MEMOREX

3670/75 Disc Storage Subsystem

MAY 7 1983

## The Memorex 3670/75—Performance Engineered, Reliable, and Proven

The Memorex® 3670/75 Disc Storage Subsystem has already established a record as the most popular replacement for the IBM 3330, 100 and 200 MB drives. A large capacity, high performance disc storage system, the Memorex 3670/75 is compatible with System/370 and other compatible computers. And with the optional 2860 selector channel attachment, large System/360 users can operate the 3670/75 under OS MFT/MVT.

One of the largest disc subsystem programs in Memorex history, the 3670/75 is engineered to exceed all performance and reliability standards for large, direct access storage devices. Double Capacity, Multiple Channel, String Switching, Disc Cache and Intelligent Dual Interface (IDI) are all enhancements to the 3670/75 subsystem.

### Greater Flexibility

The Memorex 3670/75 can provide over 6.4 billion bytes of capacity using a single 3672 or 3674 Storage Control Unit, up to four 3673 Disc Controllers, and up to sixteen 3670 and/or 3675 Disc Drive Modules (32 spindles).

An optional Memorex Disc Cache provides faster access, greater throughput, and increased I/O efficiency. Average access time of cache data is 2 MS compared with 30-50 MS for conventional disc access.

The Memorex Intelligent Dual Interface (IDI), an advanced dual port concept, resolves contention at the string level and *not* at the processor. This frees the computer to work on important programs, increasing overall system efficiency.

Other optional features such as Multiple Channel and String Switching allow the 3670/75 subsystem to be accessed by alternate channels and/or control units from a single processor. The subsystem may also be shared by multiple processors.

Memorex is the only supplier to offer 4-string switching, which provides improved data accessibility and increased configuration flexibility.

Disc packs are fully interchangeable. Memorex Mark X and Mark XI packs have equivalents in the IBM 3336 Models 1 and 11. And no conversion time is lost since the 3670/75 can use either of the appropriate disc packs.

### Memorex 3670/75 Disc Storage Subsystem Compatibility Chart

| Storage Component | Memorex | IBM |
|---|---|---|
| Storage Controller | 3672 | 3830-2 |
| Disc Controller and 2 100-MB Spindles | 3673 3670 | 3330-1 |
| Disc Controller and 2 200-MB Spindles | 3673 3675 | 3333-11 |
| Additional Modules | | |
| 2 100-MB Spindles | 3670 | 3330 |
| 2 200-MB Spindles | 3675 | 3330-11 |
| Disc Packs | Mark X | 3336-1 |
| | Mark XI | 3336-11 |

## The Memorex 3670/75—Engineered and Enhanced for the Future

Since even a small amount of downtime can offset performance advantages, Memorex has introduced several advanced concepts into the subsystem to ensure both reliability and maintainability. The 3670/75 is superior, proven in thousands of customer installations.

### Exclusive Ferrite Head Formula

In the 3675 Memorex's formula for ferrite material produces heads flying 50 percent higher than heads in a 3330 drive—without any loss of sensitivity. This higher flying height virtually eliminates head crashes.

### Patented Airflow System

The Memorex disc airflow system uses air movement generated from the spinning disc pack to both cool the linear motor and clean the read/write heads. This reduces parts count by eliminating the need for separate cooling blowers. The unique airflow system also reduces the risk of thermal shutdown and pack contamination.



*Patented Airflow System*
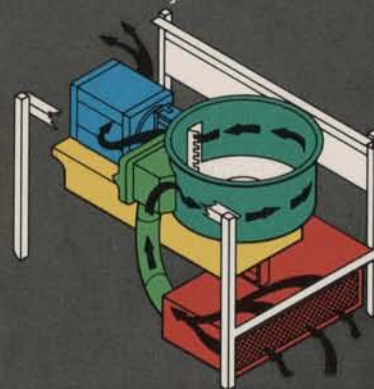
### More Efficient Monitoring and Control Circuitry

Monitoring circuits on the 3670/75 detect power failures and retract heads at a controlled velocity, thus preserving calibration and alignment. To eliminate noise and interference, the control circuitry is physically separated from the power supply.

### Fault Isolation Diagnostic System (FIDS)

A further assurance of subsystem reliability is Memorex's "FIDS" or Fault Isolation Diagnostic System. FIDS performs on-line diagnostics to detect failing components.

### Microdiagnostics

Microdiagnostics, initiated from the Storage Control Unit, can isolate failures without processor involvement, and a special tester is used to resolve drive problems off-line. This flexibility in procedures reduces disruption during problem resolution.

## Exclusive Benefits from the Memorex 3674 Storage Control Unit

The Memorex 3674 Storage Control Unit offers unmatched attachment flexibility. The 3674 attaches to System/370 Models 135 through 168 and to equivalent CPUs. It features 2-, 3-, or 4-channel switching, providing multiple data paths for a single processor or switching for the multiple processor user. The 3674 not only supports attachment of the Memorex 3670 and 3675 drives, but also supports the Memorex 3640 (3340 equivalent); the Memorex 3650, as well as its equivalent, the IBM 3350. Up to 32 drives can be intermixed on the same 3674 Storage Control Unit. And for added configuration flexibility, the 3674 can be located as far away as 200 feet from the drive string controller. Regardless of the on-line capacity or product mix, the Memorex 3674 Storage Control Unit provides the versatility to configure any combination of fixed and removable media devices.

## Intelligent Dual Interface (IDI)— A New Concept in Dual Porting

The Memorex IDI feature increases the performance of the Memorex 3670/75 Disc Storage Subsystem.

IDI provides a second access path to the string so that fewer string busies occur. Two read/writes per string are now possible simultaneously. This feature can be added to currently installed Memorex 3670 and 3675 drive strings.

Other "dual port" systems rely on the intelligence in the processor to resolve contention either by implementing the operating system's optional channel feature or by rescheduling and restarting I/O operation. Memorex's IDI feature reduces rather than increases the CPU overhead.

Contention is resolved at the string level rather than at the processor. This frees the CPU to work on programs instead of resolving disc contention.

## IDI—How It Works

Two 3673 Disc Controllers are installed in each 3670/75 drive string. The controllers contain the IDI logic. One string controller is connected to each side of the dual-ported drive string. The IDI directs the commands from the SCU and the interrupts from the drives to whichever string controller is free.
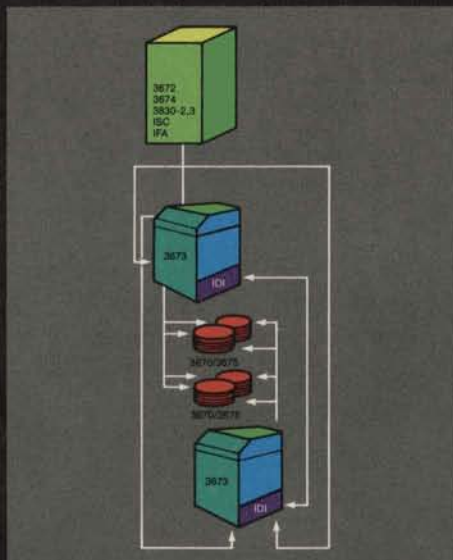


*The Memorex Intelligent Dual Interface*

Since both string controllers are active interchangeably and simultaneously, contention is resolved in both directions—not only from the system to the drives, but also from the drives back to the system. This provides the potential for significant improvements in disc subsystem throughput to increase overall system efficiency.

Up to 32 Memorex spindles can be attached to two Memorex 3674 Storage Control Units. This provides a 4:1 drive to SC ratio for maximum performance and an overall 16:1 drive to SCU ratio with dynamic redundancy to the spindle level.

## IDI Benefits

IDI provides two access paths to every spindle on a string.

Operationally, IDI appears the same as string switch to both the storage control units and the operating system. But consider:
- With IDI, one busy controller does not lock out the remainder of the string.
- With IDI, loss of one controller does not mean loss of the entire string.
- With IDI, if a request is directed to an already busy controller, the IDI will automatically pass the request to the free one. This occurs without the need to return to the operating system either to find the alternate path and reissue the request (in the case of a single CPU) or to wait for Device End (in the case of shared DASD).

In a two-CPU environment, where both processors access a shared string equally across all spindles, IDI guarantees an access path to each CPU. While string switch forces each processor to wait for its own requests plus those of the other CPU, IDI satisfies both CPUs simultaneously.

This is also true in the single-CPU environment. The heavier the I/O disc load, the greater the benefit IDI has to offer, provided that the load is evenly distributed across more than two spindles on the same string.

## The Memorex 3670/75, Caching for Increased Throughput

Whereas IDI offers more paths to the data, cache provides faster access to the data.

The Memorex 3770 Disc Cache uses memory caching logic, allowing the majority of disc access requests to be serviced from the fast access cache rather than from the disc. This can result in substantial performance improvement for applications with heavy disc access activity.

### Memorex 3770 Disc Cache— How It Works

I/O patterns are rarely random. There is often a distinct clustering of activity in the data sets, where a relatively small percentage of the data represents most of the I/O activity. The 3770's microprocessor manages the cache memory so that it contains a continually updated set of the most recently used data tracks (from 64 to 768 tracks). On a continuous basis the cache memory contents are modified to match access patterns. Many requests to read data can therefore be fulfilled from cache, thus avoiding seek time altogether.

Attached to the disc string controller, the 3770 Disc Cache consists of a microprocessor and 1 to 12 MB of semiconductor memory. The cache's inventory of recently used disc tracks is maintained by the microprocessor, which controls



Memorex 3770 Disc Cache
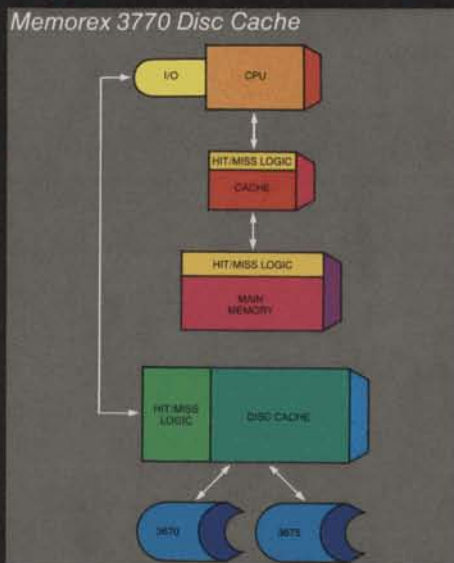
loading of disc tracks to the cache storage. The resultant dynamic cache memory contains only the most recently accessed disc tracks. The cache services subsequent accesses to these tracks. When the cache is full, the least recently referenced data is replaced.

Access to data in cache can be improved through reduction in apparent seek time, rotational delay, and/or data transfer time. Some examples of potential improvement are:

- Immediate response to set sector command—a rotating disc may delay up to 16.7 MS.
- A 33 percent reduction in data transfer time—the cache reads data at approximately 1200 KB per second while the disc reads at 806 KB per second.

The cache may delay access to data on disc drives during cache table search time and cache data loading time. For many applications, the improvements due to the cache dominate, and the customer should experience significant performance improvements.

The 3770 Disc Cache physically attaches to the Memorex 3673 String Controller and operates with large scale IBM System/370 and compatible CPUs via the Memorex 3674 Storage Control Unit.

In a controlled storage hierarchy, the combination of semiconductor and disc technologies provides significant benefits. Disc offers large capacity; cache provides extremely fast access.

### Advantages of Cache

As a disc user, you may have identified I/O bottlenecks as major performance problems.

The Memorex 3770 Disc Cache may be the high performance, cost-effective solution.

The 3770 can significantly reduce the response delay that effects I/O performance in many applications, such as TSO and highly active data sets.

As system use continues to expand in data base/data communications applications, an increasing number of systems operate at maximum I/O capacity. This is largely due to the constraints on I/O performance caused by access time to disc storage.

Totally transparent to the system, the Memorex 3770 Disc Cache can:

- reduce RPS missed reconnections
- reduce task switching
- reduce arm contention
- improve channel efficiency
- improve time-sharing response
- provide many aspects of automatic space management

Before adding more spindles to reduce contention or converting to 3350-type devices, consider the Memorex 3770 Disc Cache. Combined with the Memorex 3674 Storage Control Unit, the cache helps make the 3670/75 Disc Subsystem an excellent long-term performance investment.

The 3770 has the ability to relieve these constraints by minimizing the three components of disc access time: seek time, data transfer time, and rotational delay. These delays are greatly reduced because the cache storage elements have no moving parts. Data is more quickly available to the user; and more requests can be satisfied in the same amount of time.

# The 3670/75 Disc Subsystem's Proven Advantages

## Engineered for Now and for the Future

- A 30 percent faster data access time than the 3330
- Low-profile cabinets for fast pack load and unload
- Sliding door and top load procedure for excellent visibility to prevent pack damage
- Visible, easy-to-read operator panel to determine drive status and function
- Lower power consumption and heat output to both reduce expense and enhance the working environment
- Multiple channel and string-switching features

- 6.4 billion bytes of storage on a single SCU
- Direct replacement for 3330 on System/370 and its compatible processors
- For operation by System/360 users under OS/MFT/MVT with Memorex 3672 Storage Control Unit
- Attachment to Integrated Control Units on System/370 Models 125 through 168
- Full interchangeability with IBM 3336 Models 1 and 11 disc packs
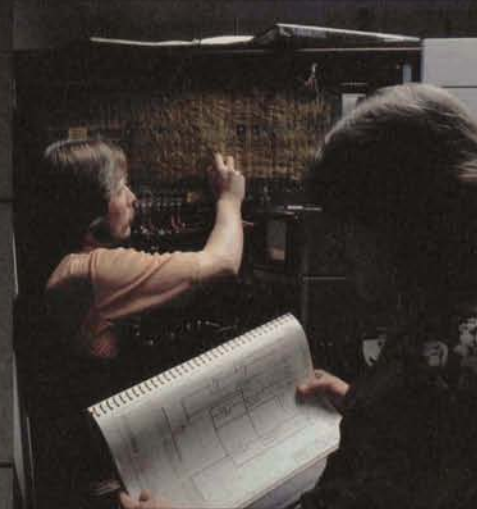
## Serviceable by Design

In addition to the high reliability of the Memorex 3670/75, the equipment is easily maintained. The design incorporates hardware service aids and isolates failures to field replaceable units.

Containing 40 subsections, the Memorex Fault Isolation and Diagnostic System (FIDS) aids in identifying a failing part for quick replacement. Microdiagnostics feature a selectable priority. The Field Engineer can optimize resource application between fault isolation and continuing production.

The 3670/75 components are packaged in pluggable, printed circuit boards according to function. Therefore, any system malfunction is easily corrected through on-site substitution of a new board. Mean Time to Repair is reduced and system uptime increased.

Memorex Field Engineers can immediately meet 95 percent of all spares requirements from their own portable spares kits. Memorex spares inventories are backed up by a comprehensive worldwide parts inventory system, with strategically located parts depots.

Memorex technical expertise is supported by complete documentation and continuing education programs.

## Memorex Invests in Its Customers

Memorex's worldwide installed base of disc drives is larger today than the combined total of all other independent suppliers. This is because Memorex not only offers the latest drive technology at great savings, but also improves existing, installed technology with innovative performance enhancements like the 3770 Disc Cache and the IDI.

Memorex enhances the value of a data processing investment as no other supplier does—we extend Memorex product life on site. Products to grow with and expand. Reliable products backed by superior customer-oriented service. From Memorex.

# 3670/75 Disc Storage System Specifications

## 3672/74 Storage Control Units

### System Interface
System/370, 3031, 3032, and 3033 processor complex, and System/360 Models 85 and 195: Attaches to Block Multiplexer Channel
The 3672 SCU also attaches to System/360 Models 65, 67, 75, 91, 95, through optional 2860 Selector Channel Attachment Feature

### System Limitation
Operates with System/370 or any other system compatible with the IBM 3330 with configuration limitations equivalent to the IBM 3330.
The 3672, with the optional 2860 Selector Channel Attachment feature operates with System/360 Models 65, 67, 75, 91, 95, under OS/MFT/MVT. (Release 21.6 and subsequent.)

### Power Requirements
208/230 VAC, 60 ±½ Hz, 3 phase, 15 amp.
220/380 VAC, 50 ±½ Hz, 3 phase, 15 amp.

### Physical Dimensions
24" wide x 60" high x 60" deep
(61.0 cm x 152.4 cm x 152.4 cm)

### Weight
850 lbs. (386 kg)

### Operating Environment
60°-90°F. 20%-80% relative humidity

### BTU Output
3672: 8500 BTU/hour
3674: 11,600 BTU/hour

## 3673 Disc Controller

### System Interface
System/370 Models 135, through 195, 3031, 3032, and 3033 processor complex and System/360 Model 195: Attaches via Memorex 3672 or 3674 Storage Control Units to Block Multiplexer Channel

### System/370 Model 125:
Attaches to 3333/3330 Direct Disk Attachment

### System/370 Models 135 and 138:
Attaches to 3330/3340 Integrated File Adapter

### System/370 Models 145, 148, 158, and 168:
Attaches to Integrated Storage Control

### Data Transfer Rate
806,000 bytes/second

### System Limitation
Operates with System/370 or any other system compatible with the IBM 3333/3330 with configuration limitations equivalent to the IBM 3333

### Power Requirements
208/230 VAC, 60 ±1.0 Hz, 3 phase, 60 amp.
220/380 VAC, 50 ±1.0 Hz, 3 phase, 60 amp.
(Modules powered from 3673.)

### Physical Dimensions
28" wide x 40" high x 32" deep
(71 cm x 102 cm x 82 cm)

### Weight
360 lbs. (163 kg)

### Operating Environment
60°-90°F. 20%-80% relative humidity

### BTU Output
2,950 BTU/hour

## 3670/75 Disc Storage Modules

### Disc Pack Configuration
10 discs, 19 recording surfaces, 404 +7 (3670) or 808 +7 (3675) spare tracks per recording surface

### 3670 Storage Capacity
100,018,280 bytes/drive
200,036,560 bytes/module

### 3675 Storage Capacity
200,036,560 bytes/drive
400,073,120 bytes/module

### Data Transfer Rate
806,000 bytes/second

### Rotational Speed
3600 RPM

### Access Time
Maximum: 50 ms
Average: 27 ms
Minimum: 7 ms

### Start Time
20 seconds

### Stop Time
20 seconds

### Data Recording Format
3670 is compatible with IBM 3330-I
3675 is compatible with IBM 3330-II

### System Interface
Attaches to Memorex 3673 Disc Controller

### Physical Dimensions
44" wide x 47" high x 32" deep (module)
(112 cm x 119 cm x 82 cm)

### Weight
1,100 lbs. (module) (499 kg)

### Operating Environment
60°-90°F. 20%-80% relative humidity.

### BTU Output
8,900 BTU/hour (module)

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**Memorex Corporation – Quality, Value, Service.**

Founded in 1961, Memorex employs nearly 12,000
highly skilled people in more than 100 locations
throughout the world. With modern headquarters
and major manufacturing facilities in Santa Clara,
California, Memorex also has production facilities
in Liege, Belgium; Nogales, Mexico; Eau Claire,
Wisconsin; and Irvine, Santa Ana, and Anaheim,
California plus a network of regional warehousing
and distribution centers.

Memorex is a worldwide supplier of high technology
equipment and magnetic recording media used in data
storage, retrieval and communications. The growing
line of products today includes high quality disc,
tape and semiconductor data storage systems;
telecommunications processors and terminals;
computer tape, disc packs and data modules; audio
and video tapes; word processing supplies; and field
engineering and facilities management services.