The Global Leader in Specialized Storage and Memory Solutions

WE BUILD WITH YOU

2025 Product Catalog

About ATP

ATP Electronics was founded in 1991, starting out with just two desks in a Silicon Valley business suite. Today, we have grown to become the industry leaders in memory and storage with an expansive global presence.

ATP is regarded as a strategic supplier by more than 70% of business leaders in Primary Storage Platforms, SD-WAN, and Enterprise Wired and Wireless LAN Infrastructure categories featured in Gartner's Magic Quadrant report.

Recognized as the "Global Leader in Specialized Storage and Memory Solutions," we remain committed to deliver solutions with exceptional reliability, endurance, and performance.

The Global Leader in Specialized Storage and Memory Solutions

Our solutions are engineered according to your specific and unique needs. We have the capability to develop and customize firmware and hardware to meet your requirements.
WE BUILD WITH YOU.

Your Storage and Memory Partner in the Cyclical Market

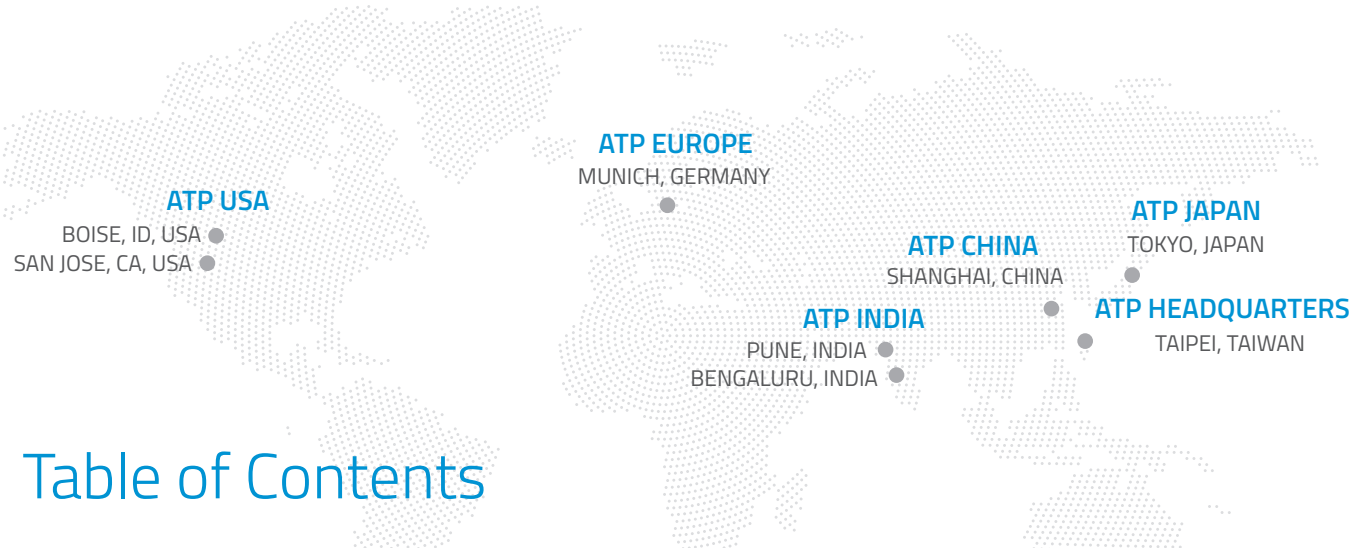
Even though the market can be volatile and unpredictable, we offer a tried-and-tested partnership that ensures stability. You can expect:

- Supply dependability: Dual-sourcing strategy
- Longevity and flexibility: Controlled BOM, long-term planning with supply partners, IC-to-module packaging capabilities
- Smooth qualifications and transitions: 5-year component roadmap

A True Manufacturer with Complete Process Ownership

We take control of every process from NAND/DRAM IC Validation all the way to Testing and Mass Production.

100% of our products are validated and thoroughly tested before leaving our manufacturing facility.



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PRESIDENT'S MESSAGE

2024 was tough. But we were tougher.

With investments being poured heavily into artificial intelligence (AI), module makers like ATP Electronics experienced demand instability from the embedded/industrial market. Still, we trudged on like the true warriors that we are, staying focused and optimistic that we will reap the fruits of our aggressive investments. And we did.

In early 2025, our new validation, production, and test facility at Ciaotou Science Park in Kaohsiung, Taiwan will enter production. The facility is built on our strong commitment to Environmental, Social, and Governance (ESG) initiatives, resulting in cost and logistics improvements for our customers and ensuring a more sustainable future.

By transitioning to smart manufacturing, we aim to reduce environmental impact and waste using renewable energy, energy-efficient processes, smart mobility, low-carbon society technologies, and efficient manufacturing practices.

A significant milestone in 2024 was the introduction of a new product class: The Industrial Enterprise Series SSDs, which are engineered for demanding conditions of uncontrolled environments at the Edge. They integrate the robustness of industrial solutions with the reliability and performance of enterprise-class storage. With ATP's Industrial Enterprise Series SSDs, customers now have the advantage of having the best of both worlds.

We are also thrilled to announce that we have achieved record-breaking endurance levels for our 3D triple level cell (TLC) way beyond the inherent capabilities of the NAND flash. The 11K P/E cycles for our native TLC solutions and 150K configuration for pseudo single level cell (pSLC) in a 512 Gbit IC package are the highest in their respective categories and are unmatched in the industry.

The coming year is paving a promising road ahead. Let us continue working together to relentlessly push boundaries in creating not only better memory and storage solutions, but also a better future for the next generation. WE BUILD WITH YOU.

Jeff Hsieh
President

ATP's Complete Process Ownership

Why are We Unique?

One size does not fit all. ATP recognizes the uniqueness of each customer's requirements, so we go the extra mile to custom-configure our storage and memory solutions according to the needs of our customers.

We begin our Solution and Quality journey at the IC level. This serves as the foundation of all ATP products.

We maintain complete control of our supply chains and take charge of all stages. We are capable of end-to-end management of all the processes to make sure that our solutions meet customers' strictest requirements.

Our Commitment: We Build With You.

Through Process Ownership, we craft the solution for your unique case.
It is your solution, your product.

NAND/DRAM IC Validation	NAND Wafer Management	Package Level Validation	NAND Flash Screening	Design Validation & Testing	Pilot Run	Mass Production

Industry-Standard Product Development

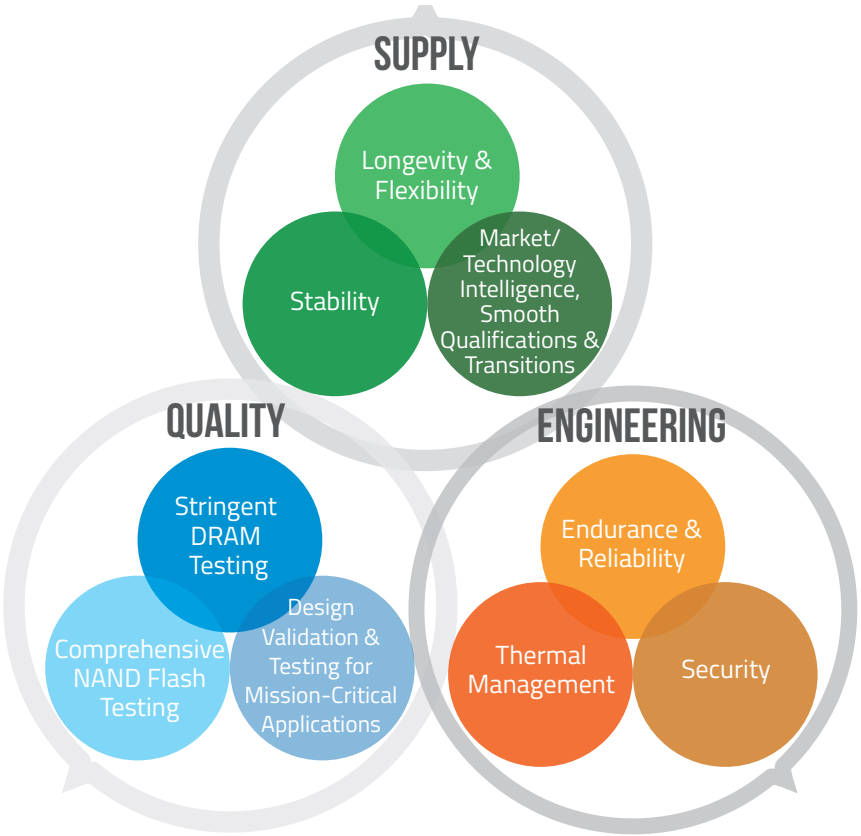
Our quality journey begins here,
at the very basic component level, the ICs.

How Does ATP's Process Ownership Help You?

Longevity & Flexibility
1. Long-term planning with supply partners
2. Controlled BOM
3. IC to module packaging capabilities

Stability
Dual-sourcing strategy

Market/Technology Intelligence
Smooth Qualifications & Transitions
5-year component roadmap from NAND maker including fab alignment diversification plan



Stringent DRAM Testing
1. Automatic Test Equipment (ATE)
2. 100% system-level burn-in testing
3. 100% test during burn-in (TDBI) with ATP-designed mini chamber

Comprehensive NAND Flash Testing
1. IC to drive-level validation
2. NAND flash production screening with ATP-designed Rapid Diagnostic Test (RDT)

Design Validation & Testing for Mission-Critical Applications
1. Design/product characterization specification validation
2. Mean Time Before Failure (MTBF) & End-Of-Life (EOL) Testing
3. Printed circuit board assembly (PCBA) solderability validation

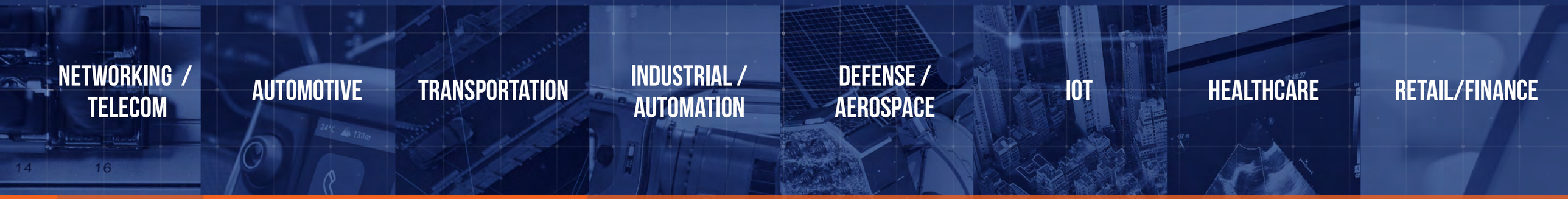
Endurance & Reliability
1. TLC-based drives configured to equal/exceed SLC/MLC endurance at reasonable total cost of ownership
2. Diverse configuration options for optimal cost-per-GB or cost-per-endurance
3. Superior data reliability with hardware-based power loss protection (PLP) technology integrated with a microcontroller unit (MCU)

Thermal Management
1. NAND flash solutions rated for operation under industrial temperature (-40°C to 85°C) and above
2. Wide-temperature DRAM solutions
3. Thermal customization testing, and validation on PCIe Gen4 and Gen3 drives for high-performance applications
4. Heatsink solutions

Security
1. Customized security solutions beyond AES 256-bit encryption, TCG Opal 2.0
2. Self-built HW, API FW, SW for data-at-rest to IoT security solutions
3. Content preload and encryption service

Segment Solutions Overview

Our legacy and latest-generation memory and NAND flash storage solutions meet the diverse reliability, endurance, and longevity requirements of applications in a wide range of segments, such as:



	NETWORKING / TELECOM	AUTOMOTIVE	TRANSPORTATION	INDUSTRIAL / AUTOMATION	DEFENSE / AEROSPACE	IOT	HEALTHCARE	RETAIL/FINANCE
Thermal		Automotive Grade temperature (AG2 & 3)						
		High/Low-temperature reliability validation						
		Tailored thermal solutions						
		Industrial temperature operation						
Endurance	Enterprise Standard Endurance				▪ High-endurance 3D TLC/pSLC/SLC series ▪ Capacity overprovisioning settings ▪ MCU-based power loss protection (PLP)			
Security					▪ AES, TCG Opal 2.0, Self-Encrypting Drive ▪ Secure Erase ▪ Customized encryption security ▪ Write Protection			
								TSE Storage Solutions
Quality	DRAM TDBI extreme low fail rate	▪ IATF 16949 ▪ AEC-Q100 ▪ VDA 6.3			MIL-STD-810G			
		▪ FCC, CE, UKCA, VCCI, BSMI, KCC, RCM, IC, UL, CB, CSA, Morocco, etc. (optional) ▪ ROHS, REACH Collaboration on customer-specific test, qualification, and validation that are beyond JEDEC standards						
	Enterprise Standard Tests							
Supply & Service	5 years+ longevity and BOM control							
		▪ Content Preload service ▪ Joint Validation						

Our Corporate Responsibility Commitment


Responsible Business Alliance

Recognition that

ATP ELECTRONICS TAIWAN INC. KAOHSIUNG BRANCH

2F., No.16-2, Neihuan S. Rd., Nantze Export Processing Zone, Nanzi Dist., Kaohsiung City, ., 811
Chinese Taipei

Completed the RBA Validated Audit Process, achieving SILVER Status without any priority findings, earning a score of 186.9

Validated Audit Report: VAR-20230410-TW-02A01-2
Audit date: April 10, 2023
Certificate issue date: April 29, 2023
Expiration date: April 11, 2025

Robert F. Lederer
CEO, RBA

Certifications

According to leading industry standards

ISO 9001:2015

ISO 28000:2017

ISO 14001:2015

ISO 45001:2018

ISO14064-1:2018

ISO/IEC 17025:2017

VDA 6.3

IATF16949:2016

Sony
Green Partner

ATP has extensive product validation experience in industry-specific standards, including:

- AEC-Q100
- SNIA
- JESD219
- IEC 60529
- IP6X
- ATIS
- JESD22-A110
- MIL-STD-883
- IEC 61000-4-2:2008
- JESD78B
- UL94-v0

Industry Associations and Compliances

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

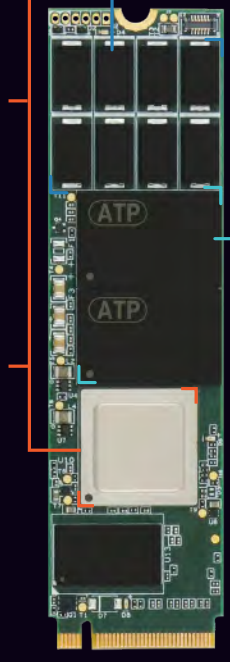
Performance behavior analysis and customization to optimize throughput and latency in a customer host application

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

Powering Space Exploration with Reliable Memory Solutions

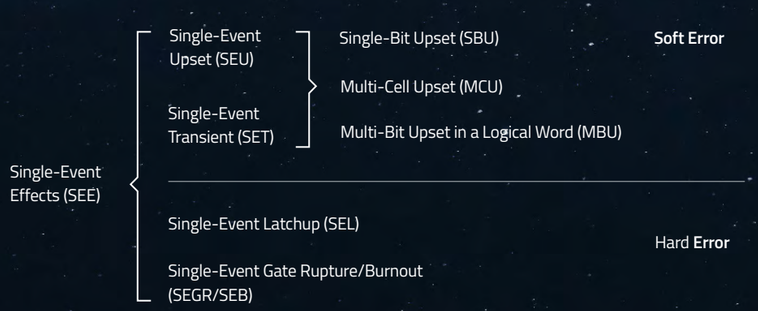
Satellites are increasingly being harnessed for commercial, military, scientific, and a multitude of other uses. In the harsh environment of space, robust memory solutions are critical to ensuring the reliability, system stability, and operational efficiency of these satellites, whether they are used for data processing, real-time communication, or large-scale Earth observation.

Advantages of Low Earth Orbit (LEO) Satellites

Low Earth Orbit Satellites encompass orbits close to the Earth's surface at altitudes ranging from 160 to 2000 km. Most LEO satellites are concentrated below 800 km and are primarily used for communications and Earth observation. These applications require high-capacity memory to store large volumes of communication and telemetry data, especially for high-resolution imagery or video transmission.

Challenges: Effects of Radiation Exposure on Electronic Components

The near-earth environment is filled with high levels of cosmic rays and solar radiation, which can lead to total ionizing dose (TID) degradation and single-event effects (SEE). These effects can cause data corruption and loss, making it crucial for NAND flash memory to be radiation-hardened/tolerant to ensure data integrity and system reliability.



Radiation Hardness to Radiation Tolerance

While radiation-hardened components are built to withstand intense radiation, radiation-tolerant systems rely on redundancy and error correction to manage the effects of radiation.

Compared to deep-space or Geosynchronous Equatorial Orbit (GEO) applications, LEO applications do not require Radiation Hardness Assurance (RHA) or Space grade components. Radiation Tolerance, Industrial Grade, Automotive Grade or "Careful" COTS (commercial off-the-shelf) components are widely adopted in LEO missions.

ATP Radiation-Tolerant Memory Solutions for LEO Satellite Applications

ATP ensures the performance and reliability of its memory and storage solutions for LEO applications through extensive testing and validation. ATP simulates the LEO environment and subjects its solutions to manage the effects of radiation in space while maintaining data integrity and reliability.

End-to-End Data Path Protection: Mitigating Soft Errors Against Radiation

Buffering Data: At DRAM (optional) and SRAM (controller) level

- SECDED (Single Error-bit Correction, Double Error-bit Detection) for error correction and detection
- E2E (End-to-End) protection generates E2E parity
- More refresh cycles (DRAM) to maintain data integrity

Storage Data: At NAND flash level

- RAID Parity is implemented to detect and correct errors, ensuring data reconstruction if a drive in the set fails
- LDPC (Low-Density-Parity-Check) Engine and Read Retry mechanisms are employed to enhance data reliability

ECC Analysis for Post Irradiation Test*

After radiation testing, we can provide ECC analysis services. With an appropriate error handling firmware (FW) architecture, the operation storage device in a sample test has lower ECC compared to the non-operation storage device.

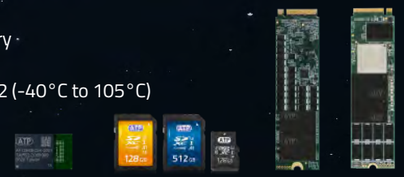
The graphs show the effectiveness of ATP's ECC after significant radiation exposure. There are no later bad blocks (no UECC in both samples), and during operation, the firmware error handling mechanism helps to recover errors.

On average, Operation's ECC< Non-Operation's ECC

ATP LEO Services, Testing, and Features

- Flying heritage*
- Ultra-low-alpha packaging material*
- Event Log Analysis*
- Longevity and controlled BOM for qualified products
- Self-packaged IC and screening test
- Rapid Diagnostic Test (RDT): 100% Screening for NAND error bits before delivery
- S.M.A.R.T. Health Report (Command, API, Software)
- Industrial Operating Temperature Grades: Grade 3 (-40°C to 85°C) and Grade 2 (-40°C to 105°C)

* Available on selected products. Contact ATP for more details.



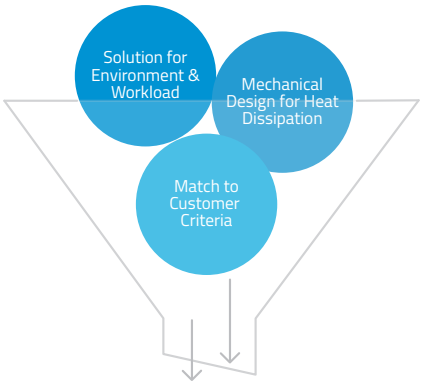
ATP Customizable Thermal Management Solutions: Steady Wins the Race

In this increasingly data-centric era, industrial applications are constantly generating data requiring storage and quick access; however, we are in a constant race not only against time, but also against heat.

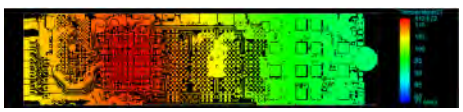
NVMe solid state drives (SSDs) deliver blazing-fast performance, running at four to six times the speed of Serial ATA (SATA), but their blistering speeds, exacerbated by extreme temperature variations and constricted embedded environments with little to no ventilation, can lead to heating issues that can compromise the stability of the storage device.

While most of the storage world is saying, "The faster the better," ATP is taking the "Steady wins the race" stance, ensuring that blazing fast does not turn to blazing hot. The ATP approach to thermal management may be likened to running a marathon. We consider the following steps:

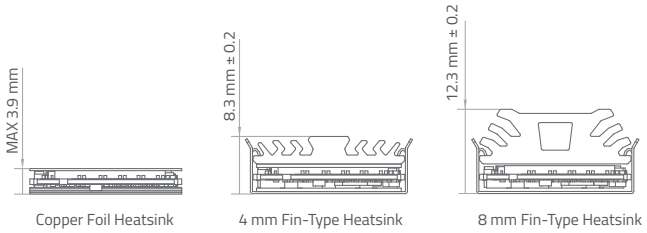
STEP 1: ASSESSMENT



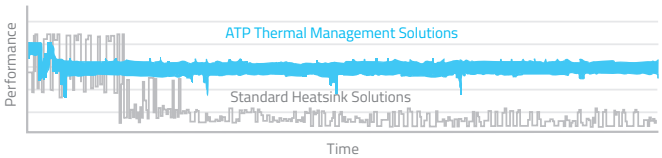
STEP 2: SIMULATION



STEP 3: CUSTOMIZATION



STEP 4: OPTIMIZATION

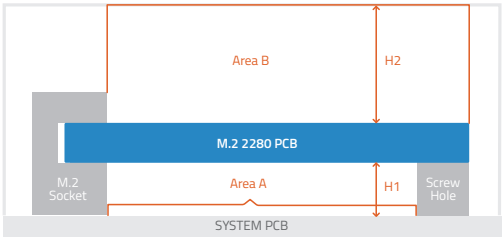


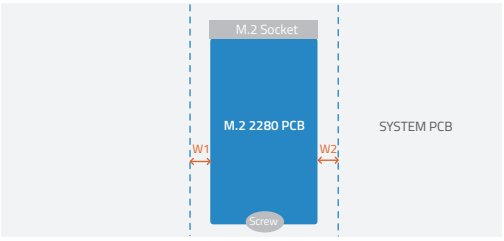
STEP 1: ASSESSMENT

How can NVMe SSDs beat the heat?

Each customer faces a unique thermal challenge, which could be an interplay of all the factors mentioned below:

- System/mechanical criteria
- User applications
- System specifications including, but not limited to:
  - Temperature
  - Airflow
  - Mechanical design
  - Workload and performance requirement





STEP 2: SIMULATION

Comprehensive Thermal Simulation Coverage

ATP utilizes a thorough thermal simulation strategy beginning with the design phase. ATP addresses various facets such as component and mechanical considerations, firmware evaluations, environmental testing for drives, and ultimately simulating thermal environments with mini-chamber tailored to meet customers' specifications.

Full Coverage of Thermal Simulation Test

Component Design Phase

- **IR Drop** Simulation
- **Power Drop** Simulation
- **Temperature Distribution**
- Optimized **PCB layout** and **Component placement**
- Improve **Signal Integrity**
- **NAND Flash IC Validation**

Mechanical Design Phase

- **Mechanical Thermal Simulation**
- **Predict airflow, temperature, and heat transfer in IC** packages, PCBs, electronic assemblies/heatsinks/ enclosures, and power electronics.

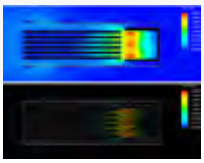
Firmware & S.M.A.R.T. Tool

- Firmware to **optimize performance** based on the temperature reported from **Thermal sensors** and **microcontroller unit (MCU)**
- **Thermal-related FW Error handling and Recovery**
- Temp. information is available via **S.M.A.R.T.** tool

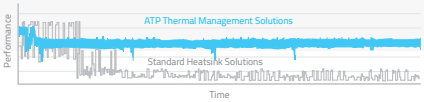
Drive (SSD) Environment Test

- **ATP-built mini chamber**
- Simulate real test environment
- Adjustable **ambient temperature, airflow, and SSD setting**
- Log files of **Performance, power consumption, and S.M.A.R.T.** info.

Cadence



Ansys Icepak



STEP 3: CUSTOMIZATION

One Scenario Does Not Fit All

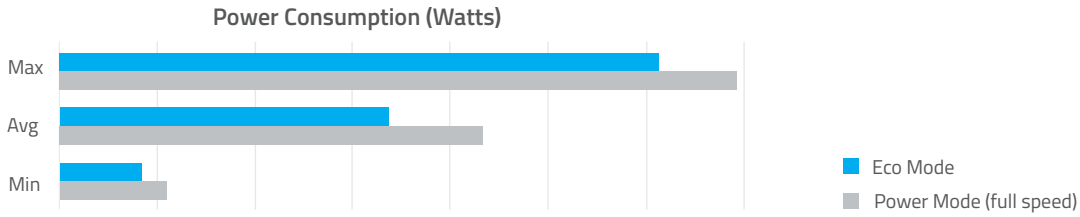
We adopt a collaborative approach with our customers, focusing on a 'WE BUILD WITH YOU' philosophy through joint development efforts. Our commitment to optimizing heat dissipation involves a continuous evaluation of our mechanical designs. This includes examining materials, appearance, airflow, and assembly processes to ensure optimal thermal management. Below is a table detailing the mechanical solutions we offer, such as heatsinks, housings, and enclosures.

Heat Dissipation Solutions						
Form Factor	HSBGA	M.2 2280			U.2	E1.S
Capacity	Up to 512 GB	Up to 1920 GB			Up to 7680 GB	
Heatsink Type	Copper Heatsink	Copper Foil	4mm Fin-Type Heatsink	8mm Fin-Type Heatsink	15mm Fin-Type Housing	9.5mm Symmetric Enclosure
Dimension: L x W x H (mm)	16 x 20 x 1.6	80 x 22 x 3.9	80 x 24.4 x 8.3	80 x 24.4 x 12.3	100.5 x 69.85 x 15	118.75 x 33.75 x 9.5
Material	Cu with Ni/Cr plating	Copper	Upper: Aluminum alloy Bottom: Stainless steel		Aluminum alloy	
Suitability	Limited space		Enough space for effective heat dissipation			
Assembly	Molding	Adhesive	Clips design		Screws design	

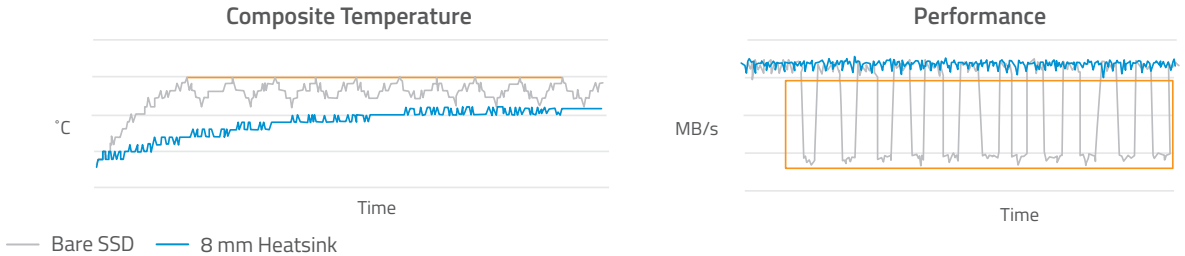
STEP 4: OPTIMIZATION

Steady Wins the Race

The ATP Dynamic Thermal Throttling utilizes firmware to prevent excessive temperature rise by continuously monitoring device temperature. This mechanism triggers Eco Mode, balancing performance and temperature, leading to lower power consumption. The accompanying figure demonstrates a significant reduction in power consumption under Eco Mode.



As the composite temperature rises, the SSD consistently slows down to cool, aided by an 8 mm heatsink and airflow support. This results in a lowered maximum composite temperature for the NVMe SSD, ensuring steady performance with an optimized firmware algorithm.



Highest-Endurance Industrial SSDs & Memory Cards with 125°C Operating Temperature Range

ATP's groundbreaking high-endurance storage solutions combine ATP's exceptional strengths — from the use of prime NAND package, stringent NAND integrated circuits (IC) characterization, and 100% NAND screening and validation capabilities, to ATP's own-developed firmware and specialized hardware configurations.

11K P/E Cycles
in Native TLC mode

100K+ P/E Cycles
in pSLC mode*

5+ Years
Supply Longevity and Locked BOM

125°C
Operating Temperature Range
and Cross-Temp Error Handling

Hardware-Based Power Loss Protection*

ATP adoption of microcontroller units (MCUs) in SSDs enhances reliability, performance, and adaptability by enabling advanced power management, data integrity protection, and real-time optimization of drive operations.

ATP Exclusive Technology*

- AcuCurrent (Signal Optimization Technology)
- PLP Diag (Self-Diagnosing Capacitor Check)
- EcoFlush (Flush Cache Optimization Technology)

* Available on specific models and/or form factors

PCIe® Gen4 NVMe M.2 2280 SSDs

The N751Pi

sets a new industry standard with the highest endurance among industrial SSDs configured with pseudo single-level cell (pSLC) NAND.

It comes with a standard high endurance rating of 100K P/E cycles but can be further configured to achieve an unparalleled endurance of 150K P/E cycles* — a 50% increase. This enhancement translates to an impressive 75 Drive Writes Per Day (DWPD) for sequential write workloads and 21 DWPD for JESD219A enterprise workloads.

The N651Si/N651Sc

boasts unmatched 11K P/E cycles endurance — the highest for any SSD configured with native triple level cell (TLC) NAND, translating to a drive-level endurance of 1 drive write per day (DWPD) with default 7% overprovisioning (OP).

SPECIFICATIONS

- Interface: PCIe Gen4 x4
- Protocol: NVMe 1.4
- Capacity: 80 GB to 3.84 TB
- Endurance: Up to 120,000 TB
- I-Temp Operable*

KEY FEATURES*

- MCU-based HW Power Loss Protection
- Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0
- End-to-End Data Path Protection
- Thermal Management Solutions

PERFORMANCE

- Sequential Read (MB/s): Up to 6,450
- Sequential Write (MB/s): Up to 6,050
- Random Reads IOPS: Up to 1,091,000
- Random Writes IOPS: Up to 1,245,000

* Depending on model and configuration.
Please refer to page 37 for complete product specifications

PCIe® Gen4 NVMe U.2 SSDs

With a massive storage capacity of up to 7.68 TB yet encased in a very lean footprint, the N751Pi/N651Si U.2 SSDs are ideal for space-restricted systems. The hot-swap functionality affords convenient drive maintenance or replacement without hampering operations. The Fin-Type heatsink design effectively transfers heat from the device to the U.2 aluminum housing to keep the device cool and to ensure sustained performance at high temperatures.

The N751Pi

offers the highest endurance among industrial U.2 pSLC-based SSDs with its standard high endurance rating of 100K+ P/E cycles.

The N651Si

surpasses industrial TLC-based SSDs with the highest-ever endurance of 11K P/E cycles, delivering 1 DWPD endurance with default 7% overprovisioning (OP).

SPECIFICATIONS

- Interface: PCIe Gen4 x4
- Protocol: NVMe 1.4
- Capacity: 320 GB to 7.68 TB
- Endurance: Up to 486,000 TB
- I-Temp Operable

KEY FEATURES*

- Hot-swappable
- MCU-based HW Power Loss Protection
- Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0
- End-to-End Data Path Protection
- 15 mm Fin-Type Heatsink Design for Optimal Heat Dissipation

PERFORMANCE

- Sequential Read (MB/s): Up to 6,100
- Sequential Write (MB/s):Up to 6,000
- Random Reads IOPS: Up to 870,000
- Random Writes IOPS: Up to 1,250,000

* Depending on model and configuration.
Please refer to page 38 for complete product specifications

PCIe® Gen4 NVMe E1.S SSDs

The N651Si

Engineered for 1U Edge servers, ATP's E1.S SSDs are designed for vertical placement in compact systems, allowing up to 6 to 12 drives in a 1U chassis. They support hot swapping/hot plugging for easy serviceability and replacement.
High cross-temperature reliability translates to low bit errors and better transmission accuracy for higher data integrity.
The 9.5 mm symmetric enclosure ensures effective thermal management, while customized hardware and sustained performance firmware tuning make these SSDs ideal for hyperscale architectures.

The N651Si Series has the highest endurance of 11K P/E cycles among similar E1.S SSDs configured in native TLC. They are the first to feature breakthrough AcuCurrent Technology, which combines ATP Electronics' proprietary firmware and microcontroller technology to dynamically fine-tune the SSDs in real time, thus ensuring optimal signal integrity across all current routes amidst diverse environments, operational usages and conditions, and NAND flash intricacies.

SPECIFICATIONS

- Interface: PCIe Gen4 x4
- Protocol: NVMe 1.4
- Capacity: 960 GB to 7.68 TB
- Endurance: Up to 79,000 TB
- I-Temp Operable

KEY FEATURES*

- AcuCurrent Technology
- MCU-based HW Power Loss Protection
- Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0
- End-to-End Data Path Protection
- Hot-pluggable/Hot-swappable

PERFORMANCE

- Sequential Read (MB/s): Up to 6,400
- Sequential Write (MB/s): Up to 6,100
- Random Reads IOPS: Up to 1,000,000
- Random Writes IOPS: Up to 1,200,000

* Depending on model and configuration.
Please refer to page 39 for complete product specifications

SATA III SSDs

ATP Serial ATA drives deliver optimal reliability and consistent performance. They feature enhanced power management and power loss protection capabilities, thanks to the breakthrough microcontroller unit (MCU)-based design.

The A750Pi

Unparalleled endurance ratings of 100K+ P/E cycles make these pSLC-configured SSDs on par with drives built on SLC flash.

The A650Si / A650Sc

With 11K P/E cycles, these drives offer unmatched endurance compared with similar TLC-based SSDs, making them on par with MLC-based drives.

SPECIFICATIONS

- Interface: SATA III 6 Gb/s
- Form Factors: M.2, 2.5", mSATA
- Capacity: 80 GB to 1.92 TB
- Endurance: Up to 59,250 TB
- I-Temp Operable*

KEY FEATURES*

- MCU-based HW Power Loss Protection
- Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0
- End-to-End Data Path Protection

PERFORMANCE

- Sequential Read (MB/s): Up to 560
- Sequential Write (MB/s): Up to 525
- Random Reads IOPS: Up to 104,000
- Random Writes IOPS: Up to 92,000

* Depending on model and configuration.
Please refer to page 41,42,43 for complete product specifications

PCIe® Gen4 NVMe CFexpress Cards

ATP CFexpress cards are trailblazers — they were among the industry's first to adopt NVMe™ protocol utilizing the PCIe® 4.0 x2 interface, surpassing standard PCIe 3.0 x2 configurations. These small but mighty storage devices consume low power, support software RAID 1,0, support Host Memory Buffer (HMB) to improve read performance, and hardware write-protect security.

The N751Pi

offers the highest endurance of 100K+ P/E cycles compared with other pSLC-configured CFexpress cards. I-Temp operable, they perform reliably under extreme temperatures.

The N651Si/N651Sc

won the prestigious "Best in Show" award at Embedded World 2024. Aside from their innovative features, they also bested other CFexpress cards built with TLC NAND as they offer the highest endurance of 11K P/E cycles.

SPECIFICATIONS

- Interface: PCIe Gen4 x2
- Protocol: NVMe 1.4
- Capacity: 40 GB to 1 TB
- Endurance: Up to 19,010 TB
- I-Temp Operable*

KEY FEATURES*

- Firmware-based Power Loss Protection
- Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0
- Host Memory Buffer (HMB) support
- Hardware Write Protect*

PERFORMANCE

- Sequential Read (MB/s): Up to 3,500
- Sequential Write (MB/s): Up to 3,200
- Random Reads IOPS: Up to 770,000
- Random Writes IOPS: Up to 768,000

* Depending on model and configuration.
Please refer to page 49 for complete product specifications

SD, microSD Memory Cards

ATP's high-endurance, low-latency memory cards are targeted for growing segments spurred by 5G, artificial intelligence (AI), and edge technologies, such as AI-enabled surveillance, smart homes, mobile monitoring, automotive recorders, remote healthcare, and security surveillance systems requiring heavy write and re-write usage.

The S750Pi

Configured with pSLC NAND, these cards are I-Temp operable and offer unmatched endurance of 100K+ P/E cycles.

The S650Si/S650Sc

With the highest endurance of up to 11K, they meet the rigid requirements of non-stop recording environments. Compared with competitors, they deliver extended recording hours with the same capacity, presenting a more cost-effective solution.

SPECIFICATIONS

- Interface: UHS-I
- Capacity: 16 GB to 512 GB
- Endurance: Up to 12,670 TB
  I-Temp Operable*

KEY FEATURES*

- Low-density parity-check (LDPC) ECC
- ATP SD Life Monitor: Intelligent Workload Inspection
- Low Latency Performance
- System-in-Package (SiP) technology

PERFORMANCE

- Sequential Read (MB/s): Up to 95
- Sequential Write (MB/s): Up to 80

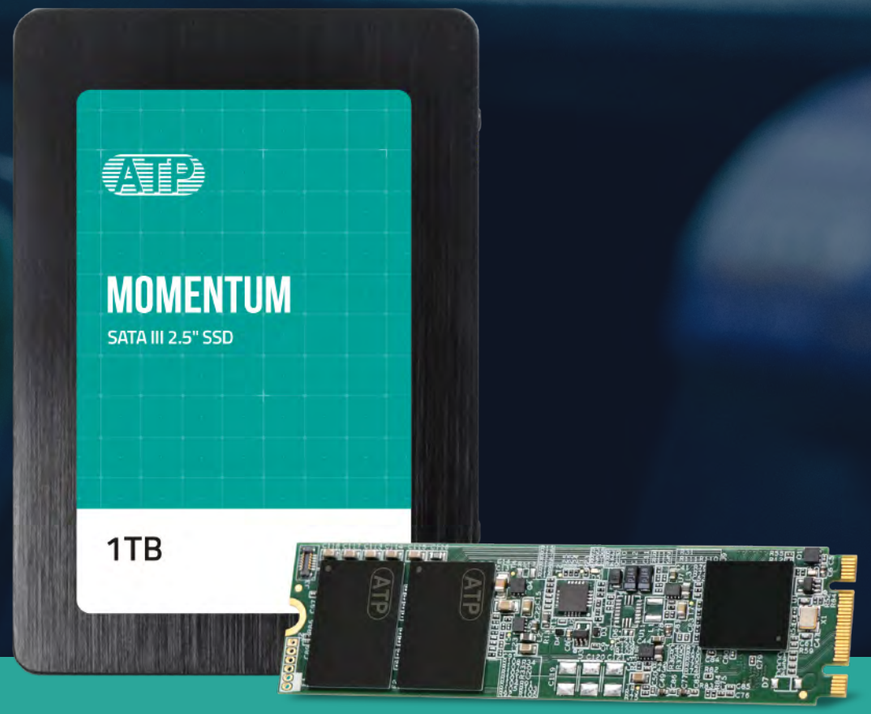
* Depending on model and configuration.
Please refer to page 47 for complete product specifications

A New Era Begins with

ATP Momentum Line

Emphasizing rapid time-to-market, broad compatibility, and cost-efficient storage, the ATP Momentum Line combines cutting-edge technology with essential solutions tailored to meet the diverse needs of the industrial market.

With ATP's commitment to quality control and rigorous verification processes, our products consistently deliver dependable results. Offering a range of mainstream specifications and storage capacities, the ATP Momentum Line provides versatile options for various industrial applications.



ATP Momentum Line SSDs

PCIe® Gen4 NVMe M.2 2280 SSD

N601Mw

- PCIe Gen4 x4, NVMe 1.4
- 1 TB to 4 TB capacities
- Extended-Commercial Temp Operable (-20°C to 75°C)
- Power loss protection for data at rest
- AutoRefresh and Auto-Read Calibration elevate runtime data integrity
- End-to-End Data Path Protection
- Host Memory Buffer (HMB) support

PCIe® Gen3 NVMe M.2 2280 SSD

N400Mw

- PCIe Gen3 x4, NVMe 1.3
- 128 GB to 1 TB capacities
- Extended-Commercial Temp Operable (-20°C to 75°C)
- Power loss protection for data at rest
- AutoRefresh and Auto-Read Calibration elevate runtime data integrity
- End-to-End Data Path Protection
- Host Memory Buffer (HMB) support

SATA III M.2 2280 SSD / 2.5" SSD

A400Mw

- SATA III 6 Gb/s
- 128 GB to 1 TB capacities
- Extended-Commercial Temp Operable (-20°C to 75°C)
- Power loss protection for data at rest
- SSD features built with ATP expertise for comprehensive reliability
- Power-efficient DRAM-less design

Product Line	Momentum			
	N601Mw	N400Mw	A400Mw	A400Mw
Interface	PCIe G4 x4	PCIe G3 x4	SATA III 6 Gb/s	SATA III 6 Gb/s
Flash Type	3D TLC			
Form Factor	M.2 2280 S3-M	M.2 2280 S2-M	M.2 2280 S2-B-M	2.5"
Operating Temperature	-20°C to 75°C			
Power Loss Protection Options	Firmware Based			
Optional SED Features	-			
Capacity	1 TB to 4 TB	128 GB to 1 TB		
Performance				
Sequential Read (MB/s) up to	7,200	2,600	550	550
Sequential Write (MB/s) up to	6,500	1,800	500	500
Random Reads IOPS up to	1,000,000	240,000	72,000	72,000
Random Writes IOPS up to	1,200,000	300,000	86,000	86,000
Endurance and Reliability				
Endurance (TBW)[1] up to	6,000 TB	695 TB	765 TB	765 TB
Reliability MTBF @ 25°C	>3,000,000 hours			
Others				
Dimensions (mm)	80.0 x 22.0 x 2.2			100 x 69.85 x 7
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH			
Warranty	2 years			

1. Under highest Sequential write value. May vary by density, configuration and applications.

ATP Momentum DRAM Series : DDR4/DDR5

The new Momentum Series industrial DRAM modules offer mainstream data transfer rates combined with a low power consumption, ensuring faster performance and greater power savings. They adhere to all JEDEC standards and utilize top-tier DRAM chips to provide high levels of reliability, compatibility, and stability across various industrial applications. With ATP's commitment to quality control and rigorous verification processes, these modules consistently deliver dependable results.

KEY FEATURES

- Densities: 8 GB to 32 GB
- JEDEC Compliant
- Top-tier DRAM chips and production traceability
- Decreased voltage for better power efficiency
- Unique ATP TDBI decreases error rate over time
- Designed and validated for confident data integrity and compatibility
- Operating Temperature: 0°C to 85°C

MOMENTUM DRAM MODULES ARE IDEAL FOR USE IN:

- Industrial PCs
- Retail/point-of-sale systems (POS)
- Kiosks/Digital Signages
- Casino Gaming
- Thin-client PCs
- Automation
- ATM
- Medical & Healthcare

Product	DIMM Type	Density	Speed (MT/s, up to)	Operating Temp.	PCB Height	Part Number	ATP TDBI	Wide Temperature
DDR5	Non-ECC UDIMM	8 GB	5600	0°C to 85°C	Low Profile	R58G00UD566CAYC	●	▲
		16 GB	5600	0°C to 85°C	Low Profile	R516G0UD568AAYC	●	▲
		32 GB	5600	0°C to 85°C	Low Profile	R532G0UD568BAYC	●	▲
	Non-ECC SO-DIMM	8 GB	5600	0°C to 85°C	Low Profile	R58G00SD566CAYC	●	▲
		16 GB	5600	0°C to 85°C	Low Profile	R516G0SD568AAYC	●	▲
		32 GB	5600	0°C to 85°C	Low Profile	R532G0SD568BAYC	●	▲
DDR4	Non-ECC UDIMM	8 GB	3200	0°C to 85°C	Low Profile	R48G00UD328AGSC R48G00UD328ACSC	●	▲
		16 GB	3200	0°C to 85°C	Low Profile	R416G0UD328BGSC R416G0UD328BCSC	●	▲
		32 GB	3200	0°C to 85°C	Low Profile	R432G0UD328BCSC R432G0UD328BASC	●	▲
	Non-ECC SO-DIMM	8 GB	3200	0°C to 85°C	Low Profile	R48G00SD328AGSC R48G00SD328ACSC	●	▲
		16 GB	3200	0°C to 85°C	Low Profile	R416G0SD328EGSC R416G0SD3282CSC	●	▲
		32 GB	3200	0°C to 85°C	Low Profile	R432G0SD3282CSC R432G0SD3282ASC	●	▲

▲: Optional

ATP's DDR5 5600/6400 MT/s Memory Feeds the Need for Speed, Higher Density, and Lower Power

Please refer to page 30 for DDR5 product specifications.

Next-generation applications require next-generation memory. DDR5 outperforms DDR4 in every aspect, satisfying the insatiable need for larger densities, reduced latency, and quicker data transfer rates, all while providing improved power efficiency.

2X the Speed

The **5600/6400*MT/s** memory bandwidth represents up to 100% increase over DDR4's maximum speed of 3200 MT/s. DDR5 is expected to scale up to 8000 MT/s channel speed, further exceeding DDR4's and translating to overall higher performance.

4-Layer TSV Enables 128 Gb Density

While DDR4 maxed out at 16 Gb in a single die package (SDP), a single DDR5 DRAM die package has up to 32 Gb.

Better Power Efficiency

Despite running at higher speeds, DDR5 operating voltage is a mere 1.1V, consuming less power and delivering more energy savings compared with DDR4's 1.2V.

Better Power Architecture

DDR5's on-board Power Management Integrated Circuit (PMIC) moves power management from the motherboard to the DIMM. This new power architecture regulates power for better distribution and signal integrity while reducing noise.

Accurate, Real-Time Temperature Control

Targeted for DDR5 Registered DIMMs (RDIMMs), a temperature sensor on the DIMM provides accurate and real-time temperature monitoring and control.

*Available in 2H 2025

DRAM SOLUTIONS

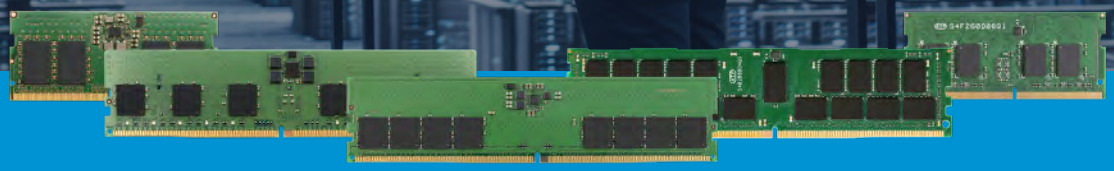
Intense Performance for Intense Workloads

ATP's industrial DRAM modules are built tough and can meet the exacting demands of the growing enterprise. On call 24/7, these hardworking modules are fast, can withstand harsh operating environments, and can handle large bandwidth requirements. ATP's DRAM lineup consists of legacy SDRAM, and a complete range of DDR1, DDR2, DDR3, DDR4, and DDR5 modules. They are available as RDIMM, RDIMM VLP, UDIMM/UDIMM ECC, SO-DIMM/SO-DIMM ECC, Mini-RDIMM, and Mini-UDIMM/Mini-UDIMM ECC.

DRAM Modules

Multi-Generational Accelerated Computing

ATP DRAM modules meet the growing need for accelerated performance in memory-intensive and high-performance computing applications to keep up with intensifying data processing requirements as the Internet of Things (IoT) and industrial IoT (IIoT) inevitably become more pervasive. Multi-generational solutions range from legacy DDR3/DDR2/DDR1, DDR4, and the latest DDR5 solutions, which deliver robust performance, durable build, and the right density for the toughest workloads. ATP's modules consist of major integrated circuits (ICs) exclusively obtained from 100% Tier 1 manufacturers, eliminating reliance on spot market sources.



The ATP Advantage: WE BUILD WITH YOU*

Value-Added Customization Services*

- **Conformal Coating** makes the DRAM module totally pinhole-free and truly conformal, shielding it from dust, chemicals, moisture, and other harmful substances.
- **Chamfering PCB Design** refers to the "beveling or tapering" of connector edges for easier insertion into the memory slots.
- **Anti-Sulfur Resistors** Ordinary silver resistors corrode and become non-conductive when exposed to sulfur. ATP DRAM modules products offer an anti-sulfur resistor option to prevent the corrosive effects of sulfur contamination, guaranteeing continued dependable performance for a long time and lowering the total cost of ownership by preventing unnecessary downtime and expensive component replacements.

Best TCO with Wide-Temp ICs

Wide-temperature ICs supporting -40°C to 85°C operating range offer the best solution to reach industrial grade performance at a lower cost.

Longevity Support for Legacy Modules

Under the Product Longevity Program, a partnership agreement with Micron Technology, Inc. ATP will continue to manufacture legacy SDR/DDR/DDR2 DRAM modules for Micron's customers that are unable to migrate, including selected legacy DRAM modules specifically for customers using AMD Embedded Geode platforms

System-Level TDBI Screens Out 0.01% Error

Even just 0.01% error on a 99.99% effective device can increase the failure rates at the module level and lead to failure in actual usage. ATP's system-level TDBI can detect and screen out the 0.01% error to ensure utmost reliability.

* Features and services may vary depending on project and customer request.

ATP DRAM Modules: Tested Rigorously for Maximum Reliability

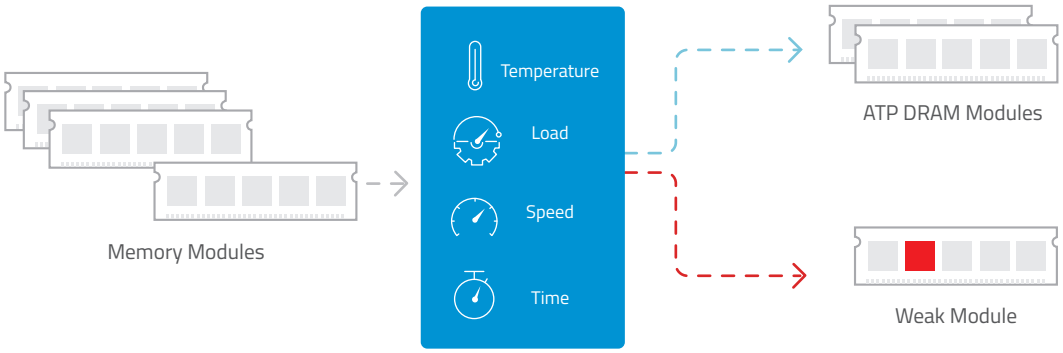
Dynamic Random Access Memory (DRAM) modules perform critical tasks for rigid workloads. Many of them are installed in systems that work non-stop in high-stress environments. They are constantly exposed to thermal, environmental as well as electro-mechanical challenges. Knowing that any vulnerability that can cause unstable system operation can also drastically impact business operations, ATP goes through extra lengths to make sure that its DRAM modules are extremely reliable.

Automatic Test Equipment (ATE)

The ATE detects component defects and structural defects related to the DIMM assembly and screens out marginal timing and signal integrity (SI) sensitivities. ATE provides electrical testing patterns with various parameter settings, such as marginal voltage, signal frequency, clock, command timing and data timing under continuous thermal cycle.

Test During Burn-in (TDBI)

- TDBI at mass production level detects early life failures (ELF) and effectively screens out weak ICs that could fail during the early product life. It combines temperature, load, speed and time to stress test memory modules and expose the weak module.
- Even just 0.01% error on a 99.99% effective device can increase the failure rates at module level and lead to failure in actual usage.
- ATP TDBI can detect and screen out the 0.01% error to ensure utmost reliability.

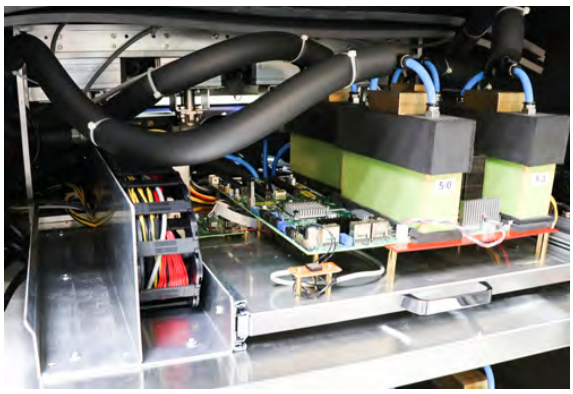


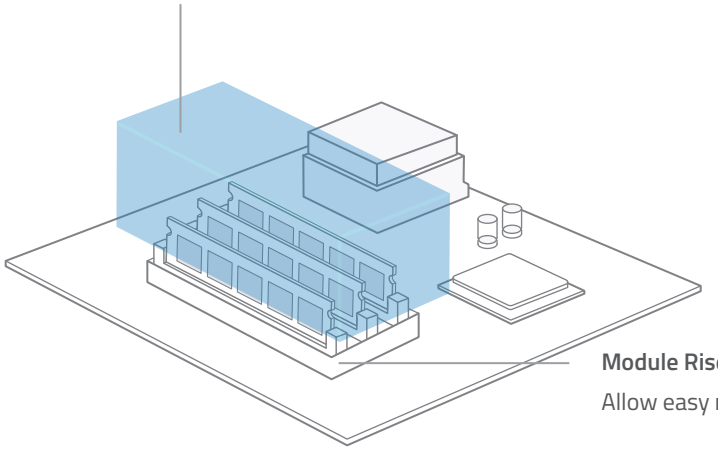
ATP TDBI: What Makes It Unique?

The ATP TDBI system applies extreme high/low temperature, high-low voltage, and pattern testing on DRAM modules. The system consists of:

The Mini Chamber

Isolates temperature cycling only to modules being tested so as not to thermally stress the rest of testing systems. This minimizes the failure of other testing components, such as the motherboards. It also allows faster debug for defects per million (DPM) fallout and reduced false failures. In conventional large thermal chambers, the failures of non-DRAM-related testing components are constant, given that the whole system is thermally stressed.



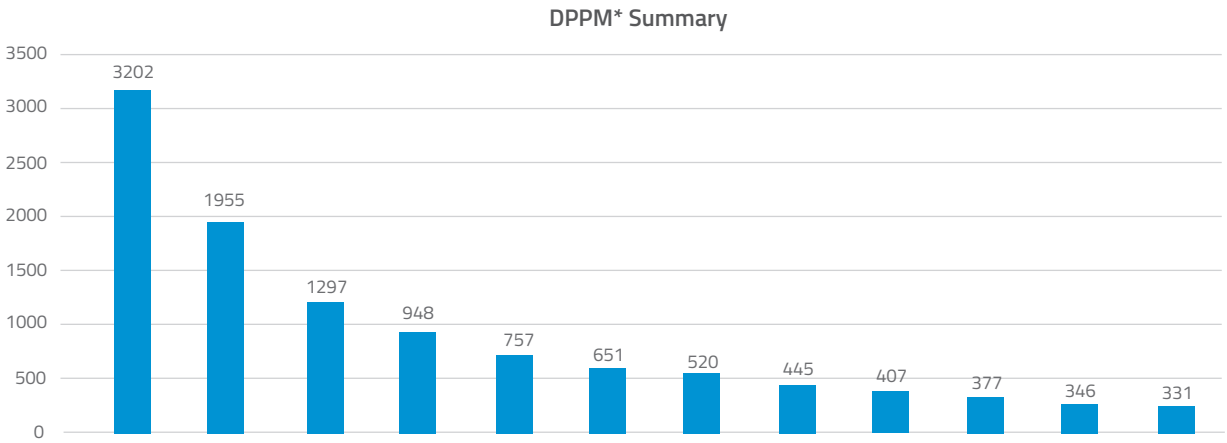


Module Riser Adapters from the Motherboard

Allow easy module insertions in production-level volumes.

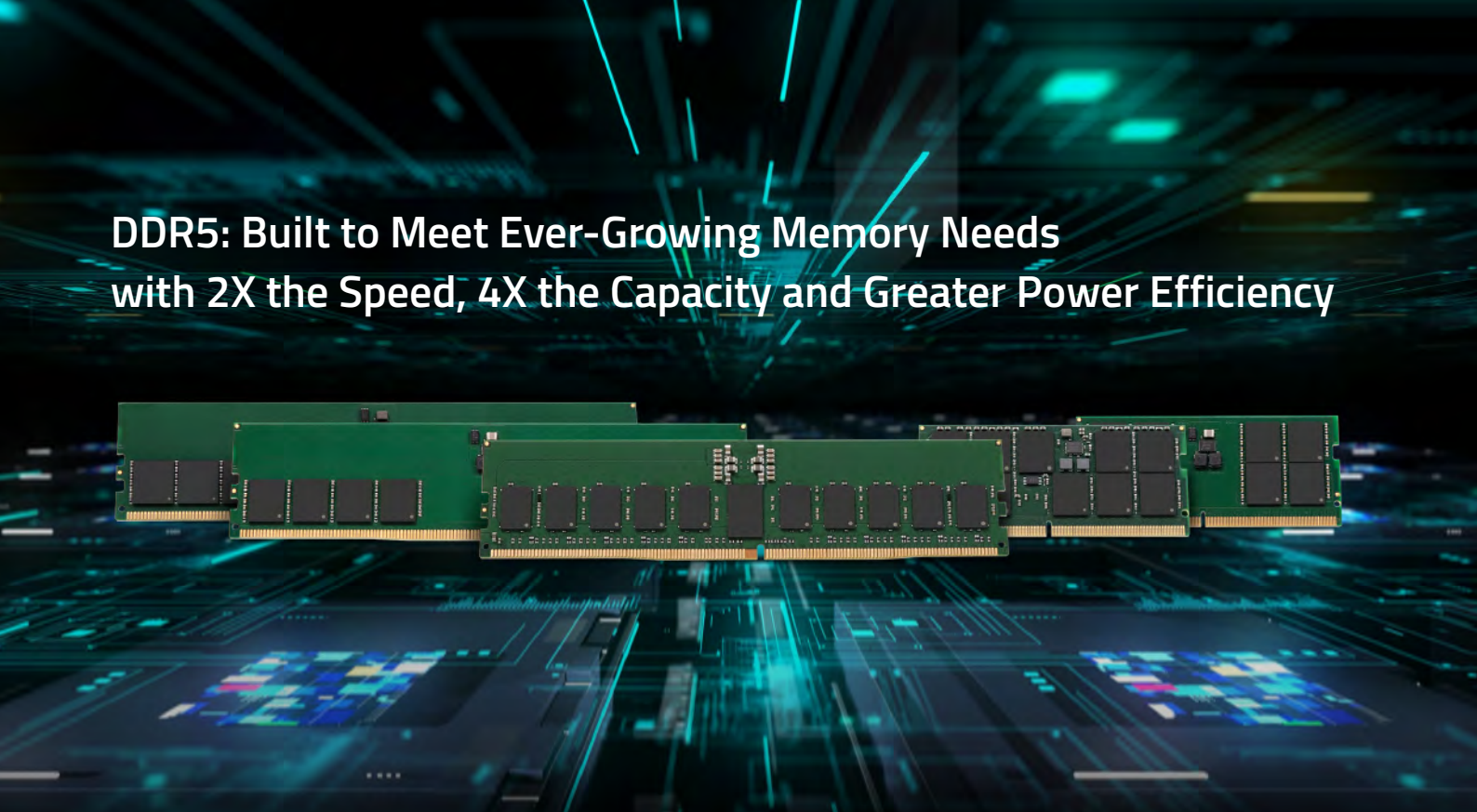
Improvements After TDBI Adoption

The following graph shows that with ATP TDBI, the error rates decrease over time. The acceptable industry limit is 3,500 DPPM,* but with ATP TDBI, the error rate has gone down significantly over the years.



*DPPM = Defective Parts per Million

DDR5: Built to Meet Ever-Growing Memory Needs with 2X the Speed, 4X the Capacity and Greater Power Efficiency



ATP's DDR5 solutions outperform DDR4 in every way, delivering faster performance, higher memory bandwidth, higher densities, and improved power efficiency. This new-generation DRAM specification meets the growing memory needs of present and future critical computing applications.

Both DDR4 and DDR5 DIMMs have 288 pins, but DDR5 can transmit data faster with its higher bandwidth.

DDR5 modules will not fit in DDR4 sockets due to different alignment keys and pinouts that accommodate the new features.

DDR5 Key Enhancements

- On-Die ECC detects and corrects errors before data is sent to the CPU.
- Dual Subchannels on a DIMM. Two 40-bit-wide channels (32 data bits and 8 ECC bits) improve memory access.
- Longer Burst Length. DDR5's burst length of 16 doubles that of DDR4, allowing access to 64 bytes of data with a single burst and using just one of two independent channels (half a DIMM), translating to better efficiency.
- Dual Data Rate (DDR) on command and address interface, as opposed to Single Data Rate (SDR) on command and address interface with DDR4, have freed up additional pins for isolation enhancements.
- Client Clock Driver (CKD) enables DDR5 CUDIMMs and CSODIMMs operating at up to 7200 MT/s or higher.

DDR5 product specifications

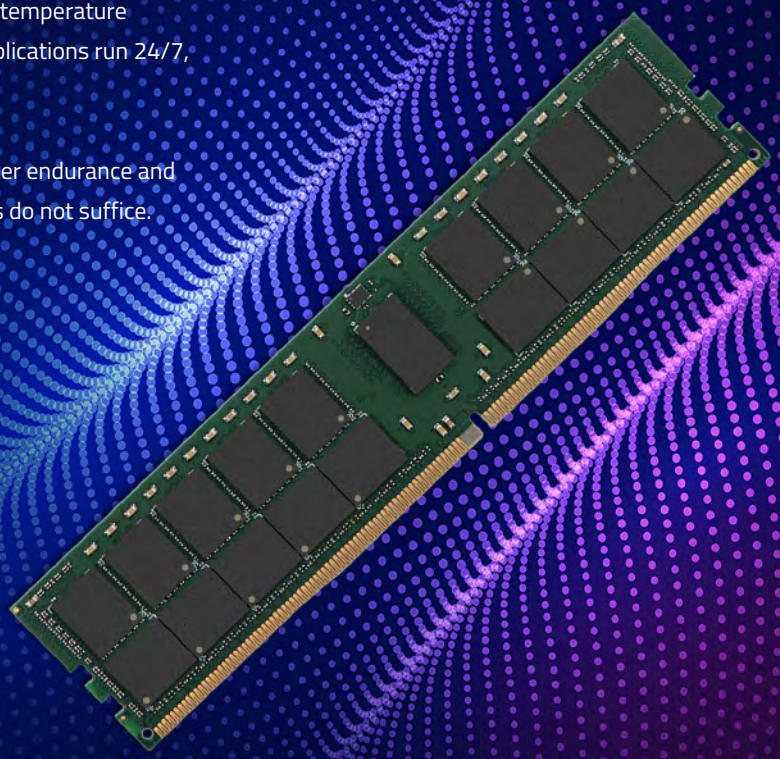
DDR5									
DIMM Type	RDIMM	ECC UDIMM	ECC CUDIMM	Non-ECC UDIMM	Non-ECC CUDIMM	ECC SO-DIMM	ECC CSO-DIMM	Non-ECC SO-DIMM	Non-ECC CSO-DIMM
Density	16 GB to 256 GB	16 GB to 64 GB		8 GB to 64 GB		16 GB to 64 GB		8 GB to 64 GB	
Speed up to (MT/s)*	6400*	5600	6400*	5600	6400*	5600	6400*	5600	6400*
PCB Height	Low profile / VLP**	Low profile / VLP**		Low profile		Low profile		Low profile	
Operating Temperature	0°C to 85°C / -40°C to 85°C								

*Available in 2H 2025
** VLP: 0.74"

Why Wide-Temp Modules?

DRAM modules are typically installed in systems that operate in harsh environments and extreme temperatures that fluctuate during daytime and the nighttime, as well as in varying weather conditions; thus, memory with a broader range of temperature capabilities is becoming more necessary as most edge computing applications run 24/7, often in challenging environments.

ATP offers industrial grade wide-temp DRAM modules to ensure better endurance and redundancy in critical environments where commercial-grade DRAMs do not suffice.



Benefits of ATP's Wide-Temp Modules

100%
Major ICs sourced from Tier 1 Manufacturers

Lifetime Warranty*
3 years for specific modules*

-40˚C to 85˚C
Operating Temperature range

UTMOST RELIABILITY
ATP's Test During Burn-In (TDBI) can detect and screen out 0.01% error to ensure utmost reliability.

* Warranty does not cover customized modifications made to the product after its sale.
A 3-year warranty is offered for specific modules, applicable to certain customers starting from the invoice date.

ATP Reaffirms Commitment to Long-Term Supply of Legacy DRAM Modules

ATP Meets Continued Demand for DDR3 Modules

With DDR4 as the current mainstream memory and companies preparing for DDR5, major memory makers are slowing down the production of DDR3 or phasing it out. However, systems that have been running for a long time supporting DDR3 remain widely in use for industrial, networking, and other embedded applications. Through its partnership with key suppliers, ATP is committed to supporting the continued demand for DDR3 SO-DIMM and UDIMM in the next 3 to 5 years.

Product Information

Module Type	DDR3 SO-DIMM	DDR3 UDIMM
Capacity	4 GB / 8 GB	4 GB / 8 GB
Function	ECC/NON-ECC	ECC/NON-ECC
Frequency	1866 MHz	1866 MHz

Micron-ATP Partnership and License Agreements: DDR2 Continuity Program

With DDR2 still widely deployed in the US, Japan and Europe, ATP and Micron are making sure that these markets will have a steady supply of Micron DDR2 SO-DIMMs and UDIMMs for industrial/embedded systems installed in high-reliability and mission-critical environments. All modules are manufactured, tested and validated by ATP, according to the equivalent specifications and testing/validation processes of the respective Micron part number.

"Micron is dedicated to maximizing customers' infrastructure investments by ensuring prolonged support for legacy systems and applications. Our proven partnership with ATP gives our customers the benefit of receiving similar Micron products and services to support their current platforms while ATP ensures the stability of their operations well into the future."

- Kris Baxter, Corporate Vice President and General Manager, Embedded Business Unit, Micron Technology, Inc.

Legacy (SDR/DDR) DRAM Modules

The license agreement stipulates the following conditions for ATP:

- 100% follow Micron's design. Offer extended support for these legacy products to minimize the customer's (re)qualification efforts.
- 100% follow Micron's BOM selection. Implement the same specifications for key components (such as IC configuration and Register/PLL type), as well as passive components (such as resistors, capacitors and EEPROM) to meet the specifications of Micron's BOM.
- 100% follow Micron's firmware settings. Implement SPD in addition to the manufacturer's information.
- 100% follow Micron's specifications. Each module will be manufactured to the equivalent specifications and test processes of the corresponding Micron part number.

Product Information

Module Type	Capacity	Function	Frequency	Number of Pins	PCB Height
DDR SO-DIMM	128 MB / 256 MB / 512 MB / 1 GB	Unbuffered Non-ECC	400 MHz	200	1.25"
DDR SO-DIMM (Industrial Grade)	256 MB / 512 MB	Unbuffered Non-ECC	400 MHz	200	1.25"

Build To Order (BTO)					
Module Type	Capacity	Function	Frequency	Number of Pins	PCB Height
DDR UDIMM	256 MB	Unbuffered Non ECC	400 MHz	184	1.25"
SDRAM SO-DIMM	64 MB / 128 MB / 256 MB	Unbuffered Non ECC	133 MHz	144	1.0" / 1.25"

Complete DRAM Portfolio

Product	DIMM Type	Capacity	Speed (MT/s, up to)	VLP/ULP*	30μ" Golden Finger	ATP TDBI	Wide Temperature	Anti-Sulfur Resistors	Conformal Coating	PCB Chamfer
DDR5	RDIMM	16 GB to 256 GB	6400*	●	●	●	▲	▲	-	▲
	ECC CUDIMM	16 GB to 64 GB	6400*	-	●	●	▲	▲	▲	▲
	Non-ECC CUDIMM	8 GB to 64 GB	6400*	-	▲	●	▲	▲	▲	▲
	ECC CSO-DIMM	16 GB to 64 GB	6400*	-	●	●	▲	▲	▲	▲
	Non-ECC CSO-DIMM	8 GB to 64 GB	6400*	-	▲	●	▲	▲	▲	▲
	RDIMM	16 GB to 256 GB	5600	●	●	●	▲	▲	-	▲
	ECC UDIMM	16 GB to 64 GB	5600	●	●	●	▲	▲	▲	▲
	Non-ECC UDIMM	8 GB to 64 GB	5600	-	▲	●	▲	▲	▲	▲
	ECC SO-DIMM	16 GB to 64 GB	5600	-	●	●	▲	▲	▲	▲
	Non-ECC SO-DIMM	8 GB to 64 GB	5600	-	▲	●	▲	▲	▲	▲
DDR4	RDIMM	4 GB to 128 GB	3200	●	●	●	▲	▲	-	▲
	ECC UDIMM	4 GB to 32 GB	3200	●	●	●	▲	▲	▲	▲
	Non-ECC UDIMM	2 GB to 32 GB	3200	●	▲	●	▲	▲	▲	▲
	ECC SO-DIMM	4 GB to 32 GB	3200	-	●	●	▲	▲	▲	▲
	Non-ECC SO-DIMM	2 GB to 32 GB	3200	-	▲	●	▲	▲	▲	▲
	Mini-RDIMM	4 GB to 16 GB	2400	●	●	●	▲	▲	-	-
	Mini-UDIMM	4 GB to 16 GB	2400	●	●	●	▲	▲	-	-
DDR3	ECC UDIMM	1 GB to 16 GB	1866	●	●	●	▲	▲	▲	▲
	Non-ECC UDIMM	1 GB to 16 GB	1866	●	●	●	▲	▲	▲	▲
	ECC SO-DIMM	1 GB to 16 GB	1866	●	●	●	▲	▲	▲	▲
	Non-ECC SO-DIMM	1 GB to 16 GB	1866	-	●	●	▲	▲	▲	▲
	Mini-UDIMM	1 GB to 8 GB	1600	●	●	●	▲	▲	-	-
DDR2	ECC UDIMM	1 GB to 2 GB	800	-	●	●	▲	-	-	-
	Non-ECC UDIMM	1 GB to 2 GB	800	-	●	●	▲	-	-	-
	Non-ECC SO-DIMM	256 MB / 1 GB to 4 GB	800	-	●	●	▲	-	-	-
DDR1	Non-ECC UDIMM	256 MB	400	-	●	●	-	-	-	-
	Non-ECC SO-DIMM	128 MB to 512 MB / 1 GB	400	-	●	●	▲	-	-	-
SDRAM	Non-ECC SO-DIMM	64 MB to 256 MB	133	-	●	●	-	-	-	-

▲: Optional * Available in 2H 2025 ** VLP: height=0.74" ,ULP : height below =0.74"

FLASH SOLUTIONS

Specialized Storage Solutions for Mission-Critical Applications

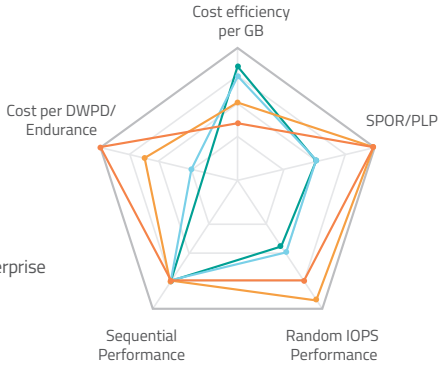
ATP's industrial flash products deliver dependable performance, efficient responsiveness, and long usage life to accomplish mission-critical tasks. Customizable* to customers' configurations, they come in different form factors, such as U.2, 2.5" SSDs, M.2 embedded modules, mSATA, CFexpress, CFast, CompactFlash, SD/microSD memory cards, USB drives, and E1.S drives for enterprise and industrial applications.

They support high-speed interfaces such as SATA 6 Gb/s and the latest NVMe™ protocol on PCIe® interface for reliable, blazing-fast, and future-ready performance. Managed NAND offerings include the automotive/industrial grade e.MMC and NVMe HSBGA SSD, which integrate flash memory and controller into a single package.

* By project support.

Flash Products Naming Rule

N	65	1	S	i	a
Interface Uppercase	**Endurance** Numeral	**Technology Iterations** Numeral	**Product Line** Uppercase	**Temperature** Lowercase	**Series** Lowercase
N: PCIe (NVMe) A: SATA B: USB I: PATA/IDE (CF) S: SD/microSD E: e.MMC/eMCP U: UFS	80: SLC 75: Enhanced SLC mode 70: SLC mode 65: Enhanced TLC 60: Native TLC/MLC 50: Native QLC 40: Read-Intensive NAND	Reserved to define Core technology/ interface generation change	P: Premium S: Superior V: Value M: Momentum	c: Commercial w: Extended-Commercial i: Industrial a: Automotive / Extended-Industrial	a: Automotive s: SecurStor e: Industrial Enterprise



Premium Line

The ATP Premium Line consists of mass storage solutions built for uncompromising performance, maximum dependability, and exceptional endurance. Outfitted with best-in-class technologies ensuring the highest levels of reliability, these solutions are hardwired for the most demanding mission-critical applications where system failures or interruptions can significantly impact operations. Unparalleled usage life and brisk write speeds set the Premium Line a cut above the rest. High input/output operations per second (IOPS) ensure consistently high performance, and ATP's power loss protection technology guarantees that data in transit are safely stored to the flash chip in the event of a power loss, thus safeguarding data integrity, averting data loss or corruption, and preventing device damage.

Superior Line

The ATP Superior Line brings together powerful and proven features and technologies for rigorous operations in diverse industries, capably handling mixed workloads with high IOPS requirements. Generous storage densities make these products ideal for data-hungry and write-intensive applications; mid-density drive options offer a wider range of choices for cost efficiency; and configurable over-provisioning gives users flexibility to make adjustments based on actual workloads for the optimal balance between drive performance and endurance.

Value Line

The ATP Value Line integrates advanced essential solutions to the growing needs of enterprises and industries, offering sustained, reliable performance and consistent reliability. Superb choices as embedded boot or boot image devices, they are ideally suited for Internet of Things (IoT) applications, spurring greater connectivity for homes, cars, medical equipment, and other smart devices. Ample storage capacity is available for installing an operating system with space to spare for other applications.

Momentum Line

Emphasizing rapid time-to-market, broad compatibility, and cost-efficient storage, the ATP Momentum Line combines cutting-edge technology with essential solutions tailored to meet the diverse needs of the industrial market. With ATP's commitment to quality control and rigorous verification processes, our products consistently deliver dependable results. Offering a range of mainstream specifications and storage capacities, the ATP Momentum Line provides versatile options for various industrial applications.

Industrial Enterprise Series

The Industrial Enterprise Series consists of comprehensive flash storage solutions that are designed, built, and tested/validated according to rigid standards for reliable operation and long product lifetime with high-quality service. They comply with ATP's Enterprise Readiness Standards (ERS), including stringent testing and enhanced firmware features, to meet edge computing requirements of reduced latency, better cost-effectiveness, real-time analytics, and accessibility. They are ideal as boot drives but are also suitable for storage and hybrid usage. They are capable of handling higher endurance and reliability requirements while working in harsher environmental conditions for extended periods without supervision.

Automotive Series

The ATP Automotive Series consists of tailor-made solutions to meet automotive customers' requirements for maximum data reliability. These solutions undergo the strictest levels of testing and are certified according to automotive-industry standards, including but not limited to IATF-16949 Certification, APQP, PPAP, IMDS, AEC-Q100, product selection/features and joint validation tests depending on project support and according

SecurStor Series

SecurStor is ATP's answer to the growing data security concerns in the industry and is integrated into most of ATP's new or upcoming industrial only flash storage solutions. Its feature set can be customized to the individual requirements of an application or a system and with that helps protect mission-critical applications against unauthorized access to data or systems.SecurStor's feature range includes, but goes far beyond, conventionally available data at rest protection mechanisms such as encryption or TCG Opal to assure protection not only of data that is stored in the NAND but can also be used as the foundation for protecting data that is being processed inside a system or sent across a network.

NEW ATP SSD Exclusive Technologies*

ATP demonstrates its mastery and expertise by harnessing the intricate interplay between controller, power IC, MCU, NAND configuration, and environmental conditions to deliver the following exclusive technologies:

ATP AcuCurrent Technology
Innovative Signal Integrity Optimization

Signal integrity is crucial for SSD performance and reliability, particularly in industrial settings with temperature fluctuations where conventional, static SSD settings no longer suffice. ATP's AcuCurrent Technology is an innovative signal optimization technology that:

- Fortifies SSD product lifetime and reliability through dynamic, temperature-responsive adjustments that minimize errors and unnecessary read retries, thus potentially reducing bad block counts and preserving spare blocks.
- Ensures stable performance across a wide range of operating ranges up to 125°C, enhancing the SSD's resilience to environmental and temperature variations.

ATP EcoFlush Technology
Intelligent SSD Flush Cache Management

Frequent and excessive flush cache commands from the host to SSDs to prevent data corruption during power loss events can increase write amplification and compromise NAND endurance.

The EcoFlush technology is built upon ATP's HW PLP mechanism. It intelligently bypasses excessive flush commands and optimizes flush intervals based on SSD workload, reducing unnecessary writes and improving overall system efficiency.

- **10X Lower WAI** translates to fewer write cycles and prolongs the SSD's operational lifespan.
- **11X higher 4K Random Write Performance.** Based on specific test patterns, the SSD can better handle demanding workloads without compromising data integrity.

ATP PLP Diag Technology
Proactive PLP Capacitor Health Check

Unmonitored capacitor degradation poses a silent risk that can compromise data safety during power outages. ATP's PLP Diag feature builds upon ATP's robust HW-PLP system, ensuring continued protection and user awareness of the system's integrity.

- Proactively checks the functionality and health status of the polymer tantalum capacitors, averting PLP failure resulting from defective capacitors.
- If capacitors fail, the SSD switches to Direct TLC mode, bypassing DRAM caching for writes. Users can also verify the PLP status through SMART commands, ensuring continuous data protection and system reliability.

* Technology availability may vary based on model and configuration.

PCIe® Gen4 NVMe M.2 SSD

KEY FEATURES

- Endurance: 1 DWPD (5 years Enterprise workload)
- Sustained Write Performance: Up to 3,000 MB/s
- Data Retention: Up to 10 years at 55°C (pSLC)*
- Power Loss Protection: MCU-based* with data-at-rest and in-flight protection
- PLP Diag* (Self-Diagnosing Capacitor Check)
- Security: Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0*
- Hardware Secure Erase / Write Protect*
- End-to-End Data Path Protection
- Thermal heatsink solutions**

* May vary by product and project support **Customization available on a project basis

Product Line	Premium	Superior		Value	Momentum
	N751Pi[1]	N651Si / N651Sc	N601Sc[2]	N601Vi / N601Vc	N601Mw
Interface	PCIe G4 x4				
Flash Type	3D TLC (pSLC mode)	3D TLC			
Form Factor	M.2 2280-D6-M / M.2 2280-D2-M		M.2 2280 M-Key	M.2 2280-S3-M	M.2 2280 S3-M
Operating Temperature	-40°C to 85°C	-40°C to 85°C / 0°C to 70°C	0°C to 70°C	-40°C to 85°C / 0°C to 70°C	-20°C to 75°C
Power Loss Protection Options	Hardware + Firmware Based / Firmware Based		Hardware + Firmware Based / Firmware Based	Firmware Based	
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0				-
Capacity	80 GB to 1.28 TB	240 GB to 3.84 TB	480 GB to 3.84 TB	240 GB to 1.92 TB	1 TB to 4 TB
Performance					
Sequential Read (MB/s) up to	6,450		7,000	5,000	7,200
Sequential Write (MB/s) up to	6,050		6,000	4,300	6,500
Random Reads IOPS up to	1,090,000	1,091,000	900,000	800,000	1,000,000
Random Writes IOPS up to	1,107,000	1,245,000	950,000	1,100,000	1,200,000
Endurance and Reliability					
Endurance (TBW)[3] up to	120,000 TB	40,000 TB	5,760 TB	4,170 TB	6,000 TB
Reliability MTBF @ 25°C	>3,000,000 hours			>3,000,000 hours	>3,000,000 hours
Others					
Dimensions (mm)[4]	80.0 x 22.0 x 3.85 80.0 x 24.4 x 12.5 (with 8 mm heatsink) / 80.0 x 22.0 x 3.6 80.0 x 24.4 x 12.5 (with 8 mm heatsink)		80.0 x 22.0 x 3.6	80.0 x 22.0 x 2.4	80.0 x 22.0 x 2.2
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH	CE, FCC, BSMI, UKCA, RoHS, REACH, UL			CE, FCC, BSMI, UKCA, RoHS, REACH
Warranty	5 years	2 years			

Product Line	Superior	
	N601Sc[2]	N601Si[2]
Interface	PCIe G4 x4	
Flash Type	3D TLC	
Form Factor	M.2 2242 M-Key	M.2 2230 M-Key
Operating Temperature	0°C to 70°C	-40°C to 85°C
Power Loss Protection Options	Hardware + Firmware Based / Firmware Based	Firmware Based
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0	
Capacity	480 GB to 1.92 TB	240 GB to 960 GB
Performance		
Sequential Read (MB/s) up to	7,000	3,500
Sequential Write (MB/s) up to	6,000	3,400
Random Reads IOPS up to	900,000	600,000
Random Writes IOPS up to	950,000	750,000
Endurance and Reliability		
Endurance (TBW)[3] up to	2,880 TB	1,440 TB
Reliability MTBF @ 25°C	>3,000,000 hours	
Others		
Dimensions (mm)	42.0 x 22.0 x 3.6	30.0 x 22.0 x 3.6
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH, UL	
Warranty	2 years	

1. 150K P/E cycle configuration drive available on a project basis.
2. Product specifications may be subject to change.
3. Under highest Sequential write value. May vary by density, configuration and applications.
4. M.2 2280-D6-M form factor (max height: 3.85 mm), offers Hardware-Based Power Loss Protection. M.2 2280-D2-M form factor (max height: 3.6 mm), provides Firmware-Based Power Loss Protection.

Technologies		S.M.A.R.T/ Life Monitor	PLP Diag	Industrial Temperature	Firmware-Based Power Loss Protection	Hardware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP	SED	Software Secure Erase	Hardware Secure Erase	Hardware Write Protect
Premium	N751Pi	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Superior	N651Si / N651Sc	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Superior	N601Si / N601Sc	○		○	○	▲	○	○	○		○	▲	▲	▲	▲
Value	N601Vi / N601Vc	○		○	○		○	○	○		○		○		
Momentum	N601Mw	○		▲	○		○	○	○	○	○		○		

▲: Customization option available on a project basis.

PCIe® Gen4 NVMe U.2 SSD

KEY FEATURES

- Endurance: 1 DWPD (5 years Enterprise workload)
- Sustained Write Performance: Up to 3,000 MB/s
- Data Retention: Up to 10 years at 55°C (pSLC)*
- Power Loss Protection: MCU-based* with data-at-rest and in-flight protection
- PLP Diag*(Self-Diagnosing Capacitor Check)
- Security: Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0*
- Hardware Secure Erase / Write Protect *
- End-to-End Data Path Protection
- 15 mm integrated fin-type heatsink enclosure

* May vary by product and project support

Product Line	Premium	Superior
	N751Pi	N651Si
Interface	PCIe G4 x4	
Flash Type	3D TLC (pSLC mode)	3D TLC
Form Factor	U.2	
Operating Temperature	-40°C to 85°C	
Power Loss Protection Options	Hardware + Firmware Based	
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0	
Capacity	320 GB to 2.56 TB	960 GB to 7.68 TB
Performance		
Sequential Read (MB/s) up to	6,100	6,000
Sequential Write (MB/s) up to	6,000	6,000
Random Reads IOPS up to	870,000	
Random Writes IOPS up to	1,250,000	1,230,000
Endurance and Reliability		
Endurance (TBW)[1] up to	486,000 TB	76,000 TB
Reliability MTBF @ 25°C	>3,000,000 hours	
Others		
Dimensions (mm)	100 x 69.85 x 15	
Certifications	RoHS/VCCI/CE/FCC/UKCA	
Warranty	5 years	2 years

1. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T/ Life Monitor	PLP Diag	Industrial Temperature	Firmware-Based Power Loss Protection	Hardware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP	SED	Software Secure Erase	Hardware Secure Erase
Premium	N751Pi	○	○	○	○	○	○	○	○	○	○	○	○	▲
Superior	N651Si	○	○	○	○	○	○	○	○	○	○	○	○	▲

▲: Customization option available on a project basis.

PCIe® Gen4 NVMe E1.S SSD

KEY FEATURES

- Endurance: 1 DWPD (5 years Enterprise workload)
- Sustained Write Performance: Up to 3,000 MB/s
- Power Loss Protection: MCU-based* with data-at-rest and in-flight protection
- PLP Diag*(Self-Diagnosing Capacitor Check)
- AcuCurrent (Signal Optimization Technology)
- Security: Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0*
- End-to-End Data Path Protection
- 9.5 mm symmetric enclosure

* May vary by product and project support

Product Line	Superior
	N651Si
Interface	PCIe G4 x4
Flash Type	3D TLC
Form Factor	E1.S
Operating Temperature	-40°C to 85°C
Power Loss Protection Options	Hardware + Firmware Based
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0
Capacity	960 GB to 7.68 TB
	Performance
Sequential Read (MB/s) up to	6,400
Sequential Write (MB/s) up to	6,100
Random Reads IOPS up to	1,000,000
Random Writes IOPS up to	1,200,000
	Endurance and Reliability
Endurance (TBW)[1] up to	79,000 TB
Reliability MTBF @ 25°C	>3,000,000 hours
	Others
Dimensions (mm)	118.75 x 33.75 x 9.5
Certifications	RoHS/VCCI/CE/FCC/UKCA
Warranty	5 years

1. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T/ Life Monitor	PLP Diag	AcuCurrent	Industrial Temperature	Firmware-Based Power Loss Protection	Hardware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP	SED	Software Secure Erase	Hardware Secure Erase	Hardware Write Protect
Superior	N651Si	○	○	○	○	○	○	○	○	○	○	○	○	○	▲	▲

▲: Customization option available on a project basis.

PCIe® Gen3 NVMe M.2 SSD

KEY FEATURES

- Power Loss Protection: MCU-based* with data-at-rest and in-flight protection
- Security: Self-Encrypting Drive (SED) with AES 256-bit encryption, TCG Opal 2.0*
- End-to-End Data Path Protection
- Thermal heatsink solutions**

* May vary by product and project support
** Customization available on a project basis

Product Line	Value	Momentum	Value	Premium	Value
	N650Vi	N400Mw	N650Vi	N700Pi / N700Pc	N600Vi / N600Vc
Interface	PCIe G3 x4				
Flash Type	3D TLC			3D TLC (pSLC mode)	3D TLC
Form Factor	M.2 2280 S2-M	M.2 2280 S2-M	M.2 2242 D5-M	M.2 2230-S4-M	
Operating Temperature	-40°C to 85°C	-20°C to 75°C	-40°C to 85°C	-40°C to 85°C / 0°C to 70°C	
Power Loss Protection Options	Firmware Based				
Optional SED Features	-			AES 256-bit Encryption, TCG Opal 2.0	-
Capacity	120 GB to 960 GB	128 GB to 1 TB	120 GB to 960 GB	40 GB to 160 GB	120 GB to 480 GB
Performance					
Sequential Read (MB/s) up to	2,600	2,600	2,600	2,000	2,050
Sequential Write (MB/s) up to	1,880	1,800	1,880	1,600	1,550
Random Reads IOPS up to	250,800	240,000	250,800	135,600	138,000
Random Writes IOPS up to	276,400	300,000	276,400	112,000	112,600
Endurance and Reliability					
Endurance (TBW)[1] up to	4,800 TB	695 TB	4,800 TB	4,280 TB	768 TB
Reliability MTBF @ 25°C	>3,000,000 hours			>2,000,000 hours	
Others					
Dimensions (mm)	80.0 x 22.0 x 2.2		42.0 x 22.0 x 3.6	30.0 x 22.0 x 2.5	
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH				
Warranty	2 years				

1. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T./ Life Monitor	Industrial Temperature	Firmware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP	SED	Software Secure Erase
Value	N650Vi	○	○	○	○	○	○	○	○	▲	○
Momentum	N400Mw	○	▲	○	○	○	○	○	○		○
Premium	N700Pi / N700Pc	○	○	○	○	○	○	○	○	○	○
Value	N600Vi / N600Vc	○	○	○	○	○	○	○	○		○

▲: Customization option available on a project basis.

SATA III M.2 SSD

KEY FEATURES

- Power Loss Protection: MCU-based* with data-at-rest and in-flight protection
- PLP Diag* (Self-Diagnosing Capacitor Check)
- EcoFlush* (Flush Cache Optimization Technology)
- Data Retention: Up to 10 years at 55°C (pSLC)*
- Security: Self-Encrypting Drive (SED) with AES 256-bit encryption, TCG Opal 2.0*
- LDPC & RAID Data Recovery
- End-to-End Data Path Protection

* May vary by product and project support

Product Line	Premium	Superior	Value	Momentum
	A750Pi	A650Si / A650Sc	A600Vc	A400Mw
Interface	SATA III 6 Gb/s			
Flash Type	3D TLC (pSLC mode)	3D TLC		
Form Factor	2280 D2-B-M		2280 S2-B-M	
Operating Temperature	-40°C to 85°C	-40°C to 85°C / 0°C to 70°C	0°C to 70°C	-20°C to 75°C
Power Loss Protection Options	Hardware + Firmware Based		Firmware Based	
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0		-	
Capacity	80 GB to 320 GB	240 GB to 960 GB	32 GB to 512 GB	128 GB to 1 TB
Performance				
Sequential Read (MB/s) up to	560			550
Sequential Write (MB/s) up to	510	520	400	500
Random Reads IOPS up to	92,000	103,000	72,000	72,000
Random Writes IOPS up to	83,000	86,000	85,000	86,000
Endurance and Reliability				
Endurance (TBW)[1] up to	29,620 TB	10,240 TB	590 TB	765 TB
Reliability MTBF @ 25°C	>3,000,000 hours		>2,000,000 hours	>3,000,000 hours
Others				
Dimensions (mm)	80 x 22 x 3.35		80 x 22 x 2.2	
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH			
Warranty	5 years	2 years		

Product Line	Premium		Superior	Value
	A800Pi	A750Pi	A650Si / A650Sc	A600Vi / A600Vc
Interface	SATA III 6 Gb/s			
Flash Type	SLC	3D TLC (pSLC mode)	3D TLC	
Form Factor	2242 D6-B-M			2242 D2-B-M
Operating Temperature	-40°C to 85°C	-40°C to 85°C	-40°C to 85°C / 0°C to 70°C	
Power Loss Protection Options	Hardware + Firmware Based			Firmware Based
Optional SED Features	-	AES 256-bit Encryption, TCG Opal 2.0		-
Capacity	8 GB to 64 GB	80 GB to 320 GB	240 GB to 960 GB	128 GB to 1 TB
Performance				
Sequential Read (MB/s) up to	535	560		
Sequential Write (MB/s) up to	400	515	525	525
Random Reads IOPS up to	76,000	92,000	104,000	70,500
Random Writes IOPS up to	76,000	86,000	92,000	92,500
Endurance and Reliability				
Endurance (TBW)[1] up to	5,333 TB	29,620 TB	10,240 TB	1,530 TB
Reliability MTBF @ 25°C	>2,000,000 hours	>3,000,000 hours		>2,000,000 hours
Others				
Dimensions (mm)	42 x 22 x 3.5			
Certifications	CE, FCC, UKCA, RoHS, REACH	CE, FCC, BSMI, UKCA, RoHS, REACH		
Warranty	5 years		2 years	

1. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T./ Life Monitor	PLP Diag	AcuCurrent	EcoFlush	Industrial Temperature	Firmware-Based Power Loss Protection	Hardware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP	SED	Software Secure Erase	Hardware Secure Erase	Hardware Write Protect
Premium	A800Pi	○				○	○	○	○	○	○			○	○		
Premium	A750Pi	○	○	▲	○	○	○	○	○	○	○	○	○	○	○	▲	▲
Superior	A650Si / A650Sc	○	○	▲	○	○	○	○	○	○	○	○	○	○	○	▲	▲
Value	A600Vi / A600Vc	○				○	○		○	○	○	○					
Momentum	A400Mw	○				▲	○		○	○	○	○					

▲: Customization option available on a project basis.

SATA III 2.5" SSD

KEY FEATURES

- Power Loss Protection: MCU-based* with data-at-rest and in-flight protection
- PLP Diag* (Self-Diagnosing Capacitor Check)
- EcoFlush* (Flush Cache Optimization Technology)
- Data Retention: Up to 10 years at 55°C (pSLC)*
- Security: Self-Encrypting Drive (SED) with AES 256-bit encryption, TCG Opal 2.0*
- LDPC & RAID Data Recovery
- End-to-End Data Path Protection

* May vary by product and project support

Product Line	Premium		Superior	Value	Momentum
	A800Pi	A750Pi	A650Si / A650Sc	A600Vi / A600Vc	A400Mw
Interface	SATA III 6 Gb/s				
Flash Type	SLC	3D TLC (pSLC mode)	3D TLC		
Form Factor	2.5"				
Operating Temperature	-40°C to 85°C		-40°C to 85°C / 0°C to 70°C		-20°C to 75°C
Power Loss Protection Options	Hardware + Firmware Based			Firmware Based	
Optional SED Features	-	AES 256-bit Encryption, TCG Opal 2.0			-
Capacity	8 GB to 256 GB	80 GB to 640 GB	240 GB to 1.92 TB	128 GB to 1 TB	
Performance					
Sequential Read (MB/s) up to	520	560			550
Sequential Write (MB/s) up to	420	510	525	525	500
Random Reads IOPS up to	76,000	92,000	103,000	70,500	72,000
Random Writes IOPS up to	74,000	85,000	90,000	92,500	86,000
Endurance and Reliability					
Endurance (TBW)[1] up to	21,333 TB	59,250 TB	21,990 TB	1,530 TB	765 TB
Reliability MTBF @ 25°C	>2,000,000 hours	>3,000,000 hours		>2,000,000 hours	>3,000,000 hours
Reliability Number of Insertions	10,000 minimum				
Others					
Dimensions (mm)	100 x 69.85 x 9.2	100 x 69.85 x 7/9.2			100 x 69.85 x 7
Certifications	CE, FCC, UKCA, RoHS, REACH	CE, FCC, BSMI, UKCA, RoHS, REACH			
Warranty	5 years		2 years		

1. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T/ Life Monitor	PLP Diag	AcuCurrent	EcoFlush	Industrial Temperature	Firmware-Based Power Loss Protection	Hardware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP	SED	Software Secure Erase	Hardware Secure Erase	Hardware Write Protect
Premium	A800Pi	○				○	○	○	○	○	○			○	○		
Premium	A750Pi	○	○	▲	○	○	○	○	○	○	○	○	○	○	○	▲	▲
Superior	A650Si / A650Sc	○	○	▲	○	○	○	○	○	○	○	○	○	○	○	▲	▲
Value	A600Vi / A600Vc	○				○	○		○	○	○	○					
Momentum	A400Mw	○				▲	○		○	○	○	○					

▲: Customization option available on a project basis.

SATA III mSATA SSD

KEY FEATURES

- Power Loss Protection: MCU-based* with data-at-rest and in-flight protection
- PLP Diag* (Self-Diagnosing Capacitor Check)
- EcoFlush* (Flush Cache Optimization Technology)
- Data Retention: Up to 10 years at 55°C (pSLC)*
- Security: Self-Encrypting Drive (SED) with AES 256-bit encryption, TCG Opal 2.0*
- LDPC & RAID Data Recovery
- End-to-End Data Path Protection

* May vary by product and project support

Product Line	Premium		Superior	Value
	A800Pi	A750Pi	A650Si / A650Sc	A600Vi / A600Vc
Interface	SATA III 6 Gb/s			
Flash Type	SLC	3D TLC (pSLC mode)	3D TLC	
Form Factor	MO-300A			
Operating Temperature	-40°C to 85°C		-40°C to 85°C / 0°C to 70°C	
Power Loss Protection Options	Hardware + Firmware Based			Firmware Based
Optional SED Features	AES 128/256-bit Encryption	AES 256-bit Encryption, TCG Opal 2.0		-
Capacity	8 GB to 128 GB	80 GB to 320 GB	240 GB to 960 GB	128 GB to 1 TB
Performance				
Sequential Read (MB/s) up to	530	560		
Sequential Write (MB/s) up to	430	510	525	
Random Reads IOPS up to	77,000	92,000	104,000	70,500
Random Writes IOPS up to	75,000	85,000	90,000	92,500
Endurance and Reliability				
Endurance (TBW)[1] up to	10,666 TB	29,620 TB	10,240 TB	1,530 TB
Reliability MTBF @ 25°C	>2,000,000 hours	>3,000,000 hours		>2,000,000 hours
Others				
Dimensions (mm)	50.8 x 29.85 x 3.5			
Certifications	CE, FCC, UKCA, RoHS, REACH	CE, FCC, BSMI, UKCA, RoHS, REACH		
Warranty	5 years		2 years	

1. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T/ Life Monitor	PLP Diag	AcuCurrent	EcoFlush	Industrial Temperature	Firmware-Based Power Loss Protection	Hardware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP	SED	Software Secure Erase	Hardware Secure Erase	Hardware Write Protect
Premium	A800Pi	○				○	○	○	○	○	○			○	○		
Premium	A750Pi	○	○	▲	○	○	○	○	○	○	○	○	○	○	○	▲	▲
Superior	A650Si / A650Sc	○	○	▲	○	○	○	○	○	○	○	○	○	○	○	▲	▲
Value	A600Vi / A600Vc	○				○	○		○	○	○	○					

▲: Customization option available on a project basis.

USB 3.2 NANODURA Dual

KEY FEATURES

- Superior Random Write performance
- Global wear leveling
- Bad block management algorithm
- High reliability
- Plug and Play with hot-swappable connection supported
- OTG Type-C connector supported

Product Line	Superior
	B600Sc
Interface	USB 3.2 Gen1 x 1
Flash Type	3D TLC
Form Factor	USB Type-A USB Type-A/Type-C Dual Connector[1] (Optional)
Operating Temperature	0°C to 70°C
Power Loss Protection Options	Firmware Based
Optional SED Features	-
Capacity	32 GB to 128 GB
	Performance
USB 3.2 Sequential Read (MB/s) up to	270
USB 3.2 Sequential Write (MB/s) up to	85
USB 2.0 Sequential Read (MB/s) up to	45
USB 2.0 Sequential Write (MB/s) up to	30
	Endurance and Reliability
Endurance (TBW)[2] up to	84 TB
Reliability MTBF @ 25°C	>2,000,000 hours
Reliability Number of Insertions	10,000 minimum
	Others
Dimensions (mm)	28 x 12.25 x 4.65 Dual Connector: 36.40 x 12.25 x 4.65
Certifications	CE, FCC, UKCA, RoHS
Warranty	2 years

1. Dual connector device supports USB On-The-Go (OTG)
2. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T/ Life Monitor	SiP	Firmware-Based Power Loss Protection	Advanced Wear Leveling	Auto-Read Calibration
Superior	B600Sc	○	○	○	○	○

USB 2.0 NANODURA

Product Line	Premium	Superior
	B800Pi	B600Sc
Interface	USB 2.0 (480 Mbps)	
Flash Type	SLC	MLC
Form Factor	USB Type-A	
Operating Temperature	-40°C to 85°C	0°C to 70°C
Power Loss Protection Options	Firmware Based	
Optional SED Features	-	
Capacity	512 MB to 8 GB	4 GB to 8 GB
Performance		
Sequential Read (MB/s) up to	21	25
Sequential Write (MB/s) up to	17	18
Endurance and Reliability		
Endurance (TBW)[1] up to	192 TB	19 TB
Reliability MTBF @ 25°C	>5,000,000 hours	>2,000,000 hours
Reliability Number of Insertions	10,000 minimum	
Others		
Dimensions (mm)	34 x 12.2 x 4.5	
Certifications	CE, FCC, UKCA, RoHS	
Warranty	5 years	2 years

1. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T/ Life Monitor	Industrial Temperature	SiP	Firmware-Based Power Loss Protection	Advanced Wear Leveling
Premium	B800Pi	○	○	○	○	○
Superior	B600Sc	○		○	○	○

KEY FEATURES

- Global wear leveling
- Bad block management algorithm
- High reliability
- Plug and Play with hot-swappable connection supported

USB 2.0 eUSB

Product Line	Premium		Superior
	B800Pi	B800Pi	B600Sc
Interface	USB 2.0 (480 Mbps)		
Flash Type	SLC		MLC
Form Factor	Pitch 2.54 mm / 2.00 mm		
Operating Temperature	-40°C to 85°C		0°C to 70°C
Power Loss Protection Options	Firmware Based	Hardware + Firmware Based	
Optional SED Features	-		
Capacity	1 GB to 16 GB	1 GB to 32 GB	8 GB to 32 GB
Performance			
Sequential Read (MB/s) up to	37	30	25
Sequential Write (MB/s) up to	23	25	19
Endurance and Reliability			
Endurance (TBW)[1] up to	1,548 TB	640 TB	19 TB[2]
Reliability MTBF @ 25°C	>5,000,000 hours		>2,000,000 hours
Reliability Number of Insertions	10,000 minimum		
Others			
Dimensions (mm)	36.9 x 26.6 x 9.5		
Certifications	CE, FCC, UKCA, RoHS		
Warranty	5 years		2 years

1. Under highest Sequential write value. May vary by density, configuration and applications.
2. Measured with Random Write. May vary by density, configuration and applications.

Technologies		S.M.A.R.T/ Life Monitor	Industrial Temperature	Firmware-Based Power Loss Protection	Hardware-Based Power Loss Protection	Advanced Wear Leveling	Hardware Write Protect
Premium	B800Pi	○	○	○	▲	○	▲
Superior	B600Sc	○		○	○	○	

▲: Customization option available on a project basis.

KEY FEATURES

- Superior Random Write Performance
- Global wear leveling
- Power Loss Protection
- Hardware Write Protect*

* May vary by product and project support

Robust, Removable Data Storage Solutions*

ATP memory cards are meticulously built and tested for diverse applications. They are available in different form factors with custom-configurable endurance, reliability, and security specifications for dependable operation even in extreme environments.

ATP-Developed Firmware, Hardware, and Value-Added Service**

Custom-Configurable SD/microSD Memory Cards

WE BUILD WITH YOU

ATP SD Life Monitor: Intelligent Workload Inspection
Provides visual representation of write operations and file sizes by the host system during pre-qualification.

ATP Joint Validation Service
Compatibility and function tests are conducted using the client's host devices and systems.

Advanced Card Analysis
ATP's uniquely designed substrate and debug tool make system-in-package (SiP) component post-analysis possible.

ATP Robust Data Integrity Technology

Read Disturb Protection

AutoRefresh Technology for Hot Zone Disturbance
Enhances data integrity in read-only areas by monitoring error bit levels and read counts. It prevents uncorrectable data damage and ensures data integrity by copying frequently read data in the affected blocks to healthy blocks before the error threshold limit is reached.

Dynamic Data Refresh Technology for Cold Zone Disturbance
Reduces read disturb and maintains integrity in seldom-accessed "cold" areas, sequentially scanning those with "flag" records. Data is moved to healthy blocks before reaching the error threshold to prevent data loss and ensure long-term data integrity.

SecurStor AES-Protected microSD

Tailored, Secure Storage

SecurStor

Multi-Layer Authentication
Privilege control for up to 10 users offers high levels of protection.

SecurBoot
Ensures the boot partition's integrity and validity by either securing it when permitted by the operating system or safeguarding the stored configuration of the Raspberry Pi system's BIOS.

Hardware AES-256 XTS Encryption (SecurEncrypt)
Secures the User Data area through robust hardware AES-256 XTS encryption, providing the highest level of encryption without compromising performance.

Secure Erase
Deletes the encryption key to prevent unauthorized retrieval or recovery of the user data.

* Technology availability may vary based on model and configuration.
** Value-added services may vary depending on project and customer request.

SD/SDHC/SDXC Card

KEY FEATURES

- High endurance
- Low latency
- Robust data integrity* (AutoRefresh and Dynamic Data Refresh)
- Power Loss Protection for data at rest
- I-Temp operable* (-40°C to 85°C)
- Low capacity for legacy usage
- Water/Dustproof and ESD-resistant System-in-Package design
- SD Life Monitor*

* May vary by product and project support

Product Line	Premium			Superior	
	S800Pi	S750Pi / S750Pc	S700Pi / S700Pc	S650Si / S650Sc	S600Si / S600Sc
Interface	512 MB to 2 GB, HS mode 4 GB to 8 GB, UHS-I	UHS-I			
Flash Type	SLC	3D TLC (pSLC mode)	2D MLC (pSLC mode)	3D TLC	2D MLC
Form Factor	SD Card				
Operating Temperature	-40°C to 85°C	-40°C to 85°C / -25°C to 85°C			
Power Loss Protection Options	Firmware Based				
Optional SED Features	-				
Capacity	512 MB to 8 GB	16 GB to 128 GB	4 GB to 8 GB	64 GB to 512 GB	8 GB to 16 GB
	Performance				
Sequential Read (MB/s) up to	81	95	96	95	97
Sequential Write (MB/s) up to	39	80	81	70	36
	Endurance and Reliability				
Endurance (TBW)[1] up to	192 TB	12,670 TB	240 TB	5,500 TB	48 TB
Reliability MTBF @ 25°C	>5,000,000 hours	>3,000,000 hours		>3,000,000 hours	>3,000,000 hours
Reliability Number of Insertions	20,000 (SDA spec minimum 10,000)				
	Others				
Dimensions (mm)	32.0 x 24.0 x 2.1				
Certifications	CE, FCC, UKCA, RoHS				
Warranty	5 years			2 years	

1. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T/ Life Monitor	Industrial Temperature	SiP	Firmware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration
Premium	S800Pi	▲	○	○	○	○			
Premium	S750Pi / S750Pc	▲	○	○	○	○	○	○	○
Premium	S700Pi / S700Pc	▲	○	○	○	○	○	○	
Superior	S650Si / S650Sc	▲	○	○	○	○	○	○	○
Superior	S600Si / S600Sc	▲	○	○	○	○	○	○	

▲: Customization option available on a project basis.

microSD/microSDHC/microSDXC Card

KEY FEATURES

- High endurance
- Low latency
- Robust data integrity* (AutoRefresh and Dynamic Data Refresh)
- Power Loss Protection for data at rest
- I-Temp operable* (-40°C to 85°C)
- Low capacity for legacy usage
- Water/Dustproof and ESD-resistant System-in-Package design
- SD Life Monitor*

* May vary by product and project support

Product Line	Premium			Superior	
	S800Pi	S750Pi / S750Pc	S700Pi / S700Pc	S650Si / S650Sc	S600Si / S600Sc
Interface	512 MB to 2 GB, HS mode 4 GB to 8 GB, UHS-I	UHS-I			
Flash Type	SLC	3D TLC (pSLC mode)	2D MLC (pSLC mode)	3D TLC	2D MLC
Form Factor	microSD Card				
Operating Temperature	-40°C to 85°C	-40°C to 85°C / -25°C to 85°C			
Power Loss Protection Options	Firmware Based				
Optional SED Features	-				
Capacity	512 MB to 8 GB	16 GB to 128 GB	4 GB to 8 GB	64 GB to 512 GB	8 GB to 16 GB
	Performance				
Sequential Read (MB/s) up to	81	95	96	95	97
Sequential Write (MB/s) up to	39	80	81	70	36
	Endurance and Reliability				
Endurance (TBW)[1] up to	192 TB	12,670 TB	240 TB	5,500 TB	48 TB
Reliability MTBF @ 25°C	>5,000,000 hours	>3,000,000 hours		>3,000,000 hours	>3,000,000 hours
Reliability Number of Insertions	20,000 (SDA spec minimum 10,000)				
	Others				
Dimensions (mm)	15.0 x 11.0 x 1.0				
Certifications	CE, FCC, UKCA, RoHS				
Warranty	5 years			2 years	

1. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T/ Life Monitor	Industrial Temperature	SiP	Firmware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration
Premium	S800Pi	▲	○	○	○	○			
Premium	S750Pi / S750Pc	▲	○	○	○	○	○	○	○
Premium	S700Pi / S700Pc	▲	○	○	○	○	○	○	
Superior	S650Si / S650Sc	▲	○	○	○	○	○	○	○
Superior	S600Si / S600Sc	▲	○	○	○	○	○	○	

▲: Customization option available on a project basis.

PCIe® Gen4 NVMe CFexpress Card

KEY FEATURES

- High endurance
- High Read/Write performance
- Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0*
- DRAM-less configuration supporting Host Memory Buffer (HMB)*
- Hardware Write Protect*
- Anti-sulfur resistor support*

* May vary by product and project support

Product Line	Premium	Superior
	N751Pi	N651Si / N651Sc
Interface	PCIe G4 x2	
Flash Type	3D TLC (pSLC mode)	3D TLC
Form Factor	CFexpress Type B	
Operating Temperature	-40°C to 85°C	-40°C to 85°C / 0°C to 70°C
Power Loss Protection Options	Firmware Based	
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0	
Capacity	40 GB to 320 GB	128 GB to 1 TB
Performance		
Sequential Read (MB/s) up to	3,500	
Sequential Write (MB/s) up to	3,100	3,200
Random Reads IOPS up to	770,000	632,000
Random Writes IOPS up to	735,000	768,000
Endurance and Reliability		
Endurance (TBW)[1] up to	19,010 TB	10,830 TB
Reliability MTBF @ 25°C	>3,000,000 hours	
Reliability Number of Insertions	10,000 minimum	
Others		
Dimensions (mm)	29.6 x 38.5 x 3.8	
Certifications	CE, FCC, RoHS, UKCA	
Warranty	5 years	2 years

1. Under highest Sequential write value. May vary by density, configuration and applications.

Technologies		S.M.A.R.T/ Life Monitor	Industrial Temperature	Firmware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP	SED	Software Secure Erase	Hardware Write Protect
Premium	N751Pi	○	○	○	○	○	○	○	○	○	○	▲
Superior	N651Si / N601Sc	○	○	○	○	○	○	○	○	○	○	▲

▲: Customization option available on a project basis.

CFast Card

Product Line	Premium
	A800Pi
Interface	SATA III 6 Gb/s
Flash Type	SLC
Form Factor	CFast Type I
Operating Temperature	-40°C to 85°C
Power Loss Protection Options	Hardware + Firmware Based
Optional SED Features	-
Capacity	8 GB to 32 GB
Performance	
Sequential Read (MB/s) up to	500
Sequential Write (MB/s) up to	310
Random Reads IOPS up to	35,800
Random Writes IOPS up to	-
Endurance and Reliability	
Endurance (TBW)[1] up to	2,667 TB
Reliability MTBF @ 25°C	>2,000,000 hours
Reliability Number of Insertions	10,000 minimum
Others	
Dimensions (mm)	36.4 x 42.8 x 3.6
Certifications	CE, FCC, UKCA, RoHS
Warranty	5 years

1. Under highest Sequential write value. May vary by density, configuration and applications.

KEY FEATURES

- Advanced wear leveling algorithm
- Bad block management
- AutoRefresh technology
- Power Loss Protection
- S.M.A.R.T support

Technologies		S.M.A.R.T/ Life Monitor	Industrial Temperature	Firmware-Based Power Loss Protection	Hardware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh
Premium	A800Pi	O	O	O	O	O	O	O

CompactFlash Card

Product Line	Premium		Superior
	I800Pi	I700Pc	I600Sc
Interface	UDMA 0~4	UDMA 0~6	
Flash Type	SLC	Pseudo SLC	MLC
Form Factor	CF Type I		
Operating Temperature	-40°C to 85°C	0°C to 70°C	
Power Loss Protection Options	Hardware + Firmware Based	Firmware Based	
Optional SED Features	-		
Capacity	512 MB to 32 GB	8 GB to 16 GB	16 GB to 32 GB
Performance			
Sequential Read (MB/s) up to	61	110	108
Sequential Write (MB/s) up to	55	80	46
Endurance and Reliability			
Endurance (TBW)[1] up to	1,280 TB	256 TB	38 TB
Reliability MTBF @ 25°C	>5,000,000 hours	>2,000,000 hours	
Reliability Number of Insertions	10,000 minimum		
Others			
Dimensions (mm)	36.4 x 42.8 x 3.3		
Certifications	CE, FCC, RoHS, UKCA		
Warranty	5 years	2 years	

1. Under highest Sequential write value. May vary by density, configuration and applications.

KEY FEATURES

- Global wear leveling and bad block management
- AutoRefresh technology
- Power Loss Protection
- Power saving mode
- S.M.A.R.T support

Technologies		S.M.A.R.T/ Life Monitor	Industrial Temperature	Firmware-Based Power Loss Protection	Hardware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh
Premium	I800Pi	O	O	O	O	O	O	O
Premium	I700Pc	O		O		O	O	O
Superior	I600Sc	O		O		O	O	O

SecurStor microSD Card

KEY FEATURES

- Additional AES Key Protection
- Library access possible (MBR required)
- Authentication / Privilege Control
- Total of 10 User Accounts can set up privileges individually

SECURITY FEATURES*

- Multi-Layer Authentication: Privilege control for up to 10 users offer high levels of protection.
- SecurBoot: Ensures the boot partition's integrity and validity by either securing it when permitted by the operating system or safeguarding the stored configuration of the Raspberry Pi system's BIOS.
- Hardware AES-256 XTS Encryption (SecurEncrypt): Secures the User Data area through robust hardware AES-256 XTS encryption, providing the highest level of encryption without compromising performance.
- Secure Erase: Deletes the encryption key to prevent unauthorized retrieval or recovery of the user data.
- Compliance with US Air Force System Security Instruction (AFSSI) 5020 standard or alike is available on a per-request basis

* Actual availability of specific features may vary by product and capacity. Please contact ATP for details.

Product Line	Premium	Superior
	S700Pcs	S600Scs
Flash Type	3D TLC (pSLC mode)	MLC
Density	80 GB	8 GB to 16 GB
Performance Sequential Read (MB/s) up to	35	10
Performance Sequential Write (MB/s) up to	35	5
Interface	SD mode	
Operating Temperature	-25°C to 85°C	
Reliability MTBF @ 25°C	>2,000,000 hours	
Reliability Number of Insertions	10,000	
Dimensions (mm)	15.0 x 11.0 x 1.0	

TSE Storage Solutions

KEY FEATURES

- Compliant with the requirements of the BSI TR-03153, Common Criteria PP-SMAERS, PP-CSP
- Projected Certificate Validity: Up to 8 years (also available with 5-year validity)
- Form Factors: microSD, SD, USB
- Capacities: 8 GB and 16 GB
- Data Retention: Up to 10 years (depending on test conditions)
- Lifetime: 20 million signatures*
- OS Support: Windows, Linux

* May vary on payload size (s)

Product Line	SecurStor
Flash Type	MLC
Density	8 GB / 16 GB
Performance Signature time	<150 ms
Interface	UHS-I
Operating Temperature	-25°C to 85°C
Reliability MTBF @ 25°C	>2,000,000 hours
Reliability Number of Insertions	10,000
Dimensions (mm)	15.0 x 11.0 x 1.0

Soldered-Down Managed NAND Storage Solutions*

ATP's managed NAND storage are soldered-down solutions featuring integrated raw NAND flash memory and hardware controller. Their small footprint, resistance to vibrations, and power efficiency make them ideal for embedded and automotive applications requiring rugged endurance and durability in harsh environments.

e.MMC Storage Solutions

Integrated, Reliable, and Compact Storage

Full Range of Temperature Grades Available

- Commercial (C-Temp: -25°C to 85°C)
- Industrial (I-Temp: -40°C to 85°C)
- Extended Industrial (Extended I-Temp: -40°C to 105°C)
- AEC-Q100 Automotive Grade 3 (AG3: -40°C to 85°C)
- AEC-Q100 Automotive Grade 2 (AG2: -40°C to 105°C)

9 x10 mm Package Available

A 9 x 10 mm package offers 40% space savings compared to the standard 11.5 x 13 mm size.

Power Savings

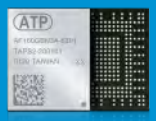
e.MMC tuning cuts power consumption by 20% in smart wearables, extending battery life during key user activities.

Ultra Low Alpha (ULA) Mold Compound

ULA mold compound reduces alpha particle-induced soft errors by 99%, effectively shielding electronic components.

NVMe HBGA Storage Solutions

Powerful Performance in a Tiny Package



pSLC Mode

Increases endurance and reliability and offers 2X-3X better sustainable performance.

5 mW Power Consumption

Low power consumption of only 5 mW during Power State 4 (Sleep Mode) delivers huge power savings.

Effective Thermal Dissipation

The heat sink effectively transfers heat to cool the device and keep the performance at optimal levels.

Optional Security Features**

HW Write Protect, HW Quick Erase, HW Secure Erase (Data Sanitization, AFSSI-5020), AES-256 Encryption, TCG Opal 2.0.

* Technology availability may vary based on model and configuration.
** Value-added service

e.MMC Automotive

KEY FEATURES

- AEC-Q100 Grade 2 (-40°C to 105°C), and Grade 3 (-40°C to 85°C) compliant*
- Robust Data Integrity* (AutoRefresh and Dynamic Data Refresh)
- Extra-high endurance: 2-3X higher than standard e.MMC*
- Smaller footprint package size*
- Complies with JEDEC e.MMC v5.1 Standard (JESD84-B51)
- 153-ball FBGA (RoHS compliant, "green package")
- LDPC ECC engine*

* May vary by product and project support

Product Line	Automotive Grade 2				Automotive Grade 3			
	Premium		Superior		Premium		Superior	
	E700Paa	E700Paa	E600Saa	E600Saa	E700Pia	E700Pia	E600Sia	E600Sia
Flash Type	3D MLC (pSLC mode)	2D MLC (pSLC mode)	3D MLC	2D MLC	3D MLC (pSLC mode)	2D MLC (pSLC mode)	3D MLC	2D MLC
IC Package	153-ball FBGA							
JEDEC Specification	v5.1, HS400							
Power Loss Protection Options	Firmware Based							
Operating Temperature	-40°C to 105°C				-40°C to 85°C			
Capacity[1]	8 GB to 64 GB	4 GB to 8 GB	16 GB to 128 GB	8 GB to 16 GB	8 GB to 64 GB	4 GB to 8 GB	16 GB to 128 GB	8 GB to 16 GB
Performance								
Sequential Read/ Write up to (MB/s)[2]	300 / 240	230 / 100	300 / 170	230 / 100	300 / 240	230 / 100	300 / 170	230 / 100
Bus Speed Modes	x1 / x4 / x8							
ICC (Typical RMS in Read/Write) mA (Max.)	145 / 175	85 / 65	125 / 175	85 / 50	145 / 175	85 / 65	125 / 175	85 / 50
ICCQ (Typical RMS in Read/Write) mA (Max.)	120 / 100	60 / 45	115 / 95	60 / 30	120 / 100	60 / 45	115 / 95	60 / 30
Endurance and Reliability								
Endurance TBW[2] **(Max.)**	1,213 TB	200 TB	824 TB	40 TB	1,213 TB	200 TB	824 TB	40 TB
Reliability MTBF @ 25°C	>2,000,000 hours	>3,000,000 hours	>2,000,000 hours	>3,000,000 hours	>2,000,000 hours	>3,000,000 hours	>2,000,000 hours	>3,000,000 hours
Others								
Dimensions (mm)	11.5 x 13.0 x 1.3	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.3	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.3	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.3	11.5 x 13.0 x 1.0
Certifications	AEC-Q100, RoHS, REACH							
Warranty	One Year							

1 Low-density parity-check error correcting code. By product support.
2 All performance is collected or measured using ATP proprietary test environment, without file system overhead.

Technologies	S.M.A.R.T/ Life Monitor	Industrial Temperature	SiP	Vibration-Proof BGA Package	Firmware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP
Premium	○	○	○	○	○	○	○	○	▲	○
Superior	○	○	○	○	○	○	○	○	▲	○

▲: Customization option available on a project basis.

e.MMC Industrial

Product Line	Extended Industrial Grade				Industrial Grade				
	Premium		Superior		Premium			Superior	
	E700Pa	E700Pa	E600Sa	E600Sa	E700Pi	E700Pi	E700Pi	E600Si	E600Si
Flash Type	3D MLC (pSLC mode)	2D MLC (pSLC mode)	3D MLC	2D MLC	3D TLC (pSLC mode)	3D MLC (pSLC mode)	2D MLC (pSLC mode)	3D TLC	3D MLC
IC Package	153-ball FBGA								
JEDEC Specification	v5.1, HS400								
Power Loss Protection Options	Firmware Based								
Operating Temperature	-40°C to 105°C				-40°C to 85°C				
Capacity[1]	8 GB to 64 GB	4 GB to 8 GB	16 GB to 128 GB	8 GB to 16 GB	10 GB to 40 GB	8 GB to 64 GB	4 GB to 8 GB	32 GB to 128 GB	16 GB to 128 GB
Performance									
Sequential Read/ Write up to (MB/s) (Max.)[2]	300 / 240	230 / 100	300 / 170	230 / 100	290 / 225	300 / 240	230 / 100	290 / 225	300 / 170
Bus Speed Modes	x1 / x4 / x8								
ICC (Typical RMS in Read/Write) mA (Max.)	145 / 175	85 / 65	125 / 175	85 / 50	100 / 110	145 / 175	85 / 65	100 / 110	125 / 175
ICCQ (Typical RMS in Read/Write) mA (Max.)	120 / 100	60 / 45	115 / 95	60 / 30	105 / 100	120 / 100	60 / 45	105 / 100	110 / 100
Endurance and Reliability									
Endurance TBW[2] (Max.)	1,213 TB	200 TB	824 TB	40 TB	1,364 TB	1,213 TB	200 TB	52 TB	824 TB
Reliability MTBF @ 25°C	>2,000,000 hours	>3,000,000 hours	>2,000,000 hours	>3,000,000 hours	>2,000,000 hours		>3,000,000 hours	>2,000,000 hours	
Others									
Dimensions (mm)	11.5 x 13.0 x 1.3	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.3	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.3	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.3
Certifications	RoHS, REACH								
Warranty	One Year								

Product Line	Industrial Grade		Commercial Grade				
	Superior	Value	Premium		Superior		Value
	E600Si	E600Vi	E700Pc	E700Pc	E600Sc	E600Sc	E600Vc
Flash Type	2D MLC	3D TLC	3D TLC (pSLC mode)	2D MLC (pSLC mode)	3D TLC	2D MLC	3D TLC
IC Package	153-ball FBGA						
JEDEC Specification	v5.1, HS400						
Power Loss Protection Options	Firmware Based						
Operating Temperature	-40°C to 85°C		-25°C to 85°C				
Capacity[1]	8 GB to 16 GB	32 GB to 64 GB	10 GB to 40 GB	4 GB to 8 GB	32 GB to 128 GB	8 GB to 16 GB	32 GB to 64 GB
Performance							
Sequential Read/ Write up to (MB/s) (Max.)[2]	230 / 100	290 / 225	290 / 225	230 / 100	290 / 225	230 / 100	290 / 225
Bus Speed Modes	x1 / x4 / x8						
ICC (Typical RMS in Read/Write) mA (Max.)	85 / 50	100 / 110	100 / 110	85 / 65	100 / 110	85 / 50	100 / 110
ICCQ (Typical RMS in Read/Write) mA (Max.)	60 / 30	105 / 100	105 / 100	60 / 45	105 / 100	60 / 30	105 / 100
Endurance and Reliability							
Endurance TBW[2] (Max.)	40 TB	20 TB	1,364 TB	200 TB	52 TB	40 TB	20 TB
Reliability MTBF @ 25°C	>3,000,000 hours	>2,000,000 hours	>2,000,000 hours	>3,000,000 hours	>2,000,000 hours	>3,000,000 hours	>2,000,000 hours
Others							
Dimensions (mm)	11.5 x 13.0 x 1.0	9.0 x 10.0 x 0.8	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.0	11.5 x 13.0 x 1.0	9.0 x 10.0 x 0.8
Certifications	RoHS, REACH						
Warranty	One Year						

1 Low-density parity-check error correcting code. By product support.
2 All performance is collected or measured using ATP proprietary test environment, without file system overhead.

Technologies	S.M.A.R.T/ Life Monitor	Industrial Temperature	SiP	Vibration-Proof BGA Package	Firmware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP
Premium	○	○	○	○	○	○	○	○	▲	○
Superior	○	○	○	○	○	○	○	○	▲	○
Value	○	○	○	○	○	○	○	○	○	

▲: Customization option available on a project basis.

PCIe® NVMe M.2 Type 1620 HSBGA SSD

KEY FEATURES

- pSLC mode with 2X-3X of Sustainable Performance*
- High/Stable performance with Optimized Thermal Throttling Firmware/Heatsink (HSBGA)
- Optimized Power Consumption: 5 mW during Power State 4
- DRAM-less configuration supporting Host Memory Buffer (HMB)*
- Optional Security features**

* Under highest Sequential write value. May vary by density, configuration, and applications.
** Customization available on a project basis

Product Line	Superior N601Si[2]	Premium N700Pi / N700Pc	Superior N600Si / N600Sc
Interface	PCIe G4 x4	PCIe G3 x4	
Flash Type	3D TLC	3D TLC (pSLC mode)	3D TLC
Form Factor	291-Ball, HSBGA		
Operating Temperature	-40°C to 85°C	-40°C to 85°C / 0°C to 70°C	
Power Loss Protection Options	Firmware Based		
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0		-
Capacity	240 GB to 960 GB	40 GB to 160 GB	120 GB to 480 GB
Performance			
Sequential Read (MB/s) up to	3,500	2,000	2,050
Sequential Write (MB/s) up to	3,400	1,600	1,550
Random Reads IOPS up to	600,000	135,600	138,000
Random Writes IOPS up to	750,000	112,000	112,600
Endurance and Reliability			
Endurance (TBW)[1] up to	1,440 TB	4,280 TB	768 TB
Reliability MTBF @ 25°C	>3,000,000 hours	>2,000,000 hours	
Others			
Dimensions (mm)	16.0 x 20.0 x 1.6		
Certifications	RoHS, REACH		
Warranty	1 year		

1. Under highest Sequential write value. May vary by density, configuration and applications.
2. Product specifications may be subject to change.

Technologies		S.M.A.R.T/ Life Monitor	Industrial Temperature	SiP	Vibration-Proof BGA Package	Firmware-Based Power Loss Protection	Advanced Wear Leveling	AutoRefresh	Dynamic Data Refresh	Auto-Read Calibration	ETEDP	SED	Software Secure Erase	Hardware Secure Erase	Hardware Write Protect
Superior	N601Si	○	○	○	○	○	○	○	○		○	▲	○	▲	▲
Premium	N700Pi / N700Pc	○	○	○	○	○	○	○	○	○	○	○	○		
Superior	N600Si / N600Sc	○	○	○	○	○	○	○	○	○	○		○		

▲: Customization option available on a project basis.

Solutions & Technologies

As a technology-driven company, ATP is committed to developing innovative solutions and harnessing the most advanced technologies to ensure that our products deliver the highest levels of data integrity, reliability and retention for mission-critical applications.

Reliability (Drive-Level)

Ensuring Consistent, Dependable Performance in Extreme Environments

PLP Diag

Building upon ATP's Hardware-based power loss protection in high-quality Polymer Tantalum capacitors, a microcontroller unit, and a power IC to safeguard data during power loss events, the ATP PLP Diag feature proactively checks the functionality and health status of the polymer tantalum capacitors, averting PLP failure resulting from defective capacitors. The innovative PLP Diag feature actively monitors capacitor health, If capacitors fail, the SSD reacts by switching to Direct TLC mode, bypassing DRAM caching for writes. Users can also verify PLP status through SMART commands, ensuring continuous data protection and system reliability.

EcoFlush

ATP's EcoFlush feature enhances SSD performance and longevity by optimizing flush cache commands. While certain host systems are designed to often issue frequent flush commands to prevent data loss during power failures, this can lead to excessive writes and increased wear on NAND flash memory. EcoFlush, integrated into ATP's hardware-based power loss protection SSDs, can be activated during initialization from the SSD production process upon request, intelligently manages flush cache commands by executing them at the SSD's optimal intervals rather than responding to every host request. This approach results in better SSD endurance with 10 times lower Write Amplification Index (WAI) and 10 times better 4K random write performance at certain conditions.

AcuCurrent

AcuCurrent combines ATP Electronics' proprietary firmware and microcontroller technology to dynamically fine-tune the SSD in real time. This ensures optimal signal integrity across all current routes amidst diverse environments, operational usages and conditions, and NAND flash intricacies — ultimately delivering enhanced performance, fortified lifespan and reliability, and operational consistency. Acucurrent minimizes unnecessary read retries, resulting in low latency, minimized errors, and greater data precision. Additionally, temperature-responsive current adjustments strengthen resilience to extreme temperature deviations within operating ranges of up to 125°C.

Life Monitor/S.M.A.R.T.*

Provides a user-friendly interface for monitoring the health status and life expectancy of a flash product.

* Compatibility and support may vary by platform or operating system.

SiP (System in Package)

Manufacturing process that encapsulates all exposed components to provide protection and shielding.

Vibration-Proof BGA Package

Soldered-down solutions can withstand vigorous shaking and are resistant against vibrations for reliable performance even during grueling operations.

Industrial Temperature

Operational stability in extreme temperatures from -40°C to 85°C.

Data Integrity (NAND-Level)

Maintaining Data Accuracy & Quality Over Extended Use

Firmware-Based Data-At-Rest Power Loss Protection

The firmware-based power failure protection effectively protects data written to the device prior to power loss. After the host receives a signal from the device that the WRITE operation has been successfully completed, newly written as well as previously written data are protected even if a sudden power loss occurs.

Hardware-Based In-Flight-Data Power Loss Protection

This hardware-based power failure protection prevents data loss during a power loss event by ensuring that the last read/write/erase command is completed and data is stored safely in non-volatile flash memory. Select NVMe modules and SATA SSDs feature a new microcontroller unit (MCU)-based design that allows the PLP array to perform intelligently in various temperatures, power glitches and charge states to protect both device and data.

Advanced Wear Leveling

Manages the reads and writes across blocks evenly to optimize the overall life expectancy of a flash product.

AutoRefresh

Monitors the error bit level in every operation. Before the error bit in a block reaches or exceeds the preset threshold value, AutoRefresh moves the data to a healthy block, thus preventing the controller from reading blocks with too many error bits and averting read disturbance and data corruption.

Dynamic Data Refresh

Runs automatically in the background to reduce the risk of read disturbance and sustain data integrity in seldom-accessed areas by sequentially scanning the user area flag record without affecting the read/write operation. The data that has been completely moved to another block will be read and compared with the source data to ensure data integrity.

Auto-Read Calibration

As program/erase (P/E) cycles increase, memory cells age and cause voltage shifts that lead to high bit error rates (BER) when predefined read thresholds are fixed.
The Auto-Read Calibration (ARC) function reduces BER and enhances reliability by adjusting/calibrating the read thresholds. ARC is supported by the TLC LDPC controller.

End-to-End Data Path Protection

Ensures error checking and correction as data moves from the host to the storage device controller and vice versa. By covering the entire data path, end-to-end protection guarantees integrity at any point during data transfer.

Data Security

Keeping Data Protected Against Threats

SED (AES 256-bit Encryption, TCG Opal 2.0)

TCG Opal Secirity Subsystem Class (SSC) 2.0 is a set of specifications for self-encrypting drives that present a hierarchy of security management standards to secure data from theft and tampering. Security features include hardware-based data encryption, pre-boot authentication (PBA) and AES-128/256 data encryption to protect the confidentiality of data at rest.

Software Secure Erase

Software Secure Erase wipes out all user data, overwrites all locations, and prevents the retrieval or recovery of erased data. This feature is activated using an ATA/NVM command to trigger a Fast Erase or Fast Erase + Purge (overwrite) for all flash physical blocks containing user data, such as user data, spare, wear leveling, and bad blocks, as well as all flash blocks containing metadata. Overwriting makes data unrecoverable by replacing all data (user data as well as areas that are not accessible to the user) with patterns or non-sensitive data.

Hardware Secure Erase

Hardware Secure Erase wipes out all user data, overwrites all locations, and prevents the retrieval or recovery of erased data. This feature is activated using the general-purpose input/output (GPIO) connector to trigger a Fast Erase or Fast Erase + Purge (overwrite) for all flash physical blocks containing user data, such as user data, spare, wear leveling, and bad blocks, as well as all flash blocks containing metadata. Overwriting makes data unrecoverable by replacing all data (user data as well as areas that are not accessible to the user) with patterns or non-sensitive data.

Hardware Write Protect

Hardware Write Protect safeguards stored data by preventing modifications and deletions. This feature is enabled by putting a jumper on specific pins on the printed circuit board (PCB). Depending on the NAND flash product, the SSD will either deny write commands from the host or render the SSD in “Read Only” mode to thwart write access and data tampering.

Customization & Services

Unique Solutions for Unique Requirements

Thermal Management Solution

ATP recognizes the unique thermal challenges for different use cases and scenarios, and thus offers holistic and customizable solutions that combine firmware and hardware technologies to meet customers' specific thermal requirements.

Anti-Sulfur Resistors

ATP NAND flash storage products offer an anti-sulfur resistor option to prevent the corrosive effects of sulfur contamination, guaranteeing continued dependable performance for a long time..

Conformal Coating

Protects electronic circuits with a coating of the chemical compound Parylene to resist dust, chemical contaminants, extreme temperature, moisture and corrosion.

Content Preload

This is a value-added service of preloading digital resources such as map data for navigation, special file systems, operating systems, application programs, and more to selected storage devices.

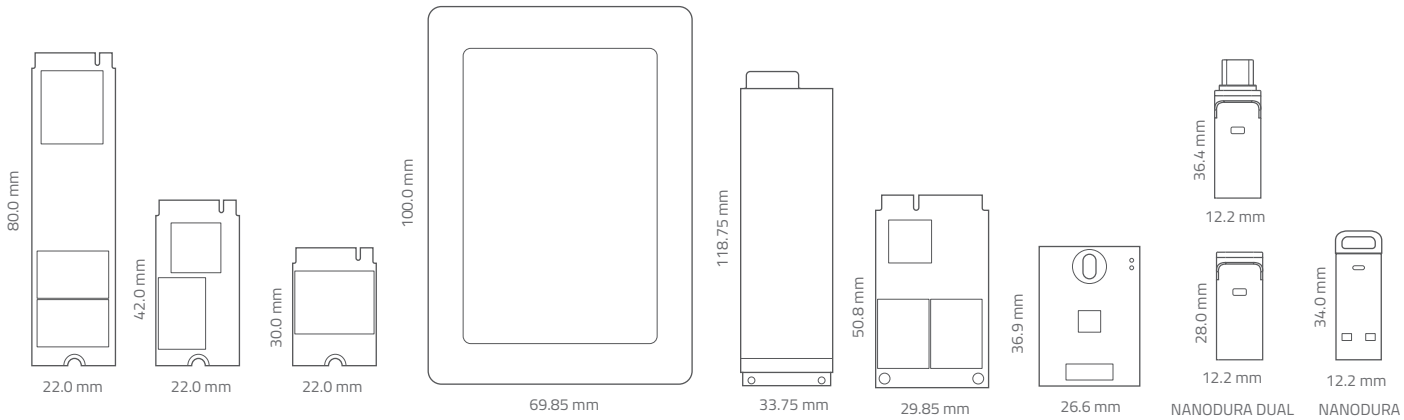
Joint Validation and Test

ATP conducts compatibility/function tests with client-supplied host devices and systems, to proactively detect and minimize failures that may not be caught in production tests, thus improving overall quality.

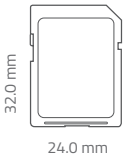
Complete Flash Portfolio

Form Factor	Interface	Product Line	Capacity	NAND	Sequential Performance MB/s (up to)		Reliability TBW (max) [1]	Operating Temperature (°C)
					Read	Write		
M.2 2280 SSD	PCIe G4 x4	N751Pi	80 GB to 1.28 TB	3D TLC (pSLC mode)	6,450	6,050	120,000	-40 to 85
		N651Si / N651Sc	240 GB to 3.84 TB	3D TLC	6,450	6,050	40,000	-40 to 85 / 0 to 70
		N601Sc[2]	480 GB to 3.84 TB	3D TLC	7,000	6,000	5,760	0 to 70
		N601Vi / N601Vc	240 GB to 1.92 TB	3D TLC	5,000	4,300	4,170	-40 to 85 / 0 to 70
		N601Mw	1 TB to 4 TB	3D TLC	7,200	6,500	6,000	-20 to 75
	PCIe G3 x4	N650Vi	120 GB to 960 GB	3D TLC	2,600	1,880	4,800	-40 to 85
		N400Mw	128 GB to 1TB	3D TLC	2,600	1,800	695	-20 to 75
	SATA 6 Gb/s	A750Pi	80 GB to 320 GB	3D TLC (pSLC mode)	560	510	29,620	-40 to 85
		A650Si / A650Sc	240 GB to 960 GB	3D TLC	560	520	10,240	-40 to 85 / 0 to 70
		A600Vc	32 GB to 512 GB	3D TLC	560	400	590	0 to 70
		A400Mw	128 GB to 1TB	3D TLC	550	500	765	-20 to 75
M.2 2242 SSD	PCIe G4 x4	N601Sc[2]	480 GB to 1.92 TB	3D TLC	7,000	6,000	2,880	0 to 70
	PCIe G3 x4	N650Vi	120 GB to 960 GB	3D TLC	2,600	1,880	4,800	-40 to 85
	SATA 6 Gb/s	A800Pi	8 GB to 64 GB	SLC	535	400	5,333	-40 to 85
		A750Pi	80 GB to 320 GB	3D TLC (pSLC mode)	560	515	29,620	-40 to 85
		A650Si / A650Sc	240 GB to 960 GB	3D TLC	560	525	10,240	-40 to 85 / 0 to 70
		A600Vi / A600Vc	128 GB to 1 TB	3D TLC	560	525	1,530	-40 to 85 / 0 to 70
M.2 2230 SSD	PCIe G4 x4	N601Si[2]	240 GB to 960 GB	3D TLC	3,500	3,400	1,440	-40 to 85
	PCIe G3 x4	N700Pi / N700Pc	40 GB to 160 GB	3D TLC (pSLC mode)	2,000	1,600	4,280	-40 to 85 / 0 to 70
		N600Vi / N600Vc	120 GB to 480 GB	3D TLC	2,050	1,550	768	-40 to 85 / 0 to 70
U.2 SSD / 2.5" SSD	PCIe G4 x4	N751Pi	320 GB to 2.56 TB	3D TLC (pSLC mode)	6,100	6,000	486,000	-40 to 85
		N651Si	960 GB to 7.68 TB	3D TLC	6,000	6,000	76,000	-40 to 85
	SATA 6 Gb/s	A800Pi	8 GB to 256 GB	SLC	520	420	21,333	-40 to 85
		A750Pi	80 GB to 640 GB	3D TLC (pSLC mode)	560	510	59,250	-40 to 85
		A650Si / A650Sc	240 GB to 1.92 TB	3D TLC	560	525	21,990	-40 to 85 / 0 to 70
		A600Vi / A600Vc	128 GB to 1 TB	3D TLC	560	525	1,530	-40 to 85 / 0 to 70
		A400Mw	128 GB to 1 TB	3D TLC	550	500	765	-20 to 75
E1.S SSD	PCIe G4 x4	N651Si	960 GB to 7.68 TB	3D TLC	6,400	6,100	79,000	-40 to 85
mSATA SSD	SATA 6 Gb/s	A800Pi	8 GB to 128 GB	SLC	530	430	10,666	-40 to 85
		A750Pi	80 GB to 320 GB	3D TLC (pSLC mode)	560	510	29,620	-40 to 85
		A650Si / A650Sc	240 GB to 960 GB	3D TLC	560	525	10,240	-40 to 85 / 0 to 70
		A600Vi / A600Vc	128 GB to 1 TB	3D TLC	560	525	1,530	-40 to 85 / 0 to 70
USB 3.2 NANODURA Dual	USB 3.2 Gen1 x 1	B600Sc	32 GB to 128 GB	3D TLC	270	85	84	0 to 70
USB 2.0 NANODURA	USB 2.0 (480 Mbps)	B800Pi	512 MB to 8 GB	SLC	21	17	192	-40 to 85
		B600Sc	4 GB to 8 GB	MLC	25	18	19	0 to 70
USB 2.0 eUSB	USB 2.0 (480 Mbps)	B800Pi	1 GB to 16 GB	SLC	37	23	1,548	-40 to 85
		B800Pi	1 GB to 32 GB	SLC	30	25	640	-40 to 85
		B600Sc[3]	8 GB to 32 GB	MLC	25	19	19	0 to 70

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Product specifications may be subject to change.
3 Measured with Random Write. May vary by density, configuration and applications.

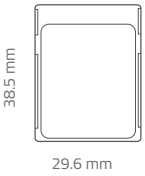


Form Factor	Interface	Product Line	Capacity	NAND	Sequential Performance MB/s (up to)		Reliability TBW (max) [1]	Operating Temperature (°C)
					Read	Write		
SD/ SDHC/ SDXC Card	HS mode / UHS-I	S800Pi	512 MB to 8 GB	SLC	81	39	192	-40 to 85
	UHS-I	S750Pi / S750Pc	16 GB to 128 GB	3D TLC (pSLC mode)	95	80	12,670	-40 to 85 / -25 to 85
		S700Pi / S700Pc	4 GB to 8 GB	2D MLC (pSLC mode)	96	81	240	-40 to 85 / -25 to 85
		S650Si / S650Sc	64 GB to 512 GB	3D TLC	95	70	5,500	-40 to 85 / -25 to 85
		S600Si / S600Sc	8 GB to 16 GB	2D MLC	97	36	48	-40 to 85 / -25 to 85
microSD/ microSDHC/ microSDXC Card	HS mode / UHS-I	S800Pi	512 MB to 8 GB	SLC	81	39	192	-40 to 85
	UHS-I	S750Pi / S750Pc	16 GB to 128 GB	3D TLC (pSLC mode)	95	80	12,670	-40 to 85 / -25 to 85
		S700Pi / S700Pc	4 GB to 8 GB	2D MLC (pSLC mode)	96	81	240	-40 to 85 / -25 to 85
		S650Si / S650Sc	64 GB to 512 GB	3D TLC	95	70	5,500	-40 to 85 / -25 to 85
		S600Si / S600Sc	8 GB to 16 GB	2D MLC	97	36	48	-40 to 85 / -25 to 85
CFexpress Card	PCIe G4 x2	N751Pi	40 GB to 320 GB	3D TLC (pSLC mode)	3,500	3,100	19,010	-40 to 85
		N651Si / N651Sc	128 GB to 1 TB	3D TLC	3,500	3,200	10,830	-40 to 85 / 0 to 70
CFast Card	SATA 6 Gb/s	A800Pi	8 GB to 32 GB	SLC	500	310	2,667	-40 to 85
CompactFlash Card	UDMA 0~4	I800Pi	512 MB to 32 GB	SLC	61	55	1,280	-40 to 85
	UDMA 0~6	I700Pc	8 GB to 16 GB	Pseudo SLC	110	80	256	0 to 70
		I600Sc	16 GB to 32 GB	2D MLC	108	46	38	0 to 70

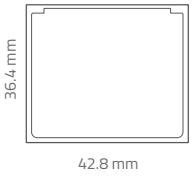


SD Card

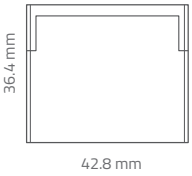
microSD Card



CFexpress Card



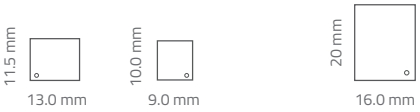
CompactFlash Card



CFast Card

Form Factor	Interface	Product Line	Capacity	NAND	Sequential Performance MB/s (up to)		Reliability TBW (max) [1]	Operating Temperature (°C)
					Read	Write		
e.MMC Automotive Grade 2	v5.1, HS400	E700Paa	4 GB to 64 GB	3D MLC / 2D MLC (pSLC mode)	300	240	1,213	-40 to 105
		E600Saa	8 GB to 128 GB	3D MLC / 2D MLC	300	170	824	-40 to 105
e.MMC Automotive Grade 3		E700Pia	4 GB to 64 GB	3D MLC / 2D MLC (pSLC mode)	300	240	1,213	-40 to 85
		E600Sia	8 GB to 128 GB	3D MLC / 2D MLC	300	170	824	-40 to 85
e.MMC Extended Industrial Grade		E700Pa	4 GB to 64 GB	3D MLC / 2D MLC (pSLC mode)	300	240	1,213	-40 to 105
		E600Sa	8 GB to 128 GB	3D MLC / 2D MLC	300	170	824	-40 to 105
e.MMC Industrial Grade		E700Pi	4 GB to 64 GB	3D / 2D MLC (pSLC mode)	300	240	1,364	-40 to 85
		E600Si	8 GB to 128 GB	3D / 2D MLC	300	225	824	-40 to 85
		E600Vi	32 GB to 64 GB	3D TLC	290	225	20	-40 to 85
e.MMC Commercial Grade		E700Pc	4 GB to 40 GB	3D TLC / 2D MLC (pSLC mode)	290	225	1,364	-25 to 85
		E600Sc	8 GB to 128 GB	3D TLC / 2D MLC	290	225	52	-25 to 85
		E600Vc	32 GB to 64 GB	3D TLC	290	225	20	-25 to 85
PCIe® NVMe M.2 Type 1620 HSBGA SSD	PCIe G4 x4	N601Si[2]	240 GB to 960 GB	3D TLC	3,500	3,400	1,440	-40 to 85
	PCIe G3 x4	N700Pi / N700Pc	40 GB to 160 GB	3D TLC (pSLC mode)	2,000	1,600	4,280	-40 to 85 / 0 to 70
		N600Si / N600Sc	120 GB to 480 GB	3D TLC	2,050	1,550	768	-40 to 85 / 0 to 70

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Product specifications may be subject to change.



e.MMC M.2 Type 1620 HSBGA SSD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