

Technical Note

Enhancing Burst Performance on Micron and Crucial SSDs With Momentum Cache

Introduction

What is Momentum Cache?

Micron's Momentum Cache is an intelligent software driver that dynamically leverages unused system resources to enhance burst performance on supported Micron and Crucial solid state drives (SSDs) in Windows operating systems. Momentum Cache is not restricted by SATA bus throughput limitations; instead, it uses additional DRAM bandwidth to achieve increased burst performance.

How Does Momentum Cache Work?

As a software driver installed on Windows operating systems,¹ Momentum Cache manages all writes and reads between a supported SSD and the system. It optimizes input/output (I/O) data by caching the data in system memory and then committing it to the SSD at a consistent rate when additional bandwidth is available.

SSDs typically have higher read performance than write performance. This is especially apparent in lower-density drives containing smaller amounts of NAND die accessed in parallel. Momentum Cache addresses this inefficiency by caching nearly all writes being transferred to the SSD. The writes are transferred from the cache to the SSD during periods of lower drive activity, providing a buffer to spread intense workloads over time and enabling improved burst performance.

Momentum Cache addresses other limitations in SSD design. When system memory is available, Momentum Cache coalesces smaller write transfers into larger transfers to reduce the impact of small random writes on the NAND. Small transfer random writes have the greatest impact on the endurance of NAND in an SSD. Additionally, Momentum Cache reduces wear on an SSD by filtering repetitive data written to the drive.

Note 1: See minimum requirements for supported configurations.

Momentum Cache in Action

Laptop and desktop computers commonly have large amounts of system memory that are not completely utilized. During periods of heightened data transfers between the system and the SSD, these resources can be leveraged to improve performance.

When enabled, Momentum Cache is optimally set at one-quarter the size of the physical system memory, up to a maximum of 4GB.² This memory allocation dynamically scales in direct relation to the amount of memory consumed by applications residing on the system.

As application memory use increases, Momentum Cache relinquishes memory to ensure the applications are not impacted. When the amount of idle memory available to the system falls below 1GB, Momentum Cache reduces its memory consumption to maintain at least 1GB of idle memory available to the system. Memory allocation between the system and Momentum Cache is continually evaluated to maintain this balance.

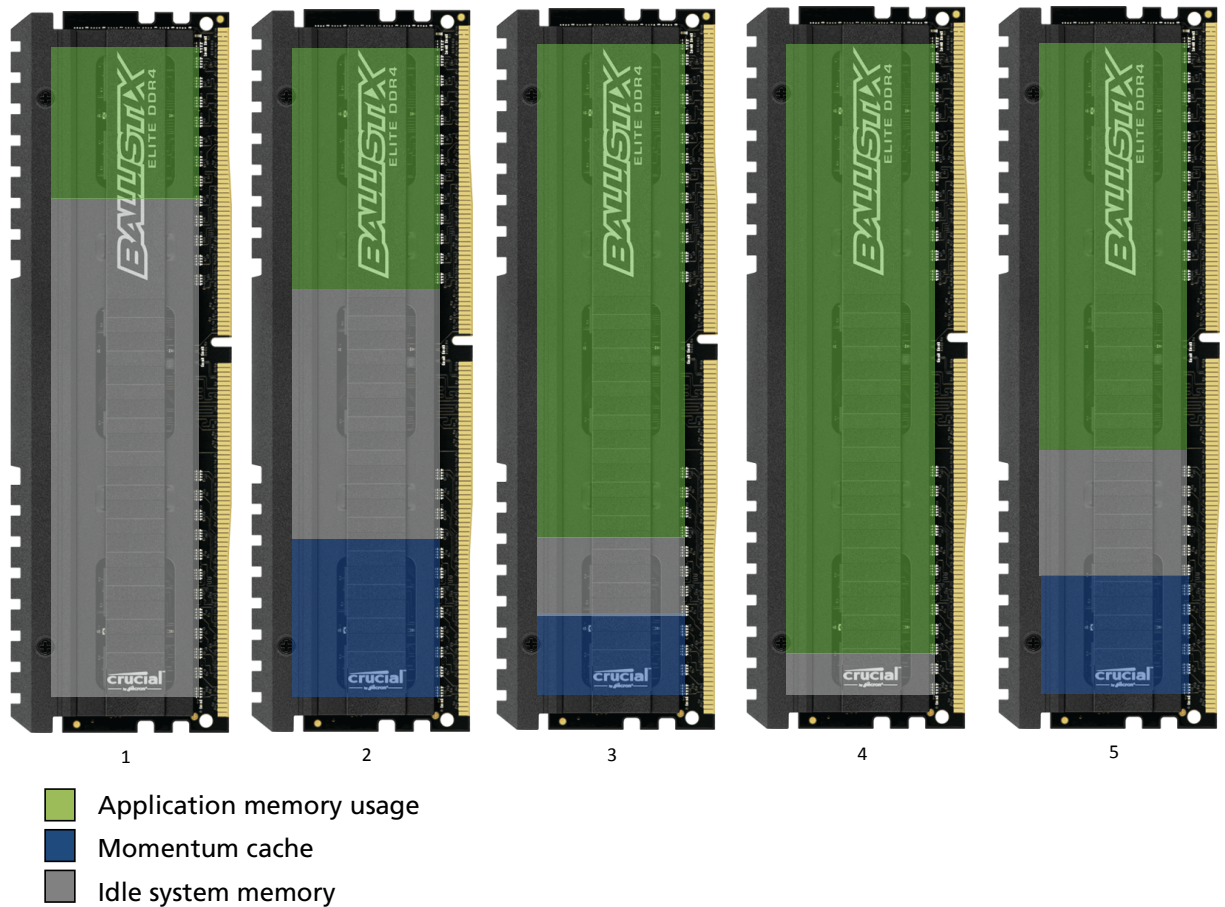
During intense application memory usage, Momentum Cache reduces its memory allocation to a minimum value of 256MB. If additional memory resources are required, Momentum Cache relinquishes all memory to the system. In this scenario, all data passes between the system and the SSD untouched by Momentum Cache.

Momentum Cache does not re-allocate idle memory until a minimum of 1.4GB of system memory becomes available. Momentum Cache continues to increase its allocation of memory as it becomes idle in the system.

Note 2: Windows 32-bit operating systems have limited memory addressing, which reduces the available memory to Momentum Cache.

Momentum Cache System Memory Use

Figure 1: How Momentum Cache Uses System Memory



1: Typical system with 8GB of total physical memory (6GB of memory in an idle state).

2: System with Momentum Cache enabled using 2GB (one quarter of the total physical memory). Memory was allocated from system resources that were previously idle.

3: Increased application memory usage de-allocates Momentum Cache to 1GB of the total physical memory.

4: Heavy application memory usage causes Momentum Cache to de-allocate all system memory and pass all data untouched.

5: Application memory usage decreases sufficiently to allow Momentum Cache to be enabled and begin caching data transfers to the SSD.

Momentum Cache Performance Benchmarking

Two industry-standard SSD performance benchmarking tools, CrystalDiskMark and AS SSD Benchmark, display the burst performance increases possible when Momentum Cache is enabled on a Micron M600 SSD.

Figure 2: CrystalDiskMark Sequential Performance

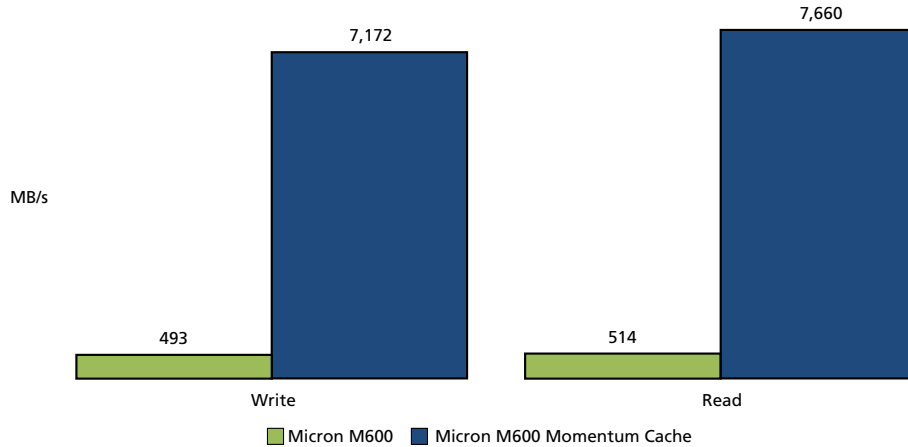
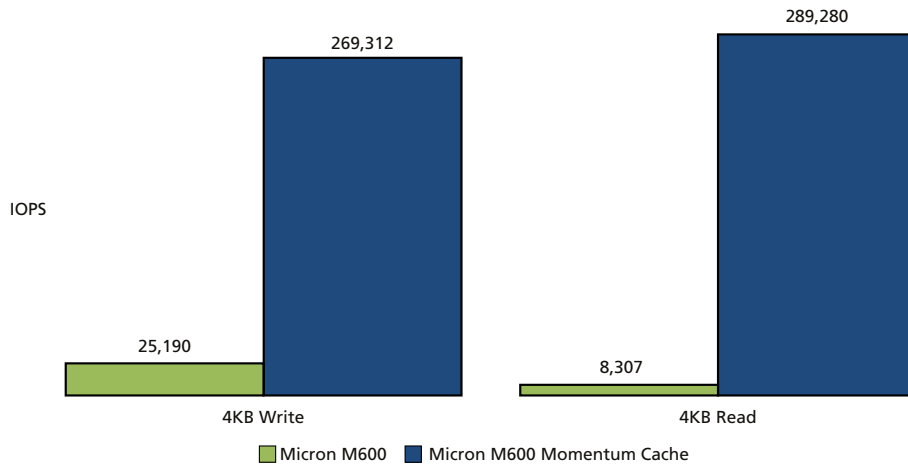


Figure 3: CrystalDiskMark Random Performance



Note: CrystalDiskMark results for Momentum Cache enabled versus disabled on a Micron 256GB M600 SSD. CrystalDiskMark test configuration = 5 iterations, 500MB, version 3.0.3 x64. All performance tests were measured on the following system configuration; user results may vary:

- Intel Core i7 4770 @ 3.4 GHz
- 16GB DDR3 memory
- Windows 7 x64
- Micron 2.5-inch 256GB M600 SSD

Figure 4: AS SSD Sequential Performance

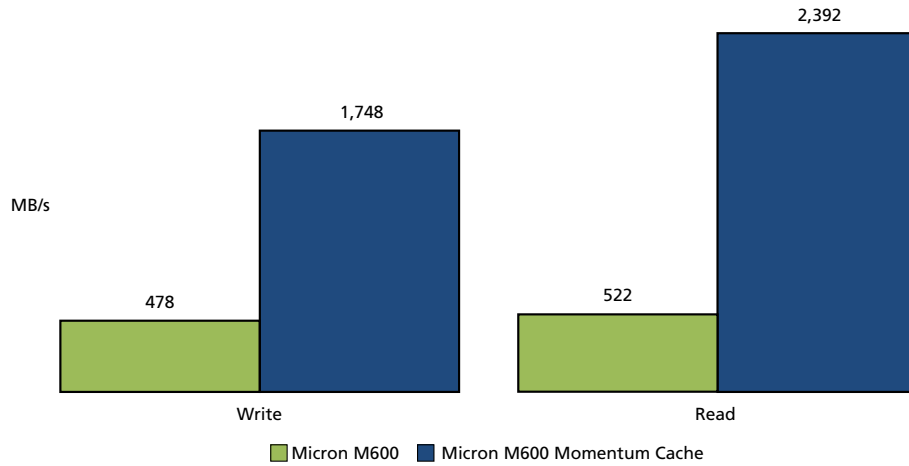
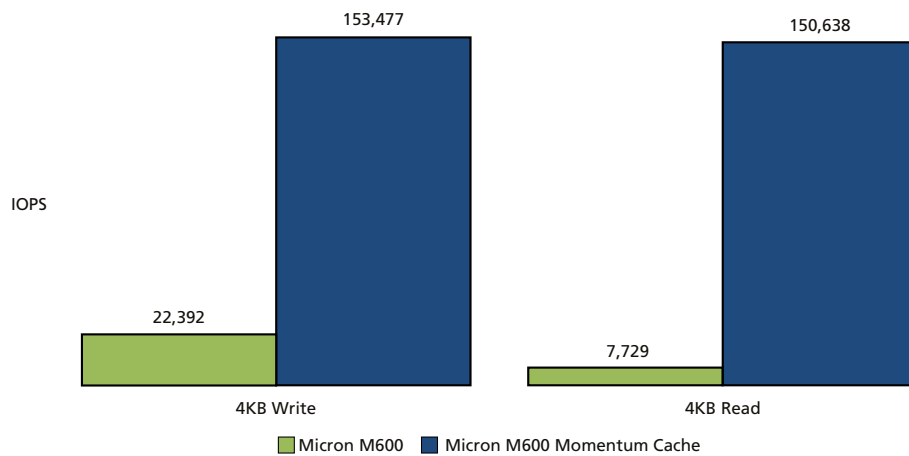


Figure 5: AS SSD Random Performance



Note: AS SSD Benchmark results for Momentum Cache enabled versus disabled on a Micron 256GB M600 SSD, AS SSD version 1.7.4739.38088. All performance tests were measured on the following system configuration; user results may vary:

- Intel Core i7 4770 @ 3.4 GHz
- 16GB DDR3 memory
- Windows 7 x64
- Micron 2.5-inch 256GB M600 SSD

Minimum Requirements

Supported SSDs

- | | |
|---------------|--------------------------|
| Micron | Crucial by Micron |
| • M500 | • MX100 |
| • M510 | • MX200 |
| • M550 | • BX100 |
| • M600 | • M500 |
| • M500DC | • M550 |
| • M510DC | |
| • P400M | |

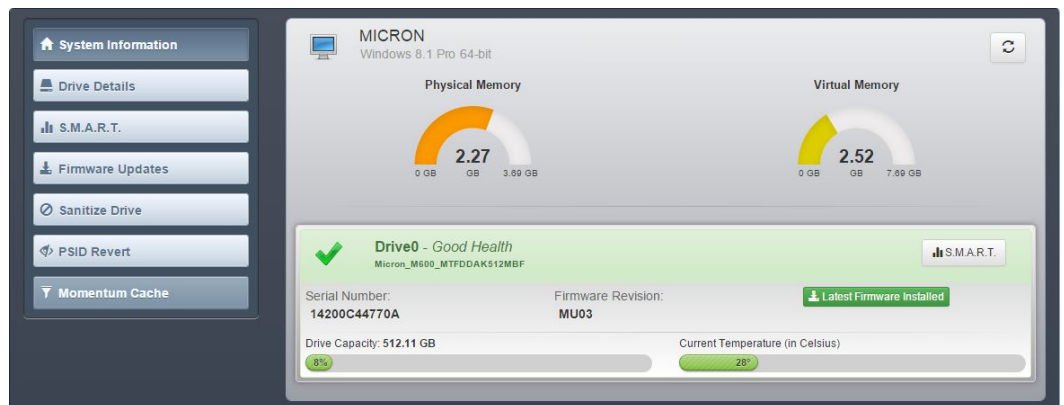
Supported Operating Systems

- Windows 7 (32-bit, 64-bit)
- Windows 8 (32-bit, 64-bit)
- Windows 8.1 (32-bit, 64-bit)

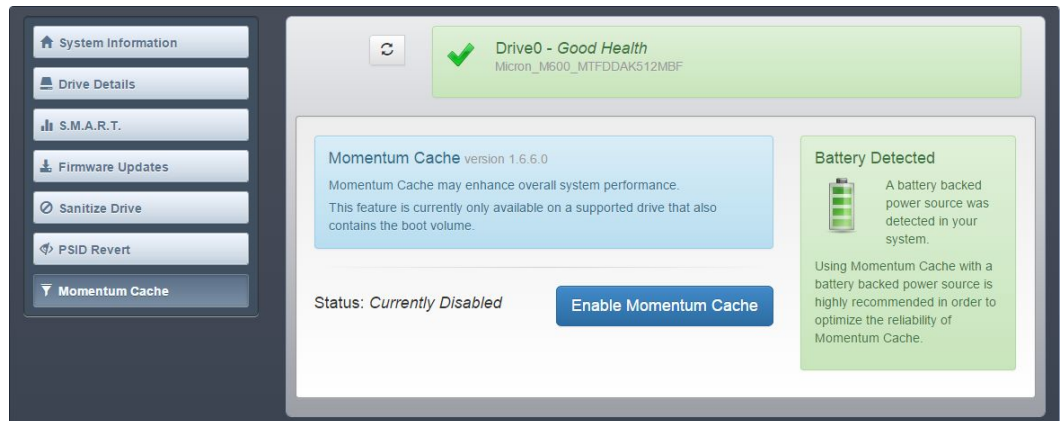
Installing Momentum Cache

Risk of data loss: *Enabling Momentum Cache leverages random access memory (RAM) to increase performance. Data stored in RAM is volatile and therefore at risk of being lost in the event of system power loss. Having a battery-backed power source is strongly recommended to reduce the risk of data loss in the event of unexpected power loss. Data loss may occur in the event of a system crash, such as a blue screen fatal system error.*

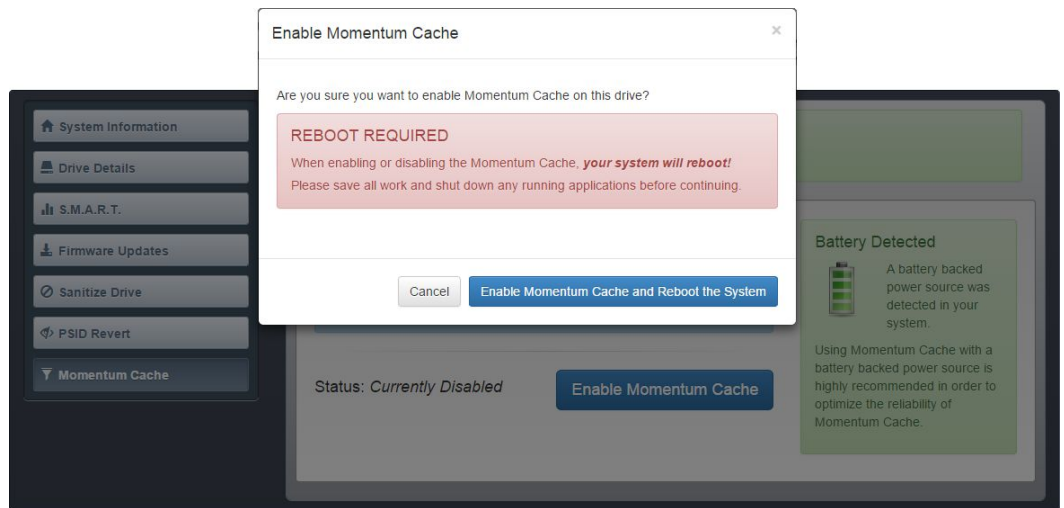
1. Download and install Storage Executive from www.micron.com or www.crucial.com based on the supported SSD.
2. Micron Storage Executive automatically launches in the system's default web browser following installation and opens to the System Information page. Select the **Momentum Cache** option.



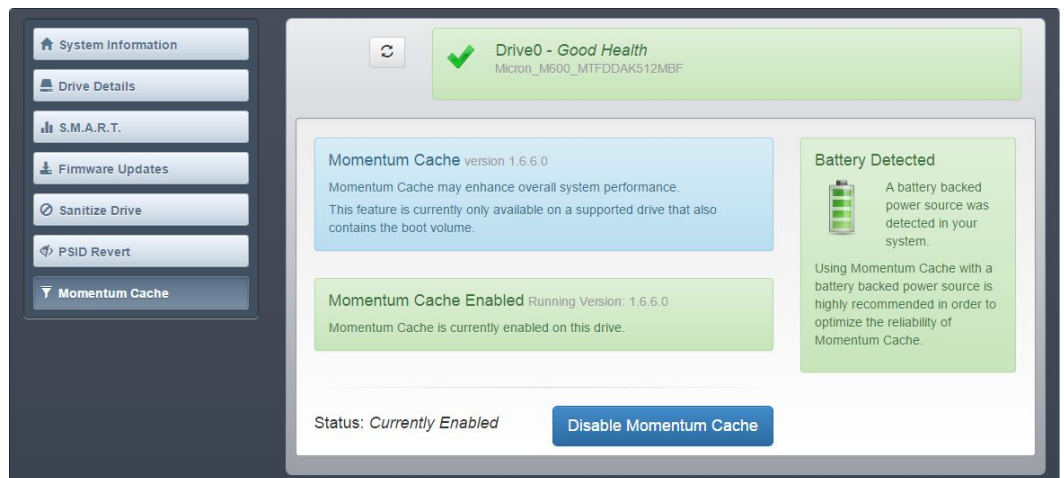
3. The drive to be cached appears on the Momentum Cache page, along with the version of Momentum Cache being installed. Select **Enable Momentum Cache**.



4. Confirm the operation by selecting **Enable Momentum Cache** and **Reboot the System**. The system reboots to complete the installation.



5. After the system reboots, verify the installation by launching Storage Executive and navigating to the Momentum Cache page. The status should state **Currently Enabled**.



Removing Momentum Cache

Momentum Cache can be removed from the system by repeating the previous steps and selecting **Disable Momentum Cache**. A system reboot is required to complete the operation.

Additional FAQ Information

I have an M600 configured with an OS partition and a storage partition. Will Momentum Cache increase burst performance on both partitions?

Yes, Momentum Cache is enabled at the drive level, which provides additional burst performance to all partitions located on the Windows OS boot drive.

What if my laptop battery is depleted while I am using Momentum Cache?

The Momentum Cache driver detects the current charge of the battery and disables the cache if the charge falls below 25% without AC power connected to the system.

I don't have an uninterruptible power supply (UPS) or a battery backup on my gaming PC. Can I still use Momentum Cache?

Yes, Momentum Cache can be enabled on a system without a battery-backed power source. However, there is an increased potential for data loss in the event of an unexpected power loss compared to a system equipped with power backup.

I added a second Micron SSD to my system for additional storage. Can I enable Momentum Cache on this SSD as well?

Enabling Momentum Cache is currently supported on the OS drive only.

My system has two Micron SSDs configured in hardware RAID. I receive the message below when attempting to enable Momentum Cache.

Not a Supported Drive

The drive Drive0 does not support Momentum Cache.

At this time you may only enable Momentum Cache on the boot device as long as it is a supported drive.

Momentum Cache is not currently supported on hardware RAID configurations.



Revision History

Rev. A – 06/15

- Initial release

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