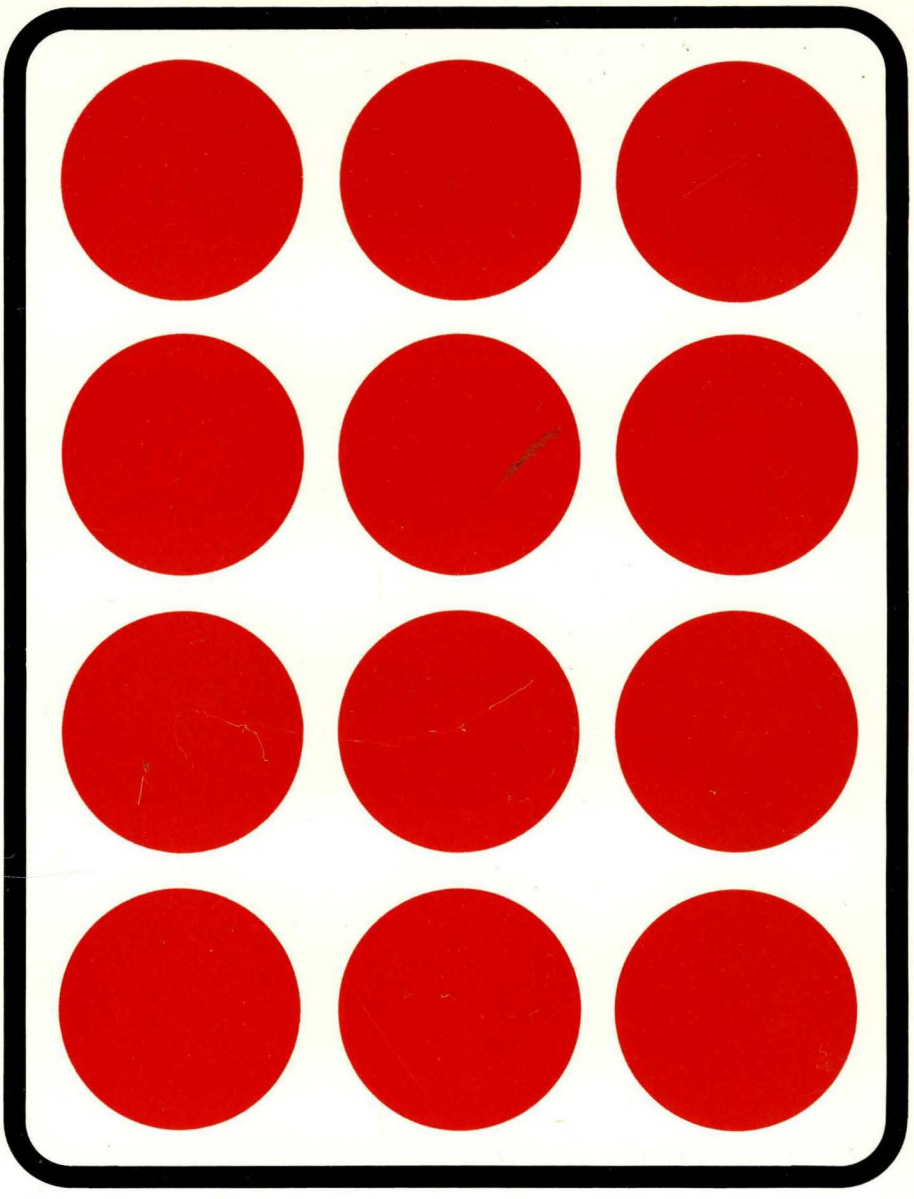
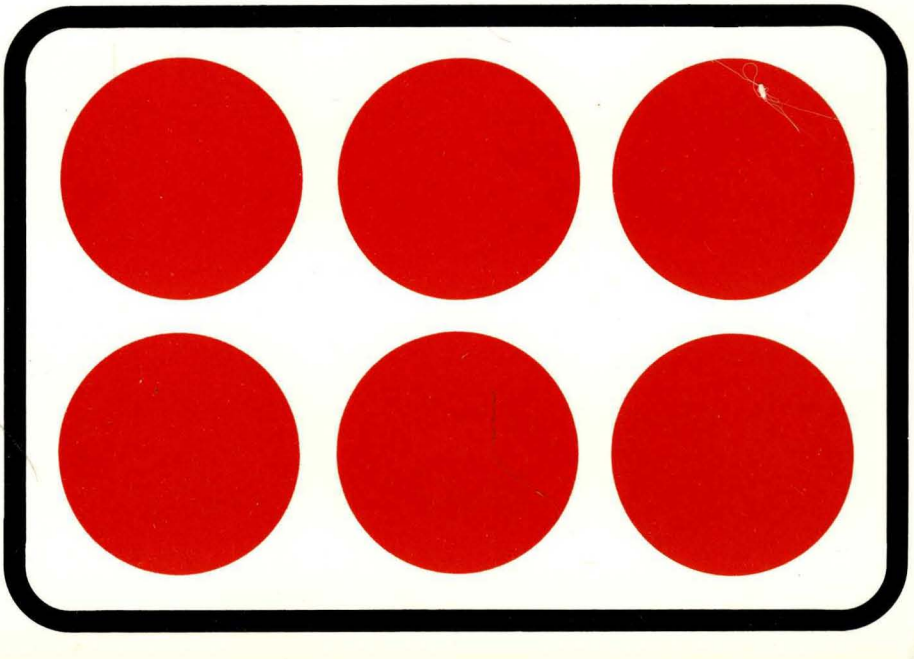


# 1985 DISK/TREND® REPORT



## FLEXIBLE DISK DRIVES

# 1985 DISK/TREND® REPORT

FLEXIBLE DISK DRIVES

December, 1985

DISK/TREND, Inc.
5150 El Camino Real, Suite B-20
Los Altos, California 94022

Telephone: 415/961-6209
Facsimile: 415/969-2560
Telex: 171914

## FOREWORD

This year has provided more change in the flexible disk drive industry than any previous period. The movement to Asian production proceeded faster than ever, competition from a new wave of Japanese manufacturers triggered a collapse in OEM prices for high volume products, and the industry had its first year in which shipments and revenues declined. Fortunately, new growth is expected for 1986 and later.

This section of the DISK/TREND Report covers flexible disk drives only, and a separate section, published in October, covers rigid disk drives. We now have completed nine years of publication for the report.

As many of you already know, Robert H. Katzive has joined our organization and has been actively involved in preparation of this year's reports. Bob and I are always willing to help you at any time by providing additional information on the industry which we may have available.

Your suggestions for improvements in the report are always welcome.

James N. Porter

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# INTRODUCTION

## The organization of the DISK/TREND Report stays mostly the same

This year's report on flexible disk drives has been organzed in much the same way as last year's, as we continue to make an effort to provide a consistent basis of comparison each year between old and new. These are the minor changes you will find in the report:

* Since 1981, special flexible disk drives, those sufficiently different from standard industry product configurations to warrant special treatment, have been covered in a separate section, but without forecasts of shipments and revenue. In this year's report, we have added statistical tables covering both shipments and revenue, in the usual DISK/TREND formats.

* Product group numbers used in the specification section and to identify each section of the report have been changed, in order to maintain consistence with the separate report on rigid disk drives.

## Please note these points

* When disk drives are produced for a drive manufacturer by a second manufacturer on a contract manufacturing basis, using designs in which the first manufacturer has a proprietary interest, we have credited the first manufacturer in our revenue and shipment statistics.

* All unit totals are given in spindles -- so that a disk drive with two spindles is counted in DISK/TREND statistics as two spindles. Drives which use a single actuator to control head movement on two flexible disks are counted as two spindles.

* Even if you are thoroughly familiar with the industry's terminology, you will find it helpful to review the definitions section of the report, since several terms with conflicting meanings have been resolved on an arbitrary basis.

# SUMMARY

## Industry size

1985 has been a poor year for flexible disk drive manufacturers, the first year of declining revenues and shipments. Worldwide unit shipments for 1985 are estimated at 18,081,600 drives, down 5.8% from the peak year of 1984, and revenues are placed at $2,902,500,000, a drop of 17.1%.

This year's declines are attributed to difficult conditions throughout most of the computer industry, especially with personal computers, the largest market for floppy drives. The low revenue figure is also caused by rapid reductions in prices for high volume drive configurations, as many new Japanese drive manufacturers fight for market share.

Although current increases in the value of the Yen in monetary markets have stabilized international OEM floppy drive pricing in the second half of 1985, continued tough competition and changes in product mix will hold projected revenue growth to an annual average of 4.5% during 1985-88. Growth in unit shipments is expected to resume at an annual average of 16.1% for the same period, with 1988 shipments reaching 28,290,000 units.

The movement of the flexible disk drive industry to Japan accelerated in 1985. U.S. captive manufacturing by IBM, Tandy and others was being closed out, and shipments of OEM drives by major producers such as Qume, Shugart, Control Data and Micro Peripherals were either being phased out or already stopped. Digital Equipment has the only continuing U.S. captive flexible disk drive manufacturing program of significance, and Tandon remains the only large-scale OEM drive manufacturer based in the United States. 22 Japanese companies now produce floppy drives in quantity.

TABLE 1

CONSOLIDATED WORLDWIDE REVENUES

ALL EXISTING FLEXIBLE DISK DRIVE GROUPS

REVENUE SUMMARY

| | DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Revenues | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | 369.4 | 513.3 | 256.5 | 369.6 | 89.1 | 135.3 | 40.0 | 60.8 | -- | -- |
| Other U.S. Captive | 285.7 | 374.1 | 177.4 | 240.7 | 96.8 | 131.1 | 65.0 | 87.3 | 34.4 | 45.9 |
| TOTAL U.S. CAPTIVE | 655.1 | 887.4 | 433.9 | 610.3 | 185.9 | 266.4 | 105.0 | 148.1 | 34.4 | 45.9 |
| PCM | 47.8 | 51.1 | 82.8 | 88.5 | 130.2 | 139.3 | 173.3 | 191.1 | 186.2 | 209.7 |
| OEM | 633.9 | 710.5 | 159.7 | 185.6 | 122.9 | 142.2 | 109.2 | 128.5 | 119.0 | 142.6 |
| TOTAL U.S. NON-CAPTIVE | 681.7 | 761.6 | 242.5 | 274.1 | 253.1 | 281.5 | 282.5 | 319.6 | 305.2 | 352.3 |
| TOTAL U.S. REVENUES | 1,336.8 | 1,649.0 | 676.4 | 884.4 | 439.0 | 547.9 | 387.5 | 467.7 | 339.6 | 398.2 |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | 169.0 | 851.4 | 191.8 | 972.0 | 201.7 | 1,102.7 | 212.5 | 1,203.7 | 200.0 | 1,213.9 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 447.2 | 1,028.8 | 461.4 | 1,046.1 | 618.8 | 1,316.8 | 735.0 | 1,496.4 | 808.4 | 1,558.5 |
| TOTAL NON-U.S. REVENUES | 616.2 | 1,880.2 | 653.2 | 2,018.1 | 820.5 | 2,419.5 | 947.5 | 2,700.1 | 1,008.4 | 2,772.4 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE REVENUES | 1,953.0 | 3,529.2 | 1,329.6 | 2,902.5 | 1,259.5 | 2,967.4 | 1,335.0 | 3,167.8 | 1,348.0 | 3,170.6 |

Marketing channels

The number of flexible disk drive manufacturers is finally starting to decline. 53 manufacturers of announced flexible disk drives are listed in this year's DISK/TREND Report, down from 61 last year.

The list of United States manufacturers has seen the sharpest reduction. 12 U.S. companies still make floppy drives, and some of those plan to phase out production. Last year 20 U.S. manufacturers were listed, and at the peak of U.S. activity in 1981, 26 firms were included. European activity is also down, with last year's total of 10 firms going down to 7 this year. In contrast, 34 Asian floppy drive manufacturers are included this year, up three.

IBM's decision to phase out production of flexible disk drives will shift the majority of industry revenues to OEM drives, in spite of modest growth in non-U.S. captive revenues. U.S. captive revenues are forecasted to drop from 25.1% of the worldwide total for all floppy drive revenues in 1984 to 1.4% in 1988.

Many system manufacturers which might previously have made their own floppy drives now prefer to buy OEM drives at low prices and avoid the product development scramble to keep up with the continuing parade of new drive configurations. Most of this business will go to non-U.S. manufacturers of OEM drives, whose share of worldwide floppy drive revenues will climb from 1984's 29.3% to 1988's 49.2%. It should be noted that the increase in unit shipments will be much greater than is reflected by these numbers, given the movement from older captive drives sold at end user price levels to newer OEM drives sold at continually declining prices.

TABLE 2

CONSOLIDATED WORLDWIDE REVENUES

ALL EXISTING FLEXIBLE DISK DRIVE GROUPS

MARKET CLASS SUMMARY

| WORLDWIDE REVENUES BY MANUFACTURER TYPE | 1984 Revenues $M | 1984 Revenues % | Forecast 1985 $M | Forecast 1985 % | Forecast 1986 $M | Forecast 1986 % | Forecast 1987 $M | Forecast 1987 % | Forecast 1988 $M | Forecast 1988 % |
|---|---|---|---|---|---|---|---|---|---|---|
| U.S. Manufacturers | | | | | | | | | | |
| IBM Captive | 513.3 | 14.5 | 369.6 | 12.7 | 135.3 | 4.6 | 60.8 | 1.9 | -- | -- |
| Other U.S. Captive | 374.1 | 10.6 | 240.7 | 8.3 | 131.1 | 4.4 | 87.3 | 2.8 | 45.9 | 1.4 |
| PCM | 51.1 | 1.5 | 88.5 | 3.1 | 139.3 | 4.7 | 191.1 | 6.0 | 209.7 | 6.7 |
| OEM | 710.5 | 20.1 | 185.6 | 6.4 | 142.2 | 4.8 | 128.5 | 4.1 | 142.6 | 4.5 |
| Total U.S. Mfgr's. | 1,649.0 | 46.7 | 884.4 | 30.5 | 547.9 | 18.5 | 467.7 | 14.8 | 398.2 | 12.6 |
| Non-U.S. Manufacturers | | | | | | | | | | |
| Captive | 851.4 | 24.1 | 972.0 | 33.5 | 1,102.7 | 37.1 | 1,203.7 | 38.0 | 1,213.9 | 38.2 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 1,028.8 | 29.2 | 1,046.1 | 36.0 | 1,316.8 | 44.4 | 1,496.4 | 47.2 | 1,558.5 | 49.2 |
| Total Non-U.S. Mfgr's. | 1,880.2 | 53.3 | 2,018.1 | 69.5 | 2,419.5 | 81.5 | 2,700.1 | 85.2 | 2,772.4 | 87.4 |
| Worldwide Total | 3,529.2 | 100.0 | 2,902.5 | 100.0 | 2,967.4 | 100.0 | 3,167.8 | 100.0 | 3,170.6 | 100.0 |

Product mix

Two sided 5.25 inch flexible disk drives continue to provide more than half of the industry's unit shipments, and this product configuration is forecasted to continue as the leader through 1988, with growth to over 14 million drives in that year. The most popular type of two sided 5.25 inch drives will be half high models with 1.6 megabyte capacity or higher, which are expected to reach 55% of 1988 shipments for the product group.

However, by 1988, microfloppy drives will be closing in on the leading position. While most other floppy drive types have been declining in shipments during 1985, microfloppies are expected to grow 71.2%. Microfloppy shipments for 1988 are projected to exceed 12.5 million drives, driven by the anticipated future strong market for small portable computers and small footprint desktop systems.

Bernoulli principle floppy drives, included in the "special drives" product group in this year's DISK/TREND Report, are expected to continue providing most of that group's strong growth in both shipments and revenues, but from a comparatively small base. All other floppy product groups are now declining rapidly, including the previous leader, single sided 5.25 inch drives.

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

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

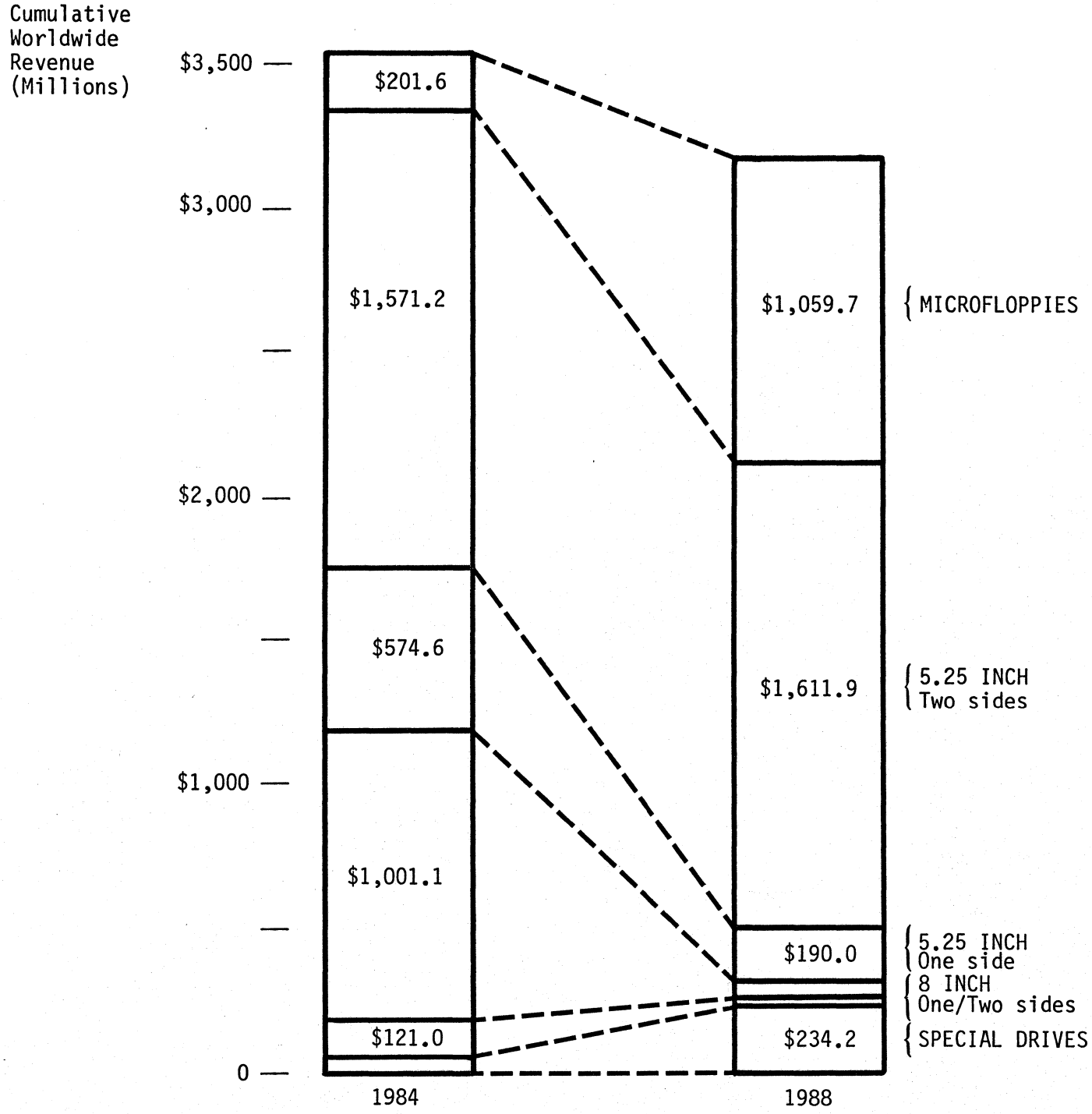

TABLE 3

WORLDWIDE SHIPMENTS

PRODUCT CATEGORY SUMMARY

ALL MANUFACTURERS

| Units: Thousands / Dollars: $ Million | | 1984 Shipments Ship | 1984 Shipments Δ% | Forecast 1985 Ship | 1985 Δ% | 1986 Ship | 1986 Δ% | 1987 Ship | 1987 Δ% | 1988 Ship | 1988 Δ% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **8 INCH DRIVES** | | | | | | | | | | | |
| One Side | Units | 216.6 | -35.6 | 124.9 | -42.3 | 88.5 | -29.1 | 62.0 | -29.9 | 40.0 | -35.4 |
| | $M | 121.0 | -35.5 | 68.6 | -43.3 | 41.5 | -39.5 | 29.9 | -27.9 | 18.8 | -37.1 |
| Two Sides | Units | 1,206.1 | - 5.4 | 801.0 | -33.5 | 562.0 | -29.8 | 334.0 | -40.5 | 142.0 | -57.4 |
| | $M | 1,001.1 | -17.2 | 666.2 | -33.4 | 403.5 | -39.4 | 199.9 | -50.4 | 56.0 | -71.9 |
| 8 INCH TOTAL | Units | 1,422.7 | -11.7 | 925.9 | -34.9 | 650.5 | -29.7 | 396.0 | -39.1 | 182.0 | -54.0 |
| | $M | 1,122.1 | -19.6 | 734.8 | -34.5 | 445.0 | -39.4 | 229.8 | -48.3 | 74.8 | -67.4 |
| **5.25 INCH DRIVES** | | | | | | | | | | | |
| One Side | Units | 4,969.3 | +14.9 | 2,828.3 | -43.0 | 2,030.0 | -28.2 | 1,381.0 | -31.9 | 893.0 | -35.3 |
| | $M | 574.6 | - 8.4 | 355.0 | -38.2 | 277.5 | -21.8 | 237.9 | -14.2 | 190.0 | -20.1 |
| Two Sides | Units | 10,646.4 | +72.6 | 10,671.4 | + .2 | 12,168.5 | +14.0 | 13,870.0 | +13.9 | 14,082.0 | + 1.5 |
| | $M | 1,571.2 | +42.2 | 1,349.4 | -14.1 | 1,429.8 | + 5.9 | 1,612.2 | +12.7 | 1,611.9 | -- |
| 5.25 INCH TOTAL | Units | 15,615.7 | +48.8 | 13,499.7 | -13.5 | 14,198.5 | + 5.1 | 15,251.0 | + 7.4 | 14,975.0 | - 1.8 |
| | $M | 2,145.8 | +23.9 | 1,704.4 | -20.5 | 1,707.3 | + .1 | 1,850.1 | + 8.3 | 1,801.9 | - 2.6 |
| **MICROFLOPPY DRIVES** | | | | | | | | | | | |
| | Units | 1,972.0 | +349.9 | 3,378.0 | +71.2 | 6,635.0 | +96.4 | 9,466.0 | +42.6 | 12,578.0 | +32.8 |
| | $M | 201.6 | +203.1 | 362.7 | +79.9 | 656.4 | +80.9 | 874.1 | +33.1 | 1,059.7 | +21.2 |
| **SPECIAL DRIVES** | | | | | | | | | | | |
| | Units | 190.1 | -- | 278.0 | +46.2 | 380.0 | +36.6 | 489.0 | +28.6 | 555.0 | +13.4 |
| | $M | 59.7 | -- | 100.6 | +68.5 | 158.7 | +57.7 | 213.8 | +34.7 | 234.2 | + 9.5 |
| **TOTAL ALL DRIVES** | | | | | | | | | | | |
| | Units | 19,200.5 | +53.1 | 18,081.6 | - 5.8 | 21,864.0 | +20.9 | 25,602.0 | +17.0 | 28,290.0 | +10.4 |
| | $M | 3,529.2 | +10.5 | 2,902.5 | -17.7 | 2,967.4 | + 2.2 | 3,167.8 | + 6.7 | 3,170.6 | -- |

Figure 2

CHANGING PRODUCT MIX

WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
ALL MANUFACTURERS

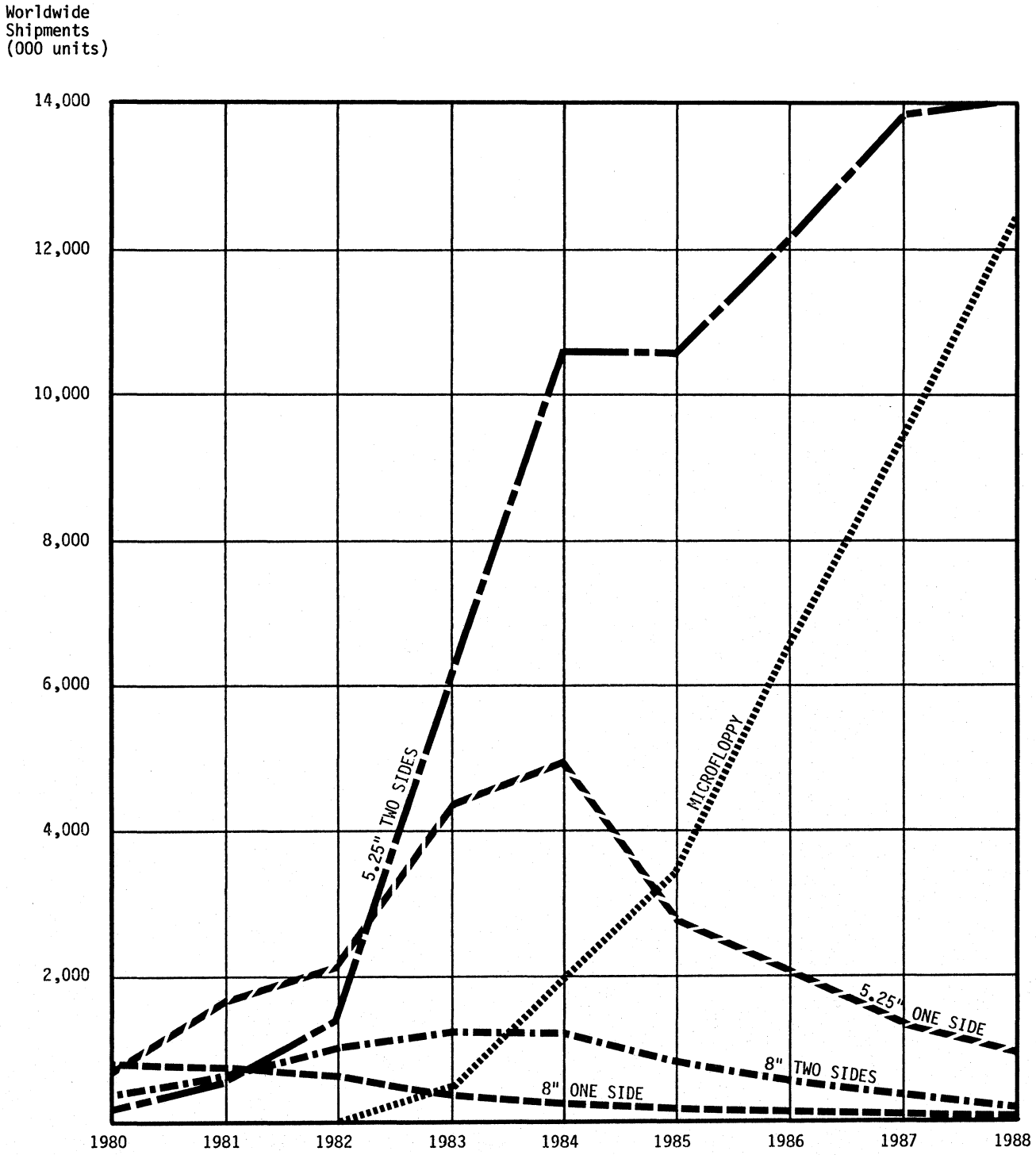

TABLE 4

WORLDWIDE SHIPMENTS

PRODUCT CATEGORY SUMMARY

MANUFACTURERS OF OEM DRIVES

| Units: Thousands / Dollars: $ Million | | 1984 Shipments Ship | 1984 Shipments Δ% | 1985 Forecast Ship | 1985 Forecast Δ% | 1986 Forecast Ship | 1986 Forecast Δ% | 1987 Forecast Ship | 1987 Forecast Δ% | 1988 Forecast Ship | 1988 Forecast Δ% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **8 INCH DRIVES** | | | | | | | | | | | |
| One Side | Units | 144.1 | -35.2 | 92.3 | -35.9 | 73.0 | -20.9 | 51.0 | -30.1 | 34.0 | -33.3 |
| | $M | 50.7 | -28.1 | 37.6 | -25.8 | 27.6 | -26.5 | 19.6 | -28.9 | 12.8 | -34.6 |
| Two Sides | Units | 611.0 | - 9.8 | 370.8 | -39.3 | 286.0 | -22.8 | 194.0 | -32.1 | 102.0 | -47.4 |
| | $M | 157.1 | -15.8 | 89.2 | -43.2 | 64.2 | -28.0 | 41.3 | -35.6 | 20.0 | -51.5 |
| 8 INCH TOTAL | Units | 755.1 | -16.1 | 463.1 | -38.6 | 359.0 | -22.4 | 245.0 | -31.7 | 136.0 | -44.4 |
| | $M | 207.8 | -19.2 | 126.8 | -38.9 | 91.8 | -27.6 | 60.9 | -33.6 | 32.8 | -46.1 |
| **5.25 INCH DRIVES** | | | | | | | | | | | |
| One Side | Units | 4,363.1 | +19.5 | 2,361.3 | -45.8 | 1,667.0 | -29.4 | 1,026.0 | -38.4 | 583.0 | -43.1 |
| | $M | 288.0 | - 4.2 | 131.1 | -54.4 | 97.3 | -25.7 | 67.8 | -30.3 | 42.2 | -37.7 |
| Two Sides | Units | 9,411.1 | +65.8 | 9,194.0 | - 2.3 | 10,585.5 | +15.1 | 11,894.0 | +12.3 | 11,904.0 | -- |
| | $M | 1,070.0 | +26.4 | 741.6 | -30.6 | 817.4 | +10.2 | 879.4 | + 7.5 | 846.6 | - 3.7 |
| 5.25 INCH TOTAL | Units | 13,774.2 | +47.7 | 11,555.3 | -16.1 | 12,252.5 | + 6.0 | 12,920.0 | + 5.4 | 12,487.0 | - 3.3 |
| | $M | 1,358.0 | +18.3 | 872.7 | -35.7 | 914.7 | + 4.8 | 947.2 | + 3.5 | 888.8 | - 6.1 |
| **MICROFLOPPY DRIVES** | | | | | | | | | | | |
| | Units | 1,846.0 | +337.1 | 2,924.0 | +58.3 | 5,918.0 | +102.3 | 8,507.0 | +43.7 | 11,484.0 | +34.9 |
| | $M | 157.3 | +163.0 | 215.4 | +36.9 | 430.4 | +99.8 | 588.2 | +36.6 | 744.1 | +26.5 |
| **SPECIAL DRIVES** | | | | | | | | | | | |
| | Units | 153.9 | -- | 190.0 | +23.4 | 230.0 | +21.0 | 275.0 | +19.5 | 312.0 | +13.4 |
| | $M | 16.2 | -- | 16.8 | + 3.7 | 22.1 | +31.5 | 28.6 | +29.4 | 35.4 | +23.7 |
| **TOTAL ALL DRIVES** | | | | | | | | | | | |
| | Units | 16,529.2 | +55.2 | 15,132.4 | - 8.4 | 18,759.5 | +23.9 | 21,947.0 | +16.9 | 24,419.0 | +11.2 |
| | $M | 1,739.3 | +18.7 | 1,231.7 | -29.1 | 1,459.0 | +18.4 | 1,624.9 | +11.3 | 1,701.1 | + 4.6 |

Figure 3

CHANGING PRODUCT MIX

WORLDWIDE FLEXIBLE DISK DRIVE SHIPMENTS
MANUFACTURERS OF OEM DRIVES

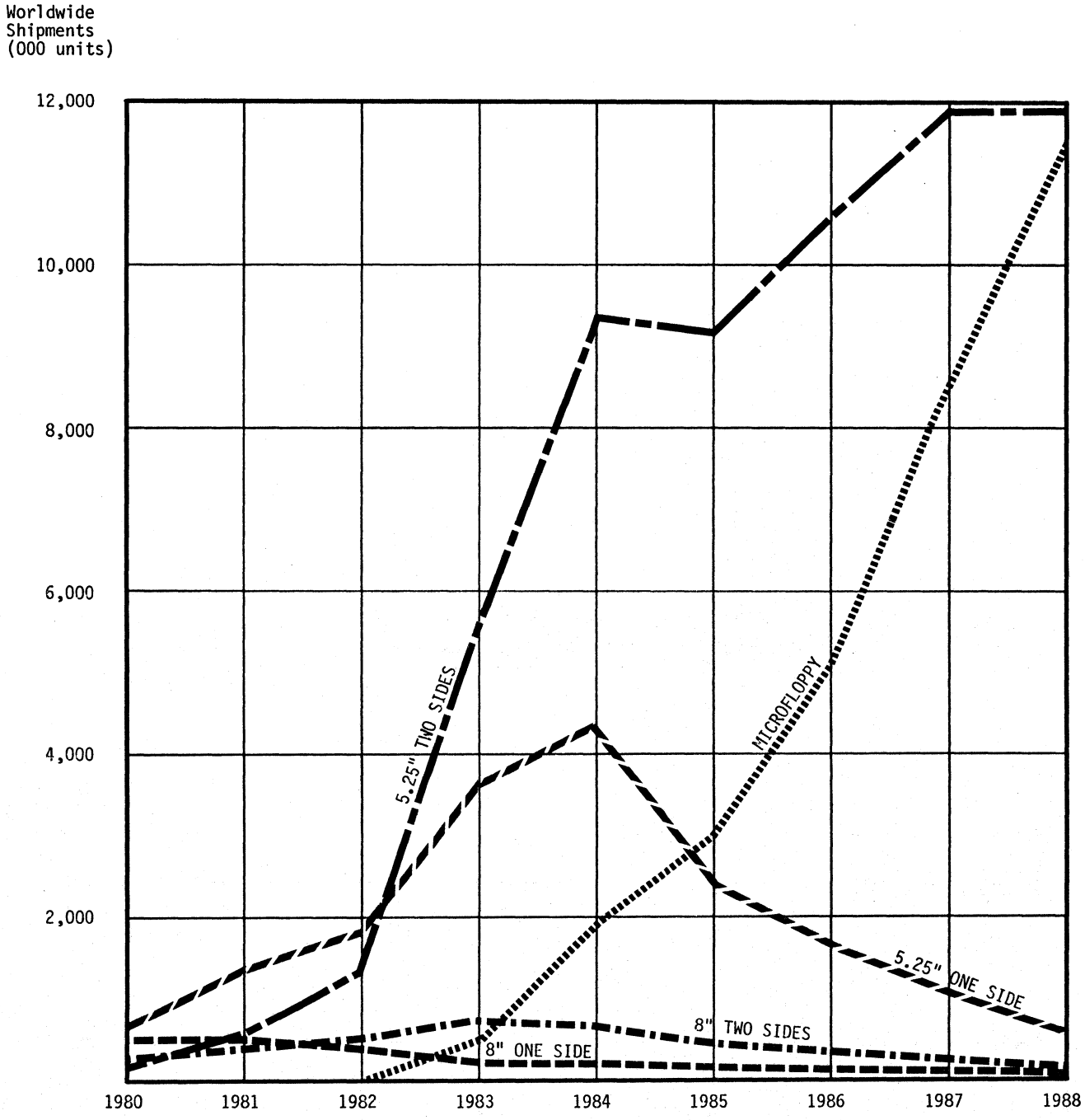

TABLE 5

1984 ESTIMATED MARKET SHARES

WORLDWIDE REVENUES OF ALL FLEXIBLE DISK DRIVES
(Value of non-U.S. currencies estimated at July, 1984, rates)

| | CAPTIVE | | NON-CAPTIVE* | | TOTAL INDUSTRY | |
|---|---|---|---|---|---|---|
| | $M | % | $M | % | $M | % |
| **U.S. MANUFACTURERS** | | | | | | |
| Control Data | 10.0 | .6 | 126.9 | 7.1 | 136.9 | 3.9 |
| Digital Equipment | 137.0 | 7.9 | -- | -- | 137.0 | 3.9 |
| IBM | 513.1 | 29.5 | -- | -- | 513.1 | 14.5 |
| Iomega | -- | -- | 51.0 | 2.8 | 51.0 | 1.4 |
| Micro Peripherals | -- | -- | 25.2 | 1.4 | 25.2 | .7 |
| Qume | 15.0 | .8 | 68.7 | 3.8 | 83.7 | 2.4 |
| Shugart | 135.0 | 7.8 | 126.2 | 7.0 | 261.2 | 7.4 |
| Tandon | -- | -- | 334.0 | 18.7 | 334.0 | 9.5 |
| Tandy | 73.5 | 4.2 | -- | -- | 73.5 | 2.1 |
| Other U.S. | 3.8 | .2 | 29.6 | 1.7 | 33.4 | .9 |
| U.S. Total | 887.4 | 51.0 | 761.6 | 42.5 | 1649.0 | 46.7 |
| **NON-U.S. MANUFACTURERS** | | | | | | |
| Alps Electric | -- | -- | 133.7 | 7.5 | 133.7 | 3.8 |
| BASF | -- | -- | 40.9 | 2.3 | 40.9 | 1.1 |
| Canon | 21.1 | 1.2 | 17.0 | .9 | 38.1 | 1.1 |
| Chinon | -- | -- | 36.2 | 2.0 | 36.2 | 1.0 |
| Epson | 76.7 | 4.4 | 28.4 | 1.6 | 105.1 | 3.0 |
| Hitachi | 49.1 | 2.8 | 30.2 | 1.7 | 79.3 | 2.2 |
| ISOT | 11.1 | .6 | 12.1 | .7 | 23.2 | .7 |
| Matsushita Com. Ind. | -- | -- | 76.1 | 4.3 | 76.1 | 2.2 |
| Mitsubishi | 63.8 | 3.7 | 105.6 | 5.9 | 169.4 | 4.8 |
| NEC | 351.7 | 20.2 | 21.9 | 1.2 | 373.6 | 10.6 |
| Olivetti | 136.9 | 7.9 | -- | -- | 136.9 | 3.9 |
| Philips | 38.1 | 2.2 | 3.1 | .2 | 41.2 | 1.2 |
| Ricoh | 15.5 | .9 | 4.7 | .3 | 20.2 | .6 |
| Sony | 19.7 | 1.1 | 90.3 | 5.0 | 110.0 | 3.1 |
| Teac | -- | -- | 177.7 | 9.9 | 177.7 | 5.0 |
| Tokyo Electric | -- | -- | 41.2 | 2.3 | 41.2 | 1.2 |
| Toshiba | 59.8 | 3.4 | 36.0 | 2.0 | 95.8 | 2.7 |
| Wong's Technology | -- | -- | 19.0 | 1.1 | 19.0 | .5 |
| YE Data | -- | -- | 105.9 | 5.9 | 105.9 | 3.0 |
| Other Non-U.S. | 7.9 | .6 | 48.8 | 2.7 | 56.7 | 1.6 |
| Non-U.S. Total | 851.4 | 49.0 | 1028.8 | 57.5 | 1880.2 | 53.3 |
| Worldwide Total | 1738.8 | 100.0 | 1790.4 | 100.0 | 3529.2 | 100.0 |

*Includes PCM and OEM drives.

TABLE 6

Codes: C = Captive
P = PCM
O = OEM
Numbers in table indicate TPI

CURRENT PRODUCT LINES
MANUFACTURERS OF FLEXIBLE DISK DRIVES

| U.S. MANUFACTURERS | TYPE | DISK/TREND PRODUCT GROUP: 13 8 INCH ONE SIDE | 14 8 INCH TWO SIDES | 15 5.25 INCH ONE SIDE | 16 5.25 INCH TWO SIDES | 17 MICRO FLOPPIES | 18 SPECIAL |
|---|---|---|---|---|---|---|---|
| Au Peripheral Products | O | | | | | 135 | |
| Caldisk | C,O | 48 | 48 | | | | |
| Control Data | C,P,O | | 48 | 48 | 48,96 | | |
| Digital Equipment | C | 48 | | 96 | | | |
| Eastman Kodak | C,O | | | | 192,333,384 | | |
| Hi-Tech Peripherals | O | | | 48 | 48,96 | | |
| IBM | C | 48 | 48 | | | | |
| Iomega | P,O | | | | | | 300,394,641 |
| Miltope | O | 48 | 48 | | | | |
| Omek | O | | | | 48,96 | | |
| Shugart | C,O | 48 | 48 | | | | |
| Tandon | O | 48 | 48 | 48 | 48,96 | 135 | |
| **ASIAN MANUFACTURERS** | | | | | | | |
| Akan | O | | | | | 135 | |
| Alps Electric | O | | | 48,96 | 48,96 | 67.5,135 | |
| Brother | C,O | | | | | 135 | |
| Canon | C,O | | | | 48,96 | 67.5,135 | |
| Chinon | O | | | 48 | 48,96 | 67.5,100,135 | |
| Citizen | O | | | | | 135 | |
| Copal | O | | | | 48,96 | 135 | |
| Epson | C,P,O | | | | 48,96 | 67.5,135 | |
| Fujitsu | C,O | | | | 48,96 | 135 | |
| Gold Star | C,O | | | 48 | 48 | | |
| Hitachi | C,O | | 48,96 | | 48,96,125 | 100 | |
| Janome Sewing Machine | O | | | | | 67.5,100,135 | |
| Lung Hwa | O | | | 48 | 48 | | |
| Matsushita Com. Ind. | C,O | | 48 | | 48,96 | 67.5,135 | |
| Matsushita Elect. Ind. | O | | | | | 100,200 | |
| Mitac | P,O | | | 48 | 48 | | |
| Mitsubishi | C,O | | 48 | | 48,96 | 135 | |
| Mitsumi | O | | | 48 | 48,96 | 67.5,135 | 72mm Spiral |
| NEC | C,O | | 48 | | 48,96 | 135 | |
| Oki Electric | C,O | | | | 48,96 | | |
| Ricoh | C,O | | 48 | | 48,96 | 67.5,135 | |
| Samsung | C,O | | | 48 | | | |
| Sankyo Seiki | O | | | | | 100,135 | 66mm Spiral |
| Seikosha | O | | | | | 135 | |
| Shinwa Co., Ltd. | O | | | | 48 | 135 | |
| Sony | C,O | | | | | 135 | |
| TEAC | O | | | 48,96 | 48,96 | 67.5,100,135 | |
| Tokyo Electric Company | O | | | 48,96 | 48,96 | 67.5,135 | 66mm Spiral |
| Toshiba | C,O | | 48 | | 48,96 | 135 | |
| Victor Co. of Japan | O | | | | 48,96 | 67.5,135 | |
| Video Technology | P,O | | | 48,96 | 48,96 | | |
| Weltec Digital | P,O | | | 48,96 | 48,96 | | |
| Wong's Technology | P,O | | | 48 | 48,96 | | |
| YE Data | O | | 48 | | 48,96 | 67.5,135 | |
| **EUROPEAN MANUFACTURERS** | | | | | | | |
| BASF | O | 48 | 48 | | 48,96 | 67.5,135 | |
| Elcomatic | O | 48 | 48,96 | 48,96 | 48,96 | | |
| Instrumentation & Automation | C | | | 48 | | | |
| ISOT | C,O | 48 | 48 | 48 | 48,96 | | |
| Olivetti | C,O | 48 | 48 | 48 | 48,96 | 135 | |
| Robotron | C,O | | | 48,96 | | | |
| Videoton/MOM | C,O | 48 | | 48 | | | |

Application mix

The share of total flexible disk drive shipments going to professional and business microcomputer systems applications increased again in 1984, to 67.5% of the worldwide total. The 1988 share for this application is expected to decline slightly to 61.4% of the total for all types of drives, however, as the consumer and hobby computer market grows at a faster rate.

Professional and business microcomputers used 71.6% of the two sided 5.25 inch drives in 1984, and the application is expected to consume 84.4% of the 1988 total for this product group, as business users continue to demand more capacity. 77.4% of microfloppy drives went to this application in 1984, but by 1988 the share of microfloppies used for this requirement is forecasted to drop to 39.6%, serving mostly the portable and small-footprint portion of the market.

Consumer and hobby computer markets used 15.1% of all floppy drives shipped in 1984, but increasing penetration of floppy drives in this application will increase the number to 26.9% in 1988. Although 69.5% of one side 5.25 inch drives will be sold for this market in 1988, due to highly competitive prices, it is expected that microfloppies will achieve higher actual shipments in that year, a total of 5,525,000 drives.

Word processing is declining in relative importance, compared to the above applications, as personal and home computers grow in their ability to provide sophisticated word processing functions combined with other applications at low cost -- dropping to 5.3% of all shipments for 1988.

TABLE 7

FLEXIBLE DISK DRIVE APPLICATION PROJECTION

CONSOLIDATED WORLDWIDE SHIPMENTS

| | 1984 ESTIMATE | | | | | | 1988 Projection | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All FDD* | 8" One Side | 8" Two Sides | 5.25" One Side | 5.25" Two Sides | Micro Floppies | All FDD* | 8" One Side | 8" Two Sides | 5.25" One Side | 5.25" Two Sides | Micro Floppies |
| **PROFESSIONAL AND BUSINESS MICRO-COMPUTER SYSTEMS** | | | | | | | | | | | | |
| Units (000) | 12,833.1 | 22.6 | 616.4 | 3,047.9 | 7,621.1 | 1,525.1 | 17,029.3 | -- | 53.1 | 107.5 | 11,887.4 | 4,981.3 |
| Share % | 67.5% | 10.4% | 51.1% | 61.3% | 71.6% | 77.4% | 61.4% | -- | 37.4% | 12.0% | 84.4% | 39.6% |
| **WORKSTATIONS USED WITH MAIN-FRAMES, MINIS** | | | | | | | | | | | | |
| Units (000) | 970.2 | 81.4 | 304.0 | 60.3 | 508.6 | 15.9 | 1,220.3 | 11.2 | 44.2 | 54.8 | 638.1 | 472.0 |
| Share % | 5.1% | 37.6% | 25.2% | 1.2% | 4.8% | .8% | 4.4% | 28.0% | 31.1% | 6.2% | 4.6% | 3.8% |
| **WORD PROCESSING AND TYPESETTING SYSTEMS** | | | | | | | | | | | | |
| Units (000) | 1,975.2 | 102.1 | 190.3 | 252.1 | 1,274.7 | 156.0 | 1,470.0 | 26.3 | 23.4 | 68.7 | 535.1 | 816.5 |
| Share % | 10.4% | 47.1% | 15.8% | 5.1% | 12.0% | 7.9% | 5.3% | 65.8% | 16.5% | 7.7% | 3.8% | 6.5% |
| **CONSUMER AND HOBBY COMPUTERS** | | | | | | | | | | | | |
| Units (000) | 2,861.1 | 4.5 | 39.8 | 1,558.6 | 1,003.6 | 254.6 | 7,460.7 | -- | -- | 609.9 | 708.0 | 6,142.8 |
| Share % | 15.1% | 2.1% | 3.3% | 31.4% | 9.4% | 12.9% | 26.9% | -- | -- | 68.3% | 5.0% | 48.8% |
| **OTHER APPLICATIONS** | | | | | | | | | | | | |
| Units (000) | 370.8 | 6.0 | 55.6 | 50.4 | 238.4 | 20.4 | 554.7 | 2.5 | 21.3 | 52.1 | 313.4 | 165.4 |
| Share % | 1.9% | 2.8% | 4.6% | 1.0% | 2.2% | 1.0% | 2.0% | 6.2% | 15.0% | 5.8% | 2.2% | 1.3% |
| **TOTAL, ALL APPLICATIONS** | | | | | | | | | | | | |
| Units (000) | 19,010.4 | 216.6 | 1,206.1 | 4,969.3 | 10,646.4 | 1,972.0 | 27,735.0 | 40.0 | 142.0 | 893.0 | 14,082.0 | 12,578.0 |
| Share % | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

*Does not include special floppy drives.

## TECHNICAL REVIEW

### Competing technologies

No competing technology has provided effective competition to flexible disk drives in their existing mainstream markets. The only significant competition for the principal floppy drive configurations has come from newer floppy drives offering more capacity, smaller size or lower price.

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

The unique combination of low cost, random access and media removability provided by flexible disk drives is the reason for their growth. To have an impact on floppy drives, any competing technology must offer a significant improvement at a competitive price.

These products are the ones with the most potential to challenge flexible disk drives in selected markets:

* Small rigid disk drives: The rapid growth of small Winchester disk drives has displaced large quantities of floppy drives which otherwise would have been sold, but availability of these rigid disk drives has probably also served to increase the size of the total market for small computer systems, and therefore boost the market for floppy drives. For almost all small fixed disk drives install-

ed, a companion removable media recording device is necessary to provide for software distribution, save/restore of programs and files, and backup to protect against hardware, software or operator error. And most of the time that removable device is a floppy disk drive.

The rigid disk challenge to flexible disk drives will probably be most effectively presented by 5.25 inch and smaller rigid disk cartridge drives. Small disk cartridge drives are one of the best ways to accomplish fast save and restore of files in the 5-10 megabyte range, and offer access times fast enough to be satisfactory as a basic system disk, in lieu of a fixed Winchester drive. Availability has been the limiting factor in growth of the disk cartridge share of this market, with only a few manufacturers so far in production. Despite their slow start, drives of this type may be expected to secure a significant share of the market requirement for 5-10 megabyte removable media devices, providing major competition to high capacity floppy drives. If floppy disk drives having capacities in the 5-10 MB range are successful, then rigid disk drives will be less attractive as a floppy disk replacement. Such high capacity floppy drives were introduced by Eastman Kodak in 1985.

* Stretched surface recording: Another candidate is the stretched surface recording (SSR) technology developed by 3M. SSR is now the subject of drive development programs by other manufacturers for both a removable cartridge and fixed drive formats. In either implementation, a magnetic recording layer is placed upon a plastic film which is then stretched across concentric cylindrical rings. The chief characteristic of this technology is that it allows a head to fly on an air cushion backed by a deformable surface that bulges slightly in the region under the head. This provides the close head-media separation needed for high capacity, but also makes the product head-crash proof. The capacity of such a product will be similar to that of a Winchester disk drive of matching diameter, but the cost may eventually be substantially less because the SSR disk has the potential of being fabricated at only one quarter of the cost of an aluminum substrate disk. If adequately supported and promoted by 3M, SSR has the potential to become a major commercial technology by 1990.

* Non-reversible optical disks: The first optical disk recording systems to enter the market are "non-reversible" or "write-once" systems. After many years of costly development programs undertaken by several European and Japanese manufacturers, such devices are beginning to be introduced as shippable products.

Write-once drives are capable of higher areal densities than magnetic recording techniques now in use. Some planned systems provide several gigabytes on a single removable disk. Other products are being used in mass storage systems which access large numbers of optical 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 raw 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. 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 and disk drives from a variety of firms, including Storage Technology, Control Data, Xerox, Alcatel Thomson, Hitachi, Toshiba, NEC and Sony are now starting to appear. STC's 7640, with first shipments delayed until 1986, 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 databases 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 now entering the market use comparable, but different technologies, with capacities per disk in the range of one tenth to three gigabytes. These systems will be marketed initially as OEM drives, and some will probably be used also in captive systems. Obviously, the market for this generation of optical disk systems will be limited to the niches which can tolerate nonreversibility. These niches do exist and 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. The

relatively high costs of drives, media, and system support as compared to the costs of floppy disk drives, media, and support make it very unlikely that write-once optical storage will have any impact on floppy disk drive markets. The vast difference in storage capacities means that there will be almost no overlap in application or usage.

* Erasable optical disks: The possibility for real inroads into the market for magnetic disk drives exists with reversible optical disk systems, when 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 power laser to change the magnetic state of an amorphous coating on a disk. The laser raises surface temperatures into the range of the coating's Curie point while a magnetic field is present, causing the stored magnetic field on the disk to align with the direction of the external field. 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. However, it is believed that the first volume shipments of major erasable optical disk drive systems will take another two to three years. Most of the technical problems may have been overcome by some of the U.S., Japanese or European companies working in the area, but none of these firms are yet known to have committed to the heavy investment required to establish volume production capability. Lack of standardization between optical technologies is causing potential manufacturers to proceed with caution, lest they make inappropriate investments in large scale production tooling.

No shippable product is anticipated before 1987, but technology announcements have been made by Verbatim and several Japanese firms. No immediate impact from erasable optical technology is seen impacting floppy disk drives. The relative costs of optical versus floppy disk implementations for low capacity storage devices are highly unfavorable to optical technology at present. However, if magneto-optical media is displaced by other types having lower production costs, then erasable optical drives have some potential to displace very high end floppy drives having capacities above five megabytes. Floppy drives below this capacity range are unlikely to see any impact, and even the high end impact is unlikely prior to 1990.

* Magnetic bubbles: If regarded as a specialized data storage product, magnetic bubbles still 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.

  Bubbles started to find suitable applications, once they were actually in production and support chips became available. The highest 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.

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 bubbles' main markets will be smaller and more specialized.

* Tape drives: When disk drive capacities used with small computer systems rise above 20-30 megabytes, the functional requirements for a removable media backup device frequently cannot be met by a flexible disk drive. Floppies' comparatively limited capacity is usually adequate for systems on which the typical file is also small, such as with word processing systems, many small business systems, and most personal computers. But if files are typically large, if a data base management system is used, or if it is necessary to back up an entire rigid disk for protection at the end of each day, most of today's floppies are usually not the best answer.

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

  The streaming tape cartridge drives now offered by several manufacturers are likely to achieve a major penetration of this market. Streamers have been available from a few suppliers during the past few years, but with different interfaces and recording formats from each manufacturer -- a situation which discouraged many system manufacturers from investing in the controller and software development needed to use these drives. However, the advent of the high capacity 5.25 inch Winchester has provided the stimulus for most of the tape cartridge drive manufacturers to quickly agree on common standards for interfaces and recording formats.

  These standards, plus new tape cartridge drives designed to the same form factor as 5.25 inch Winchesters, will probably result in major penetration by tape cartridge streamers of the back up market with 5.25 inch Winchesters in the 20-30 megabyte range and above. Will this development displace flexible disk drives? No, not

significantly, since floppies never had a logical market opportunity with higher capacity 5.25 inch Winchesters, except for applications using files typically small enough to fit a floppy. Anything larger probably will create a demand for tape streamers or removable rigid disk drives. In any event, floppy drives will undoubtedly be used on many small systems with large capacity Winchester drives, for software distribution, and as a convenient backup method for the small files which usually accompany the large ones.

## Flexible disk drive enhancements

IBM developed most of the basic technology used in flexible disk drives, but has failed to introduce a successful new floppy drive since the two sided 8 inch drive in 1976. (In 1985, IBM announced that it would phase out production of floppy disk drives.) In the late 1970s, Shugart Associates shrunk IBM's original technology down to the 5.25 inch format, pulling off one of the most influential repackaging jobs of all time.

In the meantime, the floppy formats which have created the most impact in recent years are the Sony 3.5 inch microfloppy and the Nippon Telephone & Telegraph 1.6 megabyte version of the 5.25 inch drive. Without IBM's heavy handed leadership, the industry has taken years to find its way to a consensus on these formats, while passing others by. And after all the confusion, IBM finally endorsed both the 3.5 inch and 1.6 megabyte 5.25 inch formats through product introductions. There is concern that IBM's privately expressed interest will do the same for the 2.0 megabyte 3.5 inch format in coming years. This has led to uncertainty as to the acceptance of the 1.6 megabyte 3.5 inch format planned by NTT.

The lesson of recent years is that there are many potential technical improvements in flexible disk drive recording technology, each waiting for the backing of an influential firm in the industry. Here are some of the leading contenders:

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

  Longitudinal particulate coatings: The conventional 8 and 5.25 inch diskettes used for the last 10 years, with 300 Oersted oxide coatings, have generally been recorded at 5,000 to 6,000 flux reversals per inch. The 600 Oersted cobalt modified oxide coatings now used in high density 5.25 inch and microfloppy diskettes from several manufacturers are used in numerous production drives at 8,000 to 10,000 FCI, and special types are available for use at even higher densities. New 2 megabyte 3.5 inch drives from several manufacturers use diskettes at almost 17,434 FCI, and Hitachi is offering an 8 inch Hitachi drive with 9.6 megabyte capacity recording at about 13,700 FCI, plus a new 5.25 inch drive with 6.5 megabytes achieved with 125 TPI and 19,560 BPI. The Iomega Bernoulli effect 8 inch and 5.25 inch drives achieve up to 18,000 FCI, with a diskette using similar coercivity but a thinner coating. In 1985, Eastman Kodak introduced a 12 megabyte floppy drive recording at 21,925 BPI.

  Several manufacturers of flexible media and magnetic particles have promising programs underway to improve the density of longitudinal particulate recording. Based on the information available, it appears that conventional recording methods are being stretched at least to 20,000 FCI now and can be extended to at least 40,000 FCI within a year or two. Longitudinal particulate recording has many good years left, with the full exploitation of its potential recording density probably to be paced primarily by market forces.

  Isotropic coatings: It is theoretically possible, by reducing the length of magnetic particles, which are normally very long and thin, to resolve magnetic flux changes at much higher densities. Spin Physics, a subsidiary of Eastman Kodak, has produced such particles and used them in manufacturing 5.25 inch flexible disks with greatly enhanced abilities to handle high recording densities. It has been demonstrated that such diskettes could be recorded at up to 50,000 BPI. Since diskettes suitable for isotropic recording may be produced in great quantities on coating equipment widely used by media manufacturers today, this technology could be of great interest to the industry if certain thermal instability problems associated with cobalt modification of very small particles can be resolved.

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

Several firms have announced tentative specifications for small flexible disk drives using perpendicular recording. Sony's experimental 3.5 inch drive provides 4 megabytes using 65,500 FCI. Matsushita Electric has claimed the capability to record at 70,000 FCI. Toshiba has made a preliminary announcement of a 4 megabyte 3.5 inch drive using barium ferrite particulate media.

Most planned flexible disk drives using perpendicular recording are expected to employ disks with sputtered chromium-cobalt magnetic surfaces. Sputtering technology is highly developed, but throughput is relatively slow, because it is usually a batch process. If the millions of low cost diskettes necessary to support any significant penetration of the flexible disk market by perpendicular recording are to be produced by sputtering, major improvements in production rates are probably necessary. Continuous sputtering production processes have been announced by the Japanese firms which have active drive/media programs in the field.

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

Until recently, two manufacturers of high capacity 5.25 inch drives were attempting to develop the market with different methods of achieving higher track density. However, Amlyn's late production start spoiled its chance for acceptance of the reference track technology employed in its 3.2 megabyte drive, and the firm closed down operations.

Drivetec was more successful in getting started, however, and began shipping its 3.3 megabyte two sided drive in mid 1983. Drivetec used embedded servo information on each diskette to provide tracking information and insure media interchange. Drivetec has since ceased operations, but licensed its technology to Eastman Kodak. Eastman Kodak started production of the 3.3 megabyte drive in 1984, and, in 1985, introduced 6.6 and 12 megabyte drives operating at 384 and 333 TPI, respectively. The 12 megabyte unit offers 75 millisecond average access time using a voice coil positioner.

Companies offering high capacity drives will find an interesting market with specialized system manufacturers needing floppies with more capacity. In addition, there will be a significant add-on market with personal computers, filling a need many users have for removable media with more capacity. The long term outlook for these products, however, will probably be determined by the position IBM will eventually have to take on adding floppies with capacities above 1.6 megabytes to its personal computer systems. If IBM chooses the Eastman Kodak format, high shipment levels for embedded servo floppies will result -- but if IBM stays with open loop 96 TPI 5.25 inch drives and obtains increased capacity through higher linear density, the market for embedded servo drives will probably continue to be confined to specialized systems and the PC add-on market.

When media capable of operating at 40,000 BPI becomes available, the manufacturers of floppy disk drives will be able to expand drive capacity to the 20-30 megabyte range without the need to change track density beyond the level of performance required for 12 megabyte drives. However, the lack of de-facto standards and unavailability of inexpensive controller chips may delay serious product development for years.

## 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 CLASSIFICATION

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

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

* Drives sold by DEC or IBM are considered captive, if internally manufactured.

* In the case of a joint venture disk drive manufacturer such as Magnetic Peripherals, Inc., a joint venture of Control Data, Sperry and Honeywell, MPI drives sold with Honeywell or Sperry systems are included in captive, and MPI drives sold by CDC are captive, PCM or OEM, as appropriate.

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

* Shipments by Epson are non-captive, except for drives sold with systems by parent companies or subsidiaries.

* CDC drive sales to NCR are non-captive, in that NCR does not share in ownership of MPI, and are included in OEM totals.

PCM: Disk drives sold or leased by "plug compatible manufacturers" directly to distributors or end users; to be included in this category, drives must be supplied in plug compatible configurations for add-on installation in connection with systems sold by other manufacturers. Although the PCM category currently consists primarily of drives intended for use with IBM systems, such as Series/1 or the Personal Computer family, it may include any drives which are suitably equipped to be connected without any additional hardware to systems of all types.

OEM: Floppy drives sold through any non-captive distribution channel except PCM. Drives are normally sold to OEMs to be included in complete systems or subsystems; such drives are included in OEM totals whether or not the OEM actually manufacturers 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, except for drives made on a contract manufacturing basis exclusively for the reselling manufacturer, using product designs developed by that manufacturer. Examples:

* Standard OEM drives sold by independent drive manufacturers to IBM for use with personal computers are considered to be OEM drives.

* Floppy drives designed by IBM and manufactured for IBM by an outside contract manufacturing firm are considered captive drives.

GEOGRAPHIC CLASSIFICATION

Geographic analysis is based upon two regions: The U.S. and non-U.S. Together, these two regions comprise the worldwide market.

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

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

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

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

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

UNITS OF MEASUREMENT

Revenue: Based on sale of disk drives alone, as normally sold by individual manufacturers, without auxiliary hardware or spare parts. When sold as an integral part of a system or subsystem, the value of the disk drive alone has been estimated for DISK/TREND purposes. Sale prices are estimated public sale transaction prices, whether at captive end user, PCM, or OEM levels. All projected prices are in 1985 constant dollars.

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

configurations include more than one spindle. On an arbitrary basis, drives which utilize a single actuator mechanism to control head movement on two separate flexible disks are counted as two spindles.

Forecasts: Expected shipments and revenues for current or announced 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 CHANNEL CLASSIFICATION

Shipments of non-captive drives (OEM and PCM classes) are analyzed by each of the following distribution channels:

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

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

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

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

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

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

# 1985 DISK/TREND REPORT

# FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

## Coverage

Examples of flexible disk drives in this group include:

| | |
|---|---|
| BASF | 6102 |
| Caldisk | 142M |
| Digital Equipment | RX02 |
| Elcomatic | ACP 500 |
| IBM | 3770 series, 5280 series |
| ISOT | ES 5074 |
| Miltope | DD 400 |
| Olivetti | FD 801 |
| Shugart | S 800, S 801 |
| Tandon | TM-848E-1 |
| Videoton | MFM-2, Momflex 3200 |

All drives designed to use single sided flexible disks of nominal 8 inch diameter are included in this group. "Soft sector" drives use IBM compatible media, with a single index hole. "Hard sector" drives use additional holes to identify sectors. Older OEM drives in this group were generally designed to the same physical dimensions as the Shugart 801, but most of the OEM drives introduced during the 1980's are "half high" models.

## Market status

DISK/TREND estimate of total market size:

| Worldwide sales ($M) | 1984 | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|---|
| U.S. manufacturers | 94.4 | 41.9 | 15.6 | 6.4 | -- |
| All manufacturers | 121.0 | 68.6 | 41.5 | 29.9 | 18.8 |

With the exception of continuing production programs in Eastern Bloc countries, the 8 inch, one side floppy drive is approaching the end of its useful life. After shipments peaked in 1981, production for this group

has dropped steadily, down to 216,600 drives worldwide in 1984, with 1985 shipments expected to decline to 124,900 units.

It is the older, successful computer systems designed to use 8 inch, one side floppy drives which keep this product group alive. While most newer systems use smaller floppies, the older systems will generate shipments for 8 inch floppy drives as long as the system shipments hold up. Half high 8 inch drives arrived too late to change the market, and currently constitute only about 5% of worldwide shipments.

Small business systems, terminals and word processing used to be the main application areas for 8 inch, one side drives, but only word processing remains a major market in Western countries. The principal captive production remaining is that of IBM, Digital Equipment and Shugart, but all of these programs are also continuing to decline, with the end in sight. Drives in this group are still generally used with many types of computer systems in Eastern Bloc countries, and production for this requirement in several countries currently provides most of the non-U.S. shipments.

Shugart built its early leadership in the OEM floppy drive market with 8 inch, one side models, and has maintained its lead in this group. Shugart's 74,500 drives in 1984 were 51.7% of worldwide unit shipments of non-captive drives. Videoton, the Hungarian export organization for computer and electronic equipment, shipped 13.9%, and ISOT, the Bulgarian enterprise which makes disk drives for many of the Eastern Bloc countries, was third with 11.1%. Only a few other manufacturers still produce OEM floppy drives in this group, and the number is reduced each year. No Japanese company still produces 8 inch, one side drives.

Marketing trends

Most of the system manufacturers which have used 8 inch, one side floppy drives in the past have already moved on to other flexible disk drive configurations, and the few still shipping systems with 8 inch drives are designing new systems without them. DISK/TREND forecasts indicate that all production in Western countries will cease by 1987, with only Eastern Bloc shipments continuing after that time.

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

Technical trends

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

Half high 8 inch, one side drives have appeared from several manufacturers, but they were not developed especially for this product group. The main interest of most drive manufacturers in half high 8 inch drives was in two sided drives, and since the additional cost in offering one sided versions is low, several manufacturers have introduced them. As noted above, most system manufacturers which have added 8 inch, one sided

drives in the last few years have used half high models -- but the total number has not been enough to turn the tide.

Forecasting assumptions

1. IBM usage of 8 inch, one side drives in new systems will stop in 1985, in favor of smaller diameter flexible disk drives purchased from outside vendors.

2. 8 inch, one side drives will be displaced in most new system design by smaller diameter drives.

TABLE 8

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

REVENUE SUMMARY

| | DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Revenues | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| U.S. Manufacturers | | | | | | | | | | |
| IBM Captive | 22.3 | 31.9 | 9.2 | 13.1 | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | 23.3 | 33.2 | 8.3 | 13.3 | 5.2 | 8.4 | 2.4 | 4.0 | -- | -- |
| TOTAL U.S. CAPTIVE | 45.6 | 65.1 | 17.5 | 26.4 | 5.2 | 8.4 | 2.4 | 4.0 | -- | -- |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 22.8 | 29.3 | 13.6 | 15.5 | 6.0 | 7.2 | 2.0 | 2.4 | -- | -- |
| TOTAL U.S. NON-CAPTIVE | 22.8 | 29.3 | 13.6 | 15.5 | 6.0 | 7.2 | 2.0 | 2.4 | -- | -- |
| TOTAL U.S. REVENUES | 68.4 | 94.4 | 31.1 | 41.9 | 11.2 | 15.6 | 4.4 | 6.4 | -- | -- |
| Non-U.S. Manufacturers | | | | | | | | | | |
| Captive | -- | 5.2 | -- | 4.6 | -- | 5.5 | -- | 6.3 | -- | 6.0 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | -- | 21.4 | -- | 22.1 | -- | 20.4 | -- | 17.2 | -- | 12.8 |
| TOTAL NON-U.S. REVENUES | -- | 26.6 | -- | 26.7 | -- | 25.9 | -- | 23.5 | -- | 18.8 |
| Worldwide Recap | | | | | | | | | | |
| TOTAL WORLDWIDE REVENUES | 68.4 | 121.0 | 31.1 | 68.6 | 11.2 | 41.5 | 4.4 | 29.9 | -- | 18.8 |
| OEM Average Price ($000) | .310 | .352 | .390 | .407 | .290 | .378 | .294 | .384 | -- | .376 |

TABLE 9

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

UNIT SHIPMENT SUMMARY

| | DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 Shipments | | Forecast 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | 20.3 | 29.0 | 8.8 | 12.5 | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | 27.4 | 39.0 | 10.1 | 16.1 | 6.5 | 10.5 | 3.0 | 5.0 | -- | -- |
| TOTAL U.S. CAPTIVE | 47.7 | 68.0 | 18.9 | 28.6 | 6.5 | 10.5 | 3.0 | 5.0 | -- | -- |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 73.5 | 95.1 | 34.9 | 41.8 | 20.7 | 25.0 | 6.8 | 8.0 | -- | -- |
| TOTAL U.S. NON-CAPTIVE | 73.5 | 95.1 | 34.9 | 41.8 | 20.7 | 25.0 | 6.8 | 8.0 | -- | -- |
| TOTAL U.S. SHIPMENTS | 121.2 | 163.1 | 53.8 | 70.4 | 27.2 | 35.5 | 9.8 | 13.0 | -- | -- |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | -- | 4.5 | -- | 4.0 | -- | 5.0 | -- | 6.0 | -- | 6.0 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | -- | 49.0 | -- | 50.5 | -- | 48.0 | -- | 43.0 | -- | 34.0 |
| TOTAL NON-U.S. SHIPMENTS | -- | 53.5 | -- | 54.5 | -- | 53.0 | -- | 49.0 | -- | 40.0 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE SHIPMENTS | 121.2 | 216.6 | 53.8 | 124.9 | 27.2 | 88.5 | 9.8 | 62.0 | -- | 40.0 |
| **Cumulative Shipments** | | | | | | | | | | |
| IBM | 352.4 | 490.8 | 361.2 | 503.3 | 361.2 | 503.3 | 361.2 | 503.3 | 361.2 | 503.3 |
| Non-IBM | 2,543.8 | 3,996.0 | 2,588.8 | 4,108.4 | 2,616.0 | 4,196.9 | 2,625.8 | 4,258.9 | 2,625.8 | 4,298.9 |
| WORLDWIDE TOTAL | 2,896.2 | 4,486.8 | 2,950.0 | 4,611.7 | 2,977.2 | 4,700.2 | 2,987.0 | 4,762.2 | 2,987.0 | 4,802.2 |

TABLE 10

FLEXIBLE DISK DRIVES, 8 Inch, One Side

WORLDWIDE SHIPMENTS (000)

DRIVE HEIGHT ANALYSIS

| | 1984 --Shipments-- | | Forecast 1985 | | 1986 | | 1987 | | 1988 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Units | % | Units | % | Units | % | Units | % | Units | % |
| **U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 68.0 | | 28.6 | | 10.5 | | 5.0 | | -- | |
| Full Size | 68.0 | 100.0 | 28.6 | 100.0 | 10.5 | 100.0 | 5.0 | 100.0 | -- | -- |
| OEM Total | 95.1 | | 41.8 | | 25.0 | | 8.0 | | -- | |
| Full Size | 85.9 | 90.4 | 35.1 | 84.1 | 22.0 | 88.1 | 8.0 | 100.0 | -- | -- |
| Half High | 9.2 | 9.6 | 6.7 | 15.9 | 3.0 | 11.9 | -- | -- | -- | -- |
| Total U.S. | 163.1 | | 70.4 | | 35.5 | | 13.0 | | -- | |
| Full Size | 153.9 | 94.5 | 63.7 | 90.6 | 32.5 | 91.6 | 13.0 | 100.0 | -- | -- |
| Half High | 9.2 | 5.5 | 6.7 | 9.4 | 3.0 | 8.4 | -- | -- | -- | -- |
| **NON-U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 4.5 | | 4.0 | | 5.0 | | 6.0 | | 6.0 | |
| Full Size | 4.5 | 100.0 | 4.0 | 100.0 | 5.0 | 100.0 | 6.0 | 100.0 | 6.0 | 100.0 |
| OEM Total | 49.0 | | 50.5 | | 48.0 | | 43.0 | | 34.0 | |
| Full Size | 49.0 | 100.0 | 50.5 | 100.0 | 48.0 | 100.0 | 43.0 | 100.0 | 34.0 | 100.0 |
| Total Non-U.S. | 53.5 | | 54.5 | | 53.0 | | 49.0 | | 40.0 | |
| Full Size | 53.5 | 100.0 | 54.5 | 100.0 | 53.0 | 100.0 | 49.0 | 100.0 | 40.0 | 100.0 |
| **WORLDWIDE RECAP** | | | | | | | | | | |
| Total Shipments | 216.6 | | 124.9 | | 88.5 | | 62.0 | | 40.0 | |
| Full Size | 207.4 | 95.9 | 118.2 | 94.7 | 85.5 | 96.7 | 62.0 | 100.0 | 40.0 | 100.0 |
| Half High | 9.2 | 4.1 | 6.7 | 5.3 | 3.0 | 3.3 | -- | -- | -- | -- |

TABLE 11

FLEXIBLE DISK DRIVES, 8 INCH, ONE SIDE

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

| Distribution channel | 1984 U.S. Net Shipments Units (000) | % | FORECAST 1985 % | 1986 % | 1987 % | 1988 % |
|---|---|---|---|---|---|---|
| Mainframe computer manufacturers | 7.9 | 10.7 | 9.1 | 8.5 | -- | -- |
| Mini/micro computer manufacturers | 6.2 | 8.4 | 7.3 | 4.8 | -- | -- |
| System OEMs/systems houses | 40.8 | 55.6 | 61.8 | 69.9 | 81.9 | -- |
| Independent peripherals suppliers | 7.8 | 10.6 | 6.2 | -- | -- | -- |
| Distributors, dealers, end users | 10.8 | 14.7 | 15.6 | 16.8 | 18.1 | -- |
| TOTAL | 73.5 | | | | | |

TABLE 12

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

| Drive Manufacturers | 1984 Net Shipments To United States Destinations Units (000) | % | Worldwide Units (000) | % |
|---|---|---|---|---|
| Shugart | 61.7 | 83.9 | 74.5 | 51.7 |
| Videoton | -- | -- | 20.0 | 13.9 |
| ISOT | -- | -- | 16.0 | 11.1 |
| Control Data | 2.5 | 3.4 | 9.4 | 6.5 |
| Tandon | 7.3 | 9.9 | 9.1 | 6.3 |
| BASF | -- | -- | 9.0 | 6.2 |
| Other U.S. | 2.0 | 2.8 | 2.1 | 1.5 |
| Other Non-U.S. | -- | -- | 4.0 | 2.8 |
| TOTAL | 73.5 | 100.0 | 144.1 | 100.0 |

FLEXIBLE DISK DRIVS, 8 INCH, TWO SIDES

# 1985 DISK/TREND REPORT

# FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

## Coverage

Examples of flexible disk drives in this group include:

| | |
|---|---|
| BASF | 6104 |
| Caldisk | 143M |
| Control Data | 9406 |
| Elcomatic | ACP 700, ACP 1500 |
| Hitachi | FDD-412, FDD-441 |
| IBM | 4964, 4966, System 36 |
| ISOT | ES 5083 |
| Matsushita Communication Ind. | JA-751 |
| Miltope | DD 450, DD 550 |
| Mitsubishi Electric | M2894-63 |
| NEC | FD 1160, FD 1165 |
| Olivetti | FD 802 |
| Ricoh | RF8160 |
| Shugart | S 850, S 851 |
| Tandon | TM-848E-2 |
| Toshiba | ND-40D |
| YE Data | YD-174D, YD-180 |

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

Drives using special recording formats are offered by two manufacturers. In 1983, Hitachi announced a half-high drive with 9.6 megabytes capacity, achieved with 96 TPI and 20,560 BPI, using a run length limited code, with cobalt modified oxide coated media. Elcomatic's ACP 1500 provides 3.2 megabytes by using 96 TPI and normal recording densities. Burroughs' high capacity floppy drives, which pioneered the use of a reference track for head positioning, are no longer in production.

Market size

DISK/TREND estimate of total market size:

| Worldwide sales ($M) | 1984 | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|---|
| U.S. manufacturers | 484.3 | 300.9 | 153.8 | 65.5 | -- |
| All manufacturers | 1,001.1 | 666.2 | 403.5 | 199.9 | 56.0 |

1983 was the last growth year for 8 inch, two sided drives. Worldwide shipments declined 5% in 1984, to 1,206,100 drives, and are expected to plunge 33% in 1985, down to 801,000 units.

U.S. manufacturers' shipments of 8 inch, two sided drives peaked in 1982. In recent years, the largest factor in maintaining shipments of drives in this product group at a high level has been heavy use of the two sided 8 inch format in the Japanese domestic market. But the tide has also turned in the Japanese market, as 1.6 megabyte 5.25 inch drives have been designed into more of the newer Japanese office computers, instead of 8 inch drives.

Non-U.S. drive manufacturers have been shipping 88% of their drives as half high models during 1984/85, contrasting sharply with a half high share for U.S. manufacturers below 7% in 1985. The underlying cause for low U.S. half high shipments is the fact that more than half of U.S. total shipments are by IBM, which never progressed to a half high model. Also contributing was Shugart's role as the dominant U.S. manufacturer of OEM 8 inch drives -- since the firm never produced a successful half high 8 inch drive.

Japanese companies now dominate OEM shipments in this group. YE Data led in 1984 worldwide non-captive shipments with 145,000 drives, 23.7% of the total. Also in leading positions were Hitachi with 15.5%, NEC at 13%, and Mitsubishi Electric had 10.3%. Shugart's share dropped to 8.2%.

Marketing trends

Rapid decline is expected for this product group. The average annual reduction in shipments is projected to exceed 42%, with a mere 142,000 drives forecasted for 1988. The last U.S. production is expected in 1987.

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

In addition, certain specific developments will further change the future outlook. In Japan's domestic market, most manufacturers of small office computer systems have already felt the pressure to move to desktop versions of their older systems, and the 1.6 megabyte 5.25 inch floppy drive developed under the sponsorship of Nippon Telephone & Telegraph has made it possible to do so with a half high 5.25 inch drive. Shipments of these drives are increasing rapidly in Japan, and they will displace most of the growth which would have otherwise gone to 8 inch, two sided drives.

But the knockout punch for 8 inch, two sided drives has been delivered by IBM, their originator. IBM is using 1.6 megabyte 5.25 inch drives in its multiple user personal computer, the PC AT, and is expected to broaden usage of these drives to additional new PC models and other small systems intended for office use. An obvious result will be the decline of IBM's production of 8 inch, two sided drives. IBM is now de-emphasizing

internal production of all types of flexible disk drives, in view of the ready availability of all types of floppy drives at depressed OEM price levels. Last internal IBM production of 8 inch drives in this group is now forecasted for 1987.

The market for PCM drives in this group will remain small, and is expected to dry up altogether by 1986. The attachment possibilities for independent drives on IBM's Series/1 minicomputers are limited by the wide dispersion of the minicomputer market and the poor cost effectiveness of marketing efforts to sell individual floppy drive subsystems to minicomputer users. To the extent PCM floppy drives are sold to this market, they will probably be included in larger disk subsystems sold to IBM users and systems houses.

Technical trends

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

The key reason that development of 8 inch drives has been stuck at 1.6 megabytes since 1976 is IBM's lack of innovation in the area. Since the existing 8 inch diskette's physical design and recording format were defined by IBM, and because of IBM's dominant leadership in the applications for 8 inch, two sided floppies, most manufacturers of OEM drives hesitated to attempt the introduction of their own improvements, even though some had undertaken development programs.

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

In October, 1983, Hitachi announced a 9.6 megabyte drive which uses a special Maxell cobalt modified oxide coated diskette. The Hitachi drive uses 96 TPI and triples the effective linear density to 20,560 BPI, by roughly doubling the actual recording density and using a run length limited code. This drive has been sold mostly in the Japanese domestic market, as a backup device for fixed Winchester disk drives.

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

Forecasting assumptions

1. IBM will continue to transition to 1.6 megabyte 5.25 inch floppy drives for new versions of its personal computer and other small systems, and will end internal production of 8 inch, two sided drives by 1987.

2. The Japanese domestic market will continue to move away from 8 inch, two sided floppy drives, in favor of high capacity 5.25 and 3.5 inch drives.

3. U.S. system manufacturers competing with IBM will follow IBM's move to 1.6 megabyte 5.25 inch drives, causing a continuing reduction in OEM shipments of 8 inch, two sided drives.

TABLE 13

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

REVENUE SUMMARY

| | DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Revenues | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | 236.8 | 358.8 | 166.4 | 260.1 | 89.1 | 135.3 | 40.0 | 60.8 | -- | -- |
| Other U.S. Captive | 57.9 | 74.7 | 14.6 | 19.9 | 6.1 | 8.7 | -- | -- | -- | -- |
| TOTAL U.S. CAPTIVE | 294.7 | 433.5 | 181.0 | 280.0 | 95.2 | 144.0 | 40.0 | 60.8 | -- | -- |
| PCM | .2 | .2 | .2 | .2 | -- | -- | -- | -- | -- | -- |
| OEM | 36.5 | 50.6 | 12.4 | 20.7 | 6.5 | 9.8 | 3.3 | 4.7 | -- | -- |
| TOTAL U.S. NON-CAPTIVE | 36.7 | 50.8 | 12.6 | 20.9 | 6.5 | 9.8 | 3.3 | 4.7 | -- | -- |
| TOTAL U.S. REVENUES | 331.4 | 484.3 | 193.6 | 300.9 | 101.7 | 153.8 | 43.3 | 65.5 | -- | -- |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | 17.6 | 410.3 | 5.7 | 296.8 | 8.2 | 195.3 | 3.8 | 97.8 | -- | 36.0 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 19.8 | 106.5 | 11.2 | 68.5 | 6.1 | 54.4 | 4.3 | 36.6 | 3.3 | 20.0 |
| TOTAL NON-U.S. REVENUES | 37.4 | 516.8 | 16.9 | 365.3 | 14.3 | 249.7 | 8.1 | 134.4 | 3.3 | 56.0 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE REVENUES | 368.8 | 1,001.1 | 210.5 | 666.2 | 116.0 | 403.5 | 51.4 | 199.9 | 3.3 | 56.0 |
| OEM Average Price ($000) | .314 | .257 | .306 | .241 | .244 | .224 | .224 | .213 | .174 | .196 |

TABLE 14

FLEXIBLE DISK DRIVES, 8 INCH, TWO SIDES

UNIT SHIPMENT SUMMARY

| | DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Shipments | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | 135.3 | 205.0 | 97.9 | 153.0 | 54.0 | 82.0 | 25.0 | 38.0 | -- | -- |
| Other U.S. Captive | 36.8 | 47.5 | 9.7 | 13.2 | 4.2 | 6.0 | -- | -- | -- | -- |
| TOTAL U.S. CAPTIVE | 172.1 | 252.5 | 107.6 | 166.2 | 58.2 | 88.0 | 25.0 | 38.0 | -- | -- |
| PCM | .1 | .1 | .1 | .1 | -- | -- | -- | -- | -- | -- |
| OEM | 106.4 | 142.6 | 35.1 | 56.7 | 18.7 | 28.0 | 10.0 | 14.0 | -- | -- |
| TOTAL U.S. NON-CAPTIVE | 106.5 | 142.7 | 35.2 | 56.8 | 18.7 | 28.0 | 10.0 | 14.0 | -- | -- |
| TOTAL U.S. SHIPMENTS | 278.6 | 395.2 | 142.8 | 223.0 | 76.9 | 116.0 | 35.0 | 52.0 | -- | -- |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | 29.0 | 342.5 | 10.0 | 263.9 | 8.0 | 188.0 | 4.0 | 102.0 | -- | 40.0 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 72.9 | 468.4 | 42.0 | 314.1 | 33.0 | 258.0 | 24.0 | 180.0 | 19.0 | 102.0 |
| TOTAL NON-U.S. SHIPMENTS | 101.9 | 810.9 | 52.0 | 578.0 | 41.0 | 446.0 | 28.0 | 282.0 | 19.0 | 142.0 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE SHIPMENTS | 380.5 | 1,206.1 | 194.8 | 801.0 | 117.9 | 562.0 | 63.0 | 334.0 | 19.0 | 142.0 |
| **Cumulative Shipments** | | | | | | | | | | |
| IBM | 678.1 | 1,013.6 | 776.0 | 1,166.6 | 830.0 | 1,248.6 | 855.0 | 1,286.6 | 855.0 | 1,286.6 |
| Non-IBM | 1,224.8 | 3,919.1 | 1,321.7 | 4,567.1 | 1,385.6 | 5,047.1 | 1,423.6 | 5,343.1 | 1,442.6 | 5,485.1 |
| WORLDWIDE TOTAL | 1,902.9 | 4,932.7 | 2,097.7 | 5,733.7 | 2,215.6 | 6,295.7 | 2,278.6 | 6,629.7 | 2,297.6 | 6,771.7 |

TABLE 15

FLEXIBLE DISK DRIVES, 8 Inch, Two Sides

WORLDWIDE SHIPMENTS (000)

DRIVE HEIGHT ANALYSIS

| | 1984 --Shipments-- | | Forecast | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1985 | | 1986 | | 1987 | | 1988 | |
| | Units | % | Units | % | Units | % | Units | % | Units | % |
| **U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 252.5 | | 166.2 | | 88.0 | | 38.0 | | -- | |
| Full Size | 252.5 | 100.0 | 166.2 | 100.0 | 88.0 | 100.0 | 38.0 | 100.0 | -- | -- |
| OEM Total | 142.7 | | 56.8 | | 28.0 | | 14.0 | | -- | |
| Full Size | 102.8 | 72.1 | 41.6 | 73.3 | 21.0 | 75.1 | 10.0 | 71.5 | -- | -- |
| Half High | 39.9 | 27.9 | 15.2 | 26.7 | 7.0 | 24.9 | 4.0 | 28.5 | -- | -- |
| Total U.S. | 395.2 | | 223.0 | | 116.0 | | 52.0 | | -- | |
| Full Size | 355.3 | 90.0 | 207.8 | 93.3 | 109.0 | 94.1 | 48.0 | 92.4 | -- | -- |
| Half High | 39.9 | 10.0 | 15.2 | 6.7 | 7.0 | 5.9 | 4.0 | 7.6 | -- | -- |
| **NON-U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 342.5 | | 263.9 | | 188.0 | | 102.0 | | 40.0 | |
| Full Size | 28.9 | 8.4 | 13.9 | 5.3 | 7.0 | 3.7 | 2.0 | 2.0 | -- | -- |
| Half High | 313.6 | 91.6 | 250.0 | 94.7 | 181.0 | 96.3 | 100.0 | 98.0 | 40.0 | 100.0 |
| OEM Total | 468.4 | | 314.1 | | 258.0 | | 180.0 | | 102.0 | |
| Full Size | 68.0 | 14.5 | 56.1 | 17.9 | 38.0 | 14.7 | 19.0 | 10.6 | 8.0 | 7.8 |
| Half High | 400.4 | 85.5 | 258.0 | 82.1 | 220.0 | 85.3 | 161.0 | 89.4 | 94.0 | 92.2 |
| Total Non-U.S. | 810.9 | | 578.0 | | 446.0 | | 282.0 | | 142.0 | |
| Full Size | 96.9 | 11.9 | 70.0 | 12.1 | 45.0 | 10.1 | 21.0 | 7.4 | 8.0 | 5.6 |
| Half High | 714.0 | 88.1 | 508.0 | 87.9 | 401.0 | 89.9 | 261.0 | 92.6 | 134.0 | 94.4 |
| **WORLDWIDE RECAP** | | | | | | | | | | |
| Total Shipments | 1,206.1 | | 801.0 | | 562.0 | | 334.0 | | 142.0 | |
| Full Size | 452.2 | 37.5 | 277.8 | 34.7 | 154.0 | 27.4 | 69.0 | 20.7 | 8.0 | 5.6 |
| Half High | 753.9 | 62.5 | 523.2 | 65.3 | 408.0 | 72.6 | 265.0 | 79.3 | 134.0 | 94.4 |

TABLE 16

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

| Distribution channel | 1984 U.S. Net Shipments Units (000) | % | FORECAST 1985 % | 1986 % | 1987 % | 1988 % |
|---|---|---|---|---|---|---|
| Mainframe computer manufacturers | 32.8 | 18.3 | 15.5 | 13.2 | 11.2 | 9.6 |
| Mini/micro computer manufacturers | 69.7 | 38.9 | 36.7 | 31.8 | 26.9 | 21.3 |
| System OEMs/systems houses | 57.8 | 32.2 | 35.3 | 40.5 | 45.7 | 49.8 |
| Independent peripherals suppliers | 5.9 | 3.3 | 3.1 | 2.8 | 2.4 | 2.1 |
| Distributors, dealers, end users | 13.2 | 7.3 | 9.4 | 11.7 | 13.8 | 17.2 |
| TOTAL | 179.4 | | | | | |

TABLE 17

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

| Drive Manufacturers | 1984 Net Shipments To United States Destinations Units (000) | % | Worldwide Units (000) | % |
|---|---|---|---|---|
| YE Data | -- | -- | 145.0 | 23.7 |
| Hitachi | -- | -- | 95.0 | 15.5 |
| NEC | 24.9 | 13.9 | 79.4 | 13.0 |
| Mitsubishi Electric | 44.0 | 24.5 | 63.0 | 10.3 |
| Shugart | 32.8 | 18.3 | 50.3 | 8.2 |
| Tandon | 37.6 | 21.0 | 39.6 | 6.5 |
| BASF | -- | -- | 36.0 | 5.9 |
| Control Data | 18.0 | 10.0 | 32.9 | 5.4 |
| Matsushita Com. Ind. | -- | -- | 31.0 | 5.1 |
| Other U.S. | 18.1 | 10.1 | 19.9 | 3.3 |
| Other Non-U.S. | 4.0 | 2.2 | 19.0 | 3.1 |
| TOTAL | 179.4 | 100.0 | 611.1 | 100.0 |

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

# 1985 DISK/TREND REPORT

# FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

## Coverage

Examples of flexible disk drives in this group include:

### 48 tracks per inch

| | |
|---|---|
| Alps Electric | FDD 2125, DFB 111 |
| Chinon | F-051D |
| Control Data | 9408 |
| Elcomatic | ACP548-25 |
| Hi-Tech Peripherals | H548-25 |
| Instrumentation & Automation | Pravez 5088M |
| ISOT | ES 5088 |
| Lung Hwa | LDD-104SDS |
| Mitac | MC-390, MC-395 |
| Mitsumi Electric | D 501 |
| Olivetti | FD 501 |
| Robotron | K 5600.10 |
| Tandon | TM-65-1L |
| TEAC | FD-55AV |
| Tokyo Electric Company | FB-501 |
| Video Technology | FDM 130 |
| Videoton | Momflex 900 |
| Weltec Digital | M 48S |
| Wong's Technology | WST 112-5 |

### 96/100 tracks per inch

| | |
|---|---|
| Digital Equipment | RX50 |
| Elcomatic | ACP596-05 |
| Robotron | K 5600.20 |
| TEAC | FD-55EV |
| Tokyo Electric Company | FB-502 |
| Video Technology | FDM 140 |
| Weltec Digital | M 96S |

The basic standards for physical size and recording format for this product group were created by the introduction of the Shugart SA 400, the original minifloppy, in 1976. The early growth in small microcomputer based systems inspired extensive innovation in one sided 5.25 inch drives, resulting in several products which achieved success until the industry's predominant movement to two sided versions.

An early pioneer was Micropolis, which introduced 100 TPI 5.25 inch drives in 1977, matching the 77 track standard recording format of 8 inch floppy drives. In 1980 Tandon and Micro Peripherals joined Micropolis in setting a 96 TPI standard, which established the 80 tracks/per side format now widely used with both one and two sided drives.

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

Other innovative one sided 5.25 inch drives have been introduced, with varying levels of success. Early in 1982, Amlyn started shipping a drive using a special cartridge of five diskettes, each recorded on one side at 170 TPI and 9500 BPI. This drive had limited success, and Amlyn has discontinued operations. With first shipments also in 1982, Digital Equipment Corporation offers a one sided drive which uses a single head positioning system for two diskettes, and which is now produced in large quantities for use with DEC personal computers.

Market status

DISK/TREND estimate of total market size:

| Worldwide sales ($M) | 1984 | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|---|
| U.S. manufacturers | 319.4 | 187.4 | 116.1 | 83.8 | 45.9 |
| All manufacturers | 574.6 | 355.0 | 277.5 | 237.9 | 190.0 |

5.25 inch, one side drives reached an all-time production peak in 1984, at almost 5 million units worldwide, but 1985 shipments have dropped sharply, as the home computer market has had a bad year and the office computer market continues to transition to other types of floppy drives. Worldwide shipments for 1985 are forecasted at 2,828,300 drives, a reduction of 43% from 1984.

1984's growth in personal computer sales provided one last big year for drives in this product group, but most of the shipment increases went to non-U.S. producers, who achieved an increase of 41.9% over the previous year, to 3,524,400 units. Total U.S. shipments declined 21.5% in 1984, to 1,444,900 drives, and are dropping an estimated 65.6% in 1985. The weak 1985 market is also affecting non-U.S. manufacturers, and the DISK/TREND forecast indicates a 33.9% in their worldwide shipments.

Most captive production of 5.25 inch, one side drives in Western countries has been discontinued, with the 1985 end of captive programs by Tandy, Shugart, Philips and Olivetti -- leaving only Digital Equipment's RX50 as the only major captive drive still in production. Eastern Bloc captive shipments are starting to grow, however, as several countries start to place emphasis on development of personal computer industries.

Alps Electric's large sales to Apple and other personal computer manufacturers continued to dominate OEM drive shipments in 1984. Alp's 2,500,000 drives provided 57.3% of worldwide shipments, followed by Tandon with 12.9%, Teac at 5.5% and Chinon holding 5.1%. Shugart, which once dominated this product group, held only 4.6% of worldwide shipments in 1984, the last year of shipments for its SA 400, the drive which originally started the industry's movement to the 5.25 inch format.

Marketing trends

In Western countries, production of 5.25 inch, one side flexible disk drives is destined to continue its fast drop. Worldwide shipments are expected to be down to 893,000 drives in 1988. In the U.S., the last OEM shipments are forecasted by 1987, and the remaining captive shipments by DEC are expected to be down, as newer types of drives are substituted. Newer drives will also displace OEM production by non-U.S. manufacturers, with their 1988 shipments projected to be down to 583,000 drives.

With the apparent decision in Eastern Bloc countries to concentrate on full size 5.25 inch, one side drives for their emerging personal computer industry, non-U.S. half high drive shipments will stay low. Total non-U.S. captive shipments in 1988, all in the Eastern Bloc, are expected to reach 202,000 drives.

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

Microfloppy drives will directly displace 5.25 inch, one side drives which otherwise would have been used in portable and desktop computers. While the widespread use of 5.25 inch diskette media provides considerable momentum for the format, it is expected that microfloppies will gradually build up shipment momentum in the portable and "small-footprint" desktop computer markets, at the expense of 5.25 inch drives. And IBM's use of 3.5 inch drives for briefcase size portable computers, now expected to start in early 1986, will consolidate this movement for any doubters.

## Technical trends

The industry has not invested heavily in development programs for this product group, and most of the work undertaken has been intended to result in smaller, cheaper floppy drives. Well publicized programs by Alps Electric, Tandon and Shugart resulted in mechanism-only versions of 5.25 inch, one side drives priced as low as $40 for very large quantities.

More significant to the entire industry, however, were the half high drives, just 1.625 inches in height. Although designed for both one sided and two sided models, the one sided versions have kept this product group going longer than would otherwise have been likely.

Significant changes in technology for this group during the next few years are not expected. 5.25 inch, one side drives offer neither the capacity potential of two sided 5.25 inch drives nor the smaller physical volume potential of 3.5 inch drives -- and will probably not see any further development.

## Forecasting assumptions

1. Shipments of 5.25 inch, one side drives will decline, except in Eastern Bloc countries, due to competition from microfloppies and 5.25 inch, two sided drives.

2. Eastern Bloc countries will continue to emphasize full size drives for personal computer applications.

TABLE 18

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

REVENUE SUMMARY

| | DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Revenues | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | 187.4 | 241.7 | 138.0 | 180.0 | 85.5 | 114.0 | 62.6 | 83.3 | 34.4 | 45.9 |
| TOTAL U.S. CAPTIVE | 187.4 | 241.7 | 138.0 | 180.0 | 85.5 | 114.0 | 62.6 | 83.3 | 34.4 | 45.9 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 65.3 | 77.7 | 5.6 | 7.4 | 2.0 | 2.1 | .5 | .5 | -- | -- |
| TOTAL U.S. NON-CAPTIVE | 65.3 | 77.7 | 5.6 | 7.4 | 2.0 | 2.1 | .5 | .5 | -- | -- |
| TOTAL U.S. REVENUES | 252.7 | 319.4 | 143.6 | 187.4 | 87.5 | 116.1 | 63.1 | 83.8 | 34.4 | 45.9 |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | 29.3 | 44.9 | 10.2 | 43.9 | -- | 66.2 | -- | 86.8 | -- | 101.9 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 125.2 | 210.3 | 72.7 | 123.7 | 47.8 | 95.2 | 25.4 | 67.3 | 11.5 | 42.2 |
| TOTAL NON-U.S. REVENUES | 154.5 | 255.2 | 82.9 | 167.6 | 47.8 | 161.4 | 25.4 | 154.1 | 11.5 | 144.1 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE REVENUES | 407.2 | 574.6 | 226.5 | 355.0 | 135.3 | 277.5 | 88.5 | 237.9 | 45.9 | 190.0 |
| OEM Average Price ($000) | .059 | .066 | .050 | .056 | .055 | .058 | .060 | .066 | .060 | .072 |

TABLE 19

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

UNIT SHIPMENT SUMMARY

| | DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Shipments | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | 416.6 | 535.7 | 300.0 | 390.0 | 180.0 | 240.0 | 139.0 | 185.0 | 81.0 | 108.0 |
| TOTAL U.S. CAPTIVE | 416.6 | 535.7 | 300.0 | 390.0 | 180.0 | 240.0 | 139.0 | 185.0 | 81.0 | 108.0 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 765.9 | 909.2 | 82.8 | 106.8 | 31.0 | 32.0 | 8.0 | 8.0 | -- | -- |
| TOTAL U.S. NON-CAPTIVE | 765.9 | 909.2 | 82.8 | 106.8 | 31.0 | 32.0 | 8.0 | 8.0 | -- | -- |
| TOTAL U.S. SHIPMENTS | 1,182.5 | 1,444.9 | 382.8 | 496.8 | 211.0 | 272.0 | 147.0 | 193.0 | 81.0 | 108.0 |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | 45.0 | 70.5 | 17.0 | 77.0 | -- | 123.0 | -- | 170.0 | -- | 202.0 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 2,466.3 | 3,453.9 | 1,486.9 | 2,254.5 | 869.0 | 1,635.0 | 423.0 | 1,018.0 | 192.0 | 583.0 |
| TOTAL NON-U.S. SHIPMENTS | 2,511.3 | 3,524.4 | 1,503.9 | 2,331.5 | 869.0 | 1,758.0 | 423.0 | 1,188.0 | 192.0 | 785.0 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE SHIPMENTS | 3,693.8 | 4,969.3 | 1,886.7 | 2,828.3 | 1,080.0 | 2,030.0 | 570.0 | 1,381.0 | 273.0 | 893.0 |
| **Cumulative Shipments** | | | | | | | | | | |
| IBM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Non-IBM | 11,346.2 | 14,248.2 | 13,232.9 | 17,076.5 | 14,312.9 | 19,106.5 | 14,882.9 | 20,487.5 | 15,155.9 | 21,380.5 |
| WORLDWIDE TOTAL | 11,346.2 | 14,248.2 | 13,232.9 | 17,076.5 | 14,312.9 | 19,106.5 | 14,882.9 | 20,487.5 | 15,155.9 | 21,380.5 |

TABLE 20

FLEXIBLE DISK DRIVES, 5.25 Inch, One Side

WORLDWIDE SHIPMENTS (000)

DRIVE HEIGHT ANALYSIS

| | 1984 --Shipments-- | | Forecast | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1985 | | 1986 | | 1987 | | 1988 | |
| | Units | % | Units | % | Units | % | Units | % | Units | % |
| **U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 535.7 | | 390.0 | | 240.0 | | 185.0 | | 108.0 | |
| Full Size | 415.0 | 77.6 | 285.0 | 73.2 | 240.0 | 100.0 | 185.0 | 100.0 | 108.0 | 100.0 |
| Half High | 120.7 | 22.4 | 105.0 | 26.8 | -- | -- | -- | -- | -- | -- |
| OEM Total | 909.2 | | 106.8 | | 32.0 | | 8.0 | | -- | |
| Full Size | 280.1 | 30.8 | 18.8 | 17.6 | 7.0 | 21.9 | -- | -- | -- | -- |
| Half High | 629.1 | 69.2 | 88.0 | 82.4 | 25.0 | 78.1 | 8.0 | 100.0 | -- | -- |
| Total U.S. | 1,444.9 | | 496.8 | | 272.0 | | 193.0 | | 108.0 | |
| Full Size | 695.1 | 48.1 | 303.8 | 61.3 | 247.0 | 90.9 | 185.0 | 96.0 | 108.0 | 100.0 |
| Half High | 749.8 | 51.9 | 193.0 | 38.7 | 25.0 | 9.1 | 8.0 | 4.0 | -- | -- |
| **NON-U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 70.5 | | 77.0 | | 123.0 | | 170.0 | | 202.0 | |
| Full Size | 2.5 | 3.5 | 23.0 | 29.9 | 95.0 | 77.3 | 135.0 | 79.5 | 158.0 | 78.3 |
| Half High | 68.0 | 96.5 | 54.0 | 70.1 | 28.0 | 22.7 | 35.0 | 20.5 | 44.0 | 21.7 |
| OEM Total | 3,453.9 | | 2,254.5 | | 1,635.0 | | 1,018.0 | | 583.0 | |
| Full Size | 1,567.4 | 45.4 | 194.5 | 8.6 | 55.0 | 3.4 | 78.0 | 7.7 | 103.0 | 17.7 |
| Half High | 1,886.5 | 54.6 | 2,060.0 | 91.4 | 1,580.0 | 96.6 | 940.0 | 92.3 | 480.0 | 82.3 |
| Total Non-U.S. | 3,524.4 | | 2,331.5 | | 1,758.0 | | 1,188.0 | | 785.0 | |
| Full Size | 1,569.9 | 44.5 | 217.5 | 9.3 | 150.0 | 8.5 | 213.0 | 17.9 | 261.0 | 33.2 |
| Half High | 1,954.5 | 55.5 | 2,114.0 | 90.7 | 1,608.0 | 91.5 | 975.0 | 82.1 | 524.0 | 66.8 |
| **WORLDWIDE RECAP** | | | | | | | | | | |
| Total Shipments | 4,969.3 | | 2,828.3 | | 2,030.0 | | 1,381.0 | | 893.0 | |
| Full Size | 2,265.0 | 45.6 | 521.3 | 18.4 | 397.0 | 19.6 | 398.0 | 28.8 | 369.0 | 41.3 |
| Half High | 2,704.3 | 54.4 | 2,307.0 | 81.6 | 1,633.0 | 80.4 | 983.0 | 71.2 | 524.0 | 58.7 |

TABLE 21

FLEXIBLE DISK DRIVES, 5.25 Inch, One Side

WORLDWIDE SHIPMENTS (000)

TRACK DENSITY ANALYSIS

| | 1984 --Shipments-- | | Forecast | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1985 | | 1986 | | 1987 | | 1988 | |
| | Units | % | Units | % | Units | % | Units | % | Units | % |
| **U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 535.7 | | 390.0 | | 240.0 | | 185.0 | | 108.0 | |
| 48 TPI | 295.7 | 55.3 | 150.0 | 38.6 | -- | -- | -- | -- | -- | -- |
| 96/100 TPI | 240.0 | 44.7 | 240.0 | 61.4 | 240.0 | 100.0 | 185.0 | 100.0 | 108.0 | 100.0 |
| OEM Total | 909.2 | | 106.8 | | 32.0 | | 8.0 | | -- | |
| 48 TPI | 874.9 | 96.3 | 100.8 | 94.5 | 32.0 | 100.0 | 8.0 | 100.0 | -- | -- |
| 96/100 TPI | 34.3 | 3.7 | 6.0 | 5.5 | -- | -- | -- | -- | -- | -- |
| Total U.S. | 1,444.9 | | 496.8 | | 272.0 | | 193.0 | | 108.0 | |
| 48 TPI | 1,170.6 | 81.1 | 250.8 | 50.6 | 32.0 | 11.8 | 8.0 | 4.1 | -- | -- |
| 96/100 TPI | 274.3 | 18.9 | 246.0 | 49.4 | 240.0 | 88.2 | 185.0 | 95.9 | 108.0 | 100.0 |
| **NON-U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 70.5 | | 77.0 | | 123.0 | | 170.0 | | 202.0 | |
| 48 TPI | 25.5 | 36.3 | 60.0 | 78.0 | 123.0 | 100.0 | 170.0 | 100.0 | 202.0 | 100.0 |
| 96/100 TPI | 45.0 | 63.7 | 17.0 | 22.0 | -- | -- | -- | -- | -- | -- |
| OEM Total | 3,453.9 | | 2,254.5 | | 1,635.0 | | 1,018.0 | | 583.0 | |
| 48 TPI | 3,437.0 | 99.6 | 2,254.5 | 100.0 | 1,635.0 | 100.0 | 1,018.0 | 100.0 | 583.0 | 100.0 |
| 96/100 TPI | 16.9 | .4 | -- | -- | -- | -- | -- | -- | -- | -- |
| Total Non-U.S. | 3,524.4 | | 2,331.5 | | 1,758.0 | | 1,188.0 | | 785.0 | |
| 48 TPI | 3,462.5 | 98.3 | 2,314.5 | 99.4 | 1,758.0 | 100.0 | 1,188.0 | 100.0 | 785.0 | 100.0 |
| 96/100 TPI | 61.9 | 1.7 | 17.0 | .6 | -- | -- | -- | -- | -- | -- |
| **WORLDWIDE RECAP** | | | | | | | | | | |
| Total Shipments | 4,969.3 | | 2,828.3 | | 2,030.0 | | 1,381.0 | | 893.0 | |
| 48 TPI | 4,633.1 | 93.3 | 2,565.3 | 90.8 | 1,790.0 | 88.3 | 1,196.0 | 86.7 | 785.0 | 88.0 |
| 96/100 TPI | 336.2 | 6.7 | 263.0 | 9.2 | 240.0 | 11.7 | 185.0 | 13.3 | 108.0 | 12.0 |

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

TABLE 22

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE

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

| Distribution channel | 1984 U.S. Net Shipments Units (000) | % | FORECAST 1985 % | 1986 % | 1987 % | 1988 % |
|---|---|---|---|---|---|---|
| Mainframe computer manufacturers | 220.6 | 6.8 | 5.4 | 4.4 | 3.5 | 2.8 |
| Mini/micro computer manufacturers | 19.6 | .6 | .3 | .1 | -- | -- |
| System OEMs/systems houses | 2,592.1 | 80.2 | 80.9 | 81.0 | 80.8 | 80.2 |
| Independent peripherals suppliers | 123.0 | 3.8 | 3.9 | 4.1 | 4.3 | 4.4 |
| Distributors, dealers, end users | 276.9 | 8.6 | 9.5 | 10.4 | 11.4 | 12.6 |
| TOTAL | 3,232.2 | | | | | |

TABLE 23

FLEXIBLE DISK DRIVES, 5.25 INCH, ONE SIDE
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

| Drive Manufacturers | 1984 Net Shipments To United States Destinations Units (000) | % | Worldwide Units (000) | % |
|---|---|---|---|---|
| Alps Electric | 2,200.0 | 68.1 | 2,500.0 | 57.3 |
| Tandon | 550.3 | 17.0 | 561.7 | 12.9 |
| Teac | 2.0 | .1 | 241.0 | 5.5 |
| Chinon | 30.0 | .9 | 222.0 | 5.1 |
| Shugart | 132.5 | 4.1 | 202.3 | 4.6 |
| Tokyo Electric | 160.0 | 5.0 | 160.0 | 3.7 |
| Micro Peripherals | 62.0 | 1.9 | 119.0 | 2.7 |
| Other U.S. | 21.1 | .6 | 26.2 | .7 |
| Other Non-U.S. | 74.3 | 2.3 | 330.9 | 7.5 |
| TOTAL | 3,232.2 | 100.0 | 4,363.1 | 100.0 |

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

# 1985 DISK/TREND REPORT

# FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

## Coverage

Examples of flexible disk drives in this group include:

### 48 tracks per inch

| | |
|---|---|
| Alps Electric | FDD 212B, DFB 121 |
| BASF | 6108, 6128 |
| Canon | 211, 413 |
| Chinon | F-502 |
| Control Data | 9409, 9428 |
| Copal | F-5002 |
| Elcomatic | ACP548-50 |
| Epson | SD-521 |
| Fujitsu | M2551A |
| Hi-Tech Peripherals | H548-50 |
| Hitachi | HFD 505C |
| ISOT | ES 5321 |
| Lung Hwa | LDD-106DDS |
| Matsushita Communication Ind. | JA-551 |
| Mitac | MC-425 |
| Mitsubishi Electric | MF501A |
| Mitsumi | D 503 |
| NEC | FD 1053 |
| Oki Electric | GM 3305H, GM 3315BU |
| Olivetti | FD 502, FD 602 |
| Omek | OM55 |
| Ricoh | RF5050 |
| Shinwa Co., Ltd | NFD-510 |
| Tandon | TM-100-2, TM-75-2 |
| TEAC | FD-55BV |
| Tokyo Electric Company | FB-503 |
| Toshiba | ND04D |
| Victor Company of Japan | MDP-200, MDP-2 |
| Video Technology | FDM 145 |
| Weltec Digital | M 48D |
| Wong's Technology | WST 211-5, WST 212-5 |
| YE Data | YD-274, YD-580 |

### 96/100 tracks per inch (1.0 megabyte)

| | |
|---|---|
| Alps Electric | FDD 222B, DFC 422 |
| BASF | 6118, 6138 |
| Canon | MDD-221, MDD-423, |
| Chinon | F-504 |
| Control Data | 9429, 9409-T |
| Copal | F-5004 |
| Elcomatic | ACP596-10 |

| | |
|---|---|
| Epson | SD-540 |
| Fujitsu | M2552A |
| Hi-Tech Peripherals | H596-10 |
| Hitachi | HFD 510C |
| ISOT | ES 5323 |
| Kyocera | KFD-525 |
| Matsushita Communication Ind. | JA-561 |
| Micro Peripherals | 92, 902D |
| Micropolis | 1115-VI |
| Mitsumi Electric | D 507 |
| NEC | FD 1055 |
| Oki Electric | GM 3405H, GM 3415B |
| Olivetti | FD 592, FD 692 |
| Omek | OM56 |
| Tandon | TM-65-4 |
| TEAC | FD-55FV |
| Tokyo Electric Company | FB-504 |
| Toshiba | ND-06D |
| Victor Company of Japan | MDP-100, MDP-300 |
| Video Technology | FDM 160 |
| Weltec Digital | M 96D |
| Wong's Technology | WST 221-5 |
| YE Data | YD-280, YD-480 |

96/100 tracks per inch (1.6 megabytes)

| | |
|---|---|
| Alps Electric | DFC 642, DFC 682 |
| BASF | 6148, 6149 |
| Chinon | F-506 |
| Copal | F-5006, F-5008 |
| Elcomatic | ACP596-16 |
| Epson | SD-560, SD-580 |
| Fujitsu | M2553A, M2554A |
| Hi-Tech Peripherals | H596-16 |
| Hitachi | HFD 516C, HFD 516DA |
| Matsushita Com. Ind. | JU-581, JU-595 |
| Micropolis | 1117-VI |
| Mitsubishi Electric | MF504A |
| NEC | FD 1155B, FD 1155C |
| Oki Electric | GM3505BU-1/2 |
| Olivetti | FD 595, FD 696 |
| Omek | OM57 |
| Ricoh | RF5160 |
| Tandon | TM-75-8 |
| TEAC | FD-55GV, FD-55GFV |
| Tokyo Electric Company | FB-506 |
| Toshiba | ND-08D, ND-08DE |
| Victor Company of Japan | MDP-1000, MDP-2000 |
| Weltec Digital | M 16-A |
| Wong's Technology | Challenger IV |
| YE Data | YD-380T |

96/100 tracks per inch (2.0 megabytes)

| | |
|---|---|
| Mitsubishi Electric | M4855 |

Over 100 tracks per inch

| | |
|---|---|
| Eastman Kodak | Kodak 3.3, 6.6, 12 |
| Hitachi | FDD 541 |

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

The first two thirds high drives were offered by BASF, also in 1978, followed by a handful of others, with sales mostly in Europe. However, during the last three years most manufacturers of 5.25 inch drives have introduced half high models (1.625 inches high), with an enthusiastic reaction from system manufacturers. In addition, Canon, Oki Electric and Epson offer drives only one third the height of standard drives.

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

In 1982, 1.6 megabyte 5.25 inch drives were first shipped by YE Data, designed to a standard coordinated by Nippon Telephone and Telegraph. These drives match the capacity and file organization of two sided 8 inch drives by using a minimum of 77 tracks (at 96 TPI) per side at 9600 BPI. Initial shipments were used mostly on systems sold in the Japanese domestic market. The 2.0 megabyte drive using slightly higher linear densities offered by Mitsubishi has so far generated only small sales. IBM's 1984 introduction of the PC AT, using YE Data's 1.6 megabyte drive, has stampeded the market into rapid worldwide usage of the 1.6 megabyte 5.25 inch format.

Drivetec's half high drive using an embedded servo technique -- with 192 TPI, and capacity of 3.3 megabytes -- was a technical success and a commercial failure. The company closed down in early 1985 after spending all of its money, but had licensed Eastman Kodak to make the drive in 1983. Eastman started production of a drive compatible with Drivetec's unit in 1984, and in 1985 added 3.3 and 12 megabyte models. Another type of high capacity drive is offered by Hitachi, with 6.5 megabyte capacity achieved by using 125 TPI and 29,560 BPI. The drive uses cobalt modified particulate media, and was first delivered in the first quarter of 1985.

Market status

DISK/TREND estimate of total market size:

| Worldwide sales ($M) | 1984 | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|---|
| U.S. manufacturers | 696.0 | 262.3 | 105.4 | 91.5 | 98.3 |
| All manufacturers | 1,571.2 | 1,349.4 | 1,429.8 | 1,612.2 | 1,611.9 |

After four years of spectacular growth, shipments of 5.25 inch, two sided floppy drives have suddenly gone flat in 1985. Slow 1985 growth in personal computers and other parts of the computer industry is the problem -- plus the impact from increasing usage of small Winchester disks, which reduce user demand for extra floppy drives on personal computers.

Total worldwide shipments for 1985 are estimated at 10,671,400 drives, barely equalling 1984's total. However, while the worldwide total was flat, shipments by U.S. manufacturers were dropping 54.5% from 1984, to 2,056,400 drives. During the same year, non-U.S. shipments will have increased 40.6%, to 8,615,000.

1985 is expected to be the last year for U.S. captive shipments in this product group, as Qume and IBM halt production. OEM drive activity

by U.S. producers is also declining rapidly, with most of the companies previously considered to be the major players now phasing out of floppy drive production, leaving only Tandon still at high production levels, with help from continuing business with IBM.

Non-U.S. drive manufacturers are expected to ship 7,432,000 OEM drives in 1985, but at prices so low that few, if any, will show a profit at the bottom line if all expenses are properly allocated. 19 Japanese companies are shipping 5.25 inch, two sided OEM drives this year, and most have been fighting for market share as their first objective, with profitability an objective to be hoped for at a later date.

The result has been a 1985 collapse in OEM price levels, from a 1984 worldwide $114 average for all drives in this group, down to $81 in 1985. Of course, large deals have been taken at prices barely exceeding half of the average unit price. In the last quarter of 1985, however, prices have stabilized, due to the dramatic change in international exchange rates, in which the value of the U.S. dollar has dropped to a level of about 200 yen.

Professional and business microcomputer systems continue to provide the major stimulus to growth in this product group, with 71.6% of worldwide unit shipments, a share which grows each year. The largest influence in this growth has been IBM's choice of 48 TPI two sided 5.25 inch drives for most members of its personal computer family introduced to date. Most of IBM's PC competitors have tried to be compatible, or at least comparable, in this choice.

But the mainstream two sided floppy drive configurations are now undergoing significant changes in the mix of product shipments. 1982 was the last year that full size drives held the majority of unit shipments.

Half high drives accounted for 69.8% of 1984 worldwide unit shipments and are expected to represent 89.8% of 1985 unit shipments.

The track density mix is also changing. 96 TPI and 100 TPI two sided drives were never a very important part of shipments by U.S. drive manufacturers. But with IBM's selection of 1.6 megabyte drives for the PC AT, and presumably for other PC models to follow, 1985 shipments of drives in this format are now increasing rapidly -- up from 6% of worldwide unit shipments in 1984, to 25.1% in 1985.

Tandon Corporation continued to lead in non-captive shipments for 1984, with 2,099,600 drives shipped worldwide, 22.2% of the total. Teac and Mitsubishi Electric again held second and third places, with 16.8% and 8.1%, respectively. YE Data's 697,000 units, 7.4% of the total, moved the company up to fourth position, with a boost from shipments to IBM for the PC AT program.

It is not expected that Tandon's well-publicized patent infringement proceedings against several Japanese manufacturers of two sided drives will have any material effect on the market. Several of Tandon's competitors have already taken licenses, and it is believed that the eventual resolution of the remaining disputes will have no significant effect on drive availability. Any impact on prices is probably already included in current pricing policies.

Marketing trends

The outlook for this product group, and for many key participants, has changed radically during the past year. During 1985, IBM's management has decided to drop its planned manufacturing program for 5.25 inch floppy drives, and other U.S. captive programs by Tandy, Control Data, Shugart

and Qume have been phased out. Only Tandon remains as a major U.S. participant in the OEM segment, but its role as a major vendor probably depends on IBM's continued purchases -- which are assumed for the purposes of this year's DISK/TREND forecasts.

Total worldwide shipments for the group are expected to recover from the no-growth hiatus of 1985, with 1986/87 increases in unit shipments expected to average 14%, as sales for personal computers achieve a modest recovery. For 1988, however, the increase is projected at a slight 1.5%, with the competitive impact of 3.5 inch drives finally starting to eat into the market for two sided 5.25 inch drives.

IBM's choice of the 1.6 megabyte standard is destined to influence the design of most small systems intended for the office environment. Although IBM has announced usage of this format only with the PC AT so far, much broader application with the firm's personal computers and other systems is anticipated. It is expected that 1.6 megabyte 5.25 inch drives will be used with all new IBM systems intended for office applications in the U.S. or Europe, although the 360 kilobyte drives currently in use on IBM's older PC models may well continue to be offered as an option. PCs intended for portable or home use will probably use 3.5 inch drives.

1.6 megabyte drives are expected to rapidly overtake other formats. As a result of this shift in product mix, 48 TPI drives reached their production peak in 1984. 96 TPI drives with 1.0 megabyte capacity have been much more popular in Japan than in the U.S. due to the higher data storage requirements of Japanese language word processors, but this format also peaked in 1984, as newer systems transitioned to the 1.6 megabyte standard. Shipments of 2.0 megabyte drives are expected to remain small.

The movement to half high drive configurations will continue, to be given an expected assist in 1986 as IBM moves away from full size 48 TPI drives now used with the PC XT and basic PC models. 89.8% of 1986 world-wide unit shipments are forecasted to be half high drives, rising to 98.6% in 1988.

The market for high capacity floppy drives in this group, above 1.6 megabytes, is starting to develop -- after a false start with the abortive Amlyn and Drivetec programs. The major products in this area now being shipped are Hitachi's 6.5 megabyte drive, and Eastman Kodak's 3.3 megabyte unit, with the promise of 6.6 and 12 megabyte drives in mid-1986.

High capacity floppies are expected to find a growing demand in the personal computer add-on market with users who have files larger than the floppies provided by IBM and other system manufacturers, plus sales to a variety of specialized system manufacturers. The existence of this market has already been amply demonstrated by rising shipments of rigid disk cartridge drives and the Iomega Bernoulli principle drives.

Shipments of these drives are not broken out in current DISK/TREND tables, but projections included in the totals are summarized below:

| Worldwide OEM and PCM unit shipments (000) | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|
| Drives with capacities greater than 1.6 MB | 32.0 | 65.0 | 123.0 | 243.0 |

The passage of time will undoubtedly see greatly increased demand for higher capacity floppy drives, and add-on sales to personal computer users will eventually force action by industry leaders such as IBM. But the relatively modest penetration of the potential market expressed by the above projections is believed to be the most likely pattern until then.

## Technical trends

As discussed above, the eventual appetite for more capacity will result in large volume shipments of flexible disk drives with capacities well above 1.6 megabytes. The key question is which of the several potential recording systems will prevail. While perpendicular recording is frequently mentioned as a strong contender, an entirely new production system for media would be necessary, with a high level of investment required. Particulate recording continues to be the most likely contender, making use of existing coating equipment and demonstrably able to meet established criteria for durability.

As usual, the key question is which recording format will become the industry's mainstream choice. As usual, the real decision-maker will probably be IBM, if and when it eventually decides to use a 5.25 inch format with capacity greater than 1.6 megabytes. There are three obvious possibilities for IBM's next step: The firm could use the Eastman Kodak format, at capacities up to 12 megabytes, it could stay with 5.25 inch drives using 96 TPI open loop head positioning and increase linear density to provide similar capacities, or it could abandon the 5.25 inch form factor and use 3.5 inch drives in the range of 2 megabytes or higher.

## Forecasting assumptions

1. IBM will close down its 5.25 inch flexible disk drive manufacturing facilities.

2. Growth in personal computer demand for office applications will resume healthy growth in 1986.

3. The leadership taken by Japanese floppy drive manufacturers in 1.6 megabyte OEM drives will enable non-U.S. drive manufacturers to increase their lead over U.S. manufacturers in worldwide shipments of OEM drives.

TABLE 24

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

REVENUE SUMMARY

| | DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Revenues | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | 110.3 | 122.6 | 80.9 | 96.4 | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | 17.1 | 24.5 | 16.5 | 27.5 | -- | -- | -- | -- | -- | -- |
| TOTAL U.S. CAPTIVE | 127.4 | 147.1 | 97.4 | 123.9 | -- | -- | -- | -- | -- | -- |
| PCM | 6.3 | 7.4 | 4.0 | 4.5 | 2.7 | 2.7 | 5.4 | 5.9 | 9.5 | 10.9 |
| OEM | 499.5 | 541.5 | 121.4 | 133.9 | 91.7 | 102.7 | 74.9 | 85.6 | 74.8 | 87.4 |
| TOTAL U.S. NON-CAPTIVE | 505.8 | 548.9 | 125.4 | 138.4 | 94.4 | 105.4 | 80.3 | 91.5 | 84.3 | 98.3 |
| TOTAL U.S. REVENUES | 633.2 | 696.0 | 222.8 | 262.3 | 94.4 | 105.4 | 80.3 | 91.5 | 84.3 | 98.3 |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | 100.6 | 346.7 | 146.8 | 479.4 | 147.9 | 609.7 | 154.5 | 726.9 | 144.4 | 754.4 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 213.7 | 528.5 | 247.4 | 607.7 | 301.4 | 714.7 | 344.7 | 793.8 | 336.7 | 759.2 |
| TOTAL NON-U.S. REVENUES | 314.3 | 875.2 | 394.2 | 1,087.1 | 449.3 | 1,324.4 | 499.2 | 1,520.7 | 481.1 | 1,513.6 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE REVENUES | 947.5 | 1,571.2 | 617.0 | 1,349.4 | 543.7 | 1,429.8 | 579.5 | 1,612.2 | 565.4 | 1,611.9 |
| OEM Average Price ($000) | .121 | .114 | .079 | .081 | .076 | .077 | .073 | .074 | .071 | .071 |

TABLE 25

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES

UNIT SHIPMENT SUMMARY

| | DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Shipments | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | 315.0 | 350.0 | 183.0 | 215.0 | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | 34.1 | 48.9 | 33.0 | 55.0 | -- | -- | -- | -- | -- | -- |
| TOTAL U.S. CAPTIVE | 349.1 | 398.9 | 216.0 | 270.0 | -- | -- | -- | -- | -- | -- |
| PCM | 32.0 | 38.0 | 21.4 | 24.4 | 6.0 | 6.0 | 12.0 | 13.0 | 21.0 | 24.0 |
| OEM | 3,771.5 | 4,081.5 | 1,603.7 | 1,762.0 | 1,246.8 | 1,397.0 | 1,005.8 | 1,149.0 | 927.7 | 1,080.0 |
| TOTAL U.S. NON-CAPTIVE | 3,803.5 | 4,119.5 | 1,625.1 | 1,786.4 | 1,252.8 | 1,403.0 | 1,017.8 | 1,162.0 | 948.7 | 1,104.0 |
| TOTAL U.S. SHIPMENTS | 4,152.6 | 4,518.4 | 1,841.1 | 2,056.4 | 1,252.8 | 1,403.0 | 1,017.8 | 1,162.0 | 948.7 | 1,104.0 |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | 228.5 | 798.4 | 361.0 | 1,183.0 | 406.2 | 1,577.0 | 441.0 | 1,963.0 | 430.0 | 2,154.0 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 2,124.9 | 5,329.6 | 3,054.3 | 7,432.0 | 3,914.7 | 9,188.5 | 4,711.4 | 10,745.0 | 4,856.8 | 10,824.0 |
| TOTAL NON-U.S. SHIPMENTS | 2,353.4 | 6,128.0 | 3,415.3 | 8,615.0 | 4,320.9 | 10,765.5 | 5,152.4 | 12,708.0 | 5,286.8 | 12,978.0 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE SHIPMENTS | 6,506.0 | 10,646.4 | 5,256.4 | 10,671.4 | 5,573.7 | 12,168.5 | 6,170.2 | 13,870.0 | 6,235.5 | 14,082.0 |
| **Cumulative Shipments** | | | | | | | | | | |
| IBM | 315.0 | 350.0 | 498.0 | 565.0 | 498.0 | 565.0 | 498.0 | 565.0 | 498.0 | 565.0 |
| Non-IBM | 10,935.9 | 18,796.9 | 16,009.3 | 29,253.3 | 21,583.0 | 41,421.8 | 27,753.2 | 55,291.8 | 33,988.7 | 69,373.8 |
| WORLDWIDE TOTAL | 11,250.9 | 19,146.9 | 16,507.3 | 29,818.3 | 22,081.0 | 41,986.8 | 28,251.2 | 55,856.8 | 34,486.7 | 69,938.8 |

TABLE 26

FLEXIBLE DISK DRIVES, 5.25 Inch, Two Sides

WORLDWIDE SHIPMENTS (000)

DRIVE HEIGHT ANALYSIS

| | 1984 --Shipments-- | | Forecast 1985 | | 1986 | | 1987 | | 1988 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Units | % | Units | % | Units | % | Units | % | Units | % |
| **U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 398.9 | | 270.0 | | -- | | -- | | -- | |
| Full Size | 350.0 | 87.8 | 110.0 | 40.7 | -- | -- | -- | -- | -- | -- |
| Half High | 48.9 | 12.2 | 160.0 | 59.3 | -- | -- | -- | -- | -- | -- |
| OEM Total | 4,119.5 | | 1,786.4 | | 1,403.0 | | 1,162.0 | | 1,104.0 | |
| Full Size | 2,764.0 | 67.2 | 963.2 | 54.0 | 606.0 | 43.2 | 325.0 | 28.0 | 182.0 | 16.5 |
| Half High | 1,355.5 | 32.8 | 823.2 | 46.0 | 797.0 | 56.8 | 837.0 | 72.0 | 922.0 | 83.5 |
| Total U.S. | 4,518.4 | | 2,056.4 | | 1,403.0 | | 1,162.0 | | 1,104.0 | |
| Full Size | 3,114.0 | 69.0 | 1,073.2 | 52.3 | 606.0 | 43.2 | 325.0 | 28.0 | 182.0 | 16.5 |
| Half High | 1,404.4 | 31.0 | 983.2 | 47.7 | 797.0 | 56.8 | 837.0 | 72.0 | 922.0 | 83.5 |
| **NON-U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 798.4 | | 1,183.0 | | 1,577.0 | | 1,963.0 | | 2,154.0 | |
| Full Size | 29.0 | 3.6 | 13.0 | 1.1 | 7.0 | .4 | 3.0 | .2 | 5.0 | .2 |
| Half High | 769.4 | 96.4 | 1,170.0 | 98.9 | 1,570.0 | 99.6 | 1,960.0 | 99.8 | 2,149.0 | 99.8 |
| OEM Total | 5,329.6 | | 7,432.0 | | 9,188.5 | | 10,745.0 | | 10,824.0 | |
| Full Size | 76.4 | 1.4 | 7.5 | .1 | 4.0 | -- | 9.0 | .1 | 16.0 | .1 |
| Half High | 5,253.2 | 98.6 | 7,424.5 | 99.9 | 9,184.5 | 100.0 | 10,736.0 | 99.9 | 10,808.0 | 99.9 |
| Total Non-U.S. | 6,128.0 | | 8,615.0 | | 10,765.5 | | 12,708.0 | | 12,978.0 | |
| Full Size | 105.4 | 1.7 | 20.5 | .2 | 11.0 | .1 | 12.0 | .1 | 21.0 | .2 |
| Half High | 6,022.6 | 98.3 | 8,594.5 | 99.8 | 10,754.5 | 99.9 | 12,696.0 | 99.9 | 12,957.0 | 99.8 |
| **WORLDWIDE RECAP** | | | | | | | | | | |
| Total Shipments | 10,646.4 | | 10,671.4 | | 12,168.5 | | 13,870.0 | | 14,082.0 | |
| Full Size | 3,219.4 | 30.2 | 1,093.7 | 10.2 | 617.0 | 5.1 | 337.0 | 2.4 | 203.0 | 1.4 |
| Half High | 7,427.0 | 69.8 | 9,577.7 | 89.8 | 11,551.5 | 94.9 | 13,533.0 | 97.6 | 13,879.0 | 98.6 |

TABLE 27

FLEXIBLE DISK DRIVES, 5.25 Inch, Two Sides

WORLDWIDE SHIPMENTS (000)

TRACK DENSITY ANALYSIS

| | 1984 --Shipments-- | | Forecast 1985 | | 1986 | | 1987 | | 1988 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Units | % | Units | % | Units | % | Units | % | Units | % |
| **U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 398.9 | | 270.0 | | -- | | -- | | -- | |
| 48 TPI | 398.9 | 100.0 | 165.0 | 61.2 | -- | -- | -- | -- | -- | -- |
| 96 TPI 1.6 MB | -- | -- | 105.0 | 38.8 | -- | -- | -- | -- | -- | -- |
| OEM Total | 4,119.5 | | 1,786.4 | | 1,403.0 | | 1,162.0 | | 1,104.0 | |
| 48 TPI | 3,847.2 | 93.5 | 1,664.7 | 93.3 | 1,316.0 | 93.9 | 990.0 | 85.3 | 794.0 | 72.0 |
| 96/100 TPI | 269.3 | 6.5 | 112.7 | 6.3 | 63.0 | 4.5 | 84.0 | 7.2 | 172.0 | 15.6 |
| 96 TPI 1.6 MB | 3.0 | -- | 9.0 | .4 | 24.0 | 1.6 | 88.0 | 7.5 | 138.0 | 12.4 |
| Total U.S. | 4,518.4 | | 2,056.4 | | 1,403.0 | | 1,162.0 | | 1,104.0 | |
| 48 TPI | 4,246.1 | 94.1 | 1,829.7 | 89.1 | 1,316.0 | 93.9 | 990.0 | 85.3 | 794.0 | 72.0 |
| 96/100 TPI | 269.3 | 5.9 | 112.7 | 5.5 | 63.0 | 4.5 | 84.0 | 7.2 | 172.0 | 15.6 |
| 96 TPI 1.6 MB | 3.0 | -- | 114.0 | 5.4 | 24.0 | 1.6 | 88.0 | 7.5 | 138.0 | 12.4 |
| **NON-U.S. MANUFACTURERS** | | | | | | | | | | |
| Captive Total | 798.4 | | 1,183.0 | | 1,577.0 | | 1,963.0 | | 2,154.0 | |
| 48 TPI | 560.0 | 70.2 | 621.0 | 52.6 | 659.0 | 41.9 | 574.0 | 29.2 | 429.0 | 19.9 |
| 96/100 TPI | 89.9 | 11.3 | 173.0 | 14.6 | 188.0 | 11.9 | 193.0 | 9.8 | 175.0 | 8.1 |
| 96 TPI 1.6 MB | 148.5 | 18.5 | 389.0 | 32.8 | 730.0 | 46.2 | 1,196.0 | 61.0 | 1,550.0 | 72.0 |
| OEM Total | 5,329.6 | | 7,432.0 | | 9,188.5 | | 10,745.0 | | 10,824.0 | |
| 48 TPI | 3,404.5 | 64.0 | 4,107.0 | 55.4 | 4,599.0 | 50.2 | 4,829.0 | 45.0 | 4,256.0 | 39.4 |
| 96/100 TPI | 1,425.5 | 26.7 | 1,133.5 | 15.3 | 863.0 | 9.4 | 626.0 | 5.8 | 428.0 | 4.0 |
| 96 TPI 1.6 MB | 499.6 | 9.3 | 2,191.5 | 29.3 | 3,726.5 | 40.4 | 5,290.0 | 49.2 | 6,140.0 | 56.6 |
| Total Non-U.S. | 6,128.0 | | 8,615.0 | | 10,765.5 | | 12,708.0 | | 12,978.0 | |
| 48 TPI | 3,964.5 | 64.8 | 4,728.0 | 55.0 | 5,258.0 | 48.9 | 5,403.0 | 42.6 | 4,685.0 | 36.2 |
| 96/100 TPI | 1,515.4 | 24.7 | 1,306.5 | 15.2 | 1,051.0 | 9.8 | 819.0 | 6.4 | 603.0 | 4.6 |
| 96 TPI 1.6 MB | 648.1 | 10.5 | 2,580.5 | 29.8 | 4,456.5 | 41.3 | 6,486.0 | 51.0 | 7,690.0 | 59.2 |
| **WORLDWIDE RECAP** | | | | | | | | | | |
| Total Shipments | 10,646.4 | | 10,671.4 | | 12,168.5 | | 13,870.0 | | 14,082.0 | |
| 48 TPI | 8,210.6 | 77.2 | 6,557.7 | 61.6 | 6,574.0 | 54.1 | 6,393.0 | 46.2 | 5,479.0 | 39.0 |
| 96/100 TPI | 1,784.7 | 16.8 | 1,419.2 | 13.3 | 1,114.0 | 9.2 | 903.0 | 6.5 | 775.0 | 5.5 |
| 96 TPI 1.6 MB | 651.1 | 6.0 | 2,694.5 | 25.1 | 4,480.5 | 36.7 | 6,574.0 | 47.3 | 7,828.0 | 55.5 |

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

TABLE 28

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES
DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

| Distribution channel | 1984 U.S. Net Shipments Units (000) | % | FORECAST 1985 % | 1986 % | 1987 % | 1988 % |
|---|---|---|---|---|---|---|
| Mainframe computer manufacturers | 3,180.1 | 53.6 | 42.3 | 39.8 | 36.9 | 34.0 |
| Mini/micro computer manufacturers | 796.4 | 13.4 | 13.0 | 12.6 | 12.2 | 11.9 |
| System OEMs/systems houses | 1,387.1 | 23.4 | 33.2 | 33.7 | 34.3 | 34.5 |
| Independent peripherals suppliers | 181.6 | 3.1 | 3.7 | 4.5 | 5.4 | 6.1 |
| Distributors, dealers, end users | 383.2 | 6.5 | 7.8 | 9.4 | 11.2 | 13.5 |
| TOTAL | 5,928.4 | | | | | |

TABLE 29

FLEXIBLE DISK DRIVES, 5.25 INCH, TWO SIDES
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

| Drive Manufacturers | 1984 Net Shipments To United States Destinations Units (000) | % | Worldwide Units (000) | % |
|---|---|---|---|---|
| Tandon | 2,074.0 | 35.0 | 2,099.6 | 22.2 |
| Teac | 378.0 | 6.4 | 1,590.0 | 16.8 |
| Mitsubishi Electric | 662.0 | 11.2 | 765.0 | 8.1 |
| YE Data | 265.0 | 4.5 | 697.0 | 7.4 |
| Qume | 655.1 | 11.1 | 655.1 | 6.9 |
| Matsushita Com. Ind. | -- | -- | 614.0 | 6.5 |
| Shugart | 416.5 | 7.0 | 594.8 | 6.3 |
| Control Data | 498.0 | 8.4 | 557.0 | 5.9 |
| Toshiba | 37.0 | .6 | 378.0 | 4.0 |
| Epson | 185.0 | 3.1 | 238.0 | 2.5 |
| Tokyo Electric | 220.0 | 3.7 | 220.0 | 2.3 |
| Alps Electric | 160.0 | 2.7 | 200.0 | 2.1 |
| Canon | 14.5 | .2 | 193.5 | 2.0 |
| Micro Peripherals | 76.0 | 1.3 | 119.0 | 1.3 |
| Wong's Technology | 99.5 | 1.7 | 103.0 | 1.1 |
| Other U.S. | 83.9 | 1.4 | 94.0 | 1.0 |
| Other Non-U.S. | 103.9 | 1.7 | 331.1 | 3.6 |
| TOTAL | 5,928.4 | 100.0 | 9,449.1 | 100.0 |

FLEXIBLE DISK DRIVES, MICROFLOPPIES

# 1985 DISK/TREND REPORT

# FLEXIBLE DISK DRIVES, MICROFLOPPIES

## Coverage

Examples of flexible disk drives in this group include:

### 3.5" disk diameter, one side

| | |
|---|---|
| Alps Electric | FDV 113A, DFL 313 |
| Au Peripheral Products | AP-300S |
| BASF | 6161, 6163 |
| Canon | MDD 351, MDD 353 |
| Chinon | F-351, F-353 |
| Citizen | OMDT-00A, ONDT-40A |
| Copal | F-3503 |
| Epson | SMD-150, SMD-170 |
| Fujitsu | M2431A |
| Janome Sewing Machine Co. | MFD-91 |
| Matsushita Com. Ind. | JU-313, JU-323 |
| Mitsubishi Electric | MF351A |
| Mitsumi Electric | D 355 |
| NEC | FD 1034 |
| Olivetti | FD 301 |
| Sankyo Seiki | FDU-355-SA |
| Seikosha | SD3505 |
| Sony | OA-D32V, OA-D33V, MP-F53V |
| Tandon | TM-303 |
| TEAC | FD-35E, FD-135E |
| Tokyo Electric Company | FB-352 |
| Toshiba | ND-353, ND-351S |
| Victor Company of Japan | MDP-10, MDP-30FD |

### 3.5" disk diameter, two sides

| | |
|---|---|
| Akan | 352S |
| Alps Electric | FDV 223A, DFL 413 |
| Au Peripheral Products | AP-300DS |
| BASF | 6164 |
| Brother | FB 610 |
| Canon | MDD 350 |
| Chinon | F-354, F-356 |
| Citizen | OMDT-10A, ONDT-50B |
| Copal | F-3504 |
| Epson | SMD-280, SMD-180 |
| Fujitsu | M2532A, M2536A |
| Janome Sewing Machine Co. | MFD-91D |
| Matsushita Com. Ind. | JU-363 |
| Mitsubishi | MF353, MF355 |
| NEC | FD 1035, FD 1036A |
| Olivetti | FD 302 |

3.5" disk diameter, two sides (continued)

| | |
|---|---|
| Ricoh | RF4100 |
| Sankyo Seiki | FDU-355-DA |
| Seikosha | SD3510 |
| Shinwa Co, Ltd. | FDS-36 |
| Sony | OA-D32W, MP-F53W |
| Tandon | TM-304 |
| TEAC | FD-35F, FD-35H, FD-135F |
| Tokyo Electric Company | FB-354 |
| Toshiba | ND-354, ND-352S |
| Victor Company of Japan | MDP-20, MDP-40 |
| YE Data | YD-620, YD-640 |

3.0" disk diameter, one side

| | |
|---|---|
| Chinon | F-301 |
| Hitachi | HFD 305SX |
| Janome Sewing Machine Company | MFD-80 |
| Matsushita Electronic Comp. | EME-131, EME-155 |
| Sankyo Seiki | FDU-300-S |
| TEAC | FD-30A |

3.0 disk diameter, two sides

| | |
|---|---|
| Hitachi | HFD 305D |
| Matsushita Electronic Comp. | EME-233 |
| Sankyo Seiki | FDU-300-D |

This year's DISK/TREND Report continues to treat one and two sided microfloppy drives as a single product group. There are now only two principal microfloppy media standards: (1) The 3.5 inch Sony-type diskette, for which over 20 manufacturers now offer drives, and (2) the 3.0 inch Hitachi/Matsushita Electric diskette, supported with announced drives from only six manufacturers at this time. The basic drives in each of these groups use 6,250 bytes per track, the same track capacity as "double density" 5.25 inch diskettes, and also use 40 or 80 tracks per side to maintain file compatibility with 5.25 inch diskettes.

1.6 and 2.0 megabyte 3.5 inch drives were announced for the first time in 1985 by a few manufacturers. These drives are intended for use

with the high density media proposed by Sony, and will operate at up to 17,400 BPI, using the 135 TPI standard of today's production drives. It is expected that most major manufacturers of microfloppy drives will soon announce similar drives for 1986 delivery.

Market status

DISK/TREND estimate of total market size:

| Worldwide sales ($M) | 1984 | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|---|
| U.S. manufacturers | 3.8 | -- | 7.7 | 16.8 | 30.2 |
| All manufacturers | 201.6 | 362.7 | 656.4 | 874.1 | 1,059.7 |

Microfloppy drives remain the leader in growth rate among all DISK/TREND flexible disk drive product groups. Worldwide 1984 shipments were 1,972,000 drives, and 1985's shipments, although not up to previous expectations, are projected to reach 3,378,000 units, an increase of 71.2%. The shortfall from previous forecasts is attributed partly to an off-year for the computer industry, but mostly to IBM's delay in introducing its briefcase portable computer, using 1 megabyte 3.5 inch drives.

The Sony-type 3.5 inch diskette is steadily becoming more dominant. Shipments of the Hitachi/Matsushita 3.0 inch drives are expected to increase slightly in 1985, to 262,000 units. But the long-term trend for the 3.0 inch format continues down, from 12.6% of worldwide unit shipments in 1984, to 7.8% in 1985. 3.0 inch drives have never significantly penetrated the U.S. and European markets, and after an early lead have been passed up in Japan by 3.5 inch drives, now used by many leading system manufacturers, including Fujitsu, NEC and IBM.

Within the 3.5 inch format, a striking reversal in the rankings of one side and two sided drives has occurred in the last year. In 1984, one

side 3.5 inch drives held 64.9% of all microfloppy unit shipments, but in 1985 two sided drives are expected to take 56.4% of shipments. Almost all new systems introduced in 1985 using microfloppies have adopted two sided 3.5 inch models. Most 3.5 inch drives shipped in the last year have used the standard 135 TPI, with 80 tracks per side. 67.5 TPI drives, with 40 tracks per side, have a minor role, with less than 80,000 drives in 1985.

OEM shipments continued to represent the bulk of microfloppy shipments in 1984, with captive drives only 6.4% of the worldwide total. Sony's 1,022,000 OEM drives provided 55.4% of worldwide non-captive shipments for 1984, with most other suppliers' shares in the 2% to 5% range.

Marketing trends

Excellent continuing growth is projected for microfloppies. The average annual increase in shipments for 1985-88 included in this year's DISK/TREND Report is 57.3%. By 1988, microfloppy worldwide shipments are forecasted at 12,578,000 units, rivaling two sided 5.25 inch drives.

The dominant influences in microfloppy shipment growth will continue to be briefcase-size portable computers and small-footprint desktop systems intended for office applications, followed by heavy adoption for high-end home computers. Most of the microfloppy shipments so far have been generated without the help of IBM, whose JX system offered in Asia has had only modest sales to date. But that will change.

It is expected that IBM will finally introduce its own briefcase portable using 3.5 inch 1 megabyte drives early in 1986. The program was postponed after new management was installed at IBM's Entry Systems Division this Spring, but everything seems to be back on track for this program, with shipments expected at time of announcement.

The impact of IBM's portable on the industry will be substantial, if priced aggressively. In addition to using 3.5 inch drives as the basic data storage device on the portable, IBM will probably find it necessary to offer the same drives as options on its office PC's. It is also considered likely that IBM will eventually use the 2 megabyte 3.5 inch drives now starting to appear, with a later generation of small-footprint desktop office systems.

## Technical trends

Until early 1985, the Nippon Telephone and Telegraph program to establish a 1.6 megabyte standard for 3.5 inch drives seemed to have the support of the Japanese computer industry. But the NTT 1.6 megabyte consensus collapsed after Sony proposed a new 2 megabyte media standard using a thinner coating and higher coercivity -- and IBM expressed interest. It is now clear that most Japanese microfloppy drive manufacturers will offer 2 megabyte drives, plus 1.6 megabyte versions.

Several Japanese firms have revealed work on perpendicular recording for microfloppy drive formats, but the impact on existing microfloppies will probably be slight, due to lack of an agreement on a common media standard. One of the more promising program's is Toshiba's 4 megabyte 3.5 inch drive using barium ferrite media -- but the company has not yet announced a specific product and delivery commitment.

## Forecasting assumptions

1. Two sided 3.5 inch drives will become the dominant microfloppy standard for portable, personal and home computers.

2. IBM will use two sided 3.5 inch microfloppy drives on a briefcase portable and other computers starting in early 1986.

TABLE 30

FLEXIBLE DISK DRIVES, MICROFLOPPIES

REVENUE SUMMARY

| | DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Revenues | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| U.S. Manufacturers | | | | | | | | | | |
| IBM Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| TOTAL U.S. CAPTIVE | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 3.0 | 3.8 | -- | -- | 6.2 | 7.7 | 13.4 | 16.8 | 24.2 | 30.2 |
| TOTAL U.S. NON-CAPTIVE | 3.0 | 3.8 | -- | -- | 6.2 | 7.7 | 13.4 | 16.8 | 24.2 | 30.2 |
| TOTAL U.S. REVENUES | 3.0 | 3.8 | -- | -- | 6.2 | 7.7 | 13.4 | 16.8 | 24.2 | 30.2 |
| Non-U.S. Manufacturers | | | | | | | | | | |
| Captive | 21.5 | 44.3 | 29.1 | 147.3 | 45.6 | 226.0 | 54.2 | 285.9 | 55.6 | 315.6 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 88.5 | 153.5 | 130.1 | 215.4 | 263.5 | 422.7 | 360.6 | 571.4 | 456.9 | 713.9 |
| TOTAL NON-U.S. REVENUES | 110.0 | 197.8 | 159.2 | 362.7 | 309.1 | 648.7 | 414.8 | 857.3 | 512.5 | 1,029.5 |
| Worldwide Recap | | | | | | | | | | |
| TOTAL WORLDWIDE REVENUES | 113.0 | 201.6 | 159.2 | 362.7 | 315.3 | 656.4 | 428.2 | 874.1 | 536.7 | 1,059.7 |
| OEM Average Price ($000) | .088 | .085 | .076 | .074 | .073 | .073 | .070 | .069 | .065 | .065 |

TABLE 31

FLEXIBLE DISK DRIVES, MICROFLOPPIES

UNIT SHIPMENT SUMMARY

| | DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Shipments | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| TOTAL U.S. CAPTIVE | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 26.6 | 34.1 | -- | -- | 87.2 | 109.0 | 193.6 | 242.0 | 372.0 | 465.0 |
| TOTAL U.S. NON-CAPTIVE | 26.6 | 34.1 | -- | -- | 87.2 | 109.0 | 193.6 | 242.0 | 372.0 | 465.0 |
| TOTAL U.S. SHIPMENTS | 26.6 | 34.1 | -- | -- | 87.2 | 109.0 | 193.6 | 242.0 | 372.0 | 465.0 |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | 62.0 | 126.0 | 93.0 | 454.0 | 147.0 | 717.0 | 183.0 | 959.0 | 194.0 | 1,094.0 |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | 1,014.0 | 1,811.9 | 1,703.0 | 2,924.0 | 3,582.5 | 5,809.0 | 5,187.2 | 8,265.0 | 7,038.0 | 11,019.0 |
| TOTAL NON-U.S. SHIPMENTS | 1,076.0 | 1,937.9 | 1,796.0 | 3,378.0 | 3,729.5 | 6,526.0 | 5,370.2 | 9,224.0 | 7,232.0 | 12,113.0 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE SHIPMENTS | 1,102.6 | 1,972.0 | 1,796.0 | 3,378.0 | 3,816.7 | 6,635.0 | 5,563.8 | 9,466.0 | 7,604.0 | 12,578.0 |
| **Cumulative Shipments** | | | | | | | | | | |
| IBM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Non-IBM | 1,380.2 | 2,438.8 | 3,176.2 | 5,816.8 | 6,992.9 | 12,451.8 | 12,556.7 | 21,917.8 | 20,160.7 | 34,495.8 |
| WORLDWIDE TOTAL | 1,380.2 | 2,438.8 | 3,176.2 | 5,816.8 | 6,992.9 | 12,451.8 | 12,556.7 | 21,917.8 | 20,160.7 | 34,495.8 |

TABLE 32

FLEXIBLE DISK DRIVES, MICROFLOPPIES

WORLDWIDE SHIPMENTS (000)

BREAKDOWN BY DISK DIAMETER

| | 1984 Shipments | | | Forecast | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1985 | | | 1986 | | | 1987 | | | 1988 | | |
| | 3.0" | 3.5" SS | 3.5" DS | 3.0" | 3.5" SS | 3.5" DS | 3.0" | 3.5" SS | 3.5" DS | 3.0" | 3.5" SS | 3.5" DS | 3.0" | 3.5" SS | 3.5" DS |
| U.S. MANUFACTURERS | | | | | | | | | | | | | | | |
| IBM Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | -- | 31.3 | 2.8 | -- | -- | -- | -- | 46.0 | 63.0 | -- | 22.0 | 220.0 | -- | -- | 465.0 |
| TOTAL U.S. SHIPMENTS | -- | 31.3 | 2.8 | -- | -- | -- | -- | 46.0 | 63.0 | -- | 22.0 | 220.0 | -- | -- | 465.0 |
| NON-U.S. MANUFACTURERS | | | | | | | | | | | | | | | |
| Captive | 5.0 | 56.0 | 65.0 | 8.0 | 149.0 | 297.0 | 12.0 | 192.0 | 513.0 | 10.0 | 204.0 | 745.0 | 7.0 | 179.0 | 908.0 |
| OEM | 244.4 | 1,191.2 | 376.3 | 254.0 | 1,057.0 | 1,613.0 | 240.0 | 734.0 | 4,835.0 | 166.0 | 405.0 | 7,694.0 | 92.0 | 175.0 | 10,752.0 |
| TOTAL NON-U.S. SHIPMENTS | 249.4 | 1,247.2 | 441.3 | 262.0 | 1,206.0 | 1,910.0 | 252.0 | 926.0 | 5,348.0 | 176.0 | 609.0 | 8,439.0 | 99.0 | 354.0 | 11,660.0 |
| WORLDWIDE RECAP | | | | | | | | | | | | | | | |
| Total Shipments | 249.4 | 1,278.5 | 444.1 | 262.0 | 1,206.0 | 1,910.0 | 252.0 | 972.0 | 5,411.0 | 176.0 | 631.0 | 8,659.0 | 99.0 | 354.0 | 12,125.0 |
| ANNUAL SHARE, BY DIAMETER | 12.6% | 64.9% | 22.5% | 7.8% | 35.8% | 56.4% | 3.8% | 14.6% | 81.6% | 1.9% | 6.7% | 91.4% | .8% | 2.8% | 96.4% |

TABLE 33

FLEXIBLE DISK DRIVES, MICROFLOPPIES

WORLDWIDE REVENUES ($M)

BREAKDOWN BY DISK DIAMETER

| | 1984 Revenues | | | Forecast 1985 | | | 1986 | | | 1987 | | | 1988 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.0" | 3.5" SS | 3.5" DS | 3.0" | 3.5" SS | 3.5" DS | 3.0" | 3.5" SS | 3.5" DS | 3.0" | 3.5" SS | 3.5" DS | 3.0" | 3.5" SS | 3.5" DS |
| U.S. MANUFACTURERS | | | | | | | | | | | | | | | |
| IBM Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | -- | 3.5 | .3 | -- | -- | -- | -- | 3.0 | 4.7 | -- | 1.4 | 15.4 | -- | -- | 30.2 |
| TOTAL U.S. REVENUES | -- | 3.5 | .3 | -- | -- | -- | -- | 3.0 | 4.7 | -- | 1.4 | 15.4 | -- | -- | 30.2 |
| NON-U.S. MANUFACTURERS | | | | | | | | | | | | | | | |
| Captive | 2.3 | 19.3 | 22.7 | 3.2 | 46.3 | 97.8 | 4.5 | 57.4 | 164.1 | 3.5 | 58.9 | 223.5 | 2.5 | 49.8 | 263.3 |
| OEM | 16.2 | 99.3 | 38.0 | 14.2 | 73.0 | 128.2 | 13.0 | 47.7 | 362.0 | 9.1 | 24.3 | 538.0 | 5.0 | 10.5 | 698.4 |
| TOTAL NON-U.S. REVENUES | 18.5 | 118.6 | 60.7 | 17.4 | 119.3 | 226.0 | 17.5 | 105.1 | 526.1 | 12.6 | 83.2 | 761.5 | 7.5 | 60.3 | 961.7 |
| WORLDWIDE RECAP | | | | | | | | | | | | | | | |
| Total Revenues | 18.5 | 122.1 | 61.0 | 17.4 | 119.3 | 226.0 | 17.5 | 108.1 | 530.8 | 12.6 | 84.6 | 776.9 | 7.5 | 60.3 | 991.9 |
| ANNUAL SHARE, BY DIAMETER | 9.2% | 60.7% | 30.1% | 4.8% | 33.0% | 62.2% | 2.7% | 16.5% | 80.8% | 1.4% | 9.7% | 88.9% | .7% | 5.7% | 93.6% |

TABLE 34

FLEXIBLE DISK DRIVES, MICROFLOPPIES
DISTRIBUTION CHANNEL SUMMARY
U.S. Non-Captive Disk Drives

| Distribution channel | 1984 U.S. Net Shipments Units (000) | % | FORECAST 1985 % | 1986 % | 1987 % | 1988 % |
|---|---|---|---|---|---|---|
| Mainframe computer manufacturers | -- | -- | 5.1 | 17.2 | 21.3 | 22.7 |
| Mini/micro computer manufacturers | 313.1 | 30.1 | 27.3 | 24.8 | 22.6 | 20.6 |
| System OEMs/systems houses | 684.6 | 65.8 | 63.1 | 53.0 | 50.6 | 50.8 |
| Independent peripherals suppliers | 33.6 | 3.2 | 3.5 | 3.9 | 4.3 | 4.7 |
| Distributors, dealers, end users | 9.3 | .9 | 1.0 | 1.1 | 1.2 | 1.2 |
| TOTAL | 1,040.6 | | | | | |

TABLE 35

FLEXIBLE DISK DRIVES, MICROFLOPPIES
MARKET SHARE SUMMARY
Worldwide Shipments of Non-Captive Disk Drives

| Drive Manufacturers | 1984 Net Shipments To United States Destinations Units (000) | % | Worldwide Units (000) | % |
|---|---|---|---|---|
| Sony | 950.0 | 91.3 | 1,022.0 | 55.4 |
| Alps Electric | -- | -- | 100.0 | 5.4 |
| Chinon | -- | -- | 97.7 | 5.3 |
| Sankyo Seiki | -- | -- | 90.0 | 4.9 |
| Epson | 19.6 | 1.9 | 89.0 | 4.8 |
| Matsushita Elec. Ind. | -- | -- | 80.0 | 4.3 |
| YE Data | 2.0 | .2 | 79.0 | 4.3 |
| Matsushita Com. Ind. | -- | -- | 67.0 | 3.6 |
| Hitachi | 22.0 | 2.1 | 65.0 | 3.5 |
| Teac | 6.0 | .6 | 54.0 | 2.9 |
| Other U.S. | 26.6 | 2.6 | 34.1 | 1.8 |
| Other Non-U.S. | 14.4 | 1.3 | 68.2 | 3.8 |
| TOTAL | 1,040.6 | 100.0 | 1,846.0 | 100.0 |

FLEXIBLE DISK DRIVES, SPECIAL

# 1985 DISK/TREND REPORT

# FLEXIBLE DISK DRIVES, SPECIAL

## Coverage

Examples of flexible disk drives included in this group are:

### 8 inch Bernoulli principle drives

| | |
|---|---|
| Iomega | Alpha 10H, A110H, A120H, A210H |

### 5.25 inch Bernoulli principle drives

| | |
|---|---|
| Iomega | Beta-5, B105-MAC |

### Spiral track drives

| | |
|---|---|
| Mitsumi Electric | QDM-01 Quick Disk |
| Sankyo Seiki | FMC-170, FMC-270 |
| Tokyo Electric Company | MC-116, MC-132, MC-164 |

The flexible disk drives in this group are analyzed separately, because the drives included are significantly different from those in other DISK/TREND product groups. The functional and physical characteristics of these products are varied, and will be individually discussed below. Specific shipment and revenue forecasts for products in this group have been included in the DISK/TREND Report this year for the first time.

## Special flexible disk drive market status and trends

DISK/TREND estimate of total market size:

| Worldwide sales ($M) | 1984 | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|---|
| U.S. manufacturers | 51.1 | 91.9 | 149.3 | 203.7 | 223.8 |
| All manufacturers | 59.7 | 100.6 | 158.7 | 213.8 | 234.2 |

## Iomega's Bernoulli principle drives

Iomega's drives use the Bernoulli effect to control head/disk spacing. These are high performance drives, using flexible disks in a

removable rigid cartridge, and a sophisticated internal air flow system to maintain the proper position of the disk relative to the recording head. A voice coil rotary head positioning system, in conjunction with an embedded servo, provides average seek times of about 35-40 milliseconds.

Iomega announced the 8 inch Alpha-10 in May, 1981, and deliveries of production drives, with 10 megabytes formatted capacity, started in September, 1982. The original drive was replaced by a half high 8 inch model in 1984, also with 10 megabyte capacity, and a 21 megabyte version was added in 1985. A 5 megabyte full size 5.25 inch drive was introduced in 1983.

The basic 10 megabyte 8 inch drive operates at 300 TPI and 18,000 FCI (24,000 BPI), and spins at 1,500 RPM. The new 21 megabyte version increases track density to 641 TPI. Iomega's current 5.25 inch drives offer 5.25 megabyte capacity, with 394 TPI at 17,200 BPI, and maintain the 625 kilobyte/second transfer rate standard with most 5.25 Winchester drives, by using a rotational speed of 1,964 RPM.

The capacity, performance, and pricing of Iomega's drives place them in competition with small Winchester disks and removable rigid disk cartridge drives, rather than in the existing flexible disk drive market. The only announced flexible disk drive with the potential to challenge Iomega in its key markets is the new Eastman Kodak 12 megabyte 5.25 inch drive promised for delivery in the second half of 1986.

Iomega has attracted great interest in the industry, but orders from system manufacturers were slow in coming. The firm has achieved much better success through its program to offer subsystems in the personal computer add-on market. Since the second half of 1983, an 8 inch subsystem sold through dealers to IBM PC users has been growing in sales volume. A 5.25

inch subsystem for the Apple Macintosh market was added in fourth quarter of 1984.

Iomega's subsystems provided most of the firm's growth during the last year. 36,200 drives were sold in this market in 1984, with an increase projected to 88,000 in 1985. Continued growth through 1988 is forecasted, with the total drives shipped by Iomega and any potential similar competitive drives rising to 243,000 units in that year.

These forecasts assume, of course, a market environment benign to Bernoulli drives, with no significant rearguard action by IBM in connection with its personal computer aftermarket. IBM could greatly reduce the Iomega's market by changing the PC attachment opportunity for these drives or by offering its own data storage product to serve the same function. However, there is no indication of any IBM plans to do so, for the moment.

Iomga's main difficulty in selling to system manufacturers on an OEM basis lies in lack of credible alternate sources for the drive. The products are unique, and system manufacturers, as always, are reluctant to take a chance on a sole-source product, even from a company as prosperous as Iomega.

The first step was taken with a license to SCI Systems to manufacture Iomega's drives, but no specific plans to enter the OEM market as a second source have been announced. In 1984 a license was granted to Nippon Chemi-Con, a major Japanese manufacturer of electrolytic capacitors, to manufacture and market Iomega drives in Japan. Also, Verbatim has a license to make and sell Iomega media. Further development of alternate sources for drives and media is probably essential to establish major shipments of Iomega's OEM drive configurations.

Spiral track drives:

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

All of these drives record in a single spiral track on a flexible disk ranging from 2.6 to 2.8 inches in diameter. The drives' physical size, interfaces and media are not compatible between drives from different manufacturers. Olivetti offered a similar drive, starting in 1977, but phased it out a few years ago. Olivetti's drive was used as a program loader and data storage medium on a variety of word processing and data processing equipment, but has been replaced with Olivetti's internally manufactured 5.25 inch floppy drives. The drive was offered as an OEM product for several years, without much market impact.

Sankyo Seiki's drive was introduced in 1980, and the newer Tokyo Electric drives were introduced in 1982. The most recent introduction is the Mitsumi "Quick Disk", which became available in early 1984. All of these drives are, like Olivetti's, intended to develop the market for very small, low priced serial recording devices in applications such as electronic typewriters, POS terminals, personal computers, and for other specialized systems. Most early shipments were in connection with Japanese produced electronic typewriters.

Mitsumi's Quick Disk may be the most ambitious product in this group. The target market is low cost home computers, where the intent is to provide a very low cost serial recording device which will be usable in quickly loading programs and user files into main system memory. Current drives have 64 kilobytes capacity, but higher capacity versions are expected. The drive is designed to sell for less than $30 to system manufacturers, and several home computers intended for the Japanese market

have already appeared with Quick Disk drives. Maxell offers the media, providing a credible source.

The three companies participating so far in the spiral track flexible disk drive market shipped a total of 145,000 units in 1984, with an increase to 177,000 drives in 1985. Given a reasonable success level for the Quick Disk in the MSX computer market, the 260,000 units projected for 1988 should be shipped without difficulty. Because of the very low average unit price for drives of this type, the total revenues produced remain comparatively small.

Forecasting assumptions

1. IBM will not take any actions which would significantly reduce the Iomega market opportunity in attaching drives to IBM personal computers.

2. The market for MSX computers will enjoy strong growth in the Japanese domestic market for home computers, with heavy use of spiral track floppy drives, but will have little penetration of other markets.

TABLE 36

FLEXIBLE DISK DRIVES, SPECIAL TYPES

REVENUE SUMMARY

| | DISK DRIVE REVENUES, BY SHIPMENT DESTINATION ($M) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 Revenues | | Forecast 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| TOTAL U.S. CAPTIVE | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCM | 41.3 | 43.5 | 78.6 | 83.8 | 127.5 | 136.6 | 167.9 | 185.2 | 176.7 | 198.8 |
| OEM | 6.8 | 7.6 | 6.7 | 8.1 | 10.5 | 12.7 | 15.1 | 18.5 | 20.0 | 25.0 |
| TOTAL U.S. NON-CAPTIVE | 48.1 | 51.1 | 85.3 | 91.9 | 138.0 | 149.3 | 183.0 | 203.7 | 196.7 | 223.8 |
| TOTAL U.S. REVENUES | 48.1 | 51.1 | 85.3 | 91.9 | 138.0 | 149.3 | 183.0 | 203.7 | 196.7 | 223.8 |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | -- | 8.6 | -- | 8.7 | -- | 9.4 | -- | 10.1 | -- | 10.4 |
| TOTAL NON-U.S. REVENUES | -- | 8.6 | -- | 8.7 | -- | 9.4 | -- | 10.1 | -- | 10.4 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE REVENUES | 48.1 | 59.7 | 85.3 | 100.6 | 138.0 | 158.7 | 183.0 | 213.8 | 196.7 | 234.2 |

TABLE 37

FLEXIBLE DISK DRIVES, SPECIAL TYPES

UNIT SHIPMENT SUMMARY

| | DISK DRIVE UNIT SHIPMENTS, BY SHIPMENT DESTINATION (000) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | | Forecast | | | | | | | |
| | Shipments | | 1985 | | 1986 | | 1987 | | 1988 | |
| | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW | U.S. | WW |
| **U.S. Manufacturers** | | | | | | | | | | |
| IBM Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Other U.S. Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| TOTAL U.S. CAPTIVE | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCM | 34.4 | 36.2 | 82.6 | 88.0 | 140.0 | 150.0 | 194.0 | 214.0 | 216.0 | 243.0 |
| OEM | 8.0 | 8.9 | 10.8 | 13.0 | 18.4 | 22.0 | 28.8 | 35.0 | 41.6 | 52.0 |
| TOTAL U.S. NON-CAPTIVE | 42.4 | 45.1 | 93.4 | 101.0 | 158.4 | 172.0 | 222.8 | 249.0 | 257.6 | 295.0 |
| TOTAL U.S. SHIPMENTS | 42.4 | 45.1 | 93.4 | 101.0 | 158.4 | 172.0 | 222.8 | 249.0 | 257.6 | 295.0 |
| **Non-U.S. Manufacturers** | | | | | | | | | | |
| Captive | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OEM | -- | 145.0 | -- | 177.0 | -- | 208.0 | -- | 240.0 | -- | 260.0 |
| TOTAL NON-U.S. SHIPMENTS | -- | 145.0 | -- | 177.0 | -- | 208.0 | -- | 240.0 | -- | 260.0 |
| **Worldwide Recap** | | | | | | | | | | |
| TOTAL WORLDWIDE SHIPMENTS | 42.4 | 190.1 | 93.4 | 278.0 | 158.4 | 380.0 | 222.8 | 489.0 | 257.6 | 555.0 |
| **Cumulative Shipments** | | | | | | | | | | |
| IBM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Non-IBM | 44.9 | 192.6 | 138.3 | 470.6 | 296.7 | 850.6 | 519.5 | 1,339.6 | 777.1 | 1,894.6 |
| WORLDWIDE TOTAL | 44.9 | 192.6 | 138.3 | 470.6 | 296.7 | 850.6 | 519.5 | 1,339.6 | 777.1 | 1,894.6 |

# 1985 DISK/TREND REPORT

# FLEXIBLE DISK DRIVE SPECIFICATIONS

## Coverage

This listing includes most flexible disk drives now in new production or announced, arranged alphabetically by manufacturer. Most of the listed drives are still in production.

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

## Generic type

Because they are generally understood throughout the industry, IBM media designations are used to define types of 8 inch media; Sony media designations are used to define 3.5 inch media types. However, usage of these model numbers is not intended to imply interchangeability. Media for 5.25 inch drives is identified by recording format--for example, 5.25"--2/80 means 5.25 inch media suitable for two sided 80 track recording. High density 5.25 inch diskettes are identified by manufacturer's designations. Individual drives may require media with a variety of special characteristics.

## Capacities

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

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

OEM prices

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

Accuracy

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

DISK/TREND product groups

In most cases the product groups used for individual drives are clear, but a few arbitrary decisions have been made. The IBM magazine drive has been included in the 8 inch, two sided group, since the magazine mechanism uses a single drive.

DISK/TREND PRODUCT GROUPS FOR FLEXIBLE DISK DRIVES

13. 8 inch, one side
14. 8 inch, two sides
15. 5.25 inch, one side
16. 5.25 inch, two sides
17. Microfloppies, one and two sides
18. Special flexible disk drives

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | AKAN | ALPS ELECTRIC | ALPS ELECTRIC | ALPS ELECTRIC | ALPS ELECTRIC |
| DRIVE | 352S | DFB 111 FDD 2125 | DFC 122 | DFB 121 | DFC 222 FDL 212B |
| DISK/TREND GROUP | 17 | 15 | 15 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Sony OM-D4440 | 5.25" -- 1/40 | 5.25" -- 1/40 | 5.25" -- 2/40 | 5.25" -- 2/40 |
| Nominal disk diameter | 3.5" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | High Density Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft/Hard | Soft/Hard | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5/1.0 | U: .250 | U: .250 | U: .250 | U: .5 |
| Capacity per track (Bytes) | U: 3,125/6250 | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 2 | 1 | 1 | 2 | 2 |
| Tracks per surface | 80 | 40 | 40 | 40 | 40 |
| Track density (TPI) | 135 | 48 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 4359/8118 | 5536 | 5536 | 5876 | 5876 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 6 or 12 | 6 | 6 | 6 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | 35 | 35 | 35 | 35 |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 31.25 | 31.25 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.18 x 4.0 x 5.75 | 1.69 x 5.75 x 8.0 | 1.625 5.75 x 8.0 | 1.625 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 3Q85 | 2/80 | 1985 | 1985 | 1984 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | ALPS ELECTRIC | ALPS ELECTRIC | ALPS ELECTRIC | ALPS ELECTRIC | ALPS ELECTRIC |
| DRIVE | DFC 422<br>FDL 222B | DFC 642 | DFC 682 | DFL 123<br>FDV 113A | DFL 223<br>FDV 123A |
| DISK/TREND GROUP | 16 | 16 | 16 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/80 | Maxell MD2-HD | Maxell MD2-HD | Sony OM-D3440 | Sony OM-D4440 |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 3.5" | 3.5" |
| Recording medium | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft/Hard | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0 | U: 1.6 | U: 1.0/1.6 | U: .250 | U: .5 |
| Capacity per track (Bytes) | U: 6,250 | U: 10,416 | U: 6,250/10,416 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 2 | 2 | 2 | 1 | 2 |
| Tracks per surface | 80 | 77 | 80/77 | 40 | 40 |
| Track density (TPI) | 96 | 96 | 96 | 67.5 | 67.5 |
| Maximum linear density (BPI) | 5922 | 9646 | 5922/9646 | 8126 | 8647 |
| Rotational speed (RPM) | 300 | 360 | 300/360 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 3 | 6 | 6 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 35 | 35 | 35 | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 83.3 | 100/83.3 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25 | 62.5 | 31.25/62.5 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.625 5.75 x 8.0 | 1.625 5.75 x 8.0 | 1.46 x 4.1 x 4.9 | 1.46 x 4.1 x 4.9 |
| FIRST CUSTOMER SHIPMENT | 1984 | 8/85 | 8/85 | 1985 | 1985 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | ALPS ELECTRIC | ALPS ELECTRIC | AU PERIPHERAL PRODUCTS | AU PERIPHERAL PRODUCTS | BASF |
| DRIVE | DFL 313<br>FDV 213A | DFL 413<br>FDV 223A | AP-300DS | AP-300S | 6102 |
| DISK/TREND GROUP | 17 | 17 | 17 | 17 | 13 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Sony OM-D3440 | Sony OM-D4440 | Sony OM-D4440 | Sony OM-D3440 | Diskette 1 |
| Nominal disk diameter | 3.5" | 3.5" | 3.5" | 3.5" | 8" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5 | U: 1.0 | U: .5/1.0 | U: .250/.5 | U: .401/.802 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 5,208/10,416 |
| Data surfaces per spindle | 1 | 2 | 2 | 1 | 1 |
| Tracks per surface | 80 | 80 | 80 | 80 | 77 |
| Track density (TPI) | 135 | 135 | 135 | 135 | 48 |
| Maximum linear density (BPI) | 8190 | 8717 | 4359/8718 | 4102/8204 | 3268/6536 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 6 | 6 | 6 | 6 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 14 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | 40 |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 15.63/31.25 | 31.25 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.46 x 4.1 x 4.9 | 1.46 x 4.1 x 4.9 | 1.625 x 4.0 x 6.0 | 1.625 x 4.0 x 6.0 | 4.33 x 8.66 x 14.17 |
| FIRST CUSTOMER SHIPMENT | 5/84 | 4/85 | 1Q86 | 1Q86 | 1976 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | $95 | $85 | -- |
| COMMENTS | | | | | |

| MANUFACTURER | BASF | BASF | BASF | BASF | BASF |
|---|---|---|---|---|---|
| DRIVE | 6104 | 6108 | 6118 | 6128<br>6129 | 6138<br>6139 |
| DISK/TREND GROUP | 14 | 16 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Diskette 1,2,2D | BASF 606<br>5.25" -- 2/40 | 5.25" -- 2/80 | 5.25" -- 2/40 | 5.25" -- 2/80 |
| Nominal disk diameter | 8" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft/Hard | Soft/Hard | Soft/Hard | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .8/1.6 | U: .250/.5 | U: .5/1.0 | U: .250/.5 | U: .5/1.0 |
| Capacity per track (Bytes) | U: 5,208/10,416 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 77 | 40 | 80 | 40 | 80 |
| Track density (TPI) | 48 | 48 | 96 | 48 | 96 |
| Maximum linear density (BPI) | 3406/6816 | 2938/5876 | 2961/5922 | 2938/5876 | 2961/5922 |
| Rotational speed (RPM) | 360 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw,<br>Stepping Motor | Cam,<br>Stepping Motor | Cam,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 6 | 6 | 6 | 3 |
| Settling time (msec) | 14 | 15 | 15 | 20 | 20 |
| Head load time(msec) | 40 | Continuous<br>Contact | Continuous<br>Contact | 25 | 25 |
| Average rotational delay (msec) | 83.3 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 4.33 x<br>8.66 x 14.17 | 2.1 x<br>5.75 x 7.5 | 2.1 x<br>5.75 x 7.5 | 1.28 x<br>5.75 x 8.5 | 1.28 x<br>5.75 x 8.5 |
| FIRST CUSTOMER SHIPMENT | 1978 | 4Q78 | 1982 | 1983 | 1983 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | Manufactured by Canon<br><br>6129 is 8.0" Deep | Manufactured by Canon<br><br>6238/6239 are dual drive versions<br><br>6239 is 8.0" Deep |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | BASF | BASF | BASF | BASF | BASF |
| DRIVE | 6148<br>6149 | 6161 | 6162 | 6163 | 6164 |
| DISK/TREND GROUP | 16 | 17 | 17 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Maxell MD2-HD | Sony OM-D3440 | Sony OM-D4440 | Sony OM-D3440 | Sony OM-D4440 |
| Nominal disk diameter | 5.25" | 3.5" | 3.5" | 3.5" | 3.5" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .8/1.6 | U: .125/.250 | U: .250/.5 | U: .250/.5 | U: .5/1.0 |
| Capacity per track (Bytes) | U: 5,208/10,416 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 1 | 2 | 1 | 2 |
| Tracks per surface | 80/77 | 40 | 40 | 80 | 80 |
| Track density (TPI) | 96 | 67.5 | 67.5 | 135 | 135 |
| Maximum linear density (BPI) | 4823/9646 | 4064/8128 | 4325/8650 | 4094/8188 | 4359/8718 |
| Rotational speed (RPM) | 360 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 3 | 3 | 3 |
| Settling time (msec) | 20 | 20 | 20 | 20 | 20 |
| Head load time(msec) | 25 | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 83.3 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.625/31.25 | 15.625/31.25 | 15.625/31.25 | 15.625/31.25 |
| SIZE (Inches: H x W x D) | 1.28 x 5.75 x 8.5 | 1.26 x 4.13 x 6.06 | 1.26 x 4.13 x 6.06 | 1.26 x 4.13 x 6.06 | 1.26 x 4.13 x 6.06 |
| FIRST CUSTOMER SHIPMENT | 4Q84 | 2Q85 | 2Q85 | 2Q85 | 2Q85 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | Manufactured by Canon<br><br>6149 is 8.0" Deep | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | BROTHER | BROTHER | CALDISK | CALDISK | CALDISK |
| DRIVE | FB 600 | FB 610 | 142M | 143M1 | 143M |
| DISK/TREND GROUP | 17 | 17 | 13 | 13 | 14 |
| MARKET | OEM, Captive | OEM, Captive | OEM, Captive | OEM, Captive | OEM, Captive |
| MEDIA: Generic type | Sony OM-D4440 | Sony OM-D4440 | Diskette 1 | Diskette 1 | Diskette 1,2,2D |
| Nominal disk diameter | 3.5" | 3.5" | 8" | 8" | 8" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft/Hard | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0 | U: 1.0 | U: .401/.802 | U: .401/.802 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 5,208/10,416 | U: 5,208/10,416 | U: 5,208/10,416 |
| Data surfaces per spindle | 2 | 2 | 1 | 1 | 2 |
| Tracks per surface | 80 | 80 | 77 | 77 | 77 |
| Track density (TPI) | 135 | 135 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 8717 | 8717 | 3268/6536 | 3268/6536 | 3408/6816 |
| Rotational speed (RPM) | 300 | 300 | 360 | 360 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING: Track to track (msec) | 6 | 3 | 6 | 6 | 6 |
| Settling time (msec) | 15 | 15 | 10 | 10 | 10 |
| Head load time (msec) | Continuous Contact | Continuous Contact | 30 | 30 | 30 |
| Average rotational delay (msec) | 100 | 100 | 83.3 | 83.3 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 31.25/62.5 | 31.25/62.5 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.0 x 4.0 x 5.9 | 1.0 x 4.0 x 5.9 | 4.9 x 8.4 x 15.0 | 4.9 x 8.4 x 15.0 | 4.9 x 8.4 x 15.0 |
| FIRST CUSTOMER SHIPMENT | 1986 | 1986 | 1/77 | 1/77 | 8/77 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | $420 | $427 | $505 |
| COMMENTS | | | | | |

| MANUFACTURER | CANON | CANON | CANON | CANON | CANON |
|---|---|---|---|---|---|
| DRIVE | MDD 211 | MDD 221 | MDD 413 | MDD 423 | MDD 530 |
| DISK/TREND GROUP | 16 | 16 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | 5.25" -- 2/80 | 5.25" -- 2/40 | 5.25" -- 2/80 | 5.25" -- 2/80 |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250/.5 | U: .5/1.0 | U: .250/.5 | U: .5/1.0 | U: 1.0 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 6,250 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 40 | 80 | 40 | 80 | 80 |
| Track density (TPI) | 48 | 96 | 48 | 96 | 96 |
| Maximum linear density (BPI) | 2938/5876 | 2961/5922 | 2938/5876 | 2961/5922 | 5922 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 3 | 6 | 3 | 3 |
| Settling time (msec) | 20 | 15 | 20 | 20 | 20 |
| Head load time(msec) | 25 | 25 | 25 | 25 | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.28 x 5.75 x 8.5 | 1.28 x 5.75 x 8.5 | 2.26 x 5.75 x 8.5 | 2.26 x 5.75 x 8.5 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 5/83 | 4/83 | 2/84 | 6/83 | 4/85 |
| U.S. OEM PRICE FOR 500 UNITS | $95 (1000) | $98 (1000) | $180 (1000) | $200 (1000) | $95 (1000) |
| COMMENTS | | | Dual drive | Dual drive | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | CANON | CANON | CANON | CANON | CANON |
| DRIVE | MDD 531 | MDD 350 | MDD 351 | MDD 352 | MDD 353 |
| DISK/TREND GROUP | 16 | 17 | 17 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | Sony OM-D4440 | Sony OM-D3440 | Sony OM-D4440 | Sony OM-D3440 |
| Nominal disk diameter | 5.25" | 3.5" | 3.5" | 3.5" | 3.5" |
| Recording medium | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5 | U: .5/1.0 | U: .250/.5 | U: .250/.5 | U: .125/.250 |
| Capacity per track (Bytes) | U: 6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 2 | 1 | 2 | 1 |
| Tracks per surface | 40 | 80 | 80 | 40 | 40 |
| Track density (TPI) | 48 | 135 | 135 | 67.5 | 67.5 |
| Maximum linear density (BPI) | 5876 | 4359/8717 | 4094/8187 | 4324/8647 | 4063/8126 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 3 | 3 | 6 | 6 |
| Settling time (msec) | 20 | 20 | 20 | 20 | 20 |
| Head load time(msec) | Continuous Contact | 25 | 25 | 25 | 25 |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.18 x 4.0 x 5.9 | 1.18 x 4.0 x 5.9 | 1.18 x 4.0 x 5.9 | 1.18 x 4.0 x 5.9 |
| FIRST CUSTOMER SHIPMENT | 4/85 | 11/84 | 11/84 | 11/84 | 11/84 |
| U.S. OEM PRICE FOR 500 UNITS | $90 (1000) | $95 (1000) | $93 (1000) | $93 (1000) | $90 (1000) |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | CHINON | CHINON | CHINON | CHINON | CHINON |
| DRIVE | F-051D<br>F-051M<br>F-051A | F-502 | F-504 | F-506 | F-301 |
| DISK/TREND GROUP | 15 | 16 | 16 | 16 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" - 1/40 | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD | Maxell Compact Floppy Disk |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 3.0 |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .125/.250 | U: .250/.5 | U: .5/1.0 | U: 1.0/1.6 | U: .125/.250 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 6,250/10,416 | U: 3,125/6,250 |
| Data surfaces per spindle | 1 | 2 | 2 | 2 | 1 |
| Tracks per surface | 40 | 40 | 80 | 80/77 | 40 |
| Track density (TPI) | 48 | 48 | 96 | 96 | 100 |
| Maximum linear density (BPI) | 2768/5536 | 2938/5876 | 2961/5922 | 5922/9646 | 4473/8946 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300/360 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING: Track to track (msec) | 6 | 6 | 3 | 3 | 3 |
| Settling time (msec) | 20 | 20 | 20 | 20 | 20 |
| Head load time (msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100/83.3 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.7 | 1.625 x 5.75 x 8.7 | 1.625 x 5.75 x 8.7 | 1.625 x 5.75 x 8.7 | 1.625 x 3.5 x 5.9 |
| FIRST CUSTOMER SHIPMENT | 8/83 | 4/84 | 11/84 | 7/85 | 9/83 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | F-051M is mechanism - only version<br><br>F-051A is Apple version | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | CHINON | CHINON | CHINON | CHINON | CITIZEN |
| DRIVE | F-351 | F-353 | F-354<br>F-354C | F-356 | OMDT-00A |
| DISK/TREND GROUP | 17 | 17 | 17 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | SONY OM-D3440 | SONY OM-D3440 | Sony OM-D4440 | -- | SONY OM-D3440 |
| Nominal disk diameter | 3.5 | 3.5 | 3.5" | 3.5" | 3.5" |
| Recording medium | High Density<br>Oxide Coated | High Density<br>Oxide Coated | High Density<br>Oxide Coated | High Density<br>Oxide Coated | High Density,<br>Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .125/.250 | U: .250/.5 | U: .5/1.0 | U: .8/1.6 | U: .250/.5 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 5,208/10,416 | U: 3,125/6,250 |
| Data surfaces per spindle | 1 | 1 | 2 | 2 | 1 |
| Tracks per surface | 40 | 80 | 80 | 77 | 80 |
| Track density (TPI) | 67.5 | 135 | 135 | 135 | 135 |
| Maximum linear density (BPI) | 4062/8125 | 4093/8187 | 4359/8717 | 7092/14184 | 4094/8188 |
| Rotational speed (RPM) | 300 | 300 | 300 | 360 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 3 | 3 | 3 | 12 |
| Settling time (msec) | 20 | 20 | 20 | 15 | 15 |
| Head load time(msec) | Continuous<br>Contact | Continuous<br>Contact | Continuous<br>Contact | Continuous<br>Contact | Continuous<br>Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 83.3 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 1.26 x<br>4.0 x 6.38 | 1.26 x<br>4.0 x 6.38 | 1.26 x<br>4.0 x 6.38 | 1.26 x<br>4.0 x 6.1 | 1.0 x<br>3.9 x 5.2 |
| FIRST CUSTOMER SHIPMENT | 11/83 | 6/84 | 11/84 | -- | -- |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | F-354C is<br>auto eject<br>model | | Top Loading |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | CITIZEN | CITIZEN | CITIZEN | CITIZEN | CONTROL DATA |
| DRIVE | OMDT-10A | ONDT-40A | ONDT-50B | ONDT-70A | 210-10 |
| DISK/TREND GROUP | 17 | 17 | 17 | 17 | 14 |
| MARKET | OEM | OEM | OEM | OEM | PCM |
| MEDIA: Generic type | SONY OM-D4440 | SONY OM-D3440 | SONY OM-D4440 | SONY OM-D4440 | Diskette 1,2,2D |
| Nominal disk diameter | 3.5" | 3.5" | 3.5" | 3.5" | 8" |
| Recording medium | High Density, Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5/1.0 | U: .250/.5 | U: .5/1.0 | U: .5/1.0 | F: .606208 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | F: 4,096 |
| Data surfaces per spindle | 2 | 1 | 2 | 2 | 2 |
| Tracks per surface | 80 | 80 | 80 | 80 | 74/3 |
| Track density (TPI) | 135 | 135 | 135 | 135 | 48 |
| Maximum linear density (BPI) | 4359/8718 | 4094/8188 | 4359/8718 | 4359/8718 | 3408/6816 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 12 | 6 | 6 | 3 | 3 |
| Settling time (msec) | 15 | 32 | 32 | 32 | 20 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | 40 |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.0 x 3.9 x 5.2 | 1.0 x 3.9 x 5.9 | 1.0 x 3.9 x 5.9 | 1.0 x 3.9 x 5.2 | 4.97 x 8.78 x 14.0 |
| FIRST CUSTOMER SHIPMENT | 10/84 | 1985 | 1985 | 1Q86 | 1/79 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | Top Loading | Front Loading | Front Loading | Front Loading | Series/1 interface |

| MANUFACTURER | CONTROL DATA | CONTROL DATA | CONTROL DATA | CONTROL DATA | CONTROL DATA |
|---|---|---|---|---|---|
| DRIVE | 9406-4 | 9408 | 409 | 9409 | 9409-T |
| DISK/TREND GROUP | 14 | 15 | 16 | 16 | 16 |
| MARKET | OEM | OEM | PCM | OEM | OEM |
| MEDIA: Generic type | Diskette 1,2,2D | 5.25" -- 1/40 | 5.25" -- 2/40 | 5.25" -- 2/40 | 5.25" -- 2/80 |
| Nominal disk diameter | 8" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft/Hard | Soft/Hard | Soft | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .8/1.6 | U: .125/.250 | F: .320/.360 | U: .250/.5 | U: .5/1.0 |
| Capacity per track (Bytes) | U: 5,208/10,416 | U: 3,125/6,250 | F: 4,096/4,608 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 1 | 2 | 2 | 2 |
| Tracks per surface | 77 | 40 | 40 | 40 | 80 |
| Track density (TPI) | 48 | 48 | 48 | 48 | 96 |
| Maximum linear density (BPI) | 3408/6816 | 2768/5536 | 5876 | 2938/5876 | 2961/5922 |
| Rotational speed (RPM) | 360 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 5 | 5 | 5 | 5 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 35 | 50 | 50 | 50 | 50 |
| Average rotational delay (msec) | 83.3 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.63/31.25 | 31.25 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 4.65 x 8.55 x 14.0 | 3.38 x 5.88 x 8.0 | 3.38 x 5.88 x 8.0 | 3.38 x 5.88 x 8.0 | 3.38 x 5.88 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 1981 | 3/80 | 4Q83 | 1980 | 1981 |
| U.S. OEM PRICE FOR 500 UNITS | $510 | $190 (1000) | -- | $196 (1000) | $225 (1000) |
| COMMENTS | Shugart interface | | | | |

| MANUFACTURER | CONTROL DATA | CONTROL DATA | COPAL | COPAL | COPAL |
|---|---|---|---|---|---|
| DRIVE | 9428 | 9429 | F-5002 | F-5004 | F-5006 |
| DISK/TREND GROUP | 16 | 16 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | 5.25" -- 2/80 | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft/Hard | Soft/Hard | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250/.5 | U: .5/1.0 | U: .250/.5 | U: .5/1.0 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 5,208/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 40 | 80 | 40 | 80 | 77 |
| Track density (TPI) | 48 | 96 | 48 | 96 | 96 |
| Maximum linear density (BPI) | 2938/5876 | 2961/5922 | 2938/5876 | 2961/5922 | 4823/9646 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING: Track to track (msec) | 5 | 3 | 6 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time (msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 15.625/31.25 | 15.625/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 11/83 | 12/83 | 9/85 | 6/85 | 6/85 |
| U.S. OEM PRICE FOR 500 UNITS | $165 (1000) | $195 (1000) | -- | -- | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | COPAL | COPAL | COPAL | DIGITAL EQUIPMENT CORPORATION | DIGITAL EQUIPMENT CORPORATION |
| DRIVE | F-5008 | F-3503 | F-3504 | RX02 | RX50 |
| DISK/TREND GROUP | 16 | 17 | 17 | 13 | 15 |
| MARKET | OEM | OEM | OEM | Captive | Captive |
| MEDIA: Generic type | Maxell MD2-HD | Sony OM-D3440 | Sony OM-D4440 | RX01K Diskette 1 | 5.25" -- 1/80 |
| Nominal disk diameter | 5.25" | 3.5" | 3.5" | 8" | 5.25" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | Per Diskette: |
| Total capacity (MBytes) | U: .5/1.0 or U: .8/1.6 | U: .250/.500 | U: .500/1.0 | F: .256/.512 | U: 409 Per Drive: U: 818 |
| Capacity per track (Bytes) | U: 6,250/10,416 | U: 3,125/6,250 | U: 3,125/6,250 | F: 3,328/6,656 | F: 5,120 |
| Data surfaces per spindle | 2 | 1 | 2 | 1 | 1 per diskette 2 per drive |
| Tracks per surface | 80/77 | 80 | 80 | 77 | 80 |
| Track density (TPI) | 96 | 135 | 135 | 48 | 96 |
| Maximum linear density (BPI) | 5922/9646 | 4094/8187 | 4359/8717 | 3268/6536 | 5536 |
| Rotational speed (RPM) | 300/360 | 300 | 300 | 360 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping Motor | Cam, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 3 | 6 | 6 |
| Settling time (msec) | 15 | 15 | 15 | 20 | |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | 16 | |
| Average rotational delay (msec) | 100/83.3 | 100 | 100 | 83.3 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.63/31.25 | 15.63/31.25 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.26 x 4.0 x 6.063 | 1.26 x 4.0 x 6.063 | 17 x 10.5 x 19 | 3.25 x 5.75 x 8.5 |
| FIRST CUSTOMER SHIPMENT | 6/85 | 4/85 | 4/85 | 4Q78 | 4Q82 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | Dual drive | Dual drive with single head positioning system |

| MANUFACTURER | EASTMAN KODAK | EASTMAN KODAK | EASTMAN KODAK | ELCOMATIC | ELCOMATIC |
|---|---|---|---|---|---|
| DRIVE | KODAK 3.3 | KODAK 6.6 | KODAK 12 | ACP 500<br>ACP 550 | ACP 700<br>ACP 750 |
| DISK/TREND GROUP | 16 | 16 | 16 | 13 | 14 |
| MARKET | Captive, OEM | Captive, OEM | Captive, OEM | OEM | OEM |
| MEDIA: Generic type | 5.25"-HD | 5.25"-HD | 5.25" Cartridge | Diskette 1,2,2D | Diskette 1,2,2D |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 8" | 8" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 3.33 | U: 6.6 | U: 12.76 | U: .401/.802 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 10,416 | U: 10,416 | U: 23,868 | U: 5,208/10,416 | U: 5,208/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 1 | 2 |
| Tracks per surface | 160 | 320 | 301 | 77 | 77 |
| Track density (TPI) | 192 | 384 | 333 | 48 | 48 |
| Maximum linear density (BPI) | 9908 | 9908 | 21925 | 3268/6536 | 3408/6816 |
| Rotational speed (RPM) | 360 | 360 | 600 | 360 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw/Dual Stepping Motors | Lead Screw/Dual Stepping Motors | Linear, Voice Coil | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 25 | 3 | 3 |
| Settling time (msec) | 15 | 15 | -- | 15 | 15 |
| Head load time(msec) | Continuous contact | Continuous Contact | Continuous Contact | 35 | 35 |
| Average rotational delay (msec) | 83.3 | 83.3 | 50 | 83.3 | 83.3 |
| Data transfer rate (KBytes/sec) | 62.5 | 62.5 | 250 | 31.25/62.5 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.5 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 4.35 x 8.55 x 12.0 | 4.35 x 8.55 x 12.0 |
| FIRST CUSTOMER SHIPMENT | 1Q84 | 2Q86 | 3Q86 | 4Q81 | 4Q81 |
| U.S. OEM PRICE FOR 500 UNITS | $220 (1000) | $220 | -- | -- | -- |
| COMMENTS | Embedded Servo | Embedded Servo | Embedded Servo<br>SASI/SCSI Interface<br>75 msec aver. positioning | ACP 500: AC<br>ACP 550: DC | ACP 700: AC<br>ACP 750: DC |

| MANUFACTURER | ELCOMATIC | ELCOMATIC | ELCOMATIC | ELCOMATIC | ELCOMATIC |
|---|---|---|---|---|---|
| DRIVE | ACP 1500 | ACP548-25 | ACP596-05 | ACP596-08 | ACP548-50 |
| DISK/TREND GROUP | 14 | 15 | 15 | 15 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Special | 5.25" -- 1/40 | 5.25" -- 1/80 | Maxell MD2-HD | 5.25" -- 2/40 |
| Nominal disk diameter | 8" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft/Hard | Soft/Hard | Soft | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.6/3.2 | U: .250 | U: .5 | U: .8 | U: .5 |
| Capacity per track (Bytes) | U: 10,416 | U: 6,250 | U: 6,250 | U: 10,416 | U: 6,250 |
| Data surfaces per spindle | 2 | 1 | 1 | 1 | 2 |
| Tracks per surface | 154 | 40 | 80 | 77 | 40 |
| Track density (TPI) | 96 | 48 | 96 | 96 | 48 |
| Maximum linear density (BPI) | 3408/6816 | 5536 | 5576 | 4823 | 5876 |
| Rotational speed (RPM) | 360 | 300 | 300 | 360 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 1.5 | 6 | 3 | 3 | 6 |
| Settling time (msec) | 32 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 35 | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 83.3 | 100 | 100 | 83.3 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 31.25 | 31.25 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 4.35 x 8.55 x 12.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 1983 | 1984 | 1984 | 1984 | 1984 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | ELCOMATIC | ELCOMATIC | EPSON | EPSON | EPSON |
| DRIVE | ACP596-10 | ACP596-16 | SD-521 | SD-540 | SD-560 |
| DISK/TREND GROUP | 16 | 16 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/80 | Maxell MD2-HD | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated | High Density, Oxide Coated |
| Sectoring | Soft/Hard | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0 | U: 1.6 | U: .250/.5 | U: .5/1.0 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 6,250 | U: 10,416 | U: 3,125/6250 | U: 3,125/6250 | U: 5,208/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 80 | 77 | 40 | 80 | 77 |
| Track density (TPI) | 96 | 96 | 48 | 96 | 96 |
| Maximum linear density (BPI) | 5922 | 9646 | 2938/5876 | 2938/5876 | 4823/9646 |
| Rotational speed (RPM) | 300 | 360 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 6 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | 35 | 35 |
| Average rotational delay (msec) | 100 | 83.3 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 62.5 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 7.7 | 1.625 x 5.75 x 7.7 | 1.625 x 5.75 x 7.7 |
| FIRST CUSTOMER SHIPMENT | 1984 | 1984 | 10/83 | 10/83 | 10/83 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | $70 (1000) | $90 (1000) | $95 (1000) |
| COMMENTS | | | | | |

| MANUFACTURER | EPSON | EPSON | EPSON | EPSON | EPSON |
|---|---|---|---|---|---|
| DRIVE | SD-580 | TF-20 | SMD-150 | SMD-160 | SMD-170 |
| DISK/TREND GROUP | 16 | 16 | 17 | 17 | 17 |
| MARKET | OEM | Captive, PCM | OEM | OEM | OEM |
| MEDIA: Generic type | Maxell MD2-HD | 5.25" -- 2/40 | Sony OM-D3440 | Sony OM-D4440 | Sony OM-D3440 |
| Nominal disk diameter | 5.25" | 5.25" | 3.5" | 3.5" | 3.5" |
| Recording medium | High Density, Oxide Coated | Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated |
| Sectoring | Soft | Soft/Hard | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0/1.6 | U: .250/.5<br>F: .164/.328 | U: .125/.250 | U: .250/.5 | U: .250/.5 |
| Capacity per track (Bytes) | U: 6,250/10,416 | F: 4,100 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 2 | 1 | 2 | 1 |
| Tracks per surface | 80/77 | 40 | 40 | 40 | 80 |
| Track density (TPI) | 96 | 48 | 67.5 | 67.5 | 135 |
| Maximum linear density (BPI) | 5922/9646 | 2990/5980 | 4064/8128 | 4325/8650 | 4095/8190 |
| Rotational speed (RPM) | 300/360 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Linear, Voice Coil | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 15 | 6 | 6 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 50 | 20 | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100/83.3 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 7.7 | 3.15 x 6.5 x 13.78* | 1.57 x 4 x 5.8 | 1.57 x 4 x 5.8 | 1.57 x 4 x 5.8 |
| FIRST CUSTOMER SHIPMENT | 4/85 | 9/82 | 10/83 | 10/83 | 10/83 |
| U.S. OEM PRICE FOR 500 UNITS | $95 (1000) | -- | $110 (1000) | $85 (1000) | $90 (1000) |
| COMMENTS | | *Dual drive subsystem | SMD-150 is low power model (2.9 watts, operating) | SMD-160 is low power model (2.9 watts, operating) | SMD-170 is low power model (2.9 watts, operating) |

| MANUFACTURER | EPSON | EPSON | FUJITSU | FUJITSU | FUJITSU |
|---|---|---|---|---|---|
| DRIVE | SMD-180 | SMD-280 | M2551A | M2552A | M2553A |
| DISK/TREND GROUP | 17 | 17 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Sony OM-D4440 | Sony OM-D4440 | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD |
| Nominal disk diameter | 3.5" | 3.5" | 5.25" | 5.25" | 5.25" |
| Recording medium | High Density, Oxide Coated | High Density, Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5/1.0 | U: 1.0 | U: .250/.5 | U: .5/1.0 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 5,208/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 80 | 80 | 40 | 80 | 77 |
| Track density (TPI) | 135 | 135 | 48 | 96 | 96 |
| Maximum linear density (BPI) | 4360/8720 | 8717 | 2938/5876 | 2961/5922 | 4823/9646 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Lead Screw, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 6 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 31.25 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.57 x 4 x 5.8 | 1.1 x 4.0 x 5.87 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 10/83 | 9/85 | 1/86 | 1/86 | 1/86 |
| U.S. OEM PRICE FOR 500 UNITS | $95 (1000) | $80 | $83 | $121 | $125 |
| COMMENTS | SMD-180 is low power model (2.9 watts, operating) | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | FUJITSU | FUJITSU | FUJITSU | FUJITSU | FUJITSU |
| DRIVE | M2554A | M2531A | M2532A | M2533A | M2534A |
| DISK/TREND GROUP | 16 | 17 | 17 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Maxell MD2-HD | Sony OM-D3440 | Sony OM-D4440 | -- | -- |
| Nominal disk diameter | 5.25" | 3.5" | 3.5" | 3.5" | 3.5" |
| Recording medium | High Density Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0/1.6 | U: .250/.5 | U: .5/1.0 | U: 1.6 | U: 1.0/1.6 |
| Capacity per track (Bytes) | U: 6,250/10,416 | U: 3,125/6,250 | U: 3,125/6,250 | U: 5,208/10,416 | U: 6,250/10,416 |
| Data surfaces per spindle | 2 | 1 | 2 | 2 | 2 |
| Tracks per surface | 80/77 | 80 | 80 | 77 | 80/77 |
| Track density (TPI) | 96 | 135 | 135 | 135 | 135 |
| Maximum linear density (BPI) | 5922/9646 | 4094/8187 | 4359/8717 | 7264/14528 | 8717/14528 |
| Rotational speed (RPM) | 300/360 | 300 | 300 | 360 | 300/360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 3 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100/83.3 | 100 | 100 | 83.3 | 100/83.3 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.26 x 4.0 x 6.0 | 1.26 x 4.0 x 6.0 | 1.625 x 4.0 x 6.0 | 1.625 x 4.0 x 6.0 |
| FIRST CUSTOMER SHIPMENT | 1/86 | 1/86 | 1/86 | 2/86 | 2/86 |
| U.S. OEM PRICE FOR 500 UNITS | $132 | $96 | $107 | $124 | $134 |
| COMMENTS | | | | | |

| MANUFACTURER | FUJITSU | HI-TECH PERIPHERALS | HI-TECH PERIPHERALS | HI-TECH PERIPHERALS | HI-TECH PERIPHERALS |
|---|---|---|---|---|---|
| DRIVE | M2536A | H548-25<br>H548-25A | H548-50<br>H548-50FS | H596-10 | H596-16<br>H596-16AT |
| DISK/TREND GROUP | 17 | 15 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | -- | 5.25" -- 1/40 | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD |
| Nominal disk diameter | 3.5" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | High Density Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | High Density, Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 2.0 | U: .125/.250 | U: .250/.5 | U: .5/1.0 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 6,250/12,500 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 5,208/10,416 |
| Data surfaces per spindle | 2 | 1 | 2 | 2 | 2 |
| Tracks per surface | 80 | 40 | 40 | 80 | 77 |
| Track density (TPI) | 135 | 48 | 48 | 96 | 96 |
| Maximum linear density (BPI) | 8717/17434 | 2938/5876 | 2938/5876 | 2961/5922 | 4823/9646 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING: Track to track (msec) | 3 | 6 | 6 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time (msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 4.0 x 6.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 2/86 | 8/83 | 8/83 | 8/83 | 8/83 |
| U.S. OEM PRICE FOR 500 UNITS | $145 | $120 | $120 | $140 | $195 |
| COMMENTS | | H548-25A is Apple compatible | | | |

| MANUFACTURER | HITACHI | HITACHI | HITACHI | HITACHI | HITACHI |
|---|---|---|---|---|---|
| DRIVE | FDD-412<br>FDD-413B | FDD-441 | FDD 541 | HFD 505C | HFD 510C |
| DISK/TREND GROUP | 14 | 14 | 16 | 16 | 16 |
| MARKET | Captive, OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Diskette 1,2,2D | Maxell<br>FD2-HD | Maxell<br>MD2-EH | 5.25" -- 2/40 | 5.25" -- 2/80 |
| Nominal disk diameter | 8" | 8" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | High Density<br>Oxide Coated | High Density,<br>Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .8/1.6 | U: 9.6 | U: 6.5 | U: .250/.5 | U: .5/1.0 |
| Capacity per track (Bytes) | U: 5,208/10,416 | U: 31,250 | U: 31,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 77 | 154 | 104 | 40 | 80 |
| Track density (TPI) | 48 | 96 | 125 | 48 | 96 |
| Maximum linear density (BPI) | 3408/6816 | 20560* | 29560 | 2938/5876 | 2961/5922 |
| Rotational speed (RPM) | 360 | 360 | 720 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 2 | 2 | 3 | 3 |
| Settling time (msec) | 35 | 15 | 37 | 15 | 15 |
| Head load time(msec) | 50 | Continuous<br>Contact | Continuous<br>Contact | 50 | 50 |
| Average rotational delay (msec) | 83.3 | 83.3 | 41.7 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 187.5 | 375 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 2.24 x<br>8.54 x 13.0 | 2.24 x<br>8.54 x 12.9 | 1.625 X<br>5.75 X 8.6 | 1.625 x<br>5.75 x 8.0 | 1.625 x<br>5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 2/82 | 2/84 | 1Q85 | 9/82 | 4Q83 |
| U.S. OEM PRICE FOR 500 UNITS | -- | $700 | -- | -- | -- |
| COMMENTS | | *Uses 2,7<br>RLL Code | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | HITACHI | HITACHI | HITACHI | HITACHI | IBM |
| DRIVE | HFD 516C | HFD 516DA | HFD 305SX | HFD 305D | 3770 Series<br>3790 Series<br>3601/3602<br>(33 FD Drive) |
| DISK/TREND GROUP | 16 | 16 | 17 | 17 | 13 |
| MARKET | OEM | OEM | OEM | OEM | Captive |
| MEDIA: Generic type | Maxell<br>MD2-HD | Maxell<br>MD2-HD | Maxell Compact<br>Floppy Disk | Maxell Compact<br>Floppy Disk | Diskette 1 |
| Nominal disk diameter | 5.25" | 5.25" | 3" | 3" | 8" |
| Recording medium | High Density<br>Oxide Coated | High Density,<br>Oxide Coated | High Density,<br>Oxide Coated | High Density,<br>Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .8/1.6 | U: 1.0/1.6 | U: .125/.250 | U: .250/.5 | F: .242944 |
| Capacity per track (Bytes) | U: 5,208/10,416 | U: 6,250/10,416 | U: 3,125/6,250 | U: 3,125/6,250 | F: 3,328 |
| Data surfaces per spindle | 2 | 2 | 1 | 2 | 1 |
| Tracks per surface | 77 | 80/77 | 40 | 40 | 74/3 |
| Track density (TPI) | 96 | 96 | 100 | 100 | 48 |
| Maximum linear density (BPI) | 4823/9646 | 5876/9646 | 4473/8946 | 4915/9830 | 3268 |
| Rotational speed (RPM) | 360 | 360 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Lead Screw,<br>Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 3 | 3 | 50 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 20 |
| Head load time(msec) | 50 | 50 | Continuous<br>Contact | Continuous<br>Contact | 80 |
| Average rotational delay (msec) | 83.3 | 83.3 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 37.5/62.5 | 15.63/31.25 | 15.63/31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.625 x<br>5.75 x 8.0 | 1.625 x<br>5.75 x 8.0 | 1.57 x<br>3.54 x 5.83 | 1.57 x<br>3.54 x 5.83 | -- |
| FIRST CUSTOMER SHIPMENT | 4/83 | 5/85 | 10/82 | 4Q83 | 1/75 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | IBM | IBM | IBM | IBM | IBM |
| DRIVE | 5231 | 5265-A1X<br>5265-A2X<br>5265-B1X<br>5265-B2X | 5285-X01<br>5286-X02<br>5288-X01 | 6670 | 3631/3632<br>3694<br>(43 FD Drive) |
| DISK/TREND GROUP | 13 | 13 | 13 | 13 | 14 |
| MARKET | Captive | Captive | Captive | Captive | Captive |
| MEDIA: Generic type | Diskette 1 | Diskette 1 | Diskette 1 | Diskette 1 | Diskette 1, 2 |
| Nominal disk diameter | 8" | 8" | 8" | 8" | 8" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | F: .242944 | F: .246272 | F: .246272 or<br>F: .284160 or<br>F: .303104 | F: .242944 | F: .492544<br>or<br>F: .568320 |
| Capacity per track (Bytes) | F: 3,328 | F: 3,328 | F: 3,328/3,840/<br>4,096 | F: 3,328 | F: 3,328/3,840 |
| Data surfaces per spindle | 1 | 1 | 1 | 1 | 2 |
| Tracks per surface | 74/3 | 74/3 | 74/3 | 74/3 | 74/3 |
| Track density (TPI) | 48 | 48 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 3268 | 3268 | 3268 | 3268 | 3408 |
| Rotational speed (RPM) | 360 | 360 | 360 | 360 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Band, Stepping Motor |
| POSITIONING: Track to track (msec) | 50 | 50 | 50 | 50 | 5 |
| Settling time (msec) | 20 | 20 | 20 | 20 | 35 |
| Head load time (msec) | 80 | 80 | 80 | 80 | |
| Average rotational delay (msec) | 83.3 | 83.3 | 83.3 | 83.3 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 31.25 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | -- | -- | -- | -- | -- |
| FIRST CUSTOMER SHIPMENT | -- | -- | 10/80 | -- | 1976 (3601/2) |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | 5230 Data collection system | 5265 point of sale terminal | 5280 terminal system | Information Distributor | 3600 finance communication controller |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | IBM | IBM | IBM | IBM | IBM |
| DRIVE | 4701-1 | 4701-2 | 4956<br>4965 | 4964<br>(43 FD Drive) | 4966<br>(Magazine Drive) |
| DISK/TREND GROUP | 14 | 14 | 14 | 14 | 14 |
| MARKET | Captive | Captive | Captive | Captive | Captive |
| MEDIA: Generic type | Diskette 1, 2 | Diskette 1,2,2D | Diskette 1,2,2D | Diskette 1, 2 | Diskette 1,2,2D |
| Nominal disk diameter | 8" | 8" | 8" | 8" | 8" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | F: .568320 | F: .985088 | F: .985088 or<br>F: 1.136640 or<br>F: 1.212416 | F: .492544 or<br>F: .568320 or<br>F: .606208 | F: .985088 or<br>F: 1.136640 or<br>F: 1.212416 |
| Capacity per track (Bytes) | F: 3,840 | F: 6,656 | F: 6,656/7,680/<br>8,192 | F: 3,328/3,840/<br>4,096 | F: 6,656/7,680/<br>8,192 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 74/3 | 74/3 | 74/3 | 74/3 | 74/3 |
| Track density (TPI) | 48 | 48 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 3408 | 6816 | 3408/6816 | 3408 | 3408/6816 |
| Rotational speed (RPM) | 360 | 360 | 360 | 360 | 720 |
| PERFORMANCE | | | | | |
| Actuator type | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor |
| POSITIONING:Track to track(msec) | 5 | 5 | 5 | 5 | 5 |
| Settling time (msec) | 35 | 35 | 35 | 35 | 35 |
| Head load time(msec) | | | | | |
| Average rotational delay (msec) | 83.3 | 83.3 | 83.3 | 83.3 | 41.7 |
| Data transfer rate (KBytes/sec) | 31.25 | 62.5 | 31.25/62.5 | 31.25 | 62.5/125 |
| SIZE (Inches: H x W x D) | -- | -- | -- | -- | -- |
| FIRST CUSTOMER SHIPMENT | 1982 | 1982 | 8/81 | 11/76 | 2/79 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | 4701 finance communication controller | 4701 finance communication controller | Similar drive included with 4952 and 4954 models C and XXD<br>Series 1 | Similar drive included with some 4962 models<br>Series/1 | Capacity is 2 10-diskette magazines and 3 diskettes<br>Series 1 |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | IBM | IBM | IBM | IBM | IBM |
| DRIVE | 5265-X3X<br>5265-X4X<br>5265-X5X<br>5265-X6X<br>5265-X7X<br>5265-X8X | 5281<br>5282<br>5285-X05<br>5286-X10<br>5288-X05 | 5360-A1X<br>5360-B1X<br>5360-B2X<br>5362-XXX | 5381<br>5832<br>(Magazine Drive) | 5525-021<br>5525-031<br>5525-041 |
| DISK/TREND GROUP | 14 | 14 | 14 | 14 | 14 |
| MARKET | Captive | Captive | Captive | Captive | Captive |
| MEDIA: Generic type | Diskette 2D | Diskette 1,2,2D | Diskette 1,2D | Diskette 1,2,2D | Diskette 2D |
| Nominal disk diameter | 8" | 8" | 8" | 8" | 8" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | F: .985088 | F: .985088 or<br>F: 1.136640 or<br>F: 1.212416 | F: 1.212416 | F: .985088 or<br>F: 1.212416 | F: 1.212416 |
| Capacity per track (Bytes) | F: 6,656 | F: 6,656/7,680/ 8,192 | F: 8192 | F: 6,656/8,192 | F: 8,192 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 74/3 | 74/3 | 74/3 | 74/3 | 74/3 |
| Track density (TPI) | 48 | 48 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 3408/6816 | 3408/6816 | 6816 | 3408/6816 | 6816 |
| Rotational speed (RPM) | 360 | 360 | 360 | 360 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 5 | 5 | 5 | 5 | 5 |
| Settling time (msec) | 35 | 35 | 35 | 35 | 35 |
| Head load time(msec) | | | -- | | |
| Average rotational delay (msec) | 83.3 | 83.3 | 83.3 | 41.7 | 83.3 |
| Data transfer rate (KBytes/sec) | 62.5 | 31.25/62.5 | 62.5 | 31.25/62.5 | 62.5 |
| SIZE (Inches: H x W x D) | -- | -- | -- | -- | -- |
| FIRST CUSTOMER SHIPMENT | -- | 10/80 | -- | 1/79 (S/34) | 2/80 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | 5265 point of sale terminal | 5280 terminal system | System 36 | Capacity is 2 10-diskette magazines and 3 diskettes<br><br>System 38 | 5520 administrative system |

| MANUFACTURER | IBM | IBM | IBM | IBM | INSTRUMENTATION AND AUTOMATION |
|---|---|---|---|---|---|
| DRIVE | 5525-051 (Magazine Drive) | 8101-A20<br>8101-A23/25 (43 FD Drive) | 8130-All Models<br>8140-All Models<br>8150-All Models (43 FD Drive) | Displaywriter<br>6360-20 Single<br>6360-22 Dual | Pravez 5088M |
| DISK/TREND GROUP | 14 | 14 | 14 | 14 | 15 |
| MARKET | Captive | Captive | Captive | Captive | Captive |
| MEDIA: Generic type | Diskette 2D | Diskette 1,2,2D | Diskette 1,2,2D | Diskette 1, 2D | 5.25" -- 1/40 |
| Nominal disk diameter | 8" | 8" | 8" | 8" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | F: 1.212416 | F: .492544<br>or<br>F: .985088 | F: .492544<br>or<br>F: .985088 | F: .284160<br>or<br>F: 1.136640 | U: .218 |
| Capacity per track (Bytes) | F: 8,192 | F: 3,328/6,656 | F: 3,328/6,656 | F: 3,840/7,680 | U: 6,250 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 1 |
| Tracks per surface | 74/3 | 74/3 | 74/3 | 74/3 | 35 |
| Track density (TPI) | 48 | 48 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 6816 | 3408/6816 | 3408/6816 | 3408/6816 | 5536 |
| Rotational speed (RPM) | 720 | 360 | 360 | 360 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Cam, Stepping Motor |
| POSITIONING: Track to track (msec) | 5 | 5 | 5 | 5 | 20 |
| Settling time (msec) | 35 | 35 | 35 | 35 | 10 |
| Head load time (msec) | | | | | -- |
| Average rotational delay (msec) | 41.7 | 83.3 | 83.3 | 83.3 | 100 |
| Data transfer rate (KBytes/sec) | 125 | 31.25/62.5 | 31.25/62.5 | 31.25/62.5 | 31.25 |
| SIZE (Inches: H x W x D) | -- | -- | -- | -- | 3.25 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 11/80 | 1980 | 1980 | 6/81 | 1985 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | 5520 administrative system | 8100 system | 8100 system | Models 6360-10 and 6360-11 are single and dual drives for one-sided diskettes | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | IOMEGA | IOMEGA | IOMEGA | IOMEGA | IOMEGA |
| DRIVE | A110H Bernoulli Box | A120H Bernoulli Box | A210H-APL Bernoulli Box | Alpha-10H | Alpha-20H |
| DISK/TREND GROUP | 18 | 18 | 18 | 18 | 18 |
| MARKET | PCM | PCM | PCM | OEM | OEM |
| MEDIA: Generic type | Alpha-10 Cartridge | Alpha-20 Cartridge | Alpha-10 Cartridge | Alpha-10 Cartridge | Alpha-20 Cartridge |
| Nominal disk diameter | 8" | 8" | 8" | 8" | 8" |
| Recording medium | High Density, Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | F: 10.0 | F: 21.4 | (Two Spindles) F: 20.0 | F: 10.027 or 10.497 | F: 21.4 |
| Capacity per track (Bytes) | F: 32,768 | F: 32,768 | F: 32,768 | F: 32,768 or 34,304 | F: 32,768 |
| Data surfaces per spindle | 1 | 1 | 1 | 1 | 1 |
| Tracks per surface | 306 | 654 | 306 | 306 | 654 |
| Track density (TPI) | 300 | 641 | 300 | 300 | 641 |
| Maximum linear density (BPI) | 24000 BPI 18000 FCI | 24000 BPI 18000 FCI | 24000 BPI 18000 FCI | 24000 BPI 18000 FCI | 24000 BPI 18000 FCI |
| Rotational speed (RPM) | 1500 | 1500 | 1500 | 1500 | 1500 |
| PERFORMANCE | | | | | |
| Actuator type | Rotary, Voice Coil | Rotary, Voice Coil | Rotary, Voice Coil | Rotary, Voice Coil | Rotary, Voice Coil |
| POSITIONING:Track to track(msec) | 10 (including settling) | 10 (including settling) | 10 (including settling) | 10 (including settling) | 10 (including settling) |
| Settling time (msec) | -- | -- | -- | -- | -- |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 20 | 20 | 20 | 20 | 20 |
| Data transfer rate (KBytes/sec) | 1130 | 1130 | Variable | 1130 | 1130 |
| SIZE (Inches: H x W x D) | 6.32 x 12.5 x 15.25 | 6.32 x 12.5 x 15.25 | 6.32 x 12.5 x 15.25 | 2.32 x 8.54 x 12.0 | 2.32 x 8.54 x 12.0 |
| FIRST CUSTOMER SHIPMENT | 8/85 | 10/85 | 3Q85 | 4Q84 | 3Q85 |
| U.S. OEM PRICE FOR 500 UNITS | $2695 (List) | $3295 (List) | $3750 (List) | see below | See below |
| COMMENTS | Subsystem for IBM PC<br>A210H is 2 drive version priced at $3695 | Subsystem for IBM PC<br>A220H is 2 drive version priced at $4695 | Dual drive subsystem for Appletalk Net. | 1st drive $1025<br>2nd drive $ 582 | 1st drive $1280<br>2nd drive $ 728 |

| MANUFACTURER | IOMEGA | IOMEGA | ISOT | ISOT | ISOT |
|---|---|---|---|---|---|
| DRIVE | B105-MAC | Beta-5 | ES 5074 | ES 5082 | ES 5083 |
| DISK/TREND GROUP | 18 | 18 | 13 | 13 | 14 |
| MARKET | PCM | OEM | Captive, OEM | Captive, OEM | Captive, OEM |
| MEDIA: Generic type | Alpha-5 Cartridge | Beta-5 Cartridge | Diskette 1 | Diskette 1 | Diskette 2,2D |
| Nominal disk diameter | 5.25" | 5.25" | 8" | 8" | 8" |
| Recording medium | High Density, Oxide Coated | High Density, Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | F: 5.25 | F: 5.25 | U: .401 | U: .4/.8 | U: .8/1.6 |
| Capacity per track (Bytes) | F: 13,312 | F: 13,312 | U: 5,208 | U: 5,208/10,416 | U: 5,208/10,416 |
| Data surfaces per spindle | 1 | 1 | 1 | 1 | 2 |
| Tracks per surface | 394 | 394 | 77 | 77 | 77 |
| Track density (TPI) | 394 | 394 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 17200 MFM | 17200 MFM | 3268 | 3268/6536 | 3408/6816 |
| Rotational speed (RPM) | 1964 | 1964 | 360 | 360 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Rotary, Voice Coil | Rotary, Voice Coil | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING:Track to track(msec) | 10 (including settling) | 11 (including settling) | 10 | 10 | 10 |
| Settling time (msec) | -- | -- | 10 | 25 | 20 |
| Head load time(msec) | Continuous Contact | Continuous Contact | 40 | 40 | 35 |
| Average rotational delay (msec) | 15.3 | 15.3 | 83.3 | 83.3 | 83.3 |
| Data transfer rate (KBytes/sec) | 625 | 625 | 31.25 | 31.25/62.5 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 5.1 x 10.7 x 12.5 | 3.25 x 5.75 x 8.0 | 5.2 x 10.3 x 16.1 | 5.2 x 10.3 x 16.1 | 5.2 x 10.3 x 16.1 |
| FIRST CUSTOMER SHIPMENT | 4Q84 | 8/83 | 1978 | 1983 | 1983 |
| U.S. OEM PRICE FOR 500 UNITS | $1995 (List) | $595 | -- | -- | -- |
| COMMENTS | Subsystem for Apple MacIntosh | | | | |

| MANUFACTURER | ISOT | ISOT | ISOT | ISOT | ISOT |
|---|---|---|---|---|---|
| DRIVE | ES 5088 | ES 5088M | ISOT 5050E | ES 5321 | ES 5323 |
| DISK/TREND GROUP | 15 | 15 | 15 | 16 | 16 |
| MARKET | Captive, OEM | Captive, OEM | Captive, OEM | Captive, OEM | Captive, OEM |
| MEDIA: Generic type | 5.25" -- 1/40 | 5.25" -- 1/40 | 5.25" -- 1/40 | 5.25" -- 2/40 | 5.25" -- 2/80 |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft/Hard | Soft/Hard | Soft/Hard | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .125 | U: .125/.250 | U: .250 | U: .250/.5 | U: .5/1.0 |
| Capacity per track (Bytes) | U: 3,125 | U: 3,125/6,250 | U: 6,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 1 | 1 | 1 | 2 | 2 |
| Tracks per surface | 40 | 40 | 40 | 40 | 80 |
| Track density (TPI) | 48 | 48 | 48 | 48 | 96 |
| Maximum linear density (BPI) | 2768 | 2768/5536 | 5536 | 2938/5876 | 2961/5922 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Cam, Stepping Motor | Cam, Stepping Motor | Cam, Stepping Motor | Cam, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 40 | 40 | 40 | 25 | 5 |
| Settling time (msec) | 10 | 10 | 10 | 15 | 15 |
| Head load time(msec) | 50 | 50 | 50 | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 15.63 | 15.63/31.25 | 31.25 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 3.25 x 5.75 x 8.0 | 3.25 x 5.75 x 8.0 | 3.25 x 5.75 x 8.0 | 3.25 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 1979 | 1982 | 1984 | 1984 | 1985 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | Apple II compatible | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | JANOME SEWING MACHINE CO. | JANOME SEWING MACHINE CO. | JANOME SEWING MACHINE CO. | JANOME SEWING MACHINE CO. | LUNG HWA |
| DRIVE | MFD-80 | MFD-90 | MFD-91 | MFD-91D | LDD-104SDS |
| DISK/TREND GROUP | 17 | 17 | 17 | 17 | 15 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Maxell Compact Floppy Disk | Sony OM-D3440 | Sony OM-D3440 | Sony OM-D4440 | 5.25" -- 1/40 |
| Nominal disk diameter | 3" | 3.5" | 3.5" | 3.5" | 5.25" |
| Recording medium | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250/.5 | U: .125/.250 | U: .250/.5 | U: .5/1.0 | U: .250 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 6,250 |
| Data surfaces per spindle | 1 | 1 | 1 | 2 | 1 |
| Tracks per surface | 40 | 40 | 80 | 80 | 40 |
| Track density (TPI) | 100 | 67.5 | 135 | 135 | 48 |
| Maximum linear density (BPI) | 4473/8946 | 4065/8130 | 4094/8187 | 4359/8718 | 5536 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 10 | 6 | 3 | 3 | 6 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.57 x 3.54 x 5.9 | 1.57 x 4.0 x 5.3 | 1.57 x 4.0 x 5.3 | 1.57 x 4.0 x 5.3 | 1.625 x 5.75 x 7.9 |
| FIRST CUSTOMER SHIPMENT | 2Q84 | 4Q84 | 4Q84 | 4Q84 | 1/84 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | Capable of using 48 tracks per surface.<br><br>Mechanism-only version is 3.25" wide. | | | | LDD-103SSA is Apple compat.<br><br>LDD-105SDA is Atari compat. |

| MANUFACTURER | LUNG HWA | MATSUSHITA COMMUNICATION INDUSTRIAL | MATSUSHITA COMMUNICATION INDUSTRIAL | MATSUSHITA COMMUNICATION INDUSTRIAL | MATSUSHITA COMMUNICATION INDUSTRIAL |
|---|---|---|---|---|---|
| DRIVE | LDD-106DDS | JA-751 | JA-551<br>JU-455 | JA-561<br>JU-465 | JU-475<br>JU-595 |
| DISK/TREND GROUP | 16 | 14 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | Diskette 1,2,2D | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD |
| Nominal disk diameter | 5.25" | 8" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft/Hard | Soft/Hard | Soft/Hard | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5 | U: .8/1.6 | U: .5 | U: 1.0 | U: .5/1.0 or U: .8/1.6 |
| Capacity per track (Bytes) | U: 6,250 | U: 5,208/10,416 | U: 6,250 | U: 6,250 | U: 6,250/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 40 | 77 | 40 | 80 | 77/80 |
| Track density (TPI) | 48 | 48 | 48 | 96 | 96 |
| Maximum linear density (BPI) | 5876 | 3408/6816 | 5876 | 5876 | 5876/9646 |
| Rotational speed (RPM) | 300 | 360 | 300 | 300 | 300/360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 3 | 6 | 3 | 3 |
| Settling time (msec) | 15 | 25 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | 50 | 50 | 50 | 50 |
| Average rotational delay (msec) | 100 | 83.3 | 100 | 100 | 100/83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25/62.5 | 31.25 | 31.25 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 7.9 | 2.2 x 8.6 x 12.1 | 1.625 x 5.75 x 8.5 | 1.625 x 5.75 x 8.5 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 1/85 | 1/82 | 6/82 | 6/82 | 4Q83 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | $98 | $131 | $147 |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | MATSUSHITA COMMUNICATION INDUSTRIAL | MATSUSHITA COMMUNICATION INDUSTRIAL | MATSUSHITA COMMUNICATION INDUSTRIAL | MATSUSHITA COMMUNICATION INDUSTRIAL | MATSUSHITA ELECTRONIC COMPONENTS |
| DRIVE | JU-581 | JU-313<br>JU-314 | JU-323<br>JU-324 | JU-363<br>JU-364 | EME-131 |
| DISK/TREND GROUP | 16 | 17 | 17 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Maxell MD2-HD | Sony OM-D3440 | Sony OM-D3440 | Sony OM-D4440 | -- |
| Nominal disk diameter | 5.25" | 3.5" | 3.5" | 3.5" | 3" |
| Recording medium | High Density, Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .8/1.6 | U: .125/.250 | U: .250/.5 | U: .5/1.0 | U: .5 |
| Capacity per track (Bytes) | U: 5,208/10,416 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 6,250 |
| Data surfaces per spindle | 2 | 1 | 1 | 2 | 1 |
| Tracks per surface | 77 | 40 | 80 | 80 | 80 |
| Track density (TPI) | 96 | 67.5 | 135 | 135 | 200 |
| Maximum linear density (BPI) | 4823/9646 | 4093/8186 | 4093/8186 | 4359/8717 | 8946 |
| Rotational speed (RPM) | 360 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING: Track to track (msec) | 3 | 6 | 3 | 3 | 12 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time (msec) | 50 | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 83.3 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.26 x 4.0 x 5.9 | 1.26 x 4.0 x 5.9 | 1.26 x 4.0 x 5.9 | 1.5 x 3.5 x 5.9 |
| FIRST CUSTOMER SHIPMENT | 2/83 | 1984 | 1984 | 1984 | 1985 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | $106 | -- |
| COMMENTS | | JU-313 is low power version | JU-323 is low power version | JU-363 is low power version | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | MATSUSHITA ELECTRONIC COMPONENTS | MATSUSHITA ELECTRONIC COMPONENTS | MILTOPE | MILTOPE | MILTOPE |
| DRIVE | EME-155 | EME-231 | DD 400 | DD 450 | DD 550 |
| DISK/TREND GROUP | 17 | 17 | 13 | 14 | 14 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Matsushita EBF-CF2 | -- | Diskette 1 | Diskette 2, 2D | Diskette 2, 2D |
| Nominal disk diameter | 3" | 3" | 8" | 8" | 8" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250 | U: 1.0 | U: .401/.802 | U: .8/1.6 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 5,208/10,416 | U: 5,208/10,416 | U: 5,208/10,416 |
| Data surfaces per spindle | 1 | 2 | 1 | 2 | 2 |
| Tracks per surface | 40 | 80 | 77 | 77 | 77 |
| Track density (TPI) | 100 | 200 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 8946 | 9830 | 3268/6536 | 3408/6816 | 3408/6816 |
| Rotational speed (RPM) | 300 | 300 | 360 | 360 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 12 | 12 | 6 | 5 | 5 |
| Settling time (msec) | 15 | 15 | 10 | 10 | 10 |
| Head load time(msec) | Continuous Contact | Continuous Contact | 16 | 16 | 16 |
| Average rotational delay (msec) | 100 | 100 | 83.3 | 83.3 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 31.25/62.5 | 31.25/62.5 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.5 x 3.5 x 5.9 | 1.5 x 3.5 x 5.9 | 5.44 x 8.44 x 18.0 | 5.44 x 8.44 x 18.0 | 5.44 x 8.44 x 18.0 |
| FIRST CUSTOMER SHIPMENT | 1985 | 1985 | 1977 | 1980 | 1982 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | $4950 | $5400 | $4000 |
| COMMENTS | | | Sold as militarized subsystem | Sold as militarized subsystem | Sold as militarized subsystem |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | MITAC | MITAC | MITAC | MITSUBISHI ELECTRIC CORPORATION | MITSUBISHI ELECTRIC CORPORATION |
| DRIVE | MC-390 | MC-395 | MC-425 | M2894-63 | M2896-63 |
| DISK/TREND GROUP | 15 | 15 | 16 | 14 | 14 |
| MARKET | OEM,PCM | OEM,PCM | OEM,PCM | Captive, OEM | OEM |
| MEDIA: Generic type | 5.25" -- 1/40 | 5.25" -- 1/40 | 5.25" -- 2/40 | Diskette 2,2D | Diskette 2,2D |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 8" | 8" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .125/.250 | U: .125/.250 | U: .250/.5 | U: 1.6 | U: 1.6 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,255/6,250 | U: 10,416 | U: 10,416 |
| Data surfaces per spindle | 1 | 1 | 2 | 2 | 2 |
| Tracks per surface | 40 | 40 | 40 | 77 | 77 |
| Track density (TPI) | 48 | 48 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 2768/5536 | 2768/5536 | 2938/5876 | 6816 | 6816 |
| Rotational speed (RPM) | 300 | 300 | 300 | 360 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 20 | 6 | 6 | 3 | 3 |
| Settling time (msec) | 15 | 20 | 20 | 15 | 15 |
| Head load time(msec) | 75 | Continuous Contact | Continuous Contact | 50 | 50 |
| Average rotational delay (msec) | 100 | 100 | 100 | 83.3 | 83.3 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 62.5 | 62.5 |
| SIZE (Inches: H x W x D) | 3.25 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 4.62 x 8.55 x 14.18 | 2.25 x 8.55 x 12.4 |
| FIRST CUSTOMER SHIPMENT | 6/82 | 11/85 | 4/85 | 1978 | 1982 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | $350 | $350 |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | MITSUBISHI ELECTRIC CORPORATION | MITSUBISHI ELECTRIC CORPORATION | MITSUBISHI ELECTRIC CORPORATION | MITSUBISHI ELECTRIC CORPORATION | MITSUBISHI ELECTRIC CORPORATION |
| DRIVE | M4855 | MF501A | MF504A | MF351A | MF353A |
| DISK/TREND GROUP | 16 | 16 | 16 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Maxell MD2-HD | 5.25" -- 2/40 | Maxell MD2-HD | SONY OM-D3440 | SONY OM-D4440 |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 3.5" | 3.5" |
| Recording medium | High Density, Oxide Coated | Oxide Coated | High Density Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 2.0 | U: .5 | U: 1.0/1.6 | U: .5 | U: 1.0 |
| Capacity per track (Bytes) | U: 12,500 | U: 6,250 | U: 6,250/10,416 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 2 | 2 | 2 | 1 | 2 |
| Tracks per surface | 80 | 40 | 80/77 | 80 | 80 |
| Track density (TPI) | 96 | 48 | 96 | 135 | 135 |
| Maximum linear density (BPI) | 11844 | 5877 | 5922/9870 | 8187 | 8717 |
| Rotational speed (RPM) | 300 | 300 | 300/360 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 6 | 3 | 6 | 6 |
| Settling time (msec) | 15 | 25 | 15 | 15 | 15 |
| Head load time(msec) | 50 | 50 | 50 | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100/83.3 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 62.5 | 31.25 | 31.25/62.5 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.26 x 4.0 x 5.9 | 1.26 x 4.0 x 5.9 |
| FIRST CUSTOMER SHIPMENT | 4/83 | 4Q85 | 4Q85 | 2Q85 | 2Q85 |
| U.S. OEM PRICE FOR 500 UNITS | $160 | $105 | $145 | -- | $100 |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | MITSUBISHI ELECTRIC CORPORATION | MITSUBISHI ELECTRIC CORPORATION | MITSUBISHI ELECTRIC CORPORATION | MITSUMI ELECTRIC CO. | MITSUMI ELECTRIC CO. |
| DRIVE | MF353AF | MF354 | MF355 | D 501 | D 503 |
| DISK/TREND GROUP | 17 | 17 | 17 | 15 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | SONY OM-D4440 | -- | -- | 5.25" -- 1/40 | 5.25" -- 2/40 |
| Nominal disk diameter | 3.5" | 3.5" | 3.5" | 5.25" | 5.25" |
| Recording medium | High Density, Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0 | U: 1.6 | U: 2.0 | U: .250 | U: .500 |
| Capacity per track (Bytes) | U: 6,250 | U: 10,416 | U: 12,500 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 2 | 2 | 2 | 1 | 2 |
| Tracks per surface | 80 | 77 | 80 | 40 | 40 |
| Track density (TPI) | 135 | 135 | 135 | 48 | 48 |
| Maximum linear density (BPI) | 8717 | 14184 | 17434 | 5535 | 5876 |
| Rotational speed (RPM) | 300 | 360 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 3 | 10 | 10 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 83.3 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25 | 62.5 | 62.5 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.26 x 4.0 x 5.9 | 1.625 x 4.0 x 5.75 | 1.625 x 4.0 x 5.75 | 1.625 X 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 4Q85 | 1/86 | 1/86 | 12/83 | 3/85 |
| U.S. OEM PRICE FOR 500 UNITS | $110 | -- | -- | -- | -- |
| COMMENTS | Low power model - 3.2 watts | Announced only in Japan | Announced only in Japan | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | MITSUMI ELECTRIC CO. | MITSUMI ELECTRIC CO. | MITSUMI ELECTRIC CO. | MITSUMI ELECTRIC CO. | NEC |
| DRIVE | D 507 | D 351 | D 355 | QUICK DISK QDM-01 | FD 1165 |
| DISK/TREND GROUP | 16 | 17 | 17 | 18 | 14 |
| MARKET | OEM | OEM | OEM | OEM | Captive, OEM |
| MEDIA: Generic type | 5.25" -- 2/80 | Sony OM-D3440 | Sony OM-D3440 | Maxell QD-2 | Diskette 1,2,2D |
| Nominal disk diameter | 5.25" | 3.5" | 3.5" | 72 mm | 8" |
| Recording medium | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | N/A | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0 | U: .250 | U: .500 | U: .064 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 6,250 | U: 64,000 | U: 5,208/10,416 |
| Data surfaces per spindle | 2 | 1 | 1 | 1 | 2 |
| Tracks per surface | 80 | 40 | 80 | 1 | 77 |
| Track density (TPI) | 96 | 67.5 | 135 | 59 | 48 |
| Maximum linear density (BPI) | 5922 | 8125 | 8187 | 4410 | 3408/6816 |
| Rotational speed (RPM) | 300 | 300 | 300 | 423 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Lead Screw, Stepping Motor | Band, Stepping Motor | N/A | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 12 | 3 | N/A | 3 |
| Settling time (msec) | 15 | 15 | 15 | N/A | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | N/A | 50 |
| Average rotational delay (msec) | 100 | 100 | 100 | N/A | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 31.25 | 12.63 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.26 x 4.0 x 6.1 | 1.26 x 4.0 x 6.1 | 1.73 x 4.6 x 4.1 | 2.28 x 8.68 x 13.19 |
| FIRST CUSTOMER SHIPMENT | 7/85 | 1/85 | 4/85 | 1984 | 4Q81 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | $287 (500) |
| COMMENTS | | | | 64,000 bytes in single spiral track | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | NEC | NEC | NEC | NEC | NEC |
| DRIVE | N 7707<br>FD 1160 | FD 1053 | FD 1055 | FD 1155B | FD 1155C |
| DISK/TREND GROUP | 14 | 16 | 16 | 16 | 16 |
| MARKET | Captive, OEM | Captive, OEM | Captive, OEM | OEM | Captive, OEM |
| MEDIA: Generic type | Diskette 1,2,2D | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD | Maxell MD2-HD |
| Nominal disk diameter | 8" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .8/1.6 | U: .5 | U: 1.0 | U: 1.0/1.6 | U: 1.0/1.67 |
| Capacity per track (Bytes) | U: 5,208/10,416 | U: 6,250 | U: 6,250 | U: 6,250/10,416 | U: 6,250/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 77 | 40 | 80 | 80/77 | 80 |
| Track density (TPI) | 48 | 48 | 96 | 96 | 96 |
| Maximum linear density (BPI) | 3408/6816 | 5876 | 5922 | 5922/9646 | 5922/9870 |
| Rotational speed (RPM) | 360 | 300 | 300 | 300/360 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 5 | 6 | 3 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 50 | 35 | 35 | 35 | 35 |
| Average rotational delay (msec) | 83.3 | 100 | 100 | 100/83.3 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 31.25 | 31.25 | 31.25/62.5 | 37.5/62.5 |
| SIZE (Inches: H x W x D) | 4.62 x 8.68 x 14.45 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 8/81 | 1984 | 1984 | 11/84 | 1/85 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | $132 (1000) | -- | $140 (1000) |
| COMMENTS | | | | | Compatible with IBM PC AT |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | NEC | NEC | NEC | OKI ELECTRIC | OKI ELECTRIC |
| DRIVE | FD 1034 | FD 1035 | FD 1036A | GM3305B<br>GM3315B | GM3305BU<br>GM3315BU |
| DISK/TREND GROUP | 17 | 17 | 17 | 16 | 16 |
| MARKET | Captive, OEM | Captive, OEM | Captive, OEM | OEM | OEM |
| MEDIA: Generic type | Sony OM-D3440 | Sony OM-D4440 | Sony OM-D4440 | 5.25" -- 2/40 | 5.25" -- 2/40 |
| Nominal disk diameter | 3.5" | 3.5" | 3.5" | 5.25" | 5.25" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5 | U: 1.0 | U: .5/1.0 | U: .5 | U: .5 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 3,125/6,250 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 1 | 2 | 2 | 2 | 2 |
| Tracks per surface | 80 | 80 | 80 | 40 | 40 |
| Track density (TPI) | 135 | 135 | 135 | 48 | 48 |
| Maximum linear density (BPI) | 8187 | 8717 | 4359/8717 | 5876 | 5876 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Linear, Stepping Motor | Linear, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 3 | 6 | 10 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 25 |
| Head load time(msec) | 35 | 35 | Continuous Contact | 50 | 50 |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 15.63/31.25 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 4.0 x 5.2 | 1.625 x 4.0 x 5.2 | 1.18 x 4.0 x 5.75 | 1.1 x 5.75 x 8.0 | 1.1 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 9/84 | 11/84 | 1985 | 1984 | 1Q85 |
| U.S. OEM PRICE FOR 500 UNITS | -- | $115 (1000) | -- | -- | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | OKI ELECTRIC | OKI ELECTRIC | OKI ELECTRIC | OKI ELECTRIC | OKI ELECTRIC |
| DRIVE | GM3305CU | GM3305H | GM3405B<br>GM3415B | GM3405H | GM3505BU-1 |
| DISK/TREND GROUP | 16 | 16 | 16 | 16 | 16 |
| MARKET | OEM | Captive, OEM | OEM | Captive, OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | 5.25" -- 2/40 | 5.25" -- 2/80 | 5.25" -- 2/80 | Maxell<br>MD2-HD |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | High Density<br>Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5 | U: .5 | U: 1.0 | U: 1.0 | U: 1.0/1.6 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 40 | 40 | 80 | 80 | 80 |
| Track density (TPI) | 48 | 48 | 96 | 96 | 96 |
| Maximum linear density (BPI) | 5876 | 5876 | 5922 | 5922 | 5921/9869 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Linear,<br>Stepping Motor | Linear,<br>Stepping Motor | Linear,<br>Stepping Motor | Linear,<br>Stepping Motor | Linear,<br>Stepping Motor |
| POSITIONING:Track to track(msec) | 4 | 6 | 3 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 30 | 30 | 15 |
| Head load time(msec) | Continuous<br>Contact | 50 | 50 | 50 | Continuous<br>Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 31.25 | 31.25 | 37.5/62.5 |
| SIZE (Inches: H x W x D) | 1.1 x<br>5.75 x 7.95 | 1.625 X<br>5.75 x 8.0 | 1.1 x<br>5.75 x 8.0 | 1.625 x<br>5.75 x 8.0 | 1.1 x<br>5.75 x 7.95 |
| FIRST CUSTOMER SHIPMENT | 2Q86 | 10/82 | 1984 | 5/83 | 2Q86 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | |

| MANUFACTURER | OKI ELECTRIC | OLIVETTI PERIPHERAL EQUIPMENT | OLIVETTI PERIPHERAL EQUIPMENT | OLIVETTI PERIPHERAL EQUIPMENT | OLIVETTI PERIPHERAL EQUIPMENT |
|---|---|---|---|---|---|
| DRIVE | GM3505BU-2 | FD 801 | FD 802 | FD 501 | FD 502 |
| DISK/TREND GROUP | 16 | 13 | 14 | 15 | 16 |
| MARKET | OEM | Captive, OEM | Captive, OEM | Captive, OEM | Captive, OEM |
| MEDIA: Generic type | Maxell MD2-HD | Diskette 1 | Diskette 2, 2D | 5.25" -- 1/40 | 5.25" -- 2/40 |
| Nominal disk diameter | 5.25" | 8" | 8" | 5.25" | 5.25" |
| Recording medium | High Density Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0/1.6 | U: .401/.802 | U: .8/1.6 | U: .125/.250 | U: .250/.5 |
| Capacity per track (Bytes) | U: 6,250/10,416 | U: 5,208/10,416 | U: 5,208/10,416 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 1 | 2 | 1 | 2 |
| Tracks per surface | 80 | 77 | 77 | 40 | 40 |
| Track density (TPI) | 96 | 48 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 5921/9869 | 3268/6536 | 3408/6816 | 2768/5536 | 2938/5876 |
| Rotational speed (RPM) | 300/360 | 360 | 360 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Linear, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Cam, Stepping Motor | Cam, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 3 | 25 | 25 |
| Settling time (msec) | 15 | 15 | 15 | 20 | 20 |
| Head load time(msec) | Continuous Contact | 35 | 35 | 60 | 60 |
| Average rotational delay (msec) | 100/83.3 | 83.3 | 83.3 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 31.25/62.5 | 31.25/62.5 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 1.1 x 5.75 x 7.95 | 4.52 x 9.05 x 12.3 | 4.52 x 9.05 x 12.3 | 2.51 x 5.75 x 8.0 | 2.51 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 2Q86 | 1974 | 1979 | 1980 | 1981 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | $176 | -- |
| COMMENTS | | | | | |

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|---|---|---|---|---|---|
| MANUFACTURER | OLIVETTI PERIPHERAL EQUIPMENT | OLIVETTI PERIPHERAL EQUIPMENT | OLIVETTI PERIPHERAL EQUIPMENT | OLIVETTI PERIPHERAL EQUIPMENT | OLIVETTI PERIPHERAL EQUIPMENT |
| DRIVE | FD 592 | FD 595 | FD 602 | FD 692 | FD 696 |
| DISK/TREND GROUP | 16 | 16 | 16 | 16 | 16 |
| MARKET | Captive, OEM | Captive, OEM | Captive, OEM | Captive, OEM | Captive, OEM |
| MEDIA: Generic type | 5.25" -- 2/80 | Maxell MD2-HD | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | High Density, Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft/Hard | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5/1.0 | U: .8/1.6 | U: .250/.5 | U: .5/1.0 | U: 1.0/1.6 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 5,208/10,416 | U: 3,125/6,250 | U: 3,125/6,250 | U: 6,250/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 80 | 77 | 40 | 80 | 80/77 |
| Track density (TPI) | 96 | 96 | 48 | 96 | 96 |
| Maximum linear density (BPI) | 2961/5922 | 4935/9870 | 5922 | 5922 | 5922/9870 |
| Rotational speed (RPM) | 300 | 360 | 300 | 300 | 300/360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 6 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 25 | 25 | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 83.3 | 100 | 100 | 100/83.3 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 31.25/62.5 | 15.625/31.25 | 15.625/31.25 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 3.25 x 5.75 x 8.0 | 3.25 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 6/82 | 1983 | 1Q84 | 2Q84 | 4/85 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | |

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|---|---|---|---|---|---|
| MANUFACTURER | OLIVETTI PERIPHERAL EQUIPMENT | OLIVETTI PERIPHERAL EQUIPMENT | OMEK | OMEK | OMEK |
| DRIVE | FD 301 | FD 302 | OM55 | OM56 | OM57 |
| DISK/TREND GROUP | 17 | 17 | 16 | 16 | 16 |
| MARKET | Captive, OEM | Captive, OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Sony OM-D3440 | Sony OM-D4440 | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD |
| Nominal disk diameter | 3.5" | 3.5" | 5.25" | 5.25" | 5.25" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5 | U: 1.0 | U: .5 | U: 1.0 | U: 1.6 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 1 | 2 | 2 | 2 | 2 |
| Tracks per surface | 80 | 80 | 40 | 80 | 80 |
| Track density (TPI) | 135 | 135 | 48 | 96 | 96 |
| Maximum linear density (BPI) | 8191 | 8717 | 5877 | 5922 | 9646 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 6 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 31.25 | 31.25 | 62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 4.0 x 5.0 | 1.625 x 4.0 x 5.0 | 1.625 X 5.75 X 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 1985 | 1985 | 1Q85 | 1Q85 | 1Q85 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | RICOH | RICOH | RICOH | RICOH | RICOH |
| DRIVE | RF8160 | RF5050 | RF5160 | RF4050 | RF4100 |
| DISK/TREND GROUP | 14 | 16 | 16 | 17 | 17 |
| MARKET | Captive, OEM | OEM | Captive, OEM | OEM | OEM |
| MEDIA: Generic type | Diskette 2D | 5.25" -- 2/40 | Maxell MD2-HD | Sony OM-D4440 | Sony OM-D4440 |
| Nominal disk diameter | 8" | 5.25" | 5.25" | 3.5" | 3.5" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .8/1.6 | U: .250/.5 | U: .8/1.6 | U: .5/1.0 | U: .250/.5 |
| Capacity per track (Bytes) | U: 5,208/10,416 | U: 3,125/6,250 | U: 5,208/10,416 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 77 | 40 | 77 | 40 | 80 |
| Track density (TPI) | 48 | 48 | 96 | 67.5 | 135 |
| Maximum linear density (BPI) | 3408/6816 | 2938/5876 | 4823/9646 | 4358/8717 | 4325/8649 |
| Rotational speed (RPM) | 360 | 300 | 360 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 6 | 3 | 6 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 50 | 50 | 50 | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 83.3 | 100 | 83.3 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.63/31.25 | 31.25/62.5 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 2.2 x 8.5 x 12.6 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.57 x 4.0 x 5.85 | 1.57 x 4.0 x 5.85 |
| FIRST CUSTOMER SHIPMENT | 6/83 | 3Q84 | 3Q84 | 2Q85 | 2Q85 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | |

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|---|---|---|---|---|---|
| MANUFACTURER | ROBOTRON | ROBOTRON | SANKYO SEIKI | SANKYO SEIKI | SANKYO SEIKI |
| DRIVE | K 5600.10 | K 5600.20 | FDU-300-D | FDU-300-S | FDU-355-DA |
| DISK/TREND GROUP | 15 | 15 | 17 | 17 | 17 |
| MARKET | Captive,OEM | Captive,OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 1/40 | 5.25" -- 1/80 | Maxell Compact Floppy Disk | Maxell Compact Floppy Disk | Sony OM-D4440 |
| Nominal disk diameter | 5.25" | 5.25" | 3" | 3" | 3.5" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .125/.250 | U: .250/.5 | U: .250/.5 | U: .125/.250 | U: .5/1.0 |
| Capacity per track (Bytes) | U: 3,250/6,250 | U: 3,250/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 1 | 1 | 2 | 1 | 2 |
| Tracks per surface | 40 | 80 | 40 | 40 | 80 |
| Track density (TPI) | 48 | 96 | 100 | 100 | 135 |
| Maximum linear density (BPI) | 2768/5536 | 2788/5576 | 4915/9830 | 4473/8946 | 4359/8717 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 10 | 8 | 3 | 3 | 3 |
| Settling time (msec) | 12 | 10 | 30 | 30 | 30 |
| Head load time(msec) | 40 | 40 | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 2.36 x 5.55 x 7.87 | 2.36 x 5.55 x 7.87 | 1.57 x 3.54 x 5.9 | 1.57 x 3.54 x 5.9 | 1.575 x 4.0 x 6.0 |
| FIRST CUSTOMER SHIPMENT | 1984 | 1984 | 6/83 | 6/83 | 11/84 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | SANKYO SEIKI | SANKYO SEIKI | SANKYO SEIKI | SEIKOSHA | SEIKOSHA |
| DRIVE | FDU-355-SA | FMC-170 | FMC-270 | SD3505 | SD3510 |
| DISK/TREND GROUP | 17 | 18 | 18 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Sony OM-D3440 | Special Disk | Special Disk | Sony OM-D3440 | Sony OM-D4440 |
| Nominal disk diameter | 3.5" | 2.598" | 2.598" | 3.5" | 3.5" |
| Recording medium | High Density Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | N/A | N/A | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250/.5 | U: .008 | U: .016 | U: .5 | U: 1.0 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: .008 | U: .016 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 1 | 1 | 1 | 1 | 2 |
| Tracks per surface | 80 | 1 | 1 | 80 | 80 |
| Track density (TPI) | 135 | N/A | N/A | 135 | 135 |
| Maximum linear density (BPI) | 4094/8187 | 1069 | 2138 | 8187 | 8717 |
| Rotational speed (RPM) | 300 | 405 | 405 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | N/A | N/A | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | N/A | N/A | 3 | 3 |
| Settling time (msec) | 30 | N/A | N/A | 15 | 15 |
| Head load time(msec) | Continuous Contact | N/A | N/A | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | N/A | N/A | 100 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 2 | 4 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.575 x 4.0 x 6.0 | 2.677 x 3.047 x 4.902 | 2.677 x 3.047 x 4.902 | 1.625 x 4.0 x 5.5 | 1.625 x 4.0 x 5.5 |
| FIRST CUSTOMER SHIPMENT | 6/84 | 5/83 | 5/83 | 1985 | 1985 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | 8,000 bytes in single spiral track | 16,000 bytes in single spiral track | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | SHINWA CO.,LTD. | SHINWA CO.,LTD. | SHUGART | SHUGART | SONY |
| DRIVE | NFD-510 | FDS-36 | S 800<br>S 801 | S 850<br>S 851 | MP-F52V |
| DISK/TREND GROUP | 16 | 17 | 13 | 14 | 17 |
| MARKET | OEM | OEM | OEM, Captive | OEM, Captive | Captive, OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | SONY OM-D4440 | Diskette 1 | Diskette 1,2,2D | Sony OM-D3440 |
| Nominal disk diameter | 5.25" | 3.5" | 8" | 8" | 3.5" |
| Recording medium | Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft/Hard | Soft/Hard | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250/.5 | U: .250/.5 | U: .401/.802 | U: .8/1.6 | U: .250/.5 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 5,208/10,416 | U: 5,208/10,416 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 2 | 1 | 2 | 1 |
| Tracks per surface | 40 | 80 | 77 | 77 | 80 |
| Track density (TPI) | 48 | 135 | 48 | 48 | 135 |
| Maximum linear density (BPI) | 2938/5876 | 4094/8187 | 3268/6536 | 3408/6816 | 4094/8187 |
| Rotational speed (RPM) | 300 | 300 | 360 | 360 | 600 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 3 | 8 | 3 | 6 |
| Settling time (msec) | 15 | 15 | 8 | 15 | 15 |
| Head load time(msec) | 35 | Continuous Contact | 35 | 45 | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 83.3 | 83.3 | 50 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 | 31.25/62.5 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 3.25 x 5.75 x 8.0 | 1.3 x 4.0 x 5.7 | SA 801: 4.62 x 8.55 x 14.25 | SA 851: 4.62 x 8.55 x 14.25 | 1.18 x 4.0 x 5.9 |
| FIRST CUSTOMER SHIPMENT | 1984 | 1985 | 9/75 | 6/77 | 1985 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | $83 |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | SONY | SONY | SONY | SONY | SONY |
| DRIVE | MP-F52W | MP-F53V | MP-F53W | OA-D31V | OA-D32V |
| DISK/TREND GROUP | 17 | 17 | 17 | 17 | 17 |
| MARKET | Captive, OEM | Captive, OEM | Captive, OEM | Captive, OEM | OEM |
| MEDIA: Generic type | Sony OM-D4440 | Sony OM-D3440 | Sony OM-D4440 | Sony OM-D3320 | Sony OM-D3440 |
| Nominal disk diameter | 3.5" | 3.5" | 3.5" | 3.5" | 3.5" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5/1.0 | U: .250/.5 | U: .5/1.0 | U: .2188/.4375 | U: .250/.5 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 1 | 2 | 1 | 1 |
| Tracks per surface | 80 | 80 | 80 | 70 | 80 |
| Track density (TPI) | 135 | 135 | 135 | 135 | 135 |
| Maximum linear density (BPI) | 4359/8717 | 4094/8187 | 4359/8717 | 3805/7610 | 4094/8187 |
| Rotational speed (RPM) | 600 | 300 | 300 | 600 | 600 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 6 | 6 | 15 | 12 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 30 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | 60 | 60 |
| Average rotational delay (msec) | 50 | 100 | 100 | 50 | 50 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.18 x 4.0 x 5.9 | 1.18 x 4.0 x 5.9 | 1.18 x 4.0 x 5.9 | 2.0 x 4.0 x 5.1 | 2.0 x 4.0 x 5.1 |
| FIRST CUSTOMER SHIPMENT | 1985 | 1985 | 1985 | 11/82 | 9/83 |
| U.S. OEM PRICE FOR 500 UNITS | $95 | $83 | $95 | -- | $185 |
| COMMENTS | | | | | |

| MANUFACTURER | SONY | SONY | TANDON | TANDON | TANDON |
|---|---|---|---|---|---|
| DRIVE | OA-D32W | OA-D33V | TM-848E-1 | TM-848E-2 | TM-65-1L |
| DISK/TREND GROUP | 17 | 17 | 13 | 14 | 15 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Sony OM-D4440 | Sony OM-D3440 | Diskette 1 | Diskette 1,2,2D | 5.25" -- 1/40 |
| Nominal disk diameter | 3.5" | 3.5" | 8" | 8" | 5.25" |
| Recording medium | High Density, Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft/Hard | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5/1.0 | U: .250/.5 | U: .401/.802 | U: .8/1.6 | U: .125/.250 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 5,208/10,416 | U: 5,208/10,416 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 1 | 1 | 2 | 1 |
| Tracks per surface | 80 | 80 | 77 | 77 | 40 |
| Track density (TPI) | 135 | 135 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 4359/8717 | 4094/8187 | 3268/6536 | 3406/6816 | 2768/5536 |
| Rotational speed (RPM) | 600 | 300 | 360 | 360 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 12 | 12 | 3 | 3 | 6 |
| Settling time (msec) | 30 | 30 | 15 | 15 | 15 |
| Head load time(msec) | 60 | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 50 | 100 | 83.3 | 83.3 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.63/31.25 | 31.25/62.5 | 31.25/62.5 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 2.0 x 4.0 x 5.1 | 2.0 x 4.0 x 5.1 | 2.3 x 8.55 x 13.125 | 2.3 x 8.55 x 13.125 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 1Q84 | 9/83 | 4/81 | 4/81 | 3Q82 |
| U.S. OEM PRICE FOR 500 UNITS | $235 | $185 | $250 (2500) | $285 (2500) | $75 (2500) |
| COMMENTS | | | | | |

| MANUFACTURER | TANDON | TANDON | TANDON | TANDON | TANDON |
|---|---|---|---|---|---|
| DRIVE | TM-65-2L | TM-65-4 | TM-65-8 | TM-75-2 | TM-75-8 |
| DISK/TREND GROUP | 16 | 16 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD | 5.25" -- 2/40 | Maxell MD2-HD |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | High Density Oxide Coated | Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft/Hard | Soft/Hard | Soft/Hard | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250/.5 | U: .5/1.0 | U: .8/1.6 | U: .5 | U: 1.0/1.6 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 5,208/10,416 | U: 6,250 | U: 6,250/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 40 | 80 | 77 | 40 | 80/77 |
| Track density (TPI) | 48 | 96 | 96 | 48 | 96 |
| Maximum linear density (BPI) | 2938/5877 | 2961/5922 | 4823/9646 | 5877 | 4823/9646 |
| Rotational speed (RPM) | 300 | 300 | 300/360 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 3 | 3 | 6 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | 50 |
| Average rotational delay (msec) | 100 | 100 | 83.3 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25 | 37.5/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 10/82 | 10/82 | 1984 | 4Q85 | 4Q85 |
| U.S. OEM PRICE FOR 500 UNITS | $80 (2500) | $104 (2500) | $112 (2500) | $80 (2500) | $112 (2500) |
| COMMENTS | | | | | |

| MANUFACTURER | TANDON | TANDON | TANDON | TEAC | TEAC |
|---|---|---|---|---|---|
| DRIVE | TM-100-2 | TM-303 | TM-304 | FD-55AV | FD-55EV |
| DISK/TREND GROUP | 16 | 17 | 17 | 15 | 15 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | Sony OM-D3440 | Sony OM-D4440 | 5.25" -- 1/40 | 5.25" -- 1/80 |
| Nominal disk diameter | 5.25" | 3.5" | 3.5" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft/Hard | Soft/Hard | Soft/Hard | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250/.5 | U: .250/.5 | U: .5/1.0 | U: .125/.250 | U: .250/.5 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 1 | 2 | 1 | 1 |
| Tracks per surface | 40 | 80 | 80 | 40 | 80 |
| Track density (TPI) | 48 | 135 | 135 | 48 | 96 |
| Maximum linear density (BPI) | 2938/5877 | 4094/8188 | 4359/8718 | 2768/5536 | 2788/5576 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Rack & Pinion, Stepping Motor | Rack & Pinion, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 5 | 6 | 6 | 6 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | 50 | 50 |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 3.25 x 5.75 x 8.0 | 1.625 x 4.0 x 6.0 | 1.625 x 4.0 x 6.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 11/78 | 1Q85 | 1Q85 | 4/82 | 4/82 |
| U.S. OEM PRICE FOR 500 UNITS | $110 (2500) | -- | -- | $76 (1000) | $90 (1000) |
| COMMENTS | | | | | |

| MANUFACTURER | TEAC | TEAC | TEAC | TEAC | TEAC |
|---|---|---|---|---|---|
| DRIVE | FD-55BV | FD-55FV | FD-55GFV | FD-55GV | FD-30A |
| DISK/TREND GROUP | 16 | 16 | 16 | 16 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD | Maxell MD2-HD | Maxell Compact Floppy Disk |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 3" |
| Recording medium | Oxide Coated | Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated | High Density, Oxide Coated |
| Sectoring | Soft/Hard | Soft/Hard | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250/.5 | U: .5/1.0 | U: .5/1.0 or U: .8/1.6 | U: .8/1.6 | U: .125/.250 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 6,250/10,416 | U: 5,208/10,416 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 1 |
| Tracks per surface | 40 | 80 | 80/77 | 77 | 40 |
| Track density (TPI) | 48 | 96 | 96 | 96 | 100 |
| Maximum linear density (BPI) | 2938/5876 | 2961/5922 | 5922/9646 | 4823/9646 | 4473/8946 |
| Rotational speed (RPM) | 300 | 300 | 300/360 | 360 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 3 | 3 | 3 | 12 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 50 | 50 | 50 | 50 | 50 |
| Average rotational delay (msec) | 100 | 100 | 100/83.3 | 83.3 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 | 31.25/62.5 | 15.625/31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8 | 1.57 x 3.54 x 5.9 |
| FIRST CUSTOMER SHIPMENT | 4/82 | 6/82 | 3/84 | 4/83 | 9/83 |
| U.S. OEM PRICE FOR 500 UNITS | $83 (1000) | $95 (1000) | $104 (1000) | $103 (1000) | -- |
| COMMENTS | | | Dual Speed | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | TEAC | TEAC | TEAC | TEAC | TEAC |
| DRIVE | FD-35A | FD-35B | FD-35E | FD-35F | FD-35G |
| DISK/TREND GROUP | 17 | 17 | 17 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Sony OM-D3440 | Sony OM-D4440 | Sony OM-D3440 | Sony OM-D4440 | -- |
| Nominal disk diameter | 3.5" | 3.5" | 3.5" | 3.5" | 3.5" |
| Recording medium | High Density Oxide Coated | High density oxide coated | High density oxide coated | High density oxide coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .125/.250 | U: .250/.5 | U: .250/.5 | U: .5/1.0 | U: 1.0/1.6 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 6,250/10,416 |
| Data surfaces per spindle | 1 | 2 | 1 | 2 | 2 |
| Tracks per surface | 40 | 40 | 80 | 80 | 80/77 |
| Track density (TPI) | 67.5 | 67.5 | 135 | 135 | 135 |
| Maximum linear density (BPI) | 4064/8128 | 4325/8650 | 4094/8188 | 4359/8718 | 14528/14184 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, stepping motor | Band, stepping motor | Band, stepping motor | Band, stepping motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 6 | 3 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous contact | Continuous contact | Continuous contact | Continuous contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 4.0 x 5.3 | 1.625 x 4.0 x 5.3 | 1.625 x 4.0 x 5.3 | 1.625 x 4.0 x 5.3 | 1.57 x 4.0 x 5.3 |
| FIRST CUSTOMER SHIPMENT | 2Q84 | 2Q84 | 2Q84 | 2Q84 | 1986 |
| U.S. OEM PRICE FOR 500 UNITS | $78 (1000) | $79 (1000) | $79 (1000) | $94 (1000) | -- |
| COMMENTS | | | | | |

| MANUFACTURER | TEAC | TEAC | TEAC | TEAC | TEAC |
|---|---|---|---|---|---|
| DRIVE | FD-35GF | FD-35GF II | FD-35H | FD-135A | FD-135B |
| DISK/TREND GROUP | 17 | 17 | 17 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | -- | -- | -- | Sony OM-D3440 | Sony OM-D4440 |
| Nominal disk diameter | 3.5" | 3.5" | 3.5" | 3.5" | 3.5" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0/1.6 | U: 1.6 | U: 2.0 | U: .125/.250 | U: .250/.5 |
| Capacity per track (Bytes) | U: 6,250/10,416 | U: 10,416 | U: 12,500 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 2 | 2 | 2 | 1 | 2 |
| Tracks per surface | 80/77 | 80 | 80 | 40 | 40 |
| Track density (TPI) | 135 | 135 | 135 | 67.5 | 67.5 |
| Maximum linear density (BPI) | 14528/14184 | 14184 | 17434 | 4063/8126 | 4324/8647 |
| Rotational speed (RPM) | 300/360 | 360 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping motor | Lead Screw, Stepping motor |
| POSITIONING: Track to track (msec) | 3 | 3 | 3 | 6 | 6 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time (msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous contact | Continuous contact |
| Average rotational delay (msec) | 100/83.3 | 83.3 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 62.5 | 31.25/62.5 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 1.57 x 4.0 x 5.3 | 1.57 x 4.0 x 5.3 | 1.57 x 4.0 x 5.3 | 1.0 x 4.0 x 5.9 | 1.0 x 4.0 x 5.9 |
| FIRST CUSTOMER SHIPMENT | 1986 | 1986 | 1986 | 7/85 | 7/85 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | $80 (1000) |
| COMMENTS | | Logically compatible with IBM PC-AT 5.25" FD format | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | TEAC | TEAC | TOKYO ELECTRIC COMPANY | TOKYO ELECTRIC COMPANY | TOKYO ELECTRIC COMPANY |
| DRIVE | FD-135E | FD-135F | FB-501 | FB-502 | FB-503 |
| DISK/TREND GROUP | 17 | 17 | 15 | 15 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Sony OM-D3440 | Sony OM-D4440 | 5.25" -- 1/40 | 5.25" -- 1/80 | 5.25" -- 2/40 |
| Nominal disk diameter | 3.5" | 3.5" | 5.25" | 5.25" | 5.25" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250/.5 | U: .5/1.0 | U: .250 | U: .5 | U: .5 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 6,250 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 1 | 2 | 1 | 1 | 2 |
| Tracks per surface | 80 | 80 | 40 | 80 | 40 |
| Track density (TPI) | 135 | 135 | 48 | 96 | 48 |
| Maximum linear density (BPI) | 4094/8187 | 4359/8717 | 5536 | 5576 | 5876 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping motor | Lead Screw, Stepping motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 6 | 3 | 6 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous contact | Continuous contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 31.25 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.0 x 4.0 x 5.9 | 1.0 x 4.0 x 5.9 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 7/85 | 7/85 | 3Q82 | 3Q82 | 3Q82 |
| U.S. OEM PRICE FOR 500 UNITS | $74 (1000) | $87 (1000) | -- | -- | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | TOKYO ELECTRIC COMPANY | TOKYO ELECTRIC COMPANY | TOKYO ELECTRIC COMPANY | TOKYO ELECTRIC COMPANY | TOKYO ELECTRIC COMPANY |
| DRIVE | FB-504 | FB-506 | FB-351 | FB-352 | FB-353 |
| DISK/TREND GROUP | 16 | 16 | 17 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/80 | Maxell MD2-HD | Sony OM-D3440 | Sony OM-D3440 | Sony OM-D4440 |
| Nominal disk diameter | 5.25" | 5.25" | 3.5" | 3.5" | 3.5" |
| Recording medium | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0 | U: 1.0/1.6 | U: .250 | U: .5 | U: .5 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250/10,416 | U: 6,250 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 2 | 2 | 1 | 1 | 2 |
| Tracks per surface | 80 | 80/77 | 40 | 80 | 40 |
| Track density (TPI) | 96 | 96 | 67.5 | 135 | 67.5 |
| Maximum linear density (BPI) | 5922 | 5922/9646 | 8126 | 8187 | 8647 |
| Rotational speed (RPM) | 300 | 300/360 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 6 | 3 | 6 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100/83.3 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25/62.5 | 31.25 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.625 X 5.75 X 8.0 | 1.18 x 4.0 x 5.3 | 1.18 x 4.0 x 5.3 | 1.18 x 4.0 x 5.3 |
| FIRST CUSTOMER SHIPMENT | 1Q83 | 1Q85 | 3Q84 | 3/84 | 3Q84 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | Dual Speed | | | |

| MANUFACTURER | TOKYO ELECTRIC COMPANY | TOKYO ELECTRIC COMPANY | TOKYO ELECTRIC COMPANY | TOKYO ELECTRIC COMPANY | TOSHIBA |
|---|---|---|---|---|---|
| DRIVE | FB-354 | MC-116 | MC-132 | MC-164 | ND-40D<br>ND-40DL |
| DISK/TREND GROUP | 17 | 18 | 18 | 18 | 14 |
| MARKET | OEM | OEM | OEM | OEM | Captive, OEM |
| MEDIA: Generic type | Sony OM-D4440 | Special | Special | Special | Diskette 1,2,2D |
| Nominal disk diameter | 3.5" | 66 mm OD | 66 mm OD | 66 mm OD | 8" |
| Recording medium | High Density Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | N/A | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0 | F: .016 | F: .032 | F: .064 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 6,250 | F: 16,000 | F: 32,000 | F: 64,000 | U: 5,208/10,416 |
| Data surfaces per spindle | 2 | 1 | 1 | 1 | 2 |
| Tracks per surface | 80 | 1 | 1 | 1 | 77 |
| Track density (TPI) | 135 | 33 | N/A | N/A | 48 |
| Maximum linear density (BPI) | 8717 | 2138 | 2768 | 5140 | 3408/6816 |
| Rotational speed (RPM) | 300 | 405 | 425 | 425 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | N/A | N/A | N/A | Band, Stepping Motor |
| POSITIONING: Track to track (msec) | 3 | N/A | N/A | N/A | 3 |
| Settling time (msec) | 15 | N/A | N/A | N/A | 18 |
| Head load time (msec) | Continuous Contact | N/A | N/A | N/A | 50 |
| Average rotational delay (msec) | 100 | N/A | N/A | N/A | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 6.25 | 10.4 | 20.8 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.18 x 4.0 x 5.3 | 1.61 x 3.0 X 4.9 | 1.61 x 3.0 X 6.3 | 1.61 x 3.0 X 6.3 | 2.24 x 8.54 x 12.4 |
| FIRST CUSTOMER SHIPMENT | 3/84 | 4Q82 | 4/84 | 4/84 | 1Q82 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | $230 (1000) |
| COMMENTS | | 16,000 bytes in single spiral track | Up to 32,000 bytes in single spiral track | Up to 64,000 bytes in single spiral track | |

| MANUFACTURER | TOSHIBA | TOSHIBA | TOSHIBA | TOSHIBA | TOSHIBA |
|---|---|---|---|---|---|
| DRIVE | ND-04D | ND-06D | ND-08D | ND-08DE | ND-09D |
| DISK/TREND GROUP | 16 | 16 | 16 | 16 | 16 |
| MARKET | Captive, OEM | Captive, OEM | Captive, OEM | Captive, OEM | Captive, OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD | Maxell MD2-HD | 5.25" - HD |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .250/.5 | U: .5/1.0 | U: .8/1.6 | U: 1.0/1.6 | U: 1.0/2.0 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 5,208/10,416 | U: 6,250/10,416 | U: 6,250/12,500 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 40 | 80 | 77 | 80/77 | 80 |
| Track density (TPI) | 48 | 96 | 96 | 96 | 96 |
| Maximum linear density (BPI) | 2938/5876 | 2961/5922 | 4823/9646 | 5922/9646 | 5922/11844 |
| Rotational speed (RPM) | 300 | 300 | 360 | 360 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 5 | 3 | 3 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 50 | 50 | 35 | 35 | 35 |
| Average rotational delay (msec) | 100 | 100 | 83.3 | 100/83.3 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 | 37.5/62.5 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.3 | 1.625 x 5.75 x 8.3 | 1.625 x 5.75 x 8.3 | 1.625 x 5.75 x 8.3 | 1.625 x 5.75x 8.3 |
| FIRST CUSTOMER SHIPMENT | 2Q83 | 2Q82 | 2Q84 | 1984 | 4Q84 |
| U.S. OEM PRICE FOR 500 UNITS | $75 (1000) | $85 (1000) | -- | $100 (1000) | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | TOSHIBA | TOSHIBA | TOSHIBA | TOSHIBA | VICTOR COMPANY OF JAPAN |
| DRIVE | ND-351S | ND-352S | ND-353 | ND-354 | MDP-100<br>MDP-1 |
| DISK/TREND GROUP | 17 | 17 | 17 | 17 | 16 |
| MARKET | Captive, OEM | Captive, OEM | Captive, OEM | Captive, OEM | OEM |
| MEDIA: Generic type | Sony OM-D4440 | Sony OM-D3440 | Sony OM-D3440 | Sony OM-D4440 | 5.25" -- 2/80 |
| Nominal disk diameter | 3.5" | 3.5" | 3.5" | 3.5" | 5.25" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5 | U: 1.0 | U: .250/.5 | U: .5/1.0 | U: 1.0 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 1 | 2 | 1 | 2 | 2 |
| Tracks per surface | 80 | 80 | 80 | 80 | 80 |
| Track density (TPI) | 135 | 135 | 135 | 135 | 96 |
| Maximum linear density (BPI) | 8187 | 8717 | 4096/8187 | 4359/8717 | 5922 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING: Track to track (msec) | 6 | 6 | 3 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time (msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | 35 |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 15.63/31.25 | 15.63/31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.0 x 4.0 x 5.9 | 1.0 x 4.0 x 5.9 | 1.625 x 4.0 x 5.9 | 1.625 x 4.0 x 5.9 | 1.625 x 5.75 x 8.6 |
| FIRST CUSTOMER SHIPMENT | 3/86 | 3/86 | 3Q84 | 3Q84 | 2Q84 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | $75 (1000) | $80 (1000) | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | VICTOR COMPANY OF JAPAN | VICTOR COMPANY OF JAPAN | VICTOR COMPANY OF JAPAN | VICTOR COMPANY OF JAPAN | VICTOR COMPANY OF JAPAN |
| DRIVE | MDP-200 MDP-2 | MDP-300 | MDP-1000 | MDP-3000 | MFD-51622 MDP-2000 |
| DISK/TREND GROUP | 16 | 16 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell MD2-HD | Maxell MD2-HD | Maxell MD2-HD |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5 | U: 1.0 | U: 1.6 | U: 1.0/1.6 | U: 1.0/1.6 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 10,416 | U: 6,250/10,416 | U: 6,250/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 40 | 80 | 77 | 80/77 | 80/77 |
| Track density (TPI) | 48 | 96 | 96 | 96 | 96 |
| Maximum linear density (BPI) | 5876 | 5922 | 9646 | 5922/9646 | 5922/9646 |
| Rotational speed (RPM) | 300 | 300 | 360 | 300 | 300/360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 3 | 3 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 35 | 35 | 35 | 35 | 35 |
| Average rotational delay (msec) | 100 | 100 | 83.3 | 100 | 100/83.3 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 62.5 | 37.5/62.5 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.6 | 1.625 x 5.75 x 7.9 | 1.625 x 5.75 x 7.9 | 1.625 x 5.75 x 7.9 | 1.625 x 5.75 x 7.9 |
| FIRST CUSTOMER SHIPMENT | 3Q84 | 4Q84 | 4Q84 | 4Q84 | 4Q84 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | Dual Speed |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | VICTOR COMPANY OF JAPAN | VICTOR COMPANY OF JAPAN | VICTOR COMPANY OF JAPAN | VICTOR COMPANY OF JAPAN | VICTOR COMPANY OF JAPAN |
| DRIVE | MDP-10 | MDP-20 | MDP-30 | MDP-30F | MDP-30FD |
| DISK/TREND GROUP | 17 | 17 | 17 | 17 | 17 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Sony OM-D3440 | Sony OM-D4440 | Sony OM-D3440 | Sony OM-D3440 | Sony OM-D3440 |
| Nominal disk diameter | 3.5" | 3.5" | 3.5" | 3.5" | 3.5" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5 | U: 1.0 | U: .5 | U: .250 | U: .5 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 1 | 2 | 1 | 1 | 1 |
| Tracks per surface | 80 | 80 | 80 | 40 | 80 |
| Track density (TPI) | 135 | 135 | 135 | 67.5 | 135 |
| Maximum linear density (BPI) | 8187 | 8717 | 8187 | 8125 | 8187 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 3 | 3 | 6 | 6 |
| Settling time (msec) | 15 | 15 | 15 | 20 | 20 |
| Head load time(msec) | 35 | 35 | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 31.25 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 4.0 x 5.1 | 1.625 x 4.0 x 5.1 | 1.1 x 4.0 x 5.1 | 1.57 x 4.0 x 6.4 | 1.57 x 4.0 x 6.4 |
| FIRST CUSTOMER SHIPMENT | 1Q85 | 1Q85 | 1Q85 | 4/85 | 4/85 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | VICTOR COMPANY OF JAPAN | VICTOR COMPANY OF JAPAN | VIDEO TECHNOLOGY | VIDEO TECHNOLOGY | VIDEO TECHNOLOGY |
| DRIVE | MDP-30FDW | MDP-40 | FDM 130 | FDM 140 | FDM 145 |
| DISK/TREND GROUP | 17 | 17 | 15 | 15 | 16 |
| MARKET | OEM | OEM | OEM, PCM | OEM, PCM | OEM, PCM |
| MEDIA: Generic type | Sony OM-D4440 | Sony OM-D4440 | 5.25" -- 1/40 | 5.25" -- 1/80 | 5.25" -- 2/40 |
| Nominal disk diameter | 3.5" | 3.5" | 5.25" | 5.25" | 5.25" |
| Recording medium | High Density Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0 | U: 1.0 | U: .250 | U: .5 | U: .5 |
| Capacity per track (Bytes) | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250 | U: 6,250 |
| Data surfaces per spindle | 2 | 2 | 1 | 1 | 2 |
| Tracks per surface | 80 | 80 | 40 | 80 | 40 |
| Track density (TPI) | 135 | 135 | 48 | 96 | 48 |
| Maximum linear density (BPI) | 8717 | 8717 | 5536 | 5576 | 5876 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Lead Screw, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 3 | 12 | 6 | 12 |
| Settling time (msec) | 20 | 15 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 31.25 | 31.25 | 31.25 |
| SIZE (Inches: H x W x D) | 1.57 x 4.0 x 6.4 | 1.1 x 4.0 x 5.1 | 1.625 x 5.75 x 7.6 | 1.625 x 5.75 x 7.6 | 1.625 x 5.75 x 7.6 |
| FIRST CUSTOMER SHIPMENT | 4/85 | 1Q85 | 1984 | 2Q85 | 2Q85 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | FDM 110 & FD 100 are Apple II PCM versions | FDM 120 & FD 200 are Apple II PCM versions | |

| MANUFACTURER | VIDEO TECHNOLOGY | VIDEOTON INDUSTRIE-AUSSENHALDELS | VIDEOTON INDUSTRIE-AUSSENHALDELS | VIDEOTON INDUSTRIE-AUSSENHALDELS | VIDEOTON INDUSTRIE-AUSSENHALDELS |
|---|---|---|---|---|---|
| DRIVE | FDM 160 | MFM-2<br>MFM-4 | Momflex 3200 | Momflex 6400 | Momflex 900 |
| DISK/TREND GROUP | 16 | 13 | 13 | 13 | 15 |
| MARKET | OEM, PCM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/80 | Diskette 1 | Diskette 1 | Diskette 1 | 5.25" -- 1/40 |
| Nominal disk diameter | 5.25" | 8" | 8" | 8" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft | Hard | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: 1.0 | F: .256 | U: .401 | U: .4/.8 | U: 109.4 |
| Capacity per track (Bytes) | U: 6,250 | F: 3,328 | U: 5,208 | U: 5,208/10,416 | U: 3,125 |
| Data surfaces per spindle | 2 | 1 | 1 | 1 | 1 |
| Tracks per surface | 80 | 77 | 77 | 77 | 35 |
| Track density (TPI) | 96 | 48 | 48 | 48 | 48 |
| Maximum linear density (BPI) | 5922 | 3268 | 3268 | 3268/6536 | 2616 |
| Rotational speed (RPM) | 300 | 360 | 360 | 360 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Lead Screw, Stepping Motor | Lead Screw, Stepping Motor | Band, Stepping Motor | Cam, Stepping Motor |
| POSITIONING:Track to track(msec) | 6 | 10 | 10 | 4 | 40 |
| Settling time (msec) | 15 | 40 | 25 | 15 | 10 |
| Head load time(msec) | Continuous Contact | 40 | 40 | 35 | 75 |
| Average rotational delay (msec) | 100 | 83.3 | 83.3 | 83.3 | 100 |
| Data transfer rate (KBytes/sec) | 31.25 | 31.25 | 31.25 | 31.25/62.5 | 15.63 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 7.6 | 10.5 x 19.0 x 22.0 | 5.28 x 8.5 x 14.8 | 4.4 x 8.5 x 13.9 | 3.27 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 2Q85 | 1977 | 1978 | 1980 | 4Q83 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | FDM 150 is Apple II PCM version | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | WELTEC DIGITAL | WELTEC DIGITAL | WELTEC DIGITAL | WELTEC DIGITAL | WELTEC DIGITAL |
| DRIVE | M 48S | M 96S | M 16-A<br>M 16-R<br>M 16-P | M 48D | M 96D |
| DISK/TREND GROUP | 15 | 15 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM, PCM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 1/40 | 5.25" - 1/80 | Maxell MD2-HD | 5.25" -- 2/40 | 5.25" -- 2/80 |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | High Density Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft/Hard | Soft/Hard | Soft | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .125/.250 | U: .250/.5 | U: 1.6/1.0 | U: .250/.5 | U: .5/1.0 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U:10,416/6,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 1 | 1 | 2 | 2 | 2 |
| Tracks per surface | 40 | 80 | 80 | 40 | 80 |
| Track density (TPI) | 48 | 96 | 96 | 48 | 96 |
| Maximum linear density (BPI) | 2768/5536 | 2788/5576 | 9870/5922 | 2938/5876 | 2961/5922 |
| Rotational speed (RPM) | 300 | 300 | 360/300 | 300 | 300 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 5.6 | 2.8 | 2.8 | 5.6 | 2.8 |
| Settling time (msec) | 10 | 10 | 10 | 10 | 10 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 83/100 | 100 | 100 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 62.5/31.25 | 15.63/31.25 | 15.63/31.25 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 7/83 | 7/83 | 1984 | 7/83 | 7/83 |
| U.S. OEM PRICE FOR 500 UNITS | $69 (1000) | $82 (1000) | $115 (1000) | $79 (1000) | $92 (1000) |
| COMMENTS | | | Compatiblity:<br>M16-A:IBM PC AT<br>M16-P:IBM PC XT | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | WONG'S TECHNOLOGY | WONG'S TECHNOLOGY | WONG'S TECHNOLOGY | WONG'S TECHNOLOGY | WONG'S TECHNOLOGY |
| DRIVE | Challenger I<br>Challenger II<br>Challenger V | WST 112-5<br>TITAN | Challenger ID<br>Challenger IID<br>Challenger VII | Challenger III<br>Challenger VI | Challenger IV |
| DISK/TREND GROUP | 15 | 15 | 16 | 16 | 16 |
| MARKET | PCM | OEM | PCM | PCM | PCM |
| MEDIA: Generic type | 5.25" -- 1/40 | 5.25" -- 1/40 | 5.25" -- 1/80 | 5.25" -- 2/40 | Maxell MD2-HD |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | High Density Oxide Coated |
| Sectoring | Soft | Soft/Hard | Soft | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .125/.250 | U: .125/.250 | U: .250/.5 | U: .250/.5 | U: .5/1.6 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 |
| Data surfaces per spindle | 1 | 1 | 1 | 2 | 2 |
| Tracks per surface | 40 | 40 | 80 | 40 | 40/77 |
| Track density (TPI) | 48 | 48 | 96 | 48 | 96 |
| Maximum linear density (BPI) | 5535 | 2768/5536 | 5576 | 5876 | 5876/9646 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 6/20 | 6 | 3/10 | 5/6 | 3 |
| Settling time (msec) | 15 | 20 | 15 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 37.5/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 4/85 | 4/83 | 4/85 | 4/85 | 4/85 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | Compatibility:<br>I: Apple IIe<br>II:Apple IIc<br>V: BBC | | Compatibility:<br>Id: Apple II<br>IId: Apple IIe<br>IIc<br>VII: BBC | Compatibility:<br>III: IBM PC<br>XT<br>AT<br>VI: BBC | Compatibility:<br>IV: IBM PC AT |

| MANUFACTURER | WONG'S TECHNOLOGY | WONG'S TECHNOLOGY | WONG'S TECHNOLOGY | WONG'S TECHNOLOGY | YE DATA |
|---|---|---|---|---|---|
| DRIVE | Challenger VIII | WST 211-5 ZEUS | WST 212-5 TITAN | WST 221-5 ZEUS | YD-174D |
| DISK/TREND GROUP | 16 | 16 | 16 | 16 | 14 |
| MARKET | PCM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | 5.25" -- 2/80 | 5.25" -- 2/40 | 5.25" -- 2/40 | 5.25" -- 2/80 | Diskette 1,2,2D |
| Nominal disk diameter | 5.25" | 5.25" | 5.25" | 5.25" | 8" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated | Oxide Coated |
| Sectoring | Soft | Soft/Hard | Soft/Hard | Soft/Hard | Soft/Hard |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5/1.0 | U: .250/.5 | U: .250/.5 | U: .5/1.0 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 5,208/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 80 | 40 | 40 | 80 | 77 |
| Track density (TPI) | 96 | 48 | 48 | 96 | 48 |
| Maximum linear density (BPI) | 5922 | 2938/5876 | 2938/5876 | 2961/5922 | 3408/6816 |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 5 | 6 | 5 | 3 |
| Settling time (msec) | 15 | 15 | 20 | 15 | 15 |
| Head load time(msec) | Continuous Contact | Continuous Contact | Continuous Contact | Continuous Contact | 35 |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | 83.3 |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8.0 | 3.25 x 5.75 x 8.0 | 1.625 x 5.75 x 8.0 | 3.25 x 5.75 x 8.0 | 4.5 x 8.55 x 14.57 |
| FIRST CUSTOMER SHIPMENT | 4/85 | 4/82 | 4/83 | 11/81 | 1977 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | Compatibility: VIII: BBC | | | | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | YE DATA | YE DATA | YE DATA | YE DATA | YE DATA |
| DRIVE | YD-180 | YD-274 | YD-280 | YD-380-1714 | YD-380T<br>YD-380-1710 |
| DISK/TREND GROUP | 14 | 16 | 16 | 16 | 16 |
| MARKET | OEM | OEM | OEM | OEM | OEM |
| MEDIA: Generic type | Diskette 1,2,2D | 5.25" -- 2/40 | 5.25" -- 2/80 | Maxell<br>MD2-HD | Maxell<br>MD2-HD |
| Nominal disk diameter | 8" | 5.25" | 5.25" | 5.25" | 5.25" |
| Recording medium | Oxide Coated | Oxide Coated | Oxide Coated | High Density,<br>Oxide Coated | High Density,<br>Oxide Coated |
| Sectoring | Soft/Hard | Soft/Hard | Soft/Hard | Soft | Soft |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .8/1.6 | U: .250/.5 | U: .5/1.0 | U: .5/1.0<br>or<br>U: .8/1.6 | U: .8/1.6 |
| Capacity per track (Bytes) | U: 5,208/10,416 | U: 3,125/6,250 | U: 3,125/6,250 | U: 6,250/10,416 | U: 5,208/10,416 |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | 2 |
| Tracks per surface | 77 | 40 | 80 | 80/77 | 77 |
| Track density (TPI) | 48 | 48 | 96 | 96 | 96 |
| Maximum linear density (BPI) | 3408/6816 | 2938/5876 | 2961/5922 | 5922/9646 | 4823/9646 |
| Rotational speed (RPM) | 360 | 300 | 300 | 300/360 | 360 |
| PERFORMANCE | | | | | |
| Actuator type | Band,<br>Stepping Motor | Lead Screw,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor | Band,<br>Stepping Motor |
| POSITIONING:Track to track(msec) | 3 | 20 | 3 | 3 | 3 |
| Settling time (msec) | 15 | 15 | 15 | 15 | 15 |
| Head load time(msec) | 50 | 50 | 50 | 50 | 50 |
| Average rotational delay (msec) | 83.3 | 100 | 100 | 100/83.3 | 83.3 |
| Data transfer rate (KBytes/sec) | 31.25/62.5 | 15.63/31.25 | 15.63/31.25 | 31.25/62.5 | 31.25/62.5 |
| SIZE (Inches: H x W x D) | 2.25 x<br>8.55 x 12.6 | 3.25 x<br>5.75 x 8.0 | 3.25 x<br>5.75 x 8.0 | 1.625 x<br>5.75 x 8 | 1.625 x<br>5.75 x 8.0 |
| FIRST CUSTOMER SHIPMENT | 9/81 | 1/79 | 4/81 | 1984 | 2/82 |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | -- |
| COMMENTS | | | | Dual Speed | |

| | | | | | |
|---|---|---|---|---|---|
| MANUFACTURER | YE DATA | YE DATA | YE DATA | YE DATA | |
| DRIVE | YD-480 | YD-580 | YD-620<br>YD-625 | YD-640<br>YD-645 | |
| DISK/TREND GROUP | 16 | 16 | 17 | 17 | |
| MARKET | OEM | OEM | OEM | OEM | |
| MEDIA: Generic type | 5.25" -- 2/80 | 5.25" -- 2/40 | Sony OM-D4440 | Sony OM-D4440 | |
| Nominal disk diameter | 5.25" | 5.25" | 3.5" | 3.5" | |
| Recording medium | Oxide Coated | Oxide Coated | High Density Oxide Coated | High Density Oxide Coated | |
| Sectoring | Soft/Hard | Soft/Hard | Soft | Soft | |
| CAPACITY/RECORDING DENSITY | | | | | |
| Total capacity (MBytes) | U: .5/1.0 | U: .250/.5 | U: .250/.5 | U: .5/1.0 | |
| Capacity per track (Bytes) | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | U: 3,125/6,250 | |
| Data surfaces per spindle | 2 | 2 | 2 | 2 | |
| Tracks per surface | 80 | 40 | 40 | 80 | |
| Track density (TPI) | 96 | 48 | 67.5 | 135 | |
| Maximum linear density (BPI) | 2961/5922 | 2938/5876 | 4324/8647 | 4358/8717 | |
| Rotational speed (RPM) | 300 | 300 | 300 | 300 | |
| PERFORMANCE | | | | | |
| Actuator type | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | Band, Stepping Motor | |
| POSITIONING:Track to track(msec) | 3 | 5 | 5 | 3 | |
| Settling time (msec) | 15 | 15 | 15 | 15 | |
| Head load time(msec) | 50 | 50 | Continuous Contact | Continuous Contact | |
| Average rotational delay (msec) | 100 | 100 | 100 | 100 | |
| Data transfer rate (KBytes/sec) | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | 15.63/31.25 | |
| SIZE (Inches: H x W x D) | 1.625 x 5.75 x 8 | 1.625 x 5.75 x 8 | 1.625 x 4.0 x 6.0 | 1.625 x 4.0 x 6.0 | |
| FIRST CUSTOMER SHIPMENT | 4Q82 | 4Q82 | 4/84 | 4/84 | |
| U.S. OEM PRICE FOR 500 UNITS | -- | -- | -- | -- | |
| COMMENTS | | | | | |

MANUFACTURER PROFILES

# 1985 DISK/TREND REPORT

## MANUFACTURER PROFILES

All manufacturers now producing flexible disk drives, or which have indicated specific plans to enter the market, are listed in this section. The heading "1984 FDD sales" refers to the DISK/TREND estimate of flexible disk drive sales only -- no sales of other disk drive types are included, nor are sales of parts or other related products. "1984 total net sales" covers the fiscal year ending in 1984 for each listed firm unless noted otherwise, or for the parent company if the disk drive manufacturer is a subsidiary.

### U.S Manufacturers

AU PERIPHERAL PRODUCTS
176 Race Street
San Jose, CA 95126

Composed of veterans from IBM's San Jose facility, Au developed a 3.5 inch microfloppy which will use an internally designed and manufactured stepping motor. After financing delays in 1985, the firm hopes to start production in early 1986. The initial product is a conventional 3.5 inch drive, with up to 1 megabyte capacity, using Sony-type diskettes.

BURROUGHS CORPORATION
Burroughs Place
Detroit, MI 48232

1984 total net sales: $4,808,000,000 Net income: $244,900,000

Burroughs initiated a floppy drive manufacturing program in 1976 for a unique 1.0 MB 8 inch two sided drive, with a follow-on 3.0 MB drive in 1980. The second drive used a single voice coil actuator to position heads on two 8 inch diskettes at 150 TPI, using two prerecorded servo tracks as references for the closed loop head positioning system. Attempts to market these drives as OEM products drew little response, and they were used basically as captive drives with Burroughs systems. Both drives were produced for the last time in 1984. With the purchase of Memorex in 1981, Burroughs also acquired the Memorex 651, the first OEM floppy drive, originally marketed in 1972. That product was discontinued in 1982.

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

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

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

1984 FDD sales: $136,900,000
1984 total net sales: $5,027,000,000 Net income: $32,000,000

Although an early supplier of 8 inch flexible disk drives, Control Data was a latecomer to 5.25 inch drives, starting shipments in 1980. Large production increases for 5.25 inch drives during the last few years are attributable heavily to purchases by IBM. Programs to sell peripherals on a PCM basis to users of IBM minicomputers and personal computers resulted in negligible sales in the Series/1 market and modest sales in the PC market. Manufacturing responsibility for floppy drives credited to CDC in DISK/TREND statistics is held 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. MPI drives offered for sale with any of the parent company's systems are considered captive CDC drives for the purposes of DISK/TREND statistics. During 1984 the firm started moving manufacturing for floppy drives from the MPI Oklahoma facilities to Asian contract manufacturing firms. A decision to withdraw completely from the floppy drive business was made in 1985. Control Data has stopped manufacturing flexible disk drives in the U.S., and all design of flexible disk drives has ceased. The company intends to continue the off-shore manufacture of drives until all commitments are met.

DIGITAL EQUIPMENT CORPORATION
146 Main Street
Maynard, MA 01754

1984 FDD sales: $137,000,000
1984 total net sales: $5,584,000,000 Net income: $329,000,000

Since 1976, DEC has produced large quantities of 8 inch one sided floppy drives, originally under a Calcomp license. All of these drives were produced for captive use with its own systems, and production has topped

out. DEC introduced its first 5.25 inch floppy, the RX50, along with the company's personal computer systems in late 1982 -- and has been producing large quantities during the last few years. The RX50 uses a single stepping motor to position heads on two 96 TPI one sided diskettes, and is adapted from a product acquired originally from T & E Engineering, a late 1970's floppy drive startup that never achieved large scale production.

DRIVETEC
2140 Bering Drive
San Jose, CA 95131

Drivetec's advanced floppy drive was a half high 5.25 inch model offering 3.3 megabytes capacity, and employing embedded servo techniques to achieve adequate interchangability at 192 TPI. Drivetec was founded in 1981 by veterans of the floppy drive programs at IBM, Memorex and Shugart Associates, and made its first shipments in June, 1983. In November, 1983, the firm announced a license agreement allowing Eastman Kodak to market the drive. Drivetec found it difficult to perform all the functions of a pioneer on a tight budget. After a dominant customer abruptly stopped buying new drives and returned a large inventory of old ones, the company ran out of cash and went out of business in early 1985.

EASTMAN KODAK COMPANY
343 State Street
Rochester, NY 14650

1984 total net sales: $10,600,000,000 Net income: $923,000,000

Although the Spin Physics operation of Eastman Kodak had previously introduced flexible disk media using isotropic particulate coatings, Kodak's action in licensing the Drivetec embedded servo 5.25 inch drive was the firm's first step into disk drive hardware. Production started in 1984 at the Rochester, New York, facilities. Sales for the floppy drive program include direct OEM sales by Eastman Kodak, plus OEM marketing by Data Technology Corporation, a Santa Clara controller manufacturer in which Kodak has an investment, and include direct marketing of a floppy subsystem in the IBM PC add-on market. Although not specifically announced, captive applications on Kodak equipment are also likely, eventually. In late 1985, the company announced 6.6 and 12 megagbyte versions of the drive with first shipments for the OEM market planned for mid-1986.

HI-TECH PERIPHERALS CORPORATION
15192 Triton Lane
Huntington Beach, CA 92649 714/891-0027

Hi-Tech Peripherals was started in 1982, with founders from Xerox and Remex, to develop and manufacture 5.25 inch half high OEM flexible disk drives. Production started third quarter, 1983, at its Huntington Beach

facility, and in Hong Kong. In late 1984, Hi-Tech went into Chapter 11, caught in a cash shortage as a major customer suddenly returned excess purchases. The company remains in production, however, and hopes to be able to emerge from bankruptcy in early 1986.

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

1984 FDD sales: $531,100,000
1984 total net sales: $45,937,000,000 Net income: $6,582,000,000

IBM introduced the original one and two sided 8 inch flexible disk drives, and has used them on a wide variety of business systems, word processing systems, terminals and specialized equipment. After years of neglecting the minifloppy product area, IBM emerged as the world's largest buyer of OEM floppy drives, when it started purchasing two sided 48 TPI 5.25 inch drives for the hugely successful PC program. This choice established the two sided 48 TPI format as the mainstream minifloppy configuration for the worldwide computer industry. More recently, the IBM blessing has been given to 1.6 megabyte 5.25 inch drives and to two sided one megabyte 3.5 inch microfloppies, and these configurations may now be expected to become industry standards. IBM made extensive preparations to design and manufacture its own 5.25 inch and microfloppy drives, but abruptly cancelled the program in mid-1985 -- probably on the basis that current floppy drive models are available from numerous suitable vendors at prices that would be impossible to match with internal manufacturing. So it appears that IBM will rely on the outside world for its floppy drives, at least for the next few years.

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

Innotronics set up operations in late 1977, when the key employees of Innovex, a pioneer floppy drive manufacturer, purchased the assets of the original firm at an auction forced by impatient bankers. Innotronics made small quantities of 8 inch one sided drives at Fall River, Massachusetts, until this year, for use in the firm's subsystems. Internal drive production has now been replaced by outside purchases, in recognition of today's floppy drive price levels.

IOMEGA CORPORATION
1821 West 4000 South
Roy, UT 84067

1984 total net sales: $51,117,000 Net income: $2,521,000

Iomega has been successful in establishing production capability for its unique 8 inch drive, which uses a flexible disk spinning at 1500 RPM and maintains control of head/disk contact with the Bernoulli effect. A 5.25 inch version was added in mid-1983, and these OEM drives have been supplemented with 8 and 5.25 inch subsystems sold in the personal computer add-on market. The 8 inch subsystem for the IBM PC market has been shipping since 1983 and has provided most of the company's outstanding revenue growth. Half high 8 inch drives are now the major products, including models introduced in 1985 which increase the original 10 megabytes capacity to 20 megabytes per drive. SCI Systems has been licensed to make Iomega drives for use with its own systems and for sale by Iomega. Nippon Chemi-Con has been licensed to make and sell Iomega drives in Japan, and Verbatim has been granted a media license.

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

1984 FDD sales: $25,200,000
1984 total net sales: $327,000,000 Net income: $25,000,000

Micro Peripherals was acquired in mid-1983 by CTS Corporation, a diversified manufacturer of electronic components. After management changes, abortive product introductions, and the collapse of major customers, CTS announced in September, 1984, that it planned to sell Micro Peripherals, intact or in pieces. The firm's 1984 problems with ailing customers which cancelled orders or went into bankruptcy apparently were too much for CTS. Micro Peripherals operations ceased in late 1984, and the facilities and product lines were sold to off-shore firms.

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

1984 total net sales: $60,147,000 Net income: $819,000

As the pioneer in 100 TPI floppies, Micropolis was able to establish a thriving business, even though it remained the only source for the drives during the first three years. However, with many microcomputers oriented to business applications, the higher capacity of Micropolis' drives developed a following, and finally stimulated the introduction of competitive drives, the first 96 TPI models. However, with floppy drives now subject to intense price competition, Micropolis has phased out its floppy disk drive product line, in favor of high capacity 5.25 inch Winchesters.

MILTOPE CORPORATION
1770 Walt Whitman Road
Melville, NY 11747

1984 FDD sales: $3,500,000
1984 total net sales: $43,500,000 Net income: $4,000,000

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

OMEK
1835 Dawns Way
Fullerton, CA 92631

Omek is a new manufacturer of 5.25 inch flexible disk drives, started by veterans of various Memorex disk drive operations. After a start in Northern California, the firm moved in 1985 to a new Orange County location and is now producing half high 5.25 inch drives with up to 1.6 megabyte capacity, with major emphasis on low power and quiet operation.

PER SCI, INC.
Subsidiary of EF Industries
12624 Daphne
Hawthorne, CA 20250

After suffering a decline in shipments for its fast but expensive 8 inch floppy drive, PerSci was sold in late 1982 to EF Industries, a firm which has acquired other declining computer industry manufacturing operations in the past few years. PerSci's activities now include service and low volume manufacturing of the old PerSci floppy drive line, plus similar functions for discontinued 14 inch rigid disk cartridge lines acquired from other firms.

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

1984 FDD sales: $83,700,000
1984 total net sales: $12,800,000,000 Net income: $448,000,000

Qume's floppy drive operations started in 1979, with a manufacturing license from YE Data. Except for some confusion when the firm reorganized its marketing and manufacturing programs in 1981, Qume has maintained continuous growth in the OEM market -- and received a big boost in 1983 by being selected as a vendor for half high 5.25 inch floppy drives to IBM for the PC Junior. However, Qume's management didn't care for today's floppy drive prices, and is closing down floppy drive manufacturing.

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

1984 FDD sales: $261,200,000
1984 total net sales: $8,792,000,000 Net income: $367,000,000

From the beginning of the OEM flexible disk drive industry, Shugart was always number one in total shipments, but was passed up in 1982 by Tandon Corporation. The firm's growth rate slowed during recent years as the result of several factors: Loss of certain major customers which set up internal manufacturing programs or switched to other suppliers, prolonged technical difficulties in the late 1970's on two sided drives, and failure to achieve early introduction of new floppy drive configurations and features. Shugart's management used entrepreneurial-style rewards for the development and production teams assigned to the company's microfloppy and other projects in order to speed things up, resulting in timely production starts for some new products, including microfloppies. However, the firm's major growth products were half high 5.25 inch floppy drives manufactured on a contract basis by Matsushita Communication Industrial, with declining shipments for several older floppy configurations. In the end, Xerox management decided to stop the bleeding, and most of the Shugart operations were closed down in 1985. U.S. distribution rights to the half high 5.25 inch floppy products were sold to Matsushita. Only 8 inch floppy drives remain in production, but are sinking fast.

TANDON CORPORATION
20320 Prairie Street
Chatsworth, CA 91311

1984 FDD sales: $334,600,000
1984 total net sales: $401,000,000 (FY end 9/84) Net income: $29,400,000

Tandon Corporation started shipment of two sided 5.25 inch floppy drives in 1979, and by 1982 Tandon had also become the world leader in OEM floppy drives by aggressive introduction of new products and development of low cost manufacturing facilities through extensive vertical integration. The firm still makes many of its own heads, and has added motors and subassemblies from related companies in India, while establishing an assembly facility in Singapore. IBM became Tandon's largest (and dominant) customer for floppy drives as the IBM PC grew to prominence, and IBM's purchases have been critical to keeping Tandon's OEM floppy drive revenues higher than any other company's. But with the collapse in floppy drive prices during the last year, even the low cost leader has found it impossible to stay profitable. The company is now scrambling to organize an entry into the IBM compatible personal computer business, starting with distribution in Europe, and is hoping the floppy drive business will provide enough cash to adequately launch the new venture. Tandon's patent on two-sided floppy heads may also help cash flow, as more Japanese companies sign up for licenses following Tandon's enforcement actions in the U.S. federal courts and the ITC.

TANDY CORPORATION
One Tandy Center
Fort Worth, TX 76102 817/390-3700

1984 FDD sales: $73,500,000
1984 total net sales: $2,737,000,000 Net income: $282,000,000

Texas Peripherals was established in 1980, as a joint venture by Tandy and Datapoint Corporation. Production got underway in 1981 for both 5.25 and 8 inch drives, but Datapoint sold its interest in the joint venture to Tandy in late 1982, and the operation was moved to Fort Worth. After producing 5.25 inch drives at high production levels through 1984, the floppy drive operation was phased out in 1985, in view of today's low costs for OEM drives.

VERTIMAG SYSTEMS CORPORATION
2545 West County Road C
Roseville, MN 55113 612/633-7161

For years, perpendicular recording technology has been widely expected to be an important part of the future of magnetic recording, and Vertimag hoped to use it in developing the market for high capacity flexible disk drives. The firm planned to install a continuous sputtering production line with the capability to produce several million diskettes per year. After first indicating that it would also offer drives, Vertimag switched to a strategy of concentrating on making the media for perpendicular recording available, and providing licensing and technical assistance to manufacturers of floppy drives which would be able to upgrade current products to use Vertimag media. Unfortunately, the time-scale required for such missionary activities was beyond that envisioned by the venture capitalists which funded the company, and support was withdrawn in 1985, except for a small staff performing contract research activities.

Asian Manufacturers

(1984 exchange basis used for Japanese companies: 240 Yen = $1)

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

1984 FDD sales: $133,700,000
1984 total net sales: $1,230,263,000 Net income: $54,196,000

Alps Electric is a high-growth manufacturer of electronic components and subassemblies for television, audio, instruments and computer applications. Production of captive 5.25 inch floppy drives for use with Alps systems started several years ago, but has not been emphasized. The firm's big increase in floppy drive shipments came in 1981, with a rapid build-up of shipments to Apple Computer. Alps' shipments of one sided 5.25 inch drives have topped all other floppy drive manufacturers worldwide since 1981. Alps also started shipping 3.5 inch microfloppy drives in mid-1984, and is reported to have been selected by IBM as a microfloppy drive supplier for an unannounced new personal computer. Alps has also anounced a line of 5.25" and 3.5" rigid disk drives.

BROTHER INDUSTRIES
9-35, Horita-dori
Mizuhoku, Nagoya 467
Japan

1984 total net sales: $787,171,000 Net income: $48,150,000

Brother is Japan's largest manufacturer of sewing machines, knitting machines and typewriters, with rapid growth in recent years in printers and other office equipment. Brother has developed a 3.5 inch microfloppy drive, a 1.0 inch high version announced at the 1985 Fall Comdex. First shipments to customers will occur in 1986.

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

1984 FDD sales: $38,100,000
1984 total net sales: $3,459,950,000 Net income: $145,954,000

Canon Electronics produces electronic subassemblies for Canon cameras, as well as other electronic components and systems. One and two sided 5.25 inch floppy drives have been in production since 1979 under a BASF

license, and the firm has added captive and OEM one third high drives of its own design. Canon also developed its own unique microfloppy using a 97 mm disk, but these drives have been dropped, and the firm began shipments of 3.5 inch microfloppies in late 1984. Floppy drives are produced for both captive applications and for sale to the OEM market, both domestic and export.

CHINON INDUSTRIES, INC.
21-17 Takashima 1-chome
Suwa-City, Nagano 392
Japan

1984 FDD sales: $36,200,000
1984 total net sales: $107,508,000 Net income: $4,075,000

Chinon is a manufacturer of cameras and auto radios, with worldwide distribution. Due to decreasing growth in the camera industry, Chinon intends to emphasize its data product lines in the future. The company produces printers as well as floppy disk drives. During 1984, the firm introduced its flexible disk drive product line, consisting of half high 5.25 inch drives and 3.5 inch microfloppies. In 1984, data products accounted for less than 10% of company revenues. Eastman Kodak is a minority shareholder in the firm, holding about 9.4% ownership.

CITIZEN WATCH CO., LTD.
2-1-1, Nishi-Shinjuku
Shinjuku-ku, Tokyo 160
Japan

1984 total net sales: $990,379,000 Net income: $37,838,000

Citizen is steadily expanding its diversification into additional products, from its basic position of strength as Japan's second largest watch manufacturer. Watches are now down to 72% of sales, while machine tools and office equipment are rapidly rising. In addition to printers, displays, and small computers, Citizen introduced 3.5 inch microfloppies in 1984, offering the first one-inch floppy drive and has begun an aggressive sales program in the U.S. and Europe, aimed at the OEM market.

COPAL CO., LTD.
2-16-20, Shimura
Itabashi-ku, Tokyo 174
Japan

1984 total net sales: $217,313,000 Net income: $3,813,000

Starting with camera shutters, still the firm's largest product, Copal has diversified into a wide range of electronic components, photographic equipment, clocks, machine tools and printers. Copal has been involved in contract manufacturing for floppy drives, and announced its own 3.5 inch

microfloppy drives for shipment in early 1985. A line of 5.25" drives is also in production. Fujitsu, Ltd. has a 6.5% ownership position in Copal and has supplied key personnel to assist in joint product development efforts.

FUJITSU LIMITED
6-1, Marunouchi 2-chome
Chiyoda-ku, Tokyo 100
Japan

1984 total net sales: $5,041,129,000 Net income: $277,788,000

Despite its role as Japan's leading computer manufacturer and a major participant in the worldwide market for OEM rigid disk drives, Fujitsu was not a participant in the flexible disk drive industry until 1984, except as a buyer of OEM drives for use with its systems. The firm announced in Japan a 1.6 megabyte half high 5.25 inch floppy drive and followed with 3.5 inch microfloppies. In 1985, marketing of floppy drives began in the U.S., with production to be provided by Copal. Fujitsu and Copal have publicly disclosed work on a 3.3 megabyte drive, but no product announcement has been made in 1985.

GOLD STAR TELE-ELECTRIC CO., LTD.
Kukdong Building, #60-1, Choongmu-Ro 3-Ka
Choong-Ku, Seoul
South Korea

A member of the Lucky-Gold Star Group, one of Korea's major industrial families, Gold Star Tele-Electric is a diversified manufacturer of telecommunication equipment, automation systems and computer peripherals. In an effort to expand beyond existing terminal and printer products, the company markets half high 5.25 inch floppy drives with distribution limited, so far, to Korea. Sales in the U.S. have been delayed due to a lawsuit by Tandon Corporation claiming improper use of Tandon product designs by ex-employees.

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

1984 FDD sales: $79,300,000
1984 total net sales: $18,196,433,000 Net income: $696,308,000

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

floppy standard being promoted by Hitachi, Matsushita Electric Industrial, and Hitachi's magnetic media subsidiary, Maxell. Hitachi has taken something of a leadership role in introducing high capacity flexible disk drives designed to use high density particulate media developed by Maxell, including a 9.6 megabyte 8 inch drive and a 6.5 megabyte 5.25 inch drive. The firm has also made technology announcements concerning vertical recording.

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

1984 total net sales: $328,408,000 Net income: $12,325,000

Janome is one of the world's leaders in consumer and industrial sewing machines, and supplies private label sewing machines to Sears. Due to slow growth in its basic field, Janome has started to expand into such fields as printers and disk drives. In October, 1983, the firm announced a 3 inch OEM microfloppy drive for delivery in mid-1984, and followed up with a 3.5 inch OEM drive in late 1984.

KYOCERA CORPORATION
52-11, Inouecho, Higashino
Yamashinaku, Kyoto 607
Japan

1984 total net sales: $1,046,583,000 Net income: $53,858,000

Kyocera has 70% of the worldwide market for ceramic IC packages, and has launched a broad program of expansion into manufacture of audio equipment, office automation and other electronic equipment. Included in the expansion plans are disk drives, and the firm made its first showing of a 5.25 inch flexible disk drive in 1984 at Hanover Fair. This product was superseded by a 1.0 megabyte 3.5 inch product introduced in 1985. Kyocera has also begun to make 3.5 inch rigid disk drives designed by La Pine Technology.

LUNG HWA ELECTRONICS CO., LTD.
33, Pao-Hsing Road, 5th Floor
Hsin-Tien, Taipei
Taiwan

1984 total net sales: $7,000,000

Established in 1973, Lung Hwa offers 5.25 inch and 3.5 inch floppy disk drives. Most are shipped to the U.S. add-on market for use with home computers. A line of controller cards is also supplied.

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

1984 FDD sales: $76,100,000
1984 total net sales: $1,211,479,000 Net income: $53,858,000

Matsushita Communication Industrial is a member of the Matsushita Electric Industrial group, a worldwide giant in appliances and electronics. MCI manufactured most of the Shugart floppy drive line under license for the Japanese OEM market. MCI later added floppy drives of its own design, including half high 5.25 inch and 3.5 inch microfloppy drives, with high level production now underway at a new plant at Hanamaki. The firm made half high 5.25 inch drives on a contract manufacturing basis for Shugart and in 1985 acquired the rights to market them in the United States. MCI also has major customers for its OEM drives in Japan, including IBM.

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

1984 total net sales: $19,669,475,000 Net income: $993,188,000

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

MITAC, INC
75 Nanking East Road, Section 4
Taipei
Taiwan

Mitac is a ten year old firm which started as an importer and system integrator of U.S. and European computer systems and has evolved into a manufacturer of microcomputers, terminals and flexible disk drives. The firm initially acquired a Shugart license, and has more recently designed its own half high 5.25 inch drive, sold mainly in the personal computer add-on market, but also as an OEM drive.

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

1984 FDD sales: $169,400,000
1984 total net sales: $7,253,163,000 Net income: $161,975,000

Mitsubishi Electric is a leader in the Japanese domestic small business systems market, and one of the country's leading electronic and electrical products manufacturers. Captive 8 inch drives have been used with the firm's Melcom systems for several years, and the firm also participates in the domestic OEM market. A family of half high two sided 5.25 inch drives was introduced in 1982, with capacities up to 2.0 MB. Mitsubishi also started shipping a 3.5 inch microfloppy drive in 1983 and introduced a 2.0 megabyte version in 1985. Production of flexible disk drives has been moved to expanded facilities at Mitsubishi's Koriyama Works.

MITSUMI ELECTRIC CO., LTD.
8-8-2, Kokuryomachi
Chofu-City, Tokyo 182
Japan

1984 FDD sales: $10,000,000
1984 total net sales: $333,863,000 Net income: $12,367,000

Mitsumi is a leading manufacturer of electronic subassemblies and components, including magnetic heads. The firm has a joint venture facility with Commodore, named Newtronics, to produce 5.25 inch and 3.5 inch floppy drives. In 1984 Mitsumi introduced a very low cost 2.8 inch drive using a special Maxell disk under the name "Quick Disk", which uses a single spiral track with 64,000 kilobytes capacity.

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

1984 FDD sales: $373,600,000
1984 total net sales: $7,341,083,000 Net income: $185,708,000

About one fifth of NEC's revenues are generated by computer mainframes, small business systems, minicomputers and desktop systems -- and the firm is a leader in the growing personal computer market. Since 1978 the company has manufactured two sided 8 inch floppy drives, and was one of the earliest firms to offer half high 8 inch drives, with shipments starting in late 1981. Most of NEC's floppy drive shipments have been for captive applications, with total revenues putting the firm in a leadership position in total DISK/TREND revenues. 3.5 inch microfloppy drives and half high 5.25 inch drives were introduced in 1984.

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

1984 total net sales: $1,439,063,000 Net income: $124,129,000

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

ORIENTAL PRECISION COMPANY, LTD.
Tae Wha Building, 11th Floor
194-27 Insa-dong, Chongno-gu
Seoul, Korea

OPC, established in 1953, is a diversified producer of electronic products and systems including terminals, telecommunication products, small computers and radio products. The firm is preparing to manufacture a line of 5.25 inch floppy drives under a license from Teac, and is also licensed by SyQuest to produce a 3.9 inch rigid cartridge drive.

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

1984 FDD sales: $20,200,000
1984 total net sales: $1,964,033,000 Net income: $63,263,000

Copiers, sensitized papers and photographic equipment provide the major part of Ricoh's revenues, but the firm has been investing in the growing line of data processing equipment now manufactured. Since 1979, Ricoh has made 8 inch floppy drives, in both one and two sided versions, originally under a Calcomp manufacturing license. The firm has introduced half high 5.25 inch drive and 3.5 inch microfloppy drives intended for both captive and OEM applications.

SAMSUNG PRECISION INDUSTRIES CO., LTD.
Subsidiary of the Samsung Group
Seoul
South Korea

Shugart granted a license to Samsung in 1983, for manufacturing and marketing the Shugart 5.25 inch floppy drives in South Korea. The firm is currently making only full size drives.

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

1984 FDD sales: $8,400,000
1984 total net sales: $356,017,000 Net income: $2,883,000

Sankyo Seiki is a leading manufacturer of musical movements, industrial robots and a wide variety of small electromechanical components used in cameras, video recorders, timers and other products. Since 1981, the firm has been shipping a spiral track flexible disk drive for word processing, program loading and special industrial applications. Since mid-1983, the company has also been shipping a 3 inch microfloppy, and in mid-1984 added 3.5 inch microfloppies.

SEIKO EPSON CORPORATION
3-5, Owa 3-chome, Suwa-shi
Nagano, 392
Japan

1984 FDD sales: $105,100,000

Seiko Epson is the new name for the privately held Suwa Seikosha/Epson group owned by members of the Hattori family, who also control Japan's Seiko companies active in watches and electronics. Epson is best known for matrix printers, now used worldwide with personal computers. Epson also manufactures line printers, LCD's, paper tape equipment, watch components, and its own portable computer. The first Epson floppy drive was a captive 5.25 inch one third high unit first shipped in 1982 and used with the Epson portable computer. Starting in October, 1983, Epson added an OEM floppy drive product line with a variety of 5.25 and 3.5 inch models, including 3.5 inch drives with very low power requirements. The 5.25 inch drives include both one third high and half high units. At the 1985 Fall Comdex, Seiko Epson showed a 2.5 inch floppy disk drive prototype, with media to be available from Maxell.

SEIKOSHA CO., LTD.
Subsidiary of Hattori Seiko Co., Ltd.
4-1-1, Taihei
Sumida-ku, Tokyo 130
Japan

Seikosha is a diversified manufacturer of clocks, camera shutters, semiconductors, small computers and printers, and a key member of the Seiko group. As part of an expansion in the computer area, Seikosha designed and was preparing to manufacture microfloppy drives using the Dysan 3.25 inch diskette by the end of 1984 -- but was left stranded by collapse of the Dysan/Tabor efforts in the U.S. A 3.5 inch microfloppy was introduced in 1985.

SHINWA CO., LTD.
4-12-17, Yayoi-cho
Nakano-ku, Tokyo 164
Japan

Primarily known for automotive electronics, Shinwa is also manufacturing 5.25 inch and 3.5 inch floppy disk drives. The first shipments of floppy drives began in 1984.

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

1984 FDD sales: $110,000,000
1984 total net sales: $5,319,600,000 Net income: $297,629,000

As it becomes more difficult to meet Sony's growth objectives in the consumer electronics market, several portions of which appear saturated, the firm's management has made it clear that major expansion in office products markets is planned. Among the products announced so far are word processing and personal computer equipment -- both of which use the Sony 3.5 inch microfloppy which has been shipping since late 1981. The drive has also been offered worldwide as an OEM product, with growing success. After initially taking a somewhat stiff posture on granting licenses, Sony demonstrated flexibility in working with the U.S. manufacturers concerned with establishing common standards. The result was agreement on the 3.5 inch media standard by Sony and several U.S. drive and media manufacturers -- and a growing number of Japanese firms rushing to make 3.5 inch microfloppy drives. After a big early boost when Hewlett-Packard selected Sony's drive for a variety of personal computers, there was a two year period of attack from contentious sponsors of rival standards, but the industry consensus on the Sony media standard is now firmly established. Sony's microfloppy drive and media shipments have grown, as Apple chose the drive for its Macintosh system and other systems manufacturers signed on. Sony has actively promoted a 2.0 megabyte, 3.5 inch media standard during 1985, which other Japanese firms have adopted, effectively inhibiting growth of the proposed 1.6 megabyte format. Sony is also an active producer of CD-ROM and write-once optical disk drives.

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

1984 FDD sales: $177,700,000
1984 total net sales: $314,492,000 Net income: $6,808,000

TEAC is a leading manufacturer of consumer and professional audio recorders, but digital recording equipment is a growing portion of the firm's product mix, now accounting for over 70% of total revenues.

Shipments of 5.25 inch floppies for the worldwide OEM market started in 1978, and rapid growth has boosted TEAC to the second place position in worldwide OEM floppy drive revenues. Major products today are half high 5.25 inch drives, plus 3.0 and 3.5 inch microfloppy drives. In 1985, Teac announced a line of high capacity 3.5 inch products including a 2.0 megabyte model, plus one inch high models offering capacities up to one megabyte.

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

1984 FDD sales: $41,200,000
1984 total net sales: $593,271,000 Net income: $18,063,000

Tokyo Electric is a member of the Toshiba group, and manufactures electronic cash registers, POS systems, lighting fixtures, household appliances, and a growing family of data processing products. The firm makes 5.25 inch floppy drives for the worldwide OEM market, with half high models added late in 1982. The company also added late in 1982 a small spiral track drive using 66 mm flexible disks, plus 3.5 inch microfloppy drives in early 1984.

TOKYO JUKI INDUSTRIAL CO., LTD.
1-23-3, Kabuki-cho
Shinjuku-ku, Tokyo 160
Japan

1984 total net sales: $351,288,000 Net income: $2,071,000

Tokyo Juki is Japan's largest manufacturer of industrial sewing machines and offers a broad line of electric appliances, home sewing machines and typewriters. After an attempted diversification into computer peripherals and introduction of 3.5 inch microfloppy drives in 1984, the firm decided to withdraw from the market.

TOSHIBA CORPORATION
1-1-1, Shibaura
Minato-ku, Tokyo 105
Japan

1984 FDD sales: $95,800,000
1984 total net sales: $11,278,792,000 Net income: $245,850,000

Toshiba is one of Japan's major diversified electric and electronics manufacturers, with products ranging from heavy electric machinery to home electric appliances and communications equipment. Toshiba has a major share of the Japanese minicomputer and small business system markets. 8 inch floppy drives for both captive and OEM markets have been produced

since 1977, and the product line now consists of both 8 and 5.25 inch drives. Half high two sided 5.25 inch drives were added in 1982, with the more recent addition of both 3.0 and 3.5 inch microfloppy drives. Toshiba has actively promoted advanced technology, including optical drives. High capacity barium ferrite media has been proposed by the firm for 4 megabyte 3.5 inch floppy drives, which have been announced only on a preliminary basis.

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

1983 total net sales: $2,721,946,000 Net income: $96,708,000

JVC's revenues are generated mostly by consumer electronics products; the firm has been the beneficiary of sharp growth in home video tape recorder shipments, and VTRs account for almost 70% of total revenues. JVC is now expanding into computer peripherals, with 3.5 inch Winchester and flexible disk drives among its first products in the field. Half high 5.25 inch drives were first shipped in mid-1984 and the firm began shipping 3.5 inch microfloppies in early 1985.

VIDEO TECHNOLOGY, LTD.
23/F, Tai Ping Ind. Centre, Blk.1, Lot No. 1637
Ting Kok Road, Nam Hang
Tai Po, N.T.
Hong Kong

Video Technology is an eight year old Hong Kong firm active in manufacture of consumer electronics, personal computers and computer peripherals. The firm is now making half high 5.25 inch floppy drives which are marketed as OEM and add-on drives in the personal computer market.

WELTEC DIGITAL, INC.
Subsidiary of Wearnes Brothers
2991 E. White Star Avenue
Anaheim, CA 92806

The Remex flexible disk drive operation was sold to a group controlled by Wearnes Brothers, Singapore manufacturers of electronics products, in mid-1984. All manufacturing is now in Singapore, with marketing responsibility still maintained at the old Remex Anaheim location. Products are 5.25 inch drives.

WONG'S TECHNOLOGY, LTD.
Subsidiary of Wong's Industrial (Holdings) Ltd.
Sime Darby Industrial Building
8/F, 420 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong

1984 FDD sales: $19,000,000

The Wong's Group is a major Hong Kong manufacturer of printed circuit boards and assembler of electronic products. The origins of this floppy drive manufacturing organization go back to the mid-1970s, in the form of Orbis and General Systems International, pioneer makers of OEM floppy drives. Both firms' product lines eventually ended up under Siemens ownership, and then were sold to World Storage Technology. In late 1983 Wong acquired complete ownership of World Storage Technology from other investors, and in the second half of 1984 completed moving manufacturing and engineering from California to Hong Kong. Only sales responsibility is now retained in the U.S. The products are 5.25 inch single and double sided drives.

YE DATA, INC.
Subsidiary of Yaskawa Electric Mfg. Co., Ltd.
60, 1-1, Higashi-Ikebukuro 3-chome
Toshima-ku, Tokyo 170

1984 FDD sales: $105,900,000
1984 total net sales: $530,096,000 Net income: $6,292,000

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

European Manufacturers (Exchange basis indicated for each firm)

BASF AG
D-6700 Ludwigshafen
West Germany

1984 FDD sales: $40,900,000
(Basis: DM 280 = U.S.$1)

BASF no longer markets floppy drives in the U.S., but continues with both 8 and 5.25 inch drives produced in Germany. The company first manufactured 8 inch one side drives in 1976, using rights to designs originated by GSI. 8 inch two sided drives were added in 1978, as were one and two sided 5.25 inch drives. BASF pioneered the two thirds high 5.25 inch drive, which has achieved major market share only in the European market, and in 1983 added one third high 5.25 inch drives which are obtained from Canon on a contract manufacturing basis.

DATA TRACK TECHNOLOGY LIMITED
7 Queensway, New Milton
Hampshire BH25 5NN
England

Data Track Technology initiated production in mid-1983 of a 5.25 inch flexible disk drive using a single stepping motor to position heads on two diskettes. This firm was formerly the UK distributor for comparable drives manufactured a few years ago by T & E Engineering, a California company which sold its product design to Digital Equipment Corporation. Data Track has stopped floppy drive production, unable to compete with current prices for floppy drives from Asia.

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

In July, 1981, Elcomatic acquired the 8 inch flexible disk product line of MFE. These drives had been manufactured mostly in a two sided version at plants in Salem, Massachusetts, and in Livingston, Scotland. Elcomatic moved manufacturing to a Glasgow plant and is continuing with plans to develop the European OEM market for 8 inch two sided floppy drives. The firm has announced a 96 TPI version of its 8 inch drives, plus half high 5.25 inch drives.

INSTRUMENTATION AND AUTOMATION
Boulevard Cherni Vrah, 57
1113 Sofia
Bulgaria

Instrumentation and Automation has the charter from the Bulgarian government to develop personal computers and appropriate peripherals, and to establish high volume manufacturing facilities, in order to facilitate usage throughout the country. With assistance from ISOT, plus acquisition of tooling from outside countries, the organization is starting production of 5.25 inch flexible disk drives this year.

ISOT
51, Chapaev St.
1113 Sofia 49
Bulgaria

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

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

Metrimpex, the Hungarian trading company for electronic instruments, introduced in 1982 a microfloppy drive manufactured by Budapesti Radiotechnikai Gyar, the "Budapest Radio Works". This drive used 72 mm flexible disks in a rigid plastic cartridge, with recording at 100 TPI and 6250 BPI, offering a capacity of 200 KBytes. BRG's manufacturing start up for this drive suffered delays, and the program was abandoned after Sony's 3.5 inch format became the world standard.

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

1984 FDD sales: $136,900,000
(Basis: L 1800 = U.S.$1)

Olivetti has made many changes in the last few years. In order to stay competitive in the rapidly changing office equipment market, investments have been made in a long list of high technology growth firms, and older

Olivetti products have been discontinued. In 1980, Olivetti Peripheral Equipment was established as a consolidation of the firm's printer and disk memory activities. OPE now makes 5.25 inch Winchesters plus 8, 5.25, and 3.5 inch floppy drives at Ivrea, for OEM markets as well as the firm's established captive requirements. During 1984 and 1985, Olivetti has been engaged in a major build up of production for AT&T, its new major customer and part owner.

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

1984 FDD sales: $41,200,000

Although Philips' computer industry revenues contribute less than 5% of total company revenues, the firm's minicomputer, terminal and office computer products are sold throughout Europe. The company has found it difficult to maintain profitable operations in the disk drive business, however. A few years ago it phased out production of rigid disk drives, which were manufactured in Holland for several years, and in 1985 closed down its floppy drive program in Germany.

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

The Robotron group is the East German organization responsible for manufacture of computing and office equipment, communication equipment, electronic instruments and consumer electronics devices. The Robotron facility for peripheral equipment initiated manufacture of 5.25 inch one sided floppy drives during 1984, after several years of buying similar drives from outside sources for Robotron equipment.

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

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