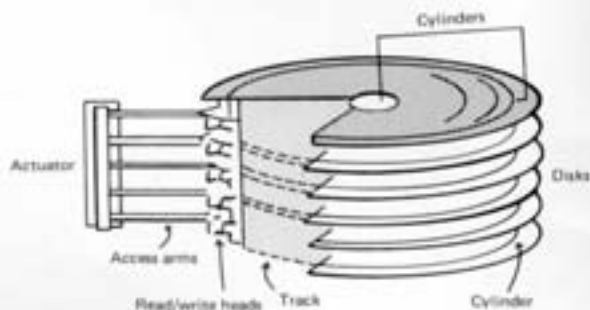


**IBM  
Direct Access  
Storage Devices  
and Control Units**

**3310, 3330/3333,  
3340/3344, 3350,  
3370, 3375, 3380,  
3830 and 3880**

**Facts  
Folder**





**Seek time:** Time to move head to desired cylinder

**Rotational delay:** Time to rotate track (disk) to where head can start data transfer

**Average rotational delay:** Time for one half of one revolution of the disk

**Data rate:** Speed at which data is transferred, expressed in MB/sec.

**Actuator:** Component containing read/write heads and associated access mechanism elements

**Head and disk assembly (HDA):** Sealed enclosure containing disks, access mechanism(s), and read/write heads

**Unit:** An installable entity -- machine type and model

**String:** An A unit and its associated B units

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Some of the characteristics, features, or capabilities described here are options available as alternates or as additions to the basic equipment. The many variations possible are beyond the scope of this publication; details should be obtained from your IBM representative.

This publication will be updated periodically, and at any one time may not reflect the latest versions of options, equipment, or programming support. The information contained herein is for general orientation only; the authoritative sources of information on the components described are the applicable technical publications. Note that numerical values given here may be rounded or may be approximations; design decisions should be based only on data obtained from specifications given in other documents.

Requests for information on availability dates or for copies of this and other IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

## Abbreviations and Acronyms

b	bit(s)
B	byte(s) (=8 data bits)
BC	basic control
BDAM	basic direct access method
bpi	bits per inch
bps	bits per second
cm	centimetre(s)
cpi	characters per inch
cps	characters per second
CPU	central processing unit
DAM	direct access method
DASD	direct access storage device
DASF	direct access storage facility
DAT	dynamic address translation
DOS	Disk Operating System
DOS/VS	DOS/Virtual Storage
DOS/VSE	DOS/Virtual Storage Extended
DPS	data path selection
EC	extended control
ECC	error checking and correction
ECPS	extended control program support
FH	fixed head
GB	gigabyte (1,000,000,000 bytes) 1 billion
HDA	head/disk assembly
in	inch(es)
I/O	input/output
IFA	integrated file adapter
ips	inches per second
ISAM	indexed sequential access method
ISC	integrated storage control
kg	kilogram(s) (1000 grams)
K	1024 bytes
lbs	pounds
lpm	lines per minute
MB	megabyte(s) (1,000,000 bytes) 1 million bytes
ms	millisecond(s) (0.001 sec) one thousandth of a second
MVS	Multiple Virtual Storage
MVS/SE	Multiple Virtual Storage/System Extension
MVS/SP	Multiple Virtual Storage/System Product
ns	nanosecond(s) (0.000,000,001 sec) one billionth of a second
OS	operating system
OS/VS	Operating System/Virtual Storage
RAS	reliability, availability, serviceability
rpm	revolutions per minute
RPO	product resulting from a "request for price quotation"
RPS	rotational position sensing
SCP	system control program
sec	second(s)
VM/BSE	Virtual Machine/Basic System Extension
VM/370	Virtual Machine Facility/370
VSAM	virtual storage access method
usec	microsecond(s) (0.000,001 sec) one millionth of a second

## IBM Direct Access Storage Devices

Improvements in read/write head design, flying height, magnetic materials, and the integration of heads, access mechanism, and disks have allowed a larger volume of data to be stored on an individual element of a direct access storage device. These advances have also made it possible to achieve reduced access times, faster data rate, greater reliability of operation, and reduced space and power requirements.

Variations in design and programming have made available a number of devices that can meet a large variety of requirements. For example, several types of direct access storage devices have both fixed and movable read/write heads. Index type data can thus be stored under the fixed-position heads, and data base information requiring random access under the movable heads. This makes it possible to appreciably reduce total access time and better utilize storage areas.

Other variations in design, such as data recording organization, contribute to the options available. Some direct access storage devices employ a count key data format to store one or more physical records on a track with appropriate identification information. Fixed block architecture, on the other hand, provides for the specification of storage space by groups of blocks, making the definition of space independent of tracks and cylinders.

Total access time can be reduced by improving read/write head movement, rotational delay, head switching, and data transfer times. There have also been changes in storage capacity, which varies with the data recording organization, the density of data on a track, and the number of data tracks available on a storage device.

The tables that follow list major characteristics and features of DASD presented in this publication.



## IBM Processors, Operating Systems, and DASD Overview

The direct access storage devices described in this folder differ in their specific characteristics, processor attachment, and operating system environments. The following table summarizes configurations supported.

Model Group	4331-1	4331-2	4341	4341	303X	S/370	Disk Format	Access Method	Type of Media	Address
3880-1	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	Fixed Block	Fixed Block	Fixed	32768/65536/131072/262144/524288/1048576
3880-2	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	Fixed Block	Fixed Block	Fixed	32768/65536/131072/262144/524288/1048576
3880-3	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	3330X/3350/3340/3344/3370/3375	Fixed Block	Fixed Block	Fixed	32768/65536/131072/262144/524288/1048576

### Processors

### DASD

3880-1	4331 Model Group 2 and 4341	3330X/3350 or 3340/3344 or 3370 or 3375
	303X	333X/3350 or 3340/3344 or 3375
	Selected S/370 Models	
3880-2	303X	One storage director: 333X/3350 or 3340/3344 or 3375 Other storage director: 3380
	Selected S/370 Models	One storage director: 333X/3350 or 3340/3344 Other storage director: 3380
	4331 Model Group 2 and 4341	One storage director: 333X/3350 or 3340/3344 or 3370 or 3375 Other storage director: 3380 connected to 303X or S/370 158, 168
3880-3	303X and S/370, 4341 158, 168	3380

- Additional combinations exist. Consult sales manual.

## IBM 3310 Direct Access Storage

The IBM 3310 Direct Access Storage is a fixed-media magnetic disk storage subsystem, employing fixed-block architecture, available in various configurations, that can be attached to the IBM 4331 Processors via the DASD Adapter.

Fixed-block architecture allows for the specification of storage space by groups of blocks and makes the space definition independent of tracks and cylinders.

The 3310 Direct Access Storage provides a choice of four models and online storage up to 258,080,768 bytes per string. It consists of from one to four disk storage devices housed in one or two enclosures (two per enclosure). Each disk storage device contains a nonremovable sealed unit that houses magnetic storage disks, read/write heads, and an actuator that moves the heads. In addition, the first disk storage device in a 3310 configuration contains a controller that communicates with the 4331 DASD Adapter.

The basic unit of transfer between the disk storage device and the 4331 is a fixed block sector of data of 512 bytes.



IBM 3310 Direct Access Storage Unit, Model 3310-1, with 3330X Processor, Model 3330X/3350, Storage Controller, Model 3330X/3350/3340/3344/3370/3375, and IBM 4331 Processor, Model 4331-1, via the DASD Adapter.

Four models of the 3310 are available:

- Model A1 contains a controller and one disk storage device in an enclosure
- Model A2 contains a controller and two disk storage devices in an enclosure
- Model B1 contains one disk storage device in a separate enclosure. The model B1 must be physically attached to a model A2 from which it derives its power and control functions.
- Model B2 contains two disk storage devices in a separate enclosure. The model B2 must be physically attached to a model A2 from which it derives its power and control functions.

The 3310 models can be arranged in any of the following subsystem configurations:

- Model A1: 64,520,192 bytes
- Model A2: 129,040,384 bytes
- Model A2 and Model B1: 193,560,576 bytes
- Model A2 and Model B2: 258,080,768 bytes

For details, refer to GA26-1660, IBM 3310 Direct Access Storage Reference Manual.

## IBM 3330 Disk Storage

The 3330 Disk Storage consists of a cabinet that encloses one or two disk storage drives. Each disk drive is installed in a drawer, which can be opened or closed by an operator control panel switch, allowing a 3336 Disk Pack to be mounted. An electromagnetic actuator is used to move and control the read/write head assembly. The 3330 Disk Storage provides general-purpose data storage and programming system residence for most System/370 models, 4331 Model Group 2, 4341 and 303X Processors.

Three models are available. Model 2 of the 3330 contains one disk drive; models 1 and 11 contain two disk drives each. The 3330 Disk Storage can be used for interconnected operation with the IBM 3333 Disk Storage and Control Model 1 or Model 11. Attachment to a System/370 or 303X CPU can be made through an integrated file adapter, an integrated storage control, or through an IBM 3830 Storage Control Model 2. Attachment to IBM 4331 Model Group 2, 4341, or 303X Processors can be made through an IBM 3880 Storage Control Model 1 and 2.

Up to three 3330 Disk Storage units (in any combination of models 1, 2, or 11) can be attached to one 3333 Disk Storage and Control. Two or more disk storage units that are connected to the same control circuitry (for example, one 3330 connected to a 3333, or two 3330s connected to a 3333) are said to form a "string" of DASDs.

Refer to GA26-1592, Reference Manual for IBM 3830 Storage Control Model 1 and IBM 3330 Disk Storage, and to GA26-1617, Reference Manual for IBM 3830 Storage Control Model 2 for details on methods of attachment. For 3880 Storage Control refer to GA26-1661.



3330-1 3330-1 3330-1 3333-1

## IBM 3333 Disk Storage and Control

The 3333 Disk Storage and Control is similar to the 3330 Disk Storage, but it also contains control circuits and safety elements that make possible the attachment to the 3333 of up to three 3330 Disk Storage units.

Model 1 of the 3333 Disk Storage and Control contains two disk drives and, except as noted above, is similar to the Model 1 of the 3330 Disk Storage.

Except for the added control circuits, Model 11 of the 3333 is similar to the Model 11 of the 3330.

Attachment of a 3333 Disk Storage and Control to a System/370 or 303X CPU can be made through an IBM 3830 Storage Control Model 2, through an integrated storage control (ISC), or through an integrated file adapter depending on CPU model and on other storage devices present in the configuration. For details refer to GA26-1617, Reference Manual for IBM 3830 Storage Control Model 2. For attachment to IBM 4331 Model Group 2, 4341, and 303X Processors via 3880 Storage Control, refer to GA26-1661, Introduction to IBM 3880 Storage Control.

## IBM 3336 Disk Pack

The IBM 3336 Disk Pack is a storage medium consisting of metal disks coated on both sides with a magnetic recording material. Eleven disks are mounted on a vertical shaft and are spaced so that the disk drive read/write heads can move between the disks. Data can be stored on the inner surfaces of the top and bottom disks, and on both surfaces of the inner disks, giving a total of 20 recording surfaces. A bottom cover and a cylindrical top cover protect the disks from dust, and complete the disk pack.

When mounted in the drawer of a disk drive, the disks rotate at a speed of 3600 rpm. The IBM 3336 Disk Pack Model 1 is designed as removable and interchangeable disk storage for use on models 1 and 2 of the 3330 Disk Storage and on model 1 of the 3333 Disk Storage and Control. Approximately 100 MB of data can be stored on one pack. Data is stored up to 13,030 bytes per track, in 19 tracks per cylinder, in a total of 411 cylinders (including the seven alternate cylinders per disk pack).

Model 11 of the IBM 3336 Disk Pack is designed as a removable and interchangeable disk storage for use on model 11 of the IBM 3330 Disk Storage and on model 11 of the IBM 3333 Disk Storage and Control. Approximately 200 MB of data can be stored on one pack. Data is stored up to 13,030 bytes per track, in 19 tracks per cylinder, in a total of 815 cylinders (including the seven alternate cylinders per disk pack).



## IBM 3340 Direct Access Storage Facility

The 3340 Direct Access Storage Facility is designed to provide high-speed, direct access storage for use with most models of System/370, IBM 303X CPUs, and 4300 Processors. The 3340 DASF consists of a cabinet that encloses one or two disk storage drives, on each of which can be mounted a 3348 Data Module. Each disk drive is mounted in a drawer that can be opened or closed by a switch on the operator control panel. An electromagnetic actuator is used to move and control the read/write head assembly; the read/write heads and access arms are mounted inside each 3348 Data Module. Data modules are loaded automatically after being placed in the 3340 drive, the drive cover is closed, and a switch is turned on. Startup time is less than 20 seconds.

Model A2 of the 3340 DASF contains two disk storage drives and the associated control. It also can provide logic and power for the attachment of up to a total of three 3340 Model B1, 3340 Model B2, and/or 3344 units.

The Model B1 of the 3340 DASF contains only one disk storage drive. Units of this model can be intermixed with 3340 Model B2 and/or 3344 units to provide 3-, 5-, or 7-drive configurations.

Model B2 of the 3340 DASF contains two disk drives, and is designed to be attached to a 3340 Model A2.

Attachment of a 3340-A2 DASF to a System/370 CPU can be made through an IBM 3830 Storage Control Model 2, through an integrated storage control (ISC), or through an integrated file adapter, depending on CPU model and on other storage devices present in the configuration. For details, refer to GA26-1619, Reference Manual for IBM 3340/3344 Disk Storage.



3340

3344

Attachment to 4331 Model Group 2, 4341, or 303X Processors can be made through IBM 3880 Storage Control. The DASD Adapter is used to directly attach to the 4331 Processors.

### IBM 3344 Direct Access Storage

The 3344 Direct Access Storage is a dual-drive, large-capacity, direct access storage unit intended for use with most models of IBM System/370, IBM 303X CPUs and with the 4300 Processors. The storage medium is a metal disk coated on both sides with a magnetic recording material. Eight disks are mounted, one above the other, on each of the two drive shafts, giving a total of 16 recording surfaces in each of the two drives. One of the recording surfaces contains servo information prerecorded during manufacture; the other 15 surfaces are used to store data, programs, etc. There are two read/write heads for each of the 15 data surfaces. Each 3344 spindle appears to the using system to be four 3340 spindles. The 3344 has no control circuits, and must be connected to the CPU through a 3340 DASD Model A2. Two models of the 3344 are available, both containing sealed read/write head assemblies and disks which cannot be dismantled by the operator.

In Model B2 of the 3344 DASD the read/write head assemblies are moved by the electromagnetic actuator to one of 560 positions.

Model B2F of the 3344 DASD is similar to the Model B2 in construction and has the same total data storage capacity, but cylinders 1 through 10 are relocated to the surface that contains the servo information. The remaining cylinders stay in their current locations and are accessed by the movable heads. The relocated cylinders are accessed by a set of fixed read/write heads, an arrangement that makes data on these cylinders accessible without the need for head seek time. There is a total of 120 logical tracks under the fixed heads of each drive, for a total storage capacity of 2 MB per 3344 unit.

### IBM 3348 Data Module

The storage element in the data module is a thin metal disk coated with a magnetic recording material. Disks are mounted on a drive spindle, and are spaced to accommodate the read/write head assemblies that are part of the data module. The disk data surface is divided into concentric tracks, each of which can store up to 8,368 bytes of data. The module forms a sealed unit, which can be placed into or removed from the disk drive of the 3340 DASD. Three models are available, the 35, the 70, and the 70F. The models 35 and 70 can be freely exchanged on the 3340 drives, but the model 70F contains fixed as well as movable heads and therefore can be used only on the 3340 drives that have been converted to the use of the 3348-70F data module.



In the 3348-35 Data Module there are two disks. There is a total of 348 cylinders, and a module has a total storage capacity of up to 34,944,768 bytes.

The 3348-70 Data Module contains four disks. There is a total of 696 cylinders with a total storage capacity of up to 69,889,536 bytes.



The 3348-70F data module has the same characteristics and total storage capacity as the 3348-70, except that cylinders 1 through 5 are accessed only by the fixed heads that read the bottom surface of the bottom disk. Data on tracks under the fixed heads (502,080 bytes) is available after a rotational delay only (i.e., with zero time for head movement); the other tracks require normal head movement time.

## IBM 3350 Direct Access Storage

A 3350 Direct Access Storage subsystem consists of from one to four dual-drive disk storage units with nonremovable, sealed head/disk assemblies. Each drive contains 16 recording surfaces, one of which contains servo and other control information prerecorded during manufacture. Fifteen surfaces are used for data storage. In the models that have fixed head storage, up to 1,144,140 bytes of data can be stored on the servo surface, where it can be accessed with zero seek time; however, total storage capacity is not changed because the fixed-head storage takes the place of an equal amount of storage under the moving heads.



Six models of the 3350 are available, each containing two drives:

- 3350-A2 contains controller circuits, and is the first in a string of 3350 units
- 3350-A2F is the same as the A2, except that it has fixed as well as movable heads
- 3350-B2 contains only drives, no control circuits, and can be only in second, third, or fourth position in a string of 3350s
- 3350-B2F is the same as the B2, except it has fixed as well as movable heads

- 3350-C2 contains alternate control circuits, and can be the last in a string of two, three, or four 3350s. This model permits the user to select either the A2/A2F or the C2/C2F as the online controller, which could be useful in case the online controller requires service
- 3350-C2F is the same as the C2, except that it has fixed as well as movable heads.

Each 3350 is formatted at manufacture into one of three operating modes: 3330-1 compatibility, 3330-11 compatibility, or 3350 native. Operational modes can vary between drives on the same string or in a unit. Storage capacities per drive (two drives per unit) vary with operational mode, up to 100 MB in 3330-1 mode, up to 200 MB in 3330-11 mode, and up to 317.5 MB in 3350 native mode. Fixed head storage capacity per drive is up to 742,710 bytes in either 3330-1 or 3330-11 mode, and up to 1,144,140 bytes in 3350 native mode.

Attachment of a 3350-A2 or 3350-A2F to System/370 or 303X Processors can be made through an IBM 3830 Storage Control Model 2. Attachment of a 3350-A2 or 3350-A2F to 4331 Model Group 2, 4341, System/370, or 303X Processors can be made via IBM 3880 Storage Control (3350 native mode only). On CPUs (such as 3148, 3158, 3168) that have integrated storage control (ISC) there is no need for a 3830. Certain models of the 3145 CPU can use an IBM 3345 Storage and Control Frame that contains an ISC as a means of attaching a 3350.

For detailed information, refer to GA26-1638, Reference Manual for IBM 3350 Direct Access Storage, and to GC20-1780, 3350/3344 Installation and Conversion Guide.

## IBM 3370 Direct Access Storage

The IBM 3370 Direct Access Storage subsystem combines two important concepts: two independent actuators each servicing half of a single stack of storage disks, and fixed-block architecture.



IBM 3370 (Similar in appearance to the IBM 3375)

Each of the two independent actuators can access one-half of the storage on the single spindle. Seeking with either actuator may be overlapped with seeking and/or reading or writing on the other actuator. Each actuator is separately addressed.

Fixed-block architecture allows for the specification of storage space by groups of blocks and makes the space definition independent of tracks and cylinders.

The 3370 uses a fixed-media head and disk assembly. The fixed storage eliminates operator handling and exposure to external contamination, and provides high reliability. Because of higher recording density on the storage surfaces, the 3370 provides a larger storage capacity for medium-size systems than has been previously available. The storage cost per byte is reduced and allows new uses for data-base-related applications.

A new service tool, the maintenance device, expedites diagnosis and repair, thus improving 3370 availability.

The 3370 subsystem string can contain from one to four two-actuator storage units. Two types of units are used: a model A1 with a controller and two actuators, and from one to three attached model B1s each with two actuators. An optional string switch feature allows a 3370 string to be connected to, and shared by, two storage controls.

The IBM 3370 attaches to the 4300 Processors. When used with the 4331 Processors, the 3370 is attached via the DASD Adapter, which is housed within the processor. When used with the 4331 Model Group 2, the 3370 may also be attached via the 3880. When using a 4341 Processor, the 3370 is attached via the 3880 Storage Control. Up to four 3370 strings can be attached to a storage director. (There are two storage directors in a 3880 Storage Control.)

For details refer to GA26-1657, Introduction to IBM 3370 Direct Access Storage.

## IBM 3375 Direct Access Storage

The IBM 3375, a new mid-range direct access storage device, is an extension of the 3370 technology. It is a high-speed, large-capacity count-key-data device for intermediate-system users, or for large-system users with relatively low or stable DASD capacity requirements.

A 3375 unit consists of two actuators, each having a maximum capacity of 409.8 MB, providing a total capacity in each unit of 819.7 MB. Improved device performance characteristics include faster seek times and a significantly higher data transfer rate than that of the 3340/3344 and 3350.

The 3375 attaches via the 3880 Storage Control Models 1 or 2 to the 4331 Model Group 2, 4341, and the 303X processors. A prerequisite for 3375 attachment is a channel that can support its 1.86 MB per second data rate. On the 4331 Model Group 2, the 3375 attaches to the optional 1.86 MB channel. On the 4341, the 3375 can attach to the standard 2 MB channel. On the 303X processors, the 3375 will attach only to channels with the data streaming feature (high-speed channel) installed.

The model A1 includes the string controller and must be the first unit on a string. Up to three B1 models can be attached to the model A1 to complete the string. A maximum of four 3375 strings can be attached to a storage director of the 3880 Storage Control for a maximum capacity of 13.11 gigabytes on a single storage director.

An optional String Switch feature (#8150) installed on the model A1 can be used to allow sharing of a 3375 string between two storage directors in the same or different 3880 Storage Controls.

Count-key-data architecture provides data format continuity between current IBM intermediate and large DASD and the IBM 3375.

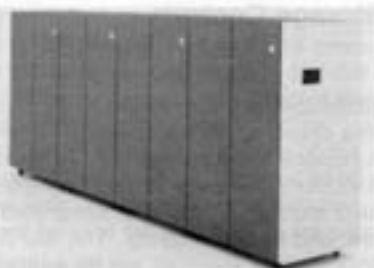
For additional information, refer to GA26-1666, Introduction to the IBM 3375 Direct Access Storage.

## IBM 3380 Direct Access Storage

The IBM 3380 is a large-capacity, high-speed direct access storage device that provides high-performance direct access storage for the IBM 303X and IBM 4341 Processors. The 3380 transfers data at 3 megabytes per second. The installation of the Data Streaming feature on the 303X or the Speed Matching Buffer feature on the 3880 Storage Control Models 2 and 3 for System/370 158, 168, and 303X is a prerequisite.

The total capacity of one 3380 unit is 2.52 billion bytes (gigabytes). It consists of two fixed-media 1.26 billion byte head and disk assemblies (HDA) each with heads, disks, and access mechanisms (actuators) within a sealed enclosure. There are two independent, movable actuators within each HDA. Each actuator has its own address and accesses 630 MB of data. All actuators are independently operated.

Average Seek Time (ms)	16
Minimum Seek Time (ms)	3
Maximum Seek Time (ms)	30
Full Track Rotation Time (ms)	16.7
Data Transfer Rate (MB/sec)	3.0
MB Capacity per Unit	2,521
MB Capacity per Drive	1,260
MB Capacity per Access Mechanism	630
MB Capacity per Fixed Head Unit	5.8
Data Cylinders per Access Mechanism	885
Tracks per Cylinder	15
Bytes per Track	47,476
Bytes per Cylinder	712,140



A 3380 storage string consists of one A unit and up to three B units. The A unit attaches to the 3880 Storage Control. It contains a controller, storage disks, four actuators, logic circuitry to support the access mechanisms, and the necessary power supplies. The 3380 Model B unit contains storage disks, four actuators, their necessary logic circuitry and power supply. Dynamic path selection is an additional function available on specific models. Dynamic path selection is included in models that contain a second independent controller in the A unit, providing an additional data path from a second storage director to the actuators for availability enhancement. Fixed-head capacity is 5.6 MB per 3380 unit, replacing an equivalent capacity of moving head storage (1.4 MB per actuator).

Four 3380 Model A units and two 3380 Model B units are available. The model designations are:

- Model A4: basic unit with one controller
- Model AA4: basic unit with two controllers and dynamic path selection
- Model A4F: basic unit with one controller and fixed heads
- Model AAF: basic unit with two controllers, dynamic path selection, and fixed heads
- Model B4: basic unit without controller
- Model B4F: basic unit without controller and with fixed heads

Model changes within A Models or between B Models can be made in the field.

Count-key-data architecture provides data format continuity between existing IBM large systems direct access storage devices and the new 3380. For additional information refer to GA26-1664, IBM 3380 Direct Access Storage Description and User's Guide.

## IBM Storage Controls

Storage devices are connected to the system through a channel, whose commands cause the many functions to be performed. To perform these functions there are storage controls, integrated storage controllers, integrated file adapters, and heads of string. The IBM 3830 and IBM 3880 Storage Controls will be addressed here.

### IBM 3830 Storage Control

The IBM 3830 Storage Control is designed to provide CPU attachment of the following storage devices: 3330, 3333, 3340, 3344, and 3350. Two models are available:

- Model 2: Designed for interconnected operations with 3330, 3333, 3340, 3344, and 3350, to System/370, 303X, 4331 Model Group 2, and 4341 Processors.
- Model 3: Provides for the attachment of 3330, 3333, 3350 DASD in a 3850 Mass Storage System environment.

The IBM 3830 Storage Control can be attached to a second channel, which may be on the same processor or a different processor, via the Two-Channel Switch. An additional Two-Channel Switch is available to provide four-channel switch capability. See GA26-1617, Reference Manual for IBM 3830 Storage Control Model 2 for further details.

### IBM 3880 Storage Control

The IBM 3880 Storage Control is designed for CPU attachment of 3340/3344, 3333/3330, 3350, 3370, 3375, and 3380 Direct Access Storage devices.

The 3880 contains two storage directors. Each storage director is logically independent and provides the basic functions of a storage control with its own data path, control path, and address for channel communication.

Attached to appropriate channels, the following DASD and processor attachments are supported from the IBM 3880:

The 3880 Models 2 and 3 attach the 3380 to the 303X and S/370 Model 158 and 168 processors. The 3880 Model 2 has one storage director that attaches 3380 and one storage director that attaches different DASD (333X/3350 or 3340/3344 or 3370 or 3375). Both of the directors in the 3880 Model 3 are for 3380 attachment only. The two storage directors in a 3880 do not have to be attached to the same processor.

The Speed Matching Buffer for 3380 feature permits the attachment of the 3380, with its 3 MB per second data rate, to the System/370 Model 158 and 168 or 303X processor's 1.5 MB channels.

The Two-Channel Switch Pair allows the attachment of each storage director to a second channel. Four unique channels may be switched, two to each storage director, or the same two channels may be switched to both storage directors. The channels to be switched may be on the same or different processors.

The Two-Channel Switch Pair, Additional adds switching for two additional channels per storage director, providing four-channel switch capability for both storage directors. Up to eight unique channels may be switched, four to each storage director.

The Eight-Channel Switch feature provides eight unique channel connections to a 3880 Storage Control. These are shared by the two storage directors.

The Remote Switch Attachment features provide an alternative location for the channel interface enable/disable switches for the Eight-Channel Switch feature.

## Maintenance Device

The Maintenance Device (MD) is a new portable maintenance support facility consisting of a microcomputer with a hand-held display, diskette reader, and keyboard. The MD, when attached to the supported units, performs diagnostic routines that help to isolate a problem or verify that the unit is operating normally. The MD is used for 3380, 3370, 3375, and 3380.

The MD provides automatic execution of microdiagnostics for re-creation and isolation of a failure, and high-speed analysis of symptom codes from console messages and error logs for field-replaceable unit isolation.

## Some Standard and Optional Features

**Autoloading:** Automatic loading after a data module is placed in the disk drive, the cover is closed, and a switch is turned on.

**Command Retry:** Enables the storage control to recover from certain subsystem errors without recourse to system recovery procedures from the processor.

**Defect Skipping:** Allows data to be stored both ahead of and after a minor surface defect. All of the recording track can be used except for minute portions. Access time is saved because heads no longer need be moved to an alternate track. Storage capacity is not changed, and the user is not aware of the defects.

**Dynamic Path Selection:** Allows command and data transfer to take place simultaneously through both controllers to two actuators on different internal paths. Dynamic path selection also provides a concurrent alternate path to all data in a 3380 facility in the event of a channel, storage director, or 3380 controller failure.

**Error Correction:** Provides the capability to detect and correct errors when data is read from a disk.

**Fixed Head:** On selected direct access storage devices it is possible to have some read/write heads that are fixed in position so that they always access the same data tracks. This reduces to zero the time required to move the read/write heads from one cylinder of data to another. The user may store system files, as well as his own programs and files, in the fixed-head area, and so take advantage of increased device performance. The presence of fixed heads does not increase total storage capacity, most of which is accessed by movable heads.

**Multiple Requesting:** Allows multiple-channel command sequences to be active, up to one sequence per actuator, and therefore allows better utilization of control units, devices, channels, and the CPU. This feature requires one unshared subchannel on a block multiplexer channel for each actuator. Multiple Requesting is provided on the 3340 when the optional Rotational Position Sensing feature is installed.

**Primary Controller Adapter:** Added to the Model A2 or A2F when the string of 3350s contains a

**Model C2 or C2F.** The adapter makes possible the manual switching of primary control from the model A2 (A2F) to the model C2 (C2F), or back.

**Remote Switch Attachment (optional):** Makes it possible to attach the string switch to a configuration control panel so that the circuits controlled by the string switch can be acted upon from a remote location.

**Rotational Position Sensing (RPS):** Reduces the channel connection time required to search for a given record after the track and head have been selected. This is accomplished by disconnecting the actuator from the channel, allowing other channel operations to be performed during the time required by the spindle to bring the desired record to the read/write head.

**String Switch:** Allows a string of DASDs to be dynamically shared by two storage controls. The feature includes two interlocked enable/disable switches, making it possible to dedicate the string of DASD to either storage control, or to be accessible to both controls.

**Write Format Release:** Frees the subsystem while the drive erases from the end of a formatted write record to the end of the track.

## Direct Access Storage Device Terms

**Actuator:** Component containing read/write heads and associated access mechanism elements

**Average rotational delay:** Time for one half of one revolution of the disk

**Data rate:** Speed at which data is transferred, expressed in MB/sec

**Head and disk assembly (HDA):** Sealed enclosure containing disks, access mechanism(s), and read/write heads.

**Rotational delay:** Time to rotate track (disk) to where head can start data transfer

**Seek time:** Time to move head to desired cylinder

**String:** An A unit and its associated B units

**Unit:** An installable entity — machine type and model

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