



Improving the Performance of M.2 NVMe SSDs at Industrial Temperatures

Peter Huang
Senior Manager, Embedded SSD BU
ATP Electronics, Inc.



Flash Memory Summit

NVMe Introduction



- Trend of embedded storage: SATA to PCIe
- Over the years, CPU and DRAM technology have been continually improving and increasing the speeds to meet escalating data-hungry requirement.
- SATA is generally the least expensive and most extensively used SSD interface today.
- To narrow the widening gap between fast CPU/DRAM and slow storage, Non-Volatile Memory Express, also known as NVMe™, was developed.



NVMe Introduction



The following table compares bandwidths by generation. ATP's M.2 NVMe SSD is designed for a PCIe 3.0 interface and fits in a x4 lane, delivering up to 7.9 Gb/s transfer rate and up to 3.9 GB/s throughput.

PCIe				SATA		
Generation	Transfer Rate	Throughput per Lane		Generation	Transfer Rate	Throughput
Gen1	2.5 Gb/s	x1: 250 MB/s	x4: 1 GB/s	Gen1	1.5 Gb/s	150 MB/s
Gen2	4.9 Gb/s	x1: 500 MB/s	x4: 2 GB/s	Gen2	3 Gb/s	300 MB/s
Gen3	7.9 Gb/s	x1: 984.6 MB/s	x4: 3.9 GB/s	Gen3	6 Gb/s	600 MB/s
Gen4	15.8 Gb/s	x1: 1,969 MB/s	x4: 7.8 GB/s			

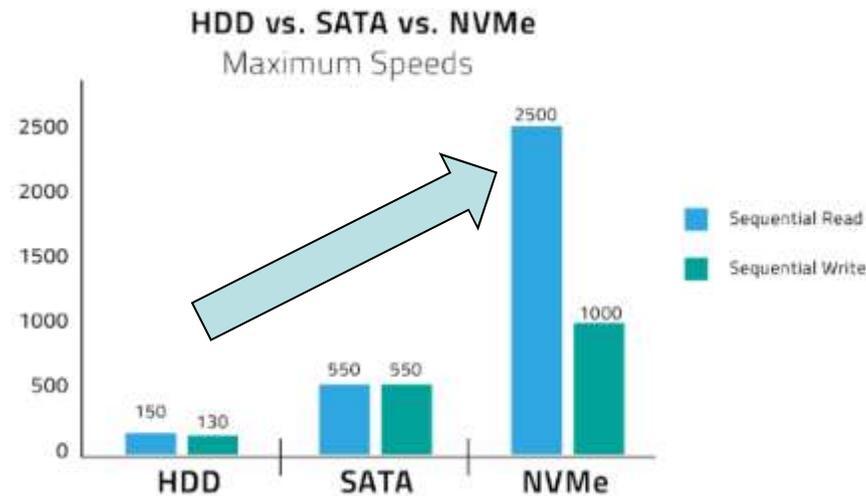


Flash Memory Summit

NVMe Performance



- The actual NVMe performance is boosting to catchup the speed requirement.
- However, the heat accumulation from full performance running becomes a big challenge during the system design.





Flash Memory Summit

Embedded Application in I-Temp



- In the embedded application, it usually has fanless design due to the space limitation. The heat inside the system becomes one of the key factors that impact the performance.
- Usually, the NVMe controller has different thermal settings to adjust the clock under the different temperatures in order to slow the performance to ease the heat dissipation issue.
- For the I-Temp environment, it's also very important to optimize this setting. Therefore, the performance could maintain in certain level with balance instead of keeping drop down.



Flash Memory Summit

NVMe M.2 2280 Form Factor



- Printed Circuit Board (PCB)
- NVMe Controller
- Thermal Sensor
- DRAM Cache
- NAND Flash chips



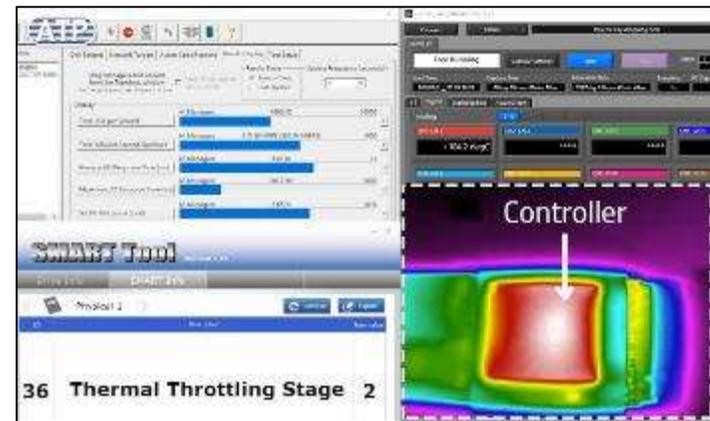
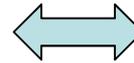
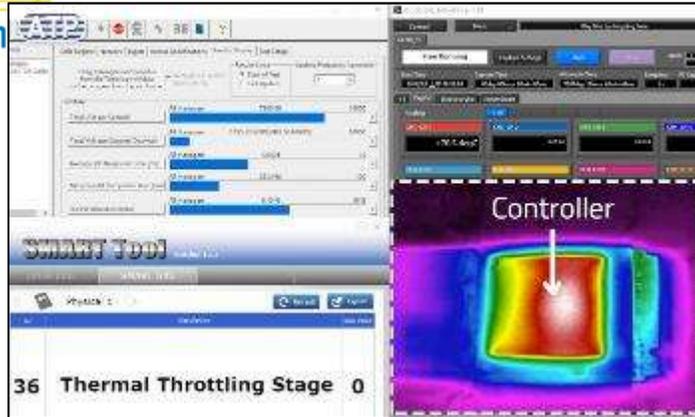
Flash Memory Summit 2018
Santa Clara, CA

ATP Confidential © 2018 ATP Electronics, Inc.



Flash Mem

Thermal Throttling Setting



Flash M
Santa Clara, CA

ATP Confidential © 2018 ATP Electronics, Inc.

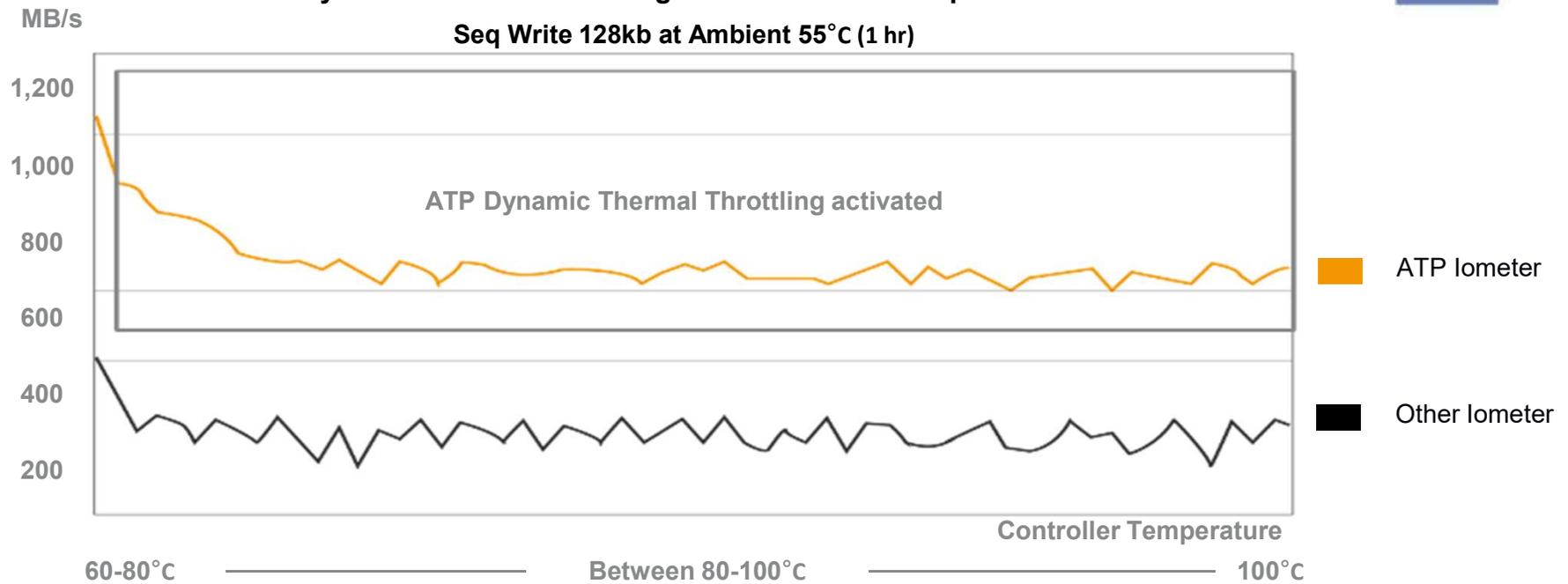


Flash Memory Summit

Dynamic Thermal Throttling



ATP vs. Other Brand 1TB NVMe SSD
Dynamic Thermal Throttling & Performance Comparison



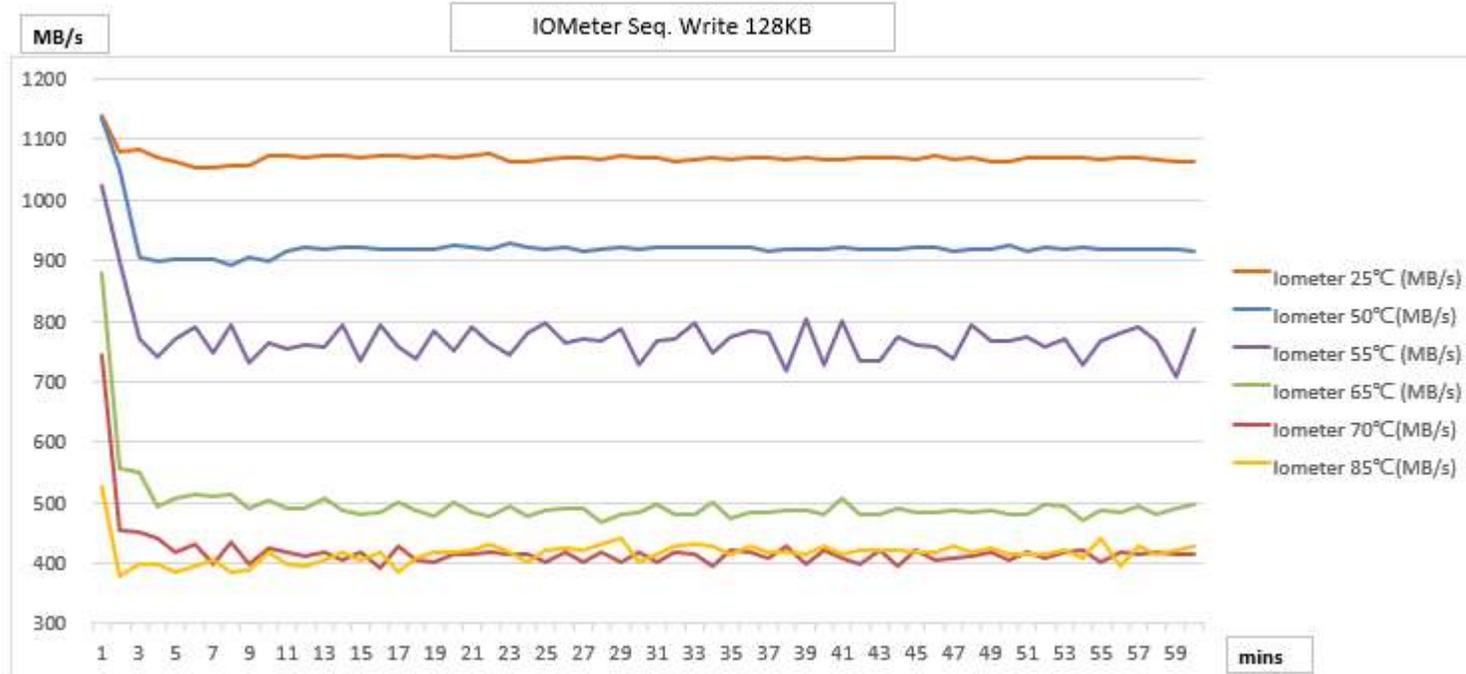


Flash Memory Summit

Dynamic Thermal Throttling



ATP 1TB NVMe SSD (T_{ambient} : 25°C~85°C)
Performance

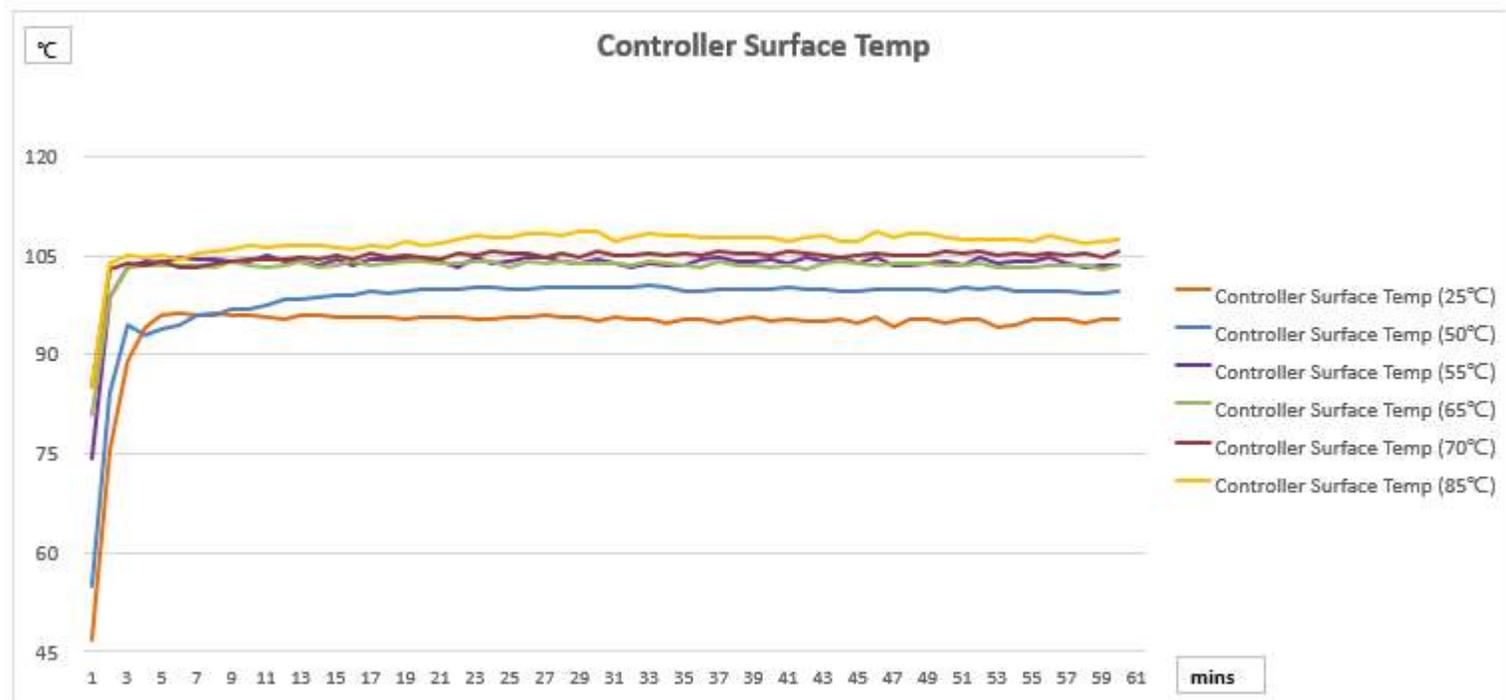




Flash Memory Summit

Dynamic Thermal Throttling

ATP 1TB NVMe SSD (T_{ambient} : 25°C~85°C)





Flash Memory Summit



3D NAND
For Industrial, Embedded Applications

Visit ATP Electronics Meeting Room 205
Reserve your meeting with ATP
2018 Flash Memory Summit August 7th ~9th

Flash Memory Summit 2018
Santa Clara, CA

ATP Confidential © 2018 ATP Electronics, Inc.