ATP Industrial Enterprise SSD Series

The Best of Both Worlds, Engineered for Uncontrolled Environments at the Edge

Information Technology (IT) and Operational Technology (OT) are converging, resulting in the rise of Edge storage/computing that requires enterprise-class quality of service and industrial-grade reliability and endurance.

Enterprise storage/computing is becoming less centralized in data centers and controlled environments and becoming more distributed. Data is being driven to the edge where operating conditions are more extreme, locations are not easy to reach, and often, on the constant move. A new breed of storage solutions is needed, which combines the benefits of industrial solid-state drives (SSDs) and enterprise solutions.

The Industrial Enterprise N651Sie Series SSDs leverage NVMe PCIe Gen4x 4 and are available as M.2, U.2, and E1.S.

They are built for the age of data deluge as centralized computing increasingly moves to the edge, and enterprise operations in uncontrolled environments become more prevalent.

They combine the best of enterprise and industrial features, making them excellent as boot drives, data storage drives, or mixed-use drives.

The Best of Both Worlds

Why choose when you can have the Best of Both Worlds?

BEST ENTERPRISE-CLASS FEATURES

Endurance
- Boot: 1 DWPD
- Read Intensive: 2 DWPD
- Mixed Use/Write Intensive: 5 DWPD

Data Retention
- 1 year at 55°C (100% P/E cycles)
- Exceeds JESD219A standards for Enterprise-Class SSDs

Consistent Performance for Enterprise Workloads
- Sequential Read/Write: up to 6,450/6,050 MB/s
- High Sustained Sequential/Random Write: up to 3,200/1,280 MB/s

High Quality of Service (QoS)
- M.2: Read <90µs, Write <10µs
- U.2 and E1.S: Read <80µs, Write <10µs

Reliability
- Very low uncorrectable bit error rate (UBER) of less than 1 in 10^17
- Validated through End-of-Life testing and Reliability Demonstration Testing (RDT)

BEST INDUSTRIAL-GRADE ADVANTAGES

I-Temp Support
- Reliable operation from -40°C to 85°C

Robust Cross-Temp Error Handling Solution
- Maintains data integrity under severe temperature changes
- Ensures reliability even towards the device's end of life

Thermal Management
- Adaptive thermal throttling
- Customizable temperature settings
- Heatsink and graphite options for excellent heat dissipation

Hardware Power Loss Protection (HW PLP)
- Protects stored data and data in transit
- Prevents data loss or corruption
- Essential for high-performance computing environments running 24/7

WE BUILD WITH YOU Firmware Customization Service

Under ATP's WE BUILD WITH YOU program, the following enhanced Firmware Customization Services are available on a project-basis to meet various enterprise customer needs in Server, Storage and Compute.

Power Loss Protection (PLP) Tuning

Optimized Flush Cache Timing. Ensures that the flush cache is completed within the capacitors' hold-up time to ensure the integrity of data in flight and at rest.

PLP Capacitor Monitoring. Performed using the on-board micro-controller unit (MCU), includes regular capacitor health checks during SSD boot-up and operation.

Performance Behavior Tuning

Performance behavior analysis and customization to optimize throughput and latency in a customer host application

Thermal Management Customization

ATP's thermal throttling solution is distinguished by the ability to adjust the temperature settings according to the customer's application-specific requirements.

SMART ID Customization

The firmware includes a range of Self-Monitoring, Analysis and Reporting Technology (SMART) ID attributes which can be customized based on customer requirements.

Download Microcode Capability

This service is part of flexible firmware maintenance, enabling Enterprise customers to rapidly make updates to their specific configurations via field updates, avoiding the hassle of sending SSDs back to ATP for reinitialization.

To ensure smooth DLMC (Download Microcode) operations during firmware verification or updates, especially when there are varying platform requirements during the validation process, ATP can provide multiple firmware binaries, allowing for testing flexibility.

This has resulted in strengthened DLMC Testing for Upload, Sideload, and Download. Building on the FW Field Update service, we perform DLMC testing between the new firmware version and its previous iterations. This includes ensuring successful self-updates for smoother transitions between different firmware versions or configurations during the customer's validation process.

Enhanced Read Disturb Resilience

The FW algorithm ensures data integrity when data is frequently accessed by the host.
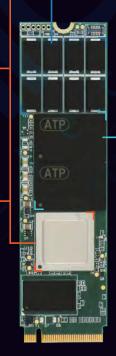ATP firmware will monitor the data and reprogram it to prevent data damage. This is especially important in read-only applications.

Frequent data reads are critical in read-only applications. ATP firmware is optimized to monitor and refresh data by implementing the "early move" (proactive approach) and "read reclaim" (reactive approach) algorithm.
"Early move" refers to the moving of data to a different block when the error meets certain criteria of error threshold as defined by ATP.
"Read reclaim" is activated by the frequency at which data is read to prevent data damage and ensure data integrity.

This feature validates Enhanced Read Disturb Resilience specifically for the Enterprise customer's script.

The firmware is modified to enhance its ability to withstand Read Disturb events. These modifications are intended exclusively for specific use cases identical to the Enterprise customer's, such as Boot-Up scenarios.

Product Specifications

Product Line	N651Sie		
Interface	Gen4 x4		
Form Factor	M.2	U.2	E1.S
Dimensions (mm)	80 x 22 x 3.85	100 x 69.85 x 15	118.75 x 33.75 x 9.5
Flash Type	TLC		
Capacity	120 GB to 1.92 TB	480 GB to 7.68 TB	
Sequential Read (up to) [1,6,7]	6,450 MB/s	6,000 MB/s	6,100 MB/s
Sequential Write (up to) [1,6,7]	6,050 MB/s	5,500 MB/s	6,000 MB/s
Random Read (up to) [2,6,7]	1,100 KIOPS	820 KIOPS	870 KIOPS
Random Write (up to) [2,6,7]	1,250 KIOPS	1,200 KIOPS	
Sustained Sequential Write (up to) [3,6,7]	3,000 MB/s	3,200 MB/s	
Sustained Random Write (up to) [4,6,7]	250 KIOPS (1,000 MB/s)	320 KIOPS (1,280 MB/s)	
Endurance [DWPD] [8]	Available in 1, 2, and 5 DWPD configurations		
QoS 99.9999% [5,6,7]	Read <90μs | Write <10μs	Read <80μs | Write <10μs	Read <80μs | Write <10μs
Data Retention	1 year at 55°C (100% P/E cycles)		
Power Loss Protection	Yes		
End to End Data Path Protection	Yes		
Sustained Read Power (Max) [7]	<9W	<14.5W	<13W
Sustained Write Power (Max) [7]	<11.5W	<17.5W	<15.5W
Supply Voltage	3.3V	12V	
Operating Temperature Tc	-40°C to 85°C (I-Temp)		
Storage Temperature Tc	-40°C to 85°C		
Vibration	Sine 16.4G, 10~2,000 Hz		
Shock	Half sine 1,500G/0.5 ms		
MTBF @ 25°C	> 3,000,000 hours		
UBER	<1 sector per 10^17 bits read		
Warranty	5 years		

Notes:
1. Sequential Burst Performance tested with IOmeter 4MB, QD64
2. Random Burst Performance tested with IOmeter 4KB, QD64
3. Average Sustained Sequential Write Performance tested with IOmeter, 4MB, QD64 for 4 hours
4. Average Sustained Random Write Performance tested with IOmeter, 4KB, QD64 for 4 hours

5. 4KB Random QD=1
6. Actual performance may vary depending on user conditions and system environment
7. Parameters tested with highest capacity drive
8. DWPD for 5 years tested with JESD219A Enterprise workload