

## SA482

### 2.5-Gigabyte Storage Array

digital



#### **A Complete Storage Solution**

We've built upon the proven Digital Storage Architecture/Standard Disk Interface (DSA/SDI) to develop the SA482 storage array, a leadership storage solution for your large VAX and VAXcluster systems. High capacity, superior performance, high reliability, exceptional data integrity, availability, and configuration flexibility features meet under the Digital Storage Architecture (DSA) umbrella in this multipath, multispindle storage array.

Additional features in software such as Software Performance Monitor (SPM) and a soon-to-be-offered Digital Educational Services Storage Skills Workshop help to meet the special needs of the large system user. A one-year warranty, backed by Digital's best-in-the-industry Field Service Organization, represents our commitment to delivering a highly reliable storage array.

## Highlights

- 2.5 gigabytes (3.4 gigabytes unformatted\*) of user-accessible data storage—452 megabytes per square foot of computer room floor space
- Multipath, multispindle throughput capabilities—the SA482 storage array provides four independent spindles configurable for the right blend of capacity and performance for your application
- High performance—2.4 megabytes/second/spindle peak transfer rate, 24 milliseconds average seektime per spindle
- Digital Storage Architecture (DSA) offers investment protection with the flexibility to configure the SA482 storage array with any of the Standard Disk Interface (SDI) I/O servers or controllers
- A one-year warranty backed by Digital's *First Rated Service Organization* signifies our commitment to quality
- Consulting, SPM services, and a Digital Educational Services Storage Skills Workshop designed to help you optimize your large storage capabilities are featured in SA482 storage array support services

## A Proven Storage Architecture:

### The Digital Storage Architecture

Because the SA482 conforms to the Digital Storage Architecture (DSA), you benefit from Digital's commitment to offer the best in storage and to protect your storage investment.

DSA is the result of a carefully derived, long-term plan that defines the framework for an expanding group of mass-storage products that protects your investment in existing and future applications and equipment. You can easily add new mass-storage products developed by Digital to your system without changing the software or replacing existing storage devices, I/O servers, or controllers.

DSA products provide extensive data availability and data integrity features to help maximize the user's access to data and avoid costly unrecoverable data errors.

Digital's intelligent I/O servers and controllers offload many of the storage-related activities commonly performed by the host system. They relieve the host system of I/O-control functions, freeing it for application-oriented tasks. DSA also eliminates the need for the operating system to support each storage device with a unique device driver. Instead, the operating system and intelligent I/O server or controller communicate in a standard manner using *Mass Storage Control Protocol (MSCP)*. It's the same for every Digital operating system, DSA I/O server and controller, and storage device.

As a DSA product, the SA482 storage array offers all the important characteristics of the DSA family: investment protection, ease of maintenance, data reliability, integrity, availability, flexibility, and high levels of performance.

### Standard Disk Interface (SDI)

The SA482 storage array is a part of the DSA product set that uses the Standard Disk Interface (SDI). Primary implementation goals for SDI are data integrity, capacity, performance, and configuration flexibility.

One of the major SDI advantages is radial connection. In a radial connection, each drive connects directly to its controller. This increases data availability by making it possible for drives to be plugged into or unplugged from running controllers without disturbing the operation of the rest of the subsystem. By providing the capability to service individual spindles within the SA482 storage array without shutting down the rest of the I/O subsystem, SDI minimizes the high cost of lost service to a large number of users.

The SA482 storage array, like all DSA/SDI drives, controllers, and I/O servers and future SDI products, is plug-compatible. This configuration flexibility allows the SA482 storage array to connect to any of the SDI I/O servers—HSC70 and HSC50—and any of the controllers—the KDB50, KDA50, and UDA50—simply by plugging in a cable. This means that you

\* Unformatted capacity provided for comparison purposes; only formatted capacity is accessible to the user in any disk device.

can use the SA482 storage array on your VAXcluster, VAX, MicroVAX, or PDP-11 system, and benefit from controller optimization features such as seek ordering and overlap, rotational optimization and, in the I/O servers, request fragmentation.

### **Capacity: A Leadership Feature in the SA482 Storage Array**

The SA482 storage array is designed with 2.5 gigabytes of user-accessible data storage (3.4 gigabytes unformatted\*) to provide cost-effective, high capacity for VAXcluster, VAX, and PDP-11 systems.

The capacity of the SA482 storage array is made possible through technology in standard ferrite heads and oxide disks, resulting in 12,545 bits per inch (b/i) and 1063 tracks per inch (t/i), or about 13.6 million bits of storage per square inch. This gives you more capacity per unit of power and floor space in your computer room, and makes the SA482 storage array a very cost-effective storage solution.

### **Performance: A Major Concern for the Large System User**

Because of the large number of users typically demanding I/O service from large systems, superior I/O subsystem performance is particularly high on the list of user concerns.

Optimal I/O subsystem performance can be defined as satisfying the highest number of requests of the required size and locality in a given amount of time. Parallel operation capabilities and sophisticated optimization algorithms make Digital's DSA I/O servers and controllers the leaders in the industry. For the large-system user, the most significant aspect of these algorithms is that they provide greater levels of available throughput than more typical subsystem implementations.

In disk drives, three characteristic measurements have traditionally been used to define performance—cylinder-to-cylinder, maximum, and average seektimes.

Cylinder-to-cylinder seektime is the time required to move the heads between adjacent cylinders. Maximum seektime is the time required to execute a full head movement. Average seektime is the sum of all possible unique seeks divided by the number of possible intercylinder movements. Even though average seektime represents a statistical measure of actuator behavior, it is not generally representative of disk usage in real application environments.

In measuring average seektime, all possible cylinder-to-cylinder head movements are given equal weight. In actual practice, there is usually a significant degree of locality of reference, so that short seek distances predominate.

Additionally, successive requests to the same cylinder require no head movement. They should, therefore, be excluded from the average seektime measured for a real application. In typical user environments, same-cylinder requests represent the most likely case.

Because short seek distances predominate in real user applications, and average seektime excludes same-cylinder requests, average seektime is not an accurate metric of actual I/O subsystem practice.

Observations of a number of application environments have revealed a high degree of locality of reference. In making such measurements, we have found it convenient to express seek distance in terms of the number of megabytes of disk storage that separate successive requests, rather than the number of tracks or cylinders. This gives the benefit of normalization. In comparing the disk subsystem performance experienced by a user application accessing first one and then another model of disk drive, differences caused by geometry and formatting characteristics are eliminated. The user can relate disk performance to the size of a contiguous data file, and estimate what the seektime will be in making consecutive requests to the first and last blocks within the file.

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In observing these application environments we found that the majority of all successive references lie within a few tens of megabytes of storage space; for the SA482 storage array the following table shows seektimes versus distances in such a range.

Seek Distance (Mbytes)	Seektime (Milliseconds)
10	9.0
20	10.6
40	12.9
60	14.1
80	15.5
100	16.8

#### **Flexibility—Performance, Capacity, and Redundancy—The Right Blend**

The flexible design of Digital's DSA I/O servers and controllers combined with the individual spindles within the SA482 storage array permits the right blend of capacity, redundancy, and performance for your application, particularly in VAXcluster environments.

The SA482 storage array can be served by a single channel on an HSC I/O server to provide a high-capacity, high-reliability, high-performance I/O subsystem. But DSA flexibility also permits the SA482 to be served by two, three, or even four channels belonging to from one to four HSC I/O servers. That permits redundant connections for failover or load distribution for maximum performance—the choice is yours.

And to make that choice easier for you, we provide services and education designed to help you understand storage-management techniques and our products so you'll get the most out of them.

From standard utilities like Monitor, to a soon-to-be-offered Digital Educational Services Storage Skills Workshop, to Software Performance Monitor (SPM) services, Digital offers you access to the important skills and information you need to get the most from your SA482 storage array.

#### **Digital's Commitment to Quality Is Embodied in Reliability and Warranty**

Investigations of customers' storage needs provide a clear message—customers rank reliability and service as the top two criteria for the selection of a storage vendor. Digital answers these criteria by delivering an extensively tested, solidly reliable storage device, and supporting it with a one-year DECservice Hardware Warranty backed by the Digital Field Service Organization.

Throughout the one-year warranty period, the SA482 storage array will have the full support of service tools and technology that have been developed for the entire VAX family with a 2-hour response time on the VAX 8000 series systems and a 4-hour response time on all others.

The one-year warranty provides Digital's highest level of onsite service. This commitment to quality is backed by experience gained in the most extensive field test of any storage product ever offered by Digital.

At the end of your one-year warranty, you can choose from our many service packages; we have a plan that's just right for your needs. If you'd like to keep the same high level of service you enjoyed during the warranty period, then choose DECservice with committed response times, available 24 hours a day, 7 days a week. For less critical applications, choose the Basic Service Agreement.

#### **The SA482 Storage Array Is Built and Serviced by a Major Force in the Mass-storage Market—Digital**

Digital is among the largest computer companies and one of the largest manufacturers of storage products, with manufacturing facilities operating worldwide. Commitment to the mass-storage business requires a significant and continuing investment in equipment and expertise. Digital makes this investment because we understand the importance of delivering complete computing solutions to our customers.

And we stand behind our products. Our Field Service organization comprises thousands of highly skilled people worldwide. Their goal—to ensure your highest level of satisfaction by providing high-quality, accessible, cost-effective services that meet your service needs.

\* Performance specifications (and others as indicated) are provided on a per spindle basis. Other specifications are applicable to the entire SA482 storage array.

† All performance data reflects raw drive hardware capability and does not include improvements resulting from controller optimization.

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## Specifications\*

### Performance†

Peak transfer rate	2.4 Mbytes/second/spindle
Average seektime	24 milliseconds/spindle
Rotational latency (average)	8.3 milliseconds/spindle
Average access time	32.3 milliseconds/spindle
Head switch latency (maximum)	3 milliseconds/spindle
Start/stop time (nominal)	50 seconds/20 seconds/spindle

### Media Characteristics

Formatted capacity	2.488 Gbytes
Unformatted capacity‡	3.420 Gbytes
Tracks per inch	1063
Bits per inch	12,545
Rotational speed	3600 r/m
Number of data surfaces	32 (8/spindle)
Number of heads per surface	2
Sectors per track	57
Bytes per sector	512
Logical cylinders	1423/spindle
Tracks per logical cylinder	15

### Power Requirements

Frequency (single phase)	60 Hz	50 Hz
Current (starting/running/per spindle)	33.6 A/7.8 A	18 A/3.5 A

### Operational Environment

Temperature range	10°C to 40°C (50°F to 104°F)
Derating for altitude	1.8°C/1000 m (1°F/1000 ft)
Relative humidity	10% to 85%, noncondensing
Max wet bulb	28°C (82°F)
Heat dissipation	2000 Btu/h (650 watts)
Altitude (max)	2400 m (8000 ft)

### Physical Characteristics

Height	156.0 cm (61.5 in)
Width	55.9 cm (22.0 in)
Depth	91.4 cm (36.0 in)
Weight	400.0 kg (880.0 lb)

### Model numbers

SA482-AA	60 Hz, 120 V
SA482-AD	50 Hz, 240 V

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