Beat the heat with Exascend's Adaptive Thermal Control™ technology

Executive summary

Exascend's proprietary *Adaptive Thermal Control*™ technology tackles the issue of overheating and thermal throttling that is unavoidable in high-performance PCIe NVMe flash storage devices.

Typically, flash storage devices maintain thermals under a set threshold by throttling performance – causing massive drops and spikes in performance as the devices try to keep up with changes in temperature.

Exascend's Adaptive Thermal Control technology mitigates this issue by intelligently finding the perfect equilibrium point between performance and device thermals where a consistently high level of performance holds steady over time – avoiding the constant performance bursts and drops endemic with high-speed NVMe devices.

The result is stable top-level performance that keeps your applications running at their peak.

About Adaptive Thermal Control

Why do we need thermal control?

We are seeing dramatically increasing SSD performance with the recent transition from SATA to PCIe NVMe, with SSD power consumption scaling alongside the increase in performance. In the meantime, the SSD form factor evolution continues toward smaller form factors such as M.2, E1.S and CFexpress – making incredibly powerful compact flash storage products possible

However, this leap in SSD performance and power consumption alongside ever-smaller form factors gives rise to a different challenge: thermal dissipation.

Without a corresponding increase in physical size, modern high-performance PCIe SSDs need to address the risk of overheating and thermal runaway in new ways. Otherwise, applications face potentially catastrophic effects on data integrity and even the integrity of hardware components.

That is why modern SSDs need thermal control.

What are the downsides of thermal control?

There is no way around it: it is necessary to decrease performance in order to stabilize increasing temperatures in an SSD.

Common implementations of thermal control throughout the flash storage industry involves a combination of thermal sensors and Self-Monitoring, Analysis and Reporting Technology (S.M.A.R.T.) to monitor the SSD's operating temperature. When the SSD's firmware determines that these datapoints suggest that overheating is under way, it dramatically reduces SSD performance, thus avoiding temperatures from getting out of control.

Unfortunately, dramatic drops in performance are often noticeable for the user and sometimes even detrimental to the application. For example, an SSD used for recording high-bitrate video will almost certainly start dropping frames once the firmware throttles performance to combat rising temperatures.

Of course, if the SSD in the example above did not throttle performance, the damage would be far worse than a choppy video recording. However, the dramatic, often one or two-step thermal throttling you see in most SSDs is unnecessarily disruptive and unpredictable. At least, that is what we at Exascend think.

Meet next-generation thermal control: Exascend *Adaptive Thermal Control*™

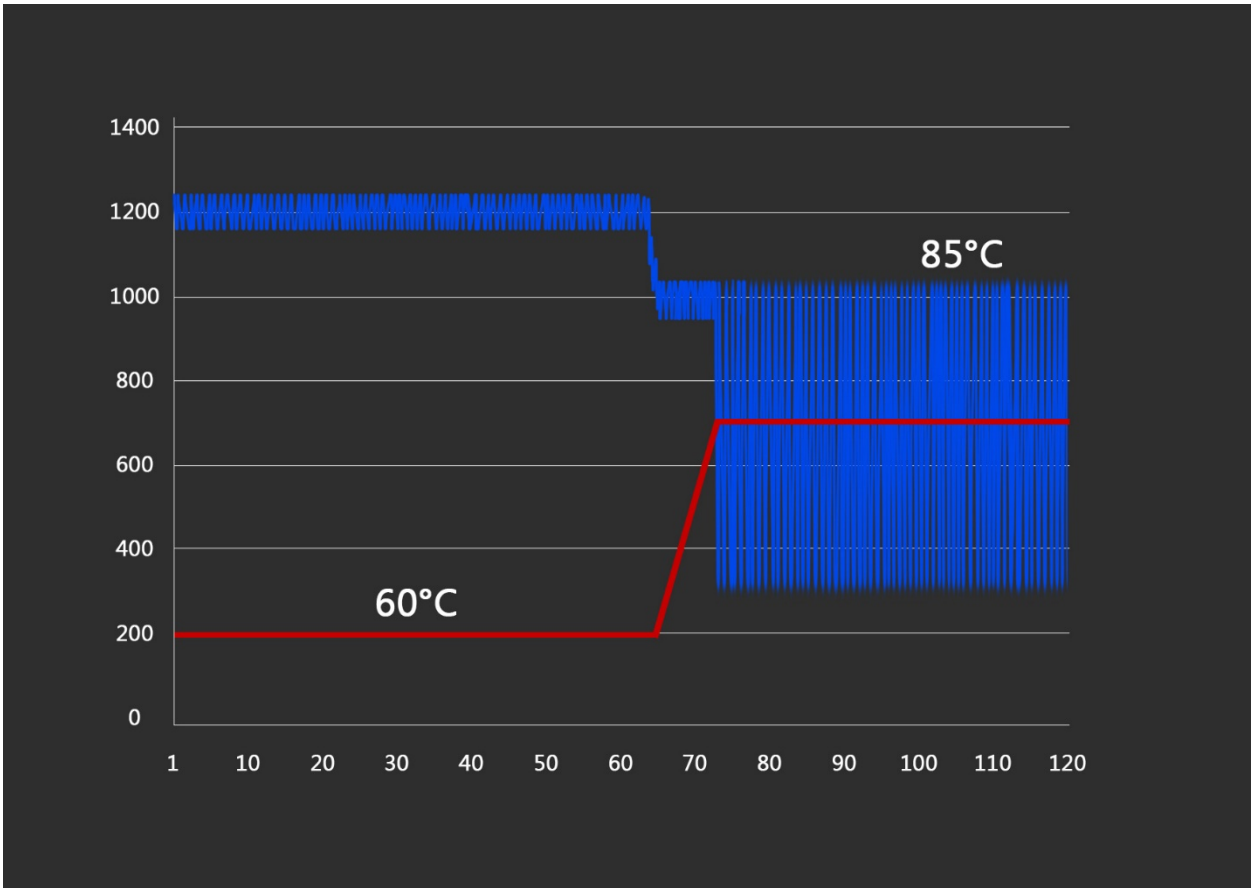
Exascend set out to solve the issue of disruptive thermal control in modern PCIe NVMe SSDs by leveraging its unique position as fully in control of both the hardware and firmware of its flash storage solutions. The goal: intelligent thermal control that is not disruptive to users or their applications. The result: our patented Adaptive Thermal Control™ technology.

Through a combination of adaptive hardware power reduction and precise SSD performance control, Adaptive Thermal Control, or ATC for short, finds the perfect balance between the highest possible performance and a safe operating temperature.

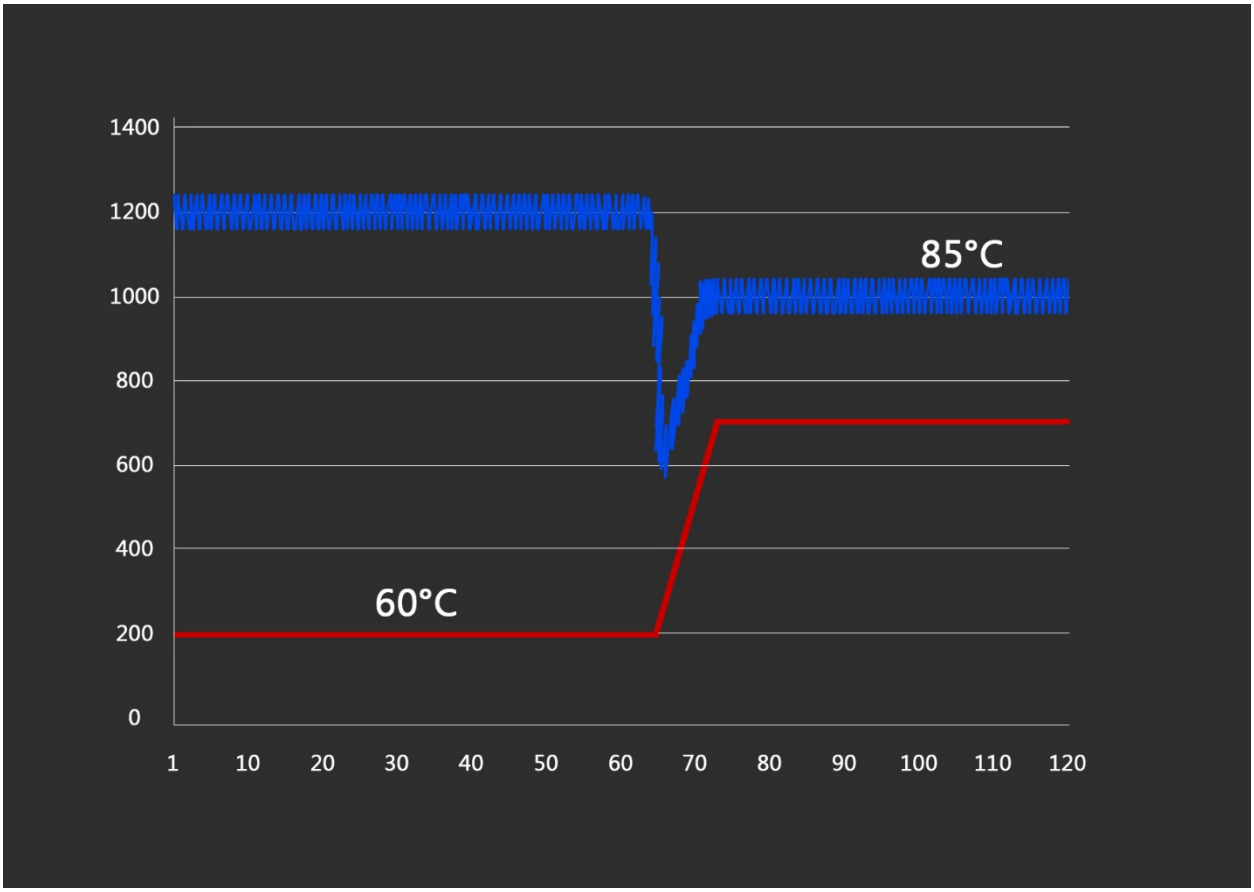
The difference between Adaptive Thermal Control and industry-standard thermal throttling is striking.

With Adaptive Thermal Control, the Exascend SSD maintains steady and high performance where it can operate indefinitely without any risk of overheating or thermal runaway.

In contrast, with thermal throttling in a regular SSD, the performance suddenly drops once a certain temperature has been reached, then climbs back up again only to drop once the temperature inevitable reaches the throttling threshold again.



Traditional SSD with thermal throttling. The performance drops dramatically, then jumps back again when the temperature has stabilized before quickly dropping back again… and again… and again…



Exascend SSD with Adaptive Thermal Control. After reducing performance when the temperature reaches its threshold, the SSD gradually increases performance until it reaches a point where it can maintain stable performance at an acceptable temperature.

At the core of this innovation is Exascend's patent-pending firmware algorithm. Constantly aware of the SSD's operating environment, the firmware algorithm continuously monitors and fine-tunes drive performance during operation. This uniquely intelligent method of operation ensures the highest possible level of sustained performance in each drive's operating environment.

Importantly, Adaptive Thermal Control, as the name implies, is fully adaptive. Should temperatures or the application's read/write behavior change, Adaptive Thermal Control keeps up and adjusts the drive's performance accordingly. That result is that the application will always enjoy the highest possible sustained performance, automatically and intelligently without any input from the user or host device.

Adaptive Thermal Control: step by step

1. When the Adaptive Thermal Control algorithm detects that the temperature has reached its threshold, the SSD automatically initiates its thermal control operation.
2. The thermal control algorithm reduces performance and the overall system power consumption, allowing the temperature to drop below the thermal threshold.
3. The thermal control algorithm gradually increases the SSD's performance to find the highest performance where the temperature can be maintained below the threshold.

4. If the operating environment changes, e.g., the ambient temperature rises, ATC will intelligently re-tune the optimal performance level for its new operating environment.

Customized Adaptive Thermal Control

As part of its commitment to offering the industry's most comprehensive customization services, Exascend offers customizable thermal thresholds for products featuring the Adaptive Thermal Control technology. For example, thermally sensitive applications can set a lower threshold for where thermal control should be initiated.

Recommended applications

			
Industrial Industrial applications demand unwavering performance in challenging environments.	**Transportation** Shocks, vibrations, and extreme temperature fluctuations demand only the best from storage devices.	**Broadcast & cinema** Put the pinnacle of broadcast and cinema within your reach.	**Productivity** Enable users to always perform at their best, no matter where they are or how they work.

Recommended products

			
PI3 • PCIe 3.0 (NVMe 1.2) interface • 3D TLC NAND flash • Up to 8 TB capacity • 3,200 MB/s sustained read • 1,600 MB/s sustained write	**SI3** • SATA-III interface • 3D TLC NAND flash • Up to 4 TB capacity • 530 MB/s sustained read • 520 MB/s sustained write	**CFexpress** • PCIe 3.0 (NVMe 1.2) interface • CFexpress Type B • Up to 1 TB capacity • 1,700 MB/s sustained read • 1,000 MB/s sustained write	**PE3** • PCIe 3.0 (NVMe 1.2) interface • 3D TLC NAND flash • Up to 8 TB capacity • 3,100 MB/s sustained read • 2,000 MB/s sustained write