

Breaking the Bottleneck: Flash Storage Considerations for High-Throughput Medical Imaging Systems

FerriSSD

High-Resolution Demands in Compact Systems

Medical imaging generates more pressure on storage than most systems will ever see. Full-slide pathology scans, AI-driven diagnostics, and high-frame-rate ultrasound all stream data without pause, expecting storage to keep up. Performance must remain consistent, and everything must function within a tight thermal and physical footprint. A single scanning session can capture hundreds of gigapixels across multiple slides, producing terabytes of raw image data.



The workloads are not only large but also time-sensitive, requiring real-time acquisition, buffering, and analysis of high-resolution data with zero tolerance for delay. Imaging systems must sustain these high-throughput writes over extended periods, often without access to active cooling. In mobile carts, point-of-care diagnostics, or embedded surgical equipment, airflow is frequently minimal, and board space is limited.

Storage must perform consistently, and with minimal system impact. The data cannot wait for caching delays, suffer from corrupted frames, or tolerate slowed performance due to thermal throttling.

Many system designers default to off-the-shelf SSDs, only to run into mechanical, thermal, and power integration challenges. Embedded systems amplify these challenges, where footprint and efficiency matter just as much as raw throughput. Silicon Motion's FerriSSD portfolio offers a distinct approach: a single-chip solution that consolidates NAND, firmware, and controller in one ultra-compact package, available with PCIe Gen 3 x2/x4 or Gen 4 x4, SATA, and NVMe interfaces. With capacities soon of up to 1 TB and industrial-grade reliability, FerriSSD addresses the specific performance and integration needs of today's medical platforms.

FerriSSD: An Integrated Storage Approach

FerriSSD directly addresses these challenges by integrating all core flash components, NAND, controller, and firmware, into a single BGA package measuring as small as 20 × 16 mm. There's no need for external DRAM, connectors, or SSD enclosures. The design simplifies power delivery, signal integrity, and thermals. From a system integration standpoint, this reduces BOM cost, board complexity, and assembly time. From a functional perspective, FerriSSD delivers high sustained throughput with power and thermal profiles that suit compact, passively cooled designs.

Silicon Motion offers several FerriSSD families to suit different interface and system requirements:

- **Ax Series (PCIe Gen 3 NVMe 1.3):**

Available in x2 or x4 configurations. Ideal for compact embedded platforms and AI-assisted imaging systems where size and latency matter.

- **Cx Series (PCIe Gen 4 NVMe 2.0):**

Provides read speeds up to 7 GB/s and write speeds over 4.5 GB/s (SLC mode), with capacities up to 1 TB (3D TLC) in a compact 16 × 20 mm BGA. With end-to-end data protection including hardware-based encryption, for embedded and industrial systems including navigation devices, POS, MFP, thin-client, telecom, factory automation.

- **Dx/Ex Series (SATA 6Gb/s):**

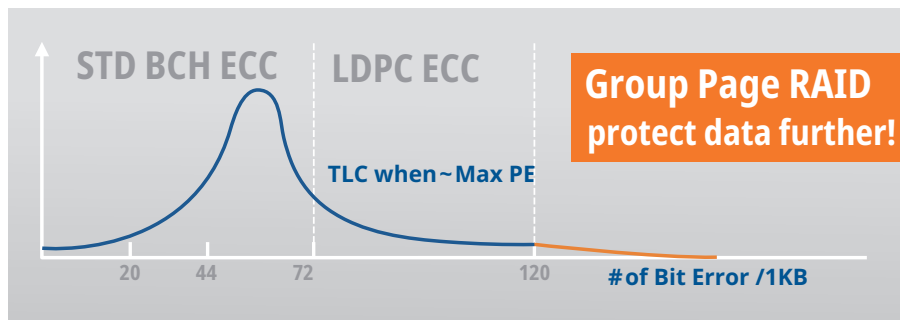
Optimised for legacy or cost-sensitive applications. These models offer reliable performance in lower-power systems that still require industrial-grade endurance and long-term availability.

Each of these series includes industrial-grade temperature options, and long lifecycle availability, all critical features for certified medical equipment.

Sustained Throughput, Not Just Peak Speeds

Unlike many SSDs that advertise peak numbers measured under ideal conditions, FerriSSD delivers consistent performance under real-world sustained workloads. Imaging systems don't write data in short bursts; they stream continuously, and any latency spike or write stall risks clinical data integrity.

Silicon Motion built its firmware stack to support continuous, high-intensity workloads. Its proprietary NANDXtend® ECC uses LDPC decoding, group page RAID protection, and intelligent block management to reduce uncorrectable bit errors and prevent premature wear. These features ensure imaging systems maintain consistent performance throughout the SSD's operating life.



Thermal Resilience for Clinical Consistency

Sustained NAND writes generate significant internal heat, especially in passively cooled enclosures. Without thermal mitigation, storage subsystems may throttle aggressively just as the system workload reaches peak demand.

FerriSSD includes firmware-level IntelligentThermal™ management with support for both Host-Controlled (HCTM) and Device-Controlled (DCTM) modes. These thermal profiles anticipate heat buildup and adjust NAND access proactively, helping maintain consistent throughput across long imaging sessions without triggering performance drops mid-scan.

Industrial-grade models operate from -40°C to $+85^{\circ}\text{C}$, while automotive variants are qualified up to $+105^{\circ}\text{C}$. That makes FerriSSD a reliable fit for mobile diagnostic platforms, outdoor deployment, or emergency care environments where environmental control is limited or non-existent.

Use Case: Portable Ultrasound Under Load

Consider a handheld ultrasound device designed for emergency responders. The system must capture and buffer high-resolution video from a probe in real time, possibly with on-device AI assistance for triage.

The workload is continuous, power is battery-limited, and active cooling is not an option. With FerriSSD:

- FerriSSD delivers sufficient throughput to capture high-frame-rate imaging.
- Firmware-controlled thermal throttling ensures consistent operation even during back-to-back sessions in a warm ambulance.

These features enable reliable diagnostic performance in compact, ruggedised equipment—without overengineering the storage solution.



Lifecycle, Compliance, and Secure Operation

Medical OEMs often require storage solutions that are certifiable, long-lived, and secure. FerriSSD addresses these needs with:

- **Long-term availability:** Designed for stable supply over years, not quarters.
- **Secure boot and firmware update support:** Including digitally signed firmware and optional eFuse protection.
- **Power-fail protection:** Minimises data loss risk in uncontrolled shutdowns.

FerriSSD products also support IntelligentLog™ telemetry and programmable health monitoring, enabling medical OEMs to implement predictive maintenance.

When Reliability Isn't Optional

Medical imaging systems don't get second chances. A lost frame during a biopsy, or a stalled scan mid-surgery, can compromise diagnosis or endanger treatment. That's why the storage platform must be more than just fast; it must be predictable, resilient, and invisible to the end user.

FerriSSD delivers that reliability in a package small enough to fit behind a touchscreen, silent sufficient for surgical suites, and robust enough for 24/7 diagnostic infrastructure.

By consolidating controller logic, NAND management, and error recovery into a fully qualified single chip, Silicon Motion provides engineers with a storage solution ideal for medical-grade demands, without forcing compromises on size, power, or long-term support.

For more information about MonTitan family, please go to www.siliconmotion.com or send email to service@siliconmotion.com