

# SUN STORAGE F5100 FLASH ARRAY

## KEY FEATURES

### ACCELERATING DATABASE PERFORMANCE WITH THE WORLD'S FASTEST SOLID-STATE FLASH ARRAY

- Unprecedented performance, power, and space efficiency
- World's first flash storage array with more than 1 million IOPS in 1U of space, equivalent to more than 3,000 disk drives in I/O performance
- Up to 2 TB of solid-state capacity in just 1U of space, scalable up to 80 TB and more than 50 million IOPS in a single rack
- More than 100 times less power and space versus traditional disk drives for the same I/O performance
- Up to 80 percent less cost versus disk drives for similar performance
- High reliability with enterprise-class SLC flash technology, advanced wear leveling, write endurance, and integrated data protection

*Oracle's Sun Storage F5100 flash array, with its blazing record performance, offers a new approach to solving the storage performance issues that slow down modern enterprise applications. With well over 1 million I/O operations per second (IOPS) in just one rack unit (1U) of space and using only 300 watts of power, the system can help eliminate storage bottlenecks, decrease latencies, and improve response times while conserving datacenter resources. Its power and space requirements are as much as 100 times lower than traditional disk drive solutions, allowing you to reach new levels of transactional scalability while also reducing operating costs.*

### Challenges IT Managers Face

Today more and more applications, especially databases, are being choked by disk drives that can no longer keep up with CPU performance, causing latencies and I/O bottlenecks. The traditional approach of using large numbers of mechanical disk drives to address growing storage performance needs can greatly increase power, cooling, and space costs. IT managers are looking for more-cost-effective and highly scalable storage solutions that can quickly accelerate application performance while also reducing operating costs.

### Hungry for I/O Performance

Many of today's enterprise applications require a high volume of I/O throughput to deliver the high service levels needed to keep users productive. Oracle database applications, such as enterprise resource planning solutions, often serve thousands of users with a single central database instance that is accessed for each transaction. High-performance computing and financial trading applications represent additional categories of applications that require low-latency access to large data stores to support adequate application performance. Scaling to meet the performance requirements of these applications can be a very costly undertaking using traditional storage architectures.

For I/O-intensive applications, performance is not bound by the CPU, but by I/O throughput. Disk access speeds remain one of the major bottlenecks. While CPU performance has been doubling every year with Moore's law and continues to grow rapidly with today's multicore CPUs, disk drive performance has not kept pace.

Seek times on today's mechanical disk drives are more than 200 times slower than today's servers, causing application performance to suffer from storage latencies and I/O bottlenecks. To compensate for this performance gap and slow seek times, application data is often spread across a large pool of high-performance 15 K rpm disk drives that are "short stroked" for better performance.

This effectively multiplies I/O throughput by enabling read and write operations to take advantage of multiple spinning disks. However, it also results in inefficiencies, because the need for performance results in configurations with more disk drives than would be warranted based solely on capacity requirements. The high power requirements of 15 K rpm drives and the poor space use of partially filled disks also result in unnecessary datacenter power, space, and capital costs.

Another approach to compensating for slow disk access speeds is to deploy a large buffer of DRAM, so that an entire application's working set can be stored in memory, thus reducing latency. Although DRAM offers very high performance, it is also quite costly and requires a battery backup due to its volatile nature.

Both of these traditional storage architectures are costly to acquire and operate. Furthermore, as CPU performance continues its exponential growth, these architectures will eventually become impractical. A new approach is needed that can meet today's demanding storage performance requirements at a minimum cost and with minimum power, space, and cooling requirements.

### **Solid-State Flash Technology Offers an Alternative**

Recent advances in the production of flash technology have made solid-state drives (SSDs) and flash array products much more cost effective, enabling a new approach to tiered storage. Solid-state flash and SSDs fall in a cost and performance "sweet spot" between mechanical drives and DRAM. They are nonvolatile and significantly cheaper than DRAM. They also offer much-higher performance and greater power efficiency than hard disk drives (HDDs).

Reliability characteristics of enterprise-class flash and SSDs have also improved, yielding mean time between failures (MTBF) ratings that exceed those of HDDs. Like HDDs, enterprise SSDs also support bad block management, wear leveling, and error correction codes to foster the highest level of data integrity and reduce service downtime. The solid-state nature of flash allows enterprise SSDs to withstand significantly higher shock and vibrations than HDDs.

### **Sun Storage F5100 Flash Array**

The Sun Storage F5100 flash array is the world's first solid-state flash storage array delivering more than 1.2 million read and write IOPS and up to 2 TB of solid-state capacity in 1U of space. That's the equivalent of more than 3,000 enterprise disk drives in I/O performance while using less than three lightbulbs (300 watts) of power. A single rack of systems can deliver more than 50 million IOPS with more than 80 TB of capacity. This blazing performance can help you accelerate applications while improving productivity and ecoefficiency.

### **Redefining Storage Performance**

The Sun Storage F5100 flash array redefines storage performance and efficiency with an incredible 1.6 million read and 1.2 million write IOPS in just 1.75 inches of rack space. It sets new benchmark records for IOPS per dollar, IOPS per watt, and IOPS per space. I/O-intensive database applications with heavy I/O read and 4 K block-aligned write workloads can take advantage of the Sun Storage F5100 flash array to accelerate their performance, improve response times, and increase transactional scalability, while also reducing power and space costs.

### **Breakthrough Economics**

The Sun Storage F5100 flash array offers a breakthrough in storage economics with industry-leading price/performance, power/performance, and space/performance efficiency. By using the Sun Storage F5100 flash array to address your performance needs, you can supplant costly and inefficient 15 K rpm disk drives, which drive up power and storage costs. This can help you significantly reduce both storage costs and operating costs, resulting in much-lower TCO.

### **High Reliability**

The Sun Storage F5100 flash array provides a very high level of reliability with an all-solid-state durable design consisting of 80 nonvolatile enterprise-class single-level cell (SLC) flash modules, each with MTBF exceeding that of enterprise disk drives. The system uses sophisticated wear leveling, advanced bad block mapping, and enhanced write endurance to help ensure the highest level of reliability and longevity. Redundant power and cooling helps reduce the risk of downtime, and integrated supercapacitors help prevent interruptions in write operations should a power failure occur. Host-based mirroring can also be used for mirroring internal domains or individual flash arrays.

The flash array takes advantage of data integrity features in the Oracle Solaris Zettabyte File System (ZFS), including ZFS RAID, automatic data integrity checking, and correction with block-level checksums. When a corrupt block is identified, self-healing features in Oracle Solaris ZFS will direct another copy to be written as an automatic repair, thus helping to prevent silent data corruption.

### **Easy to Deploy and Manage**

The Sun Storage F5100 flash array appears as a normal storage device enabling easy deployment with instant performance benefits into new or existing environments, whether using the Oracle Solaris operating system, Windows, or Linux. The flash array can be managed together with other Sun storage arrays using Sun StorageTek Common Array Manager (CAM) software, which provides a common, simple-to-use management interface. Sun StorageTek CAM's fully integrated Service Advisor software offers proactive health checking and supports quick time to service. System error messages are connected directly to specific repair procedures in the patch knowledgebase, making common repairs simple and easy.

### **Services to Help Maximize Your Investment**

Make the most of your solution and meet your need for high performance with support and services that can help you be successful installing, optimizing, and maintaining your system.

Oracle's global services organization can consult with you to architect, implement, and manage a tailored solution to address your unique IT and storage challenges, so that you can quickly realize benefits from your investment. Oracle teams provide ongoing expertise throughout the IT lifecycle with consulting services that architect the strategies and infrastructures needed to reduce business risk and lower storage costs. Installation and implementation services are designed to address your needs for performance, availability, capability planning, and management efficiency.

Oracle's consulting and managed services also offer clear and simple choices to address your regulatory concerns as well as your requirements for complex storage growth, resource management, and scalability. Oracle's dedicated storage service professionals can help you gain and sustain measurable results with the reliability and flexibility that you require.

<b>Sun Storage F5100 Flash Array Specifications</b>			
	20 Flash Modules	40 Flash Modules	80 Flash Modules
<b>Capacity</b>			
Capacity*	480 GB	960 GB	1,920 GB
Domains	Four	Four	Four
<b>I/O Performance**</b>			
Random read IOPS (4 K)	397 K IOPS	795 K IOPS	1.6 M IOPS
Random write IOPS (4 K)	304 K IOPS	610 K IOPS	1.2 M IOPS
<b>Throughput***</b>			
Sequential read rate	3.2 GB/sec	6.4 GB/sec	12.8 GB/sec
Sequential write rate	2.4 GB/sec	4.8 GB/sec	9.7 GB/sec
<b>Latency</b>			
Read latency	0.378 ms	0.378 ms	0.378 ms
Write latency	0.245 ms	0.245 ms	0.245 ms
<b>Interfaces</b>			
Ports	16 x 4-wide SAS-1 (64 channels)		
Zoning	Yes		
<b>Power</b>			
Input	100 V to 120 V AC or 200 V to 240 V AC	100 V to 120 V AC or 200 V to 240 V AC	100 V to 120 V AC or 200 V to 240 V AC
Idle	129 W	157 W	213 W
Active	228 W	281 W	386 W
Power backup	Four energy storage modules (ESMs)	Four ESMs	Four ESMs
<b>Reliability</b>			
Endurance (50% read / 50% write)	Approximately six years		
Redundant power and fans	Yes		
<b>Physical Dimensions</b>			
Height	1.746 in. (44 mm) – 1U		
Width	16.750 in. (425 mm)		
Depth	28.125 in. (714 mm)		
Weight	35 lb. (15.9 kg)		

<b>Environmental</b>	
Temperature	Operating: 5°C to 35°C; Nonoperating: – 40°C to 65°C
Relative humidity	Operating: 10% to 90%, 27°C max; Nonoperating: 10% to 93%, 35°C max
Altitude	Operating: 3,000 m; Nonoperating: 12,000 m
Acoustic	55.4 dB
<b>Management</b>	
Management	Sun StorageTek CAM
Host bus adapter (HBA) performance	New HBA firmware (ver. 1.27.03) required for the best Sun Storage F5100 flash array performance

\* Not shown is additional 25 percent capacity used for advanced wear leveling, write durability, and performance enhancements.

\*\* System, HBA, application, and workload dependent. 4 K write block optimized. (Results based on four corners performance as tested with four SPARC Enterprise T5240 systems from Oracle and 16 SAS-1 HBAs.)

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### Warranty

Visit [oracle.com/sun/warranty](http://oracle.com/sun/warranty) for Oracle's global warranty support information on Sun products.

### Services

Visit [oracle.com/sun/services](http://oracle.com/sun/services) for information on Oracle's service program offerings for Sun products.

### Contact Us

For more information about Oracle's Sun Storage F5100 flash array, please visit [oracle.com/storage](http://oracle.com/storage) or call +1.800.786.0404 to speak to an Oracle representative.



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