

## Storage Array Family

Architecturally Compatible Storage Solutions for VAX Computing

digital



*Portrait of the Storage Array Family. Left to right: the SA482 Storage Array, the SA600 Storage Array, the SA550 Mixed Storage Array, and the SA650 Mixed Storage Array.*

### **Mainframe Storage in a Minicomputer Footprint**

The Storage Array Family of integrated storage products offers high-performance, leadership solutions to your large-scale database and storage requirements.

Storage Array Family members are configured with Digital's fastest, most reliable, and highest-capacity disk drives to optimize use of computer room floor space. The result is a unique family of storage products which feature:

- Mainframe storage in a minicomputer footprint
- Complementary performance and mass storage solutions in a single cabinet
- State-of-the-art reliability
- Maximum system availability and data integrity
- Full conformance with Digital Storage Architecture (DSA)

The Storage Array Family currently consists of the SA650 and SA550 Mixed Storage Arrays and the SA600 and SA482 Storage Arrays. These range in capacity from 1.8 to 9.7 gigabytes all in the same small footprint, offering the capacity and performance flexibility to meet varying customer needs.

The Storage Arrays are available in entry-level, partially populated configurations called Storage Array Building Blocks (SABBs). Additional component drives can easily be added to SABBs in the field for maximum storage potential.



*The SA550 Mixed Storage Array, left, offers performance boost with use of the RA70 and RA82 component disk drives. The SA650 Mixed Storage Array combines the most advanced technologies with use of the RA90 and RA70 component disk drives.*

## Highlights

- The best of both worlds—performance and capacity. With the mixed disk drive strategy used in the SA650 and SA550 Mixed Storage Arrays, new technology allows frequently accessed files and large capacity requirements to be served in one storage array.
- Optimized footprint. Up to 9.7 gigabytes of user-accessible formatted capacity (12.8 gigabytes unformatted\*) in a mere 5.5 square feet of computer room floor space is available in the SA600 Storage Array. Up to 9.5 gigabytes of user-accessible formatted capacity (12.4 gigabytes unformatted\*) in the same footprint is available in the SA650 Mixed Storage Array.
- Minimized I/O bottlenecks. The Mixed Storage Array, together with VAX Performance Advisor (VPA) Version 2.0, minimizes I/O bottlenecks and “hot files” by distributing I/O workload over multiple smaller spindles.
- State-of-the-art reliability. Digital's Storage Arrays are backed by extensive qualification and verification tests to ensure that our customers receive outstanding reliability. The proven reliability of the SA482 Storage Array has shown Digital's commitment to our customers' needs, and the entire Storage Array Family continues to extend reliability to meet our customers' increasing requirements.
- Maximized system availability and data integrity. In concert with Digital Storage Architecture (DSA), VAXcluster Systems technology, and Digital's predictive maintenance tool, VAXsimPLUS, Digital's

Storage Arrays maximize system uptime.

- Full conformance with Digital Storage Architecture (DSA). Digital Storage Arrays adhere to DSA's requirement that DSA-based products provide compatibility across technological generations. Therefore, unprecedented investment protection in hardware, software, and expertise is guaranteed.

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

### **The Storage Array Concept**

Digital recognizes that today's applications require storage systems with both capacity and performance while making optimal use of computer room floor space.

With these requirements in mind, Digital created the Storage Array Family, combining disk drives from our fastest and highest capacity RA-series disk drives into a space- and power-efficient package. The Storage Array Family competes on the leading edge of the mainframe storage industry.

The Digital Storage Array Family is designed to provide simplicity in ordering, configuring, and servicing. Available in partially populated versions called Storage Array Building Blocks (SABBs), the Storage Array Family offers all the advantages of high-end storage solutions with a low entry price and an easy expansion path. Should applications demand increasing performance or capacity, additional component drives can



*The SA482 Storage Array, left, offers 2.5 gigabytes of formatted storage capacity. The SA600 Storage Array offers 9.7 gigabytes.*

easily be added to SABBs without interruption to a system.

Like all RA-series drives, the Storage Array Family's compliance with Digital's Storage Architecture/Standard Disk Interconnect (DSA/SDI) ensures that the Storage Array

Family is compatible with the full line of Digital I/O servers (HSC family) and controllers (UDA50, KDA50, KDB50). DSA/SDI permits the Storage Array Family to elegantly incorporate new technology, thereby protecting your total investment.

### **SA650—Premium Capacity and Performance**

The SA650 Mixed Storage Array and SA650 Building Blocks combine all new disk drive technologies to offer the best of both worlds—superior performance and extensive storage capacity. Configured with up to six RA90 1,216-megabyte disk drives and up to eight RA70 5.25", 280-megabyte dual port disk drives, the SA650 Mixed Storage Array offers up to 9.5 gigabytes of user-



accessible formatted storage.

The SA650 Mixed Storage Array permits 1.7 times the number of users or 1.7 times the I/O throughput of the SA600 Storage Array. Housed in a 60-inch high cabinet, the SA650 Mixed Storage Array oc-

cupies only 5.5 square feet of computer room floor space.

The dual disk drive strategy exhibited in the SA650 Mixed Storage Array creates a complementary storage solution which makes the most of the RA90 disk drive's half height composition and large storage capacity, and the RA70 disk drive's multiple spindle accessing of data and extremely high I/O service rates. The RA70 disk drive also provides 280 megabyte increments, offering greater configuration flexibility to the demanding system manager. Fully compatible with the entire family of DSA/SDI controllers and I/O servers, the SA650 Mixed Storage Array is easily integrated with Digital's entire family of mid-range and high-end VAX processors.

The RA70 and RA90 disk drives both are constructed of state-of-the-art thin film media, giving the SA650 Mixed Storage Array an industry-leading overall density of recording surface. This makes the SA650 Mixed Storage Array extremely cost effective from a cost per megabyte perspective. And, a flexible configuration provides far-reaching applications, dependent upon a customer's needs and configuration choice.

The SA650 Mixed Storage Array is exceptionally reliable due to use of Digital's predictive maintenance tool, VAXsimPLUS, and extensive testing done to all the subsystem components. Maintenance ease also is a main feature of the array, so any problems that might occur are kept to a minimum of time and complexity.

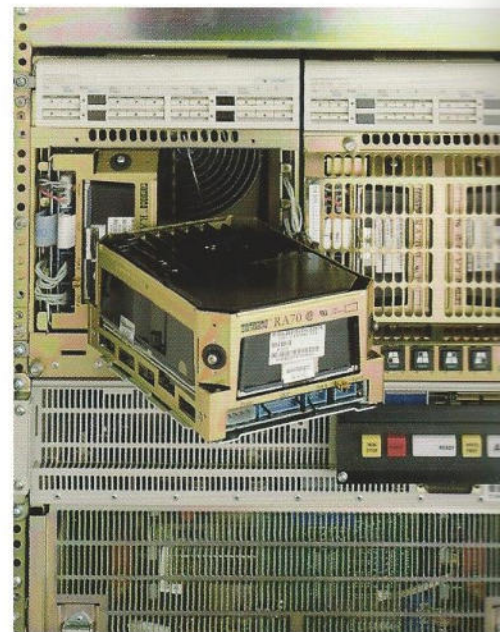
Encompassing high quality data availability and data integrity found with Digital disk drives, the SA650

Mixed Storage Array offers a top-of-the-line high-end storage system solution for exceptional performance and capacity in a cost-effective, reliable package.

### **SA550—Performance Boost with Investment Protection**

The SA550 Mixed Storage Array and SA550 Building Blocks bring the benefits of added performance and investment protection to an installed base. The mix is composed of up to three RA82 622-megabyte disk drives and up to eight RA70 5.25", 280-megabyte dual port disk drives.

The SA550 Mixed Storage Array permits 2.75 times the number of users or 2.75 times the I/O throughput of the SA482 Storage Array. And, offering up to 4.1 gigabytes of user-accessible formatted capacity, the 60-inch high SA550 Mixed Storage Array cabinet uses a small 5.5 square feet of computer room floor space. This is 1.7 times the



*The RA70 5.25" dual port disk drive offers extremely high I/O service rates.*

floor space utilization of the SA482 Storage Array.

With the the RA70 disk drive's high I/O service rates and the RA82 disk drive's large capacity storage, the SA550 Mixed Storage Array makes available a complementary storage solution for frequently accessed, disk performance bound applications. Like all RA drives, it is fully compatible with the BI, CI, and UNIBUS.



The RA70 continues Digital's reliability tradition through use of thin film media and both thin film and mini-composite heads. Achieving an areal density of 30.4 megabits per square inch, the SA70 boosts performance by utilizing multiple spindle accessing of data. This enables simultaneous operation of actuators and thus quicker service time in obtaining data, and adds to the total subsystem performance found with Digital's controller optimization features.

The low cost per megabyte advantage makes the SA550 Mixed Storage Array extremely cost effective, especially given its Digital Storage Architecture data integrity and availability attributes, and complete SDI functionality. The RA70 provides 280 megabyte increments which offer greater configuration flexibility to the demanding system manager, and is fully compatible with the range of Digital processors.

The SA550 configuration allows the flexibility to accommodate both a customer's installed drive base and future applications needs with the minimum of difficulty. Additional component drives can easily be added to SA550 Storage Array SABBs for easy upgrade in the field. This allows a flexible growth path for maximum storage potential in the same size footprint.

The superior data availability and reliability associated with Digital disk drives combine to make the SA550 Mixed Storage Array an optimal, investment-protecting storage solution for performance enhancement.

#### **SA600—Optimal Footprint, Data Availability, and Reliability**

The SA600 Storage Array and SA600 Building Blocks provide maximum storage potential for the most demanding mainframe database requirements. Composed of up to eight RA90 1.2 gigabyte disk drives in a 60-inch high cabinet, the SA600 Storage Array offers up to 9.7 gigabytes of user-accessible storage in a mere 5.5 square feet of floor space. A fully configured SA600 packs 1.8 gigabytes into each square foot of computer room floor space.

The capacity of the SA600 Storage



Array is made possible through advanced, thin-film heads and media which provide an industry-leading density of over 40 million bits per square inch of recording surface.

The SA600 Storage Array and its component drive, the RA90, extend the successful compatibility record of the Digital Storage Architecture. The SA600 Storage Array is plug compatible with the entire family of DSA/SDI controllers and I/O servers and is therefore compatible with Digital's entire family of mid-range and high-end VAX processors.

State-of-the-art reliability was a key design consideration in the SA600 Storage Array. Before being released, the SA600 Storage Array was put through exhaustive design maturity, verification, heads, media, and component testing. This established the SA600 as one of Digital's highly reliable high-end disk storage products, a status maintained through continued

testing, ensuring current product improvements. In addition, Digital has made a substantial investment in automated manufacturing equipment to establish process repeatability, cleanliness, and quality, all of which contribute to outstanding Head Disk Assembly (HDA) reliability.

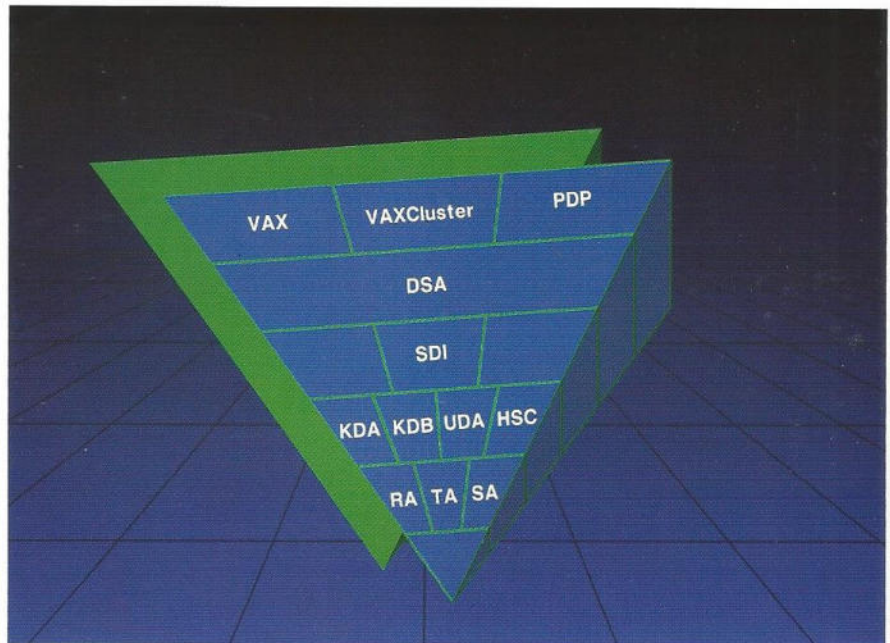
The result is a storage array designed for a wide range of application environments in which performance, capacity, reliability, and cost are key criteria.

#### **SA482—Entry-level Mainframe Storage**

The SA482 Storage Array and SA482 Building Blocks are ideal for entry-level storage solutions which require an easy growth path and high performance. Composed of up to four RA82 622-megabyte disk drives in a 60-inch high cabinet, the SA482 Storage Array offers up to 2.5 gigabytes of user-accessible formatted capacity in a mere 5.5 square feet of computer room floor space. A peak transfer rate of 2.4 megabytes/second/drive makes the SA482 Storage Array at home in departmental computing environments.

The SA482 Storage Array offers full SDI functionality including dual-porting, and has all the data integrity and data availability our customers have come to expect from the Digital Storage Architecture. In addition, the SA482 Storage Array provides proven reliability and therefore low service cost.

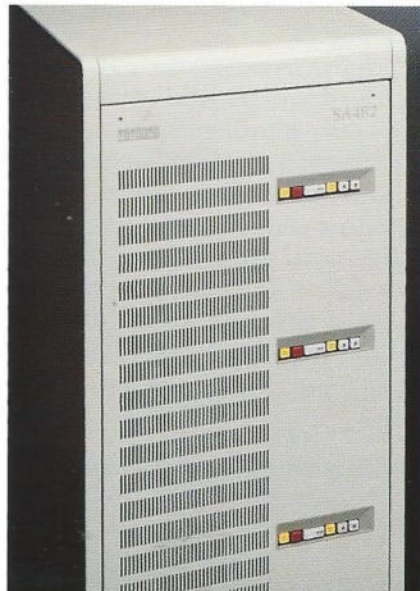
Each of the RA82 component drives in the SA482 Storage Array uses a fully independent rotary positioner. To minimize seek distance and maximize user-visible performance, each rotary positioner implements two heads per recording surface. In



*The unique architectural approach of DSA storage products enables layers of new products to incorporate leading-edge technology while remaining compatible with existing devices.*

addition, the RA82 disk drive positioner has been specifically tuned for maximum throughput in typical VAX systems environments.

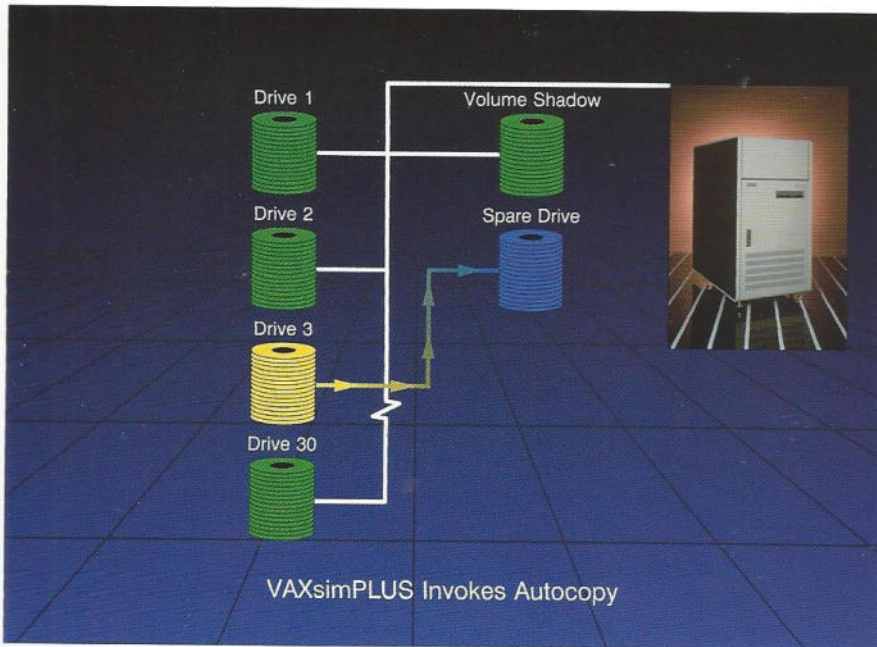
Coupled with Digital's intelligent I/O servers and controllers, the SA482 Storage Array offers high performance, high capacity, and maximum system uptime.



#### **DSA/SDI: Tracking New Technology While Protecting Your Investment**

The Storage Array Family fully conforms to the Digital Storage Architecture/Standard Disk Interconnect (DSA/SDI). As a result, the SA650 Mixed Storage Array, SA550 Mixed Storage Array, SA600 Storage Array, and SA482 Storage Array—like other Digital DSA/SDI storage products—offer exclusive benefits, including:

- Maximized data integrity through an industry-leading 170-bit error correction code, an error detection code (to cross-check controller data paths), and bad block replacement system which is transparent to host applications. Data integrity is further extended by quadruplicate copies of header information, auto-correlated sync fields, and reserved blocks for field service diagnostics.



*Disk-related downtime is virtually eliminated with VAXsimPLUS. Using knowledge-based diagnostics, VAXsimPLUS software automatically predicts problems in RA-series drives and devises a course of action.*

- High system availability through radial, transformer-coupled, and electrically isolated connections. A drive can be added to the system or removed for service without affecting other drives in the array or system uptime.

Like all DSA/SDI drives, controllers, and I/O servers, the SA650 and SA550 Mixed Storage Arrays and the SA482 and SA600 Storage Arrays are plug compatible. This means any Storage Array component drive can be connected to any of the SDI I/O servers or controllers simply by plugging in a cable.

DSA enables use of any Digital Storage Array with the VAXcluster system and most VAX and PDP systems. Benefits are found from such controller optimization features as seek ordering, rotational optimization, and, in the I/O servers, request fragmentation.

### Maximize Storage Uptime with VAXsimPLUS

Digital's new knowledge-based diagnostic tool, VAXsimPLUS, further extends the reliability of all RA-series drives, and therefore, the Storage Array Family. Representing a significant advancement in service technology, VAXsimPLUS provides an "early warning" capability that alerts customers to potential problems. Available at no charge as part of the standard Digital service agreement, VAXsimPLUS automatically notifies the operator and/or Digital Field Service of a suspect Field Replaceable Unit (FRU) and suggests an appropriate course of action.

The "PLUS" in VAXsimPLUS refers to the addition of expert-based software for predicting potential failures in RA-series Winchester disks prior to any data loss. In a

VAXcluster System, VAXsimPLUS provides automatic fail-over capability through VMS Volume Shadowing to create a "realtime" copy of the suspect disk. The duplicate disk is then used to keep the system operating while the failing component is replaced and the disk is returned to operation. This service capability virtually eliminates disk-related downtime.

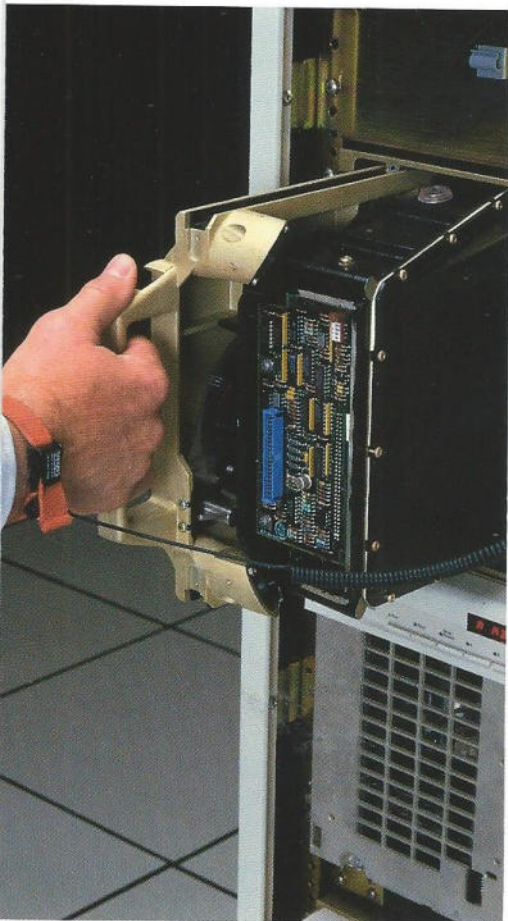
### Designed-in Reliability, Backed by a One-year Warranty

Digital designed the Storage Array Family to provide reliable storage products consisting of fewer functional components with well-defined interfaces. Fewer components for diagnosis and replacement means higher reliability and quicker repair times.

The RA90 component drives in the SA600 Storage Array and SA650 Mixed Storage Array, and the RA70 component drives in the SA650 and SA550 Mixed Storage Arrays, for example, are designed for maintainability with a minimum of FRUs. If a component drive experiences a problem, the FRU in question can be replaced quickly and efficiently, thereby minimizing mean time to repair (MTTR). FRUs in all Storage Array Family members can be diagnosed and replaced without affecting the total operation of the array.

What's more, the Storage Array Family's wealth of onboard diagnostics and extensive fault isolation and recovery mechanisms makes each Storage Array self-diagnosing. Most diagnostics can be run without affecting system operation.

Besides delivering extensively tested, high-quality, mid-range and high-end storage products, Digital



*Reliability and serviceability are designed into the Storage Array family. Field Replaceable Units (FRUs) can be replaced without affecting the operation of the total array.*

supports the Storage Array Family with a one-year warranty. The level of warranty service is the same as the system to which they are attached, assuring a consistent level of service for the entire system.

Each system features a choice of three System Support levels:

- *Basic*, providing a fundamental level of support for non-critical applications.
  - *Standard*, providing the recommended level of support satisfying the needs of the majority of applications.
  - *Optimum*, including higher levels of support for critical applications. Please see your salesperson for more details.
- \* Service terms may vary depending on geographic location. Check with your local Digital Field Service Office for details on response time in the service terms offered in your area.

#### **Let Us Help You Find the Answers**

To learn more about the Storage Array Family or any other Digital product, please call your nearest Digital sales office. Or, in the United States, if you have specific questions, call our toll-free information hotline, 1-800-DEC-INFO (1-800-332-4636).

### **Storage Arrays Specifications**

#### **CAPACITY**

Formatted capacity  
 Unformatted capacity \*

#### **PERFORMANCE**

Maximum requests/second \*\*  
 (@ 50 ms avg response time)  
 Maximum requests/second  
 (@ 100 ms avg response time) \*\*\*

#### **POWER REQUIREMENTS**

Frequency  
 option xA  
 option xD

Voltage  
 option xA  
 option xD

Number of phases

Start up current  
 option xA  
 option xD

Power receptacle type  
 option xA  
 option xD

#### **OPERATIONAL ENVIRONMENT**

Temperature range  
 Maximum wet bulb temp.

Relative humidity  
 (noncondensing)

Maximum altitude km

Maximum altitude ft

Derating factor °C/m  
 for altitude °F/ft

Heat dissipation Btu/h  
 watts

#### **PHYSICAL CHARACTERISTICS**

Height

Width

Depth

Weight kg

lb

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



**(Full Configurations)**

| SA650                      | SA550                      | SA600                      | SA482                      |
|----------------------------|----------------------------|----------------------------|----------------------------|
| 9.5 GB                     | 4.1 GB                     | 9.7 GB                     | 2.5 GB                     |
| 12.4 GB                    | 5.4 GB                     | 12.9 GB                    | 3.4 GB                     |
| 530                        | 410                        | 310                        | 150                        |
| 640                        | 500                        | 370                        | 180                        |
| 50/60 Hz                   | 60 Hz                      | 50/60 Hz                   | 60 Hz                      |
| 50/60 Hz                   | 50 Hz                      | 50/60 Hz                   | 50 Hz                      |
| 120/208                    | 120/208                    | 120/208                    | 120/208                    |
| 240/416                    | 240/416                    | 240/416                    | 240/416                    |
| 3                          | 3                          | 3                          | 3                          |
| 17.8                       | 41.8                       | 16.5                       | 35 ****                    |
| 10.5                       | 18.9                       | 9.9                        | 17.7 ****                  |
| L21/30R                    | L21/30R                    | L21/30R                    | L21/30R                    |
| IEC 309                    | IEC 309                    | IEC 309                    | IEC 309                    |
| 10-40°C<br>(50-104°F)      | 10-40°C<br>(50-104°F)      | 10-40°C<br>(50-104°F)      | 10-40°C<br>(50-104°F)      |
| 28°C (82°F)                | 28°C (82°F)                | 28°C (82°F)                | 28°C (82°F)                |
| 10%-85%                    | 10%-85%                    | 10%-85%                    | 10%-85%                    |
| 2.4 km<br>8000 ft          | 2.4 km<br>8000 ft          | 2.4 km<br>8000 ft          | 2.4 km<br>8000 ft          |
| 1.8°C/1000 m<br>1°F/1000ft | 1.8°C/1000 m<br>1°F/1000ft | 1.8°C/1000 m<br>1°F/1000ft | 1.8°C/1000 m<br>1°F/1000ft |
| 8164 Btu/h<br>2392 watts   | 8533 Btu/h<br>2500 watts   | 7870 Btu/h<br>2306 watts   | 8873 Btu/h<br>2600 watts   |
|                            | ← 156 cm (61.5 inches) →   |                            |                            |
|                            | ← 55.9 cm (22 inches) →    |                            |                            |
|                            | ← 91.4 cm (36 inches) →    |                            |                            |
| 925 lb<br>420 kg           | 925 lb<br>420 kg           | 885 lb<br>402 kg           | 880 lb<br>400 kg           |

\*\* For a typical VAX I/O environment, with specification margin and subsystem overhead.

\*\*\* For symmetrical load balancing. It is recommended that Storage Arrays be loaded at more conservative levels.

\*\*\*\* Drives start up sequentially.

## Component Disk Drives Specifications

|   | RA90      |
|---|-----------|
| <b>CAPACITY</b>                             |           |
| Formatted capacity                          | 1.2 GB    |
| Unformatted capacity *                      | 1.6 GB    |
| <b>PERFORMANCE</b>                          |           |
| Peak transfer rate **                       | 2.8 MB/s  |
| Average seek time **                        | 18.5 ms   |
| Average rotational latency **               | 8.3 ms    |
| Start/stop time (maximum) **                | 40 s/30 s |
| Maximum requests/second ***<br>(at 50 ms)   | 39        |
| Maximum requests/second ****<br>(at 100 ms) | 46        |
| <b>MEDIA CHARACTERISTICS</b>                |           |
| Tracks per inch                             | 1750      |
| Bits per inch                               | 22839     |
| Rotational speed                            | 3600 rpm  |
| No. of data surfaces                        | 13        |
| No. of heads per surface                    | 1         |
| Data sectors per track                      | 69        |
| Spare sectors per track                     | 1         |
| Bytes per sector                            | 512       |
| Logical cylinders                           | 2649      |
| Tracks per logical cylinder                 | 13        |

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

\*\* All performance data reflects raw drive hardware capability and may not include improvements due to controller optimizations.

\*\*\* For a typical VAX I/O environment, with specification margin and subsystem overhead.

\*\*\*\* For symmetrical load balancing. It is recommended that Storage Arrays be loaded at more conservative levels.

| <b>RA70</b> | <b>RA82</b> | <b>RA81</b> |
|-------------|-------------|-------------|
| 280 MB      | 622 MB      | 456 MB      |
| 350 MB      | 855 MB      | 627 MB      |
| 1.45 MB/s   | 2.4 MB/s    | 2.2 MB/s    |
| 19.5 ms     | 20.0 ms     | 28.0 ms     |
| 7.5 ms      | 8.3 ms      | 8.3 ms      |
| 44 s/15 s   | 50 s/20 s   | 50 s/20 s   |
| 38          | 37          | 30          |
| 45          | 45          | 37          |
| 1355        | 1063        | 960         |
| 22437       | 12545       | 11400       |
| 4000 rpm    | 3600 rpm    | 3600 rpm    |
| 11          | 8           | 7           |
| 1           | 2           | 2           |
| 33          | 57          | 51          |
| 1           | 1           | 1           |
| 512         | 512         | 512         |
| 1507        | 1423        | 1248        |
| 11          | 15          | 14          |

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