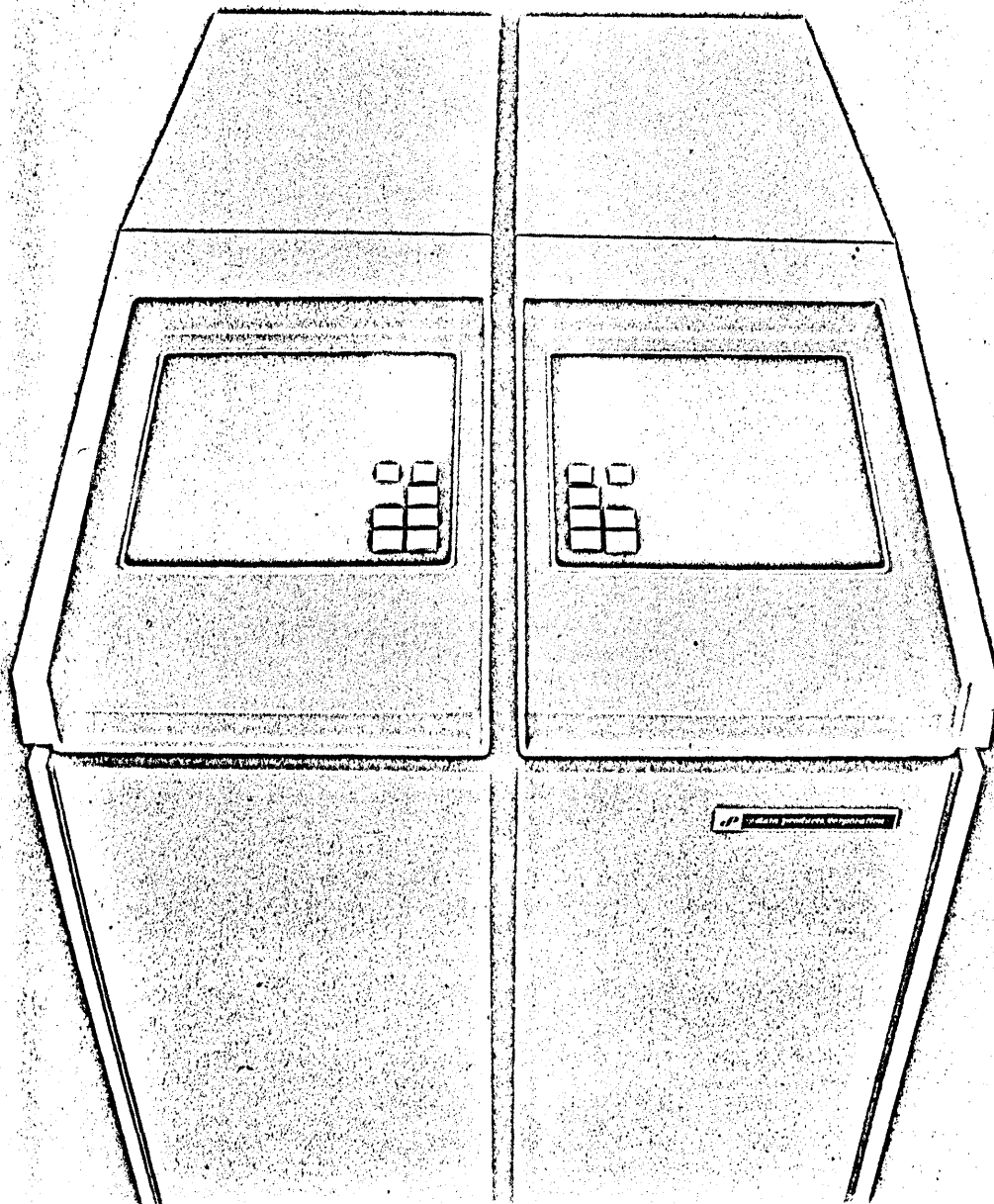


LARGE DISC STORE

6040 DISCFILE

DATA PRODUCTS
Disk Storage Division



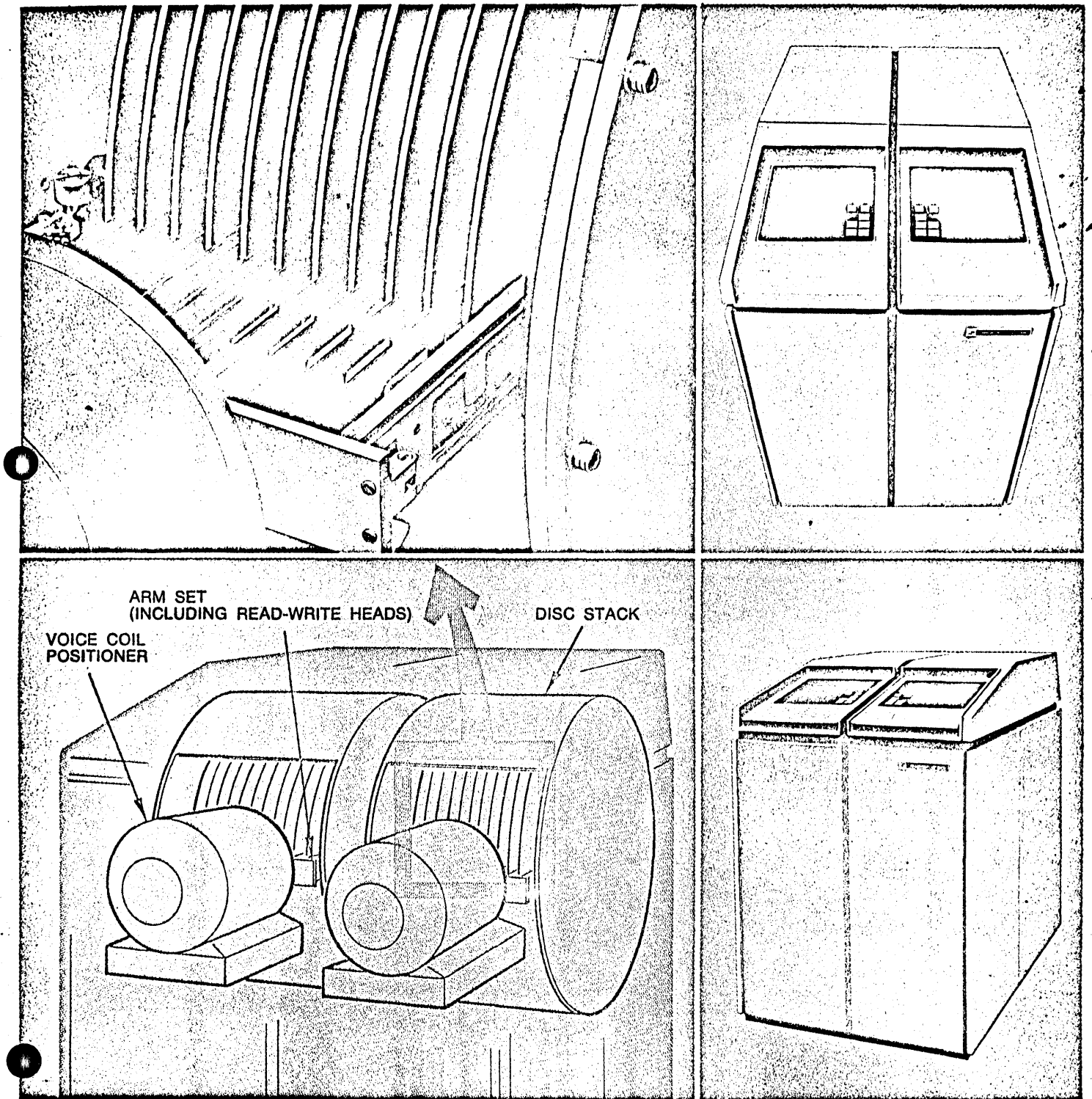


FIGURE 1. 8040 DISCFILE PHYSICAL ARRANGEMENT

INTRODUCTION

The latest Data Products Corporation direct access storage facility — the 6040 DISCFILE — is specifically designed to provide high capacity at a low cost per bit with rapid access times. The characteristics of this storage system are especially suitable where large amounts of data are desired on line. It provides 250 million bytes of direct access storage at approximately one-half the cost of removable pack drives.

The 6040 provides the following features:

- Magnetic card storage prices
- 250 million byte (2×10^9 bits) capacity
- Voice coil positioner — 60 ms average seek time
- IBM 2314 disc drive compatibility
- Independently serviceable positioner modules
- Dual channel option for operation with two computers
- Parallel head read/write option for improved transfer rates
- Fixed head option for immediate access
- Low floor space requirement (13 ft²)
- Expandable capacity to eight 6040's or 2,000 million bytes (16×10^9 bits)

FUNCTIONAL DESCRIPTION

The Data Products 6040 DISCFILE contains two independently addressable positioner modules (PM's), each accessing data from its own disc set. Each of the two disc sets is mounted on its own horizontal spindle driven by an individual belt coupled motor. The positioner module contains a SERVO/LOC positioner which drives a comb-type arm assembly containing 40 read/write heads. The physical arrangement is shown in Figure 1.

Average seek time is 60 milliseconds, with a cylinder to cylinder seek time of 10 milliseconds and a full stroke seek time of 100 milliseconds. Latency varies from nil to 34 milliseconds with an average of 17 milliseconds.

Each servo locked position forms a 40 track cylinder. There are 406 cylinders per positioner module or 812 per DISCFILE. With 7800 bytes (62,400 bits) per track available, the storage capacity becomes 250 million bytes (2×10^9 bits). This figure does not include 12 spare tracks per surface (3 per 200 track zone) which provide alternate data areas should any bad spots be found on the disc surface. As an option, a two frequency format can be supplied in which the outer half of the disc is recorded at a higher frequency than the inner, providing increased bits per track. This option yields a 291 million byte (2.33×10^9 bits) capacity. In addition, up to 60 fixed heads can be added as an option. These heads fly over the inside control disc and provide access without seek time to approximately 4 million extra bits of data.

The amount of the 6040's storage capacity which is usable for data is a function of the format selected and the record length of the stored data. Either the variable length record format of the IBM System 360 or the fixed length record format of

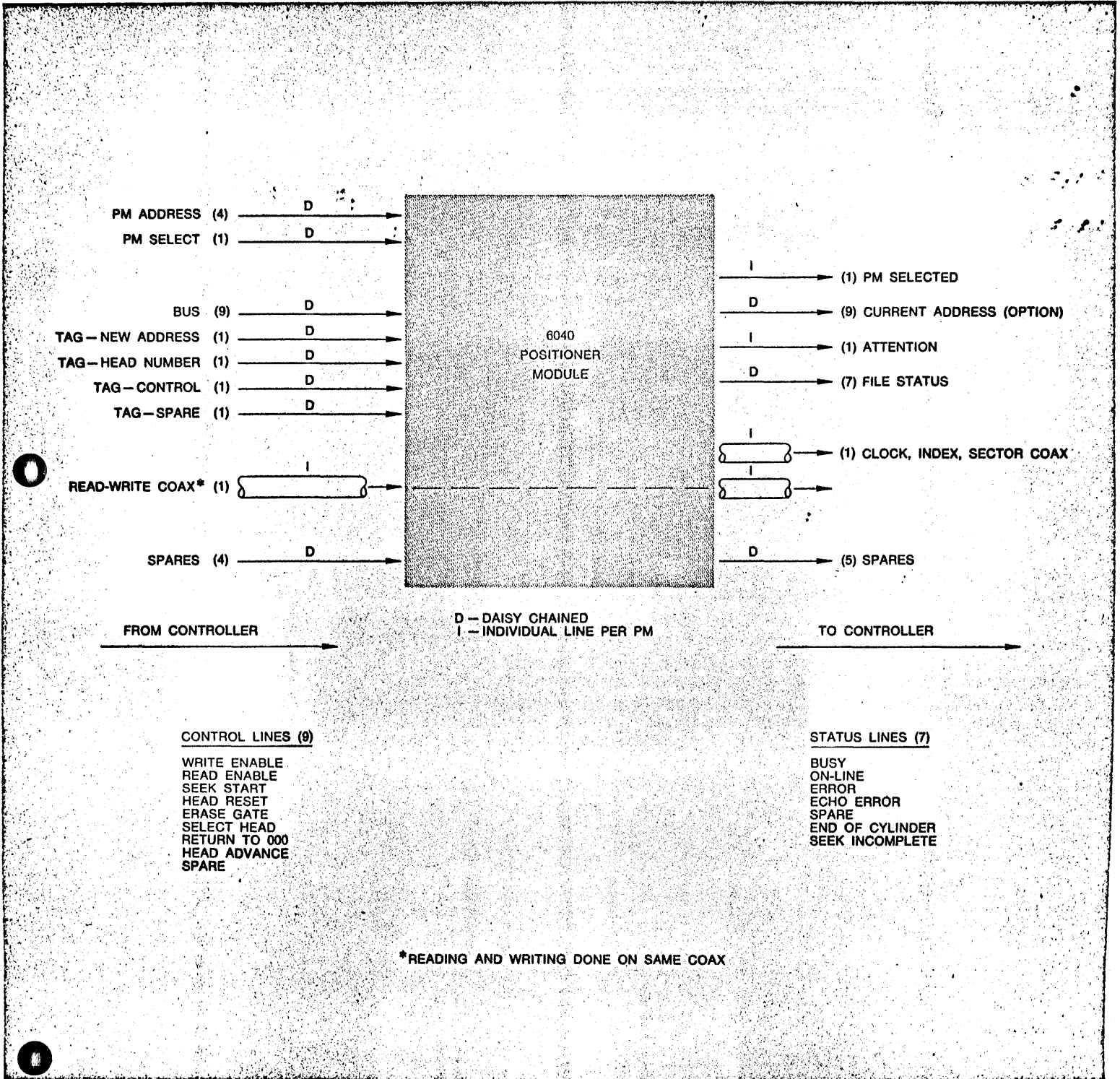


FIGURE 2. POSITIONER MODULE INTERFACE

prior Data Products DISCFILES may be specified. When the variable length format is used, the 6040 is compatible with the IBM 2314 disc drive. When using fixed length records, formatting logic in the controller can be simplified by using permanently recorded sector marks to control the record format.

The 24-inch discs spin at 1800 rpm, which at 1800 bpi on the innermost track, yields a 1.875 megahz transfer rate under the standard format. Under the two frequency format the inner zone transfer rate remains at 1.875 megahz, but the outer zone transfer rate increases to 2.25 megahz. Data Products also offers two other options which increase transfer rate. These are a dual channel option and an option of providing 2, 4, 5, 8 or 10 heads operating in parallel.

The dual channel option allows selection of each PM by either one of two channels for operation with two computers. In this case, two sets of interface electronics and a switch are provided with each PM. A method of reserving a particular PM is provided to prevent its selection by more than one channel.

Another means of increasing transfer rate is provided by the parallel head option. This option allows either a simultaneous read or a simultaneous write by 2, 4, 5, 8 or 10 heads in the same cylinder operating in parallel. The effective transfer rate is increased thereby by a factor of the number of channels in use.

INTERFACE

The interface described herein is the interface to the 6040 DISCFILE itself, and is designed to provide a means for carrying out the two basic functions of any disc file — the seek and the read/write. Each 6040 positioner module (PM) contains the interface electronics necessary for it to operate independently of all other positioner modules. The interface to each PM is similar in concept to the interface to the IBM 2314 disc drive unit.

There are two general kinds of signal line arrangements, individual lines to each PM and lines which are daisy chained to each PM. In the standard configuration, there are four individual lines: a read/write coaxial cable, a clock coaxial cable, a line to indicate that a positioner module has been selected, and an attention line which indicates that a PM is ready to receive another command.

The balance of the lines are daisy chained among the positioner modules and consist of 22 input lines and 22 output lines per module. Nine of the input lines represent a bus which is time-shared by the new cylinder address, head address, and control functions depending on which of the tag lines is high. A cluster of up to 8 6040's (16 PM's) can be connected to this bus to provide 2,000 million bytes (16×10^9 bits) capacity. A summary of the various input and output signals to each positioner module is contained in Figure 2. A typical DISCFILE cluster is shown in Figure 3.

RELIABILITY

As previously discussed, the 6040 has been designed for very large capacity, on line applications. While there are a number of important characteristics which determine

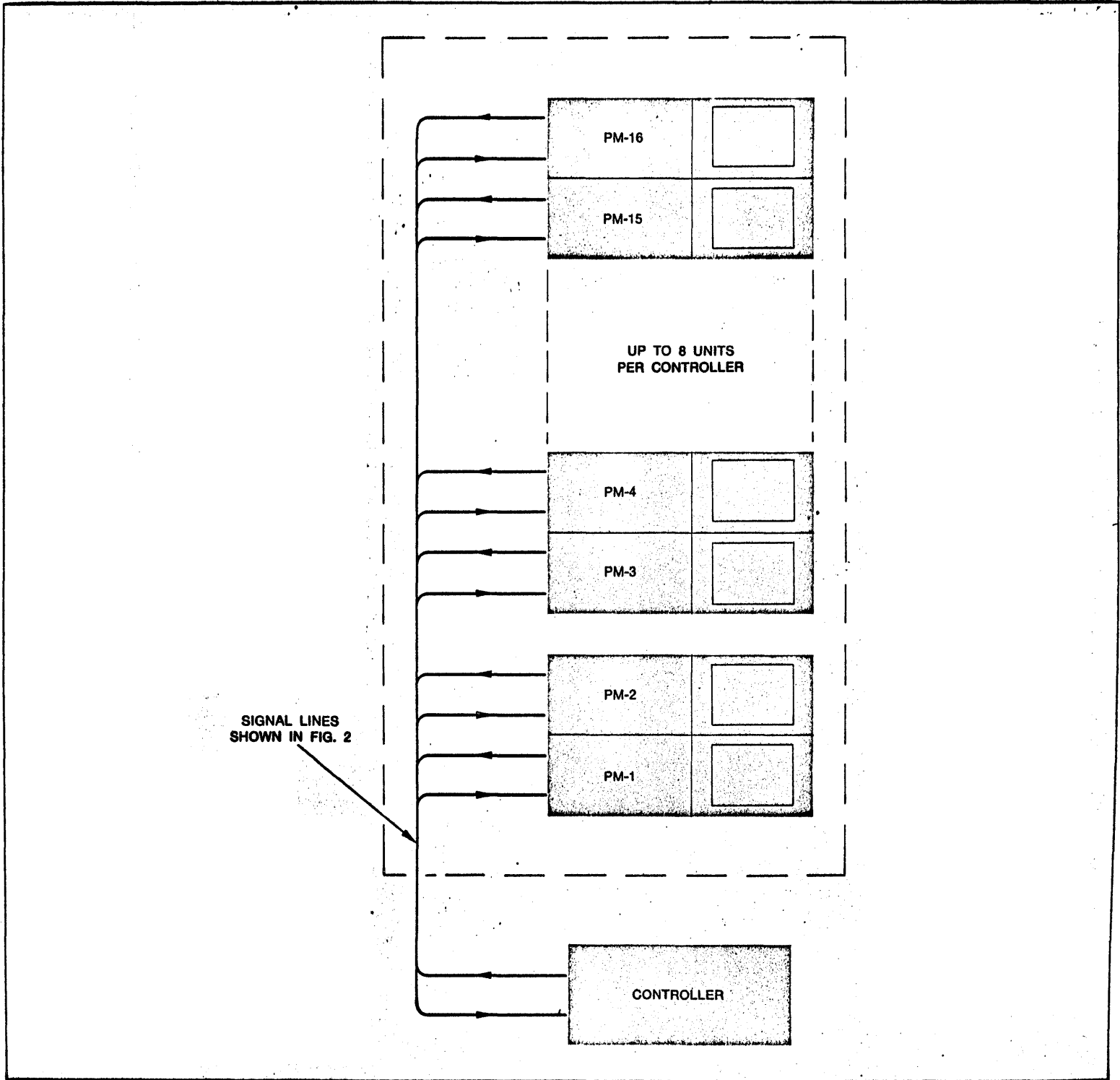


FIGURE 3. TYPICAL 6040 DISCFILE CLUSTER ARRANGEMENT

the effectiveness of a DISCFILE in a particular system (access time, transfer rate, capacity, etc.), the design of the 6040 was predicated on the most important characteristic being operational reliability. It is apparent that downtime overwhelms other considerations in determining how much a system costs. Hence, **reliability has been the major design goal of the 6040 since inception of the project.**

Improved reliability and reduced maintenance are provided:

- **By utilizing proven components which have a low failure rate**
- **By keeping discs and heads free from contamination**
- **By maintaining uniform temperatures in the DISCFILE**
- **By utilizing IC digital electronics throughout**
- **By incorporating protective features into the design**
- **By providing self-monitoring devices in the file**
- **By a modular design which allows adjacent modules to remain on line if a failure should occur in a particular positioner module**
- **By easy access, and fast, accurate removal and replacement procedures**
- **By providing means of preventive maintenance which minimize downtime**
- **By thorough testing of all units and subassemblies prior to shipment**

These characteristics are discussed more fully in the following paragraphs.

Key to having a reliable DISCFILE is having reliable components. Data Products has followed the philosophy of developing its own components and has utilized these components in its line of DISCFILES over the past eight years. The 6040 is the first of a family of files which will be based on the latest evolution of Data Products head, disc, and positioner technology. Special care has gone into the design of the positioner to make it as free as possible from mechanical intricacies which would promote wear. The only parts subject to mechanical wear are the two carriage bearings and the brushes. An optical transducer and a servo system have been used to provide a positioning reference, and, hence, no mechanical detent is required. More detail on the components is contained in the next section.

Another step in providing reliable operation is the special treatment given air around the discs in order to keep it free from contamination. The disc air remains inside the shroud, occasionally passing through a shunt filter as it is circulated by the rotation of the discs. The shroud prevents entrance of contamination from outside and the filter prevents circulation of any internally generated contaminate. The outside air is circulated over the shroud, cooling the inside air. Additionally, a thermal servo system is provided in each positioner module. This system maintains a constant temperature in the disc and shroud area, thereby, minimizing distortions due to uneven heating and cooling.

In the electronics area a major effort was undertaken to reduce the number of components consistent with operational design requirements. Solid state IC switching

is utilized throughout. Write drivers and preamplifiers are located in the movable arms near the head to minimize noise and line losses.

The DISCFILE also has a number of protective features incorporated into its design. Among these, for example, is a feature which automatically retracts the heads should a power failure occur, a circuit which stops the positioner motor in case of track overshoot, and several circuits which ensure that the proper read/write sequence is followed. In addition to protective features there are a number of monitoring and alarm features. For example, there are low and high temperature alarms, an air flow alarm, and a positioner bearing wear indicator. These various monitoring and protective features allow the operator time to transfer data to an alternate area before this data is disturbed because of a failure.

The story of reliability is only partly told by describing the design features incorporated and testing undertaken to prevent failures. Another aspect is the system impairment caused should a failure occur. Data Products has minimized system degradation by designing the 6040 DISCFILE modularly. Each positioner module is a unique device with its own disc stack, positioner, power supply, drive motor, and electronics. Hence, a component failure in one positioner module has no effect on adjacent modules. This modular approach has been followed down to the component level. The arms of the positioner can be swung free of the DISCFILE, allowing head servicing or replacement without shutting down the rotating assembly. In fact, an entire positioner assembly can be replaced in the field without shutting the drive motor off.

Any of the discs in the set can be replaced in about 20 minutes, thereby minimizing the time that the rotating assembly need be off line should a disc failure occur. Appropriate handling devices are provided to help remove and replace discs.

Closely associated with reliability is maintenance. The challenge is to provide sufficient preventive maintenance techniques to assure long life, but at the same time to keep system downtime due to maintenance as low as possible. Maintenance aspects of the 6040 were designed under these criteria.

For example, component access is convenient. Rail mounted electronics are hinged so that all circuit boards are accessible. The bulk of the electronics is located in the lower part of the cabinet — isolated from the controlled environment of the heads and discs previously described. The comb-type arm assembly of each positioner can swing free of its disc set for head servicing even during disc rotation. This feature permits head cleaning, the prime system maintenance operation, to be carried out as required without system shutdown.

The preceding paragraphs have described the major design decisions made to effect a reliable DISCFILE. In addition, each unit undergoes extensive testing prior to shipment. All critical parts are manufactured in a clean room. Each part is inspected and tested by precise optical and electrical devices. Then, each major assembly is thoroughly tested prior to its incorporation in the system. The system then undergoes another reliability test before shipment. Field computational conditions are simulated by randomizing data patterns and addresses, and no unrecoverable errors are allowed.

THE COMPONENTS

The SERVO/LOC Positioner

The SERVO/LOC Positioner is a moving coil type device driven by a closed loop servo system. This positioner drives the arm set assembly rapidly and precisely to the addressed location.

A patented variation of the moving coil principal allows development of a very rapid acceleration coupled with a long stroke length. The movement of the positioner itself is controlled by a damped servo system which continually compares the new address with the track count, producing a velocity curve along which the positioner travels. The system will position the head within 50 micro-inches of the desired track center with no oscillation, and will travel its full three-inch stroke in 100 milliseconds.

The carriage which moves the arm assembly rides on bearings. These bearings and the brushes are the only parts of the positioner which are subject to mechanical wear. Because of the nature of the servo system described above, no mechanical detent is required to lock the positioner into its final position.

THE DISCS

The discs used in the 6040 are the latest of an evolutionary series of discs developed at Data Products. The entire manufacturing process is done in-house using the know-how and technology derived from eight years of producing discs for Data Products' 5000 series files. First the aluminum blank is machined to a mirror-like finish; then it is cleaned, anodized, cleaned, coated, baked, honed, polished, cleaned, edged, and tested. The entire disc surface is tested with specially engineered equipment, and no more than 3 bad spots in any 203 track half-zone are allowed.

This process results in a disc whose hard coating is corrosion resistant and very tolerant of mechanical abuse. Contact between the heads and discs can occur at operating speeds without damaging the disc surface.

THE ARM SET

The arm set consists of a comb-like structure of 11 arms with 40 heads mounted on a support plate attached to the positioner. The arm set contains the heads, the read/write preamplifiers, the write drivers, the head matrix, and the multiplexers and demultiplexers.

The head contains a 5 mil wide erase gap positioned 20 mils in front of the 5 mil wide read/write gap. (The erase gap structure causes more fringing than occurs at the read/write gap, thus effecting a wide erase.) The head uses a cylindrical ceramic pad and flies at 120 micro-inches from the surface of the disc. The design objective of this head technology will allow significant future advances in both track density and bit density.

The heads are landed by a spring arrangement actuated by a simple interposer. As previously mentioned, the arm set is designed for ease of maintenance. The assembly pivots near the end of the carriage rails, allowing the arms to be swung clear of the discs and the heads retracted during disc rotation.

OPTIONS

The 6040 DISCFILE can be purchased with a number of options to improve flexibility and performance.

Two Frequency Format

As previously described, the disc surface can be divided into two zones with the outer zone operating at 2.25 mhz and the inner zone at the standard 1.875 mhz, thereby achieving a larger storage capacity and a faster transfer rate than is available in the standard unit.

Fixed Head Array

Up to 30 fixed heads (3 arms) can be furnished with each positioner module. Under the standard format, up to 3,750,000 extra bits of data can be accessed immediately.

Dual Channel Interface

Two sets of interface electronics are provided at each positioner module for operation from two computers.

Parallel Heads

2, 4, 5, 8, or 10 heads operating in parallel can be provided for each positioner module. The effective transfer rate becomes the product of the number of heads in parallel and the standard transfer rate.

Data Discrimination In File

The standard configuration is for discrimination to be provided in the controller. This option provides for discrimination in the file and the transmission of data in two separate lines for zeros and ones.

Transmission of Positioner Current Address to Controller

With this option the current address is transmitted on a set of spare interface lines to the controller.

Write Lock Out

This feature prevents a write operation on a zone which has been selected to have constant data.

SUMMARY OF SYSTEMS CHARACTERISTICS

CLUSTER ORGANIZATION

Positioner Modules Per 6040 DISCFILE	2
6040 DISCFILE Per Cluster	1 to 8

6040 DISCFILE ORGANIZATION

Positioner Modules Per 6040 DISCFILE	2
Disc Sets Per Positioner Module	1
Discs Per Disc Set	10 data discs 1 control disc

POSITIONER MODULE ORGANIZATION

Cylinders Per Positioner	406
Data Tracks Per Cylinder	40
Heads Per Disc Surface	2
Frequency Zones	1 or 2
Clock Heads	1 or 2

TRANSFER RATE

Single-Frequency Format	1,875,000 bits per sec.
Two-Frequency Format	
Inner Zone	same-as-Single-Frequency
Outer Zone	2,250,000 bits per sec.

DATA ORGANIZATION

<i>Track Capacities</i>	
Single-Frequency Format	7800 bytes (62,400 bits)
Two-Frequency Format	
Inner Zone	same as Single-Frequency
Outer Zone	9375 bytes (75,000 bits)

CYLINDER CAPACITIES

<i>Bytes Per Cylinder</i>	
Single-Frequency Format	312,000 bytes (2.496 x 10 ⁶ bits)
Two-Frequency Format	343,500 bytes (2.748 x 10 ⁶ bits)

FIXED-HEAD OPTION

Fixed-Heads Per Positioner Module Up To	30
Fixed-Heads Per 6040 Up to	60
Capacity Per 6040	
Single-Frequency Format	468,000 bytes (3.744 x 10 ⁶ bits)
Two-Frequency Format	515,250 bytes (4.122 x 10 ⁶ bits)

CAPACITY (Standard Configuration)

Bytes Per 6040 DISCFILE	250 million (2 x 10 ⁹ bits)
Bytes Per 6040 DISCFILE Cluster	2,000 million (16 x 10 ⁹ bits)

DISC ROTATIONAL SPEED

At 50 to 60 hz	1800 rpm
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ACCESS TIMES

<i>Servo/Loc Positioner Seek Time</i>	
Cylinder to Cylinder	10 msec
Full Stroke	100 msec
Random Average	60 msec
Random Average Within 203 Tracks	40 msec
<i>Latency</i>	
Minimum	nil
Maximum	34 msec
Average	17 msec

ENVIRONMENTAL

Operating Temperature	60°F (15°C) to 90°F (32°C)
Operating Relative Humidity	10% to 80% non-condensing
Storage Temperature	-20°F (-28°C) to 150°F (65°C)
Storage Relative Humidity	98% maximum non-condensing

POWER DISCFILE

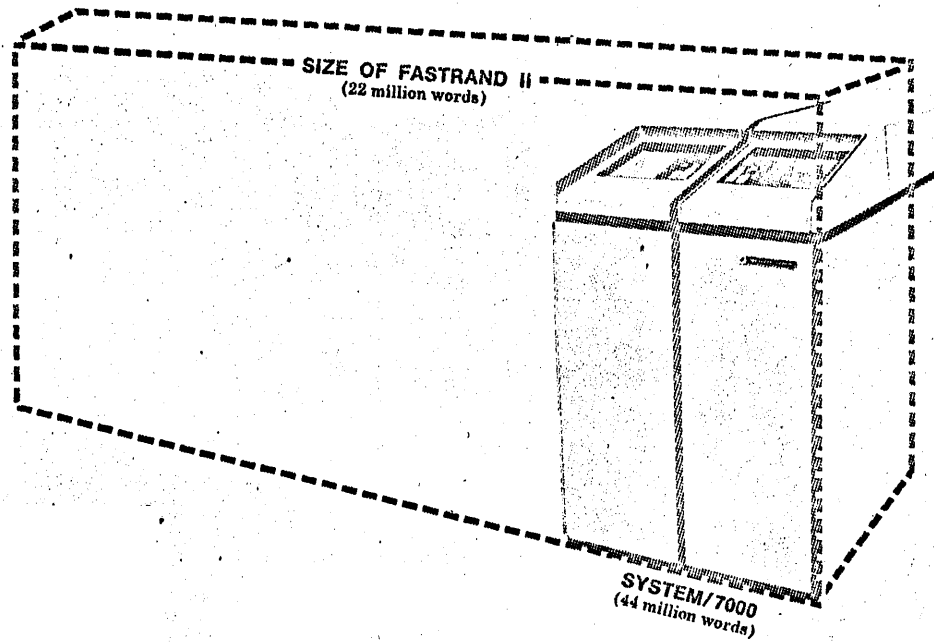
<i>Input Power</i>	
Voltage	208,230 or 380 + 10% VAC
Frequency	50 or 60 hz ± 1 hz
Phase	3
Power Dissipation	6 KW maximum

SIZE OF DISCFILE CABINET

Depth	53 inches
Width	35 inches
Height	53 inches

WEIGHT OF DISCFILE

1,300 pounds



**You'll know our large disc store is different.
Your 1108 computer won't.**

**System/7000
Large Disc Store
Model 7114
Data Sheet**

528 milchav 316,400 purchase 7,425/mo = 4 Fastrand Dual Controller

Total Compatibility with Univac Fastrand II. Your Univac 1108 computer can't tell the difference. Our Model 7114 disc store is totally compatible with the Fastrand II drum file. Record format is the same. Everything else, as far as your computer is concerned, is the same.

But it's Smaller and Faster. Data Products made the 7114 physically different, though. In ways that you'll know and appreciate. Like size. Our Large Disc Store (LDS) measures 53 x 53 x 35 inches. That's less than half the size of a Fastrand II. And there's speed: our LDS has a minimum access time of 10 milliseconds. That's three

times faster. And its average latency time is twice as fast as the Fastrand II.

A Third the Cost per Bit. Our 7114 stores 44 million words, as compared to 22 million words for the Fastrand II. You get twice the amount of storage at an average savings of 35 per cent.

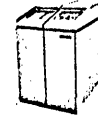
DATA PRODUCTS
systems division

System/7000 Large Disc Store
 Model 7114
 System Characteristics

Characteristics

Fastrand II

Data Products 7114



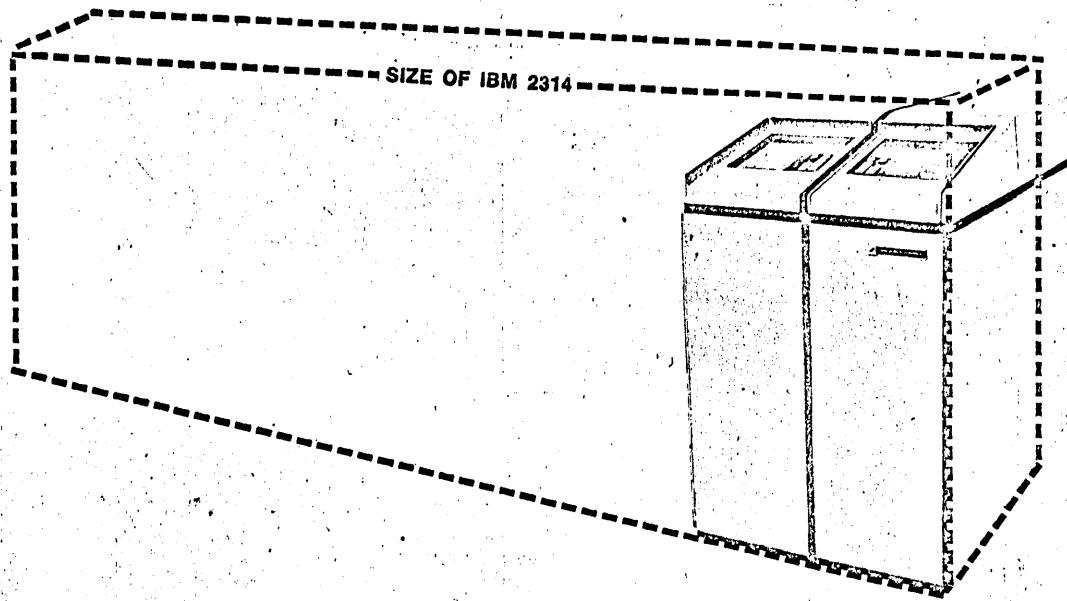
Drums/Discs per Unit	2	2
Positioning Modules per File	1	2
Tracks per Unit	12,288	24,576
Sectors per Track	64	64*
Words (36-Bit) per Sector	28	28
Words per Track	1,792	1,792*
Read/Write Heads	64	40
Tracks per Read/Write Head	192	203
Sectors per Positioner	4,096	4,096*
Words/Unit	22,020,196	44,040,392
Transfer Rate	158KC	262KC 312 KBS
Rotational Speed	880 RPM	1800 RPM
Access Time		
Minimum	30	10
Average	57	60
Maximum	86	100
Latency Time		
Minimum	0	0
Average	35	17
Maximum	70	34
Environmental Conditions		
Operating Temperature	60°→79°F	60°→90°F
Operating Relative Humidity	10→80%	10→80%
Storage Unit (in inches)		
Height	63 3/4	53
Width	121 1/2	35
Depth	32 1/2	53
Weight	5450 lbs.	1300 lbs.

* Equivalent

DATA PRODUCTS
 systems division

6219 DeSoto Avenue / Woodland Hills, California 91364 / Telephone: (213) 887-8000 / Telex 674-734





**You'll know our large disc store is different.
Your System/360 computer won't.**

**System/700
Large Disc Store
Model 7314
Data Sheet**

Total Compatibility with IBM 2314 Disc Drive. Your System/360 computer can't tell the difference. Our Model 7314 disc store is totally compatible with the 2314. Capacity is the same: 2 billion bits. Record format is the same: variable length. Everything else, as far as your computer is concerned, is the same.

But it's Much Smaller. Data Products made the 7314 different, though. In ways that you'll know and appreciate. Like size. Our Large Disc Store (LDS) is 53 x 53 x 35 inches. That's about a third the size of an IBM 2314 with the same 2 billion-bit-capacity.

And it Costs Less. Much, much less, as a matter of fact. A four-unit 7000 system runs less than half the cost of 2314s. And because the 7000 is so small, you pay less for floor space in your computer installation.

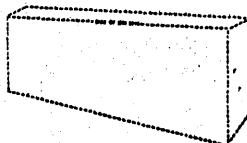
DATA PRODUCTS
systems division

System 7000 Large Disc Store
 Model 7314
 System Characteristics

Characteristics

IBM 2314

Data Products 7314



Positioning Modules Per System	8	2
Disc Sets Per Positioning Module	10 Data 1 Control	10 Data 1 Control
Cylinders Per Positioning Module	203	406
Data Tracks Per Cylinder	20	40
Heads Per Surface	1	2
Zones Per Surface	1	2
Heads Per Zone	1	1
Track Capacity (Bytes)	7,294	7,294
Cylinder Capacity (Bytes)	145,880	291,760
Positioning Module Capacity (Bytes)*	29,176,000	116,704,000
Subsystem Capacity (Bytes)	232,408,000	232,408,000
Transfer Rate	312KBS	234KBS
Disc Rotational Speed	2400 RPM	1800 RPM
Access Times		
Cylinder to Cylinder	25 ms	10 ms
Full Stroke	130 ms	100 ms
Average	60 ms	60 ms
Average within 203 Tracks	60 ms	40 ms
Latency Time		
Minimum	0	0
Average	12.5	17
Maximum	25	34
Environmental Conditions		
Operating Temperature	60° → 90°F	60° → 90°F
Operating Relative Humidity	8 → 80%	10 → 80%
Size (in inches)		
Cabinet		
Depth	31 3/4	53
Width	112	35
Height	57	53

* One 7314 positioning module is equivalent to four 2314 modules.

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