch units by drives using smaller diameter disks, at lower unit prices.

Fixed disk drives less than 30 megabytes remain the revenue leader for OEM disk drive manufacturers, and will become even more dominant in future years, taking a projected 35.3% of the 1986 worldwide OEM revenue total. Because of the low prices at which these drives are sold, the unit shipment projections are rather startling: 1982's 314,800 total is forecasted to rise to 3,812,400 in 1986, for 78.3% of all OEM drives to be sold in that year. 99% of the unit shipments for 1986 are expected to be drives using disks 5.25 inch and smaller.

Among other fixed disk drive groups, 30-100 megabytes drives should hold second place in 1986 unit shipments with 8.6% of the worldwide OEM total, but 100-300 megabyte drives are expected to be second in revenues with 16% of the 1986 worldwide OEM total. Most of this growth through 1986 will be generated by sales of 8 and 5.25 inch drives for multiple user systems in office applications, plus a variety of specialized markets.

TABLE 3

CONSOLIDATED WORLDWIDE SHIPMENTS
PRODUCT CATEGORY REVIEW

REVENUE SUMMARY

WORLDWIDE REVENUES ALL MANUFACTURERS	1982 Shipments $M	1982 Shipments %	FORECAST 1983 $M	1983 %	1984 $M	1984 %	1985 $M	1985 %	1986 $M	1986 %
DISK CARTRIDGE DRIVES Less than 12 MB	271.8	3.7	277.8	3.0	228.7	1.9	175.5	1.2	137.5	.8
DISK CARTRIDGE DRIVES More than 12 MB	342.6	4.6	304.9	3.3	417.7	3.5	616.3	4.2	806.5	4.8
DISK PACK DRIVES Less than 100 MB	360.3	4.9	320.9	3.4	276.0	2.3	262.1	1.8	238.5	1.4
DISK PACK DRIVES More than 100 MB	655.7	8.9	562.0	6.0	549.6	4.6	508.3	3.5	438.4	2.6
FIXED DISK DRIVES Less than 30 MB	596.8	8.1	1,070.7	11.5	1,678.3	13.9	2,381.4	16.4	3,266.8	19.3
FIXED DISK DRIVES 30-100 MB	1,055.6	14.3	1,343.9	14.4	1,469.2	12.2	1,450.1	10.0	1,368.5	8.1
FIXED DISK DRIVES 100-300 MB	298.4	4.0	789.5	8.5	1,414.5	11.7	2,042.9	14.0	2,590.2	15.3
FIXED DISK DRIVES 300-500 MB	1,037.9	14.0	809.1	8.7	957.4	7.9	934.6	6.4	961.7	5.7
FIXED DISK DRIVES More than 500 MB	2,784.3	37.6	3,852.3	41.3	5,081.1	42.1	6,186.6	42.5	7,134.9	42.1
Total Worldwide Revenue	7,403.4	100.0	9,331.1	100.0	12,072.5	100.0	14,557.8	100.0	16,943.0	100.0
% U.S. Mfg.	81.3	--	79.0	--	77.0	--	77.6	--	77.8	--
Annual Growth Rate	--	--	+26.0%	--	+29.4%	--	+20.6%	--	+16.4%	--

TABLE 4

OEM WORLDWIDE SHIPMENTS
PRODUCT CATEGORY REVIEW

REVENUE SUMMARY

WORLDWIDE REVENUES ALL MANUFACTURERS	1982 Shipments $M	1982 Shipments %	FORECAST 1983 $M	1983 %	1984 $M	1984 %	1985 $M	1985 %	1986 $M	1986 %
DISK CARTRIDGE DRIVES Less than 12 MB	94.8	7.2	94.1	4.6	100.9	3.7	107.2	3.3	108.2	2.9
DISK CARTRIDGE DRIVES More than 12 MB	171.8	13.1	170.5	8.4	163.0	6.0	167.5	5.1	179.0	4.8
DISK PACK DRIVES Less than 100 MB	139.9	10.7	131.8	6.5	138.0	5.1	148.7	4.5	150.8	4.0
DISK PACK DRIVES More than 100 MB	306.9	23.4	260.0	12.8	195.3	7.2	142.3	4.4	97.8	2.6
FIXED DISK DRIVES Less than 30 MB	257.0	19.6	642.3	31.5	902.9	33.5	1,111.3	34.0	1,318.0	35.3
FIXED DISK DRIVES 30-100 MB	143.5	10.9	333.7	16.4	449.1	16.7	510.7	15.6	567.9	15.2
FIXED DISK DRIVES 100-300 MB	62.3	4.7	152.0	7.5	306.0	11.4	473.8	14.5	595.9	16.0
FIXED DISK DRIVES 300-500 MB	29.1	2.2	133.3	6.5	205.5	7.6	253.6	7.8	287.3	7.7
FIXED DISK DRIVES More than 500 MB	107.3	8.2	120.3	5.9	233.9	8.7	354.1	10.8	424.0	11.4
Total Worldwide Revenue	1,312.6	100.0	2,038.0	100.0	2,694.6	100.0	3,269.2	100.0	3,728.9	100.0
% U.S. Mfg.	83.0	--	78.8	--	76.3	--	72.7	--	68.4	--
Annual Growth Rate	--	--	+55.3%	--	+32.2%	--	+21.3%	--	+14.1%	--

TABLE 5

OEM WORLDWIDE SHIPMENTS
PRODUCT CATEGORY REVIEW

UNIT SHIPMENT SUMMARY

WORLDWIDE UNIT SHIPMENTS ALL MANUFACTURERS	1982 Shipments Units	1982 Shipments %	FORECAST (000 UNITS) 1983 Units	1983 %	1984 Units	1984 %	1985 Units	1985 %	1986 Units	1986 %
DISK CARTRIDGE DRIVES Less than 12 MB	38.0	7.1	54.7	3.5	89.8	3.4	142.5	3.8	191.0	3.9
DISK CARTRIDGE DRIVES More than 12 MB	39.8	7.4	44.0	2.8	51.8	1.9	66.8	1.8	87.9	1.8
DISK PACK DRIVES Less than 100 MB	26.0	4.9	24.7	1.6	26.1	1.0	29.2	.8	31.0	.6
DISK PACK DRIVES More than 100 MB	29.9	5.6	25.0	1.6	19.7	.7	14.8	.4	10.4	.2
FIXED DISK DRIVES Less than 30 MB	314.8	58.9	1,161.0	74.3	2,088.6	78.4	2,908.2	78.4	3,812.4	78.3
FIXED DISK DRIVES 30-100 MB	61.1	11.4	185.5	11.9	251.5	9.4	321.0	8.7	418.3	8.6
FIXED DISK DRIVES 100-300 MB	13.8	2.6	39.3	2.5	86.0	3.2	153.2	4.1	227.3	4.7
FIXED DISK DRIVES 300-500 MB	4.0	.7	19.9	1.3	33.5	1.3	45.6	1.2	56.0	1.2
FIXED DISK DRIVES More than 500 MB	7.2	1.3	7.6	.5	16.2	.6	26.4	.7	34.8	.7
Total Worldwide Shipments	534.6	100.0	1,561.7	100.0	2,663.2	100.0	3,707.7	100.0	4,869.1	100.0
% U.S. Mfg.	83.0	--	78.8	--	76.3	--	72.7	--	68.4	--
Annual Growth Rate	--	--	+192.1%	--	+70.5%	--	+39.2%	--	+31.3%	--

TABLE 6

1982 ESTIMATED MARKET SHARES

WORLDWIDE SHIPMENTS OF ALL MOVING HEAD DISK DRIVES
(Value of non-U.S. currencies estimated at July, 1983, rates)

	CAPTIVE		PCM		OEM		TOTAL INDUSTRY	
	$M	%	$M	%	$M	%	$M	%
U.S. MANUFACTURERS								
Ampex	--	--	--	--	40.1	3.1	40.1	.5
Burroughs	128.0	2.3	--	--	1.1	.1	129.1	1.7
Century Data Systems	--	--	--	--	72.0	5.5	72.0	1.0
Control Data	379.9	6.9	82.8	14.8	593.9	45.2	1,056.6	14.3
Data General	115.0	2.1	--	--	--	--	115.0	1.5
Datapoint	20.9	.4	--	--	--	--	20.9	.3
Digital Equipment	252.0	4.5	--	--	--	--	252.0	3.4
Hewlett-Packard	253.8	4.6	--	--	--	--	253.8	3.4
IBM	2,825.5	51.1	--	--	--	--	2,825.5	38.2
International Memories	48.4	.9	--	--	21.5	1.6	69.9	.9
Memorex	--	--	121.8	21.7	24.9	1.9	146.7	2.0
Microdata	59.9	1.1	--	--	--	--	59.9	.8
Micropolis	--	--	--	--	22.2	1.7	22.2	.3
Priam	--	--	--	--	36.3	2.8	36.3	.5
Quantum	--	--	--	--	35.8	2.7	35.8	.5
Seagate	--	--	--	--	50.7	3.9	50.7	.7
Shugart	87.4	1.6	--	--	44.8	3.4	132.2	1.8
Sperry	239.6	4.3	--	--	33.6	2.6	273.2	3.7
Storage Technology	--	--	299.2	53.3	4.2	.3	303.4	4.1
Tandon	--	--	--	--	24.9	1.9	24.9	.3
Other U.S.	18.2	.3	--	--	84.1	6.4	102.3	1.4
U.S. Total	4,428.6	80.1	503.8	89.8	1,090.1	83.1	6,022.5	81.3
NON-U.S. MANUFACTURERS								
Cii-Honeywell Bull	22.7	.4	--	--	12.9	1.0	35.6	.5
Fujitsu	288.7	5.2	9.6	1.7	66.6	5.1	364.9	4.9
Hitachi	186.6	3.4	18.0	3.2	21.0	1.6	225.6	3.0
ISOT	7.0	.1	--	--	47.0	3.6	54.0	.7
Mitsubishi	45.6	.8	--	--	7.2	.5	52.8	.7
NEC	282.8	5.1	--	--	13.4	1.0	296.2	4.0
Nippon Peripherals	23.9	.4	29.6	5.3	2.3	.2	55.8	.8
Nixdorf	85.0	1.6	--	--	--	--	85.0	1.2
Siemens	69.8	1.3	--	--	--	--	69.8	.9
Toshiba	51.6	.9	--	--	4.6	.3	56.2	.8
Other Non-U.S.	37.5	.7	--	--	47.5	3.6	85.0	1.2
Non-U.S. Total	1,101.2	19.9	57.2	10.2	222.5	16.9	1,380.9	18.7
Worldwide Total	5,529.8	100.0	561.0	100.0	1,312.6	100.0	7,403.4	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	Disk Pack Drives <100 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		
Amcodyne	O		8					8		
Ampex	O			14	14	5		14	14	
Applied Information Memories	O							5		
Applied Peripheral Systems	O								14	14
Atasi	O					5	5			
Athenaeum	O		5				5			
Ball Computer	O			14	14					
Burroughs	C			14	14	14	14	14		14
Cardiff	O		5				5			
Century Data Systems	O		8	14	14	14	14	14	14	14
Cipher	O	14	14							
Cogito	O					5				
Computer Memories	O					5	5			
Control Data	C,O,P	14	8,14	8,14	14	3,5,8,14	5,8,14	8,14	8,14	8,14
Data General	C	14	14	14	14	8,14	14		14	
Datapoint	C					5				
Digital Equipment	C	14	14		14			14	14	
Disc Tech One	O					8	8,14	14	14	
Disctron	O	8				5	5,8	8		
Disk Memory Technology	O					8				
DMA Systems	O	5	5			5	5			
Evotek	O					5	5			
Hewlett-Packard	C,O		14	14	14	14	14	14	14	
Ibis	O,P									14
IBM	C,O					8	8	14		14
International Memories	O					5,8	5,8			
Kennedy	O					8,14	8,14	14		
Maxtor	O						5	5		
Megavault	O					8	8	8		
Memorex	C,O,P				14		5			14
Microdata	C							14		
Micropolis	O					5,8	5,8	8		
Microscience International	O					5				
Miniscribe	O					5	5			
New World	O	5								
Northern Telecom	C,O					8,14	8	8		
Priam	O						5,8,14	5,8,14		
Quantum	O					5,8	5,8			
Seagate Technology	O					5				
Shugart	C,O					5,8,14				
Storage Technology	O,P								14	14
Syquest	O	3				3				
Tandon	O					5	5			
Tecstor	O						14	14	14	
Texas Instruments	C					5,8	8			
Tulin	O					5				
Vermont Research	O	8	8,14							
Vertex	O						5			
Western Dynex	O	5,14								
Japanese Manufacturers										
Fujitsu	C,O		14		14	5,8	5,8,14	8,14	8,10,14	10,14
Hitachi	C,O,P					5	8	8	8,14	14
Matsushita Com. Ind.	O					5				
Mitsubishi	C,O	14	14	14	14	5,8,14	8,14			
NEC	C,O				14	5,8,14	8,14	8,14	8,14	14
Nippon Electric Industry	O					5				
Nippon Peripherals	C,O,P					5	5,8	8,14	14	14
Otari	O					5				
TEAC	O					5				
Tokico	C,O					5				
Toshiba	C,O		14		14	8,14	8,14	8		
European Manufacturers										
BASF	O					5				
Cii-Honeywell Bull	C,O	10	5,10			5	5,10	10		
Hawker Siddley	O					5				
Hightrack Computer Technik	O						8	8		
ISOT*	C,O	14		14	14					
Newbury	O	5,14	14				8			
Nixdorf	C			14						
Olivetti	C,O					5,8				
Pertec	C,O	14	14							
Rodime	O					3,5	5			
ROM-Control Data*	O									
Siemens	C				14				14	

* Manufactures disk drives of 2314 type.

TECHNICAL REVIEW

Survival of the fittest

It's no secret that everyone wants a piece of the disk drive pie. The industry is now too big to ignore, and the promise of future growth is still spectacular.

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.

Among the technological newcomers, it is reasonable to expect those with outstanding strengths for specific applications to be successful in gradually developing selected niche markets. Today's leading candidates for commercial success are:

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

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

  In broad terms, two kinds of systems will be offered: Document storage and data storage systems. Systems intended to store images of documents are already on the market in Japan, offered by Toshiba and Matsushita Electric. Document storage systems do not require the extremely low error rates demanded for data storage, and can live with the relatively poor error rates common to all optical recording systems. At this time, it does not appear that optical document storge systems will be able to compete on a price per image basis with microfilm for bulk storage of images which are not frequently referred to.

However, the fast and convenient access to stored images provided by optical disk systems will probably create a major place for them in the emerging office automation market, for numerous specialized applications. The early emphasis on optical document storage systems in the Japanese market is explained by the extremely complicated character of the Japanese alphabet. Since most business communication and records are in handwritten characters, the emphasis first on copying machines, then facsimile transmission, and now optical document storage systems is understandable.

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

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

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

  Most current magneto-optical development programs involve using a low powered laser to change the magnetic state of an amorphous gadolinium coating on a disk, by raising surface temperatures into the range of the coating's Curie point, while a magnetic

field is present. These changes are detected during reading, as the affected spot on the disk causes a small rotation in the polarized light reflected from the surface or transmitted through the disk.

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

Advocates of both technologies claim the ability to reverse the state at individual disk locations more times than would ever be necessary, and believe that their disks will be adequately stable for archival storage. Individual firms are also working on other proposed reversible optical recording technologies, but none of these are known to have overcome all of the problems, which have included: Slow completion of the reversal cycle, limitations on the number of reversals before degradation, poor shelf life, and low recording density.

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

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

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

So bubbles started to find suitable applications, once they were actually in production and support chips became available. The largest manufacturing levels are still maintained by Hitachi,

with most production used by Nippon Telephone and Telegraph for a variety of telecommunication applications. AT&T, with manufacturing by Western Electric, is believed to be much further behind in developing internal bubble applications, despite the fact that the basic technology was invented at Bell Labs.

The successful bubble program of Intel 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 3.2 MB 5.25" floppies now starting to appear from Amlyn and Drivetec will find an excellent market, but capacities in this range are only the beginning of the potential expansion of floppy drive capabilities. 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 1984 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. Vertimag plans to solve this problem by the installation of a continuous sputtering process of their own design, with the projected capability to make five million 5.25" flexible disks per year -- enough to get the entire program off to a good start if all goes well.

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

Until a few years ago, the disk drive industry found it convenient to let IBM develop all the basic disk recording technology, then merely adapt heads, disks and other components to the specific drive configurations desired. However, the slow, controlled release of new disk products by IBM, combined with the firm's lack of development in small disk drives, has been frustrating to many other firms. The industry is still happy to take advantage of IBM's development investments in many areas, such as heads, but now reacts to technology improvements from other directions.

* 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. Independent manufacturers of thin film heads are now attempting to develop the potential market among OEM disk drive producers, by designing heads optimized for small disk drives and by setting prices "down the learning curve". Penetration of this market will still depend on availability and price, but the door may be starting to open slightly.

* 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, recent years have seen considerable activity 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, SyQuest, and Texas Instruments, all for 5.25" or smaller disk drives, and Ibis, for 14" drives. Ampex has supplied most of the plated disks used to date, and has licensed CCT, which plans to establish a new production facility for disks, and BASF, which plans production of plated disks in Germany. Both Control Data and Tandon are preparing to produce plated disks for internal requirements. Some of this activity has been generated because of the higher density potential of plated disks (few of the above drives need more density than oxide disks offer), but most of the early choices were made because of plated disks' better physical durability.

There is now a stampede by numerous established and new firms to establish production capability for plated disks. Most are aiming at the market for 5.25" and smaller disk drives, and the managements involved recognize the need to establish credibility by offering facilities capable of producing large quantities of disks, with adequate process controls, at prices competitive with oxide disks of comparable quality. A second wave of companies planning to use sputtering methods to deposit thin metal films is also underway. And some plan to use both plating and sputtering technologies in multiple layer disks.

* 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. The firm has sold a license to Control Data for this technology, and both companies are cooperating in development of hardware. Although the CDC program will probably take a few years to result in actual products, it is expected that some other firms may find the potential competitive advantages they are looking for in perpendicular recording. Drives using this technology may actually be shipped in 1984, 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. Sperry recently became a co-owner of MPI, and starting in 1983 Sperry shipments will be combined with those of Control Data, MPI's managing partner.

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 with systems by its parent company or other subsidiaries.

* CDC disk drives 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 Hitachi 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 Hewlett-Packard 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.

Spindles: The basic unit in counting disk drives. One spindle consists of the disk drive mechanism required to utilize a single disk. All DISK/TREND unit totals are counted in spindles, even though some drive configurations include more than one spindle.

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 1983 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, 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 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, Xylogics and Emulex.

Direct to end user/distributors: (1) 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. (2) Distribution through wholesalers, such as Hamilton Avent or Arrow.

DISK CARTRIDGE DRIVES, LESS THAN 12 MB

1983 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
Digital Equipment	RL01, RL02
ISOT	CM 5400, CM 5410
Mitsubishi	M802
Newbury Data	D9427H
Pertec	D3321, D3442
Western Dynex	DD-6222

10.5" disk diameter

Cii-Honeywell Bull	D120

8" disk diameter

Disctron	DP-100
Vermont Research	8010

5.25" disk diameter

DMA Systems	Micro-magnum 5/5, 5
Memorex	410
New World	Micro-Disc 5/5
Newbury Data	505
Western Dynex	WD-505

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)	1982	1983	1984	1985	1986
U.S. manufacturers	220.4	233.5	184.4	142.5	125.6
All manufacturers	271.8	277.8	228.7	175.5	137.5

For the third year, 14" disk cartridge drives are continuing to decline in shipments during 1983, but shipments of drives using smaller diameter disks are finally achieving enough growth to generate an overall increase in 1983 unit shipments for the product group. Worldwide revenues for the group are up a modest 2.2% in 1983, to $277.8 million.

14" disk drives in this group have been displaced in small business systems, their largest market, by the flood of 8" and 5.25" fixed disk drives which have become available in the last few years. Shipments of drives using removable disks in these diameters were very small before 1983, due to limited availability. Seagate Technology dropped its announced 5.25" disk cartridge drive before shipment, but DMA Systems has established quantity production and has licensed its drive to Memorex and Newbury Data

Captive drive shipments, mostly Digital Equipment Corporation's RL01/RL02 14" drives, are expected to increase slightly in 1983, due to a delay in DEC's introduction of a planned replacement product. DEC's 8" "Aztec" drive, which will offer 42 MB per spindle, had been expected to severely impact the firm's shipments of older 14" disk cartridge drives, but has still not been introduced.

With the decline in shipments of 14" drives by U.S. manufacturers for the OEM market, the leading producer of non-captive drives in 1982 was ISOT, the Bulgarian organization which manufactures disk cartridge drives

for minicomputers produced in Eastern Bloc countries. ISOT's 11,500 drives equalled 30.3% of the worldwide total, while Control Data's 9,800 drives amounted to 25.8% of the total.

Marketing trends

Continuing decline in shipments of 14" drives in this group is assured by the well established trend to small diameter fixed disk drives, plus the current availability of small diameter removable disk cartridge drives. Last production of U.S. OEM 14" drives is expected for 1984, with captive drives ending in 1985. OEM and captive shipments by nonU.S. manufacturers, principally for Eastern Bloc consumption, will continue at least through 1984.

With the passage of time, the outlook for 8" disk cartridge drives in this capacity group does not appear promising; only a few manufacturers are active in the market, and sales have been small. Volume shipments of 5.25" drives, however, are now well established by DMA Systems, with further availability expected from licensees. DMA Systems also expects to introduce a half high 5.25" disk cartridge drive at Comdex in late November. And SyQuest Technology is still planning to ship its 3.9" disk cartridge drive in quantity during 1983, after a difficult manufacturing startup earlier in the year.

Small disk cartridge drives bear higher prices than fixed disk drives using similar disks, due to the greater mechanical complexity required to achieve media interchange and reliability. It is clear that their higher prices will limit disk cartridge drives to a smaller market than fixed disk drives, but the market available is nevertheless expected to be a desirable one. No other data recording device with removable media in

this capacity range offers the same combination of direct access and fast save/restore of data.

DISK/TREND forecasts for this group have been lowered, primarily because of delayed manufacturing startups and Seagate's departure from the product area, not because of lowered demand. Delayed availability has resulted in loss of numerous system manufacturers which now use fixed disk drives, and are not likely to return to removable disk drives except for specialized applications. The DISK/TREND forecast for 1986 is now 194,200 drives, 99% of which are expected to be 5.25" or smaller in disk diameter.

Technical trends

Technology used in the new small disk cartridge drives is adapted from older designs. Heads use variations from 3330 and 3350 designs, in some cases combined with smaller sliders. Disks include conventional Winchester oxide coated and plated types.

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. Both 5.25" and less than 5.25" drives in this group will be available in quantities adequate to meet demand, starting in 1984.

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

TABLE 8

DISK CARTRIDGE DRIVES, LESS THAN 12 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1982 Shipments		Forecast							
			1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	100.7	166.4	103.6	172.0	68.9	114.8	37.4	60.5	18.9	27.0
TOTAL U.S. CAPTIVE	100.7	166.4	103.6	172.0	68.9	114.8	37.4	60.5	18.9	27.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	34.9	54.0	42.4	61.5	52.8	69.6	62.3	82.0	74.6	98.6
TOTAL U.S. NON-CAPTIVE	34.9	54.0	42.4	61.5	52.8	69.6	62.3	82.0	74.6	98.6
TOTAL U.S. SHIPMENTS	135.6	220.4	146.0	233.5	121.7	184.4	99.7	142.5	93.5	125.6
Non-U.S. Manufacturers										
Captive	--	10.6	--	11.7	--	13.0	--	7.8	--	2.3
PCM	--	--	--	--	--	--	--	--	--	--
OEM	4.2	40.8	1.5	32.6	1.0	31.3	.4	25.2	--	9.6
TOTAL NON-U.S. SHIPMENTS	4.2	51.4	1.5	44.3	1.0	44.3	.4	33.0	--	11.9
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	139.8	271.8	147.5	277.8	122.7	228.7	100.1	175.5	93.5	137.5
OEM Average Price ($000)	2.6	2.5	1.6	1.7	.9	1.1	.6	.8	.6	.6

TABLE 9

DISK CARTRIDGE DRIVES, LESS THAN 12 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1982 Shipments		Forecast 1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	(5.6)	(8.2)	(5.4)	(7.9)	(4.7)	(6.9)	(4.3)	(6.3)	(4.3)	(6.3)
Other U.S. Captive	22.4	37.0	24.4	40.5	16.8	28.0	9.6	15.5	6.3	9.0
TOTAL U.S. CAPTIVE	16.8	28.8	19.0	32.6	12.1	21.1	5.3	9.2	2.0	2.7
PCM	--	--	--	--	--	--	--	--	--	--
OEM	13.3	20.6	27.5	39.9	58.7	77.3	97.6	128.5	135.4	179.0
TOTAL U.S. NON-CAPTIVE	13.3	20.6	27.5	39.9	58.7	77.3	97.6	128.5	135.4	179.0
TOTAL U.S. SHIPMENTS	30.1	49.4	46.5	72.5	70.8	98.4	102.9	137.7	137.4	181.7
Non-U.S. Manufacturers										
Captive	--	1.5	--	2.1	--	2.5	--	1.5	--	.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	1.8	17.4	.7	14.8	.4	12.5	.2	14.0	--	12.0
TOTAL NON-U.S. SHIPMENTS	1.8	18.9	.7	16.9	.4	15.0	.2	15.5	--	12.5
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	31.9	68.3	47.2	89.4	71.2	113.4	103.1	153.2	137.4	194.2
Installed at Year End										
IBM	31.0	46.2	25.6	38.3	20.9	31.4	16.6	25.1	12.3	18.8
Non-IBM	487.6	882.2	540.2	979.5	616.1	1,099.8	723.5	1,259.3	865.2	1,459.8
WORLDWIDE TOTAL	518.6	928.4	565.8	1,017.8	637.0	1,131.2	740.1	1,284.4	877.5	1,478.6

TABLE 10

DISK CARTRIDGE DRIVES, LESS THAN 12 MB

WORLDWIDE SHIPMENTS (000)

BREAKDOWN BY DISK DIAMETER

	1982 Shipments			Forecast														
				1983				1984				1985				1986		
	14"	8"	5.25"	14"	8"	5.25"	<5.25"	14"	8"	5.25"	<5.25"	14"	8"	5.25"	<5.25"	8"	5.25"	<5.25"
U.S. Manufacturers																		
IBM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	37.0	--	--	40.5	--	--	--	28.0	--	--	--	12.5	--	3.0	--	--	9.0	--
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	14.5	3.5	2.6	8.9	5.0	17.0	9.0	3.8	6.5	41.0	26.0	--	5.5	78.0	45.0	2.0	112.0	65.0
TOTAL U.S. SHIPMENTS	51.5	3.5	2.6	49.4	5.0	17.0	9.0	31.8	6.5	41.0	26.0	12.5	5.5	81.0	45.0	2.0	121.0	65.0
Non-U.S. Manufacturers																		
Captive	.9	.6	--	.6	1.5	--	--	.5	2.0	--	--	.3	1.2	--	--	.5	--	--
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	15.4	2.0	--	13.8	1.0	--	--	9.0	.5	3.0	--	6.0	--	8.0	--	--	12.0	--
TOTAL NON-U.S. SHIPMENTS	16.3	2.6	--	14.4	2.5	--	--	9.5	2.5	3.0	--	6.3	1.2	8.0	--	.5	12.0	--
TOTAL WORLDWIDE SHIPMENTS	67.8	6.1	2.6	63.8	7.5	17.0	9.0	41.3	9.0	44.0	26.0	18.8	6.7	89.0	45.0	2.5	133.0	65.0
ANNUAL SHARE, BY DIAMETER	89%	8%	3%	66%	8%	17%	9%	34%	7%	37%	22%	12%	4%	56%	28%	1%	66%	33%

NOTE: In this table, 10.5" drives are grouped with 8" drives. Retirements of IBM 14" drives are not included.

TABLE 11

DISK CARTRIDGE DRIVES, LESS THAN 12 MEGABYTES

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

Distribution Channel	1982 U.S. Net Shipments Units (000)	%	FORECAST 1983 %	1984 %	1985 %	1986 %
Mainframe computer manufacturers	2.4	15.9	14.3	12.7	11.1	9.4
Mini/micro computer manufacturers	4.8	31.8	27.0	23.0	19.5	16.6
System OEMs/systems houses	6.5	43.0	49.3	54.6	59.4	63.7
Independent peripherals suppliers	1.1	7.3	7.6	8.1	8.5	8.9
Direct to end user/distributors	.3	2.0	1.8	1.6	1.5	1.4
TOTAL	15.1					

TABLE 12

DISK CARTRIDGE DRIVES, LESS THAN 12 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1982 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
ISOT	--	--	11.5	30.3
Control Data	6.5	43.1	9.8	25.8
Disctron	2.8	18.5	3.5	9.2
Other U.S.	4.0	26.5	7.3	19.2
Other Non-U.S.	1.8	11.9	5.9	15.5
TOTAL	15.1	100.0	38.0	100.0

DISK CARTRIDGE DRIVES, MORE THAN 12 MB

1983 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
Digital Equipment	RK06, RK07
Fujitsu	M2201, F451
Hewlett-Packard	7906
Mitsubishi	M803
Newbury Data	D9448-32, D9448-64, D9448-96
Pertec	D3461, D3482
Toshiba	MK-900R-32/64/96
Vermont Research	5017-4

10.5" disk diameter

Cii-Honeywell Bull	D140, D145

8" disk diameter

Amcodyne	Arapahoe 7110
Century Data Systems	C2075
Control Data	9454, 9455, 9457
Vermont Research	8520

5.25" disk diameter

Athenaeum	Aegis 10/10
Cardiff Technology	D-240, R-120
Cii-Honeywell Bull	D520
DMA Systems	Micro-Magnum 5/10, 5/15
Memorex	415

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 disks in a single drive. Several unique configurations are also included, such as Fujitsu's M-2201 (50 MB removable), DEC's RK06 and

RK07 (up to 27.5 MB in a special two-disk 14" removable cartridge), and Vermont Research's pioneer embedded servo drive, the 5017-4 (14" 26 MB fixed/26 MB removable).

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1982	1983	1984	1985	1986
U.S. manufacturers	278.8	229.6	326.0	524.5	720.9
All manufacturers	342.6	304.9	417.7	616.3	806.5

Control Data's large OEM shipments of the 9448 "Phoenix" cartridge module drive continue to dominate activity in this product group. CDC shipped over 28,000 CMD drives worldwide to OEM customers in 1982. Shipments are declining in 1983, but the lag in CMD's is being more than offset by long-overdue growth in sales of Control Data's 8" Lark disk cartridge drives, principally the later version, with 25 MB fixed/25 MB removable capacity.

Total worldwide shipments for all OEM drives in this group were 39,800 units in 1982, growing to an estimated 44,000 in 1983. Control Data shipped 81% of the 1982 non-captive total, or 32,300 drives.

Only eight system manufacturers still maintained production of 14" captive drives during 1982, with worldwide shipments totaling 15,600 units. 1982 worldwide shipments of all captive drives were 16,200 units, expected to drop to 13,800 drives in 1983. In most cases, system manufacturers are replacing disk cartridge drives in this capacity range with fixed disk drives, usually in smaller disk sizes.

Marketing trends

Excellent growth in total unit shipments for this product group is anticipated in DISK/TREND forecasts, but the future belongs to drives with smaller disk diameters -- initially 8" drives, later 5.25" drives. Average annual growth through 1986 is expected to reach 44%, with total worldwide shipments for all drives in that year estimated at 173,200 units, valued at $806.5 million.

The largest single stimulus to this expected growth will be the belated introduction by Digital Equipment Corporation of the "Aztec" 8" disk cartridge drive. The Aztec reportedly has been delayed for the last few years by technical problems, but is expected to be introduced in time to achieve substantial shipments in 1984, as the successor to DEC's high volume 14" disk cartridge drive, the RL02. The RL02 offers 10.4 MB on a single removable 14" disk, while the Aztec is expected to provide twice that capacity on its single removable 8" disk, which will also be matched by a single 8" fixed disk with the same capacity.

The OEM shipments of 14" drives which have sustained this product group are expected to drop to insignificant levels by 1986. But the production shipments of 8" drives already underway by Control Data in 1983 are expected to see sharp growth in 1984, augmented by the production shipments by Amcodyne, Century Data Systems and Vermont Research now being initiated. Production shipments of 5.25" drives in this group are also expected in 1984, with initial capacities of 12 MB per disk cartridge. The 1986 product mix is forecasted at 68% 8" drives, 30% 5.25" drives.

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 to the older 3330 technology.

The 8" drives introduced to date incorporate elements of the older technologies, but utilize head designs similar to Winchester heads, sometimes with "mini" sliders. 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 high density recording between disk cartridge drives and fixed disk drives 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 for lower contamination levels. It may be possible to increase density in removable disk drives, but the degree of engineering difficulty will 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, with volume production of OEM drives available from U.S. and European manufacturers in 1984.

3. Digital Equipment will introduce the Aztec 8" disk cartridge drive in time to make major product shipments during 1984.

TABLE 13

DISK CARTRIDGE DRIVES, MORE THAN 12 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1982 Shipments		Forecast							
	1983		1984		1985		1986			
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	81.3	132.8	52.1	85.2	113.1	188.7	228.7	380.4	340.5	562.5
TOTAL U.S. CAPTIVE	81.3	132.8	52.1	85.2	113.1	188.7	228.7	380.4	340.5	562.5
PCM	1.2	1.2	1.3	1.3	1.3	1.3	2.4	2.4	3.0	3.0
OEM	92.7	144.8	93.4	143.1	89.3	136.0	94.1	141.7	104.0	155.4
TOTAL U.S. NON-CAPTIVE	93.9	146.0	94.7	144.4	90.6	137.3	96.5	144.1	107.0	158.4
TOTAL U.S. SHIPMENTS	175.2	278.8	146.8	229.6	203.7	326.0	325.2	524.5	447.5	720.9
Non-U.S. Manufacturers										
Captive	--	36.8	--	47.9	--	64.7	--	66.0	--	62.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	8.9	27.0	7.2	27.4	7.8	27.0	11.1	25.8	11.9	23.6
TOTAL NON-U.S. SHIPMENTS	8.9	63.8	7.2	75.3	7.8	91.7	11.1	91.8	11.9	85.6
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	184.1	342.6	154.0	304.9	211.5	417.7	336.3	616.3	459.4	806.5
OEM Average Price ($000)	4.4	4.3	3.9	3.9	3.2	3.1	2.5	2.5	2.1	2.0

TABLE 14

DISK CARTRIDGE DRIVES, MORE THAN 12 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	7.9	12.9	5.2	8.5	13.3	22.2	29.7	49.4	45.4	75.0
TOTAL U.S. CAPTIVE	7.9	12.9	5.2	8.5	13.3	22.2	29.7	49.4	45.4	75.0
PCM	.1	.1	.1	.1	.1	.1	.2	.2	.3	.3
OEM	21.0	32.8	23.5	36.0	27.9	42.5	36.2	54.5	49.5	74.0
TOTAL U.S. NON-CAPTIVE	21.1	32.9	23.6	36.1	28.0	42.6	36.4	54.7	49.8	74.3
TOTAL U.S. SHIPMENTS	29.0	45.8	28.8	44.6	41.3	64.8	66.1	104.1	95.2	149.3
Non-U.S. Manufacturers										
Captive	--	3.3	--	5.3	--	8.4	--	9.7	--	10.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	2.3	7.0	2.1	8.0	2.7	9.3	5.3	12.3	7.0	13.9
TOTAL NON-U.S. SHIPMENTS	2.3	10.3	2.1	13.3	2.7	17.7	5.3	22.0	7.0	23.9
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	31.3	56.1	30.9	57.9	44.0	82.5	71.4	126.1	102.2	173.2
Installed at Year End										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	124.4	223.0	155.3	280.9	199.3	363.4	270.7	489.5	372.9	662.7
WORLDWIDE TOTAL	124.4	223.0	155.3	280.9	199.3	363.4	270.7	489.5	372.9	662.7

TABLE 15

DISK CARTRIDGE DRIVES, MORE THAN 12 MB

WORLDWIDE SHIPMENTS (000)

BREAKDOWN BY DISK DIAMETER

	1982 --Shipments--		Forecast											
			1983			1984			1985			1986		
	14"	8"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"
U.S. Manufacturers														
IBM	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	12.2	.7	7.0	1.5	--	4.2	18.0	--	2.4	45.0	2.0	--	68.0	7.0
PCM	.1	--	.1	--	--	.1	--	--	.1	.1	--	--	.3	--
OEM	29.0	3.8	22.1	13.9	--	14.4	23.6	4.5	8.0	33.0	13.5	3.0	45.0	26.0
TOTAL U.S. SHIPMENTS	41.3	4.5	29.2	15.4	--	18.7	41.6	4.5	10.5	78.1	15.5	3.0	113.3	33.0
Non-U.S. Manufacturers														
Captive	2.7	.6	2.3	3.0	--	1.6	4.8	2.0	.7	3.5	5.5	--	2.0	8.0
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	5.4	1.6	4.7	2.7	.6	3.3	3.2	2.8	1.8	3.0	7.5	.7	2.2	11.0
TOTAL NON-U.S. SHIPMENTS	8.1	2.2	7.0	5.7	.6	4.9	8.0	4.8	2.5	6.5	13.0	.7	4.2	19.0
TOTAL WORLDWIDE SHIPMENTS	49.4	6.7	36.2	21.1	.6	23.6	49.6	9.3	13.0	84.6	28.5	3.7	117.5	52.0
ANNUAL SHARE, BY DIAMETER	88%	12%	63%	36%	1%	29%	60%	11%	10%	67%	23%	2%	68%	30%

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

TABLE 16

DISK CARTRIDGE DRIVES, MORE THAN 12 MEGABYTES

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

Distribution Channel	1982 U.S. Net Shipments Units (000)	1982 U.S. Net Shipments %	FORECAST 1983 %	1984 %	1985 %	1986 %
Mainframe computer manufacturers	5.6	23.9	21.5	19.4	16.3	13.0
Mini/micro computer manufacturers	8.6	36.8	35.0	33.2	31.6	30.0
System OEMs/systems houses	8.3	35.5	39.6	42.9	46.9	51.0
Independent peripherals suppliers	.8	3.4	3.9	4.5	5.2	6.0
Direct to end user/distributors	.1	.4	--	--	--	--
TOTAL	23.4					

TABLE 17

DISK CARTRIDGE DRIVES, MORE THAN 12 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1982 Net Shipments To United States Destinations Units (000)	To United States Destinations %	Worldwide Units (000)	Worldwide %
Control Data	20.8	88.9	32.3	81.0
Other U.S.	.3	1.3	.6	1.5
Other Non-U.S.	2.3	9.8	7.0	17.5
TOTAL	23.4	100.0	39.9	100.0

DISK PACK DRIVES, LESS THAN 100 MB

1983 DISK/TREND REPORT

DISK PACK DRIVES, LESS THAN 100 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, 271-10
Data General	6067
Hewlett-Packard	7920
ISOT	CM 5412
Mitsubishi	M2850F, M2851F, M2854F
Sperry	8149

9" disk diameter

Control Data	9710

The Control Data 9760 and 9762, the original "storage module drives", have exerted broad influence in the industry, since their 1974 introduction. "SMD" became the generally used term for drives using 3330 technology in packs with five data surfaces, as well as for the larger 19 data surface disk pack drives using similar interfaces. The SMD interface itself became the dominant industry standard for high performance OEM disk drives. The term SMD is used throughout the DISK/TREND Report as a generic description for these 14" Control Data drives and competitive equivalents.

Control Data's 9" "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 "FSD" 9" fixed disk drive, which was also introduced at the 1982 NCC.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1982	1983	1984	1985	1986
U.S. manufacturers	267.9	220.5	183.8	170.2	159.9
All manufacturers	360.3	320.9	276.0	262.1	238.5

Despite continuing captive manufacturing programs for 14" disk pack drives in this class by Control Data, Burroughs, Hewlett-Packard, Data General, Nixdorf and Mitsubishi, worldwide OEM drive unit shipments are clearly dominant, with 66% of the 1983 total.

OEM drive shipments in this group peaked in 1980 with 41,800 units. 1982's worldwide OEM total was down to 26,000 drives, but the long-term downward trend has reached a plateau in 1983, at an estimated 24,700 units (which includes 2,500 9" drives).

All existing manufacturers of 14" OEM drives have experienced an unexpectedly strong market during the last 12 months, as shipments of minicomputer-based systems have improved with the easing of the recession. Control Data continued to dominate worldwide shipments of non-captive drives in 1982, with 17,400 units, for 65.9% of the total. Century Data Systems maintained a share of 25%, with 6,600 drives.

Captive shipments peaked in 1979/1980, and the decline is continuing during 1982 and 1983 for all producers except Nixdorf, the most recent system manufacturer to initiate captive production of drives in this group. 1983 worldwide captive shipments are estimated at 12,300 drives.

Marketing trends

Previous DISK/TREND forecasts for 9" disk pack drives in this group have been lowered this year, reflecting the growing availability of 8" and

5.25" fixed disk drives with similar capacities, the emergence of multiple sources for disk cartridge drives with capacities overlapping the low end of this product group, and Control Data's continuing status as sole supplier for the 9" RSD disk pack drive.

The current forecast foresees virtually flat worldwide shipments of all drives in the group through 1986, with the combined total for 14" and 9" drives hovering in the range from 35,000 to 38,000 drives per year. During this period shipments of 14" drives are expected to decline steadily, while 9" drives climb to 70% of the total.

Most of the expected growth in 9" drives will come from the existing market for 14" OEM drives, with captive shipments remaining small. It appears captive shipments will be limited to the companies affiliated with Control Data in ownership of Magnetic Peripherals, Inc., the manufacturer of the RSD.

The question of whether other manufacturers of OEM drives will develop their own versions of the Control Data RSD is critical to further expansion of the OEM market. So far, nothing has been heard from Century Data Systems or Ampex, CDC's traditional competitors in the SMD market. These firms, as well as most of the rest of the industry, are now primarily active in product development for fixed disk drives and may be reluctant to invest in another removable disk pack program.

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.

Forecasting assumptions

1. Captive and OEM shipments of 14" drives in this group will continue to decline through 1986, 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 1985.

3. The changing product mix in OEM drives in favor of the RSD will cause average OEM prices to continually decline through 1986.

4. Control Data will remain the only manufacturer for 9" disk pack drives.

TABLE 18

DISK PACK DRIVES, LESS THAN 100 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1982		Forecast							
	---Shipments--		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	69.9	124.7	47.4	93.5	32.3	60.6	25.4	50.8	24.2	48.3
TOTAL U.S. CAPTIVE	69.9	124.7	47.4	93.5	32.3	60.6	25.4	50.8	24.2	48.3
PCM	4.5	4.5	4.4	4.4	5.2	5.2	4.8	5.8	4.4	6.2
OEM	93.5	138.7	83.5	122.6	81.0	118.0	78.2	113.6	71.8	105.4
TOTAL U.S. NON-CAPTIVE	98.0	143.2	87.9	127.0	86.2	123.2	83.0	119.4	76.2	111.6
TOTAL U.S. SHIPMENTS	167.9	267.9	135.3	220.5	118.5	183.8	108.4	170.2	100.4	159.9
Non-U.S. Manufacturers										
Captive	8.4	91.2	8.4	91.2	6.7	72.2	5.0	56.8	3.3	33.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	1.2	--	9.2	--	20.0	--	35.1	--	45.4
TOTAL NON-U.S. SHIPMENTS	8.4	92.4	8.4	100.4	6.7	92.2	5.0	91.9	3.3	78.6
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	176.3	360.3	143.7	320.9	125.2	276.0	113.4	262.1	103.7	238.5
OEM Average Price ($000)	5.4	5.4	5.2	5.3	5.0	5.3	4.6	5.1	4.2	4.9

TABLE 19

DISK PACK DRIVES, LESS THAN 100 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	5.1	9.1	3.5	6.9	2.5	4.7	2.1	4.2	2.1	4.2
TOTAL U.S. CAPTIVE	5.1	9.1	3.5	6.9	2.5	4.7	2.1	4.2	2.1	4.2
PCM	.4	.4	.4	.4	.5	.5	.5	.6	.5	.7
OEM	17.4	25.8	16.0	23.5	16.2	23.6	17.0	24.7	17.1	25.1
TOTAL U.S. NON-CAPTIVE	17.8	26.2	16.4	23.9	16.7	24.1	17.5	25.3	17.6	25.8
TOTAL U.S. SHIPMENTS	22.9	35.3	19.9	30.8	19.2	28.8	19.6	29.5	19.7	30.0
Non-U.S. Manufacturers										
Captive	.5	5.4	.5	5.4	.4	4.3	.3	3.4	.2	2.0
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	.2	--	1.2	--	2.5	--	4.5	--	5.9
TOTAL NON-U.S. SHIPMENTS	.5	5.6	.5	6.6	.4	6.8	.3	7.9	.2	7.9
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	23.4	40.9	20.4	37.4	19.6	35.6	19.9	37.4	19.9	37.9
Installed at Year End										
IBM	--	--	--	--	--	--	--	--	--	--
Non-IBM	172.6	263.6	193.0	301.0	212.6	336.6	232.5	374.0	252.4	411.9
WORLDWIDE TOTAL	172.6	263.6	193.0	301.0	212.6	336.6	232.5	374.0	252.4	411.9

TABLE 20

DISK PACK DRIVES, LESS THAN 100 MB

WORLDWIDE SHIPMENTS (000)

BREAKDOWN BY DISK DIAMETER

	1982 Shipments	Forecast							
		1983		1984		1985		1986	
	14"	14"	8"	14"	8"	14"	8"	14"	8"
U.S. Manufacturers									
IBM	--	--	--	--	--	--	--	--	--
Other U.S. Captive	9.1	6.8	.1	3.4	1.3	1.4	2.8	--	4.2
PCM	.4	.4	--	.4	.1	.3	.3	.1	.6
OEM	25.8	21.0	2.5	15.8	7.8	8.7	16.0	3.5	21.6
TOTAL U.S. SHIPMENTS	35.3	28.2	2.6	19.6	9.2	10.4	19.1	3.6	26.4
Non-U.S. Manufacturers									
Captive	5.4	5.4	--	4.3	--	3.4	--	2.0	--
PCM	--	--	--	--	--	--	--	--	--
OEM	.2	1.2	--	2.5	--	4.5	--	5.9	--
TOTAL NON-U.S. SHIPMENTS	5.6	6.6	--	6.8	--	7.9	--	7.9	--
TOTAL WORLDWIDE SHIPMENTS	40.9	34.8	2.6	26.4	9.2	18.3	19.1	11.5	26.4
ANNUAL SHARE, BY DIAMETER	100%	93%	7%	74%	26%	49%	51%	30%	70%

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

TABLE 21

DISK PACK DRIVES, LESS THAN 100 MEGABYTES

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

Distribution Channel	1982 U.S. Net Shipments Units (000)	%	FORECAST 1983 %	1984 %	1985 %	1986 %
Mainframe computer manufacturers	.1	.6	.6	.5	.4	.3
Mini/micro computer manufacturers	8.9	50.0	48.5	47.1	45.6	44.3
System OEMs/systems houses	7.5	42.1	44.4	46.4	48.3	49.8
Independent peripherals suppliers	.9	5.1	4.1	3.3	2.6	2.1
Direct to end user/distributors	.4	2.2	2.4	2.7	3.1	3.5
TOTAL	17.8					

TABLE 22

DISK PACK DRIVES, LESS THAN 100 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1982 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Control Data	11.5	64.6	17.4	65.9
Century Data Systems	5.9	33.2	6.6	25.0
Other U.S.	.4	2.2	2.2	8.3
Other Non-U.S.	--	--	.2	.8
TOTAL	17.8	100.0	26.4	100.0

DISK PACK DRIVES, MORE THAN 100 MB

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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
Burroughs	9484-12
Century Data Systems	T200, T300
Control Data	9766, 270-30
Data General	6060, 6061, 6122
Digital Equipment	RA60
Fujitsu	F479
Hewlett-Packard	7925, 7935H
ISOT	ES 5066, ES 5067.02
Memorex	677
Mitsubishi	M2838F, M2839F
NEC	N7745
Siemens	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 major 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 under DEC model numbers.

Other disk pack drives with unique physical configurations in this group include: Ampex DM-9160 (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)	1982	1983	1984	1985	1986
U.S. manufacturers	535.9	503.8	501.0	475.3	403.4
All manufacturers	655.7	562.0	549.6	508.3	438.4

Total worldwide shipments of all newly manufactured disk pack drives in this group continue to decline: From 52,200 in 1981, to 46,000 in 1982, to an estimated 39,300 in 1983. Through 1982, however, most of the reduction in shipments has come from captive drives.

After years of increases in OEM drive shipments, primarily fueled by the appetite of minicomputer manufacturers for 300 MB drives with SMD interfaces, sales by U.S. manufacturers of OEM drives remained flat during the 1981-1982 period, with shipments of 27,500 spindles in each of the two years. The increase in shipments of non-U.S. drives for 1982 was caused by the start of ISOT's production of large disk pack drives for use with Eastern Bloc minicomputers.

Control Data retained 63.2% of worldwide non-captive drive shipments in 1982, for a total of 18,900 spindles. Memorex, Century Data Systems and Ampex were bunched with 8.4% to 9.7% of the worldwide total. OEM shipments for 1983 by U.S. manufacturers will decline, with the largest drops in volume expected for Memorex and Control Data, as Digital Equipment transitions from major buy-out programs for large disk pack drives to internally built captive drives, in both removable and fixed disk configurations.

Marketing trends

While OEM drive shipments whither through 1986 in the face of

competition from more cost-effective fixed disk drives of various sizes, total shipments of captive disk pack drives in this group are expected to achieve a gradual increase.

The principal reason for the boost in captive drive shipments will be new programs by two U.S. manufacturers. Digital Equipment's RA60, a new 205 MB rack mounted disk pack drive now starting into production, is expected to achieve high shipment levels. And Burroughs has exploited its acquisition of Memorex by adding a new captive version of the Memorex 677 disk pack drive.

Retirements of IBM and PCM disk pack drives will remain high for several years, as they are replaced by larger fixed disk drives.

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 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 1986, 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)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	123.6	253.0	131.9	267.8	170.3	335.7	186.7	366.0	180.8	340.6
TOTAL U.S. CAPTIVE	123.6	253.0	131.9	267.8	170.3	335.7	186.7	366.0	180.8	340.6
PCM	--	--	--	--	--	--	--	--	--	--
OEM	235.5	282.9	172.3	236.0	115.8	165.3	74.1	109.3	40.0	62.8
TOTAL U.S. NON-CAPTIVE	235.5	282.9	172.3	236.0	115.8	165.3	74.1	109.3	40.0	62.8
TOTAL U.S. SHIPMENTS	359.1	535.9	304.2	503.8	286.1	501.0	260.8	475.3	220.8	403.4
Non-U.S. Manufacturers										
Captive	--	95.8	--	34.2	--	18.6	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	24.0	--	24.0	--	30.0	--	33.0	--	35.0
TOTAL NON-U.S. SHIPMENTS	--	119.8	--	58.2	--	48.6	--	33.0	--	35.0
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	359.1	655.7	304.2	562.0	286.1	549.6	260.8	508.3	220.8	438.4
OEM Average Price ($000)	10.3	10.3	10.4	10.4	9.9	9.9	9.5	9.6	9.1	9.4

TABLE 24

DISK PACK DRIVES, MORE THAN 100 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	(5.0)	(8.3)	(5.4)	(9.0)	(5.0)	(8.4)	(4.3)	(7.2)	(3.5)	(5.9)
Other U.S. Captive	6.3	12.9	6.5	13.2	10.2	20.1	12.7	24.9	13.8	26.0
TOTAL U.S. CAPTIVE	1.3	4.6	1.1	4.2	5.2	11.7	8.4	17.7	10.3	20.1
PCM	(4.6)	(5.7)	(5.0)	(6.2)	(4.6)	(5.8)	(3.9)	(4.9)	(3.2)	(4.0)
OEM	22.9	27.5	16.5	22.6	11.7	16.7	7.8	11.5	4.4	6.9
TOTAL U.S. NON-CAPTIVE	18.3	21.8	11.5	16.4	7.1	10.9	3.9	6.6	1.2	2.9
TOTAL U.S. SHIPMENTS	19.6	26.4	12.6	20.6	12.3	22.6	12.3	24.3	11.5	23.0
Non-U.S. Manufacturers										
Captive	--	3.2	--	1.1	--	.6	--	--	--	--
PCM	--	--	--	--	--	--	--	--	--	--
OEM	--	2.4	--	2.4	--	3.0	--	3.3	--	3.5
TOTAL NON-U.S. SHIPMENTS	--	5.6	--	3.5	--	3.6	--	3.3	--	3.5
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	19.6	32.0	12.6	24.1	12.3	26.2	12.3	27.6	11.5	26.5
Installed at Year End										
IBM	28.5	47.1	23.1	38.1	18.1	29.7	13.8	22.5	10.3	16.6
Non-IBM	184.8	323.1	202.8	356.2	220.1	390.8	236.7	425.6	251.7	458.0
WORLDWIDE TOTAL	213.3	370.2	225.9	394.3	238.2	420.5	250.5	448.1	262.0	474.6

TABLE 25

DISK PACK DRIVES, MORE THAN 100 MEGABYTES

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

Distribution Channel	1982 U.S. Net Shipments Units (000)	%	FORECAST 1983 %	1984 %	1985 %	1986 %
Mainframe computer manufacturers	2.7	11.8	8.2	4.8	1.0	--
Mini/micro computer manufacturers	9.0	39.3	29.5	22.1	19.9	17.9
System OEMs/systems houses	7.6	33.2	49.7	63.0	71.0	75.6
Independent peripherals suppliers	3.4	14.8	12.6	10.1	8.1	6.5
Direct to end user/distributors	.2	.9	--	--	--	--
TOTAL	22.9					

TABLE 26

DISK PACK DRIVES, MORE THAN 100 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1982 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Control Data	15.8	69.0	18.9	63.2
Memorex	2.6	11.4	2.9	9.7
Century	2.5	10.9	2.8	9.4
Ampex	1.9	8.3	2.5	8.4
Other U.S.	.1	.4	.4	1.3
Other Non-U.S.	--	--	2.4	8.0
TOTAL	22.9	100.0	29.9	100.0

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

FIXED DISK DRIVES, LESS THAN 30 MB

1983 DISK/TREND REPORT

FIXED DISK DRIVES, LESS THAN 30 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

Burroughs	FD 211
Century Data Systems	M20
Control Data	230-10, 240-15
Data General	6098, 6100
Hewlett-Packard	7910, 7911
Kennedy	5301-14
Mitsubishi	M2883-10, M2883-20
NEC	D1210, N7721
Northern Telecom	4518, 4521
Shugart	SA4004, SA4008
Toshiba	MK-100F

8 disk diameter

IBM	4963-29, 5247-011
Control Data	9410-8, 9410-24
Data General	6220, 6227
Disc Tech One	8432
Fujitsu	M2301, M2302
Hewlett-Packard	7908
International Memories	7710, 7720
Kennedy	6172
Megavault	MV16, MV26
Micropolis	1202SA, 1222MII
Mitsubishi	M2860-1
NEC	D2220, N7724
Northern Telecom	Aspen I, Aspen II
Olivetti	HD 830
Quantum	Q2010, Q2020
Shugart	SA1004
Texas Instruments	WD 800-18
Toshiba	MK-80F-10/20

5.25" disk diameter

Ampex	Pyxis 7, 13, 20, 27
Atasi	3020
BASF	6182, 6185, 6185S*
Cii-Honeywell Bull	D505, D510
Cogito Systems	CG906*, CG912*
Computer Memories	CM4213*, CM5412, CM6426
Control Data	9415-19

5.25" disk diameter (continued)

Datapoint	9301, 9302, 9303
Disctron	D-514, D-526, D-720
DMA Systems	Micro-Magnum 26F
Evotek	ET-5530, ET-5820
Fujitsu	M2232, M2240
Hitachi	DK 501-1/2/3
International Memories	2312H*, 5012H
Micropolis	1302
Microscience International	HH612*
Miniscribe	2012, 3012*, 4020
Mitsubishi	M4863-2/3
NEC	D5215, D5244
Nippon Electric Industry	RD-4127, RD-5133
Nippon Peripherals	NP02-13*, NP04-26
Olivetti	HD 562/12, HD563/13
Otari	RMS-514, RMS-526
Quantum	Q520
Rodime	RO 201, RO 204
Seagate Technology	ST206*, ST412, ST425
Shugart	SA612, SA712*
Tandon	TM503, TM252*
TEAC	SD 412
Texas Instruments	525/62
Tokico	DK501-2, DK502-3
Tulin	TL213*, TL226*

3.9" disk diameter

SyQuest Technology	SQ325F*

3.5" disk diameter

Control Data	9270-6*
Rodime	RO 351*, RO352*

*Indicates drives 1.625 inches high (one half the standard height for drives using 5.25" disks).

With the exception of a single 14" drive still using 2314 technology, all drives in this group use variations of the technology loosely described as "Winchester". Most use 3340/3350 type ferrite heads, but the Control Data 2970 Cricket 3.5" drive will use an advanced type of thin film head, and some new 5.25" drives will use ferrite heads with sliders similar to those used with IBM's 3380 thin film heads. The majority of drives in this group use conventional oxide disks, but a growing number of

manufacturers have started to use plated disks, including International Memories, Evotek, Texas Instruments, SyQuest Technology, Microscience International, Control Data, Tulin, Tandon, Miniscribe, and Datapoint.

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)	1982	1983	1984	1985	1986
U.S. manufacturers	423.7	744.8	1,065.3	1,555.9	2,161.7
All manufacturers	596.8	1,070.7	1,678.3	2,381.4	3,266.8

For years, fixed disk drives under 30 MB capacity have been an area of dynamic growth and rapid change. The peak shipment year for 14" drives in the product group was 1979, with 50,500 units. 8" drives peaked in 1982, with 123,300 drives. Shipments of 5.25" drives are forecasted at 1,157,500 units for 1983, with the peak at least two years in the future.

The sharp growth of personal computers made possible the fast climb of 5.25" fixed disk drive shipments, as an upgrade to floppy-only systems. While only about 8% of personal computers shipped in 1982 used hard disk drives, 20% usage is expected for 1983. Other desktop computers, including multiple user systems, have also become significant markets, responding to low cost, reliability and general availability.

OEM drive shipments dominate this group, with 92% of the 1983 worldwide total. Seagate Technology, which pioneered the 5.25" Winchester

disk drive, shipped 87,000 drives in 1982, for 27.6% of the worldwide total for all non-captive drives and 40.5% of the 5.25" total. Shugart's 14.9% of the overall total is 46,900 units, led by 39,600 8" drives. Tandon shipped 38,600 drives in 1982, all 5.25", for 12.3%.

Marketing trends

The rate of change for this product group will not slow down in the next few years. In addition to the challenge of 3.5" drives, it is reasonable to expect displacement by 1986 of a large portion of the existing full size 5.25" Winchester drives by half high models, echoing the rapid sales growth of half high floppy drives.

The DISK/TREND forecast for full size 5.25" drives, half size 5.25" drives, and drives less than 5.25" is summarized below:

Worldwide captive & OEM Unit shipments (000)	1982	1983	1984	1985	1986
5.25" full size	239.7	1,085.5	1,705.2	1,552.4	1,076.0
	100%	93%	75%	46%	23%
5.25" half high	--	72.0	379.8	929.6	1,321.0
	--	6%	17%	28%	28%
Less than 5.25"	--	8.0	181.0	872.0	2,288.0
	--	1%	8%	26%	49%
Combined total	239.7	1,165.5	2,266.0	3,354.0	4,685.0

Currently, it is assumed that all captive 5.25" drives to be produced through 1986 will be full size models, with the system manufacturers making their own drives opting for ease of manufacture over miniaturization. Captive drives less than 5.25" are expected, however, with the first introduction expected in early 1984.

The growth rate already experienced in small Winchester disk drives, combined with the obviously rosy future for desktop and portable computers

makes it easy to be confident in the aggressive forecasts included in this study, especially in view of the high data storage requirements of many new software application packages now entering the marketplace.

However, it is not as easy to be confident in the future balance of OEM vs. captive drive shipments. The existing DISK/TREND forecasts for 5.25" and smaller drives assume that 18.9% of 1986 unit shipments will be captive drives. This is considered only a modest displacement of the OEM market, with intense price competition and plentiful supply of OEM drives reducing the incentive for initiation of new captive programs.

However, early decisions to produce internally by only a few companies (such as IBM, DEC or Apple) could sharply alter the balance in favor of captive production. In any event, the previous make/buy patterns of several firms which are currently large buyers of OEM drives suggest strongly that they will eventually start captive production, and the current forecasts assume the start of significant captive shipments from these firms during 1985-86.

With 5.25" drives in the 25 MB range now available from several manufacturers, production of 14" drives in this group is expected to end in 1984, and 8" drives will decline to only 1% of 1986 unit shipments.

Technical trends

The ability to produce drives with significantly higher recording density in large volume production is the key to future low product costs. This has always been a truism in the disk drive industry, but two current developments in this product group put recording density in the spotlight.

The movement to half high 5.25" and smaller diameter drives, principally 3.5", is forcing manufacturers to use higher linear densities

to maintain file organization and capacity similar to current 5.25" models. For example, the Control Data Cricket 3.5" drive, with only 6.38 megabyte capacity, uses a maximum linear density of 15,390 BPI -- a very ambitious specification for a low cost drive.

The other development involves attempts by various groups within the industry to reach consensus on a new interface standard which would double the 5 megabit per second transfer rate of the Seagate interface, the de facto standard. In addition to the ESDI standard offered by certain manufacturers of higher capacity 5.25" drives, Seagate has proposed a 10 megabit interface called the 412HP. The commercial success of either proposal depends heavily on availability of suitable low cost controllers, the first of which could appear in about six months.

It is likely that both of the above developments will be combined in actual disk products during 1984 -- that is, drives smaller than full size 5.25" models, using 10 megabit transfer rates to make possible higher recording densities using less disk surface area. The result, of course, will be reduced costs.

Forecasting assumptions

1. Continued growth in the overall desktop and portable computer market will create very high growth for 5.25" and smaller drives.
2. Half high 5.25" and less than 5.25" drives will dominate shipments in this group by 1986, accompanied by continual pressure for lower prices.
3. Major captive production programs for 5.25" drives will not start significant manufacturing levels before 1985-86.

TABLE 27

FIXED DISK DRIVES, LESS THAN 30 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	20.8	21.6	37.2	43.3	22.6	23.4	9.9	12.1	--	--
Other U.S. Captive	174.8	190.8	137.9	164.4	232.0	325.8	458.3	702.5	824.3	1,300.3
TOTAL U.S. CAPTIVE	195.6	212.4	175.1	207.7	254.6	349.2	468.2	714.6	824.3	1,300.3
PCM	--	--	--	--	--	--	--	--	--	--
OEM	193.0	211.3	481.1	537.1	607.6	716.1	684.0	841.3	688.4	861.4
TOTAL U.S. NON-CAPTIVE	193.0	211.3	481.1	537.1	607.6	716.1	684.0	841.3	688.4	861.4
TOTAL U.S. SHIPMENTS	388.6	423.7	656.2	744.8	862.2	1,065.3	1,152.2	1,555.9	1,512.7	2,161.7
Non-U.S. Manufacturers										
Captive	12.4	127.4	16.6	220.7	43.8	426.2	65.0	555.5	93.8	648.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	12.0	45.7	40.9	105.2	86.2	186.8	133.1	270.0	209.1	456.6
TOTAL NON-U.S. SHIPMENTS	24.4	173.1	57.5	325.9	130.0	613.0	198.1	825.5	302.9	1,105.1
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	413.0	596.8	713.7	1,070.7	992.2	1,678.3	1,350.3	2,381.4	1,815.6	3,266.8
OEM Average Price ($000)	.825	.816	.550	.553	.430	.432	.380	.382	.344	.346

TABLE 28

FIXED DISK DRIVES, LESS THAN 30 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	2.6	2.7	4.9	5.7	3.1	3.2	1.4	1.7	(1.3)	(2.0)
Other U.S. Captive	32.9	35.9	32.8	39.1	72.5	101.8	183.3	281.0	392.5	619.2
TOTAL U.S. CAPTIVE	35.5	38.6	37.7	44.8	75.6	105.0	184.7	282.7	391.2	617.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	232.8	254.8	879.0	981.3	1,422.9	1,677.1	1,814.2	2,231.5	2,018.7	2,526.2
TOTAL U.S. NON-CAPTIVE	232.8	254.8	879.0	981.3	1,422.9	1,677.1	1,814.2	2,231.5	2,018.7	2,526.2
TOTAL U.S. SHIPMENTS	268.3	293.4	916.7	1,026.1	1,498.5	1,782.1	1,998.9	2,514.2	2,409.9	3,143.4
Non-U.S. Manufacturers										
Captive	2.6	26.7	4.5	60.0	13.7	133.2	23.2	198.4	39.1	270.2
PCM	--	--	--	--	--	--	--	--	--	--
OEM	15.8	60.0	69.9	179.7	189.8	411.5	333.5	676.7	588.9	1,286.2
TOTAL NON-U.S. SHIPMENTS	18.4	86.7	74.4	239.7	203.5	544.7	356.7	875.1	628.0	1,556.4
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	286.7	380.1	991.1	1,265.8	1,702.0	2,326.8	2,355.6	3,389.3	3,037.9	4,699.8
Installed at Year End										
IBM	67.0	94.3	71.9	100.0	75.0	103.2	76.4	104.9	75.1	102.9
Non-IBM	466.2	658.5	1,452.4	1,918.6	3,151.3	4,242.2	5,505.5	7,629.8	8,544.7	12,331.6
WORLDWIDE TOTAL	533.2	752.8	1,524.3	2,018.6	3,226.3	4,345.4	5,581.9	7,734.7	8,619.8	12,434.5

TABLE 29

FIXED DISK DRIVES, LESS THAN 30 MB

WORLDWIDE SHIPMENTS (000)

BREAKDOWN BY DISK DIAMETER

	1982 Shipments			Forecast													
				1983				1984				1985			1986		
	14"	8"	5.25"	14"	8"	5.25"	<5.25"	14"	8"	5.25"	<5.25"	8"	5.25"	<5.25"	8"	5.25"	<5.25"
U.S. Manufacturers																	
IBM	--	11.1	--	--	21.2	--	--	--	15.4	--	--	12.4	--	--	8.7	--	--
Other U.S. Captive	11.5	15.2	9.2	4.1	10.5	24.5	--	1.8	8.0	78.0	14.0	4.5	218.5	58.0	1.0	415.2	203.0
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	12.7	69.2	172.9	12.9	41.6	923.8	3.0	1.5	26.6	1,527.0	122.0	17.0	1,618.5	596.0	10.4	1,286.8	1,229.0
TOTAL U.S. SHIPMENTS	24.2	95.5	182.1	17.0	73.3	948.3	3.0	3.3	50.0	1,605.0	136.0	33.9	1,837.0	654.0	20.1	1,702.0	1,432.0
Non-U.S. Manufacturers																	
Captive	1.2	9.7	15.8	.4	11.9	47.7	--	.1	11.1	122.0	--	6.7	167.7	24.0	3.0	187.7	79.5
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	.1	18.1	41.8	.1	13.1	161.5	5.0	--	8.5	358.0	45.0	5.4	477.3	194.0	2.4	507.3	776.5
TOTAL NON-U.S. SHIPMENTS	1.3	27.8	57.6	.5	25.0	209.2	5.0	.1	19.6	480.0	45.0	12.1	645.0	218.0	5.4	695.0	856.0
TOTAL WORLDWIDE SHIPMENTS	25.5	123.3	239.7	17.5	98.3	1,157.5	8.0	3.4	69.6	2,085.0	181.0	46.0	2,482.0	872.0	25.5	2,397.0	2,288.0
ANNUAL SHARE, BY DIAMETER	6%	32%	62%	1%	8%	90%	1%	--	3%	89%	8%	1%	73%	26%	1%	51%	48%

NOTE: Retirements of IBM 14" drives are not included.

TABLE 30

FIXED DISK DRIVES, LESS THAN 30 MEGABYTES

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

Distribution Channel	1982 U.S. Net Shipments Units (000)	%	FORECAST 1983 %	1984 %	1985 %	1986 %
Mainframe computer manufacturers	7.3	3.0	26.4	27.9	28.2	28.0
Mini/micro computer manufacturers	73.6	29.6	24.0	21.6	19.4	17.5
System OEMs/systems houses	125.1	50.3	35.9	36.3	37.6	39.0
Independent peripherals suppliers	29.6	11.9	8.4	8.5	8.8	9.2
Direct to end user/distributors	13.0	5.2	5.5	5.7	6.0	6.3
TOTAL	248.6					

TABLE 31

FIXED DISK DRIVES, LESS THAN 30 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1982 Net Shipments To United States Destinations Units (000) 14"	8"	5.25"	Total	%	Worldwide Units (000) 14"	8"	5.25"	Total	%
Seagate	--	--	82.7	82.7	33.3	--	--	87.0	87.0	27.6
Shugart	4.4	36.2	1.8	42.4	17.1	5.2	39.6	2.1	46.9	14.9
Tandon	--	--	35.5	35.5	14.3	--	--	38.6	38.6	12.3
International Memories	--	7.2	13.3	20.5	8.3	--	8.0	14.0	22.0	7.0
Computer Memories	--	--	14.0	14.0	5.6	--	--	14.5	14.5	4.6
Rodime	--	--	7.2	7.2	2.9	--	--	13.6	13.6	4.3
Quantum	--	11.7	--	11.7	4.7	--	13.0	--	13.0	4.1
Fujitsu	--	4.6	--	4.6	1.8	--	10.0	.6	10.6	3.4
Miniscribe	--	--	8.8	8.8	3.5	--	--	9.3	9.3	2.9
Century	6.8	--	--	6.8	2.7	7.5	--	--	7.5	2.4
Nippon Electric Industries	--	--	2.5	2.5	1.0	--	--	6.0	6.0	1.9
Other U.S.	--	6.2	4.2	10.4	4.2	--	8.6	7.4	16.0	5.1
Other Non-U.S.	--	.5	1.0	1.5	.6	.1	8.1	21.6	29.8	9.5
TOTAL	11.2	66.4	171.0	248.6	100.0	12.8	87.3	214.7	314.8	100.0

FIXED DISK DRIVES, 30-100 MB

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Coverage

Examples of disk drives in this group include:

14" disk diameter

Burroughs	FD 214
Century Data Systems	M40, M80
Control Data	9730-80
Data General	6234
Disc Tech One	3306
Fujitsu	M2280
Hewlett-Packard	7912
Kennedy	5303-42, 5305-70, 5380
Mitsubishi	M2883-40, M2883-60
NEC	D-1245, N7723
Priam	3350, 6650
Sperry	8402-50, 8402-75
Tecstor	3/83, 3/100
Toshiba	MK-300F

10.5" disk diameter

Cii-Honeywell Bull	D160/4, D160/6

8" disk diameter

IBM	3310, 4963-64, 5360-AXX, 676, 680
Control Data	9410-32, 9410-40
Fujitsu	M2303, M2311K, M2321K
Hightrack Computer Technik	HT 80
Hitachi	DK 811-4, DK8125-8
International Memories	7740
Kennedy	7340, 7380, 7173
Megavault	MV48, MV80
Micropolis	1203ANSI, 1403SMD
Mitsubishi	M2860-2
NEC	D2230, N7726
Newbury	9412
Northern Telecom	MFD/8202, MFD/8204
Nippon Peripherals	NP30-80, NP31-A2
Priam	3450, 7050, 803
Quantum	Q2030, Q2040, Q2080
Texas Instruments	WD 800-43
Toshiba	MK-80F-30, MK-182F

5.25" disk diameter

Atasi	3033, 3046
Athenaeum	Aegis 30
Cardiff Technology	F-240, F-360
Cii-Honeywell Bull	D530, D550, D570
Computer Memories	CM6640
Control Data	9415-32, 94155
Disctron	D-740, D-760
DMA Systems	Micro-Magnum 39F
Evotek	ET-5540, ET-5840
Fujitsu	M2241, M2242
International Memories	5650H
Maxtor	XT-1065, XT-2085, EXT-4075
Memorex	512, 513, 514
Micropolis	1303, 1303
Miniscribe	5338, 5451
Nippon Peripherals	NP04-36, NP04-50
Priam	502, 503, 504
Quantum	Q530, Q540
Rodime	RO 206, RO 208
Tandon	TM703, TM705
Tulin	TL 240
Vertex Peripherals	V130, V150, V170

All disk drives in this group are nominally "Winchester" technology drives, but many variations to that technology are used, including plated disks and ferrite heads with sliders in the 3380 configuration. Most use rotary or linear voice coil head positioning systems, but a few use other techniques, such as stepping motors or torque motors.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1982	1983	1984	1985	1986
U.S. manufacturers	851.7	1,020.1	1,029.9	960.7	839.2
All manufacturers	1,055.6	1,343.9	1,469.2	1,450.1	1,368.5

IBM's 64MB Piccolo 8" drive was the dominant leader in shipments for this group for several years, but no longer. With the end of System/34, and other systems using the Piccolo reaching the peak of their product life cycles, shipments of the drive appear to be headed down. Including

shipments of the newer 8" 30.8 MB drive, the IBM total for the group is estimated at 73,600 drives for 1982, with 1983 substantially the same.

The major growth in this group is currently being generated by 8" and 5.25" OEM drives for use with multiple-user systems. 1982 worldwide shipments of 8" and 5.25" OEM drives were 45,800 and 200 units, respectively, climbing to 98,100 and 68,500 in 1983. The 1982 leader in 8" non-captive drive shipments was Quantum, with 24.0% of the worldwide total, followed by Micropolis with 21.6% and Fujitsu with 16.2%. When 1982 non-captive shipments of all diameters are combined, Priam was in front with 25.8% of the worldwide total, representing 15,800 units.

Non-IBM captive drive shipments have also enjoyed recent growth, with the sharpest increases derived from Japanese 8" drives. Every Japanese manufacturer of captive 14" drives in this group is now in production of 8" drives, and all of these programs are increasing during 1983.

Marketing trends

As 14" drives in this product group continue to decline from their 1983 peak, 8" drives are expected to peak in 1984, with the lead going to 5.25" drives in 1985. U.S. manufacturers of OEM drives are leading the way, through smaller, lower cost hardware -- but are being challenged by Fujitsu's 48 and 84 MF 8" drives, featuring a fast 20 millisecond average access time which is highly valued for Unix operating systems.

While 8" drives currently grow in shipments, an intense effort is underway by at least 12 U.S. and a few non-U.S. manufacturers of OEM drives to establish quantity production for their announced 5.25" drives. Atasi, Quantum and Maxtor appear to have an early lead, but it is too early to rule out any of the contenders.

The 5.25" drives which secure major market positions are expected to displace most existing 8" OEM drives in this capacity range and to share in the growth predicted for multiple-user desktop systems. It appears that IBM and other major system manufacturers intend to buy OEM drives for this requirement. Accordingly, DISK/TREND forecasts have been increased, with 1986 worldwide shipments for 5.25" OEM drives set at 324,000 units.

Technical trends

Several evolutionary changes in recording technology are expected to be used in 5.25" drives in this group, as industry suppliers establish reliable sourcing for the plated disks, sputtered disks, and thin film heads needed to extend existing recording densities. Both longitudinal and perpendicular recording will be used in very high density drives, which by 1986 are expected to include both 3.5" and half high 5.25" models in this capacity range. Higher densities, however, will mean higher transfer rates, with the need to establish an industry consensus on interface standards. It is expected that the frenzied political maneuvering undertaken in support of various proposed interfaces during 1983 will subside, as growing hardware shipments during 1984 establish the usual de facto standards for the industry.

Forecasting assumptions

1. Sharp growth in demand for 5.25" drives will be created by rapid increases in shipments of multiple-user desktop computers and file servers used in local area networks.

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

3. Significant captive production of 5.25" drives in this group will not start until 1986.

TABLE 32

FIXED DISK DRIVES, 30-100 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	424.8	662.4	414.5	631.2	340.8	511.2	278.5	408.7	204.4	291.8
Other U.S. Captive	53.7	82.1	102.8	142.1	132.4	181.5	129.0	180.0	113.5	160.0
TOTAL U.S. CAPTIVE	478.5	744.5	517.3	773.3	473.2	692.7	407.5	588.7	317.9	451.8
PCM	1.1	1.1	1.1	1.1	1.1	1.1	--	--	--	--
OEM	89.9	106.1	212.1	245.7	280.5	336.1	304.2	372.0	310.3	387.4
TOTAL U.S. NON-CAPTIVE	91.0	107.2	213.2	246.8	281.6	337.2	304.2	372.0	310.3	387.4
TOTAL U.S. SHIPMENTS	569.5	851.7	730.5	1,020.1	754.8	1,029.9	711.7	960.7	628.2	839.2
Non-U.S. Manufacturers										
Captive	--	166.5	--	235.8	8.7	326.3	11.3	350.7	20.3	348.8
PCM	--	--	--	--	--	--	--	--	--	--
OEM	15.0	37.4	46.9	88.0	62.2	113.0	74.9	138.7	94.5	180.5
TOTAL NON-U.S. SHIPMENTS	15.0	203.9	46.9	323.8	70.9	439.3	86.2	489.4	114.8	529.3
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	584.5	1,055.6	777.4	1,343.9	825.7	1,469.2	797.9	1,450.1	743.0	1,368.5
OEM Average Price ($000)	2.3	2.3	1.8	1.8	1.8	1.8	1.6	1.6	1.3	1.4

TABLE 33

FIXED DISK DRIVES, 30-100 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1982 Shipments		Forecast							
			1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	47.2	73.6	48.2	73.4	42.6	63.9	35.7	52.4	26.9	38.4
Other U.S. Captive	5.1	7.8	11.0	15.2	15.4	21.1	17.2	24.0	18.3	25.8
TOTAL U.S. CAPTIVE	52.3	81.4	59.2	88.6	58.0	85.0	52.9	76.4	45.2	64.2
PCM	.1	.1	.1	.1	.1	.1	--	--	--	--
OEM	39.5	46.6	125.3	145.2	165.0	197.7	202.8	248.0	238.7	298.0
TOTAL U.S. NON-CAPTIVE	39.6	46.7	125.4	145.3	165.1	197.8	202.8	248.0	238.7	298.0
TOTAL U.S. SHIPMENTS	91.9	128.1	184.6	233.9	223.1	282.8	255.7	324.4	283.9	362.2
Non-U.S. Manufacturers										
Captive	--	16.7	--	25.5	1.0	37.5	1.4	43.3	2.7	46.5
PCM	--	--	--	--	--	--	--	--	--	--
OEM	5.8	14.5	21.5	40.3	29.6	53.8	39.4	73.0	63.0	120.3
TOTAL NON-U.S. SHIPMENTS	5.8	31.2	21.5	65.8	30.6	91.3	40.8	116.3	65.7	166.8
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	97.7	159.3	206.1	299.7	253.7	374.1	296.5	440.7	349.6	529.0
Installed at Year End										
IBM	141.9	220.1	190.1	293.5	232.7	357.4	268.4	409.8	295.3	448.2
Non-IBM	90.5	169.1	248.4	395.4	459.5	705.6	720.3	1,093.9	1,043.0	1,584.5
WORLDWIDE TOTAL	232.4	389.2	438.5	688.9	692.2	1,063.0	988.7	1,503.7	1,338.3	2,032.7

TABLE 34

FIXED DISK DRIVES, 30-100 MB

WORLDWIDE SHIPMENTS (000)

BREAKDOWN BY DISK DIAMETER

	1982 Shipments			Forecast												
				1983			1984			1985			1986			
	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	<5.25"
U.S. Manufacturers																
IBM	--	73.6	--	--	73.4	--	--	63.9	--	--	52.4	--	--	38.4	--	--
Other U.S. Captive	5.8	2.0	--	7.5	7.2	.5	8.3	9.0	3.8	6.4	8.1	9.5	4.1	6.0	15.7	--
PCM	.1	--	--	.1	--	--	.1	--	--	--	--	--	--	--	--	--
OEM	14.8	31.6	.2	18.7	68.0	58.5	13.3	76.2	108.2	7.5	62.5	178.0	3.0	43.0	240.0	12.0
TOTAL U.S. SHIPMENTS	20.7	107.2	.2	26.3	148.6	59.0	21.7	149.1	112.0	13.9	123.0	187.5	7.1	87.4	255.7	12.0
Non-U.S. Manufacturers																
Captive	4.7	12.0	--	2.4	23.1	--	1.5	32.8	3.2	.3	35.0	8.0	--	33.0	13.5	--
PCM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	.3	14.2	--	.2	30.1	10.0	.1	36.7	17.0	--	38.0	35.0	--	32.3	84.0	4.0
TOTAL NON-U.S. SHIPMENTS	5.0	26.2	--	2.6	53.2	10.0	1.6	69.5	20.2	.3	73.0	43.0	--	65.3	97.5	4.0
TOTAL WORLDWIDE SHIPMENTS	25.7	133.4	.2	28.9	201.8	69.0	23.3	218.6	132.2	14.2	196.0	230.5	7.1	152.7	353.2	16.0
ANNUAL SHARE, BY DIAMETER	16%	84%	--	10%	67%	23%	6%	59%	35%	3%	45%	52%	1%	29%	67%	3%

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

TABLE 35

FIXED DISK DRIVES, 30-100 MEGABYTES

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

Distribution Channel	1982 U.S. Net Shipments Units (000)	1982 U.S. Net Shipments %	FORECAST 1983 %	1984 %	1985 %	1986 %
Mainframe computer manufacturers	--	--	2.1	4.5	5.3	5.0
Mini/micro computer manufacturers	10.5	23.1	23.8	24.5	25.0	25.4
System OEMs/systems houses	32.1	70.7	67.9	64.6	63.2	62.9
Independent peripherals suppliers	2.0	4.4	4.6	4.9	5.1	5.4
Direct to end user/distributors	.8	1.8	1.6	1.5	1.4	1.3
TOTAL	45.4					

TABLE 36

FIXED DISK DRIVES, 30-100 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1982 Net Shipments To United States Destinations Units (000) 14"	8"	5.25"	Total	%	1982 Net Shipments Worldwide Units (000) 14"	8"	5.25"	Total	%
Priam	7.5	7.3	--	14.8	32.6	7.7	8.1	--	15.8	25.8
Quantum	--	9.9	--	9.9	21.8	--	11.0	--	11.0	18.0
Micropolis	--	7.1	--	7.1	15.6	--	10.1	--	10.1	16.5
Fujitsu	--	3.0	--	3.0	6.6	.2	7.4	--	7.6	12.4
Other U.S.	5.7	1.9	.2	7.8	17.2	7.2	2.4	.2	9.8	16.0
Other Non-U.S.	--	2.8	--	2.8	6.2	.1	6.8	--	6.9	11.3
TOTAL	13.2	32.0	.2	45.4	100.0	15.2	45.8	.2	61.2	100.0

FIXED DISK DRIVES, 100-300 MB

1983 DISK/TREND REPORT

FIXED DISK DRIVES, 100-300 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

IBM	4967-2CX, 5360-BXX
Ampex	Capricorn 165
Burroughs	9494-2, 9494-4
Century Data Systems	M160
Control Data	9730-160, 241
Digital Equipment	RA80, RM80
Disc Tech One	4160
Fujitsu	M2284, F436, F6411
Hewlett-Packard	7914
Kennedy	53160
Microdata	Reflex II
NEC	D1280
Nippon Peripherals	NP24
Priam	15450
Sperry	8402-100, 8417
Tecstor	3/166, 3/199

10.5" disk diameter

Cii-Honeywell Bull	D160/8

9" disk diameter

Control Data	9715-160

8" disk diameter

Amcodyne	Comanche 8160
Disctron	D-1100, D1600
Fujitsu	M2322K
Hightrack Computer Technik	HT 160
Hitachi	DK8125-12
Megavault	MV116, MV212
Micropolis	1406SMD
NEC	D2257, N7757
Nippon Peripherals	NP30-120
Northern Telecom	MFD/8206, MFD/8210
Priam	804
Toshiba	MK184F, MK186F

5.25" disk diameter

Applied Information Memories	Dart 130, Lance 850
Maxtor	XT-1140, XT-190, EXT-4280
Priam	505

IBM's 3344, a 280 MB version of the classic 3350, was in production from 1976 through 1981, and preceeded all other drives in this group. Currently, IBM's only drive in the group is a recently introduced 200 MB 14" drive used with Series/1 minicomputers and the new System/36 business system.

The last year has seen many new 8" drive introductions, with the start of an expected wave of 5.25" drives. These, as well as the older 14" drives in the group, all use variations of Winchester technology. Disks are mostly oxide coated, but plated and sputtered disks are used on the 5.25" drives. Heads are all ferrite types, and several are "mini" types patterned after the 3380 slider.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1982	1983	1984	1985	1986
U.S. manufacturers	213.4	629.9	1,151.1	1,634.6	2,027.3
All manufacturers	298.4	789.5	1,414.5	2,042.9	2,590.2

Captive drives in this group are currently in a growth phase, particularly 14" drives from several U.S. manufacturers including IBM, plus new 8" drives from Japanese firms. IBM's 200 MB 14" drive, new in 1983, is forecasted at 11,400 spindles for the year. Other U.S. captive 14" drives are estimated at 22,800 units for 1983, up from 12,500 in 1982.

Control Data shipped 60.1% of the non-captive total for 1982, with 8,300 units, mostly 14". Although 14" drives are still far ahead in 1983,

significant shipments of 8" OEM drives started, including the 9" CDC FSD, which is grouped with 8" drives in DISK/TREND tables. First shipments of OEM 5.25" drives over 100 MB also occurred in 1983, by Maxtor.

Marketing trends

Steady growth for captive drives in this group is forecasted, with unit shipments growing from 1983's worldwide total of 42,100 units to 141,900 in 1986. The largest boost is expected to come from IBM's 200 MB drive, shipping since mid-year with Series/1 and System/36 systems. These applications, plus future system announcements, are expected to increase IBM's shipments to 66,000 in 1986.

Captive shipments of 14" drives by U.S. firms will peak in 1985, with growth after that coming from 8" and 5.25" drives. Non-U.S. manufacturers produced equal quantites of 14" and 8" captive drives in 1983, and all future growth will go to 8" drives.

OEM 14" drives are expected to reach their shipment peak in 1984, hurt by stiff competition from small diameter drives. 8" OEM drives will maintain vigorous growth through 1986, becoming the principal disk drive used with minicomputer-based systems requiring direct access storage in this capacity range. Even greater growth is expected from 5.25" drives used as file servers with local area networks and as the principal disk drive with multiuser desktop systems. The 1986 estimate is for OEM worldwide shipments of 115,000 5.25" drives, compared to 96,200 8" drives.

Technical trends

This product group continues to be a likely proving ground for new recording technologies with the potential to provide drastic increases in

linear recording density. All of the 5.25" drives with capacities over 100 MB offered to date use either plated or sputtered disks, to facilitate the high recording densities used. When thin film heads are available at prices competitive to high density ferrite heads, new drives offered in this product group will probably use them. And it is likely that perpendicular recording will find early application in 5.25" drives in this capacity range, as soon as production of disks is established.

Marketability of drives with higher transfer rates will be directly affected by whether the industry reaches an early consensus on interface standards suitable for higher transfer rates, paving the way for availability of appropriate controllers. The marketplace will eventually settle the issues, but a spirit of compromise among drive manufacturers could facilitate earlier introduction of actual products. In the meantime, most new drives will use existing interface standards in order to make immediate sales possible.

A current example of the design constraints involved is provided by the new Maxtor 5.25" drive, which retains the standard 5 megabit Seagate transfer rate, but uses a special drive motor inside the disks to conserve space, so twice the usual number of disks may be squeezed into the standard 5.25" drive form factor, thus providing the targeted capacity.

Forecasting assumptions

1. IBM will rely primarily on its 200 MB 14" drive to satisfy disk drive requirements in this capacity range.

2. Major customers for OEM drives will substitute 8"-9" drives for currently used 14" drives for most applications.

3. 5.25" drive production programs will be successfully initiated in 1983-84, with shipment leadership going to 5.25" drives by 1986.

TABLE 37

FIXED DISK DRIVES, 100-300 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1982 Shipments		Forecast							
			1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	156.0	228.0	381.9	524.4	572.4	842.4	754.8	1,103.3
Other U.S. Captive	108.5	167.5	190.4	292.6	267.8	412.1	303.8	472.4	329.4	524.3
TOTAL U.S. CAPTIVE	108.5	167.5	346.4	520.6	649.7	936.5	876.2	1,314.8	1,084.2	1,627.6
PCM	--	--	--	--	--	--	2.1	2.1	3.2	4.2
OEM	32.2	45.9	90.9	109.3	177.8	214.6	258.0	317.7	310.5	395.5
TOTAL U.S. NON-CAPTIVE	32.2	45.9	90.9	109.3	177.8	214.6	260.1	319.8	313.7	399.7
TOTAL U.S. SHIPMENTS	140.7	213.4	437.3	629.9	827.5	1,151.1	1,136.3	1,634.6	1,397.9	2,027.3
Non-U.S. Manufacturers										
Captive	--	65.8	--	116.9	--	172.0	19.2	252.2	45.6	362.5
PCM	--	2.8	--	--	--	--	--	--	--	--
OEM	10.0	16.4	27.4	42.7	60.3	91.4	105.3	156.1	132.5	200.4
TOTAL NON-U.S. SHIPMENTS	10.0	85.0	27.4	159.6	60.3	263.4	124.5	408.3	178.1	562.9
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	150.7	298.4	464.7	789.5	887.8	1,414.5	1,260.8	2,042.9	1,576.0	2,590.2
OEM Average Price ($000)	4.5	4.5	3.9	3.9	3.5	3.6	3.1	3.1	2.6	2.6

TABLE 38

FIXED DISK DRIVES, 100-300 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	--	--	7.8	11.4	20.1	27.6	31.8	46.8	44.4	64.9
Other U.S. Captive	8.1	12.5	14.9	22.9	20.6	31.7	24.5	38.1	28.4	45.2
TOTAL U.S. CAPTIVE	8.1	12.5	22.7	34.3	40.7	59.3	56.3	84.9	72.8	110.1
PCM	--	--	--	--	--	--	.2	.2	.3	.4
OEM	6.8	9.7	23.6	28.4	50.8	61.3	86.0	105.9	124.2	158.2
TOTAL U.S. NON-CAPTIVE	6.8	9.7	23.6	28.4	50.8	61.3	86.2	106.1	124.5	158.6
TOTAL U.S. SHIPMENTS	14.9	22.2	46.3	62.7	91.5	120.6	142.5	191.0	197.3	268.7
Non-U.S. Manufacturers										
Captive	--	3.9	--	7.8	--	12.2	1.5	19.7	4.0	31.8
PCM	--	.2	--	--	--	--	--	--	--	--
OEM	2.5	4.1	7.0	10.9	16.3	24.7	31.9	47.3	45.7	69.1
TOTAL NON-U.S. SHIPMENTS	2.5	8.2	7.0	18.7	16.3	36.9	33.4	67.0	49.7	100.9
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	17.4	30.4	53.3	81.4	107.8	157.5	175.9	258.0	247.0	369.6
Installed at Year End										
IBM	4.8	8.0	12.6	19.4	32.7	47.0	64.5	93.8	108.9	158.7
Non-IBM	39.4	67.8	84.9	137.8	172.6	267.7	316.7	478.9	519.3	783.6
WORLDWIDE TOTAL	44.2	75.8	97.5	157.2	205.3	314.7	381.2	572.7	628.2	942.3

TABLE 39

FIXED DISK DRIVES, 100-300 MB

WORLDWIDE SHIPMENTS (000)

BREAKDOWN BY DISK DIAMETER

	1982 --Shipments--		Forecast											
			1983			1984			1985			1986		
	14"	8"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"
U.S. Manufacturers														
IBM	--	--	11.4	--	--	28.1	--	--	47.6	--	--	66.0	--	--
Other U.S. Captive	12.5	--	22.8	.1	--	30.8	.9	--	32.3	2.8	3.0	29.7	6.0	9.5
PCM	--	--	--	--	--	--	--	--	--	.2	--	--	.4	--
OEM	9.4	.3	19.4	6.5	2.5	22.3	21.0	18.0	17.8	43.1	45.0	12.0	58.2	88.0
TOTAL U.S. SHIPMENTS	21.9	.3	53.6	6.6	2.5	81.2	21.9	18.0	97.7	46.1	48.0	107.7	64.6	97.5
Non-U.S. Manufacturers														
Captive	3.8	.1	3.9	3.9	--	3.2	9.0	--	2.2	16.5	1.0	.8	24.0	7.0
PCM	.2	--	--	--	--	--	--	--	--	--	--	--	--	--
OEM	3.9	.2	6.6	4.3	--	7.2	15.5	2.0	6.3	29.0	12.0	4.1	38.0	27.0
TOTAL NON-U.S. SHIPMENTS	7.9	.3	10.5	8.2	--	10.4	24.5	2.0	8.5	45.5	13.0	4.9	62.0	34.0
TOTAL WORLDWIDE SHIPMENTS	29.8	.6	64.1	14.8	2.5	91.6	46.4	20.0	106.2	91.6	61.0	112.6	126.6	131.5
ANNUAL SHARE, BY DIAMETER	98%	2%	79%	18%	3%	58%	29%	13%	41%	35%	24%	30%	34%	36%

NOTE: 10.5" drives are grouped with 14" drives and 9" drives are grouped with 8" drives in this table.
Retirements of IBM 14" drives are not included.

TABLE 40

FIXED DISK DRIVES, 100-300 MEGABYTES

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

Distribution Channel	1982 U.S. Net Shipments Units (000)	1982 U.S. Net Shipments %	FORECAST 1983 %	1984 %	1985 %	1986 %
Mainframe computer manufacturers	--	--	--	1.2	2.0	2.4
Mini/micro computer manufacturers	4.7	50.5	52.1	52.6	53.3	54.3
System OEMs/systems houses	3.4	36.6	34.8	33.0	31.4	29.8
Independent peripherals suppliers	1.2	12.9	13.1	13.2	13.3	13.5
Direct to end user/distributors	--	--	--	--	--	--
TOTAL	9.3					

TABLE 41

FIXED DISK DRIVES, 100-300 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1982 Net Shipments To United States Destinations Units (000) 14"	8"	Total	%	1982 Net Shipments Worldwide Units (000) 14"	8"	Total	%
Control Data	5.2	.2	5.4	58.1	8.1	.2	8.3	60.1
Other U.S.	1.3	.1	1.4	15.0	1.3	.1	1.4	10.2
Other Non-U.S.	2.4	.1	2.5	26.9	3.9	.2	4.1	29.7
TOTAL	8.9	.4	9.3	100.0	13.3	.5	13.8	100.0

FIXED DISK DRIVES, 300-500 MB

1983 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, 4835-3
Century Data Systems	AMS 315
Control Data	33501, 33750, 819-11
Data General	6236
Digital Equipment	RA81
Disc Tech One	4300
Fujitsu	M2294, F493
Hewlett-Packard	7933H
Hitachi	DKU-95, H-8595-12
NEC	D-1510, N7751
Nippon Peripherals	NP25
Siemens	3470
Storage Technology	8350, 8360
Tecstor	3/315, 3/332

10.5" disk diameter

Fujitsu	M2350A, F6421

9" disk diameter

Control Data	9715-340

8" disk diameter

Hitachi	DKU-80
NEC	JS4380N

5.25" disk diameter

Maxtor	EXT-4380

Many of the older disk drives in this group are patterned after IBM's 3350, and all of these 317.5 MB floor-standing drives are intended for use with mainframes, including both plug compatible applications and other captive systems.

During the past year, however, newer rack-mounted 14" drives have been introduced for both captive (DEC, Data General, Hewlett-Packard) and OEM (Tecstor, Century, Fujitsu) markets. Led by the successful Fujitsu 10.5" Eagle, other small drives announced in the last year have included the Control Data 9" FSD with 344 MB, the Hitachi 8" DKU-80 with 427 MB, and the Maxtor 5.25" EXT-4380 with 382 MB.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1982	1983	1984	1985	1986
U.S. manufacturers	741.4	377.1	501.0	628.7	752.4
All manufacturers	1,037.9	809.1	957.4	934.6	961.7

During 1982-83, total revenues for this product group are dropping, reflecting the sharp cut-off of IBM's 3350 production and evaporation of the market for independent plug compatible 317 MB 14" drives. Storage Technology led 1982 non-captive shipments with 48.6% of the worldwide total, representing 8,600 spindles, but PCM drive shipments by all vendors are down in 1983. The IBM 3380, because of superior cost effectiveness and current high production levels, has effectively replaced the 3350.

Currently, the only real exception to the downtrend for PCM drives is the 317 MB version of the Fujitsu 10.5" Eagle drive being marketed by Amdahl. This drive is competing against the 3380 by offering users a competitive price per megabyte, smaller physical size, and eliminating the need to convert files. For an overall view of the disk drive market created by IBM's mainframes, see Table 50, in the next product section.

Several captive drive programs by other manufacturers are undergoing excellent growth, with non-IBM worldwide shipments expected to climb from

14,200 spindles in 1982 to 25,700 in 1983. Digital Equipment's RA81 with 456 MB capacity is providing the largest portion of current growth for captive drives in this product group, and represents a major displacement of OEM disk pack drives DEC previously purchased from outside vendors.

OEM drive activity in this group is relatively new. The 1982 OEM total was only 4,000 drives, but 1983 shipments should reach 19,900 units, with Japanese firms slightly ahead. Fujitsu's 10.5" Eagle has become a powerful OEM competitor, and rack mounted 14" drives from several U.S. manufacturers are now meeting with good success. First shipments of Control Data's 344 MB version of the 9" FSD are expected during 1983.

Marketing trends

Growth in captive drives through 1986 is expected to be driven primarily by U.S. production of drives for minicomputer and superminicomputer applications. While DISK/TREND forecasts show a decline in non-U.S. captive shipments, worldwide captive drive shipments by U.S. manufacturers are expected to increase to 35,500 spindles in 1986.

However, the major growth in this product group is anticipated from OEM disk drives. Total worldwide shipments are expected to almost triple by 1986, to 56,000 units.

It is believed that the current growth of 14" OEM rack mounted drives in the 315-330 MB range will peak in 1985. Drives with smaller diameter disks will be available from U.S. manufacturers in 1984, offering significant advantages in physical size and price. 1984's initial production of both 8-9" and 5.25" OEM drives is expected to grow to 18,500 and 10,000 units, respectively, in 1986.

Technical trends

Development activities in this product group will be concentrated on squeezing more capacity into smaller boxes during the next few years. Control Data's 344 MB version of the 9" FSD has been designed to a fairly conservative linear density specification, by today's standards, of 9,492 BPI. The 230 mm disk used with the FSD provides more recording area than the 195-210 mm disks used with 8" drives, allowing use of less ambitious specifications and making it easier to produce the drive in large quantities.

Other development programs now underway for OEM drives target similar capacities for 8" and 5.25" drives, in order to conform to standard form factors established by flexible disk drives. These constraints, combined with transfer rate limitations imposed by de facto interface standards and availability of controllers, have forced manufacturers to seek innovative design solutions, such as Maxtor's placement of the drive motor inside the inner diameter of the stack of disks.

The demand for more capacity in small spaces will continue. Expect to see extensive use of thin film heads and disks, run length limited encoding methods, perpendicular recording, intelligent interfaces and extensive use of VLSI in drive electronics.

Forecasting assumptions

1. IBM will introduce no new drives in this group through 1986.
2. Sustained growth for superminicomputers, large workstation clusters and specialized systems 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)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	252.8	474.0	7.5	15.0	--	--	--	--	--	--
Other U.S. Captive	60.6	103.0	164.7	264.2	222.8	381.2	263.9	467.5	307.7	557.4
TOTAL U.S. CAPTIVE	313.4	577.0	172.2	279.2	222.8	381.2	263.9	467.5	307.7	557.4
PCM	111.5	154.5	29.0	48.4	3.2	5.3	--	--	--	--
OEM	7.6	9.9	43.3	49.5	92.9	114.5	125.5	161.2	144.6	195.0
TOTAL U.S. NON-CAPTIVE	119.1	164.4	72.3	97.9	96.1	119.8	125.5	161.2	144.6	195.0
TOTAL U.S. SHIPMENTS	432.5	741.4	244.5	377.1	318.9	501.0	389.4	628.7	452.3	752.4
Non-U.S. Manufacturers										
Captive	--	248.1	--	267.4	--	260.4	--	175.5	--	117.0
PCM	6.6	29.2	43.0	80.8	63.0	105.0	22.8	38.0	--	--
OEM	7.5	19.2	62.7	83.8	57.7	91.0	51.5	92.4	47.3	92.3
TOTAL NON-U.S. SHIPMENTS	14.1	296.5	105.7	432.0	120.7	456.4	74.3	305.9	47.3	209.3
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	446.6	1,037.9	350.2	809.1	439.6	957.4	463.7	934.6	499.6	961.7
OEM Average Price ($000)	6.9	7.3	6.6	6.7	6.0	6.1	5.5	5.6	5.1	5.1

TABLE 43

FIXED DISK DRIVES, 300-500 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1982		Forecast							
	---Shipments--		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	16.0	30.0	.5	1.0	--	--	--	--	--	--
Other U.S. Captive	3.0	5.1	9.6	15.4	13.5	23.1	16.6	29.4	19.6	35.5
TOTAL U.S. CAPTIVE	19.0	35.1	10.1	16.4	13.5	23.1	16.6	29.4	19.6	35.5
PCM	8.3	11.5	2.7	4.5	.3	.5	--	--	--	--
OEM	1.3	1.7	7.7	8.8	17.2	21.2	24.6	31.6	29.5	39.8
TOTAL U.S. NON-CAPTIVE	9.6	13.2	10.4	13.3	17.5	21.7	24.6	31.6	29.5	39.8
TOTAL U.S. SHIPMENTS	28.6	48.3	20.5	29.7	31.0	44.8	41.2	61.0	49.1	75.3
Non-U.S. Manufacturers										
Captive	--	9.1	--	10.3	--	9.3	--	6.5	--	4.5
PCM	.5	2.2	4.2	7.9	6.3	10.5	2.4	4.0	--	--
OEM	.9	2.3	8.3	11.1	7.8	12.3	7.8	14.0	8.3	16.2
TOTAL NON-U.S. SHIPMENTS	1.4	13.6	12.5	29.3	14.1	32.1	10.2	24.5	8.3	20.7
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	30.0	61.9	33.0	59.0	45.1	76.9	51.4	85.5	57.4	96.0
Installed at Year End										
IBM	115.8	197.3	116.3	198.3	116.3	198.3	116.3	198.3	116.3	198.3
Non-IBM	57.0	110.5	89.5	168.5	134.6	245.4	186.0	330.9	243.4	426.9
WORLDWIDE TOTAL	172.8	307.8	205.8	366.8	250.9	443.7	302.3	529.2	359.7	625.2

TABLE 44

FIXED DISK DRIVES, 300-500 MB

WORLDWIDE SHIPMENTS (000)

BREAKDOWN BY DISK DIAMETER

	1982 --Shipments--		Forecast										
			----1983-----		---------1984---------			---------1985---------			---------1986---------		
	14"	8"	14"	8"	14"	8"	5.25"	14"	8"	5.25"	14"	8"	5.25"
U.S. Manufacturers													
IBM	30.0	--	1.0	--	--	--	--	--	--	--	--	--	--
Other U.S. Captive	5.1	--	15.4	--	22.8	.3	--	28.6	.8	--	34.2	1.3	--
PCM	11.5	--	4.5	--	.5	--	--	--	--	--	--	--	--
OEM	1.7	--	8.3	.5	14.8	5.2	1.2	17.7	9.4	4.5	16.8	15.0	8.0
TOTAL U.S. SHIPMENTS	48.3	--	29.2	.5	38.1	5.5	1.2	46.3	10.2	4.5	51.0	16.3	8.0
Non-U.S. Manufacturers													
Captive	9.1	--	10.3	--	9.3	--	--	6.5	--	--	4.5	--	--
PCM	2.2	--	7.9	--	10.5	--	--	4.0	--	--	--	--	--
OEM	2.2	.1	10.9	.2	12.0	.3	--	12.6	1.2	.2	10.7	3.5	2.0
TOTAL NON-U.S. SHIPMENTS	13.5	.1	29.1	.2	31.8	.3	--	23.1	1.2	.2	15.2	3.5	2.0
TOTAL WORLDWIDE SHIPMENTS	61.8	.1	58.3	.7	69.9	5.8	1.2	69.4	11.4	4.7	66.2	19.8	10.0
ANNUAL SHARE, BY DIAMETER	100%	--	99%	1%	91%	7%	2%	81%	13%	6%	69%	21%	10%

NOTE: 10.5" drives are grouped with 14" drives and 9" drives are grouped with 8" drives in this table.

TABLE 45

FIXED DISK DRIVES, 300-500 MEGABYTES

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

Distribution Channel	1982 U.S. Net Shipments Units (000)	%	FORECAST 1983 %	1984 %	1985 %	1986 %
Mainframe computer manufacturers	--	--	--	--	--	--
Mini/micro computer manufacturers	.7	6.4	25.6	29.0	34.2	36.8
System OEMs/systems houses	1.1	10.0	38.5	43.4	51.4	55.1
Independent peripherals suppliers	.4	3.6	5.8	6.7	7.5	8.1
Direct to end user/distributors	8.8	80.0	30.1	20.9	6.9	--
TOTAL	11.0					

TABLE 46

FIXED DISK DRIVES, 300-500 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1982 Net Shipments To United States Destinations Units (000)	%	Worldwide Units (000)	%
Storage Technology	6.5	59.1	8.6	48.6
Fujitsu	1.2	10.9	2.3	13.0
Control Data	1.3	11.8	1.7	9.6
Other U.S.	1.8	16.4	2.9	16.4
Other Non-U.S.	.2	1.8	2.2	12.4
TOTAL	11.0	100.0	17.7	100.0

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

FIXED DISK DRIVES, MORE THAN 500 MB

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FIXED DISK DRIVES, MORE THAN 500 MEGABYTES

Coverage

Examples of disk drives in this group include:

14" disk diameter

IBM	3370, 3375, 3380
Applied Peripheral Systems	4865
Burroughs	9494-5
Century Data Systems	AMS 513, AMS 571
Control Data	33800, 9771, 9775
Fujitsu	M2298, F496
Hitachi	DKU-97S, H-8598
Ibis	1400, 5380
Memorex	3680, 3652, 680
NEC	D1550, N7761
Nippon Peripherals	NP-37, NP-75S
Sperry	8470, 8480
Storage Technology	8650, 8380, 8775

10.5" disk diameter

Fujitsu	F6425

9" disk diameter

Control Data	9715-500

Until recently, disk drives in this group consisted mostly of PCM, IBM and other captive floor-standing drives intended for use with mainframe systems. The list of OEM drives was expanded during the past year, however, with the addition of several rack-mounted models intended for sale in the growing superminicomputer market.

Market status

DISK/TREND estimate of total market size:

Worldwide sales ($M)	1982	1983	1984	1985	1986
U.S. manufacturers	2,489.3	3,407.7	4,350.2	5,208.4	5,987.8
All manufacturers	2,784.3	3,852.3	5,081.1	6,186.6	7,134.9

IBM's rapid build-up of 3380 production has reduced the market available to the firm's plug compatible competitors. The 14,000 spindles shipped worldwide in 1982 were only slightly above expectations, but the 48,000 spindles now forecasted for 1983 are a shock to competitors. Shipments at this level should substantially remove the backlog -- eliminating delay in filling new orders, and removing one of the key motivations IBM's customers have had for buying independent disk drives in past product generations. PCM 3380 vendors are left with only minor product differences and price cutting as sales tools.

It should be remembered that IBM is also shipping large quantities of 3370 and 3375 drives for smaller mainframes. The 1983 worldwide combined total for the two drives is estimated at 32,400. New models of the 3370, increasing capacity to 729 MB by using the same recording density already employed on the 3375, were recently announced.

Storage Technology had 40.4% and Memorex 17.8% of the worldwide non-captive unit shipments for 1982, consisting mostly of PCM drives. Control Data shipped 24.8% of the total, with a combination of PCM and OEM drives.

Marketing trends

It is assumed IBM will introduce a double density version of the 3380 in time to start shipments during 1984. It is not clear which technical options IBM will use in this drive, so the potential impact on controllers, channels and user operating efficiencies is confused. DISK/TREND forecasts assume that existing 3380 models will be produced for several years, but declining after 1984. Because doubled capacity per 3380 spindle is foreseen, the total IBM unit shipment forecast is essentially flat after 1985, but revenues are up 138% over the 1982 level.

Until recently, other captive shipments in this product group have been composed mostly of double density versions of IBM-type 3350 drives, but 1983/84 will see 3380-type drives shipped by the Japanese mainframe manufacturers, plus Burroughs and the firms associated with Control Data in ownership of Magnetic Peripherals, Inc.

PCM vendors are now starting 3380 production, and 19,000 spindles are forecast for 1984, dropping in later years in the face of IBM's double density drive. Independent double density drives will probably be a year behind IBM, but it is estimated that 1986 worldwide PCM shipments will total 36,800 spindles, of which 21,200 will be double density drives.

Considerable growth in OEM drives is expected, with worldwide shipments increasing from 7,200 units in 1982 to 34,800 in 1986. Drives using 3380 technology, such as Control Data's 14" XMD and 9" FSD, as well as the 630 MB version of the Fujitsu 10.5" Eagle, will ship in quantity starting in 1984. By 1986, 45% are expected to be in the 8-9" group.

Technical trends

IBM's choices in doubling the capacity of the 3380 are tough ones, since doubling either the track or linear density could be difficult without major changes in the technology employed. The answer may be a combination of higher BPI and TPI, perhaps joined by measures to improve throughput, such as improved cache or even more actuators.

Forecasting assumptions

1. IBM will ship a double density 3380 starting in 1984.
2. PCM 3380 production will start in 1983, with rapid 1984 growth.
3. Other captive and OEM products will both experience strong growth, driven by mainframe and supermini markets.

TABLE 47

FIXED DISK DRIVES, MORE THAN 500 MEGABYTES

REVENUE SUMMARY

	DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	843.3	1,667.5	1,498.2	2,719.1	1,780.2	3,186.4	1,981.8	3,629.6	2,180.0	3,976.0
Other U.S. Captive	178.2	382.8	243.2	412.8	247.9	444.4	351.0	629.8	455.4	808.5
TOTAL U.S. CAPTIVE	1,021.5	2,050.3	1,741.4	3,131.9	2,028.1	3,630.8	2,332.8	4,259.4	2,635.4	4,784.5
PCM	227.2	342.5	91.4	174.4	343.2	534.5	451.5	710.4	594.3	912.9
OEM	74.6	96.5	71.8	101.4	131.1	184.9	166.1	238.6	185.9	290.4
TOTAL U.S. NON-CAPTIVE	301.8	439.0	163.2	275.8	474.3	719.4	617.6	949.0	780.2	1,203.3
TOTAL U.S. SHIPMENTS	1,323.3	2,489.3	1,904.6	3,407.7	2,502.4	4,350.2	2,950.4	5,208.4	3,415.6	5,987.8
Non-U.S. Manufacturers										
Captive	--	259.0	--	337.3	--	492.1	7.6	581.4	11.7	647.4
PCM	10.8	25.2	36.4	88.4	74.3	189.8	114.3	281.3	152.3	366.1
OEM	--	10.8	3.4	18.9	29.8	49.0	75.9	115.5	79.5	133.6
TOTAL NON-U.S. SHIPMENTS	10.8	295.0	39.8	444.6	104.1	730.9	197.8	978.2	243.5	1,147.1
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	1,334.1	2,784.3	1,944.4	3,852.3	2,606.5	5,081.1	3,148.2	6,186.6	3,659.1	7,134.9
OEM Average Price ($000)	14.6	14.9	15.7	15.8	14.4	14.4	13.4	13.4	12.1	12.2

TABLE 48

FIXED DISK DRIVES, MORE THAN 500 MEGABYTES

UNIT SHIPMENT SUMMARY

	DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1982		Forecast							
	Shipments		1983		1984		1985		1986	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
U.S. Manufacturers										
IBM	22.0	43.5	44.3	80.4	53.3	95.4	54.0	98.9	54.5	99.4
Other U.S. Captive	5.4	11.6	7.6	12.9	7.7	13.8	10.7	19.2	13.8	24.5
TOTAL U.S. CAPTIVE	27.4	55.1	51.9	93.3	61.0	109.2	64.7	118.1	68.3	123.9
PCM	13.0	19.6	5.5	10.5	13.1	20.4	15.0	23.6	16.6	25.5
OEM	5.1	6.6	4.6	6.5	9.5	13.4	13.5	19.4	16.9	26.4
TOTAL U.S. NON-CAPTIVE	18.1	26.2	10.1	17.0	22.6	33.8	28.5	43.0	33.5	51.9
TOTAL U.S. SHIPMENTS	45.5	81.3	62.0	110.3	83.6	143.0	93.2	161.1	101.8	175.8
Non-U.S. Manufacturers										
Captive	--	7.4	--	9.5	--	13.3	.2	15.3	.3	16.6
PCM	.6	1.4	1.4	3.4	2.7	6.9	3.9	9.6	4.7	11.3
OEM	--	.6	.2	1.1	1.7	2.8	4.6	7.0	5.0	8.4
TOTAL NON-U.S. SHIPMENTS	.6	9.4	1.6	14.0	4.4	23.0	8.7	31.9	10.0	36.3
Worldwide Recap										
TOTAL WORLDWIDE SHIPMENTS	46.1	90.7	63.6	124.3	88.0	166.0	101.9	193.0	111.8	212.1
Installed at Year End										
IBM	33.5	68.5	77.8	148.9	131.1	244.3	185.1	343.2	239.6	442.6
Non-IBM	51.6	92.9	70.9	136.8	105.6	207.4	153.5	301.5	210.8	414.2
WORLDWIDE TOTAL	85.1	161.4	148.7	285.7	236.7	451.7	338.6	644.7	450.4	856.8

TABLE 49

FIXED DISK DRIVES, MORE THAN 500 MB

WORLDWIDE SHIPMENTS (000)

BREAKDOWN BY DISK DIAMETER

	1982 Shipments	Forecast							
		1983		1984		1985		1986	
	14"	14"	8"	14"	8"	14"	8"	14"	8"
U.S. Manufacturers									
IBM	43.5	80.4	--	95.4	--	98.9	--	99.4	--
Other U.S. Captive	11.6	12.9	--	12.8	1.0	16.0	3.2	19.2	5.3
PCM	19.6	10.5	--	20.4	--	23.6	--	25.5	--
OEM	6.6	6.4	.1	9.4	4.0	10.8	8.6	11.8	14.6
TOTAL U.S. SHIPMENTS	81.3	110.2	.1	138.0	5.0	149.3	11.8	155.9	19.9
Non-U.S. Manufacturers									
Captive	7.4	9.5	--	13.3	--	15.3	--	16.6	--
PCM	1.4	3.4	--	6.9	--	9.6	--	11.3	--
OEM	.6	1.1	--	2.8	--	6.6	.4	7.5	.9
TOTAL NON-U.S. SHIPMENTS	9.4	14.0	--	23.0	--	31.5	.4	35.4	.9
TOTAL WORLDWIDE SHIPMENTS	90.7	124.2	.1	161.0	5.0	180.8	12.2	191.3	20.8
ANNUAL SHARE, BY DIAMETER	100%	100%	--	97%	3%	94%	6%	90%	10%

NOTE: 10.5" drives are grouped with 14" drives and 9" drives are grouped with 8" drives in this table.

TABLE 50

WORLDWIDE SHIPMENTS OF IBM AND PCM FIXED DISK DRIVES FOR MAIN FRAMES

PRODUCT MIX ANALYSIS

	DISK DRIVE SHIPMENTS, BY SHIPMENT DESTINATION (000)									
	1982		Forecast							
	---Shipments--		-----1983-----		-----1984-----		-----1985-----		-----1986-----	
	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW	U.S.	WW
3350 Type										
IBM 317 MB	16.0	30.0	.5	1.0	--	--	--	--	--	--
PCM 317 MB*	8.8	13.7	6.9	12.4	6.6	11.0	2.4	4.0	--	--
PCM 635 MB	13.5	20.6	5.1	10.3	1.9	3.6	.6	1.0	--	--
TOTAL	38.3	64.3	12.5	23.7	8.5	14.6	3.0	5.0	--	--
3370 Type (571 MB)										
IBM	7.0	17.5	7.2	18.0	7.4	18.4	7.1	17.8	5.7	14.2
PCM	.1	.4	.6	1.7	1.1	3.2	1.3	3.7	1.1	3.0
TOTAL	7.1	17.9	7.8	19.7	8.5	21.6	8.4	21.5	6.8	17.2
3375 Type (819 MB)										
IBM	6.0	12.0	6.9	14.4	7.3	15.8	7.4	16.3	6.5	14.7
PCM	--	--	--	--	.9	1.5	1.7	2.9	1.6	2.6
TOTAL	6.0	12.0	6.9	14.4	8.2	17.3	9.1	19.2	8.1	17.3
3380 Type (1260 MB)										
IBM	9.0	14.0	30.2	48.0	36.6	58.0	23.2	38.0	9.6	16.0
PCM	--	--	1.2	1.9	12.0	19.0	10.8	18.0	6.0	10.0
TOTAL	9.0	14.0	31.4	49.9	48.6	77.0	34.0	56.0	15.6	26.0
TOTAL SPINDLES	60.4	108.2	58.6	107.7	73.8	130.5	54.5	101.7	30.5	60.5
Drive Capacity (Terabytes)										
Existing Models		64.6		96.7		129.3		100.5		56.7
Future Models		--		--		8.0		86.0		189.2
TOTAL CAPACITY		64.6		96.7		137.3		186.5		245.9
		+74%		+50%		+42%		+36%		+32%

* Includes 10.5" drives in 317 MB 3350 format.

TABLE 51

FIXED DISK DRIVES, MORE THAN 500 MEGABYTES

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

Distribution Channel	1982 U.S. Net Shipments Units (000)	1982 U.S. Net Shipments %	FORECAST 1983 %	1984 %	1985 %	1986 %
Mainframe computer manufacturers	.8	4.3	8.2	8.2	8.1	5.2
Mini/micro computer manufacturers	3.6	19.2	24.6	18.5	16.2	10.8
System OEMs/systems houses	.2	1.1	3.3	7.0	10.1	10.2
Independent peripherals suppliers	.5	2.7	4.9	7.4	6.1	4.6
Direct to end user/distributors	13.6	72.7	59.0	58.9	59.5	69.2
TOTAL	18.7					

TABLE 52

FIXED DISK DRIVES, MORE THAN 500 MEGABYTES

MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

Drive Manufacturers	1982 Net Shipments To United States Destinations Units (000)	To United States Destinations %	Worldwide Units (000)	Worldwide %
Storage Technology	8.4	44.9	11.4	40.4
Control Data	4.7	25.1	7.0	24.8
Memorex	2.2	11.8	5.0	17.8
Other U.S.	2.8	15.0	2.8	9.9
Other Non-U.S.	.6	3.2	2.0	7.1
TOTAL	18.7	100.0	28.2	100.0

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

DISK DRIVE SPECIFICATIONS

1983 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, model numbers of IBM or other manufacturers are used to describe the general physical form of drives and media, since these designations are well known throughout the industry. However, such usage of a specific model number is not meant to imply interchangeability, due to variations in 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 when appropriate, using a broad interpretation of IBM specifications, since later drives frequently use higher track and linear densities. "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. Since these prices may be changed by manufacturers without notice, 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.

1983 DISK/TREND product groups

REMOVABLE MEDIA:	1.	Disk cartridge drives, less than 12 MB
	2.	Disk cartridge drives, more than 12 MB
	3.	Disk pack drives, less than 100 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	AMCODYNE	AMCODYNE	AMPEX	AMPEX
DRIVE	Atlas	Arapahoe 7110	Comanche 8160	DFR-932	DFR-964
DISK/TREND GROUP	6	2	7	2	2
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	CDC 91204	CDC 91204
Generic type	Fixed	8" Cartridge	Fixed	CMD	CMD
Nominal disk diameter	14"	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	14"	14"
Magnetic surface	Plated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Special	Modified 3350	Modified 3350	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 128.0	U: 26.6	U: 165.9	U: 16.289	U: 48.868
REMOVABLE	--	U: 26.6	--	U: 16.289	U: 16.289
Capacity per track (Bytes)	U: 20,160	U: 20,672	U: 20,672	U: 20,160	U: 20,160
Data surfaces per spindle	5	4	10	1 Fixed 1 Removable	3 Fixed 1 Removable
Heads per data surface	10	1	1	2 Fixed 1 Removable	2 Fixed 1 Removable
Tracks per surface	1280	644	823	823	823
TPI	540	550	960	367 Fixed 384 Removable	367 Fixed 384 Removable
BPI	600	7259 FRPI 10889 BPI*	6500 FRPI 9750 BPI*	6274 Fixed 6038 Removable	6274 Fixed 6038 Removable
RPM	3600	3545	3600	3600	3600
Actuator type	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Fix: Rotary VC Rem: Linear VC	Fix: Rotary VC Rem: Linear VC
Average positioning time (msec)	18	30	25	30	30
Average rotational delay (msec)	8.3	8.45	8.3	8.3	8.3
Average access time (msec)	26.3	38.45	33.3	38.3	38.3
Data transfer rate (KByte/sec)	1209	1229	1229	1209	1209
FIRST CUSTOMER SHIPMENT	3Q83	1Q83	1Q84	4Q79	4Q79
U.S. OEM PRICE FOR 100 UNITS	$5,995	$3,175	$3,650	$4,525	$5,145
COMMENTS		Embedded Servo *2,7 RLL Code	Embedded Servo *2,7 RLL Code	Mfg. by Toshiba	Mfg. by Toshiba

MANUFACTURER	AMPEX	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE	DFR-996	DM-980	DM-9160	DM-9300	DM-9300A
DISK/TREND GROUP	2	3	4	4	4
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	CDC 91204	--	--	--	CDC 9883-91
Generic type	CMD	SMD	SMD	3336-11	3336-11
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	3330-11	3336-11	3336-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 81.446	--	--	--	--
REMOVABLE	U: 16.289	U: 82.8	U: 165.8	U: 312.0	U: 315.0
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	5 Fixed 1 Removable	5	5	19	19
Heads per data surface	2 Fixed 1 Removable	1	1	1	1
Tracks per surface	823	823	1645	815	823
TPI	367 Fixed 384 Removable	384	768	370	384
BPI	6274 Fixed 6038 Removable	6038	6038	6038	6038
RPM	3600	3600	3600	3600	3600
Actuator type	Fix: Rotary VC Rem: Linear VC	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	28	28	28
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	38.3	38.3	36.3	36.3	36.3
Data transfer rate (KByte/sec)	1209	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT	4Q79	1/76	1980	5/76	3Q80
U.S. OEM PRICE FOR 100 UNITS	$5,700	$5,605	$6,605	$9,870	$9,870
COMMENTS	Mfg. by Toshiba				

MANUFACTURER	AMPEX	AMPEX	AMPEX	AMPEX	AMPEX
DRIVE	PTD-930X Parallel Transfer Drive	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	--	--	--	--	--
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 Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Special	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 6.67	U: 13.33	U: 20.0	U: 26.67
REMOVABLE	U: 312.177	--	--	--	--
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	815	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	11/78	5/82	5/82	5/82	5/82
U.S. OEM PRICE FOR 100 UNITS	$55,000	$545	$655	$795	$920
COMMENTS	Up to 9 track parallel data transfer	Manufactured under Rodime license	Manufactured under Rodime license	Manufactured under Rodime license	Manufactured under Rodime license

MANUFACTURER	AMPEX	AMPEX	APPLIED INFORMATION MEMORIES	APPLIED INFORMATION MEMORIES	APPLIED PERIPHERAL SYSTEMS
DRIVE	165 Capricorn 165E Capricorn	330 Capricorn	DART 130	LANCE 850	4830-2
DISK/TREND GROUP	7	8	7	7	8
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Sputtered	Sputtered	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Special	Special	3380
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Thin Film
Interface	SMD	SMD	ANSI	SMD/SCSI	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 165.9	U: 330.3	F: 133.57	F: 213.7	U: 337.1
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,832	U: 33,331	U: 40,960
Data surfaces per spindle	5	8	7	7	5
Heads per data surface	2	2	1	1	2
Tracks per surface	1646	2048	916	916	1646
TPI	960	960	1000	1000	694
BPI	5950	6250	19220	30752 BPI 23064 FCI	12877*
RPM	3600	3600	3600	3600	1785
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	18	18	25
Average rotational delay (msec)	8.3	8.3	8.3	8.3	16.8
Average access time (msec)	38.3	38.3	26.3	26.3	41.8
Data transfer rate (KByte/sec)	1209	1209	1250	2000	1200
FIRST CUSTOMER SHIPMENT	3Q81	3Q81	4/84	3Q84	3/82
U.S. OEM PRICE FOR 100 UNITS	$5,155	$7,050	$2,464 (1000)	$9,850 (500)	$7,800
COMMENTS	165E emulates DM-9160			(Price above per drive). Drive has four spindles.	*RLL Code

MANUFACTURER	APPLIED PERIPHERAL SYSTEMS	APPLIED PERIPHERAL SYSTEMS	APPLIED PERIPHERAL SYSTEMS	APPLIED PERIPHERAL SYSTEMS	ATASI
DRIVE	4830-3	4835-2	4835-3	4865	3020
DISK/TREND GROUP	8	8	8	9	5
MARKET	OEM	OEM	OEM	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	3380	3380	3380	3380	Modified 3350
Heads	Thin Film	Thin Film	Thin Film	Thin Film	Ferrite
Interface	SMD	Modified SMD	Modified SMD	Modified SMD	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 404.5	U: 337.1	U: 404.5	U: 640.4	U: 19.84
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 40,960	U: 40,960	U: 40,960	U: 40,960	U: 10,416
Data surfaces per spindle	6	5	6	9.5	3
Heads per data surface	2	2	2	2	1
Tracks per surface	1646	1646	1646	1646	635
TPI	694	694	694	694	800
BPI	12877*	12877*	12877*	12877*	8780
RPM	1785	2964	2964	2964	3600
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	33 (including settling)
Average rotational delay (msec)	16.8	10.1	10.1	10.1	8.3
Average access time (msec)	41.8	35.1	35.1	35.1	41.3
Data transfer rate (KByte/sec)	1200	2000	2000	2000	625
FIRST CUSTOMER SHIPMENT	3/82	8/82	8/82	9/83	10/82
U.S. OEM PRICE FOR 100 UNITS	$8,280	$7,800	$8,280	$9,780	$1,598
COMMENTS	*RLL Code	*RLL Code	*RLL Code	*RLL Code	

MANUFACTURER	ATASI	ATASI	ATHENAEUM	ATHENAEUM	BALL COMPUTER PRODUCTS
DRIVE	3033	3046	AEGIS 10/10	AEGIS 30	BD-50
DISK/TREND GROUP	6	6	2	6	3
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	5.25" Cartridge	Fixed	SMD
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	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	ST506	ST506	Modified ST506	ST506	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 33.07	U: 46.3	U: 12.75	U: 38.25	--
REMOVABLE	--	--	U: 12.75	--	U: 54.7
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,420	U: 10,420	U: 13,440
Data surfaces per spindle	5	7	2 Fixed 2 Removable	6	5
Heads per data surface	1	1	1	1	1
Tracks per surface	635	635	612	612	815
TPI	800	800	690	690	370/384
BPI	8780	8780	9074	9074	4040
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	33 (including settling)	33 (including settling)	35	35	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	41.3	41.3	43.3	43.3	38.3
Data transfer rate (KByte/sec)	625	625	625	625	806
FIRST CUSTOMER SHIPMENT	10/82	11/82	4Q83	1Q84	8/76
U.S. OEM PRICE FOR 100 UNITS	$1,776	$1,954	$2,100	$2,100	$4,795
COMMENTS			Dedicated Servo surface on additional fixed disk.	Dedicated Servo surface on additional fixed disk.	

MANUFACTURER	BALL COMPUTER PRODUCTS	BALL COMPUTER PRODUCTS	BASF	BASF	BASF
DRIVE	BD-80	BD-100	6182	6183	6185
DISK/TREND GROUP	3	4	5	5	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	SMD	SMD	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	3330-11	3330-11	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	U: 6.38	U: 9.57	U: 27.5
REMOVABLE	U: 82.1	U: 103.2	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	5	5	4	6	6
Heads per data surface	1	1	1	1	1
Tracks per surface	815	1024	153	153	440
TPI	370/384	465	254	254	508
BPI	6060	6060	7690	7690	8853
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)	30	30	76 (including settling)	76 (including settling)	142 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	38.3	38.3	84.3	84.3	150.3
Data transfer rate (KByte/sec)	1209	1209	625	625	625
FIRST CUSTOMER SHIPMENT	4/77	8/79	1Q82	1Q82	1983
U.S. OEM PRICE FOR 100 UNITS	$5,950	$6,300	--	--	--
COMMENTS					

MANUFACTURER	BASF	BURROUGHS	BURROUGHS	BURROUGHS	BURROUGHS
DRIVE	6185S	9484-5	9484-12	FD 211	FD 214
DISK/TREND GROUP	5	3	4	5	6
MARKET	OEM	End User	Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	9974-5	--	--	--
Generic type	Fixed	Trident	3336-11	Fixed	Fixed
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	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite Intelligent	Ferrite Intelligent
Interface	ST506	Burroughs	Burroughs	Parallel 1/F	Parallel 1/F
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	15.0	--	--	F: 19.955	F: 79.822
REMOVABLE	--	F: 65.2	F: 252	--	--
Capacity per track (Bytes)	U: 10,416	F: 16,200	F: 16,200	F: 14,848	F: 14,848
Data surfaces per spindle	4	5	19	2	8
Heads per data surface	1	1	1	2	2
Tracks per surface	360	815	815	672	672
TPI	406	370	384	300	300
BPI	8853	6039	6060	5500	5500
RPM	3600	3672	3600	3000	3000
Actuator type	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	142 (including settling)	25	28.50	35	35
Average rotational delay (msec)	8.3	8.3	8.33	10	10
Average access time (msec)	150.3	33.3	36.83	45	45
Data transfer rate (KByte/sec)	625	1210	1209	888	888
FIRST CUSTOMER SHIPMENT	1983	1977	1Q83	12/79	12/79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	1.625" High		B2900 B7900 B7800	Equivalent to B9493-19 and B9493-20	Equivalent to B9493-76 and B9493-80

MANUFACTURER	BURROUGHS	BURROUGHS	BURROUGHS	CARDIFF TECHNOLOGY	CARDIFF TECHNOLOGY
DRIVE	9494-2	9494-4	9494-5	D-240	R-120
DISK/TREND GROUP	7	7	9	2	2
MARKET	End User	End User	Captive	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
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	Plated	Plated
DRIVE: Technology type	3330-11	3330-11	3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Burroughs	Burroughs	Burroughs	Modified ST506	Modified ST506
CAPACITY/PERFORMANCE		(2 spindles)			
Total capacity (MBytes) FIXED	F: 201.0	F: 402.0	F: 542	F: 15.7	--
REMOVABLE	--	--	--	F: 15.7	F: 15.7
Capacity per track (Bytes)	F: 16,060	F: 16,060	F: 16,200	F: 8,192	F: 8,192
Data surfaces per spindle	8	8	15	4	2
Heads per data surface	1	1	2	1	1
Tracks per surface	1564	1564	2250	960	960
TPI	714	714	960	965	965
BPI	6551	6551	6425	10500	10500
RPM	3672	3672	3600	3406	3406
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	28	28	22.00	25	25
Average rotational delay (msec)	8	8	8.33	8.8	8.8
Average access time (msec)	36	36	30.33	33.8	33.8
Data transfer rate (KByte/sec)	1300	1300	1209	625	625
FIRST CUSTOMER SHIPMENT	4Q78	4Q78	4Q83	4Q83	2Q84
U.S. OEM PRICE FOR 100 UNITS	--	--	--	$1,650	--
COMMENTS	B1800-B7800 Embedded Servo	B1800-B7800 Embedded Servo	B4900 B7800 B7900	Embedded Servo	Embedded Servo

MANUFACTURER	CARDIFF TECHNOLOGY	CARDIFF TECHNOLOGY	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS
DRIVE	F-240	F-360	C2075	T50 Trident	T80 T82 Trident
DISK/TREND GROUP	6	6	2	3	3
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	8" Cartridge	Trident	Trident
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	200 mm OD 63.5 mm ID	14"	14"
Magnetic surface	Plated	Plated	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	ST506	ST506	SMD	Trident	T80: Trident T82: SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 31.5	F: 47.2	U: 51.89	--	--
REMOVABLE	--	--	U: 25.9	U: 54.7	U: T80: 82.1
Capacity per track (Bytes)	F: 8,192	F: 8,192	U: 20,790	U: 13,440	U: 20,160
Data surfaces per spindle	4	6	6	5	5
Heads per data surface	1	1	1	1	1
Tracks per surface	960	960	624	815	T80: 815 T82: 823
TPI	965	965	555	370	T80: 370 T82: 384
BPI	10500	10500	11761*	4040	6060
RPM	3406	3406	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	30	30	30
Average rotational delay (msec)	8.8	8.8	8.3	8.3	8.3
Average access time (msec)	33.8	33.8	38.3	38.3	38.3
Data transfer rate (KByte/sec)	625	625	1300	806	1209
FIRST CUSTOMER SHIPMENT	3Q84	3Q84	3/82	5/75	8/75
U.S. OEM PRICE FOR 100 UNITS	--	--	$3,450	$5,200	$5,935
COMMENTS	Embedded Servo	Embedded Servo	* RLL Code Embedded Servo		

MANUFACTURER	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS
DRIVE	T200 T202 Trident	T300 T302 T306 Trident	M20 Marksman	M40 Marksman	M80 Marksman
DISK/TREND GROUP	4	4	5	6	6
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	3330-11	3330-11	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	T200: Trident T202: SMD	T300: Trident T302/6: SMD	Marksman	Marksman	Marksman, SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	U: 20.16	U: 40.32	U: 80.64
REMOVABLE	U: T200: 208.1	U: T300: 312.1	--	--	--
Capacity per track (Bytes)	U: 13,440	U: 20,160	U: 24,000	U: 24,000	U: 24,000
Data surfaces per spindle	19	19	2	4	3
Heads per data surface	1	1	2	2	2
Tracks per surface	T200: 815 T202: 823	T300: 815 T302/6: 823	426	426	1138
TPI	T200: 370 T202: 384	T300: 370 T302/6: 384	182	182	480
BPI	4040	6060	7545	7545	7545
RPM	3600	3600	2400	2400	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Torque Motor
Average positioning time (msec)	30	30	65	65	50
Average rotational delay (msec)	8.3	8.3	12.5	12.5	12.5
Average access time (msec)	38.3	38.3	77.5	77.5	62.5
Data transfer rate (KByte/sec)	806	1209	960	960	960
FIRST CUSTOMER SHIPMENT	6/76	8/76	3Q78	3Q78	4Q81
U.S. OEM PRICE FOR 100 UNITS	$9,055	$10,255	$1,780	$2,235	$3,265
COMMENTS					

MANUFACTURER	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CENTURY DATA SYSTEMS	CII-HONEYWELL BULL
DRIVE	M160 Marksman	AMS 315	AMS 513	AMS 571	D120 D122 Cynthia
DISK/TREND GROUP	7	8	9	9	1
MARKET	OEM	OEM	OEM	OEM	Captive, OEM
MEDIA: Manufacturer's number	--	--	--	--	M4120
Generic type	Fixed	Fixed	Fixed	Fixed	Special Cartridge
Nominal disk diameter	14"	14"	14"	14"	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	Modified 3350	Modified 3350	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Marksman, SMD	SMD	SMD	SMD	Cynthia
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 315.2	U: 513.7	U: 571.0	--
REMOVABLE	U: 160.7	--	--	--	F: 10.0
Capacity per track (Bytes)	U: 32,000	U: 20,160	U: 32,000	U: 32,000	F: 12,800
Data surfaces per spindle	3	9.5	9.5	9.5	2
Heads per data surface	2	2	2	2	1
Tracks per surface	1690	1646	1690	1882	392
TPI	712	712	712	800	500
BPI	10000	6363	10000	10000	4750
RPM	2400	3600	2400	3600	3600
Actuator type	Band, Torque Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	50	25	25	25	50
Average rotational delay (msec)	12.5	8.3	12.5	8.3	8.3
Average access time (msec)	62.5	33.3	37.5	33.3	58.3
Data transfer rate (KByte/sec)	1280	1209	1280	1920	920
FIRST CUSTOMER SHIPMENT	1Q82	11/82	1/83	8/83	7/78
U.S. OEM PRICE FOR 100 UNITS	$4,050	$6,780	$7,200	$9,000	$1,890
COMMENTS					Embedded Servo

MANUFACTURER	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL
DRIVE	D140 D142 Cynthia	D145 Cynthia	D520 Cynthia	D505 Cynthia	D510 Cynthia
DISK/TREND GROUP	2	2	2	5	5
MARKET	Captive, OEM	OEM	OEM	Captive, OEM	Captive, OEM
MEDIA: Manufacturer's number	M4120	M4120	M4040	--	--
Generic type	Special Cartridge	Special Cartridge	5.25" Cartridge	Fixed	Fixed
Nominal disk diameter	10.5" OD 6.6" ID	10.5" OD 6.6" 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	3330-11	3330-11	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Cynthia	SASI	Cynthia	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 10.0	F: 10.0	F: 10.485	U: 6.38	U: 12.76
REMOVABLE	F: 10.0	F: 10.0	F: 10.485	--	--
Capacity per track (Bytes)	F: 12,800	F: 12,800	F: 8,192	U: 10,416	U: 10,416
Data surfaces per spindle	4	4	4	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	392	392	640	153	306
TPI	500	500	860	255	345
BPI	4750	4750	9200	7690	9074
RPM	3600	3600	3400	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	50	50	40	170 (including settling)	170 (including settling)
Average rotational delay (msec)	8.3	8.3	8.8	8.3	8.3
Average access time (msec)	58.3	58.3	48.8	178.3	178.3
Data transfer rate (KByte/sec)	920	920	625	625	625
FIRST CUSTOMER SHIPMENT	4Q79	8/82	3Q83	1982	1983
U.S. OEM PRICE FOR 100 UNITS	$2,675	$3,150	$1,530	--	--
COMMENTS	Embedded Servo	Embedded Servo	Embedded Servo	Mfg. under Seagate license	Mfg. under Seagate license

MANUFACTURER	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL	CII-HONEYWELL BULL
DRIVE	D160/4 D162/4 Cynthia	D160/6 D162/6 Cynthia	D530	D550	D570
DISK/TREND GROUP	6	6	6	6	6
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	10.5" OD 6.6" ID	10.5" OD 6.6" 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	Plated	Plated	Plated
DRIVE: Technology type	3350	3350	Modified 3350	Modified 3350	Modified 3350
Heads	Thin Film	Thin Film	Ferrite	Ferrite	Ferrite
Interface	Cynthia	Cynthia	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 60.21	F: 90.31	U: 30.8	U: 51.4	U: 72.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 12,800	F: 12,800	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	4	6	3	5	7
Heads per data surface	1	1	1	1	1
Tracks per surface	1176	1176	987	987	987
TPI	900	900	960	960	960
BPI	4850	4850	9920	9920	9920
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	40	40	30	30	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	48.3	48.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	920	920	625	625	625
FIRST CUSTOMER SHIPMENT	3Q81	3Q81	3Q83	3Q83	3Q83
U.S. OEM PRICE FOR 100 UNITS	$2,850	$3,100	$1,480	$1880	$2200
COMMENTS	Embedded Servo	Embedded Servo	Mfg. Under Vertex Peripherals License	Mfg. Under Vertex Peripherals License	Mfg. Under Vertex Peripherals License

MANUFACTURER	CII-HONEYWELL BULL	CIPHER	CIPHER	CIPHER	COGITO SYSTEMS
DRIVE	D160/8 D162/8 Cynthia	VF-2221 VT-2221	VF-2222 VT-2222	VT-2422	CG906
DISK/TREND GROUP	7	1	1	2	5
MARKET	OEM	OEM, Captive	OEM, Captive	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	2315/5440	2315/5440	5440	Fixed
Nominal disk diameter	10.5" OD 6.6" ID	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	2314	2314	2314	Modified 3350
Heads	Thin Film	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Cynthia	Various Options	Various Options	Various Options	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 120.42	U: 6.25	U: 6.25	U: 12.5	U: 6.38
REMOVABLE	--	U: 6.25	U: 6.25	U: 12.5	--
Capacity per track (Bytes)	F: 12,800	U: 7,812	U: 7,812	U: 15,625	U: 10,416
Data surfaces per spindle	8	4	4	4	2
Heads per data surface	1	1	1	1	1
Tracks per surface	1176	408	408	408	306
TPI	900	200	200	200	345
BPI	4850	200	200	4400	8783
RPM	3600	1500	2400	2400	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	40	35	35	35	85 (including settling)
Average rotational delay (msec)	8.3	20	12.5	12.5	8.3
Average access time (msec)	48.3	55	47.5	47.5	93.3
Data transfer rate (KByte/sec)	920	195	312.5	625	625
FIRST CUSTOMER SHIPMENT	3Q81	2Q80	2Q80	2Q80	6/83
U.S. OEM PRICE FOR 100 UNITS	$3,350	see below	see below	$4,320	$695
COMMENTS	Embedded Servo	F-$3,660 T-$3,600	F-$3,660 T-$3,600		1.625" High

MANUFACTURER	COGITO SYSTEMS	COMPUTER MEMORIES	COMPUTER MEMORIES	COMPUTER MEMORIES	COMPUTER MEMORIES
DRIVE	CG912	CM4213	CM5206	CM5412	CM5619
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	ST506	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.76	U: 13.34	U: 6.38	U: 12.76	U: 19.14
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	4	6
Heads per data surface	1	1	1	1	1
Tracks per surface	306	640	306	306	306
TPI	345	750	345	345	345
BPI	8783	9275	8650	8650	8650
RPM	3600	3573	3600	3600	3600
Actuator type	Band, Stepping Motor	Rotary, Torque Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	85 (including settling)	75 (including settling)	130 (including settling)	130 (including settling)	130 (including settling)
Average rotational delay (msec)	8.3	8.39	8.3	8.3	8.3
Average access time (msec)	93.3	83.39	138.3	138.3	138.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	6/83	3Q83	1Q82	1Q82	1Q82
U.S. OEM PRICE FOR 100 UNITS	$795	$880	$750	$880	$1,010
COMMENTS	1.625" High	1.625" High			

MANUFACTURER	COMPUTER MEMORIES	COMPUTER MEMORIES	COMPUTER MEMORIES	CONTROL DATA	CONTROL DATA
DRIVE	CM6213	CM6426	CM6640	9427H Hawk	280-10 280-20
DISK/TREND GROUP	5	5	6	1	2
MARKET	OEM	OEM	OEM	OEM, Captive	PCM
MEDIA: Manufacturer's number	--	--	--	9848	91204
Generic type	Fixed	Fixed	Fixed	5440	Cartridge Module Drive
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	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	2314	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST506	ST506	ST506	Various Options	IBM Series 1
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 13.34	U: 26.68	U: 40	U: 6.25	F: 64.5
REMOVABLE	--	--	--	U: 6.25	F: 13.3
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 7,812	F: 16,384
Data surfaces per spindle	2	4	6	4	5 Fixed 1 Removable
Heads per data surface	1	1	1	1	1
Tracks per surface	640	640	640	406	814
TPI	750	750	750	200	384
BPI	9275	9275	9275	2200	6038
RPM	3573	3573	3573	2400/1500	3600
Actuator type	Rotary, Torque Motor	Rotary, Torque Motor	Rotary, Torque Motor	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	40 (including settling)	40 (including settling)	40 (including settling)	35	30
Average rotational delay (msec)	8.39	8.39	8.39	12.5/20	8.3
Average access time (msec)	48.39	48.39	48.39	47.5/55	38.3
Data transfer rate (KByte/sec)	625	625	625	312.5/195	1209
FIRST CUSTOMER SHIPMENT	1/83	1/83	1/83	8/74	4/82
U.S. OEM PRICE FOR 100 UNITS	$1,050	$1,180	$1,310	$4,230	--
COMMENTS					

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	9448-32 Phoenix or CMD	9448-64 Phoenix or CMD	9448-96 Phoenix or CMD	9454 Lark	9455 Lark
DISK/TREND GROUP	2	2	2	2	2
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	91204	91204	91204	91208	91208
Generic type	Cartridge Module Drive	Cartridge Module Drive	Cartridge Module Drive	Lark Module Drive	Lark Module Drive
Nominal disk diameter	14"	14"	14"	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	3330-11	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	SMD	LDI	LDI, SMD, ISI
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 16.289	U: 48.869	U: 81.446	U: 8.35	U: 8.35
REMOVABLE	U: 16.289	U: 16.289	U: 16.289	U: 8.35	U: 8.35
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	U: 20,672	U: 20,672
Data surfaces per spindle	1 Fixed 1 Removable	3 Fixed 1 Removable	5 Fixed 1 Removable	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	823	823	823	202	202
TPI	384	384	384	237	237
BPI	6038	6038	6038	6774 FRPI 10161 BPI	6774 FRPI 10161 BPI
RPM	3600	3600	3600	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	30	50	50
Average rotational delay (msec)	8.3	8.3	8.3	8.55	8.55
Average access time (msec)	38.3	38.3	38.3	58.55	58.55
Data transfer rate (KByte/sec)	1209	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT	9/78	9/78	9/78	1Q82	1Q81
U.S. OEM PRICE FOR 100 UNITS	$5,315	$6,005	$6,695	--	$2,600
COMMENTS	Separate Servo surface for fixed and removable disks	Separate Servo surface for fixed and removable disks	Separate Servo surface for fixed and removable disks	Embedded Servo	Embedded Servo

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	9457 Lark	270-10 270-20 271-10	9710 RSD	9760 SMD	9762 SMD
DISK/TREND GROUP	2	3	3	3	3
MARKET	OEM, Captive	PCM	OEM	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	9877	--	9876	9877
Generic type	Lark Module Drive	Storage Module Drive	Removable Storage Drive	Storage Module Drive	Storage Module Drive
Nominal disk diameter	195 mm OD 100 mm ID	14"	230 mm OD 100 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	3330-11	Modified 3350	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	LDI, SMD, ISI	IBM Series 1	SMD,ISI	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 25.0	--	--	--	--
REMOVABLE	U: 25.0	U: 63.2	U: 82.9	U: 40.7	U: 81.5
Capacity per track (Bytes)	U: 20,672	U: 15,360	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	4	5	5	5	5
Heads per data surface	1	1	1	1	1
Tracks per surface	606	823	823	411	823
TPI	715	384	550	192	384
BPI	6774 FRPI 10161 BPI	6038	10000*	6038	6038
RPM	3510	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	35	30	30	30	30
Average rotational delay (msec)	8.55	8.3	8.3	8.3	8.3
Average access time (msec)	43.55	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	1209	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT	4Q82	1978	1Q83	3/74	3/75
U.S. OEM PRICE FOR 100 UNITS	$3,440	--	$4,915	$6,500	$6,715
COMMENTS	Embedded Servo		*RLL Code		

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	270-30	9766 SMD	230-10 240-10	230-15 240-15	9270-6 Cricket
DISK/TREND GROUP	4	4	5	5	5
MARKET	PCM	OEM, Captive	PCM	PCM	OEM
MEDIA: Manufacturer's number	9883-91	9883-91	--	--	--
Generic type	3336-11	3336-11	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	3.5"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Plated
DRIVE: Technology type	3330-11	3330-11	3350	3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Thin Film
Interface	IBM Series 1	SMD	IBM Series 1	IBM Series 1	ST506
CAPACITY/PERFORMANCE			1.48 MB Fixed Head Option	1.48 MB Fixed Head Option	
Total capacity (MBytes) FIXED	--	--	F: 9.3	F: 13.9	U: 6.38
REMOVABLE	F: 240.1	U: 309.5	--	--	--
Capacity per track (Bytes)	F: 15,360	U: 20,160	F: 15,360	F: 15,360	U: 10,416
Data surfaces per spindle	19	19	1	1.5	2
Heads per data surface	1	1	2	2	1
Tracks per surface	823	823	606	606	306
TPI	384	384	296	296	450
BPI	6038	6038	6220	6220	15390
RPM	3600	3600	3600	3600	3566
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	30	30	25	25	117
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.4
Average access time (msec)	38.3	38.3	33.3	33.3	125.4
Data transfer rate (KByte/sec)	1209	1209	1209	1209	625
FIRST CUSTOMER SHIPMENT	1978	3/76	1Q79	2Q79	3Q83
U.S. OEM PRICE FOR 100 UNITS	--	$12,355	--	--	--
COMMENTS					

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	9410-8 Finch	9410-24 Finch	9415-19 Wren	9410-32 Finch	9410-40 Finch
DISK/TREND GROUP	5	5	5	6	6
MARKET	OEM, Captive	OEM, Captive	Captive, OEM	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	195 mm OD 100 mm ID	195 mm OD 100 mm ID	130 mm OD 40 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	3350	3350	Modified 3350	3350	3350
Heads	Ferrite Finch, LDI	Ferrite Finch, LDI	Ferrite	Ferrite Finch, LDI	Ferrite Finch, LDI
Interface	SMD, SA 1000	SMD, SA 1000	Finch, ST506	SMD, SA 1000	SMD, SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 8.13	U: 24.39	U: 21.0	U: 32.5	U: 40.67
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 13,440	U: 13,440	U: 10,080	U: 13,440	U: 13,440
Data surfaces per spindle	1	3	3	4	5
Heads per data surface	1	1	1	1	1
Tracks per surface	605	605	635	605	605
TPI	554	554	800	554	554
BPI	6800	6800	8730	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	40	50	50
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	58.3	58.3	48.3	58.3	58.3
Data transfer rate (KByte/sec)	806	806	605	806	806
FIRST CUSTOMER SHIPMENT	6/81	6/81	2Q83	12/81	8/82
U.S. OEM PRICE FOR 100 UNITS	$1,510	$1,820	$1,315	$2,150	$2,280
COMMENTS					

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	9415-32 Wren	94153 Wren	94155 Wren	94156 Wren	9730-80 MMD
DISK/TREND GROUP	6	6	6	6	6
MARKET	Captive, OEM	OEM	OEM	OEM	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	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	Thin Film	Thin Film	Thin Film	Ferrite
Interface	Finch, ST506	CDC Finch	ST506	ESDI	SMD
CAPACITY/PERFORMANCE					0.96 or 1.93 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 36.0	U: 80.10	U: 85.96	U: 85.96	U: 82.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,080	U: 10,080	U: 10,416	U: 10,416	U: 20,160
Data surfaces per spindle	5	9	9	9	5
Heads per data surface	1	1	1	1	2
Tracks per surface	635	883	917	917	823
TPI	800	960	960	960	340
BPI	8730	9230	9540	9540	6220
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	40	30	30	30	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	48.3	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	605	605	625	625	1209
FIRST CUSTOMER SHIPMENT	2Q83	2Q84	2Q84	2Q84	1Q79
U.S. OEM PRICE FOR 100 UNITS	$1,660	--	--	--	$5,040
COMMENTS					

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	231 241	9715-160 FSD	9730-160 MMD	33501-A2 33501-B2 33501-C2	33750
DISK/TREND GROUP	7	7	7	8	8
MARKET	PCM	OEM	OEM, Captive	PCM	PCM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	230 mm OD 100 mm ID	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	Modified 3350	Modified 3350	Modified 3350	3380
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Thin Film
Interface	IBM Series 1	SMD, ISI	SMD	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 126.4	U: 165.9	0.96 or 1.93 MB Fixed Head Option U: 165.9	1.72 MB Fixed Head Option F: 317.5	F: 409.8
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 15,360	U: 20,160	U: 20,160	F: 19,069	
Data surfaces per spindle	5	10	5	20	8
Heads per data surface	2	1	2	2	2
Tracks per surface	1646	823	1646	843	1774
TPI	680	550	680	660	800
BPI	6220	10000*	6220	6350	16174*
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	30	30	30	18	16
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	38.3	38.3	38.3	26.3	24.3
Data transfer rate (KByte/sec)	1209	1209	1209	1198	3000
FIRST CUSTOMER SHIPMENT	5/83	4Q82	2Q79	1978	4Q83
U.S. OEM PRICE FOR 100 UNITS	--	$4,960	$5,785	--	--
COMMENTS		*RLL Code			PCM 3375 4 spindles per drive *RLL Code

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	33801-A2 33801-B2 33801-C2 (3330 Format)	819-11	9715-340 FSD	33502-A2 33502-B2 33502-C2	33800-A4 33800-AA4 33800-B4
DISK/TREND GROUP	8	8	8	9	9
MARKET	PCM	Captive	OEM	PCM	PCM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	230 mm OD 100 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	3330-11	3380	Modified 3350	3380
Heads	Ferrite	Ferrite	Thin Film	Ferrite	Thin Film
Interface	IBM	CDC	SMD, ISI	IBM	IBM
CAPACITY/PERFORMANCE	1.24 MB Fixed Head Option			1.72 MB Fixed Head Option	
Total capacity (MBytes) FIXED	F: 400.0	U: 325.8	U: 344.0	F: 635.0	F: 630
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 13,030	U: 20,160	U: 20,160	F: 19,069	F: 47,476
Data surfaces per spindle	20	40	12	20	8
Heads per data surface	2	1	2	2	2
Tracks per surface	1686	411	1422	1686	1774
TPI	660	192	960	660	800
BPI	6350	6000	9492	6350	16174*
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	25	50	20	24	16
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	33.3	58.3	28.3	32.3	24.3
Data transfer rate (KByte/sec)	1198	4840	1209	1198	3000
FIRST CUSTOMER SHIPMENT	1978	1978	4Q83	1Q79	1/83
U.S. OEM PRICE FOR 100 UNITS	--	--	$7,290	--	--
COMMENTS		4 track parallel data transfer		CDC Model 885	PCM 3380 4 spindles per drive *RLL Code

MANUFACTURER	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA	CONTROL DATA
DRIVE	819-21	885-42	9715-500 FSD	9771 XMD	9775 FMD
DISK/TREND GROUP	9	9	9	9	9
MARKET	Captive	Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	230 mm OD 100 mm ID	14"	Module Drive 14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	Modified 3350	3380	3380	Modified 3350
Heads	Ferrite	Ferrite	Thin Film	Thin Film	Ferrite
Interface	CDC	CDC	Modified SMD, ISI	Modified SMD, ISI, SDI	SMD
CAPACITY/PERFORMANCE					1.9 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 651.6	U: 673.0	U: 516.0	U: 825.0	U: 675.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 30,240	U: 50,400	U: 20,160
Data surfaces per spindle	40	20	12	8	20
Heads per data surface	1	2	2	2	2
Tracks per surface	823	1686	1422	2046	1686
TPI	384	660	960	960	660
BPI	6000	6350	15159*	15400*	6350
RPM	3600	3600	3600	2160	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	50	25	20	16	25
Average rotational delay (msec)	8.3	8.3	8.3	13.89	8.3
Average access time (msec)	58.3	33.3	28.3	29.89	33.3
Data transfer rate (KByte/sec)	4840	4788	1825	1825	1209
FIRST CUSTOMER SHIPMENT	1978	1982	4Q83	3Q83	4/80
U.S. OEM PRICE FOR 100 UNITS	--	--	$8,530	$10,660	$16,690
COMMENTS	4 track parallel data transfer	Cyber 865 & 875 4 track parallel data transfer. Drive has two spindles.	*RLL Code	*RLL Code	

MANUFACTURER	CONTROL DATA	DATA GENERAL	DATA GENERAL	DATA GENERAL	DATA GENERAL
DRIVE	9797	6045 6046 6047 6048 6050	6095	6070	6067
DISK/TREND GROUP	9	1	1	2	3
MARKET	OEM	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	1121	1121	1145	1143
Generic type	Fixed	5440	5440	5440	SMD
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	2314	2314	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Special	Data General	Data General	Data General	Data General
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 651.6	F: 5.014	F: 5.014	F: 10.027	--
REMOVABLE	--	F: 5.014	F: 5.014	F: 10.027	F: 50.074
Capacity per track (Bytes)	U: 20,160	F: 6,144	F: 6,144	F: 12,288	F: 12,288
Data surfaces per spindle	40	4	4	4	5
Heads per data surface	1	1	1	1	1
Tracks per surface	822	408	408	408	815
TPI	384	200	200	200	370
BPI	6000	2200	2200	4400	4040
RPM	3600	2400	2400	2400	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	50	38	38	38	35
Average rotational delay (msec)	8.3	12.5	12.5	12.5	8.3
Average access time (msec)	58.3	50.5	50.5	50.5	43.3
Data transfer rate (KByte/sec)	4840	312.5	312.5	625	806
FIRST CUSTOMER SHIPMENT	1977	1976	1978	1978	1978
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	4 track parallel data transfer				

MANUFACTURER	DATA GENERAL	DATA GENERAL	DATA GENERAL	DATA GENERAL	DATA GENERAL
DRIVE	6060	6061	6122	6098 6099 6101 6102	6100 6103 6104 6105
DISK/TREND GROUP	4	4	4	5	5
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	1122	1123	1163	--	--
Generic type	3336-1	3336-11	3336-11	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	3330-11	3330-11	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Data General	Data General	Data General	Data General	Data General
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	F: 12.58	F: 25.16
REMOVABLE	F: 95.957	F: 190.280	F: 277.491	--	--
Capacity per track (Bytes)	F: 12,288	F: 12,288	F: 17,920	F: 16,384	F: 16,384
Data surfaces per spindle	19	19	19	2	4
Heads per data surface	1	1	1	2	2
Tracks per surface	411	815	815	384	384
TPI	192	370	370	166	166
BPI	4040	4040	6060	5760	5760
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)	35	35	35	60 (including settling)	60 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	10.1	10.1
Average access time (msec)	43.3	43.3	43.3	70.1	70.1
Data transfer rate (KByte/sec)	806	806	1209	910.6	910.6
FIRST CUSTOMER SHIPMENT	1976	1976	1Q80	3Q79	4Q79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	DATA GENERAL	DATA GENERAL	DATA GENERAL	DATA GENERAL	DATAPOINT
DRIVE	6220 6225	6222 6227	6234	6236	9301 9302 9303
DISK/TREND GROUP	5	5	6	8	5
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	200 mm OD 63.5 mm OD	200 mm OD 63.5 mm OD	14"	14"	130 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Plated
DRIVE: Technology type	3350	3350	3350	3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Data General	Data General	Data General	Data General	Datapoint
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 5.0	F: 15.0	F: 50.7	F: 354.0	F: 20.24
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 10,240	F: 10,240	F: 22,016	F: 28,672	F: 6,144
Data surfaces per spindle	2	6	6	8	6
Heads per data surface	1	1	2	2	1
Tracks per surface	245	245	384	1572	549
TPI	200	200	166	714	500
BPI	6500	6500	7678	10438*	8000
RPM	3155	3155	2385	3000	5520
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	66 (including settling)	66 (including settling)	60 (including settling)	20	75 (without settling)
Average rotational delay (msec)	9.5	9.5	12.5	10	5.4
Average access time (msec)	75.5	75.5	72.5	30	80.4
Data transfer rate (KByte/sec)	625	625	971	1680	725
FIRST CUSTOMER SHIPMENT	9/82	9/82	3/83	9/83	1981
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS				*RLL Code	9301 includes 20 MB tape

MANUFACTURER	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION
DRIVE	RL01	RL02	RK06	RK07	RM02
DISK/TREND GROUP	1	1	2	2	3
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	RL01K	RL02K	RK06K	RK07K	--
Generic type	5440	5440	Special Cartridge	Special Cartridge	SMD
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-1	3330-1	3330-1	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Unibus, LSI-11	Unibus, LSI-11	Unibus	Unibus	Unibus, Massbus
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	F: 5.24	F: 10.48	F: 13.89	F: 27.54	F: 67.42
Capacity per track (Bytes)	F: 10,240	F: 10,240	F: 11,264	F: 11,264	F: 16,384
Data surfaces per spindle	2	2	3	3	5
Heads per data surface	1	1	1	1	1
Tracks per surface	256	512	411	815	823
TPI	125	250	192.3	384.6	384
BPI	3725	3725	4040	4040	6038
RPM	2400	2400	2400	2400	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	55	55	38	36.5	30
Average rotational delay (msec)	12.5	12.5	12.5	12.5	12.5
Average access time (msec)	67.5	67.5	50.5	49	42.5
Data transfer rate (KByte/sec)	512.5	512.5	538	538	806
FIRST CUSTOMER SHIPMENT	4/78	1979	12/76	4/78	4/78
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Embedded Servo	Embedded Servo			Manufactured by CDC

MANUFACTURER	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION
DRIVE	RM03	RA60	RM05	RP06	RA80
DISK/TREND GROUP	3	4	4	4	7
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	RA 60P	--	RP06P	--
Generic type	SMD	Special Disk Pack	3330-11	3330-11	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-11	Modified 3330	3330-11	3330-11	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Unibus, Massbus	Unibus	Massbus	Unibus, Massbus	Unibus
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	F: 121.0
REMOVABLE	F: 67.42	F: 205.0	F: 256.0	F: 176.0	--
Capacity per track (Bytes)	F: 16,384	F: 21,504	F: 16,384	F: 11,264	F: 15,872
Data surfaces per spindle	5	6	19	19	7
Heads per data surface	1	1	1	1	2
Tracks per surface	823	1600	823	815	1092
TPI	384	779	384	384	478
BPI	6038	7251 FRPI 9668 BPI	6038	4040	6339
RPM	3600	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	30	41.7	30	30	25
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	38.3	50.0	38.3	38.3	33.3
Data transfer rate (KByte/sec)	1209	1980	1209	806	1200
FIRST CUSTOMER SHIPMENT	4Q77	3Q83	3Q80	4Q76	1/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Manufactured by CDC	Embedded Servo	Manufactured by CDC	Manufactured by Memorex	

MANUFACTURER	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DIGITAL EQUIPMENT CORPORATION	DISC TECH ONE
DRIVE	RM80	RA81	RP20	RP07	8432
DISK/TREND GROUP	7	8	8	9	5
MARKET	Captive	Captive	Captive	Captive	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	210 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Massbus	Unibus	Massbus	Massbus	ANSI X3T9/1226
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 124.0	F: 456.0	F: 483.4	F: 516.0	U: 20.07
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 26,112	F: 14,400	F: 25,600	U: 17,920
Data surfaces per spindle	7	7	15	16	4
Heads per data surface	2	2	2	2	1
Tracks per surface	1122	2496	2238	1260	280
TPI	478	960	957	537	219
BPI	6339	8550 FRPI 11400 BPI	6425	11139*	8649
RPM	3600	3600	3600	3600	3125
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Stepping Motor
Average positioning time (msec)	25	28	25	23	65
Average rotational delay (msec)	8.3	8.3	8.3	8.3	9.6
Average access time (msec)	33.3	36.3	33.3	31.3	74.6
Data transfer rate (KByte/sec)	1200	2200	1198	2160	933.3
FIRST CUSTOMER SHIPMENT	1981	9/82	4Q80	7/81	4/81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	$1,000
COMMENTS		Embedded Servo	2 spindles per drive Manufactured by Storage Technology	*Effective BPI Manufactured by ISS/Univac	Previously 3M Product

MANUFACTURER	DISC TECH ONE	DISC TECH ONE	DISC TECH ONE	DISC TECH ONE	DISCTRON
DRIVE	8533	3306	4160	4300	DP-100
DISK/TREND GROUP	6	6	7	8	1
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	DP-10
Generic type	Fixed	Fixed	Fixed	Fixed	8" Cartridge
Nominal disk diameter	210 mm OD 100 mm ID	14"	14"	14"	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	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ANSI X3T9/1226	SMD	SMD	SMD	Modified SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 60	U: 83.95	U: 165.9	U: 301.0	--
REMOVABLE	--	--	--	--	U: 11.6
Capacity per track (Bytes)	U: 17,920	U: 20,160	U: 20,160	U: 25,872	U: 13,440
Data surfaces per spindle	4	6	5	7	2
Heads per data surface	1	2	2	2	1
Tracks per surface	838	704	1646	1664	426
TPI	693	286	706	706	478
BPI	8555	6122	6270	8072	6968
RPM	3125	2964	3600	2964	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	29	38	35	35	60
Average rotational delay (msec)	9.6	10.12	8.3	10.1	8.3
Average access time (msec)	38.6	48.12	43.3	45.1	68.3
Data transfer rate (KByte/sec)	933.3	1000	1209	1278	875
FIRST CUSTOMER SHIPMENT	1/82	7/77	1Q83	1Q83	4/81
U.S. OEM PRICE FOR 100 UNITS	$2,500	$3,000	$4,000	$5,000	$1,580
COMMENTS	Previously 3M Product				Embedded Servo

MANUFACTURER	DISCTRON	DISCTRON	DISCTRON	DISCTRON	DISCTRON
DRIVE	D-507	D-514	D-519	D-526	D-720
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	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST506	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.38	U: 12.75	U: 19.13	U: 25.5	U: 26.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,417	U: 10,417	U: 10,417	U: 10,417	U: 10,416
Data surfaces per spindle	2	4	6	8	3
Heads per data surface	1	1	1	1	1
Tracks per surface	306	306	306	306	860
TPI	383	383	383	383	960
BPI	8944	8944	8944	8944	9300
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Band, Stepping Motor	Rotary, Band, Stepping Motor	Rotary, Band, Stepping Motor	Rotary, Band, Stepping Motor	Linear, Voice Coil
Average positioning time (msec)	90 (including settling)	90 (including settling)	90 (including settling)	90 (including settling)	35
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	98.3	98.3	98.3	98.3	43.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	11/82	11/82	11/82	11/82	3Q83
U.S. OEM PRICE FOR 100 UNITS	$580	$685	$775	$895	$745
COMMENTS					

MANUFACTURER	DISCTRON	DISCTRON	DISCTRON	DISCTRON	DISCTRON
DRIVE	D-740	D-760	DP-400	D-1100	D-1600
DISK/TREND GROUP	6	6	6	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID
Magnetic surface	Plated	Plated	Oxide Coated	Plated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST506	ST506	Modified SA 1000	Modified SA1000	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 44.9	U: 62.7	U: 46.4	U: 121.9	U: 157.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 13,440	U: 13,440	U: 20,160
Data surfaces per spindle	5	7	4	7	7
Heads per data surface	1	1	1	1	1
Tracks per surface	860	860	864	1296	1116
TPI	960	960	640	960	960
BPI	9300	9300	8325	8108	10780
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	60	35	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	43.3	43.3	68.3	43.3	38.3
Data transfer rate (KByte/sec)	625	625	875	875	1209
FIRST CUSTOMER SHIPMENT	3Q83	3Q83	4/82	3Q83	1Q84
U.S. OEM PRICE FOR 100 UNITS	$885	$990	$1,770	$1,980	$2,635
COMMENTS			Embedded Servo		

MANUFACTURER	DISK MEMORY TECHNOLOGY	DISK MEMORY TECHNOLOGY	DMA SYSTEMS	DMA SYSTEMS	DMA SYSTEMS
DRIVE	601A	601B	5R Micro-Magnum	5/5 Micro-Magnum	5/10 Micro-Magnum
DISK/TREND GROUP	5	5	1	1	2
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	"Micro-Magnum"	"Micro-Magnum"	"Micro-Magnum"
Generic type	Fixed	Fixed	5.25" Cartridge	5.25" Cartridge	5.25" Cartridge
Nominal disk diameter	9"	9"	130 mm OD	130 mm OD	130 mm OD
Magnetic surface	Nickel-Cobalt Plated	Nickel-Cobalt Plated	40 mm ID Oxide Coated	40 mm ID Oxide Coated	40 mm ID Oxide Coated
DRIVE: Technology type	Special	Special	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Unique	Unique	Modified SA1000	Modified SA 1000	Modified SA 1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 2.8	U: 5.5	--	U: 6.75	U: 13.5
REMOVABLE	--	--	U: 6.75	U: 6.75	U: 6.75
Capacity per track (Bytes)	U: 6,750	U: 13,500	U: 10,560	U: 10,560	U: 10,560
Data surfaces per spindle	2	2	2	4	4
Heads per data surface	2	2	1	1	1
Tracks per surface	408	408	320	320	640 fixed 320 removable
TPI	256	256	454	454	908 fixed 454 removable
BPI	3750	7500	8617	8617	8617
RPM	1800	1800	3443	3443	3443
Actuator type	Lead Screw Stepping Motor	Lead Screw Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	130	130	40	40	40
Average rotational delay (msec)	16.7	16.7	8.7	8.7	8.7
Average access time (msec)	146.7	146.7	48.7	48.7	48.7
Data transfer rate (KByte/sec)	219	438	625	625	625
FIRST CUSTOMER SHIPMENT	9/80	9/80	9/82	5/82	10/82
U.S. OEM PRICE FOR 100 UNITS	Varies*	Varies*	$1,775	$2000	$2,400
COMMENTS	*Normally sold only as subsystem, with price dependent on specific system	*Normally sold only as subsystem, with price dependent on specific system	Embedded Servo	Embedded Servo	Embedded Servo

MANUFACTURER	DMA SYSTEMS	DMA SYSTEMS	DMA SYSTEMS	EVOTEK	EVOTEK
DRIVE	5/15 Micro-Magnum	26F Micro-Magnum	39F Micro-Magnum	ET-5510	ET-5520
DISK/TREND GROUP	2	5	6	5	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	"Micro-Magnum"	"Micro-Magnum"	"Micro-Magnum"	--	--
Generic type	5.25" Cartridge	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	Plated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite Modified	Ferrite Modified	Ferrite Modified	Ferrite	Ferrite
Interface	SA 1000	SA 1000	SA 1000	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 20.2	U: 27.0	U: 40.5	U: 7.81	U: 15.62
REMOVABLE	U: 6.75	--	--	--	--
Capacity per track (Bytes)	U: 10,560	U: 10,560	U: 10,560	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	960 fixed 320 removable	640	960	375	375
TPI	1156 fixed 454 removable	908	1156	367	367
BPI	8617	8617	8617	9825	9825
RPM	3443	3443	3443	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	40	40	40	49 (including settling)	49 (including settling)
Average rotational delay (msec)	8.7	8.7	8.7	8.3	8.3
Average access time (msec)	48.7	48.7	48.7	57.3	57.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	1Q84	1Q84	1Q84	4Q82	4Q82
U.S. OEM PRICE FOR 100 UNITS	$2,455	$1,850	$2,320	$1,125	$1,350
COMMENTS	Embedded Servo	Embedded Servo	Embedded Servo		

MANUFACTURER	EVOTEK	EVOTEK	EVOTEK	EVOTEK	EVOTEK
DRIVE	ET-5530	ET-5810	ET-5820	ET-5540	ET-5830
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	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	ST506	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 23.43	U: 12.9	U: 25.83	U: 31.24	U: 38.75
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 17,220	U: 17,220	U: 10,416	U: 17,220
Data surfaces per spindle	6	2	4	8	6
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	16250	16250	9825	16250
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	1025	1025	625	1025
FIRST CUSTOMER SHIPMENT	4Q82	4Q82	4Q82	4Q82	4Q82
U.S. OEM PRICE FOR 100 UNITS	$1,390	$1,295	$1,475	$1,600	$1,750
COMMENTS					

MANUFACTURER	EVOTEK	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE	ET-5840	F451	F452	F6417	M2201
DISK/TREND GROUP	6	2	2	2	2
MARKET	OEM	Captive	Captive	Captive	OEM
MEDIA: Manufacturer's number	--	F922P	F922P	F924P	M2951
Generic type	Fixed	Special Cartridge	Special Cartridge	Special Cartridge	Special Cartridge
Nominal disk diameter	130 mm OD 40 mm ID	14"	14"	14"	14"
Magnetic surface	Plated	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	ST506	Fujitsu	Fujitsu	Fujitsu	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 51.68	--	--	--	--
REMOVABLE	--	F: 19.86	F: 39.7	F: 67.6	U: 50.56
Capacity per track (Bytes)	U: 17,220	F: 16,384	F: 16,384	F: 16,736	U: 20,480
Data surfaces per spindle	8	3	3	5	3
Heads per data surface	1	1	1	1	1
Tracks per surface	375	404	808	808	823
TPI	367	370	370	370	370
BPI	16250	6135	6135	5636	6135
RPM	3600	2400	2400	2400	2400
Actuator type	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	49 (including settling)	30	30	30	30
Average rotational delay (msec)	8.3	12.5	12.5	12.5	12.5
Average access time (msec)	57.3	42.5	42.5	42.5	42.5
Data transfer rate (KByte/sec)	1025	819	819	717	819
FIRST CUSTOMER SHIPMENT	4Q82	3Q77	3Q77	4Q79	4Q77
U.S. OEM PRICE FOR 100 UNITS	$1,995	--	--	--	--
COMMENTS					

MANUFACTURER	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD	FUJITSU, LTD.	FUJITSU, LTD.
DRIVE	M2211	F479	M2230AS/B	M2231A/B	M2232A/B
DISK/TREND GROUP	2	4	5	5	5
MARKET	OEM	Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	M2952	F949P	--	--	--
Generic type	Special Cartridge	3336-11	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	3330-11	3330-11	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	Fujitsu	AS=ST506 B=SA4000	A = ST506 B = SA4000	A = ST506 B = SA4000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	U: 6.66	U: 6.66	U: 10.0
REMOVABLE	U: 84.27	F: 200.0	--	--	--
Capacity per track (Bytes)	U: 20,480	F: 13,030	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	5	19	2	4	6
Heads per data surface	1	1	1	1	1
Tracks per surface	823	815	320	160	160
TPI	370	370	300	254	254
BPI	6135	4040	10,200	8020	8020
RPM	2400	3600	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	30	25	83 (including settling)	95 (including settling)	95 (including settling)
Average rotational delay (msec)	12.5	8.4	8.3	8.3	8.3
Average access time (msec)	42.5	33.4	91.3	103.3	103.3
Data transfer rate (KByte/sec)	819	806	625	625	625
FIRST CUSTOMER SHIPMENT	4Q79	3Q75	4/83	7/82	7/82
U.S. OEM PRICE FOR 100 UNITS	--	--	$750	--	$1,050
COMMENTS					

MANUFACTURER	FUJITSU, LTD	FUJITSU, LTD	FUJITSU, LTD	FUJITSU, LTD	FUJITSU, LTD.
DRIVE	M2233AS/B	M2234AS/B	M2235AS/B	M2240	M2301B/K
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	200 mm OD 100 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	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	AS=ST506 B=SA4000	AS=ST506 B=SA4000	AS=ST506 B=SA4000	ST506, SA4000	B=SA4000, K= Bidirectional
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 13.3	U: 20.0	U: 26.7	U: 29.1	U: 11.712
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 12,000
Data surfaces per spindle	4	6	8	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	320	320	320	699	244
TPI	300	300	300	*	195
BPI	10,200	10,200	10,200	*	6100
RPM	3600	3600	3600	3600	2964
Actuator type	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	83 (including settling)	83 (including settling)	83 (including settling)	30	70 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	10.1
Average access time (msec)	91.3	91.3	91.3	38.3	80.1
Data transfer rate (KByte/sec)	625	625	625	625	593
FIRST CUSTOMER SHIPMENT	4/83	4/83	11/83	2Q84	7/80
U.S. OEM PRICE FOR 100 UNITS	$875	$1,050	--	--	$1,610 (B)
COMMENTS				*Not Announced	

MANUFACTURER	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD	FUJITSU, LTD
DRIVE	M2301BE/KE	M2302B/K	M2302BE/KE	M2241	M2242
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	200 mm OD 100 mm ID	200 mm OD 100 mm ID	200 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	Modified 3350	3340	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	BE=SA4000, KE= Bidirectional	B=SA4000, K= Bidirectional	BE=SA4000, KE= Bidirectional	ST506, SA4000	ST506, SA4000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 11.87	U: 23.424	U: 23.74	U: 50.9	U: 80.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 24,320	U: 12,000	U: 24,320	U: 10,416	U: 10,416
Data surfaces per spindle	2	8	4	7	11
Heads per data surface	1	1	1	1	1
Tracks per surface	244	244	244	699	699
TPI	195	195	195	*	*
BPI	12360	6100	12360	*	*
RPM	2964	2964	2964	3600	3600
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	70 (including settling)	70 (including settling)	70 (including settling)	30	30
Average rotational delay (msec)	10.1	10.1	10.1	8.3	8.3
Average access time (msec)	80.1	80.1	80.1	38.3	38.3
Data transfer rate (KByte/sec)	1200	593	1200	625	625
FIRST CUSTOMER SHIPMENT	9/82	7/80	9/82	2Q84	2Q84
U.S. OEM PRICE FOR 100 UNITS	$1,610 (BE)	$2,090 (B)	$1,850 (BE)	--	--
COMMENTS				*Not Announced	*Not Announced

MANUFACTURER	FUJITSU, LTD	FUJITSU, LTD.	FUJITSU, LTD	FUJITSU, LTD	FUJITSU, LTD
DRIVE	M2280	M2303BE/KE	M2311K	M2312K	M2321K
DISK/TREND GROUP	6	6	6	6	6
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	200 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	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	B=SA4000, K= Bidirectional	SMD, SCSI	SMD, SCSI	SMD, SCSI
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 84.3	U: 47.47	U: 48.25	U: 84.44	U: 84.2
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,480	U: 24,320	U: 20,480	U: 20,480	U: 20,480
Data surfaces per spindle	3	8	4	7	5
Heads per data surface	2	1	1	1	1
Tracks per surface	1646	244	589	589	823
TPI	680	195	720	720	683
BPI	6580	12360	9550	9550	9867
RPM	2964	2964	3600	3600	3600
Actuator type	Rotary, Voice Coil	Band, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	27	70 (including settling)	20	20	20
Average rotational delay (msec)	10.12	10.1	8.3	8.3	8.3
Average access time (msec)	37.12	80.1	28.3	28.3	28.3
Data transfer rate (KByte/sec)	1012	1200	1229	1229	1229
FIRST CUSTOMER SHIPMENT	4Q79	9/82	4/81	4/81	11/83
U.S. OEM PRICE FOR 100 UNITS	$3,817	$2,250 (BE)	$3,195	$3,400	--
COMMENTS					

MANUFACTURER	FUJITSU, LTD.	FUJITSU, LTD	FUJITSU, LTD.	FUJITSU, LTD	FUJITSU, LTD
DRIVE	F436	F437	F6411	M2284	M2322K
DISK/TREND GROUP	7	7	7	7	7
MARKET	Captive	Captive	Captive	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	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	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Fujitsu	Fujitsu	Fujitsu	SMD	SMD, SCSI
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 100.0	F: 158	F: 135.0	U: 168.6	U: 168.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 16,384	F: 16,736	U: 20,480	U: 20,480
Data surfaces per spindle	5	6	5	5	10
Heads per data surface	2	2	2	2	1
Tracks per surface	1630	1630	1630	1646	823
TPI	668	680	668	680	683
BPI	6580	6580	5694	6580	9867
RPM	2400	2400	2964	2964	3600
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	20
Average rotational delay (msec)	12.5	12.5	10.1	10.12	8.3
Average access time (msec)	39.5	39.5	37.1	37.12	28.3
Data transfer rate (KByte/sec)	819	819	885	1012	1229
FIRST CUSTOMER SHIPMENT	4/79	10/81	4/79	4Q79	11/83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	$4,787	--
COMMENTS					

MANUFACTURER	FUJITSU, LTD	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD	FUJITSU, LTD.
DRIVE	F438	F493	F6421	M2294	M2294K/N
DISK/TREND GROUP	8	8	8	8	8
MARKET	Captive	Captive	Captive	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	10.5" OD 4" ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Fujitsu	Fujitsu	Fujitsu	SMD	SMD
CAPACITY/PERFORMANCE		1.144 MB Fixed Head Option	1.607 or 1.144 MB Fixed Head Option		
Total capacity (MBytes) FIXED	F: 300	F: 317.5	F: 446/317.5	U: 335.5	U: 335.544
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 24,576	F: 19,069	F: 26,793/ 19,069	U: 20,480	U: 20,480
Data surfaces per spindle	6	15	10	8	8
Heads per data surface	2	2	2	2	2
Tracks per surface	2048	1110	1680	2048	2048
TPI	793	480	880	858	850
BPI	9870	6362	12790	6500	6500
RPM	2400	3600	3961	2964	2964
Actuator type	Rotary, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	27	20	18	27	27
Average rotational delay (msec)	12.5	8.3	7.5	10.12	10.12
Average access time (msec)	39.5	28.3	25.5	37.12	37.12
Data transfer rate (KByte/sec)	1229	1198	1859	1012	1012
FIRST CUSTOMER SHIPMENT	6/83	4Q79	3Q81	3/83	3/83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	$6,920	--
COMMENTS		Drive has two spindles	Drive has four spindles		

MANUFACTURER	FUJITSU, LTD	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD.	FUJITSU, LTD
DRIVE	M2350A	M2351A	F496	F6425	M2298
DISK/TREND GROUP	8	8	9	9	9
MARKET	OEM	OEM	Captive	Captive	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	10.5" OD 4" ID	10.5" OD 4" ID	14"	10.5" OD 4" ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Sputtered/Oxide	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Special	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	T. Film/Ferrite	Ferrite
Interface	Modified SMD	Modified SMD	Fujitsu	Fujitsu	Modified SMD
CAPACITY/PERFORMANCE		1.69 MB Fixed Head Option	1.144 MB Fixed Head Option	1.4 MB Fixed Head Option	
Total capacity (MBytes) FIXED	U: 473.6	U: 474.214	F: 635.0	F: 630.0	U: 671
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 28,160	U: 28,160	F: 19,069	F: 47,476	U: 40,960
Data surfaces per spindle	10	10	20	8	8
Heads per data surface	2	2	2	2	2
Tracks per surface	1684	1684	1660	1770	2048
TPI	880	880	668	*	858
BPI	12790	12790	6426	*	8,667 FCI 13,000 BPI
RPM	3961	3961	3600	3600	2964
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	18	18	20	15	27
Average rotational delay (msec)	7.5	7.5	8.3	8.3	10.12
Average access time (msec)	25.5	25.5	28.3	23.3	37.12
Data transfer rate (KByte/sec)	1.86/7.44/9.3	1859	1198	3000	2024
FIRST CUSTOMER SHIPMENT	2/84	3/82	2Q80	3Q83	3Q84
U.S. OEM PRICE FOR 100 UNITS	--	$8,800	--	--	--
COMMENTS	Parallel data transfer, 4 or 5 channels		Drive has two spindles	*Not Announced Drive has four spindles	

MANUFACTURER	HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD
DRIVE	7906	7920	7925	7935H	7908
DISK/TREND GROUP	2	3	4	4	5
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	12940A	13394A	13356A	97935	--
Generic type	2315	Special SMD	Special Pack	Special Disk Pack	Fixed
Nominal disk diameter	14"	14"	14"	14"	200 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-1	3330-11	--	Modified 3330	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	HPIB	HPIB	HPIB	HPIB	HPIB
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 9.38	--	--	--	F: 16.5
REMOVABLE	F: 9.38	F: 50.07	F: 120.18	F: 404.4	--
Capacity per track (Bytes)	F: 12,288	F: 12,288	U: 16,384	F: 23,552	F: 8,960
Data surfaces per spindle	3	5	9	13	5
Heads per data surface	1	1	1	2	1
Tracks per surface	812 Fixed 406 Removable	815	815	1321	370
TPI	384 Fixed 192 Removable	384	384	625	300
BPI	4860	4680	6250	8320*	6000
RPM	3600	3600	2700	2700	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	25	25	25	24.0	41.6
Average rotational delay (msec)	8.3	8.3	11.1	11.1	8.3
Average access time (msec)	33.3	33.3	36.1	35.1	49.9
Data transfer rate (KByte/sec)	937.5	937.5	937.5	1000	537.6
FIRST CUSTOMER SHIPMENT	3/78	3/77	6/78	4/83	9/81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS				*Uses RLL Code	Drive manufactured by International Memories

MANUFACTURER	HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD	HEWLETT-PACKARD
DRIVE	7910	7911	7912	7914	7933H
DISK/TREND GROUP	5	5	6	7	8
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	3340	3350	3350	3350	Modified 3330
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	HPIB	HPIB	HPIB	HPIB	HPIB
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 12.04	F: 28.1	F: 65.6	F: 132.1	F: 404.4
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 8,192	F: 16,384	F: 16,384	F: 16,384	F: 23,552
Data surfaces per spindle	2	1.5	3.5	3.5	13
Heads per data surface	1	2	2	2	2
Tracks per surface	738	1144	1144	2288	1321
TPI	300	478	478	910	625
BPI	3225	6161	6161	6161	8320*
RPM	3000	3600	3600	3600	2700
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	70	26.7	26.7	26.7	24.0
Average rotational delay (msec)	10	8.3	8.3	8.3	11.1
Average access time (msec)	80	35.0	35.0	35.0	35.1
Data transfer rate (KByte/sec)	526	983	983	983	1000
FIRST CUSTOMER SHIPMENT	1Q79	10/81	10/81	2/83	12/81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					*Uses RLL Code

MANUFACTURER	HIGHTRACK COMPUTER TECHNIK GMBH	HIGHTRACK COMPUTER TECHNIK GMBH	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	HT 80	HT 160	DK 501-1	DK 501-2	DK 501-3
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	Plated	Plated	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	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 82.955	U: 165.910	U: 6.7	U: 10.0	U: 13.3
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	5	10	4	6	8
Heads per data surface	1	1	1	1	1
Tracks per surface	823	823	160	160	160
TPI	572	572	254	254	254
BPI	11286	11286	7800	7800	7800
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	30	30	78 (including settling)	78 (including settling)	78 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	38.3	38.3	86.3	86.3	86.3
Data transfer rate (KByte/sec)	1209	1209	625	625	625
FIRST CUSTOMER SHIPMENT	12/81	1/83	4Q82	4Q82	4Q82
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	DK 811-4	DK 811-8	DK8125-5	DK8125-8	DK8125-12
DISK/TREND GROUP	6	6	6	6	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Modified SMD	Modified SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 48.0 F: 40.0	U: 89.1 F: 71.1	U: 51	U: 85	U: 119
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 12,800	F: 12,800	U: 20,672	U: 20,672	U: 20,672
Data surfaces per spindle	6	11	3	5	7
Heads per data surface	1	1	1	1	1
Tracks per surface	521	526	823	823	823
TPI	480	480	750	750	750
BPI	7495	7495	6433 FCI 9650 BPI	6433 FCI 9650 BPI	6433 FCI 9650 BPI
RPM	3521	3521	3510	3510	3510
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	25	25	25	25	25
Average rotational delay (msec)	8.5	8.5	8.5	8.5	8.5
Average access time (msec)	33.5	33.5	33.5	33.5	33.5
Data transfer rate (KByte/sec)	904	904	1209	1209	1209
FIRST CUSTOMER SHIPMENT	10/80	3/82	4Q83	4Q83	4Q83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.	HITACHI, LTD.
DRIVE	DK8125-17	DKU-80	DKU-95 H-8595-12 H-8595-22 H-8595-32	DKU-97I	DKU-97S
DISK/TREND GROUP	7	8	8	9	9
MARKET	OEM	OEM	Captive, OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	8" Nominal	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	*	3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	IBM, SMD	IBM	IBM	SMD
CAPACITY/PERFORMANCE			1.144 MB Fixed Head Option		
Total capacity (MBytes) FIXED	U: 170.1	U: 427.7	F: 317.5	F: 635.0	U: 697.059
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,672	U: 26,880	F: 19,069	F: 19,069	U: 20,672
Data surfaces per spindle	10	13	15	20	20
Heads per data surface	1	2	2	2	2
Tracks per surface	823	1224	1110	1666	1682
TPI	750	*	478	720	720
BPI	6433 FCI 9650 BPI	*	6425	6425	6425
RPM	3510	3000	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Dual Rotary, Voice Coil	Dual Rotary, Voice Coil
Average positioning time (msec)	25	18	20	20/18	20
Average rotational delay (msec)	8.5	10.0	8.3	8.3	8.3
Average access time (msec)	33.5	28.0	28.3	28.3/26.3	28.3
Data transfer rate (KByte/sec)	1209	1344	1198	1198	1240
FIRST CUSTOMER SHIPMENT	4Q83	*	1979	1981	3Q83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS		*Not Announced	Drive has two spindles	Drive has two spindles	

MANUFACTURER	HITACHI, LTD.	HITACHI, LTD.	IBIS	IBIS	IBM
DRIVE	DKU-98I H-8598	H-8576-12 H-8576-22	1400	5380	2311-1
DISK/TREND GROUP	9	9	9	9	--
MARKET	Captive, OEM	Captive	OEM	PCM	Captive
MEDIA: Manufacturer's number	--	--	--	--	1316
Generic type	Fixed	Fixed	Fixed	Fixed	1316
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Plated	Plated	Oxide Coated
DRIVE: Technology type	3380	Modified 3350	Special	Special	2311
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	Custom	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 1260	F: 635.0	U: 1,409.0	F: 1,260.0	--
REMOVABLE	--	--	--	--	F: 7.45
Capacity per track (Bytes)	*	F: 19,069	U: 49,728	F: 47,476	F: 3,625
Data surfaces per spindle	20	20	16	15	10
Heads per data surface	2	2	2	2	1
Tracks per surface	1770	1666	1776	1770	203
TPI	600	720	769	769	100
BPI	15240**	6425	15294	15294	1100
RPM	3600	3600	3600	3600	2400
Actuator type	Dual Rotary, Voice Coil	Dual Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Hydraulic
Average positioning time (msec)	16	20	16	16	75
Average rotational delay (msec)	8.3	8.3	8.3	8.3	12.5
Average access time (msec)	24.3	28.3	24.3	24.3	87.5
Data transfer rate (KByte/sec)	3000	1198	Up To 12,000	3,000	156
FIRST CUSTOMER SHIPMENT	4Q82	4Q80	4Q83	4Q83	6/65
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	*Not Announced **RLL Code Drive has two spindles	Drive has two spindles	Drive has one spindle, with two actuators. Up to 4 track parallel data transfer.	Drive has one spindle, each with two actuators.	System/360

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	2311-11	2311-12	2314-1	2314-A 2314-B 2312 2319	3340-A2 3340-B1 3340-B2
DISK/TREND GROUP	--	--	--	--	--
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	1316	1316	2316	2316	3348-35/70/70F
Generic type	1316	1316	2316	2316	3348
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	2311	2311	2314	2314	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	--	--
REMOVABLE	F: 5.4	F: 2.7	F: 29.176	F: 29.176	F: 34.9/69.8
Capacity per track (Bytes)	F: 2,700	F: 2,700	F: 7,294	F: 7,294	F: 16,736
Data surfaces per spindle	10	10	20	20	3/6
Heads per data surface	1	1	1	1	2
Tracks per surface	203	103	203	203	696
TPI	100	100	100	100	300
BPI	1100	1100	2200	2200	5636
RPM	2400	2400	2400	2400	2964
Actuator type	Linear, Hydraulic	Linear, Hydraulic	Linear, Hydraulic	Linear, Hydraulic	Linear, Voice Coil
Average positioning time (msec)	75	60	75	60	25
Average rotational delay (msec)	12.5	12.5	12.5	12.5	10.1
Average access time (msec)	87.5	72.5	87.5	72.5	35.1
Data transfer rate (KByte/sec)	156	156	312.5	312.5	885
FIRST CUSTOMER SHIPMENT	11/70	11/70	4/65	see below	11/73
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/360	System/360	System/360 System/370	A-8/69 B, 2319-12/70 System/360 System/370	Original Winchester Disk Drive

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5445	1131 2310	5444-1	5444-2/3	5444-A1
DISK/TREND GROUP	--	1	1	1	1
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	2316	2315	5440	5440	5440
Generic type	2316	2315	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	2314	2310	5444	5444	5444
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	F: 1.22	F: 2.45	F: 1.22
REMOVABLE	F: 20.48	F: 1,024	F: 1.22	F: 2.45	F: 1.22
Capacity per track (Bytes)	F: 5,120	F: 2,560	F: 6,144	F: 6,144	F: 6,144
Data surfaces per spindle	20	2	4	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	203	200	100	200	100
TPI	100	100	100	100	100
BPI	2200	1100	2200	2200	2200
RPM	2400	1500	1500	1500	1500
Actuator type	Linear, Hydraulic	Linear, Stepping Voice Coil	Lead Screw, Friction Drive	Lead Screw, Friction Drive	Lead Screw, Stepping Motor
Average positioning time (msec)	60	520	153	269	86
Average rotational delay (msec)	12.5	20	20	20	20
Average access time (msec)	72.5	540	173	289	106
Data transfer rate (KByte/sec)	312.5	97.5	199	199	199
FIRST CUSTOMER SHIPMENT	6/72	11/65	9/70	1970	1971
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/3	1130	System/3	System/3	System/3

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5444-A2	3330-1	3330-11	4952-30D 4954-30D 4956-30D 4965-30D	4963-23A 4963-23B
DISK/TREND GROUP	1	4	4	5	5
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	5440	3336-1	3336-11	--	--
Generic type	5440	3336-1	3336-11	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	5444	3330-1	3330-1	Modified 3350	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: 2.45	--	--	F: 30.84	F: 23.461888
REMOVABLE	F: 2.45	F: 100.018	F: 200.036	--	--
Capacity per track (Bytes)	F: 6,144	F: 13,030	F: 13,030	F: 17,408	F: 16,384
Data surfaces per spindle	4	19	19	4	5
Heads per data surface	1	1	1	1	1
Tracks per surface	200	411	815	443	359
TPI	100	192	370	523	450
BPI	2200	4040	4040	6875 FRPI 10312 BPI	8530
RPM	1500	3600	3600	3151	3125
Actuator type	Lead Screw, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	126	30	30	38	27
Average rotational delay (msec)	20	8.3	8.3	9.5	9.6
Average access time (msec)	146	38.3	38.3	47.5	36.6
Data transfer rate (KByte/sec)	199	806	806	1250	1031
FIRST CUSTOMER SHIPMENT	1971	8/71	1973	9/83	2/79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/3	System/370 303X Series 43XX	System/370 303X Series 43XX	Series/1 Embedded Servo 64 KB Cache	Series/1

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	4963-29A 4963-29B	5247-011	5525-020 5525-030	8101-A11	8130-A21 8130-A31 A41, A51 A61, A71
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	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	3350	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: 15.4	F: 29.327360	F: 29.327360	F: 29.327360
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 17,408	F: 16,384	F: 16,384	F: 16,384
Data surfaces per spindle	5	2	5	5	5
Heads per data surface	1	1	1	1	1
Tracks per surface	359	443	359	359	359
TPI	450	523	450	450	450
BPI	8530	6875 FRPI 10312 BPI	8530	8530	8530
RPM	3125	3151	3125	3125	3125
Actuator type	Rotary, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	27	38	27	27	27
Average rotational delay (msec)	9.6	9.51	9.6	9.6	9.6
Average access time (msec)	36.6	49.51	36.6	36.6	36.6
Data transfer rate (KByte/sec)	1031	1250	1031	1031	1031
FIRST CUSTOMER SHIPMENT	2/79	9/82	2/80	3Q79	3Q79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	Series/1	Embedded Servo Shared storage for Datamaster	5520 Admin. System	8100 System	8100 System

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	8130-A22 8140-A32 A42, A52 A62, A72	3310-A1 3310-A2 3310-B1 3310-B2	4963-58A 4963-58B	4963-64A 4963-64B	5247-012
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	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE	.131072 MB Fixed Heads		0.131 MB Fixed Heads		
Total capacity (MBytes) FIXED	F: 23.461888	F: 64.520192	F: 58.654720	F: 64.520192	F: 30.84
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 16,384	F: 16,384	F: 16,384	F: 17,408
Data surfaces per spindle	5	11	11	11	4
Heads per data surface	1	1	1	1	1
Tracks per surface	359	359	359	359	443
TPI	450	450	450	450	523
BPI	8530	8530	8530	8530	6875 FRPI 10312 BPI
RPM	3125	3125	3125	3125	3151
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	27	27	27	27	38
Average rotational delay (msec)	9.6	9.6	9.6	9.6	9.51
Average access time (msec)	36.6	36.6	36.6	36.6	47.51
Data transfer rate (KByte/sec)	1031	1031	1031	1031	1250
FIRST CUSTOMER SHIPMENT	3Q79	3/79	2/79	2/79	9/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	8100 System	4331	Series/1	Series/1	Embedded Servo Shared storage for Datamaster

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5340-XX4	5340-XX5	5360-AX1	5360-AX2	5381- All Models
DISK/TREND GROUP	6	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	Modified 3350	Modified 3350	Piccolo
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE		(2 spindles)		(2 Spindles)	
Total capacity (MBytes) FIXED	F: 63.905792	F: 128.425984	F: 30.84	F: 61.69	F: 64.520192
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 16,384	F: 17,408	F: 17,408	F: 16,384
Data surfaces per spindle	11	11	4	4	11
Heads per data surface	1	1	1	1	1
Tracks per surface	359	359	443	443	359
TPI	450	450	523	523	450
BPI	8530	8530	6875 FRPI 10312 BPI	6875 FRPI 10312 BPI	8530
RPM	3125	3125	3151	3151	3125
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	27	27	38	38	27
Average rotational delay (msec)	9.6	9.6	9.5	9.5	9.6
Average access time (msec)	36.6	36.6	47.5	47.5	36.6
Data transfer rate (KByte/sec)	1031	1031	1250	1250	1031
FIRST CUSTOMER SHIPMENT	1/79	1/79	7/83	7/83	8/79
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/34	System/34	System/36 Embedded Servo	System/36 Embedded Servo	System/38 5381 Processor available with up to six disk spindles

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5525-040 5525-050	676	680	8101-A13	8130-A23 8130-B23 8140-A33 A43, A53 A63, A73
DISK/TREND GROUP	6	6	6	6	6
MARKET	Captive	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	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	Modified 3350	Piccolo	Piccolo	Piccolo
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 64.520192	F: 31.8 U: 38.6	F: 64.5	F: 64.520192	F: 64.520192
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 17,920 U: 21,700	F: 16,384	F: 16,384	F: 16,384
Data surfaces per spindle	11	4	11	11	11
Heads per data surface	1	1	1	1	1
Tracks per surface	359	445	358	359	359
TPI	450	523	450	450	450
BPI	8530	6875 FRPI 10312 BPI	8530	8530	8530
RPM	3125	3151	3125	3125	3125
Actuator type	Rotary, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	27	38	27	27	27
Average rotational delay (msec)	9.6	9.51	9.6	9.6	9.6
Average access time (msec)	36.6	47.51	36.6	36.6	36.6
Data transfer rate (KByte/sec)	1031	1250	1031	1031	1031
FIRST CUSTOMER SHIPMENT	11/80	12/82	1/82	3Q79	3Q79
U.S. OEM PRICE FOR 100 UNITS	--	$2,750	$4,375	--	--
COMMENTS	5520 Admin. System -050 Model is Dual Spindle	Embedded Servo	Embedded Servo	8100 System	8100 System

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	8130-A24 8130-B24 8140-A34 A44, A54 A64, A74	8140-B51 B61 B71	8140-B52 B62 B72	3344-B2 3344-B2F	4967-2CA 4967-2CB
DISK/TREND GROUP	6	6	6	7	7
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Piccolo	Piccolo	Piccolo	3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE	.131072 MB Fixed Heads	.131072 MB Fixed Heads	.131072 MB Fixed Heads (2 spindles)	1.004 MB Fixed Head Option	
Total capacity (MBytes) FIXED	F: 58.654720	F: 58.654720	F: 123.174912	F: 279.558	F: 200.202
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 16,384	F: 16,384	F: 16,736	F: 25,088
Data surfaces per spindle	11	11	11	15	7
Heads per data surface	1	1	1	2	2
Tracks per surface	359	359	359	1114	1140
TPI	450	450	450	478	485
BPI	8530	8530	8530	5636	9751
RPM	3125	3125	3125	2964	2964
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	27	27	27	25	25
Average rotational delay (msec)	9.6	9.6	9.6	10.1	10.1
Average access time (msec)	36.6	36.6	36.6	35.1	35.1
Data transfer rate (KByte/sec)	1031	1031	1031	885	1500
FIRST CUSTOMER SHIPMENT	3Q79	4Q80	4Q80	2Q76	7/83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	8100 System	8100 System	8100 System	System/370 System/3 303X Series 4341 Drive has two spindles	Series/1 384 KB Cache

MANUFACTURER	IBM	IBM	IBM	IBM	IBM
DRIVE	5360-BX3	3350-A2 3350-B2 3350-C2	3370-A1 3370-A11 3370-B1 3370-B11	3370-A02 3370-A12 3370-B02 3370-B12	3375-A1 3375-B1 3375-D1
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	Modified 3350	3350	3370	3370	3370
Heads	Ferrite	Ferrite	Thin Film	Thin Film	Thin Film
Interface	IBM	IBM	IBM	IBM	IBM
CAPACITY/PERFORMANCE		1.144 MB Fixed Head Option	1.144 MB Fixed Head Option		
Total capacity (MBytes) FIXED	F: 200.202	F: 317.5	F: 571.392	F: 729.858	F: 819.7
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 25,088	F: 19,069	F: 31,744	F: 31,744	F: 35,616
Data surfaces per spindle	7	15	12	12	12
Heads per data surface	2	2	2	2	2
Tracks per surface	1140	1110	1500	1916	1918
TPI	485	478	635	800	800
BPI	9751	6425	8128 FRPI 12134 BPI	8128 FRPI 12134 BPI	8128 FRPI 12134 BPI
RPM	2964	3600	2964	2964	2964
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	19
Average rotational delay (msec)	10.1	8.4	10.1	10.1	10.1
Average access time (msec)	35.1	33.4	30.1	29.1	29.1
Data transfer rate (KByte/sec)	1500	1198	1859	1859	1859
FIRST CUSTOMER SHIPMENT	7/83	1Q76	10/79	2Q84	3Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System/36 5360-BX4 uses 2 spindles,with total 400.4 MB	System/370 303X Series 43XX Drive has two spindles	43X1 Series System/38	4341 4361 4381 System/38	4331 4341 303X Series

MANUFACTURER	IBM	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.
DRIVE	3380-A4 3380-AA4 3380-B4	2306H	2312H	5006H	5012H
DISK/TREND GROUP	9	5	5	5	5
MARKET	Captive	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	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 Coated	Plated	Plated	Plated	Plated
DRIVE: Technology type	3380	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Thin Film	Ferrite	Ferrite	Ferrite	Ferrite
Interface	IBM	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 1,260.4878	U: 6.38	U: 12.75	U: 6.38	U: 12.76
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 47,476	U: 10,417	U: 10,417	U: 10,416	U: 10,416
Data surfaces per spindle	15	2	4	2	4
Heads per data surface	2	1	1	1	1
Tracks per surface	1770	306	306	306	306
TPI	800	303	303	303	303
BPI	10160 FRPI 15240 BPI	9706	9706	9706	9706
RPM	3620	3600	3600	3600	3600
Actuator type	Dual, Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	16	85 (including settling)	85 (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)	24.3	93.3	93.3	108.3	108.3
Data transfer rate (KByte/sec)	3000	625	625	625	625
FIRST CUSTOMER SHIPMENT	4Q81	4Q83	4Q83	6/82	6/82
U.S. OEM PRICE FOR 100 UNITS	--	$725	$850	$725	$850
COMMENTS	303X Series 370/158, 158-3 370/168, 168-3 Drive has two spindles	1.625" High	1.625" High		

MANUFACTURER	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.	INTERNATIONAL MEMORIES, INC.
DRIVE	5018H	7710	7720	5650H	7740
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	130 mm OD 40 mm ID	200 mm OD 63.5 mm ID
Magnetic surface	Plated	Oxide Coated	Oxide Coated	Plated	Oxide Coated
DRIVE: Technology type	Modified 3350	3350	3350	Modified 3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST506	IMI, ANSI X3T9/1226	IMI, ANSI X3T9/1226	ST506	IMI, ANSI X3T9/1226
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 19.14	U: 12.57	U: 20.95	U: 51.0	U: 41.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,800	U: 10,800	U: 10,417	U: 10,800
Data surfaces per spindle	6	3	5	8	5
Heads per data surface	1	1	1	1	1
Tracks per surface	306	388	388	612	776
TPI	303	300	300	606	600
BPI	9706	6200	6200	10300	6200
RPM	3600	3600	3600	3600	3600
Actuator type	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Band, Stepping Motor	Linear, Voice Coil
Average positioning time (msec)	100 (including settling)	35	35	49 (including settling)	50
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	108.3	43.3	43.3	57.3	58.3
Data transfer rate (KByte/sec)	625	648	648	625	648
FIRST CUSTOMER SHIPMENT	6/82	1/79	1/80	4Q83	2Q81
U.S. OEM PRICE FOR 100 UNITS	$975	--	--	--	--
COMMENTS					

MANUFACTURER	ISOT	ISOT	ISOT	ISOT	ISOT
DRIVE	ES 5061	CM 5400-00 CM 5400-01	CM 5400-02 CM 5400-03	CM 5410	CM 5412
DISK/TREND GROUP	--	1	1	1	3
MARKET	OEM	OEM	OEM	Captive OEM	OEM
MEDIA: Manufacturer's number	ES 5261	ES 5269	ES 5269	ISOT 5269.E1	ISOT 002C
Generic type	2316	5440	5440	5440	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	2314	2314	2314	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface		Various Options	Various Options	Various Options	SMD
CAPACITY/PERFORMANCE				--	--
Total capacity (MBytes) FIXED	--	U: 3.125	--	U: 5.75	
REMOVABLE	F: 29	U: 3.125	U: 3.125	U: 5.75	U: 80
Capacity per track (Bytes)	F: 7,294	U: 7,812	U: 7,812	U: 7,812	U: 20,160
Data surfaces per spindle	20	4	4	4	5
Heads per data surface	1	1	1	1	1
Tracks per surface	203	204	204	406	823
TPI	100	100	100	200	400
BPI	2200	2200	2200	2200	6060
RPM	2400	2400/1500	2400/1500	2400/1500	2400/3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	50	50	50	50	45
Average rotational delay (msec)	12.5	12.5/20	12.5/20	12.5	12.5/8.3
Average access time (msec)	62.5	62.5/70	62.5/70	62.5	57.5/53.3
Data transfer rate (KByte/sec)	312	312/195	312/195	312/195	806/1209
FIRST CUSTOMER SHIPMENT	1976	1979	1979	1982	1983
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	ISOT	ISOT	KENNEDY	KENNEDY	KENNEDY
DRIVE	ES 5066 ES 5067.01 ES 5067.02	ES 5067	5301-14	6172	5303-42
DISK/TREND GROUP	4	4	5	5	6
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	ES 5266	ES 5267	--	--	--
Generic type	3336-1	3336-11	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	210 mm OD 100 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3330-1	3330-11	3340	3350	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface			Kennedy	SMD, DISK BUS, ANSI X3T9/1226	Kennedy
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	U: 14.112	U: 24.5	U: 42.336
REMOVABLE	F: 100	F: 200	--	--	--
Capacity per track (Bytes)	F: 13,030	F: 13,030	U: 20,160	U: 13,444	U: 20,160
Data surfaces per spindle	19	19	1	3	3
Heads per data surface	1	1	2	1	2
Tracks per surface	411	815	700	600	700
TPI	192	370	300	500	300
BPI	4040	4040	6000	6542	6000
RPM	3600	3600	3000	3600	3000
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	30	30	45	40	45
Average rotational delay (msec)	8.3	8.3	10	8.3	10
Average access time (msec)	38.3	38.3	55	48.3	55
Data transfer rate (KByte/sec)	806	806	1000	800	1000
FIRST CUSTOMER SHIPMENT	1980	1981	1Q78	4Q79	1Q78
U.S. OEM PRICE FOR 100 UNITS	--	--	$2,800	$1,595	$3,200
COMMENTS					

MANUFACTURER	KENNEDY	KENNEDY	KENNEDY	KENNEDY	KENNEDY
DRIVE	5305-70	5380	6173	7340	7380
DISK/TREND GROUP	6	6	6	6	6
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	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	3340	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Kennedy	SMD	SMD, DISK BUS, ANSI X3T9/1226	SMD, PICO, ANSI X3T9/1226	SMD, PICO, ANSI X3T9/1226
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 70.56	U: 82.9	U: 40.9	U: 41.4	U: 82.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 13,444	U: 20,160	U: 20,160
Data surfaces per spindle	5	5	5	5	5
Heads per data surface	2	2	1	1	1
Tracks per surface	700	823	600	411	823
TPI	300	430	500	560	1120
BPI	6000	6330	6542	9006	9006
RPM	3000	3000	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	45	30	40	30	30
Average rotational delay (msec)	10	10	8.3	8.3	8.3
Average access time (msec)	55	40	48.3	38.3	38.3
Data transfer rate (KByte/sec)	1000	1000	800	1209	1209
FIRST CUSTOMER SHIPMENT	1Q78	3Q81	4Q81	2Q82	1Q83
U.S. OEM PRICE FOR 100 UNITS	$3,600	$3,700	$2,195	$2,560	$3,195
COMMENTS					

MANUFACTURER	KENNEDY	MAXTOR	MAXTOR	MAXTOR	MAXTOR
DRIVE	53160	XT-1065	XT-2085	EXT-4075	XT-1105
DISK/TREND GROUP	7	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"	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	Plated	Plated	Plated
DRIVE: Technology type	3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	ST506	ST506	ESDI	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 165.5	U: 66.99	U: 89.24	U: 76.49	U: 105.27
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 10,416	U: 10,416	U: 20,832	U: 10,416
Data surfaces per spindle	5	7	7	3	11
Heads per data surface	2	1	1	1	1
Tracks per surface	1646	918	1224	1224	918
TPI	680	980	980	980	980
BPI	6330	9875	11155	22310 BPI 14873 FCI	9875
RPM	3000	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)	10	8.3	8.3	8.3	8.3
Average access time (msec)	40	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	1000	625	625	1250	625
FIRST CUSTOMER SHIPMENT	4Q82	3Q83	1Q84	1Q84	3Q83
U.S. OEM PRICE FOR 100 UNITS	$4,625	$1,890	$2,080	$1,610	$2,660
COMMENTS					

MANUFACTURER	MAXTOR	MAXTOR	MAXTOR	MAXTOR	MAXTOR
DRIVE	XT-1140	XT-2140	XT-2190	EXT-4175	EXT-4280
DISK/TREND GROUP	7	7	7	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID	130 mm OD 40 mm ID
Magnetic surface	Plated	Plated	Plated	Plated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST506	ST506	ST506	ESDI	ESDI
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 143.55	U: 140.24	U: 191.24	U: 178.48	U: 280.48
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 20,832	U: 20,832
Data surfaces per spindle	15	11	15	7	11
Heads per data surface	1	1	1	1	1
Tracks per surface	918	1224	1224	1224	1224
TPI	980	980	980	980	980
BPI	9875	11155	11155	22310 BPI 14873 FCI	22310 BPI 14873 FCI
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)	625	625	625	1250	1250
FIRST CUSTOMER SHIPMENT	3Q83	1Q84	1Q84	1Q84	1Q84
U.S. OEM PRICE FOR 100 UNITS	$3,430	$2,930	$3,775	$2,595	$3,665
COMMENTS					

MANUFACTURER		MAXTOR	MEGAVAULT	MEGAVAULT	MEGAVAULT	MEGAVAULT
DRIVE		EXT-4380	MV16	MV26	MV48	MV80
DISK/TREND GROUP		8	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	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	ESDI	SMD, ANSI, SCSI SA1000/ST506*	SMD, ANSI, SCSI SA1000/ST506*	SMD, ANSI, SCSI SA1000/ST506*	SMD, ANSI, SCSI SA1000/ST506*
CAPACITY/PERFORMANCE						
Total capacity (MBytes)	FIXED	U: 382.48	U: 16.0	U: 26.0	U: 48.0	U: 80.0
	REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)		U: 20,832	U: 20,160	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle		15	1	1	3	3
Heads per data surface		1	1	1	1	1
Tracks per surface		1224	823	1316	823	1316
TPI		980	600	960	600	960
BPI		22310 BPI 14873 FCI	8850 FRPI 11500 BPI	8850 FRPI 11500 BPI	8850 FRPI 11500 BPI	8850 FRPI 11500 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)		30	45	45	45	45
Average rotational delay (msec)		8.3	8.3	8.3	8.3	8.3
Average access time (msec)		38.3	53.3	53.3	53.3	53.3
Data transfer rate (KByte/sec)		1250	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT		1Q84	4/82	8/83	4/82	8/83
U.S. OEM PRICE FOR 100 UNITS		$4,715	$2,670	$2,810	$2,930	$3,100
COMMENTS			*Reduced capacity	*Reduced capacity	*Reduced capacity	*Reduced capacity

MANUFACTURER	MEGAVAULT	MEGAVAULT	MEGAVAULT	MEGAVAULT	MEGAVAULT
DRIVE	MV83	MV116	MV132	MV186	MV212
DISK/TREND GROUP	6	7	7	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	200 mm OD 63.5 mm ID	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	SMD, ANSI, SCSI SA1000/ST506*	SMD, ANSI, SCSI SA1000/ST506*	SMD, ANSI, SCSI SA1000/ST506*	SMD, ANSI, SCSI SA1000/ST506*	SMD, ANSI, SCSI SA1000/ST506*
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 83.0	U: 116.0	U: 132.0	U: 186.0	U: 212.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	5	7	5	7	8
Heads per data surface	1	1	1	1	1
Tracks per surface	823	823	1316	1316	1316
TPI	600	600	960	960	960
BPI	8850 FRPI 11500 BPI	8850 FRPI 11500 BPI	8850 FRPI 11500 BPI	8850 FRPI 11500 BPI	8850 FRPI 11500 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)	45	45	45	45	45
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	53.3	53.3	53.3	53.3	53.3
Data transfer rate (KByte/sec)	1209	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT	4/82	4/82	7/82	8/83	8/83
U.S. OEM PRICE FOR 100 UNITS	$3,190	$3,450	$3,320	$3,630	$4,020
COMMENTS	*Reduced capacity	*Reduced capacity	*Reduced capacity	*Reduced capacity	*Reduced capacity

MANUFACTURER	MEGAVAULT	MEGAVAULT	MEMOREX	MEMOREX	MEMOREX
DRIVE	MVP132	MVP212	410	415	677-30
DISK/TREND GROUP	7	7	1	2	4
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	Mark XIII
Generic type	Fixed	Fixed	5.25" Cartridge	5.25" Cartridge	3336-11
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	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, ANSI, SCSI	SMD, ANSI, SCSI	Modified SA1000	Modified SA1000	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 132.0	U: 212.0	U: 6.75	U: 13.5	--
REMOVABLE	--	--	U: 6.75	U: 6.75	U: 309.5
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 10,560	U: 10,560	U: 20,160
Data surfaces per spindle	8	8	4	4	19
Heads per data surface	1	1	1	1	1
Tracks per surface	823	1316	320	640 Fixed 320 Removable	823
TPI	600	960	454	908 Fixed 454 Removable	384
BPI	8850 FRPI 11500 BPI	8850 FRPI 11500 BPI	8617	8617	6038
RPM	3600	3600	3443	3443	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	45	45	40	40	28.5
Average rotational delay (msec)	8.3	8.3	8.7	8.7	8.3
Average access time (msec)	53.3	53.3	48.7	48.7	36.8
Data transfer rate (KByte/sec)	4825 (4 tracks)	4825 (4 tracks)	625	625	1209
FIRST CUSTOMER SHIPMENT	7/82	11/83	1982	1982	3Q80
U.S. OEM PRICE FOR 100 UNITS	$7,500	$8,500	$1,800	$1,980	$10,500
COMMENTS	4 Track parallel data transfer	4 Track parallel data transfer	Embedded Servo Licensed From DMA Systems	Embedded Servo Licensed From DMA Systems	

MANUFACTURER	MEMOREX	MEMOREX	MEMOREX	MEMOREX	MEMOREX
DRIVE	677-70	101	102	306	310
DISK/TREND GROUP	4	5	5	5	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	Mark XI	--	--	--	--
Generic type	3336-11	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	200 mm OD 100 mm ID	200 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	3330-11	3340	3340	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SA4000	SA4000	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	U: 11.7	U: 23.4	U: 6.66	U: 10.0
REMOVABLE	U: 206.0	--	--	--	--
Capacity per track (Bytes)	U: 13,440	U: 12,000	U: 12,000	U: 10,416	U: 10,416
Data surfaces per spindle	19	4	8	4	6
Heads per data surface	1	1	1	1	1
Tracks per surface	815	244	244	160	160
TPI	370	195	195	254	254
BPI	4040	6100	6100	8020	8020
RPM	3600	2964	2964	3600	3600
Actuator type	Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	28.5	70 (including settling)	70 (including settling)	95 (including settling)	95 (including settling)
Average rotational delay (msec)	8.3	10.1	10.1	8.3	8.3
Average access time (msec)	36.8	80.1	80.1	103.3	103.3
Data transfer rate (KByte/sec)	806	593	593	625	625
FIRST CUSTOMER SHIPMENT	1977	2Q80	1Q81	1Q82	1Q82
U.S. OEM PRICE FOR 100 UNITS	$10,500	$1,450	$1,700	$750	$920
COMMENTS		Manufactured by Fujitsu	Manufactured by Fujitsu	Manufactured by Nippon Peripherals	Manufactured by Nippon Peripherals

MANUFACTURER	MEMOREX	MEMOREX	MEMOREX	MEMOREX	MEMOREX
DRIVE	313	321	322	323	324
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	ST506	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 13.4	U: 6.66	U: 13.33	U: 20.0	U: 26.66
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	6	2	4	6	8
Heads per data surface	1	1	1	1	1
Tracks per surface	214	320	320	320	320
TPI	254	298	298	298	298
BPI	8900	10,200	10,200	10,200	10,200
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)	75 (including settling)	95 (including settling)	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)	83.3	103.3	103.3	103.3	103.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	1Q82	7/83	7/83	7/83	4Q83
U.S. OEM PRICE FOR 100 UNITS	$860	$645	$775	$905	--
COMMENTS	Mfg. by Nippon Peripherals	Mfg. by Nippon Peripherals	Mfg. by Nippon Peripherals	Mfg. by Nippon Peripherals	Mfg. by Nippon Peripherals

MANUFACTURER	MEMOREX	MEMOREX	MEMOREX	MEMOREX	MEMOREX
DRIVE	213	214	512	513	514
DISK/TREND GROUP	6	6	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 100 mm ID	200 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	Plated	Plated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 48.25	U: 85.439	U: 30.3	U: 50.5	U: 70.7
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,480	U: 20,480	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	4	7	3	5	7
Heads per data surface	1	1	1	1	1
Tracks per surface	589	589	961	961	961
TPI	720	720	970	970	970
BPI	9550	9550	9912	9912	9912
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	20	20	25	25	25
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	28.3	28.3	33.3	33.3	33.3
Data transfer rate (KByte/sec)	1229	1229	625	625	625
FIRST CUSTOMER SHIPMENT	7/82	7/82	1/84	1/84	1/84
U.S. OEM PRICE FOR 100 UNITS	$3,550	$3,675	$1,430	$1,820	$2,210
COMMENTS	Manufactured by Fujitsu	Manufactured by Fujitsu			

MANUFACTURER	MEMOREX	MEMOREX	MEMOREX	MEMOREX	MEMOREX
DRIVE	3650-A2 3650-B2 3650-C2	3652-A2 3652-B2 3652-C2	3680	3690	680
DISK/TREND GROUP	9	9	9	9	9
MARKET	PCM	PCM	PCM	PCM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3380	3370	3380
Heads	Ferrite	Ferrite	Thin Film	Thin Film	Thin Film
Interface	IBM	IBM	IBM	IBM	ISI/IPI
CAPACITY/PERFORMANCE	1.144 MB Fixed Head Option	1.144 MB Fixed Head Option			
Total capacity (MBytes) FIXED	F: 317.5	F: 635.0	F: 1260	F: 571.3	U: 1320
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 19,069	F: 19,069	F: 47,476	F: 31.744	U: 49,720
Data surfaces per spindle	15	15	15	12	15
Heads per data surface	2	2	2	2	2
Tracks per surface	1110	2220	1,768	1,500	1,772
TPI	480	960	806	635	806
BPI	6425	6425	15,240*	12,128*	15,240*
RPM	3600	3600	3600	2964	3600
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	16	20	16
Average rotational delay (msec)	8.3	8.3	8.3	10.1	8.3
Average access time (msec)	33.3	33.3	24.3	30.1	24.3
Data transfer rate (KByte/sec)	1198	1198	3000	1859	3000
FIRST CUSTOMER SHIPMENT	4Q77	3Q79	3/83	9/82	3Q83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	$19,000
COMMENTS	PCM 3350	PCM 3350 Double Density	Drive Has One Spindle *RLL Code	Drive Has One Spindle *RLL Code Mfg. By Nippon Peripherals	Drive Has One Spindle *RLL Code

MANUFACTURER	MICRODATA	MICRODATA	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE	4721 Reflex II	4722 Reflex II	1202 ANSI	1202 SA	1221-MII
DISK/TREND GROUP	7	7	5	5	5
MARKET	Captive, OEM	Captive, OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID	200 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	ANSI X3T9/1226	SA1000	Micropolis Intelligent
CAPACITY/PERFORMANCE	1.2 MB Fixed Head Option	1.2 MB Fixed Head Option			
Total capacity (MBytes) FIXED	U: 113.1	U: 158.3	U: 27.4	U: 20.6	U: 8.911
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 15,364	U: 10,416	U: 15,360
Data surfaces per spindle	5	7	3	3	1
Heads per data surface	2	2	1	1	1
Tracks per surface	1122	1122	595	660	580
TPI	478	478	478	478	478
BPI	6427	6427	5749 FRPI 8623 BPI	6154	5749 FRPI 8623 BPI
RPM	3530	3530	3600	3125	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	30	30	42	47	42
Average rotational delay (msec)	8.5	8.5	8.3	9.6	8.3
Average access time (msec)	38.5	38.5	50.3	56.6	50.3
Data transfer rate (KByte/sec)	1175	1175	922	542.5	922
FIRST CUSTOMER SHIPMENT	1979	1979	7/82	5/82	11/79
U.S. OEM PRICE FOR 100 UNITS	--	--	$2,192	$1,975	$2,048
COMMENTS					

MANUFACTURER	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE	1222-MII	1302	1203 ANSI	1203 SA	1223-MII
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	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	Modified 3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Micropolis Intelligent	ST506	ANSI X3T9/1226	SA1000	Micropolis Intelligent
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 26.73	U: 26.0	U: 45.7	U: 34.3	U: 44.56
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 15,360	U: 10,416	U: 15,364	U: 10,416	U: 15,360
Data surfaces per spindle	3	3	5	5	5
Heads per data surface	1	1	1	1	1
Tracks per surface	580	830	595	660	580
TPI	478	960	478	478	478
BPI	5749 FRPI 8623 BPI	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)	42	33	42	47	42
Average rotational delay (msec)	8.3	8.3	8.3	9.6	8.3
Average access time (msec)	50.3	41.3	50.3	56.6	50.3
Data transfer rate (KByte/sec)	922	625	922	542.5	922
FIRST CUSTOMER SHIPMENT	11/79	2Q83	7/82	5/82	11/79
U.S. OEM PRICE FOR 100 UNITS	$2,481	$1,199	$2,607	$2,390	$2,896
COMMENTS					

MANUFACTURER	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS	MICROPOLIS
DRIVE	1303	1304	1403 SMD	1403 ANSI	1406 ANSI
DISK/TREND GROUP	6	6	6	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	130 mm OD 40 mm ID	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	ST506	ST506	SMD	ANSI X3T9/1226	ANSI X359/1226
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 43.0	U: 51.9	U: 82.9	U: 82.9	U: 165.9
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	5	6	5	4	8
Heads per data surface	1	1	1	1	1
Tracks per surface	830	830	823	823	823
TPI	960	960	960	960	960
BPI	9400	9400	9287	9287	9287
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)	33	33	22	22	22
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	41.3	41.3	30.3	30.3	30.3
Data transfer rate (KByte/sec)	625	625	1209	1248	1248
FIRST CUSTOMER SHIPMENT	2Q83	2Q83	3Q83	4Q83	4Q83
U.S. OEM PRICE FOR 100 UNITS	$1,518	$1,698	$2,517	$2,515	$3,195
COMMENTS					

MANUFACTURER	MICROPOLIS	MICROSCIENCE INTERNATIONAL	MINISCRIBE	MINISCRIBE	MINISCRIBE
DRIVE	1406 SMD	HH612	2006 Miniscribe II	2012 Miniscribe II	3006 Miniscribe III
DISK/TREND GROUP	7	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	Plated	Oxide Coated	Oxide Coated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 165.9	U: 12.76	U: 6.4	U: 12.8	U: 6.4
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	10	2	2	4	2
Heads per data surface	1	2	1	1	1
Tracks per surface	823	612	306	306	306
TPI	960	648	402	402	588
BPI	9287	9680	8280	8280	8290
RPM	3600	3550	3600	3600	3600
Actuator type	Rotary, Voice Coil	Band, Stepping Motor	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor
Average positioning time (msec)	22	85 (including settling)	85 (including settling)	85 (including settling)	85 (including settling)
Average rotational delay (msec)	8.3	8.45	8.3	8.3	8.3
Average access time (msec)	30.3	93.45	93.3	93.3	93.3
Data transfer rate (KByte/sec)	1209	625	625	625	625
FIRST CUSTOMER SHIPMENT	3Q83	7/83	7/82	7/82	2Q83
U.S. OEM PRICE FOR 100 UNITS	$3,203	$725	$562	$674	$500
COMMENTS		1.625" High Embedded Servo			1.625" High

MANUFACTURER	MINISCRIBE	MINISCRIBE	MINISCRIBE	MINISCRIBE	MITSUBISHI ELECTRIC CORPORATION
DRIVE	3012 Miniscribe III	4020 Miniscribe IV	5338 Miniscribe V	5451 Miniscribe V	M802F M802S
DISK/TREND GROUP	5	5	6	6	1
MARKET	OEM	OEM	OEM	OEM	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	370111
Generic type	Fixed	Fixed	Fixed	Fixed	5440
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	14"
Magnetic surface	Plated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	2314
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST506	ST506	ST506	ST506	Mitsubishi, Hawk, Diablo
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.8	U: 20.0	U: 38.2	U: 51.0	U: 6.375
REMOVABLE	--	--	--	--	U: 6.375
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 7,812
Data surfaces per spindle	2	4	6	8	4
Heads per data surface	1	1	1	1	1
Tracks per surface	612	480	612	612	408
TPI	588	588	588	588	200
BPI	1000	8575	10030	10030	2211
RPM	3600	3600	3600	3600	2400
Actuator type	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor	Rack & Pinion, Stepping Motor	Linear, Voice Coil
Average positioning time (msec)	155 (including settling)	120 (including settling)	95 (including settling)	95 (including settling)	45
Average rotational delay (msec)	8.3	8.3	8.3	8.3	12.5
Average access time (msec)	163.3	128.3	103.3	103.3	57.5
Data transfer rate (KByte/sec)	625	625	625	625	312.5
FIRST CUSTOMER SHIPMENT	2Q83	8/82	3Q83	3Q83	1974
U.S. OEM PRICE FOR 100 UNITS	$602	$733	--	--	--
COMMENTS	1.625" High				

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION
DRIVE	M803F M803S	M2850F	M2851F	M2854F	M2838F
DISK/TREND GROUP	2	3	3	3	4
MARKET	OEM, Captive	OEM, Captive	OEM, Captive	OEM	OEM, Captive
MEDIA: Manufacturer's number	802029	50-802282	80-802282	--	J20789
Generic type	5440	Trident	Trident	SMD	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	3330-1	3330-11	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Mitsubishi	Trident	Trident	SMD	Trident
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.75	--	--	--	--
REMOVABLE	U: 12.75	U: 54.7	U: 82.1	U: 82.9	U: 312.1
Capacity per track (Bytes)	U: 15,624	U: 13,440	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	4	5	5	5	19
Heads per data surface	1	1	1	1	1
Tracks per surface	408	815	815	823	815
TPI	200	370	370	384	370
BPI	4422	4040	6060	6060	6060
RPM	2400	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)	45	30	30	30	30
Average rotational delay (msec)	12.5	8.3	8.3	8.3	8.3
Average access time (msec)	57.5	38.3	38.3	38.3	38.3
Data transfer rate (KByte/sec)	625	806	1209	1209	1209
FIRST CUSTOMER SHIPMENT	1976	1977	1978	1980	1979
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	M2839F	M2860-1	M2883-10	M2883-20	M4863-2
DISK/TREND GROUP	4	5	5	5	5
MARKET	OEM	OEM	OEM, Captive	OEM, Captive	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	SMD	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	200 mm OD 63.5 mm ID	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	3340	3340	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	Trident, SMD, SA1000	Trident, SMD	Trident, SMD	ST506
CAPACITY/PERFORMANCE			0.81 MB Fixed Head Option	0.81/2.42 MB Fixed Head Option	
Total capacity (MBytes) FIXED	--	U: 21.73	U: 13.47	U: 26.93	U: 6.66
REMOVABLE	U: 315.2	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 13,440	U: 20,160	U: 20,160	U: 10,416
Data surfaces per spindle	19	3	1	2	4
Heads per data surface	1	1	2	2	1
Tracks per surface	823	549	678	678	160
TPI	384	480	286	286	256
BPI	6060	7300	6060	6060	7900
RPM	3600	3600	3000	3000	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Stepping Motor
Average positioning time (msec)	30	35	38	38	75
Average rotational delay (msec)	8.3	8.3	10	10	8.3
Average access time (msec)	38.3	43.3	48	48	83.3
Data transfer rate (KByte/sec)	1209	806	996	996	625
FIRST CUSTOMER SHIPMENT	4/81	1981	4Q78	4Q78	2/82
U.S. OEM PRICE FOR 100 UNITS	--	$2,200	--	--	--
COMMENTS					

MANUFACTURER	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION	MITSUBISHI ELECTRIC CORPORATION
DRIVE	M4863-3	M2860-2	M2860-3	M2883-40	M2883-60
DISK/TREND GROUP	5	6	6	6	6
MARKET	OEM	OEM	Worldwide	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	Modified 3350	3340	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST506	Trident, SMD, SA1000	SMD, Trident	Trident, SMD	Trident, SMD
CAPACITY/PERFORMANCE				0.81/2.42 MB Fixed Head Option	0.81 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 10.0	U: 50.71	U: 85.37	U: 53.86	U: 80.8
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 13,440	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	6	7	7	4	6
Heads per data surface	1	1	1	2	2
Tracks per surface	160	549	621	678	678
TPI	256	480	546	286	286
BPI	7900	7300	10900	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	30	38	38
Average rotational delay (msec)	8.3	8.3	8.3	10	10
Average access time (msec)	83.3	43.3	38.3	48	48
Data transfer rate (KByte/sec)	625	806	1209	996	996
FIRST CUSTOMER SHIPMENT	2/82	1981	9/82	4Q78	4Q78
U.S. OEM PRICE FOR 100 UNITS	--	$2,600	$3,400	--	--
COMMENTS					

MANUFACTURER	NEC	NEC	NEC	NEC	NEC
DRIVE	N7745	D-1210 N7721	D2220	D2226 N7724	D5214
DISK/TREND GROUP	4	5	5	5	5
MARKET	Captive	Captive, OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	3336-11	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	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	3330-11	3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	NEC	SMD	SMD	SMD	ST506
CAPACITY/PERFORMANCE		0.48/0.96 MB Fixed Head Option			
Total capacity (MBytes) FIXED	--	U: 20.8	U: 25.5	U: 28.3	U: 6.45
REMOVABLE	F:200	--	--	--	--
Capacity per track (Bytes)	F: 13,030	U: 19,968	U: 20,480	U: 20,480	U: 10,416
Data surfaces per spindle	19	1	3	2	2
Heads per data surface	1	2	1	1	1
Tracks per surface	815	1040	415	692	310
TPI	370	480	480	720	350
BPI	4040	6370	8800	9040	9000
RPM	3600	3600	3510	3510	3600
Actuator type	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Stepping Motor
Average positioning time (msec)	30	40	25	25	85 (including settling)
Average rotational delay (msec)	8.3	8.3	8.55	8.55	8.3
Average access time (msec)	38.3	48.3	33.55	33.55	93.3
Data transfer rate (KByte/sec)	806	1198	1198	1198	625
FIRST CUSTOMER SHIPMENT	11/75	9/78	3/81	5/82	4/83
U.S. OEM PRICE FOR 100 UNITS	--	--	$2,375	--	$915
COMMENTS					

MANUFACTURER	NEC	NEC	NEC	NEC	NEC
DRIVE	D5215 N7717	D5224	D5234	D5244	D-1220 N7722
DISK/TREND GROUP	5	5	5	5	6
MARKET	OEM	OEM	OEM	OEM	Captive, 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	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	ST506	ST506	ST506	ST506	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.38	U: 12.91	U: 19.37	U: 25.83	0.48/0.96 MB Fixed Head Option U: 41.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 19,968
Data surfaces per spindle	4	4	6	8	2
Heads per data surface	1	1	1	1	2
Tracks per surface	153	310	310	310	1040
TPI	200	350	350	350	480
BPI	8900	9000	9000	9000	6370
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Voice Coil
Average positioning time (msec)	118 (including settling)	85 (including settling)	85 (including settling)	85 (including settling)	40
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	126.3	93.3	93.3	93.3	48.3
Data transfer rate (KByte/sec)	625	625	625	625	1198
FIRST CUSTOMER SHIPMENT	5/82	4/83	4/83	5/83	9/78
U.S. OEM PRICE FOR 100 UNITS	--	$1,180	$1,250	$1,410	--
COMMENTS					

MANUFACTURER	NEC	NEC	NEC	NEC	NEC
DRIVE	D-1245 N7723	D2230	D2236 N7725	D2246 N7726	D1280
DISK/TREND GROUP	6	6	6	6	7
MARKET	Captive, OEM	OEM	OEM	OEM, Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	210 mm OD 100 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID	14"
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	SMD	SMD
CAPACITY/PERFORMANCE	0.48/0.96 MB Fixed Head Option				
Total capacity (MBytes) FIXED	U: 84.8	U: 42.5	U: 42.5	U: 85.0	U: 180.6
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 19,968	U: 20,480	U: 20,480	U: 20,480	U: 19,968 F: 19,069
Data surfaces per spindle	4	5	3	6	6
Heads per data surface	2	1	1	1	2
Tracks per surface	1040	415	692	692	1508
TPI	480	480	720	720	680
BPI	6370	8800	9040	9040	6400
RPM	3600	3510	3510	3510	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	29	25	25	25	25
Average rotational delay (msec)	8.3	8.55	8.55	8.55	8.3
Average access time (msec)	37.3	33.55	33.55	33.55	33.3
Data transfer rate (KByte/sec)	1198	1198	1198	1198	1198
FIRST CUSTOMER SHIPMENT	9/80	3/81	5/82	5/82	3/82
U.S. OEM PRICE FOR 100 UNITS	--	$2,375	--	$3,200	--
COMMENTS		--			

MANUFACTURER	NEC	NEC	NEC	NEC	NEC
DRIVE	D2257 N7757	D-1510	JS4380N	N7751	D1550
DISK/TREND GROUP	7	8	8	8	9
MARKET	OEM	OEM	Captive	Captive	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	210 mm OD 100 mm ID	14"	210 mm OD 100 mm ID	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	3350	Modified 3350	3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	Special	NEC	SMD
CAPACITY/PERFORMANCE		1.19 MB Fixed Head Option	U: 402 Per Spindle	1.144 MB Fixed Head Option	1.19 MB Fixed Head Option
Total capacity (MBytes) FIXED	U: 167.7	U: 331.5	U: 3,200 Total	F: 317.5	U: 663.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,480	U: 19,968	U: 25,520	F: 19,069	U: 19,968
Data surfaces per spindle	8	15	13	15	15
Heads per data surface	1	2	2	2	2
Tracks per surface	1024	1122	1226	1122	2242
TPI	720	480	1080	480	960
BPI	9420	6400	13840	6400	6400
RPM	3510	3600	3000	3600	3600
Actuator type	Rotary, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	20	20	18	20	20
Average rotational delay (msec)	8.55	8.3	10	8.3	8.3
Average access time (msec)	28.55	28.3	28	28.3	28.3
Data transfer rate (KByte/sec)	1198	1200	1344	1198	1200
FIRST CUSTOMER SHIPMENT	5/83	5/78	3/82	12/77	1982
U.S. OEM PRICE FOR 100 UNITS	$3,675	$9,800	--	--	--
COMMENTS			8 spindles per drive		

MANUFACTURER	NEC	NEC	NEW WORLD COMPUTER COMPANY, INC.	NEWBURY DATA	NEWBURY DATA
DRIVE	N7755	N7761	5/5 Micro-Disc V	505	D9427H
DISK/TREND GROUP	9	9	1	1	1
MARKET	Captive	Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Micro-Disc Cartridge	5.25" Cartridge	5440
Nominal disk diameter	14"	14"	130 mm OD 40 mm ID	130 mm OD 40 mm ID	14"
Magnetic surface	Oxide Coated	Oxide Coated	Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	3380	Special	Modified 3350	2314
Heads	Ferrite	Thin Film	Ferrite	Ferrite Modified	Ferrite
Interface	NEC	NEC	ST506	SA 1000	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 635.0	F: 630.0	U: 6.38	U: 6.75	U: 6.25
REMOVABLE	--	--	U: 6.38	U: 6.75	U: 6.25
Capacity per track (Bytes)	F: 19,069	F: 49,950	U: 10,416	U: 10,890	U: 7,812
Data surfaces per spindle	15	7	4	4	4
Heads per data surface	2	2	12	1	1
Tracks per surface	2244	1800	312	320	406
TPI	960	820	325	454	200
BPI	6400	10133 FRPI 152600 BPI	9576	8737	2200
RPM	3600	3600	3600	3443	2400
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Stepping Motor	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	20	16	24.6 (including settling)	40	35
Average rotational delay (msec)	8.3	8.3	8.3	8.7	12.5
Average access time (msec)	28.3	24.3	32.9	48.7	47.5
Data transfer rate (KByte/sec)	1198	3000	625	625	312.5
FIRST CUSTOMER SHIPMENT	1979	1983	4Q83	3Q83	1Q80
U.S. OEM PRICE FOR 100 UNITS	--	--	-	--	--
COMMENTS		4 spindles per drive		Embedded servo Licensed from DMA Systems	

MANUFACTURER	NEWBURY DATA	NEWBURY DATA	NEWBURY DATA	NEWBURY DATA	NIPPON ELECTRIC INDUSTRY
DRIVE	D9448-32	D9448-64	D9448-96	9412	RD-4064
DISK/TREND GROUP	2	2	2	6	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	CDC 91204	CDC 91204	CDC 91204	--	--
Generic type	CMD	CMD	CMD	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	195 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	3330-11	3330-11	3330-11	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	SMD	SMD	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 16.289	U: 48.869	U: 81.446	U: 80.0	U: 6.4
REMOVABLE	U: 16.289	U: 16.289	U: 16.289	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 20,160	U: 20,736	U: 10,416
Data surfaces per spindle	1 Fixed 1 Removable	3 Fixed 1 Removable	5 Fixed 1 Removable	5	2
Heads per data surface	1	1	1	1	1
Tracks per surface	823	823	823	784	306
TPI	384	384	384	735	400
BPI	6038	6038	6038	10161*	8200
RPM	3600	3600	3600	3500	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	30	30	30	25	85 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.57	8.3
Average access time (msec)	38.3	38.3	38.3	33.57	118.3
Data transfer rate (KByte/sec)	1209	1209	1209	1209	625
FIRST CUSTOMER SHIPMENT	2Q81	2Q81	2Q81	5/83	7/83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS				*RLL Code	

MANUFACTURER	NIPPON ELECTRIC INDUSTRY	NIPPON ELECTRIC INDUSTRY	NIPPON ELECTRIC INDUSTRY	NIPPON ELECTRIC INDUSTRY	NIPPON ELECTRIC INDUSTRY
DRIVE	RD-4127	RD-4191	RD-4255	RD-5067	RD-5133
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	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.7	U: 19.1	U: 25.5	U: 6.7	U: 13.3
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	6	8	4	8
Heads per data surface	1	1	1	1	1
Tracks per surface	306	306	306	160	160
TPI	400	400	400	254	254
BPI	8200	8200	8200	8200	8200
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)	85 (including settling)	85 (including settling)	85 (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)	118.3	118.3	118.3	103.3	103.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	7/83	7/83	7/83	4/82	4/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD
DRIVE	NP02-6	NP02-13	NP04-13T	NP04-20G	NP04-20T
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	ST506	ST506	ST506	SA4000	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.67	U: 13.33	U: 13.33	20.0	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	2	4	4	6	6
Heads per data surface	1	1	1	1	1
Tracks per surface	320	320	320	320	320
TPI	298	298	298	298	298
BPI	10200	10200	10200	10200	10200
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)	95 (including settling)	95 (including settling)	95 (including settling)	100 (including settling)	95 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	103.3	103.3	103.3	108.3	103.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	9/83	9/83	2/83	1983	2/83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	1.625" High	1.625" High			

MANUFACTURER	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD
DRIVE	NP04-26F	NP05-6	NP05-10	NP05-10G	NP05-10S
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	ST506	ST506	ST506	SA4000	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 26.66	U: 6.66	U: 10	U: 10.0	U: 10.0
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	8	4	6	6	6
Heads per data surface	1	1	1	1	1
Tracks per surface	320	160	160	160	160
TPI	298	254	254	221	221
BPI	10200	8020	8020	8020	8020
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)	95 (including settling)	175 (including settling)	175 (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)	103.3	183.3	183.3	103.3	103.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	5/83	4Q81	4Q81	4/82	10/81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD
DRIVE	NP05-13G	NP04-36	NP04-50	NP30-80	NP31-A1 NP31-A2 NP31-B1 NP31-B2
DISK/TREND GROUP	5	6	6	6	6
MARKET	OEM	OEM	OEM	OEM	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	130 mm OD 40 mm ID	210 mm OD 100 mm ID	210 mm OD 100 mm ID
Magnetic surface	Oxide Coated	Plated	Plated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Piccolo	Piccolo
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA4000	ST506	ST506	SMD	IBM
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 13.37	U: 36.4	U: 50.9	U: 80.6	F: 64.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 19,800	F: 16,384
Data surfaces per spindle	6	5	7	11	11
Heads per data surface	1	1	1	1	1
Tracks per surface	214	699	699	370	360
TPI	254	754	754	479	465
BPI	8900	9375	9375	8530	8530
RPM	3600	3600	3600	3125	3125
Actuator type	Rotary, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	80 (including settling)	40 (including settling)	40 (including settling)	27	27
Average rotational delay (msec)	8.3	8.3	8.3	9.6	9.6
Average access time (msec)	88.3	48.3	48.3	36.6	36.6
Data transfer rate (KByte/sec)	625	625	625	1031	1031
FIRST CUSTOMER SHIPMENT	1983	4Q83	4Q83	1Q81	1Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					PCM 3310

MANUFACTURER	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD	NIPPON PERIPHERALS LTD
DRIVE	NP24	NP30-120	NP25-A2 NP25-B2 NP25-C2	NP37-A01 NP37-B01	NP75S
DISK/TREND GROUP	7	7	8	9	9
MARKET	PCM	OEM	PCM	OEM, PCM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	210 mm OD 100 mm ID	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	Piccolo	3350	3370	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	T. Film/Ferrite	Ferrite
Interface	IBM	SMD	IBM	IBM, Special	SMD
CAPACITY/PERFORMANCE	1.004 MB Fixed Head Option		1.144 MB Fixed Head Option		
Total capacity (MBytes) FIXED	F: 279.558	U: 120.9	F: 317.499	F: 571.392	U: 868.848 F: 756.548
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,736	U: 19,800	F: 19,069	F: 31,744	F: 32,768
Data surfaces per spindle	15	11	15	12	12
Heads per data surface	2	1	2	2	2
Tracks per surface	1114	555	1110	1500	1924
TPI	480	719	480	635	809
BPI	5636	8530	6425	12000*	12000*
RPM	2964	3125	3600	2964	2964
Actuator type	Linear, Voice Coil	Rotary, Voice Coil	Linear, Voice Coil	Dual, Linear, Voice Coil	Dual Linear, Voice Coil
Average positioning time (msec)	20	27	20	20	19
Average rotational delay (msec)	10.1	9.6	8.3	10.12	10.1
Average access time (msec)	30.1	36.6	28.3	30.12	29.1
Data transfer rate (KByte/sec)	885	1031	1198	1859	1859
FIRST CUSTOMER SHIPMENT	1977	1Q81	1977	1982	1Q84
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	PCM 3344		PCM 3350	*RLL Code	*RLL Code

MANUFACTURER	NORTHERN TELECOM	NORTHERN TELECOM	NORTHERN TELECOM	NORTHERN TELECOM	NORTHERN TELECOM
DRIVE	4518	4520 4521	Aspen I	Aspen II	MFD/8202
DISK/TREND GROUP	5	5	5	5	6
MARKET	Captive	Captive	Captive	Captive	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	200 mm OD 63.5 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	2314	2314	3350	3350	Modified 3350
Heads	Ferrite Northern Telecom	Ferrite Northern Telecom	Ferrite Northern Telecom	Ferrite Northern Telecom	Ferrite
Interface					SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 5.3	F: 10.7	F: 11.0 U: 13.2	F: 22.0 U: 26.4	U: 45.09
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 6,656	F: 13,312	U: 14,700	U: 14,700	U: 21,912
Data surfaces per spindle	2	2	2	4	2
Heads per data surface	1	1	1	1	1
Tracks per surface	400	400	447	447	1029
TPI	200	200	480	480	985
BPI	2200	4400	6250	6250	10238
RPM	2400	2400	3600	3600	3313.5
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Torque Motor	Rotary, Torque Motor	Rotary, Torque Motor
Average positioning time (msec)	50	50	22	27	20 (256 Byte sector)
Average rotational delay (msec)	12.5	12.5	8.3	8.3	9.05
Average access time (msec)	62.5	62.5	30.3	35.3	29.05
Data transfer rate (KByte/sec)	312.5	625	869	869	1209
FIRST CUSTOMER SHIPMENT	1975	1978	1981	1981	9/83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			Embedded Servo	Embedded Servo	Embedded Servo

MANUFACTURER	NORTHERN TELECOM	NORTHERN TELECOM	NORTHERN TELECOM	NORTHERN TELECOM	OLIVETTI
DRIVE	MFD/8204	MFD/8206	MFD/8208	MFD/8210	HD 512/3
DISK/TREND GROUP	6	7	7	7	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	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	SMD	SMD	SMD	SMD	Olivetti
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 90.19	U: 135.28	U: 180.38	U: 225.47	U: 21.7
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 21,912	U: 21,912	U: 21,912	U: 21,912	U: 10,080
Data surfaces per spindle	4	6	8	10	5
Heads per data surface	1	1	1	1	1
Tracks per surface	1029	1029	1029	1029	430
TPI	985	985	985	985	605
BPI	10238	10238	10238	10238	8166
RPM	3313.5	3313.5	3313.5	3313.5	3600
Actuator type	Rotary, Torque Motor	Rotary, Torque Motor	Rotary, Torque Motor	Rotary, Torque Motor	Linear, Voice Coil
Average positioning time (msec)	20 (256 Byte sector)	20 (256 Byte sector)	20 (256 Byte sector)	20 (256 Byte sector)	26
Average rotational delay (msec)	9.05	9.05	9.05	9.05	8.3
Average access time (msec)	29.05	29.05	29.05	29.05	34.3
Data transfer rate (KByte/sec)	1209	1209	1209	1209	605
FIRST CUSTOMER SHIPMENT	9/83	9/83	9/83	9/83	1982
U.S. OEM PRICE FOR 100 UNITS	$3,865	$4,613	$4,978	$5,380	--
COMMENTS	Embedded Servo	Embedded Servo	Embedded Servo	Embedded Servo	

MANUFACTURER	OLIVETTI	OLIVETTI	OLIVETTI	OLIVETTI	OLIVETTI
DRIVE	HD 562/11	HD 562/12	HD 562/13	HD 563/11	HD 563/12
DISK/TREND GROUP	5	5	5	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	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	ST506	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 3.75	U: 7.5	U: 11.25	U: 6.38	U: 12.76
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	2	4	6	2	4
Heads per data surface	1	1	1	1	1
Tracks per surface	180	180	180	306	306
TPI	254	254	254	345	345
BPI	7820	7820	7820	9074	9074
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)	84 (including settling)	84 (including settling)	84 (including settling)	85 (including settling)	85 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	92.3	92.3	92.3	93.3	93.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	6/82	6/82	6/82	1983	1983
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	OLIVETTI	OLIVETTI	OTARI ELECTRIC CO., LTD.	OTARI ELECTRIC CO., LTD.	OTARI ELECTRIC CO., LTD.
DRIVE	HD 563/13	HD 830	RMS-507	RMS-514	RMS-519
DISK/TREND GROUP	5	5	5	5	5
MARKET	OEM, Captive	Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	210 mm OD 100 mm ID	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	ST506	Olivetti	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 19.14	U: 28.9	U: 6.38	U: 12.75	U: 19.13
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 17,800	U: 10,417	U: 10,417	U: 10,417
Data surfaces per spindle	6	3	2	4	6
Heads per data surface	1	1	1	1	1
Tracks per surface	306	627	306	306	306
TPI	345	605	383	383	383
BPI	9074	8284	8944	8944	8944
RPM	3600	3125	3600	3600	3600
Actuator type	Band, Stepping Motor	Linear, Voice Coil	Rotary, Band Stepping Motor	Rotary, Band Stepping Motor	Rotary, Band Stepping Motor
Average positioning time (msec)	85 (including settling)	40	90 (including settling)	90 (including settling)	90 (including settling)
Average rotational delay (msec)	8.3	9.6	8.3	8.3	8.3
Average access time (msec)	93.3	49.6	98.3	98.3	98.3
Data transfer rate (KByte/sec)	625	925	625	625	625
FIRST CUSTOMER SHIPMENT	1983	1982	3Q83	3Q83	3Q83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS			Licensed By Disctron	Licensed By Disctron	Licensed By Disctron

MANUFACTURER	OTARI ELECTRIC CO., LTD.	PERTEC	PERTEC	PERTEC	PERTEC
DRIVE	RMS-526	D3321/D3322	D3341/D3342	D3421/D3422	D3441/D3442
DISK/TREND GROUP	5	1	1	1	1
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	5440	2315	5440	2315
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	ST506	Various Options	Various Options	Various Options	Various Options
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 25.5	U: 3.17	U: 3.17	U: 6.34	U: 6.34
REMOVABLE	--	U: 3.17	U: 3.17	U: 6.34	U: 6.34
Capacity per track (Bytes)	U: 10,417	U: 7,812	U: 7,812	U: 7,812	U: 7,812
Data surfaces per spindle	8	4	4	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	306	203	203	406	406
TPI	383	100	100	200	200
BPI	8944	2200	2200	2200	2200
RPM	3600	1500/2400	1500/2400	1500/2400	1500/2400
Actuator type	Rotary, Band Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	90 (including settling)	35	35	40	40
Average rotational delay (msec)	8.3	20/12.5	20/12.5	20/12.5	20/12.5
Average access time (msec)	98.3	55/47.5	55/47.5	60/52.5	60/52.5
Data transfer rate (KByte/sec)	625	195/312.5	195/312.5	195/312.5	195/312.5
FIRST CUSTOMER SHIPMENT	3Q83				1977
U.S. OEM PRICE FOR 100 UNITS	--	--	$3,795	$3,795	$3,975
COMMENTS	Licensed By Disctron				

MANUFACTURER	PERTEC	PERTEC	PRIAM	PRIAM	PRIAM
DRIVE	D3461/D3462	D3481/D3482	502	503	504
DISK/TREND GROUP	2	2	6	6	6
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	5440	2315	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	Plated	Plated	Plated
DRIVE: Technology type	2314	2314	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Various Options	Various Options	ST506	Priam, ANSI	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 19.03	U: 19.03	U: 55	U: 71	U: 86
REMOVABLE	U: 6.34	U: 6.34	--	--	--
Capacity per track (Bytes)	U: 7,812	U: 7,812	U: 10,416	U: 13,440	U: 10,416
Data surfaces per spindle	8	8	7	7	11
Heads per data surface	1	1	1	1	1
Tracks per surface	406	406	755	755	755
TPI	200	200	960	960	960
BPI	2200	2200	9212	11886	9212
RPM	1500/2400	1500/2400	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	40	40	32	32	32
Average rotational delay (msec)	20/12.5	20/12.5	8.3	8.3	8.3
Average access time (msec)	60/52.5	60/52.5	40.3	40.3	40.3
Data transfer rate (KByte/sec)	195/312.5	195/312.5	625	625	625
FIRST CUSTOMER SHIPMENT	1977		1Q84	1Q84	1Q84
U.S. OEM PRICE FOR 100 UNITS	$4,720	$4,720	$1,780	$2,160	$2,240
COMMENTS					

MANUFACTURER	PRIAM	PRIAM	PRIAM	PRIAM	PRIAM
DRIVE	803	3350	3450	6650	7050
DISK/TREND GROUP	6	6	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	14"	200 mm OD 63.5 mm ID	14"	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	Priam, SMD, ANSI	Priam, SMD	Priam, SMD	Priam, SMD	Priam, SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 85.68	U: 33.9	U: 35.28	U: 67.9	U: 70.49
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 13,440	U: 20,160	U: 13,400
Data surfaces per spindle	5	2	5	2	5
Heads per data surface	1	2/1	1	2/1	1
Tracks per surface	850	1122	525	2246	1049
TPI	960	480	480	960	960
BPI	9100	6430	6670	6430	6670
RPM	3600	3125	3600	3125	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	35	45	42	45	42
Average rotational delay (msec)	8.3	9.7	8.3	9.7	8.3
Average access time (msec)	43.3	54.7	50.3	54.7	50.3
Data transfer rate (KByte/sec)	1209	1040	800	1040	800
FIRST CUSTOMER SHIPMENT	8/83	8/79	4Q80	3Q80	4Q81
U.S. OEM PRICE FOR 100 UNITS	$3,065	$2,275	$2,325	$2,660	$2,920
COMMENTS					

MANUFACTURER	PRIAM	PRIAM	PRIAM	QUANTUM	QUANTUM
DRIVE	505	804	15450	Q520	Q2010
DISK/TREND GROUP	7	7	7	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 63.5 mm ID	14"	130 mm OD 40 mm ID	200 mm OD 63.5 mm ID
Magnetic surface	Plated	*	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Priam, ANSI	Priam, SMD, ANSI	Priam, SMD	ST506	SA1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 111	U: 105.7	U: 158.5	U: 21.33	U: 10.66
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 13,440	U: 20,160	U: 20,160	U: 10,416	U: 10,400
Data surfaces per spindle	11	5	4	4	2
Heads per data surface	1	1	2/1	1	1
Tracks per surface	755	1049	2246	512	512
TPI	960	960	960	591	345
BPI	9212	10005	6430	9200	6600
RPM	11886	3600	3125	3529	3000
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Rotary, Torque Motor	Rotary, Torque Motor
Average positioning time (msec)	32	42	40	45	50
Average rotational delay (msec)	8.3	8.3	9.7	8.5	10
Average access time (msec)	40.3	50.3	49.7	53.5	60
Data transfer rate (KByte/sec)	625	1209	1040	625	543
FIRST CUSTOMER SHIPMENT	1Q84	5/83	3Q81	4/83	1Q81
U.S. OEM PRICE FOR 100 UNITS	$2,860	$3,280	$4,095	$1,245	$1,350
COMMENTS		*Not Announced			

MANUFACTURER	QUANTUM	QUANTUM	QUANTUM	QUANTUM	QUANTUM
DRIVE	Q2020	Q530	Q540	Q2030	Q2040
DISK/TREND GROUP	5	6	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	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	3350	3350	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA1000	ST506	ST506	SA1000	SA1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 21.33	U: 31.99	U: 42.66	U: 32.0	U: 42.66
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,400	U: 10,416	U: 10,416	U: 10,400	U: 10,400
Data surfaces per spindle	4	6	8	6	8
Heads per data surface	1	1	1	1	1
Tracks per surface	512	512	512	512	512
TPI	345	591	591	345	345
BPI	6600	9200	9200	6600	6600
RPM	3000	3529	3529	3000	3000
Actuator type	Rotary, Torque Motor	Rotary, Torque Motor	Rotary, Torque Motor	Rotary, Torque Motor	Rotary, Torque Motor
Average positioning time (msec)	55	45	45	60	65
Average rotational delay (msec)	10	8.5	8.5	10	10
Average access time (msec)	65	53.5	53.5	70	75
Data transfer rate (KByte/sec)	543	625	625	543	543
FIRST CUSTOMER SHIPMENT	1Q81	4/83	4/83	1Q81	1Q81
U.S. OEM PRICE FOR 100 UNITS	$1,625	$1,365	$1,485	$1,950	$2,275
COMMENTS					

MANUFACTURER	QUANTUM	RODIME	RODIME	RODIME	RODIME
DRIVE	Q2080	RO 201	RO 202	RO 203	RO 204
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	SA1000	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 85.45	U: 6.67	U: 13.33	U: 20.0	U: 26.67
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	7	2	4	6	8
Heads per data surface	1	1	1	1	1
Tracks per surface	1172	320	320	320	320
TPI	789	360	360	360	360
BPI	6600	8720	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)	40	90 (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)	50	98.3	98.3	98.3	98.3
Data transfer rate (KByte/sec)	543	625	625	625	625
FIRST CUSTOMER SHIPMENT	11/82	6/82	6/82	6/82	6/82
U.S. OEM PRICE FOR 100 UNITS	$2,800	$650	$800	$950	$1,150
COMMENTS					

MANUFACTURER	RODIME	RODIME	RODIME	RODIME	SEAGATE TECHNOLOGY
DRIVE	RO 351	RO 352	RO 206	RO 208	ST206
DISK/TREND GROUP	5	5	6	6	5
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	96 mm OD	96 mm OD	130 mm OD	130 mm OD	130 mm OD
Magnetic surface	Oxide/Plated	Oxide/Plated	40 mm ID Oxide Coated	40 mm ID Oxide Coated	40 mm ID Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST506	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.38	U: 12.75	U: 40.0	U: 53.34	U: 6.38
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	2	4	6	8	2
Heads per data surface	1	1	1	1	1
Tracks per surface	306	306	640	640	306
TPI	600	600	600	600	345
BPI	11000	11000	10300	10300	9074
RPM	3600	3600	3600	3600	3600
Actuator type	Stepping Motor	Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	85 (including settling)	85 (including settling)	50 (including settling)	50 (including settling)	85 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	93.3	93.3	58.3	58.3	93.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	3Q83	3Q83	3/83	3/83	1983
U.S. OEM PRICE FOR 100 UNITS	$730	$940	$1,550	$1,935	$750
COMMENTS					1.625" High

MANUFACTURER	SEAGATE TECHNOLOGY	SEAGATE TECHNOLOGY	SEAGATE TECHNOLOGY	SEAGATE TECHNOLOGY	SEAGATE TECHNOLOGY
DRIVE	ST406	ST412	ST419	ST425	ST506
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	ST506	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.38	U: 12.76	U: 19	U: 25.5	U: 6.38
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	2	4	6	6	4
Heads per data surface	1	1	1	1	1
Tracks per surface	306	306	306	408	153
TPI	345	345	345	480	255
BPI	9074	9074	9074	9074	7690
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)	85 (including settling)	85 (including settling)	85 (including settling)	60 (including settling)	170 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	93.3	93.3	93.3	68.3	178.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	3Q82	2/82	4Q82	4Q83	7/80
U.S. OEM PRICE FOR 100 UNITS	$720	$900	$1,065	$1,270	$720
COMMENTS					

MANUFACTURER	SHUGART	SHUGART	SHUGART	SHUGART	SHUGART
DRIVE	SA607	SA612	SA706	SA712	SA1004
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	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	3340
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST506	ST506	ST506	ST506	SA1000
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.47	U: 12.95	U: 6.37	U: 12.74	U: 10.67
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,400
Data surfaces per spindle	2	4	2	4	4
Heads per data surface	1	1	1	1	1
Tracks per surface	311	311	306	306	256
TPI	345	345	360	360	172
BPI	9300	9300	9036	9036	6270
RPM	3600	3600	3600	3600	3125
Actuator type	Rotary, Band, Stepping Motor	Rotary, Band, Stepping Motor	Rotary, Band, Stepping Motor	Rotary, Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	92 (including settling)	92 (including settling)	99 (including settling)	99 (including settling)	70 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	9.6
Average access time (msec)	100.3	100.3	107.3	107.3	79.6
Data transfer rate (KByte/sec)	625	625	625	625	542.5
FIRST CUSTOMER SHIPMENT	12/82	12/82	4/83	6/83	4Q79
U.S. OEM PRICE FOR 100 UNITS	$532	$665	$500	--	$1,061
COMMENTS			1.625" High	1.625" High	

MANUFACTURER	SHUGART	SHUGART	SIEMENS	SIEMENS	SIEMENS
DRIVE	SA4004	SA4008	3455	3465	3468
DISK/TREND GROUP	5	5	4	4	4
MARKET	OEM	OEM	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	V26374-Q7	V26374-Q9	--
Generic type	Fixed	Fixed	Special	Special	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	3340	3340	3330-11	3330-11	3330-11
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SA4000	SA4000	Siemens	Siemens	Siemens
CAPACITY/PERFORMANCE	0.144 MB Fixed Head Option	0.144 MB Fixed Head Option			
Total capacity (MBytes) FIXED	U: 14.5	U: 29.0	--	--	--
REMOVABLE	--	--	F: 71.8	F: 143.6	F: 303.2
Capacity per track (Bytes)	U: 18,000	U: 18,000	F: 19,750	F: 19,750	F: 19,750
Data surfaces per spindle	2	4	9	9	19
Heads per data surface	2	2	1	1	1
Tracks per surface	404	404	404	808	808
TPI	172	172	192	384	384
BPI	5534	5534	6060	6060	6060
RPM	2964	2964	2400	2400	2400
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	65 (including settling)	65 (including settling)	25	25	25
Average rotational delay (msec)	10.1	10.1	12.5	12.5	12.5
Average access time (msec)	75.1	75.1	37.5	37.5	37.5
Data transfer rate (KByte/sec)	887.5	887.5	806	806	806
FIRST CUSTOMER SHIPMENT	3Q78	3Q78	9/75	12/76	1977
U.S. OEM PRICE FOR 100 UNITS	$1,680	$2,100	--	--	--
COMMENTS					

MANUFACTURER	SIEMENS	SPERRY	SPERRY	SPERRY	SPERRY
DRIVE	3470 3472	8149	8402-50	8402-75	8402-100
DISK/TREND GROUP	8	3	6	6	7
MARKET	Captive	Captive	Captive	Captive	Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	SMD	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	3330-11	3350	3350	3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Siemens	Univac	Univac	Univac	Univac
CAPACITY/PERFORMANCE	1.115 MB Fixed Head Option				
Total capacity (MBytes) FIXED	F: 420.25	--	F: 50.7	F: 76.0	F: 101.4
REMOVABLE	--	F: 72.3	--	--	--
Capacity per track (Bytes)	F: 16,384	F: 16,800	F: 13,312	F: 13,312	F: 13,312
Data surfaces per spindle	19	7	7	7	7
Heads per data surface	2	1	2	2	2
Tracks per surface	1350	815	544	816	1088
TPI	590	370	476	476	476
BPI	6060	5050	6366	6366	6366
RPM	2400	2800	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil
Average positioning time (msec)	20	33	35	35	35
Average rotational delay (msec)	12.5	10.7	8.3	8.3	8.3
Average access time (msec)	32.5	43.7	43.3	43.3	43.3
Data transfer rate (KByte/sec)	806	784	1198	1198	1198
FIRST CUSTOMER SHIPMENT	10/78	12/80	3/81	3/81	3/81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	3472 is dual spindle drive with 840 MB total capacity	System 80	BC/7-900	BC/7-900	BC/7-900

MANUFACTURER	SPERRY	SPERRY	SPERRY	STORAGE TECHNOLOGY CORPORATION	STORAGE TECHNOLOGY CORPORATION
DRIVE	8417	8470	8480	8350-A2 8350-B2 8350-C2	8360-A2 8360-B2
DISK/TREND GROUP	7	9	9	8	8
MARKET	Captive	Captive	Captive	PCM	PCM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	14"	14"	14"	14"
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated
DRIVE: Technology type	3350	3350	8470	3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Univac	Univac	Univac	IBM	IBM
CAPACITY/PERFORMANCE	.86 MB Fixed Head Option	1.524 MB Fixed Head Option	1.524 MB Fixed Head Option	1.144 MB Fixed Head Option	1.144 MB Fixed Head Option
Total capacity (MBytes) FIXED	F: 118.2	F: 564.48	U: 564.48	F: 317.5	F: 317.5
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 19,900	F: 28,224	F: 28,224	F: 19,069	F: 19,069
Data surfaces per spindle	7	16	16	15	15
Heads per data surface	2	2	2	2	2
Tracks per surface	1100	1250	1250	1110	1110
TPI	476	538	538	480	957
BPI	6366	11134*	11134*	6425	6425
RPM	3400	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	23	23	25	23
Average rotational delay (msec)	8.82	8.3	8.3	8.3	8.3
Average access time (msec)	43.82	31.3	31.3	33.3	31.3
Data transfer rate (KByte/sec)	1130	2097	2097	1198	1198
FIRST CUSTOMER SHIPMENT	12/80	6/80	1Q83	4/77	2Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	System 80	*3PM Code	*3 PM Code Drive has 4 spindles.	PCM 3350 Drive has two spindles	PCM 3350 Drive has two spindles

MANUFACTURER	STORAGE TECHNOLOGY CORPORATION	STORAGE TECHNOLOGY CORPORATION	STORAGE TECHNOLOGY CORPORATION	SYQUEST TECHNOLOGY	SYQUEST TECHNOLOGY
DRIVE	8650-A2 8650-B2	8775	8380-A4 8380-AA4 8380-B4	SQ306R	SQ306F
DISK/TREND GROUP	9	9	9	1	5
MARKET	PCM	OEM	PCM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	QPAK	--
Generic type	Fixed	Fixed	Fixed	3.9" Cartridge	Fixed
Nominal disk diameter	14"	14"	14"	100 mm OD 40 mm ID	100 mm OD 40 mm ID
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Plated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	3380	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Thin Film	Ferrite	Ferrite
Interface	IBM	SMD	IBM	ST506	ST506
CAPACITY/PERFORMANCE	1.144 MB Fixed Head Option				
Total capacity (MBytes) FIXED	F: 635	U: 673.95	F: 1,260	--	U: 6.38
REMOVABLE	--	--	--	U: 6.38	--
Capacity per track (Bytes)	F: 19,069	U: 19,969	F: 47,476	U: 10,416	U: 10,416
Data surfaces per spindle	15	15	15	25	2
Heads per data surface	2	2	2	1	1
Tracks per surface	2220	2250	1770	306	306
TPI	957	957	*	435	435
BPI	6425	6425	*	12000	12000
RPM	3600	3600	3620	3547	3547
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Dual, Linear, Voice Coil	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	18	23	16	85 (including settling)	85 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.46	8.46
Average access time (msec)	26.3	31.3	24.3	93.46	93.46
Data transfer rate (KByte/sec)	1198	1198	3000	625	625
FIRST CUSTOMER SHIPMENT	5/79	9/82	1983	9/82	3/85
U.S. OEM PRICE FOR 100 UNITS	--	$13,750	--	$710	$600
COMMENTS	PCM 3350 Drive has two spindles		PCM 3380 Drive has two spindles *Not Announced	Embedded Servo 1.675" High 4.8" Wide	Embedded Servo 1.675" High 4.8" Wide

MANUFACTURER	SYQUEST TECHNOLOGY	SYQUEST TECHNOLOGY	TANDON	TANDON	TANDON
DRIVE	SQ312F	SQ325F	TM501	TM502	TM503
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	100 mm OD 40 mm ID	100 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	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	ST506	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 12.75	U: 25.5	U: 6.38	U: 12.75	U: 19.14
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	2	4	2	4	6
Heads per data surface	1	1	1	1	1
Tracks per surface	612	612	306	306	306
TPI	750	750	345	345	345
BPI	12500	12500	9074	9074	9074
RPM	3547	3547	3600	3600	3600
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Stepping Motor
Average positioning time (msec)	85 (including settling)	85 (including settling)	206 (including settling)	206 (including settling)	206 (including settling)
Average rotational delay (msec)	8.46	8.46	8.3	8.3	8.3
Average access time (msec)	93.46	93.46	214.3	214.3	214.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	4Q83	4Q83	9/82	9/82	9/82
U.S. OEM PRICE FOR 100 UNITS	--	--	$440 (2500)	$550 (2500)	$660 (2500)
COMMENTS	Embedded Servo 1.675" High 4.8" Wide	Embedded Servo 1.675" High 4.8" Wide			

MANUFACTURER	TANDON	TANDON	TANDON	TANDON	TEAC
DRIVE	TM251	TM252	TM703	TM705	SD 412
DISK/TREND GROUP	5	5	6	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	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	ST506	ST506	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.38	U: 12.75	U: 30.1	U: 50.1	U: 12.76
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 10,416	U: 10,417
Data surfaces per spindle	2	4	5	5	4
Heads per data surface	1	1	1	1	1
Tracks per surface	306	306	578	962	306
TPI	345	345	600	1000	345
BPI	9074	9074	9528	9528	9074
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Stepping Motor	Rotary, Stepping Motor	Rotary, Voice Coil	Rotary, Voice Coil	Band, Stepping Motor
Average positioning time (msec)	100 (including settling)	100 (including settling)	39 (including settling)	39 (including settling)	170 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	108.3	108.3	47.3	47.3	178.3
Data transfer rate (KByte/sec)	625	625	625	625	625
FIRST CUSTOMER SHIPMENT	7/83	7/83	1/83	9/83	3Q82
U.S. OEM PRICE FOR 100 UNITS	--	--	$945 (2500)	--	--
COMMENTS	1.625 " High	1.625 " High			Licensed by Seagate

MANUFACTURER	TEAC	TECSTOR	TECSTOR	TECSTOR	TECSTOR
DRIVE	SD 506	3/83	3/100	3/166	3/199
DISK/TREND GROUP	5	6	6	7	7
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	130 mm OD 40 mm ID	14"	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	ST506	SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 6.38	U: 82.9	U: 99.5	U: 165.9	U: 199.1
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 10,417	U: 20,160	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	4	2.5	3	5	6
Heads per data surface	1	2	2	2	2
Tracks per surface	153	1646	1646	1646	1646
TPI	255	680	680	680	680
BPI	7690	6450	6450	6450	6450
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)	170 (including settling)	29	29	29	29
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	178.3	37.3	37.3	37.3	37.3
Data transfer rate (KByte/sec)	625	1209	1209	1209	1209
FIRST CUSTOMER SHIPMENT	3Q82	2/82	6/82	12/81	6/82
U.S. OEM PRICE FOR 100 UNITS	--	$4,400	$4,500	$4,850	$5,000
COMMENTS	Licensed by Seagate				

MANUFACTURER	TECSTOR	TECSTOR	TEXAS INSTRUMENTS	TEXAS INSTRUMENTS	TEXAS INSTRUMENTS
DRIVE	3/315	3/332	525/62	525/61	525/122
DISK/TREND GROUP	8	8	5	5	5
MARKET	OEM	OEM	Captive	Captive	Captive
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	Plated	Plated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	SMD	T.I.	T.I.	T.I.
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 315.2	U: 331.8	U: 6.38	U: 6.38	U: 12.75
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	U: 20,160	U: 20,160	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	9.5	10	4	2	4
Heads per data surface	2	2	1	1	1
Tracks per surface	1646	1646	153	306	306
TPI	680	680	254	400	400
BPI	6450	6450	7690	9200	9200
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	29	29	170 (including settling)	115 (including settling)	115 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	37.3	37.3	178.3	123.3	123.3
Data transfer rate (KByte/sec)	1209	1209	625	625	625
FIRST CUSTOMER SHIPMENT	12/82	12/82	3Q81	3Q82	3Q82
U.S. OEM PRICE FOR 100 UNITS	$5,600	$5,700	--	--	--
COMMENTS			Mfg. under Seagate license		

MANUFACTURER	TEXAS INSTRUMENTS	TEXAS INSTRUMENTS	TOKICO	TOKICO	TOKICO
DRIVE	WD 800-18	WD 800-43	DK501-1	DK501-2	DK501-3
DISK/TREND GROUP	5	6	5	5	5
MARKET	Captive	Captive	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	200 mm OD	200 mm OD	130 mm OD	130 mm OD	130 mm OD
Magnetic surface	63.5 mm ID Oxide Coated	63.5 mm ID Oxide Coated	40 mm ID Oxide Coated	40 mm ID Oxide Coated	40 mm ID Oxide Coated
DRIVE: Technology type	3350	3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	T.I.	T.I.	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 18	F: 43	U: 6.66	U: 10.0	U: 13.3
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 9,288	F: 9,288	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	3	7	4	6	8
Heads per data surface	1	1	1	1	1
Tracks per surface	656	656	160	160	160
TPI	478	478	254	254	254
BPI	6500	6500	7800	7800	7800
RPM	3600	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, Voice Coil	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor
Average positioning time (msec)	40	40	78 (including settling)	78 (including settling)	78 (including settling)
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	48.3	48.3	86.3	86.3	86.3
Data transfer rate (KByte/sec)	602	602	625	625	625
FIRST CUSTOMER SHIPMENT	4/82	4/82	12/82	12/82	12/82
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS	DS990 Models Mfg. under Megavault license	DS990 Models Mfg. under Megavault license			

MANUFACTURER	TOKICO	TOKICO	TOKICO	TOSHIBA CORPORATION	TOSHIBA CORPORATION
DRIVE	DK502-1	DK502-2	DK502-3	MK-800R-32	MK-800R-64
DISK/TREND GROUP	5	5	5	2	2
MARKET	OEM	OEM	OEM	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	CMD	CMD
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	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	ST506	ST506	ST506	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 13.3	U: 20.0	U: 26.6	U: 16.289	U: 48.868
REMOVABLE	--	--	--	U: 16.289	U: 16.289
Capacity per track (Bytes)	U: 10,416	U: 10,416	U: 10,416	U: 20,160	U: 20,160
Data surfaces per spindle	4	6	8	1 Fixed 1 Removable	3 Fixed 1 Removable
Heads per data surface	1	1	1	2 Fixed 1 Removable	2 Fixed 1 Removable
Tracks per surface	320	320	320	823	823
TPI	360	360	360	367 Fixed 384 Removable	367 Fixed 384 Removable
BPI	9260	9260	9260	6274 Fixed 6038 Removable	6274 Fixed 6038 Removable
RPM	3600	3600	3600	3600	3600
Actuator type	Band, Stepping Motor	Band, Stepping Motor	Band, Stepping Motor	Fix: Rotary VC Rem: Linear VC	Fix: Rotary VC Rem: Linear VC
Average positioning time (msec)	85 (including settling)	85 (including settling)	85 (including settling)	30	30
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	93.3	93.3	93.3	38.3	38.3
Data transfer rate (KByte/sec)	625	625	625	1209	1209
FIRST CUSTOMER SHIPMENT	4Q83	4Q83	4Q83	2Q80	2Q80
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION
DRIVE	MK-800R-96	DSU-450	MK-100F	MK80F-10	MK80F-20
DISK/TREND GROUP	2	4	5	5	5
MARKET	OEM, Captive	Captive	OEM, Captive	OEM, Captive	OEM, Captive
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	CMD	3336-11	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	3330-11	3330-11	3340	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	Toshiba	Toshiba	SMD	SMD
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 80.446	--	U: 12.0 F: 10.2	U: 15.3	U: 23.0
REMOVABLE	U: 16.289	F: 200	--	--	--
Capacity per track (Bytes)	U: 20,160	F: 13,030	F: 16,384	U: 20,160	U: 20,160
Data surfaces per spindle	5 Fixed 1 Removable	19	1	2	3
Heads per data surface	2 Fixed 1 Removable	1 1	630	1	1
Tracks per surface	823	815	318	380	380
TPI	367 Fixed 384 Removable	370	5940	450	450
BPI	6274 Fixed 6038 Removable	4040	2800	8824	8824
RPM	3600	3600	40	3600	3600
Actuator type	Fix: Rotary VC Rem: Linear VC	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	30	30	40	40	40
Average rotational delay (msec)	8.3	8.3	10.8	8.3	8.3
Average access time (msec)	38.3	38.3	50.8	48.3	48.3
Data transfer rate (KByte/sec)	1209	806	896	1210	1210
FIRST CUSTOMER SHIPMENT	2Q80	1975	1977	2Q81	2Q81
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION	TOSHIBA CORPORATION
DRIVE	MK-300F	MK80F-30	MK181F	MK182F	MK184F
DISK/TREND GROUP	6	6	6	6	7
MARKET	OEM, Captive	OEM, Captive	Captive, OEM	Captive, OEM	Captive, OEM
MEDIA: Manufacturer's number	--	--	--	--	--
Generic type	Fixed	Fixed	Fixed	Fixed	Fixed
Nominal disk diameter	14"	210 mm OD 100 mm ID	210 mm OD 100 mm ID	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	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	Toshiba	SMD	SMD	SMD	SMD
CAPACITY/PERFORMANCE	.262 MB Fixed Head Option				
Total capacity (MBytes) FIXED	U: 36.0 F: 30.6	U: 38.3	U: 49.8	U: 83.0	U: 116.1
REMOVABLE	--	--	--	--	--
Capacity per track (Bytes)	F: 16,384	U: 20,160	U: 20,160	U: 20,160	U: 20,160
Data surfaces per spindle	3	5	3	5	7
Heads per data surface	630	1	1	1	1
Tracks per surface	318	380	823	823	823
TPI	5940	450	900	900	900
BPI	2800	8824	6,000 FCI 9,000 BPI	6,000 FCI 9,000 BPI	6,000 FCI 9,000 BPI
RPM	40	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	35	35	35
Average rotational delay (msec)	10.8	8.3	8.3	8.3	8.3
Average access time (msec)	50.8	48.3	43.3	43.3	43.3
Data transfer rate (KByte/sec)	896	1210	1210	1210	1210
FIRST CUSTOMER SHIPMENT	1977	2Q81	2Q83	2Q83	2Q83
U.S. OEM PRICE FOR 100 UNITS	--	--	--	--	--
COMMENTS					

MANUFACTURER	TOSHIBA CORPORATION	TULIN	TULIN	TULIN	VERMONT RESEARCH
DRIVE	MK186F	TL213	TL226	TL240	8010
DISK/TREND GROUP	7	5	5	5	1
MARKET	Captive, OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	--	--	--	--	8610
Generic type	Fixed	Fixed	Fixed	Fixed	8" Cartridge
Nominal disk diameter	210 mm OD 100 mm ID	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
Magnetic surface	Oxide Coated	Plated	Plated	Plated	Oxide Coated
DRIVE: Technology type	Modified 3350	Modified 3350	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	SMD	ST506	ST506	ST506	VRL, SASI, ANSI X3T9/1226
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	U: 165.9	U: 13.34	U: 26.7	U: 40.0	--
REMOVABLE	--	--	--	--	F: 9.7
Capacity per track (Bytes)	U: 20,160	U: 10,416	U: 10,416	U: 10,416	F: 8,192
Data surfaces per spindle	10	2	4	6	2
Heads per data surface	1	1	1	1	1
Tracks per surface	823	640	640	640	596
TPI	900	640	640	640	500
BPI	6,000 FCI 9,000 BPI	10,000	10,000	10,000	6000
RPM	3600.	3600	3600	3600	3600
Actuator type	Rotary, Voice Coil	Rotary, band, stepping motor	Rotary, band stepping motor	Rotary, band, stepping motor	Linear, Voice Coil
Average positioning time (msec)	35	95 (Including settling)	95 (Including settling)	95 (Including settling)	55
Average rotational delay (msec)	8.3	8.3	8.3	8.3	8.3
Average access time (msec)	43.3	103.3	103.3	103.3	53.3
Data transfer rate (KByte/sec)	1210	625	625	625	625
FIRST CUSTOMER SHIPMENT	4Q83	1/84	1/84	1/84	2Q83
U.S. OEM PRICE FOR 100 UNITS	--	$650	$850	$1,055	$3,000
COMMENTS		Embedded servo 1.625" high	Embedded servo 1.625" high	Embedded servo 1.625" high	Embedded Servo

MANUFACTURER	VERMONT RESEARCH	VERMONT RESEARCH	VERTEX PERIPHERALS	VERTEX PERIPHERALS	VERTEX PERIPHERALS
DRIVE	8520	5017-4	V130	V150	V170
DISK/TREND GROUP	2	2	6	6	6
MARKET	OEM	OEM	OEM	OEM	OEM
MEDIA: Manufacturer's number	8610	VRC 5517	--	--	--
Generic type	8" Cartridge	5440	Fixed	Fixed	Fixed
Nominal disk diameter	200 mm OD 63.5 mm ID	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	Modified 3350	3330-11	Modified 3350	Modified 3350	Modified 3350
Heads	Ferrite	Ferrite	Ferrite	Ferrite	Ferrite
Interface	VRL, SASI, ANSI X3T9/1226	VRL, SASI, ANSI X3T9/1226	ST506	ST506	ST506
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	F: 9.7	F: 26.2	U: 30.8	U: 51.4	U: 72.0
REMOVABLE	F: 9.7	F: 26.2	--	--	--
Capacity per track (Bytes)	F: 8,192	F: 12,800	U: 10,416	U: 10,416	U: 10,416
Data surfaces per spindle	4	4	3	5	7
Heads per data surface	1	1	1	1	1
Tracks per surface	596	1024	987	987	987
TPI	500	500	960	960	960
BPI	6000	4000	9920	9920	9920
RPM	3600	3165	3600	3600	3600
Actuator type	Linear, Voice Coil	Linear, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil	Rotary, Voice Coil
Average positioning time (msec)	60	45	30	30	30
Average rotational delay (msec)	8.3	9.5	8.3	8.3	8.3
Average access time (msec)	68.3	54.5	38.3	38.3	38.3
Data transfer rate (KByte/sec)	625	673	625	625	625
FIRST CUSTOMER SHIPMENT	2Q83	1975	7/83	7/83	7/83
U.S. OEM PRICE FOR 100 UNITS	$3,500	$13,065	$1,480	$1,880	$2,200
COMMENTS	Embedded Servo	Embedded Servo			

MANUFACTURER	WESTERN DYNEX	WESTERN DYNEX	WESTERN DYNEX	WESTERN DYNEX	
DRIVE	WD-505	DD-6121	DD-6122	DD-6221	
DISK/TREND GROUP	1	1	1	1	
MARKET	OEM	OEM	OEM	OEM	
MEDIA: Manufacturer's number	--	--	--	--	
Generic type	5.25" Cartridge	2315/5440	2315/5440	2315/5440	
Nominal disk diameter	130 mm OD 40 mm ID	14"	14"	14"	
Magnetic surface	Oxide Coated	Oxide Coated	Oxide Coated	Oxide Coated	
DRIVE: Technology type	Modified 3350	2314	2314	2314	
Heads	Ferrite	Ferrite	Ferrite	Ferrite	
Interface	ST506	Various Options	Various Options	Various Options	
CAPACITY/PERFORMANCE					
Total capacity (MBytes) FIXED	--	--	--	U: 3.13	
REMOVABLE	F: 6.38	U: 3.13	U: 6.25	U: 3.13	
Capacity per track (Bytes)	U: 10,416	U: 7,812	U: 7,812	U: 7,812	
Data surfaces per spindle	2	2	2	4	
Heads per data surface	1	1	1	1	
Tracks per surface	306	203	406	203	
TPI	345	100	200	100	
BPI	9022	2200	2200	2200	
RPM	3600	1500/2400	1500/2400	1500/2400	
Actuator type	Band, Stepping Motor	Linear, Voice Coil	Linear, Voice Coil	Linear, Voice Coil	
Average positioning time (msec)	45 (including settling)	35	35	35	
Average rotational delay (msec)	8.3	20/12.5	20/12.5	20/12.5	
Average access time (msec)	53.3	55/47.5	55/47.5	55/47.5	
Data transfer rate (KByte/sec)	625	195/312.5	195/312.5	195/312.5	
FIRST CUSTOMER SHIPMENT	4Q83	1972	1973	1972	
U.S. OEM PRICE FOR 100 UNITS	$875	--	--	--	
COMMENTS					

MANUFACTURER PROFILES

1983 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 "1982 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. "1982 total net sales" covers the fiscal year ending in 1982 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

1982 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, with first shipments planned for 1983.

AMCODYNE, INC.
1301 South Sunset Street
Longmont, CO 80501 303/772-2601

1982 disk sales: None

Organized in 1981 by a group of industry veterans with high performance disk drive experience at Storage Technology, Amcodyne started first shipments of its 8" disk cartridge drive (26 MB fixed/26 MB removable) in early 1983. The firm's second product, an 8" fixed disk drive with 165 MB capacity, is planned for delivery in early 1984. Both are high performance drives targeted at the SMD interface market.

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

1982 disk sales: $40,100,000
1982 total net sales: $4,935,600,000 Net income: $113,200

While most of Ampex' disk drive revenues have been derived from disk pack drives in recent years, the balance is now shifting to 14" and 5.25" Winchester models. A previously announced 8" fixed disk drive was dropped in 1983, victim of of an overly lengthy development period. The existing 14" rack mounted OEM drives, with capacities up to 330 MB, were successfully introduced in 1981, before several competitive drives. Ampex took a license from Rodime for 5.25" drives, with production now underway at Singapore.

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

1982 disk sales: None

Started in 1982 to develop high capacity 5.25" drives using perpendicular recording, AIM has changed direction for the time being, and has recently announced 5.25" fixed disk drives using longitudinal recording techniques. The firm says it will deliver its first drive, with 133 MB capacity and 18 millisecond average seek time, in second quarter, 1984. Disks will be internally produced using a hybrid plated/sputtering process, and a new production facility is planned for Austin, Texas.

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

1982 disk sales: None
1982 total net sales: $142,756,000 Net income: $9,010,000

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 now offer 200 to 640 MB capacities, using thin film heads with oxide coated Dysan disks, and with transfer rates up to 2 MB/second. Production shipments are underway, with APS targeting the high transfer rate, high performance market for rack mounted OEM drives now led by Control Data and Fujitsu.

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

1982 disk sales: Negligible

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 have been in production since late 1982, giving Atasi an opportunity to secure an attractive market share because of its early 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.

ATHENAEUM TECHNOLOGY, INC.
105 Bay State Drive
Braintree, MA 02184 617/848-8388

1982 disk sales: None

Athenaeum was started in 1982 to develop and manufacture 5.25" disk drives in two initial configurations: A disk cartridge drive with 12 MB fixed and 12 MB removable capacity, plus a fixed disk drive with 38 MB capacity. Both drives are scheduled for production by first quarter, 1984, in a new manufacturing facility planned for Rochester, New York.

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

1982 disk sales: $9,100,000
1982 total net sales: $889,100,000 Net income: $34,500,000

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 a 100 MB version using the same five data surface configuration. Ball's major disk drive sales have been in Europe, but the lack of new models makes the continuation of the product line questionable.

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

After many years of captive disk drive production, Burroughs acquired Memorex in late 1981. All Burroughs disk drive operations have now been consolidated in the firm's Memorex subsidiary and are reviewed under the heading for that organization.

CARDIFF TECHNOLOGY, INC.
Subsidiary of Innovative Data Technology
4060 Morena Boulevard
San Diego, CA 92117 619/270-3997

IDT is a tape drive manufacturer with OEM disk drive ambitions. The Cardiff subsidiary has announced 5.25" drives in several models: Disk cartridge drives with 15.7 MB per disk in removable only and fixed/removable models, plus fixed disk drives with up to 47.2 MB capacity. Cartridge drive first shipments are promised by the end of 1983.

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

1982 disk sales: $72,000,000
1982 total net sales: $8,455,600,000 Net income: $423,700,000

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 in 1981. Century is pinning its future hopes on the higher capacity 14" fixed diskdrives introduced during the past two years, plus the 8" disk cartridge drive announced in mid-1982.

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

1982 disk sales: $9,500,000
1982 total net sales: $55,164,000 Net income: $2,236,000

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 developed by Wangco several years earlier. These products are late in their product life cycle, and the 8" disk cartridge drives developed during Perkin-Elmer's ownership have been dropped. Cipher has announced that its last disk drives shipments will be made in the first half of 1984.

COGITO SYSTEMS CORPORATION
118 Charcot Avenue
San Jose, CA 95131 408/942-8262

Cogito started operations in 1982, with funding from Chin Fong Investments, Ltd., a Taiwan organization which also owns Magnex, a thin film head manufacturer. Cogito's first products are half high 5.25" Winchester drives, with production start-up in mid-1983.

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

1982 disk sales: $10,900,000
1982 total net sales: $2,445,000 Net income: ($369,000)

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. CMI has been successful in developing a stable customer base, with a very respectable market share. One of those customers, Intel Corporation, has purchased 20% of the company, along with rights to manufacture CMI products. CMI has rapidly expanded its product line with half high versions and with higher capacity drives with capacities up to 40 MB.

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

1982 disk sales: $1,056,600,000
1982 total net sales: $4,292,000,000 Net income: $155,100,000

In 1982 Control Data's share of OEM rigid disk drive revenues was 45.2% of the worldwide total, the first time in several years it fell below 50%. Nevertheless, CDC was the revenue leader for OEM disk drives in six of the nine DISK/TREND rigid disk product groups. The firm's area of product weakness has been in fast-growing small fixed drive products, but recent introductions indicate an attempt to exploit CDC's high end technology in small disk drives, hoping to gain an advantage over entrepreneurial firms which do not design and make their own heads, media and semiconductors. 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 8-9" 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, the new CDC drives are now in production and are being well received by the firm's large, loyal customer base. Disk drives sold by Control Data are designed and manufactured by Magnetic Peripherals, Inc., a joint venture with ownership now shared by CDC, Honeywell, Sperry and Cii-Honeywell Bull. Control Data manages the joint venture and has exclusive responsibility for sales of its products in the OEM and PCM markets. Drives made by MPI for sale with any of the parent company's systems are considered captive CDC drives for the purposes of DISK/TREND statistics, and captive drives for both parents are a significant portion of MPI shipments. Control Data is also a major participant in the PCM market, generally gaining slightly on the competition each year, and is expected to remain in the game during the 3380-equivalent PCM generation.

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

1982 disk sales: $115,000,000
1982 total net sales: $805,910,000 Net income: $24,658,000

Data General manufactured all disk drive requirements internally for years, covering its requirements with several captive disk cartridge, disk pack and 14" Winchester drives. Despite the 1981 addition of a higher capacity Control Data OEM 14" Winchester to its product line, Data General has continued with introduction of internally developed drives, adding low end 8" drives in 1982 and a 354 MB 14" fixed drive in 1983.

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

1982 disk sales: $20,900,000
1982 total net sales: $508,486,000 Net income: $2,405,000

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 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

1982 disk sales: $252,000,000
1982 total net sales: $3,880,771,000 Net income: $417,155,000

In recent years DEC's rigid disk drive revenues for captive products have been derived from disk cartridge drives, notably the high volume RL02. However, in 1981 a new family of 14" Winchester drives started to appear, with the major introductions at the 1982 NCC. The product with the greatest revenue expectations is the RA81, a 14" rack mounted Winchester drive with a formatted capacity of 456 MB; the other major drive in the group is the RA60, a rack mounted disk pack drive with 205 MB formatted capacity. These were DEC's first internally designed and produced high end disk drives, and the manufacturing startup for the drives and their controller was painful, but now underway. DEC's new drives will replace older drives purchased externally on an OEM basis, and all are expected to reach large production quantities. The next major new DEC disk drive will probably be the Aztec, a long-delayed 8" disk cartridge drive which will supersede the 14" RL02, and which will also be a large volume product. Meanwhile, DEC continues to be one of the largest OEM buyers of 14" disk drives, from STC, Memorex and Control Data, until the newly introduced

drives completely fill DEC requirements for larger drives. Although DEC will probably produce 5.25" drives internally, it is now buying low end 5.25" drives from Seagate, and recently negotiated a purchase of mid-range capacity drives from Evotek.

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

1982 disk sales: $2,600,000

Disc Tech One is the new name for the Ohio Scientific disk drive operation (previously owned by Okidata) which was sold by M/A-Com in mid-1982 to a group of independent investors. Although most of 1982's revenues were generated by shipments of older 14" 40 and 80 MB drives, newer 165 and 301 MB versions have been in production since early 1983. In mid-1983, Disc Tech One acquired 3M's 8" Winchester product lines, and moved manufacturing from 3M's Camarillo plant to its own Santa Barbara facility.

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

1982 disk sales: $12,900,000
1982 total net sales: $70,087,000 Net income: $5,103,000

CCT established Disctron from the combination of Data Peripherals and Rotating Memory Systems, following the acquisition of RMS in mid-1982. Most of the 8" and 5.25" drives from the older firms remain in production, in a consolidated facility at Milpitas, supplemented by newer high end 5.25" Winchesters. Shakedown of products and organization appears complete, and Disctron is currently in a growth mode, especially with 5.25" Winchesters. CCT has acquired a license to manufacture plated disks with the Ampex Alar process, and its Ultradisc subsidiary will produce disks for Disctron and the OEM disk market.

DISK MEMORY TECHNOLOGY, INC.
Subsidiary of Datricon Corporation
155 B Avenue
Lake Oswego, OR 97034 503/636-7675
Disk Memory Technology, which produced its first disk drive in 1976, was purchased in 1982 by Datricon. 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

1982 disk sales: $3,600,000

DMA Systems successfully started shipments of its 5.25" 5/5 MB fixed-removable disk cartridge drive in 1982, and has established a leadership position in the 5.25" disk cartridge field. Other products announced for early 1984 shipment are disk cartridge drives with up to 27 MB total capacity and fixed disk drives with up to 40 MB capacity. DMA will also formally announce at the 1983 Comdex its half high disk cartridge drive, in order to position its product line for the expected surge in 5.25" half high disk drives of all kinds. Manufacturing licenses have been sold to Memorex, which so far is making disk cartridges but not the drives, and to Newbury Data, which is expected to start manufacturing the drives in England by the end of 1983.

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

1982 disk sales: None

Evotek is an ambitious start up company formed in 1981 to manufacture 5.25" fixed disk drives, with assistance from Ibis and its financial backers. Evotek announced a family of 5.25" fixed drives with capacities ranging from 7 to 51 MB, and a relatively fast 49 millisecond average access time, at the 1982 NCC. The 51 MB capacity is attained by increasing linear density to 16,250 BPI. Like many new Winchester disk drive manufacturers, Evotek has had a difficult production startup phase, but started shipments in mid-1983, and has made a major OEM sale to Digital Equipment Corporation.

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

1982 disk sales: $253,800,000
1982 total net sales: $4,254,000,000 Net income: $383,000,000

Hewlett-Packard has an extensive manufacturing operation for captive disk drives at Boise, established in 1977 and since expanded, supplemented in mid-1983 with a new $50 million facility 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 as a fixed drive in late 1981 and released as a removable disk pack drive in 1983. A new 132 MB 14" drive was also introduced in early 1983. The industry expects H-P to become a major producer of small fixed disk drives using advanced recording technology.

IBIS SYSTEMS, INC.
5775 North Lindero Canyon Drive
Westlake Village, CA 91360 213/706-2505

1982 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. First deliveries, delayed from the initial schedule, are promised for late 1983.

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

1982 disk sales: $2,825,500,000
1982 total net sales: $34,364,000,000 Net income: $4,409,000,000

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 surprisingly large quantities from plants in the U.S., Europe and Japan. IBM's PCM competitors now expect IBM to introduce a double density version of the 3380, probably early in 1984, but the exact TPI/BPI/access time mix is still being guessed at by outsiders. Production of 8" Piccolo drives is also a large revenue producer, and new 15 and 30 MB 8" drives using a linear actuator have been introduced for use with the System/23 Datamaster, Series/1, and new System/36. The new 30 MB drive and the 64 MB Piccolo have been offered by IBM as OEM products -- so far, with no impact. The firm has also been quietly making OEM sales presentations for 3380 drives to competitive manufacturers of mainframes and superminicomputers. 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 as detachable drives. On the other side of the coin, IBM has become the world's largest buyer of OEM disk drives, at least on a unit total basis. The firm's 5.25" disk drive requirements for personal computers and other systems have driven it to purchase OEM drives from at least five outside suppliers.

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

1982 disk sales: $69.900,000
1982 total net sales: $58,674,000 Net income: $5,186,000

IMI revenues from 8" and 5.25" Winchester drives have grown 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. In its 5.25" product lines, IMI has announced half high models and a full size 51 MB drive, all scheduled for delivery by the end of 1983. The firm is also now participating in the major purchases of 5.25" drives being made by IBM in connection with its personal computer program -- which signals the first use by IBM of drives with plated disks.

IRWIN MAGNETICS, INC.
2000 Green Road
Ann Arbor, MI 48105 313/996-3320

After a 1982 merger of Irwin International and the U.S. operations of Olivetti OPE, the firm which emerged was frustrated in its attempts to develop the market for Irwin's pioneering 5.25" Winchester disk drive, and was subsequently cut down to a much smaller entity, without Olivetti products. Irwin Magnetics is concentrating on a tape cartridge drive, and the disk drive has been withdrawn from the market.

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

1982 disk sales: $273,200,000

Sperry's Santa Clara disk drive operations were known until recently as the firm's ISS Operating Unit, and trace their origins to a pioneering plug compatible and OEM disk drive company founded by ex-IBMers in the 1960's. In August, 1983, Sperry completed the sale of these facilities to Magnetic Peripherals, Inc., in exchange for a 13% share of MPI. Sperry now joins Control Data, Honeywell and Cii-Honeywell Bull in ownership of MPI, which is managed by Control Data. The old ISS facilities are now known as the Santa Clara Division of MPI. In subsequent editions of the DISK/TREND Report, statistics for captive and OEM drive shipments from this facility will be included in the Control Data totals.

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

1982 disk sales: $10,500,000
1982 total net sales: $2,839,000,000 Net income: $51,100,000

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 was added in late 1982. In addition to its own 41 and 82 MB 8" drives, Kennedy acquired in mid-1982 the BASF 8" Winchester product line. These products are now being sold under the Kennedy name.

MAXTOR CORPORATION
61 East Daggett Drive
San Jose, CA 95134 408/942-1700

1982 disk sales: None

Maxtor was formed in 1982 to develop and manufacture high capacity 5.25" Winchester disk drives for the OEM market, and has become the most controversial new disk drive company in years. The founders are veterans of previous Santa Clara valley disk drive start up companies, with ambitious plans. Maxtor startled its competitors by announcing late in 1982 a family of 5.25" drives with up to 140 MB capacity. These drives, which are now in production, maintain the standard Seagate transfer rate of five megabits per second, and offer an average access time of 30 milliseconds. Eight disks are used, twice the number any other manufacturer has attempted to place in a 5.25" drive, by placing the drive motor inside the disk's inner diameter. At the 1983 NCC, Maxtor turned up the heat again with the announcement of models with capacities up to 380 MB, a capacity achieved with more tracks per surface and doubling the transfer rate, and promised for early 1984 delivery. In an attempt to pave the way for the drive's higher transfer rate, Maxtor personnel led in establishment of a proposed 10 megabit/second interface standard. Despite profound skepticism by competitors, Maxtor is positioned for big things if it can establish quantity production for the products already announced.

MEGAVAULT
6431 Independence Avenue
Woodland Hills, CA 91367 213/884-7300

SLI, a veteran industry supplier of voice coil actuators, changed its name in 1982 to reflect its new emphasis on complete disk drives. A Megavault kit is used by Texas Instruments in their current 8" Winchesters. Megavault's own 8" Winchester product line covers a capacity range from 20 to 212 MB, with choice of SCSI, SA 1000, SMD or ANSI interfaces.

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

1982 Memorex disk sales: $146,700,000
1982 Burroughs disk sales: $129,100,000
1982 total net sales: $4,095,000,000 Net income: $91,000,000

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. Burroughs has placed all disk drive development and manufacturing responsibility for the entire company in the Memorex organization, and the Burroughs facilities still concerned with disk drive production have been transferred to Memorex. Currently, the Memorex operation faces declining PCM markets for 3350 type drives, its major product line. First production deliveries of the firm's 3380 equivalent drive were made in mid-September, 1983, as promised -- and Memorex is now faced with the pressing need to ramp up production rapidly in order to maintain its role as a major PCM disk drive supplier. 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. Internally developed drives using Memorex produced 5.25" plated disks, with capacity up to 70 MB, have been announced for early 1984 delivery. The DEC purchases of disk pack drives will decline in favor of internally manufactured drives. One of the first major projects at Memorex under Burroughs management, already satisfactorily completed, was development of controllers to make possible the use of large Memorex disk drives with Burroughs systems -- thus creating another market for Memorex drives, a captive one.

MICRODATA CORPORATION
Subsidiary of McDonnell Douglas Corporation
17481 Red Hill Avenue
Irvine, CA 92714 714/250-1000

1982 disk sales: $59,900,000
1982 total net sales: $7,331,000,000 Net income: $215,000,000

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

1982 disk sales: $22,200,000
1982 total net sales: $33,009,000 Net income: $83,000

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 an ambitious 8" Winchester program, with announced products offering up to 165 MB capacities, and a variety of optional 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.

MICROSCIENCE INTERNATIONAL CORPORATION
575 East Middlefield Road
Mountain View, CA 94043 415/961-2212

1982 disk sales: None

Microscience International was formed early in 1982 by experienced disk drive engineering managers. The firm started shipments in mid-1983 for its half high 5.25" 12 MB drive. The drive uses plated disks, and has several innovative design features intended to improve reliability.

MINISCRIBE CORPORATION
1871 Lefthand Circle
Longmont, CO 80501 303/656-6000

1982 disk sales: $5,043,000
1982 total net sales: $5,043,000 Net income: ($3,247,000)

Production of Miniscribe's 5.25" Winchester drives started in late 1981, stayed at modest levels through most of 1982, then soared starting in late 1982 as IBM started taking 5.25" Winchester deliveries for the personal computer program. Other major OEM customers were subsequently added, and the company is definitely in the first tier of 5.25" Winchester manufacturers, in terms of monthly shipment volume. Miniscribe's drives use an unusual rack and pinion head positioning system driven by a stepping motor. Miniscribe started shipping half high 5.25" drives in the first half of 1983, and is now leading the industry in shipments of half high Winchesters.

NEW WORLD COMPUTER COMPANY, INC.
6670 Amador Plaza Road
Dublin, CA 94568 415/463-9292

1982 total net sales: $608,000 Net income: ($1,492,000)

New World Computer is the industry's perennial startup company. The firm was organized in 1977, and in 1979 announced an unconventional 8" disk drive with multiple heads per slider. The product line went through various model revisions over the years, eventually becoming a removable cartridge drive using 5.25" plated disks, while retaining the concept of using several heads on each slider. The firm was not able to successfully start production and subsequently was merged with LAN Systems, Inc. The New World Computer name was retained, but the company is under new management, and is being moved to Northern California from its original Orange County location.

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

1982 disk sales: $19,800,000
1982 total net sales: $2,467,886,000 Net income: $122,926,000
(Basis: C$ 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 four years ago. Products now in production include a pair of 8" fixed Winchester technology drives with 11 and 22 MB formatted capacities. In 1983 Northern Telecom also formed the Memory Systems Division in Ann Arbor, Michigan, which has announced a family of high performance 8" Winchester drives, with capacities up to 225 MB, and deliveries promised before the end of 1983.

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

1982 disk sales: $36,300,000
1982 total net sales: $30,003,000 Net income: $1,450,000
(FY ending 6/30/82)

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. 8" Winchesters with capacities up to 105 MB are now in large scale production, and 5.25" drives up to 111 MB have been promised for early 1984. Priam has continued to limit its product line to high performance OEM disk drives, but with an emphasis on producibility.

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

1982 disk sales: $35,800,000
1982 total net sales: $41,779,000 Net income: $7,838,000

Quantum's original game plan was to provide a low-cost upgrade for the market created by Shugart Associates' SA 1000 8" Winchester drives. The Quantum plan worked very well, and the firm has become a high growth operation. The 10 MB SA 1000 was a major product, and its customer base welcomed the 20, 30 and 40 MB 8" Quantum drives, which provided additional capacity with the same interface and file organization. Quantum also benefited from Shugart Assocates' late start for its own upgrade product, and its subsequent withdrawl. Quantum's 8" drives now go up to 85 MB, and 20, 30 and 40 MB 5.25" drives have been added, all now in production.

SEAGATE TECHNOLOGY
920 Disc Drive
Scotts Valley, CA 95066 408/438-6550

1982 disk sales: $50,700,000
1982 total net sales: $40,445,000(FY end 6/81) Net income: $9,891,000

The term "Seagate compatible" has become part of the industry's language. In 1981, Seagate shipped two thirds of the 5.25" drives produced worldwide, with 35,000 units -- and another defacto standard was created. In 1982, Seagate's many new competitors nibbled the company's worldwide share of low end 5.25" Winchesters down to 40%, but that share appears to be stable, with most major vendor/buyer relationships now established. The current Seagate product line consists of the original 6.38 MB drive, now offered in a single disk version, plus 12.76, 19, and 25.5 MB fixed disk drives. A 6.38 MB disk cartridge drive and 38 MB fixed disk drive were dropped before shipments started. Seagate's future is expected to be in two directions -- up in capacity and down in size. The earlier high capacity drive was of low interest to the industry because it retained stepping motor head positioning and access time was too slow for the planned capacity. Future higher capacity drives from Seagate will undoubtedly offer more appropriate access times. A smaller drive, the ST 206 half high model, is behind schedule and offers only 6.38 MB, really too small to impact the mainstream 12 MB market for low end drives; a 12 MB version is expected soon. Seagate has also been a participant in the industry jockeying over sub-5.25" drive standards, first endorsing the Sony 3.5" floppy drive, then dumping it for the 3.25" Tabor floppy drive. Many in the industry will be surprised if Seagate actually produces any microfloppy drive, but few doubt the company will soon announce a micro-Winchester drive -- meaning that the maneuvering over floppy drives was really to set the box size for rigid disk drives. The next challenge will be high performance interfaces, with Seagate trying to sell a simple modification to its current standard, instead of supporting the more sophisticated proposals offered by some manufacturers of high capacity 5.25" drives.

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

1982 disk sales: $132,200,000
1982 total net sales: $8,445,600,000 Net income: $423,700,000

Shugart Associates took advantage of its early leadership in flexible disk drives with its 1979 introduction of an early low-end 14" Winchester drive, the 14" SA 4000. But the 8" SA 1000, a year later, was the real winner, until competition at the same capacities from 5.25" drives became severe. Unfortunately, Shugart Associates' performance with newer rigid disk drives was not as good. Delays in the SA 1100 capacity upgrade for the SA 1000 enabled Quantum to dominate that market segment, and similar delays for the SA 600 5.25" Winchester prevented Shugart from securing a significant share of the booming 5.25" market. Special new internal programs to establish entrepreneurial-style emphasis on high priority development projects seem to be paying off for Shugart, however, and the firm is an early participant in the half high 5.25" Winchester market, shipping products well before Seagate.

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

1982 disk sales: $303,400,000
1982 total net sales: $1,079,000,000 Net income: $63,300,000

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. But PCM disk drive vendors hit the wall in 1982, as IBM 3380 shipments started in earnest, and 1983 is worse. STC was faced with the need to scale back production, well before its next generation of IBM compatible drives were ready for manufacture. Like other PCM disk drive manufacturers, STC plans to start quantity production of 3380 equivalent drives in third quarter of this year. IBM is doing what it can to make life difficult, however, by achieving very high production levels and eliminating the 3380 backlog before the first plug compatible drives arrive in the market. At this point, it would appear that STC is unlikely to dominate the PCM 3380 market as it did with 3350's by establishing a 6-9 month lead on its competitors. And it's not certain that the total market will be as attractive as it was in the good old days of the 3350.

SYQUEST TECHNOLOGY
47923 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. SyQuest's plan was extremely ambitious, with a production start up scheduled before the end of 1982 and very large quantities planned for 1983. Unfortunately, technical problems with the drive severely compromised the big plans, and the firm has been scrambling during 1983 to get the drive into shape for production and to hold customers' interest.

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

1982 disk sales: $24,900,000
1982 total net sales: $150,490,000 Net income: $15,700,000

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 its drives' content, and has exploited its low costs with an aggressive pricing policy. The basic 6.38 MB, 12.75 MB and 19.1 MB drives have been supplemented with 6.38 MB and 12.75 MB half high models, plus 30 MB and 50 MB drives with voice coil actuators -- all planned for delivery during 1983.

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

1982 disk sales: $2,300,000

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. While all of these drives offer interface and file compatibility with several of the Control Data drives in the SMD interface family, the two models over 300 MB are best positioned to develop significant market share.

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

1982 disk sales: $19,300,000
1982 total net sales: $4,326,600,000 Net income: $144,000,000

TI is assembling 8" Winchesters for captive use with TI computer systems, under a license from Megavault, and is making 5.25" Winchesters, also for captive use, originally starting the program under a Seagate Technology license. TI had planned to use the 5.25" drives as its entry point into the OEM disk drive market, but withdrew that program in 1983 after limited success.

TULIN CORPORATION
2393 Qume Drive
San Jose, CA 95131 408/942-1717

Tulin is the latest Santa Clara Valley startup company to announce its family of half high 5.25" Winchester disk drives. With initial funding from ITT, the parent of neighboring Qume Corporation, and founders with extensive disk drive industry backgrounds, Tulin has announced the highest capacity half high drives to date. The drives range from 13 MB to 40 MB, with production deliveries scheduled for early 1984.

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

1982 disk sales: $1,300,000
1982 total net sales: $13,489,000 Net income: $1,143,000

VRC is primarily a manufacturer of head-per-track disk drives and magnetic drum memories, with manufacturing both in Vermont and England. Lower demand for these memory devices has caused flat sales and a shrinkage in the company's staff. 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 starting in mid-1983.

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. Drives with 30.8, 51.4 and 72 MB capacity, and offering 30 milliseconds average access, were announced in late 1982, for mid-1983 delivery.

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

1982 disk sales: $6,000,000

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, with deliveries set for the end of 1983. The drive will use the Dysan 5.25" cartridge, and was originally intended to be Seagate compatible. With Seagate's withdrawl of its announced disk cartridge drive, Western Dynex becomes the only company in the industry to offer a removable-only 5.25" disk cartridge drive as its sole product in the field.

Japanese Manufacturers (Exchange basis: 235 Yen = $1)

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

1982 disk sales: $364,900,000
1982 total net sales: $3,405,532,000 Net income: $135,153,000

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 1982 the company moved up to third place in worldwide total disk drive revenues. 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. During 1983 higher capacity versions of several existing OEM drives were announced.

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

1982 disk sales: $225,600,000
1982 total net sales: $15,739,268,000 Net income: $583,370,000

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 IBM compatible 635 MB and 3380 equivalent drives to National Advanced Systems for distribution with NAS systems in the U.S., and in 1983 started selling 3380 equivalent drives to BASF for distribution in the European PCM market.

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

1982 total net sales: $939,055,000 Net income: $45,855,000

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. In 1981, MCI announced several Winchester technology fixed disk drives, including low end 5.25" drives and a family of 8" Winchester drives of its own design, using linear voice coil actuators. The drives were later dropped as specific OEM products, but it is believed the firm is prepared to ship them as part of systems manufactured on a contract basis.

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

1982 disk sales: $52,800,000
1982 total net sales: $6,132,757,000 Net income: $147,409,000

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.

NEC CORPORATION
33-1, Shiba Gochome
Minato-ku, Tokyo 108 (03) 454-1111

1982 disk sales: $296,200,000
1981 total net sales: $5,328,596,000 Net income: $118,762,000

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

1982 disk sales: $2,700,000
1982 total net sales: $84,574,000 Net income: $157,000

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 5.25" Winchesters of its own design, with capacities up to 25 MB.

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

1982 disk sales: $55,800,000

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, and to Memorex, which markets 3370 equivalent drives in Europe and the U.S. 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

1982 total net sales: $24,900,000

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 5.25" Winchester drives for sale in Japan. Disctron, the RMS successor, is continuing its cooperation, and Otari is expected to be in production in the second half of 1983.

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

1982 disk sales: $1,300,000
1982 total net sales: $179,740,000 Net income: ($6,464,000)

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. Production started in the second half of 1982.

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

1982 disk sales: $1,300,000
1982 total net sales: $356,902,000 Net income: $7,745,000

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

1982 disk sales: $56,200,000
1982 total net sales: $9,973,362,000 Net income: $188,562,000

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

1982 total net sales: $13,235,000,000 Net income: $152,800,000
(Basis: DM 2.40 = 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., plus a 3380 equivalent drive made by Hitachi.

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

1982 disk sales: $35,600,000

Cii-Honeywell Bull's management got 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. A 5.25" disk cartridge drive was added in 1983, and this drive is involved in a cross-license with Vertex Peripherals -- in which Cii-HB plans to make the high capacity 5.25" Vertex drives and Vertex will make the Cii-HB 5.25" cartridge disk drive.

HAWKER SIDDELEY DYNAMICS ENGINEERING, LTD
Subsidiary of Hawker Siddeley Group
Bridge Road East
Welwyn Garden City, Herts
England

Computer Memories, Inc., and Hawker Siddeley have reached an agreement in principle on a proposed joint venture which would manufacture CMI's 5.25" Winchester disk drives in England at an existing Hawker Siddeley facility. The firm is a manufacturer of vending machine mechanisms and navigational equipment. It is believed that the European joint venture will initially assemble drives with CMI head/disk assemblies, then produce complete drives later in 1984.

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

Hightrack has upgraded its product line to 82 MB and 165 MB capacities, and is now is producing OEM fixed disk drives using 8" plated disks. Specifications for interface, track capacity and cylinder organization are compatible with Control Data's SMD standards.

ISOT
51, Chapaev St.
Sofia, Bulgaria

1982 disk sales: $54,000,000

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 and ISOT's newest product, a 14" 80 MB disk pack drive similar to Control Data's storage module drives.

NEWBURY DATA RECORDING, LTD
Subsidiary of Data Recording Instruments Co., Ltd.
Hawthorne Road, Staines
Middlesex TW18 3BJ
England (0784) 51388

1982 disk sales: $15,900,000

Newbury Data is the new name for the organization known for the last several years as Data Recording Equipment, or DRE. Disk drive products now sold by Newbury Data 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, plus the Windsor, an 8" 80 MB Winchester derived from a DRE development program underway at the time of the 1979 joint venture agreement. Newbury Data has also agreed with DMA Systems on a license for the DMA 5.25" disk cartridge drives, which will be manufactured in England.

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

1982 disk sales: $85,000,000

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 previously 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

1982 disk sales: $14,500,000

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 withdrew from Irwin Olivetti, the Ann Arbor, Michigan, firm which was to have had marketing responsibility for Olivetti's peripherals in the U.S.

ments in 1981, and achieved a healthy growth rate in 1982. Ampex has acquired a license to sell and manufacture the Rodime drives in the United States. Rodime has expanded its product line to include 5.25" models with as much as 53 MB capacity, and is the first manufacturer to ship 3.5" Winchester disk drives.

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

1982 disk sales: $69,800,000
1982 total net sales: $16,710,664,000 Net income: $275,638,000
(Basis: DM 2.40 = 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.