# Silicon Motion's New FerriSSD®

Boosts Server Performance in a BGA-SSD

Introduction

Over the past few years, an increasing number of solid state storage drives (SSDs) have been appearing in consumer devices. Not surprisingly, servers are now utilizing SSD's superior performance to keep pace with dramatic increase in data traffic – a task that traditional hard disk drives (HDDs) simply cannot accomplish.

One area where SSDs are been adopted in Servers is for boot drives, for SSD are far superior to HDD as boot drives for a multiplicity of reasons. First, SSDs are faster - where HDDs may require minutes to boot up a server, a SSD can fire up a server in seconds. This dramatic improvement is because SSDs are powered by fast NAND flash technology instead of rotating media found in HDDs. As a result, SSDs triumph over HDDs in performing random read/write operations and delivering blazing fast performance – especially in retrieving the small files read during the boot sequence. Second, since SSDs have no moving parts (unlike HDDs) they can withstand environments with higher ambient temperatures and more vibrations, and therefore are much more robust in terms of reliability.

In a server, the performance of the boot drive is paramount - with a faster boot SSD, the overall server system performance can be greatly enhanced. For example, when the server DRAM is full, the OS must shift some "secondary" data to the boot SSD to make room for the new data request. This "swapping" process creates a virtual memory mapping, as it
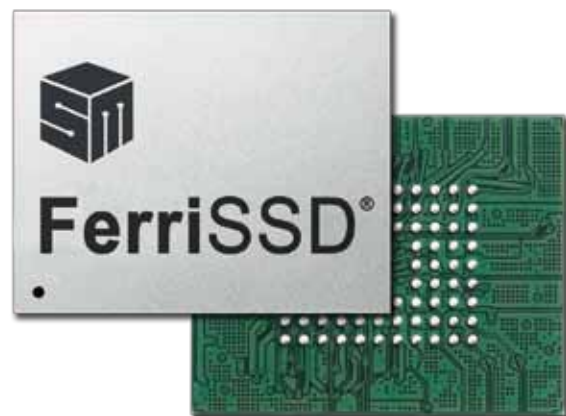
allows the server to run in a limited DRAM memory space. Contrast this with a traditionally slow HDD, which suffers from slow latency because of the "secondary" data that must be read from and written to the storage drive. Therefore, data swapping enabled in a boot SSD boost the overall system performance.

An embedded SSD's small form factor makes it a perfect fit as a server boot drive. Compared to an HDD, adopting an embedded SSD as the server boot SSD is more cost-effective as the basic HDD typically comes with a minimum capacities (usually in Terabytes) and minimum pricing of approximately $50, a boot SSD usually comes with capacities of 128GB or less, resulting in overall cost savings. In addition, a Boot SSD's power consumption is much lower than a typical HDD, saves precious server space, reduces overall cost of ownership and delivers a much more desirable option.

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![SiliconMotion logo]

FerriSSD® Single-Package Server Grade SSD

More servers are now configuring their boot drives with SSDs. A Boot SSD, such as Silicon Motion's FerriSSD, is typically installed as an SSD module (either using a SATA DOM or M.2 form factor) or installed directly onboard with a BGA-SSD. This small form factor enables the FerriSSD to be placed virtually anywhere inside a tight server chassis, including a MicroServer's extremely restricted space.

Armed with Silicon Motion's proprietary IntelligentScan & DataRefresh, FerriSSD will intelligently activate a self-scanning feature to prevent potential data lost before it occurs; the self-scan frequency will be intelligently adjusted by ambient temperature, erase count, read count, and associated factors. FerriSSD's unique features, FastWrite*, PowerShield** and DataPhoenix***, are designed to handle sudden power loss by working together to ensure no data is lost even in the event of a sudden power off.

Adopting FerriSSD as the Boot SSD will enhance the overall server performance, eliminate potential downtime, and reduce the total cost of ownership, generating even greater customer and end-user satisfaction.

· **Small BGA SSD**
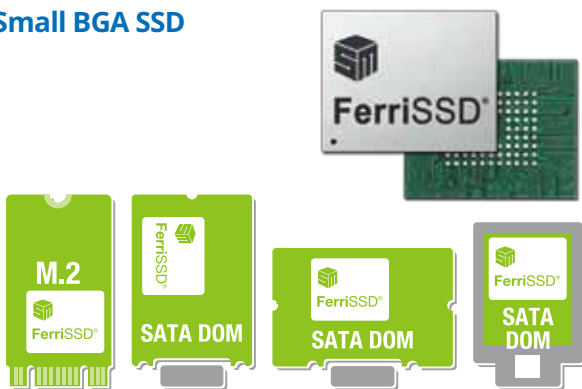
There is no one standard form factor for a server Boot SSD. FerriSSD is designed with a small BGA SSD form

factor so that it can easily fit into a server's tight space. FerriSSD's small package (16x20mm) size can be directly soldered onto the main board or fit it into small modules of a user's choice: M.2 (2230, 2242, etc.), MO300A, MO297, various SATA DOM modules, or even a 2.5" module. With its industrial- standard 1mm ball pitch size, the FerriSSD provides the simplest layout for mechanical engineers, and it is the easiest to manufacture. In addition to utilizing standard module form factors, FerriSSD can be soldered down directly to the main PCB or designed in OEMs' proprietary form factors.

· **The world's best performance in a BGA-SSD**

Silicon Motion's new FerriSSD might be small in size, but it is the world's fastest BGA-SSD, delivering exceptional performance and high reliability for continual operation – making it the perfect choice for Boot SSD. The tables below show FerriSSD performance specs in various configuration and modes (SLC or MLC).

	SLC mode			
FerriSSD Part Number	SM659GX8-CD	SM659GXA-CD	SM659GXB-CD	SM659GXC-CD
Density & Configuration	8GB, 1CH1WAY	16GB, 2CH1WAY	32GB, 4CH1WAY	64GB, 4CH2WAY
CDM 3.0 Coverage Range	500MB	1GB	2GB	4GB
Sequential Read	152.20	299.60	529.20	526.10
Sequential Write	59.61	119.00	235.60	398.00
512K Random Read	136.50	243.80	377.90	362.80
512K Random Write	61.86	124.60	247.70	415.20
4K Random Read	42.97	39.60	39.81	40.01
4K random Write	61.24	110.30	112.40	117.90
4K QD32 Read	71.23	138.60	267.00	294.80
4K QD32 Write	63.32	125.50	248.60	289.30

	MLC			
FerriSSD Part Number	SM619GXA-CD	SM619GXB-CD	SM619GXC-CD	SM619GXD-CD
Density & Configuration	16GB, 1CH1WAY	32GB, 2CH1WAY	64GB, 4CH1WAY	128GB, 4CH2WAY
CDM 3.0 Coverage Range	1GB	2GB	4GB	4GB
Sequential Read	140.10	278.30	526.30	527.4
Sequential Write	24.52	48.45	95.44	184.9
512K Random Read	125.20	222.30	351.70	359.1
512K Random Write	24.89	48.98	96.26	186.7
4K Random Read	35.47	31.63	30.59	31.12
4K random Write	24.46	48.47	95.30	112.4
4K QD32 Read	55.36	107.30	206.70	288.3
4K QD32 Write	24.50	48.77	96.19	186.1

FerriSSD's Essential Features

Silicon Motion has designed FerriSSD to be a complete embedded storage solution, encompassing both hardware and firmware to support an array of industry-leading capabilities, using proprietary technologies. Its features include:

–Advanced NAND Flash management, including error correction, bad block management, cell health monitoring, and automatic recovery

–IntelligentScan with DataRefresh to enhance data retention and read-disturbance protection

–**PowerShield offers advanced protection against a sudden power loss, while ***DataPhoenix delivers instant data recovery.

–Global wear leveling evenly distributes program/erase cycles across all NAND cells; combined with a low write amplification index, this maximizes the SSD lifespan.

–Available in both commercial (0°C to 70°C) and industrial temperature grades (-40°C to 85°C)

–SLC, SLC mode, and MLC NAND Flash types to fit your budget considerations

–Density: 1GB to 128GB (256GB by 2H/2016)

FerriSSD's Proprietary Features

As mentioned earlier in this white paper, FerriSSD is a complete embedded storage solution, including firmware. It offers customizable firmware that supports self-monitoring, analysis and health status reporting, all designed to boost drives with high reliability. Here are some of FerriSSD's outstanding features:

· **100% full range screening delivers lower dPPM**

In server applications, any defect can result in downtime – which is an unacceptable condition. As one of the most effective preventative measures, all FerriSSDs have undergone 100% screening at a customer-specified temperature (c-temp or i-temp) prior to shipping. By undertaking, on a mass production scale, burning in boards at full range temperature, assisted by Silicon Motion's in-depth screen pattern, potentially weak cells are effectively screened off to prevent downtime during usage life. As a result of employing Silicon Motion's years of NAND experience to engineer a proprietary process, FerriSSDs extremely low dPPM can satisfy the rigid demand of today's exacting embedded server market.

Program Erase Cycle with in usage life under normal operation

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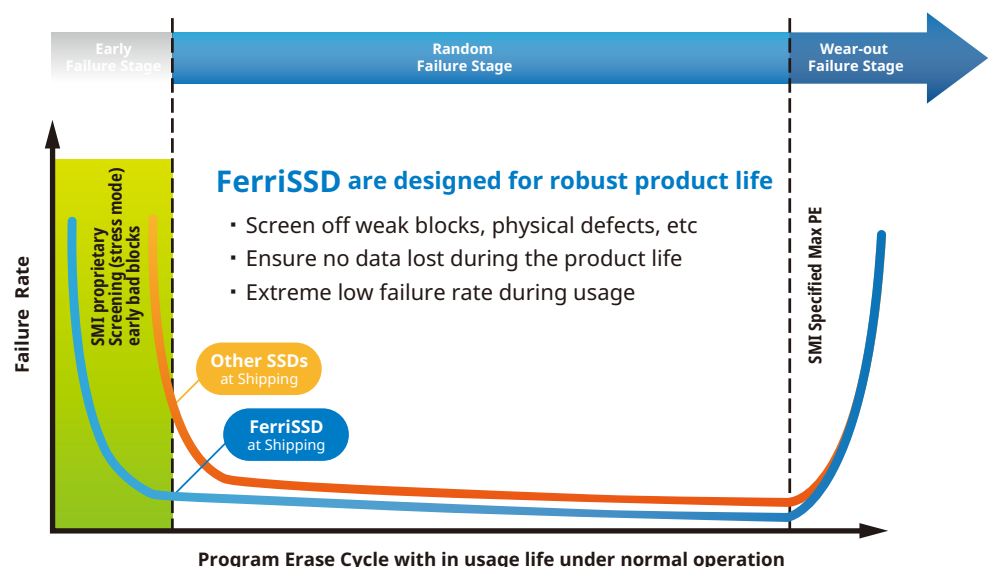
· Server grade data protection: IntelligentScan with DataRefresh

In a server boot SSD application, the application is mostly read without power off for 365 days a year. The most commonly experienced issues are read disturbance from excessive read, and potential data retention corruption as a result of high temperatures within the server chassis. In the world of enterprise computing, data-loss protection ranks as a much higher priority than it does in client computing. While it is vital to protect data at rest (data physically saved to storage media), it is crucial to safeguard data stored in SSDs. The SSD must guarantee that all data is written to the drive and protected.

Here SMI has stepped in and engineered FerriSSD's unique protection: IntelligentScan with DataRefresh, which has proven to be extremely effective against read disturbance and data retention in high temperatures.

With Intelligent Scan, FerriSSD's firmware will respond to changing usage conditions to intelligently determine where, when and how frequently to scan the SSD. The scan will be triggered during idle time, based on preset thresholds and self-adopting algorithms, to determine which cells should be scanned according to severity priority (such as temperature readings, read counts, and other factors).

When IntelligentScan identifies overstressed cells, SMI's proprietary DataRefresh function will be activated automatically to recharge, repair or retire the cell block accordingly. As a result of the combination of Intelligent Scan and Data Refresh, FerriSSD can prolong its usage life much beyond typical NAND specifications.

· *Rapid data save protection via FastWrite™

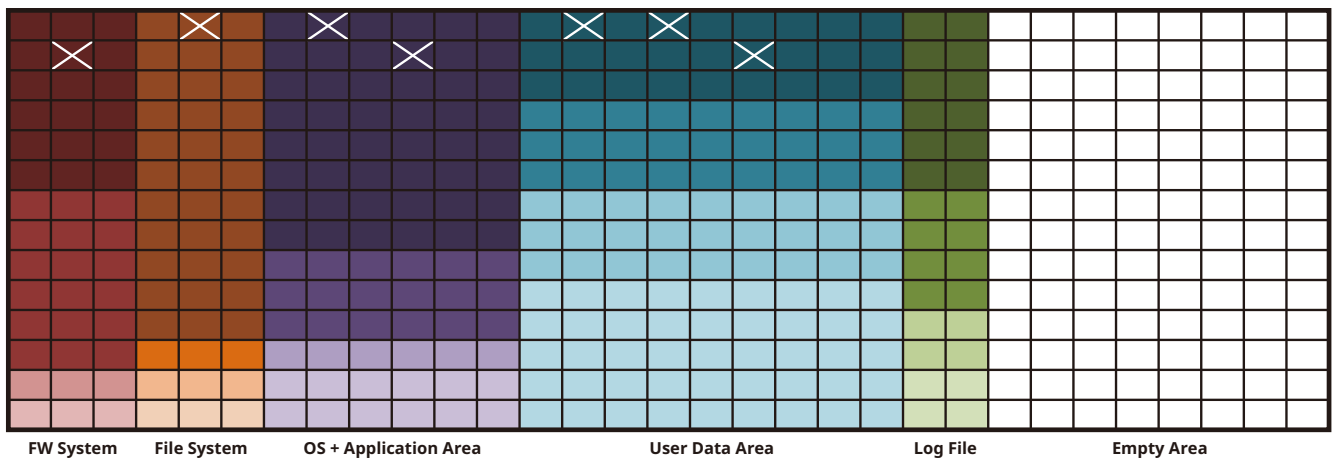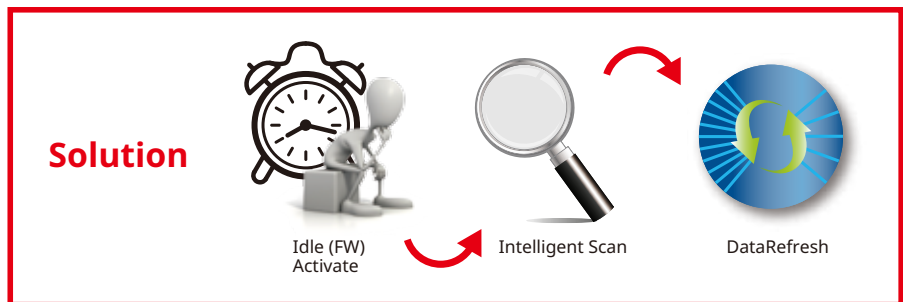When an unexpected power loss occurs, an SSD is unable to close out its final operations. This can

FW System | File System | OS + Application Area | User Data Area | Log File | Empty Area

Illustration	Description
✕✕✕✕✕	= access extremely frequently
	= access hourly/daily
	= access weekly
	= access montly
	= access yearly or less

Solution

Idle (FW) Activate   Intelligent Scan   DataRefresh

in permanent loss of current written data and data corruption to previously stored data. To prevent this, a conventional server must deploy expensive forms of UPS (Uninterruptable Power Supply) or NVDIMM-N (Non-Volatile Dual In-line Memory Module) to handle such situations.

With the onset of sudden power loss, FerriSSD offers a safeguard in the form of its FastWrite option, which can reduce UPS size needed and completely replace the NVDIMM-N. FastWrite can boost write speed 2~3x faster (compared to typical MLC write speed) to a reserved area to allow max write throughput for DRAM data dump; during an sudden power off, this feature can quickly save all DRAM data to FerriSSD before a power off.
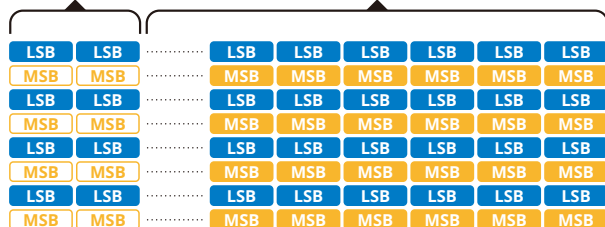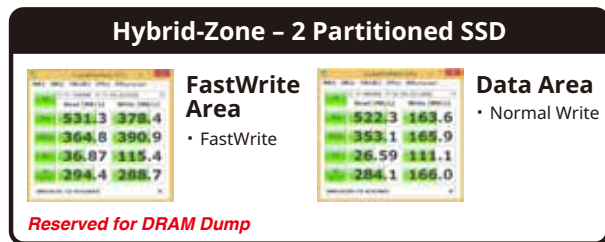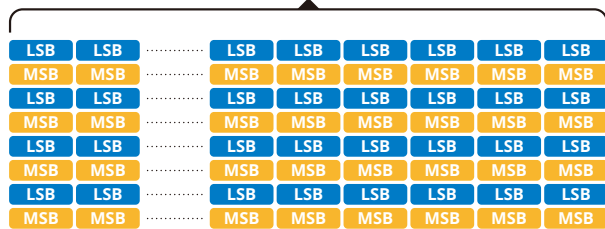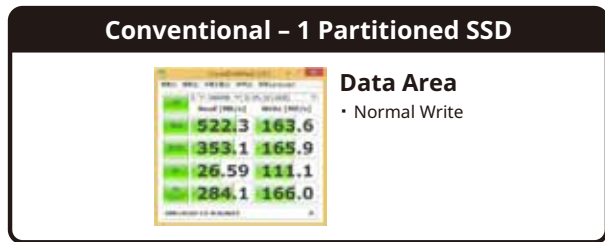
· Remote firmware update capability

Many of our Ferri-SSDs are deployed as Boot SSDs worldwide. FerriSSD's proprietary remote firmware update capability gives our partners the freedom to instantly update SSD firmware remotely, regardless of the location, as long as there is Internet access. The Boot SSD can complete the firmware update within less than one second during run time, without impacting its daily service, to complete firmware update.

Conclusion

FerriSSD is yet another demonstration of Silicon Motion's strength as a leader in the field of NAND Flash storage solutions. FerriSSD features Silicon Motion's cutting-edge firmware technology, such as advanced protection against a sudden power loss; instant data recovery; error correction, bad block management, cell health monitoring, and automatic recovery; and Silicon Motion's proprietary FastWrite option.

FerriSSD represents a complete embedded storage solution that is both cost-effective and high-performance. Owing to the fact that it has no mechanical moving parts, it can withstand higher ambient temperatures, thereby extending the life of a server. As an added benefit, it does not require high capacity, and its small form saves space. Requiring lower power consumption, it also delivers lower operating temperatures, reducing burnout. In addition, it offers flexible PCB design and features a very significant virtue in today's competitive marketplace—low-cost manufacturing.

When considered as a whole, these facts demonstrate why, as an embedded SSD, FerriSSD is far superior to an HDD as a server boot drive for servers in terms of reliability, cost savings, and overall efficiency.

For more information about Ferri Family, please go to **www.siliconmotion.com** or send email to **ferri@siliconmotion.com**

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