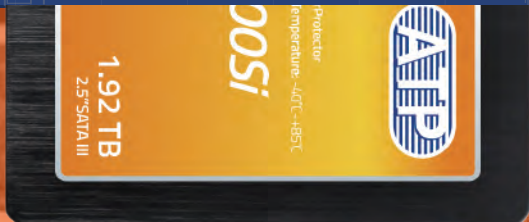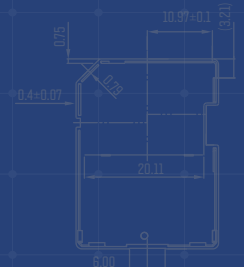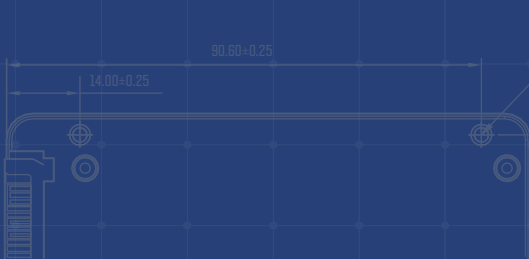# ATP

The Global Leader in Specialized Storage and Memory Solutions

WE BUILD WITH YOU

2022 PRODUCT CATALOG

About ATP

Since 1991, we have consistently distinguished ourselves as one of the world's leading original equipment manufacturers (OEM) of high-performance, high-quality and high-endurance NAND flash products and DRAM modules. As a manufacturing leader, we provide memory and storage solutions trusted by diverse industries that require high levels of technical proficiency, manufacturing quality, and wide operating temperature ranges.

We reinforce our leadership by continuing to blaze the trail as:

The Global Leader in Specialized Storage and Memory Solutions

ATP-developed firmware and mass production infrastructure are fully capable of addressing any variety of embedded/industrial usage cases. We can provide specialized configurations to support unique memory and storage requirements, all with the aim of delivering best total cost of ownership (TCO) for our customers.

The Thermal Experts in Storage and Memory Solutions

We are widely known as one of the first to develop industrial-temperature (I-Temp) 3D NAND flash storage for extreme operating conditions. This expertise continues to this day as customizable thermal solutions are made available for the latest NVMe modules that run at blistering speeds. Through constant collaboration with customers, as well as our top-notch firmware and hardware engineering capabilities, we make sure that optimal sustained performance is achieved despite freezing cold or blazing hot temperatures.

A True Manufacturer

We manage every stage of the manufacturing process to ensure quality and product longevity, offering in-house design, testing, and tuning from integrated circuits (ICs) to module and drive level. All products are meticulously tested and validated before leaving our manufacturing facilities to make sure that they comply with the strictest industry standards and that they will operate reliably under rugged conditions and workloads for a long time.

ATP USA
SAN JOSE, CA, USA

ATP EUROPE
MUNICH, GERMANY

ATP CHINA
SHANGHAI, CHINA

ATP JAPAN
TOKYO, JAPAN

ATP HEADQUARTERS
TAIPEI, TAIWAN

Table of Contents

Our Corporate Responsibility Commitment

Certifications

According to leading industry standards

ISO 9001:2015

ISO 14001:2015

ISO45001:2018

ISO14064-1:2018

ISO 17025

VDA 6.3

IATF 16949 (LOC)

**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

THE GLOBAL LEADER IN SPECIALIZED STORAGE AND MEMORY SOLUTIONS

One size does not fit all. Providing Unique Solutions for Unique Challenges.

We at ATP recognize the uniqueness of each customer's requirements, so we go the extra mile to custom-configure our memory and storage solutions according to the needs of our customers.

Adding Value to Optimize TCO

We want to offer our customers an opportunity to stand out in the market, optimize investments, and add value without incurring huge costs.

Sustaining Competitiveness

Due to ATP's advanced manufacturing capabilities and control of the supply chain as a true manufacturer, we can provide specialized solutions for specific needs while maintaining competitiveness in unit cost.

Pillars of ATP Customization

THERMAL

With a variety of customer host environments in terms of sustained temperature, cross temperature, and air flow, ATP custom-configures firmware and hardware to manage the best balance of performance and device life span.

ENDURANCE

ATP's experience dealing with a wide scope in workload models allow for custom set configurations, tailor-fitted to customer's requirements meeting the best compromise in terms of cost per GB, DWPD, and performance.

*Collaboration Between ATP and Customers is Key to Meeting Diverse
Usage Requirements with Specialized Services*

Collaboration is Key

To help customers articulate their needs, we engage in constant dialog with them. Through such dialogs, we can define product configurations based on their endurance, thermal and other requirements.

Our Commitment: We Build with You.

This depicts our commitment to involve you, our customers, in the process of producing the memory and storage products you need. By empowering you in crafting the solution for your unique case, it becomes your solution, your product.

LONGEVITY

Long product cycles with a 5-year roadmap, support for legacy memory products, and controlled BOM with PCN/EOL notice typically 6 months in advance ensure consistent quality and supply availability.
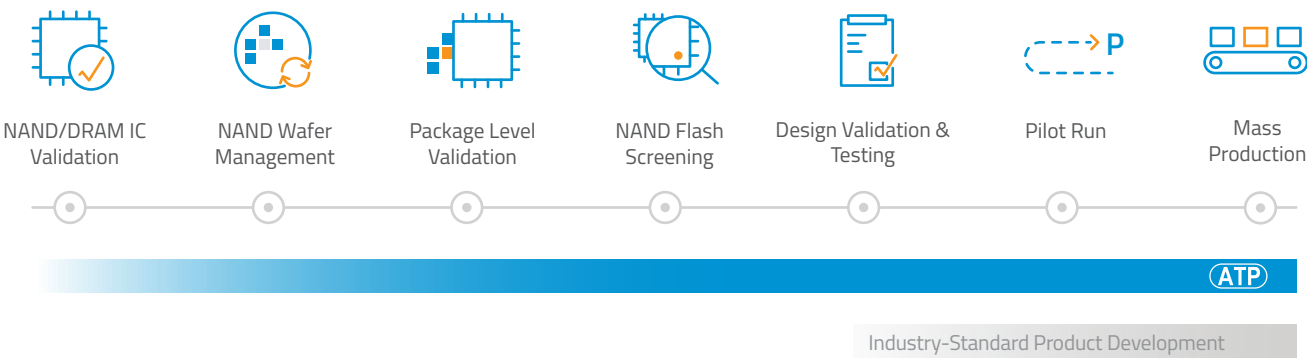
SECURITY

A wide range of optional custom security technologies provide extra layers of protection safeguarding data at rest and in transit.

ATP Delivers Specialized Storage and Memory Products with Own-Developed FW and MP Infrastructure

As a true manufacturer, ATP is in charge of all the stages of the manufacturing process. This makes ATP totally capable of developing customizable firmware and mass production infrastructure to meet the thermal, security, endurance, and other requirements of customers. Such specialized configurations can address any variety of embedded and industrial use cases.

This once again demonstrates ATP's commitment to deliver optimal total cost of ownership (TCO) value for its customers as storage demands of the Industrial Internet of Things (IIoT), edge computing, and other high-reliability applications continue on the upsurge.

The following figure shows ATP's quality journey beginning with the very basic component level, the ICs, which serve as the building blocks of all ATP products.

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

Industry-Standard Product Development

Three Stages of ATP's Complete Process Ownership

All DRAM and flash storage products go through a series of functional and reliability tests to ensure that they match the specifications agreed upon by ATP and the customer and to ensure that they are compatible with host environments.

1. NAND Flash IC Level

ATP ensures the reliability of the NAND flash via thorough meticulous IC-level validation for reliability and functionality.

3. Mass Production Level

100% Rapid Diagnostic Test (RDT) performed during the pilot run ensures proven reliability at mass production (MP) scale.

2. Module Level

To ensure complete module functionality and reliability, ATP performs:
- Module design/layout validation
- Controller hardware validation
- Controller firmware/FTL (flash translation layer) validation
- OEM customer joint validation: Compatibility testing for new device; module-level validation with host platform

Key Manufacturing Processes

ATP demonstrates its extensive expertise in the use of NAND wafer through its own packaging capabilities to deliver IC/package-level field support and extended support for legacy products.

Packaged IC

System-in-Package (SiP)

Surface Mount Technology (SMT)

SiP Process

Integrates components within a single package. ATP's SiP process encapsulates all exposed components to provide protection and shielding.

Air Shower	Clean Room	Wafer	Wafer Grinding

Wafer Saw	Die Attach	Wire Bonding	Molding
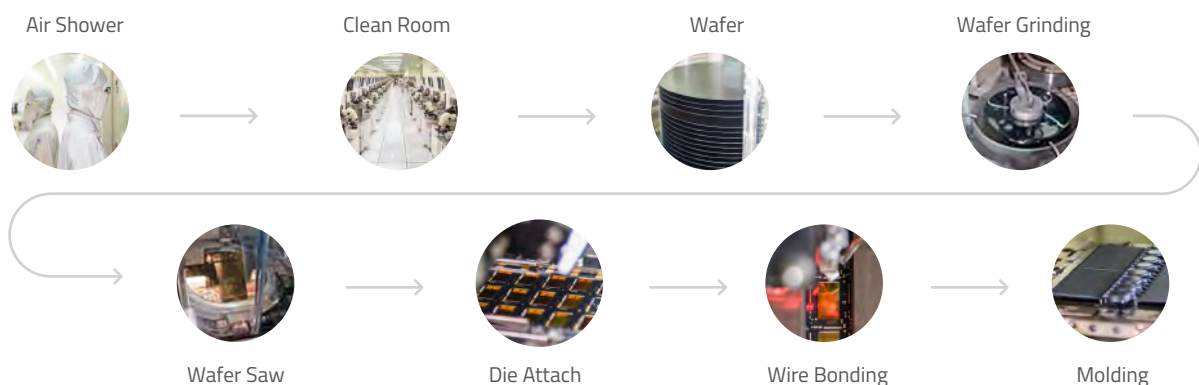
Surface Mount Technology

ATP's SMT process includes mandatory 100% Solder Paste Inspection (SPI) In-Line System, which is optional for other manufacturers. ATP's N_2 Reflow effectively limits the amount of oxygen to prevent oxidation in components during the heating process by pumping nitrogen into the reflow chamber. It also improves solder wetting, which allows the metal in the solder (in the form of molten fluid) to adhere properly to the components for optimal solder joint.

Solder Paste Printing	Solder Paste Inspection	Component Placement	N_2 Reflow	Automatic Optical Inspection	PCB Depanelization
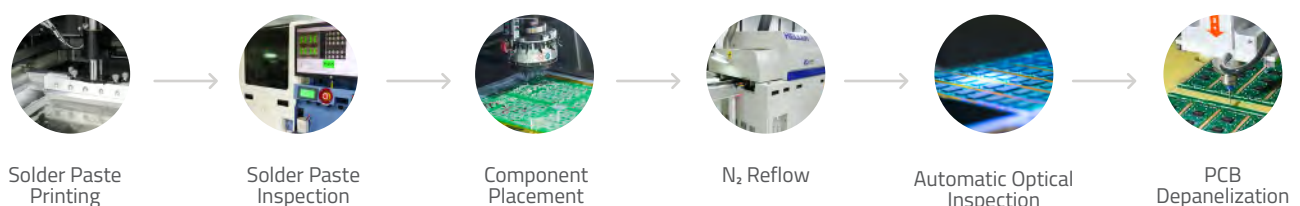
ATP Customizable Thermal Management Solutions:
Steady Wins the Race

In this increasingly data-centric era, 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.

How can NVMe SSDs beat the heat?

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 aspects:

- **Environmental Assessment.** Similar to checking environmental factors, such as the weather and road conditions, we first check the airflow within the system. Is the airflow enough to provide cooling, especially for fan-less systems?
- **Physical Conditions.** Next, we assess heat dissipation by looking at the "racetrack" – which is the physical and mechanical design of the system. Considering the available space, what is the ideal heatsink solution and what material should be used? Will components on the printed circuit board (PCB) cause mechanical interference with the heatsink?
- **Ambient Simulation.** The ATP-built mini chamber is used to test the SSD within a controlled test environment, with a temperature test range from 25˚C to 85˚C. The mini chamber simulates and adjusts thermal environments based on customer's profile.
- **Suitable Gear/Equipment.** Selecting the suitable gear for a race can make a huge difference. What you wear keeps you cooler. The same is true in thermal management. Choosing a heatsink with excellent conductivity, reliability, design and hardness can help determine the success of the heatsink solution and may impact the total cost of ownership (TCO).
- **Pacing Strategy.** Managing heat while keeping performance optimized is a big challenge. The ATP Dynamic Thermal Throttling mechanism provides a delicate balance between performance and temperature by continuously detecting device temperature and adjusting the pace.

Steady wins the race!

Composite Temperature	Performance

˚C ⎯ Time | MB/S ⎯ Time

⎯⎯ Bare SSD   ⎯⎯ 8 mm Heatsink
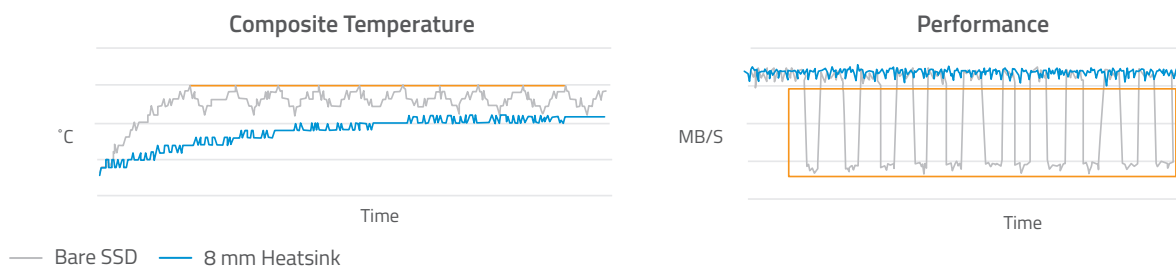
When the composite temperature keeps increasing, the SSD repeatedly slows down to cool it. The 8 mm heatsink can dissipate heat complemented by airflow support. The maximum composite temperature of NVMe SSD is reduced, and the performance is steady with optimized FW algorithm.

The ATP Solution
Simulation and Customization: One Scenario Does Not Fit All
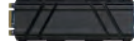
Each customer faces a unique thermal challenge, which could be an interplay of all the factors mentioned.
As a global leader in customization, ATP recognizes the unique thermal challenges for different use cases and scenarios, and thus offers holistic and customizable solutions that combine firmware and hardware technologies to meet customers' specific thermal requirements.

ATP provides simulation and customization options depending on project and according to customers' request. The following table shows available heatsink solutions.
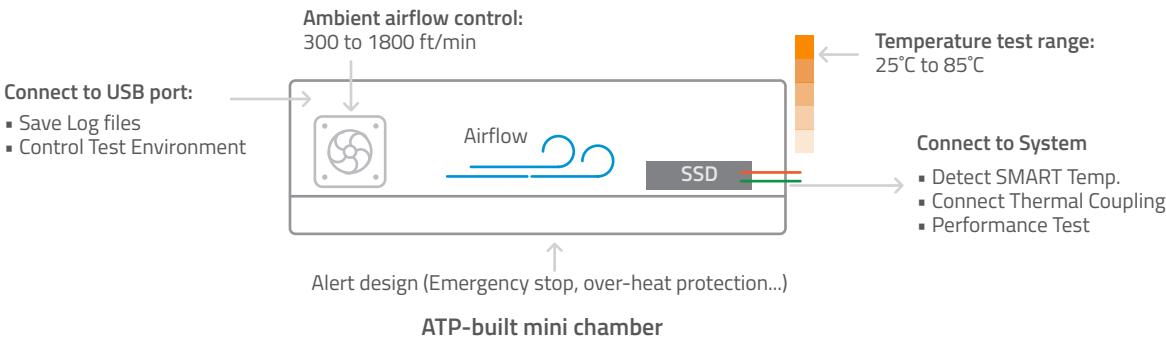
Heat Dissipation Solutions

	Copper Foil	4 mm Fin-Type Heatsink	8 mm Fin-Type Heatsink
Dimensions: L x W x H (mm)	80 x 22 x 3.9	80 x 24.4 x 8.3	80 x 24.4 x 12.3
Material	Copper	Upper: Aluminum alloy Bottom: Stainless steel	Upper: Aluminum alloy Bottom: Stainless steel
Suitability	Limited space	Enough space for effective heat dissipation	
Fixedness	Stick	Clips design	Clips design

ATP Simulation Strategy: Testing Under Worst-Case Scenario to Determine Sufficient Cooling Solutions

Simulation is an important aspect of the manufacturing process. It allows ATP to test and validate its thermal solutions under different conditions and challenges in controlled environments.

ATP combines both hardware and software simulation in its three-pronged simulation testing strategy for thermal solutions:

- **Component-Level Simulation.** This is a pure hardware simulation based on full-speed operation, which is the worst-case scenario, to determine heat distribution in each PCB layer. Components using cooling solutions are subjected to high temperatures to test heat distribution efficiency considering various factors such as ambient temperature, airflow, thermal resistance, and power consumption of main components.
- **System-Level Simulation.** The Cadence® simulation software can run system/module-level simulation. By providing contrasting results for scenarios with or without thermal solution, the simulation software demonstrates the efficiency of ATP heatsinks under worst-case ambient and airflow conditions.
- **ATP-Built Mini Chamber.** The proprietary ATP-built mini chamber simulates and adjusts thermal environments based on customer's profile. The mini chamber can run a real SSD test by simply connecting to a system's USB port.

Ambient airflow control:
300 to 1800 ft/min

Temperature test range:
25°C to 85°C

Connect to USB port:
- Save Log files
- Control Test Environment

Airflow

SSD

Connect to System
- Detect SMART Temp.
- Connect Thermal Coupling
- Performance Test

Alert design (Emergency stop, over-heat protection...)

ATP-built mini chamber

ATP Optimization Strategy: Steady Wins the Race

The ATP Dynamic Thermal Throttling is a firmware-based mechanism that prevents extreme temperature increase by continuously detecting device temperature. As the mechanism balances performance and temperature, Eco Mode is triggered, resulting in lower power consumption.

The following figure shows that power consumption is significantly reduced under Eco Mode.

Power Consumption (Watts)

- Max
- Avg
- Min

T0 (Eco Mode)
Full Speed (Power Mode)
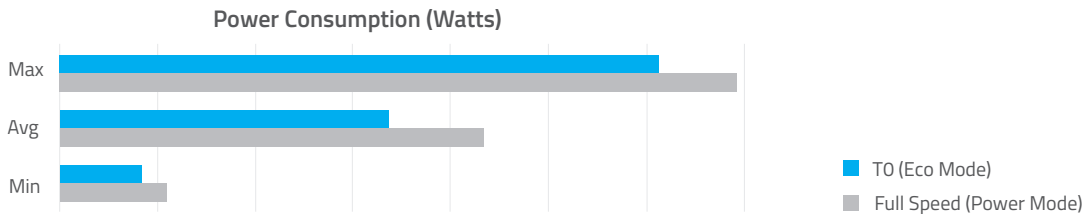
A750Pi, A650Si/Sc Series SATA SSDs Built with 3D TLC Flash Match SLC/MLC Endurance

66% Higher TBW than Other SSDs in Native TLC, 50% in pSLC

Key Features

- Available in M.2 2280/2242, 2.5" & mSATA form factors
- Endurance on par with MLC & SLC flash
- 120 to 1920 GB capacities for native TLC (A650Si/A650Sc)
- 80 to 640 GB capacities for pSLC (A750Pi)
- Industrial temperature operable (A750Pi/A650Si)
- MCU-based Power Loss Protection design with Level 4 (data-in-flight) protection
- LDPC ECC & RAID support
- End-to-end data path protection
- SED features*

*Optional

Manufactured using a new die package, the new Serial ATA (SATA) A750Pi and A650Si/Sc Series embedded solid state drives (SSDs) are breaking endurance records and making them suitable for write-intensive workloads.

The A650Si/Sc Series in native TLC delivers 66% higher terabytes written (TBW) than other SSDs to achieve endurance close to multi-level cell (MLC). The A750Pi Series in pseudo single level cell (pSLC) mode matches SLC with 50% higher endurance.

The A750Pi, A650Si/Sc Series feature a newly designed power loss protection (PLP) array, which includes a power management IC (PMIC) and firmware-programmable MCU (microcontroller unit), allowing the PLP array to perform intelligently in various temperatures, power glitches and charge states.

N750Pi, N650Si/Sc Series M.2 2280 NVMe SSDs Break 3D TLC Limits with up to 2000 MB/s Sustained Sequential Write Performance

pSLC Drives Achieve Near-SLC Endurance with 54% Higher TBW than Other TLC Drives

Key Features

- Endurance on par with MLC & SLC flash
- 120 to 960 GB capacities for native TLC (N650Si/N650Sc)
- 40 to 320 GB capacities for pSLC (N750Pi)
- Industrial temperature operable (N750Pi/N650Si)
- MCU-based Power Loss Protection design with Level 4 (data-in-flight) protection
- LDPC ECC
- End-to-end data path protection
- SED features*

*Optional

The N750Pi and N650Si/Sc Series is ATP's latest line of M.2 2280 NVMe solid state drives (SSDs) built on 3D triple level cell (TLC) NAND flash. They use a new die package to surmount the endurance and write performance challenges of 3D TLC NAND flash and to meet write-intensive industrial and embedded applications' requirements of speed, sustained sequential write performance, reliability, and long service life.

N750Pi SSDs are configured as full-drive pseudo single level cell (pSLC) with sustained sequential write performance reaching over 2000 MB/s, along with performance and endurance extending to near-SLC levels. The new die package prolongs lifespan with 54% higher endurance compared with other NVMe SSDs built on TLC.

N650Si/Sc Series SSDs operate in native TLC flash. The new die package allows these SSDs to perform reliably and extend endurance by 66% more than other TLC drives. These drives have TBW ratings that come close to those of drives built on multi-level cell (MLC).

Reliability Testing and Validation:
Setting ATP SSDs a Cut Above the Rest

Reliability testing is an important cornerstone in the ATP manufacturing process. ATP's embedded SSDs go through standard as well as customizable testing depending on customer requests and application-specific requirements.

Reliability Demonstration Test (RDT)

Validates the mean time between failures (MTBF) rating of the drive through actual drive-level testing instead of relying on reliability prediction systems.

End-of-Life Validation Test

Makes sure that ATP SSDs perform reliably and maintain data integrity over their life span (and even beyond) as required.

PCBA Solderability Validation

Ensures effective bonding of components on the printed circuit board assembly (PCBA) for reliable electro-mechanical connections.

Four-Corner, Temperature Cycling, and Power Cycling Tests

Demonstrate reliable performance and stored data handling without data miscompare even under harsh conditions.

Compliance Testing. Uses the following ULINK DriveMaster Test Suites to test and validate compliance:

NVMe Protocol

NVM Express Compliance

TCG Opal 2.0 Compliance

Verifies the correct behavior of storage devices implementing one or more of the Opal family SSC Specifications. Compliance is tested according to the requirements of the "TCG Storage Opal Family Test Cases Specification Version 1.00, Revision 1.00."
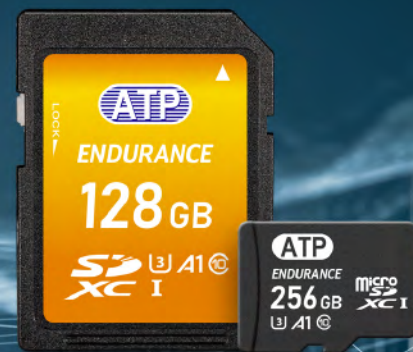
Regression

Power cycle tests and JEDEC Workload Client/Enterprise Compliance

Go the Extra Mile with High-Endurance S650Si/Sc Series SD/microSD Cards

Suitable for Growing Write-Intensive Mobility Services

Key Features

- Capacities:
  - SD Card: 32 GB to 128 GB
  - microSD Card: 32 GB to 256 GB
- ATP own-developed firmware (Auto Read Calibration, Power Failure Protection, Auto/Dynamic Data Refresh)
- ATP own-developed hardware design (substrate with testing pin)
- Low latency timing optimization
- Reduced write amplification index (WAI) to prevent early end-of-life*
- LDPC ECC engine

* Under development
Please refer to page 29, 30 for product specifications.

The global health crisis spurred the growth of mobility services and a surge in the demand for the safe and fast transport of essential goods, medical provisions, and frontline personnel. Smart factories, surveillance systems, delivery robots, drones, and autonomous vehicles equipped with telematic systems, GPS tracking and drive recorders are among the emerging segments that require high-endurance, portable, and built-to-last data storage devices.

ATP's new S650Si/Sc Series SD/microSD cards manufactured using a new package meet the toughest demands of today's write-intensive applications. These SD/microSD cards offer exceptional endurance in a tiny form factor for convenient access to data anywhere with little or no network availability. They are effective edge storage devices that can receive and store data onsite and in real time.

Ruggedly built for reliable operation in harsh environments and extreme temperature ranging from -40°C to 85°C (I-Temp) and -25°C to 85°C (C-Temp) , the new S650Si/Sc Series SD/microSD cards also perform with low latency, thus improving host boot-up time to prevent missing recording of urgent events. They support continuous recording of up to over 43,000 hours, while low-density parity-check error correcting code (LDPC ECC) significantly improves data transfer reliability.

Get the Job Done with Long-Life E750Pi/Pc, E650Si/Sc Series e.MMC

Optimized Power Consumption, Customizable Options
Offer Flexibility for Diverse Application Requirements

Key Features

- Capacities:
  - Native TLC (E650Si/Sc): 32 GB to 64 GB
  - pSLC (E750Pi/Pc): 10 GB to 21 GB
- Industrial temperature operable (E750Pi/ E650Si)
- Endurance on par with MLC and SLC flash
- Customizable configurations*
- Optimized power consumption

* Depending on customer request.
Please refer to page 42 for product specifications.

As industrial/embedded applications become more varied, so do their storage requirements. ATP's e.MMC managed NAND solutions are increasingly being adopted in a wide array of applications for their high reliability, extended endurance, and tiny footprint.

ATP's new E750Pi/Pc Series e.MMC offerings are built with 3D TLC NAND flash but are configured as pSLC to offer endurance on par with SLC drives, while E650Si/Sc Series in native TLC has near-MLC endurance. They are available in a variety of capacities as well as customizable configurations* such as power consumption, to meet different usages, operating environments, and application requirements.

All-Terrain Automotive Storage Solutions for the Road Ahead

ATP Electronics leverages over 30 years of manufacturing experience and more than a decade of automotive expertise to provide best-in-class automotive-grade memory and storage solutions.

The world's leading OEM/Tier 1 suppliers, system developers and service providers trust ATP to deliver the highest levels of data accuracy, consistency and integrity for the most demanding automotive applications.

Up to Speed with EV & Vehicle Data Logging NAND Flash Storage Requirements

Next-generation electric vehicles require fast, reliable, and robust data storage media, not only for navigation and infotainment systems, but also for advanced applications to ensure riding safety and comfort. Vehicle data logging systems collect real-time sensor data such as temperature, speed and more, over long periods of time to aid in testing autonomous cars. ATP NAND flash storage products come in compact packages with high density and superior read/write performance, making them ideal solutions for constrained spaces and rugged operating environments.

Why the Automotive World Trusts ATP

Automotive Quality System Qualified, Certified and Recognized

Compliance with the most stringent international quality standards

International Automotive Task Force (IATF) 16949
Defines the quality management system requirements for the design, development, production and, when relevant, installation, and service of automotive-related products.

VDA 6.3
Defines a process-based audit standard for production parts and services to evaluate and improve controls in a manufacturing organization.

International Material Data System (IMDS)
A global archive of information on all materials found in finished automobile manufacturing.

Automotive Compliance and Standards

Always Ready for the Rough Road

AEC-Q100*
- **e.MMC:** -40°C to +105°C (Grade 2), -40°C to +85°C (Grade 3) ambient operating temperature range
- **SD/microSD:** Selected AEC-Q100 and AEC-Q104 test items; -40°C to +85°C (Grade 3) ambient operating temperature range

* Selected AEC-Q100 test items and conditions approved by customers. May vary by product and project support.

International Protection Marking*
- Waterproof (IPX7)
- Dustproof (IP6X/IP5X)

* For SD/microSD cards only.

Longevity Commitment

Your Partner for the Long Haul

Controlled BOM with PCN/EOL Notice*
- Long product cycles with buffer inventory
- Any changes affecting the process or product are communicated to customers
- 5-year roadmap
- PCN/EOL notice typically 6 months in advance

* May vary by product and project support.

Global and Local FAE Support
- Over 100 engineers and technical staff worldwide
- Global presence in five countries with support sales and service offices
- Global and regional franchised distributors

Applications

Vehicles typically traverse areas with little or no network connectivity, move between varied climates and temperatures, and constantly generate and record vast amounts of data. Automotive storage, therefore should be able to keep data accurate, secure, and available when needed.

- Drive Recorder / Surround View Monitoring
- Driver Monitoring System (DMS)
- Autonomous/ Self-Driving Car
- Telematics
- Event Data Recorder (EDR) / Tachograph
- Fleet Surveillance/ Management
- In-Vehicle Infotainment (IVI)/ Navigation System
- In-Vehicle Computer Automotive
- Advanced Driver Assistance System (ADAS)
- EV/PHV Charging Station
- Automotive Test Equipment / Data Logger

Automotive Storage Portfolio

Form Factor	Product Line Naming	Interface	Capacity	NAND	Endurance TBW (max) *	Sequential Performance MB/s (up to)		Operating Temperature (°C)
						Read	Write	
SD/ SDHC/ SDXC	S650Si	UHS-I	32 GB to 128 GB	3D TLC	256 TB	96	62	-40 to 85
	S650Sc	UHS-I	32 GB to 128 GB	3D TLC	256 TB	96	62	-25 to 85
	S600Si	UHS-I	32 GB to 256 GB	3D TLC	307 TB	96	65	-40 to 85
	S600Sc	UHS-I	4 GB to 64 GB	MLC	77 TB	87	58	-25 to 85
	S600Sia	UHS-I	32 GB to 256 GB	3D TLC	307 TB	96	65	-40 to 85
microSD/ microSDHC/ microSDXC	S650Si	UHS-I	32 GB to 256 GB	3D TLC	512 TB	96	65	-40 to 85
	S650Sc	UHS-I	32 GB to 256 GB	3D TLC	512 TB	96	65	-25 to 85
	S600Si	UHS-I	32 GB to 256 GB	3D TLC	307 TB	96	70	-40 to 85
	S600Sc	UHS-I	4 GB to 8 GB	MLC	10 TB	68	24	-25 to 85
	S600Sia	UHS-I	32 GB to 256 GB	3D TLC	307 TB	96	70	-40 to 85
e.MMC	E700Paa	v5.1, HS400	8 GB to 64 GB	3D Pseudo SLC	1,213 TB	300	240	-40 to 105 (AEC-Q100 Grade 2)
	E600Saa	v5.1, HS400	16 GB to 128 GB	3D MLC	309 TB	300	170	-40 to 105 (AEC-Q100 Grade 2)
	E700Pia	v5.1, HS400	8 GB to 64 GB	3D Pseudo SLC	1,320 TB	300	240	-40 to 85 (AEC-Q100 Grade 3)
	E600Sia	v5.1, HS400	16 GB to 128 GB	3D MLC	824 TB	300	170	-40 to 85 (AEC-Q100 Grade 3)
M.2 2280	N600Si**	PCIe G3 x4	3.84 TB	TLC	10,600 TB	2,200	1,250	-40 to 85
	N600Sc	PCIe G3 x4	3.84 TB	TLC	10,600 TB	2,700	1,500	0 to 70
U.2	N600Si	PCIe G3 x4	960 GB to 7.68 TB	TLC	21,000 TB	3,100	1,400	-40 to 85

* Under highest Sequential write value. May vary by density, configuration and applications.
** Data subject to change

Customizable ATP SecurStor microSD Cards Offer High-Level Protection with Multi-Layer Authentication, Secure Boot, HW AES-256 XTS Encryption

Portability, ease of use, versatility, and convenience — these are just some of the many benefits of microSD cards, making them a leading choice among storage devices; however, they are also vulnerable to unauthorized access and could be easily misplaced or lost, which can expose sensitive data to risks if it falls into the hands of the wrong party.

SecurStor microSD cards meet the growing clamor for heightened security in removable storage devices. These microSD cards provide standard data-at-rest protection but may be fitted with optional custom features, depending on specific customer requirements.
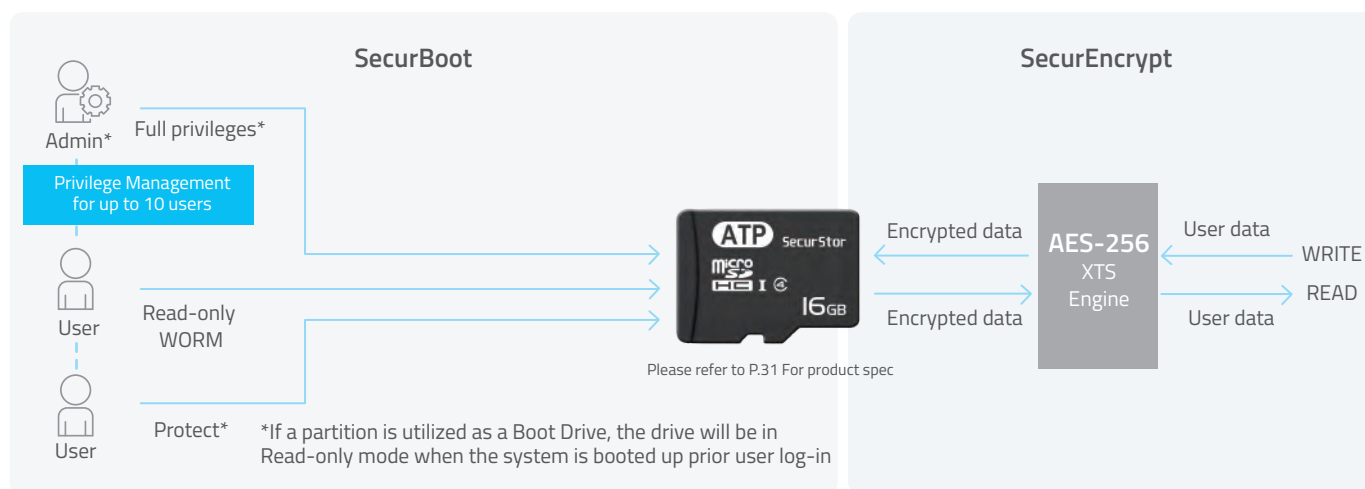
SecurStor

SecurBoot

Admin* Full privileges*

Privilege Management for up to 10 users

User Read-only WORM

User Protect*

ATP SecurStor microSDHC I 4 16GB

Please refer to P.31 For product spec

*If a partition is utilized as a Boot Drive, the drive will be in Read-only mode when the system is booted up prior user log-in

SecurEncrypt

Encrypted data → **AES-256** XTS Engine ← User data → WRITE

Encrypted data → User data → READ

Security Features*

- **Multi-Layer Authentication:** Privilege control for up to 10 users offer high levels of protection.
- **SecurBoot:** Ensures the integrity and validity of the system's stored BIOS configuration.
- **Hardware AES-256 XTS Encryption (SecurEncrypt):** Protects the User Data area with the highest level of hardware encryption without performance trade-off.
- **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

Key Features

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

Platform/OS Support**

- x86 Windows 10 & Linux
- ARM Raspbian Linux

Windows 10

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*   Actual availability of specific features may vary by product and capacity.
    Please contact ATP for details.
** Support for other operating systems may be available on request.

ATP TSE Flash Solutions

Upgrade Modules Compliant with BSI TR-03153 Requirements
Offer Up to 8 Years of Tamper-Proof POS Transactions

ATP Electronics Technical Security Solutions (TSE) provide you with up to 8 years of secure, tamper-proof transaction storage following the TR-03153 guidelines of Bundesamt für Sicherheit in der Informationstechnik, BSI.

A TSE is an add-on to your current POS system that ensures tamper-proof recording of all fiscal transactions to prevent unauthorized manipulation for the purpose of tax fraud. ATP's solution consists of two basic elements:

ATP TSE Flash Solutions

Security Module Application for Electronic Record-keeping Systems (SMAERS)

Manages the transaction data flow from the cash register into the CSP and the NAND and prepares the data if requested by the tax authorities.

Cryptographic Service Provider (CSP)

Digitally signs transactions, which are then stored in the NAND media.
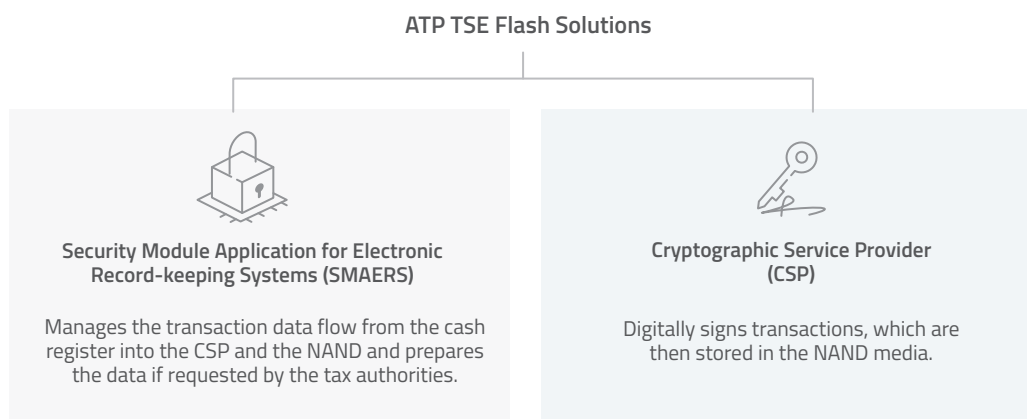
Key Specifications:

- TSE Requirements: 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: More than 20 million signatures
- Signature time less than 150 ms
- OS Support: Windows, Android, Linux

* BSI Certification Target: 2022

Extensive NVMe Lineup Offers Customizable Thermal Management, I-Temp Support, and Optimal Capacities for Diverse High-Performance Applications

Key Features

- Capacities: 40 GB to 7.68 TB
- Operating Temperature: -40°C to 85°C (I-Temp) or 0°C to 70°C (C-Temp)
- Flash Mode Configurations: pSLC or native TLC
- Optional
  - Thermal management / heatsink solutions
  - SED features (AES-256 encryption, TCG Opal 2.0 compliance)

The NVMe transport protocol delivers high bandwidth and low latency through the PCI Express (PCIe) bus. ATP M.2 2280 and U.2 SSDs based on NVMe specifications deliver fast response times even for complex applications.

ATP's NVMe SSDs are suitable for all kinds of computing environments, but they are especially strong and reliable when installed in compact systems with little to no ventilation and when operating in extreme or harsh conditions. Available with optional customizable heatsink and firmware thermal management solutions, they deliver consistent sustained performance without drastic drops even when running at top speeds. They are built on 3D TLC flash configured as either native TLC or pSLC mode for extended endurance. Select SSDs are self-encrypting drives (SEDs) with AES-256 encryption and are compliant with TCG Opal 2.0.

COMING SOON!

NVMe M.2 2280 and U.2 SSDs Built on 176-layer 3D TLC NAND with PCIe Gen 4.0 x4 Lanes Deliver Quicker, More Responsive Performance for Data-Heavy Workloads

Key Features

- Form Factors: M.2 and U.2
- Capacities
  - M.2 2280: 240/480/960/1920/3840 GB
  - U.2: 960 GB, 1.92/3.84/7.68 TB
- LDPC ECC, End-to-End Data Path Protection
- Optional
  - Anti-sulfuric capacitors for M.2 2280
  - SED features (AES-256 encryption, TCG Opal 2.0 compliance)

ATP leverages breakthrough replacement-gate NAND technology and PCI Express (PCIe) Generation 4.0 interface to boost the read/write performance of its latest solid-state drives. Available in M.2 2280 and U.2 form factors, these SSDs are built on an unprecedented 176-layer 3D TLC NAND flash, which uses a smaller die size yet offers higher densities and 35% faster read and write. This translates to faster boot times and application responsiveness.

The PCIe Generation 4.0 interface doubles the PCIe 3.0 data transfer rate from 8 GT/s (giga transfers per second) per lane to 16 GT/s per lane. Using 4 PCIe lanes, the SSDs will operate at a maximum theoretical transfer rate of 64 GT/s, compared with 32 GT/s via PCIe 3.0. With this significant bandwidth increase, PCIe Gen4 x4 SSDs enables faster data transmission and lower latency.

The new NVMe M.2 2280 SSDs offer up to 7500 MB/s and 6800 MB/s sequential read/write performance, respectively. They will be available in capacities of 240/480/960/1920/3840 GB.

NVMe M.2 2280 SSDs with anti-sulfur* components are protected from the damaging effects of sulfur contamination, especially when installed in systems or devices that are near volcanoes, hot springs, mining areas or other areas that are susceptible to sulfur contamination.

The NVMe U.2 SSDs will also don the latest PCIe 4.0 interface on x4 lanes, delivering ultra-speedy read/write performance. The larger form factor has the advantage of offering massive capacities from 960 GB to 7.68 TB. Sequential read/write performance is up to 7600 MB/s and 6800 MB/s, respectively. Onboard DDR4 DRAM offers better performance while its larger physical size allows better dissipation and operation at higher temperatures, thus increasing the SSD lifespan.

* Optional, value-added feature

N600Si

Industrial Temperature: -40°C ~85°C

7.68 TB
INDUSTRIAL NVMe U.2 SSD

COMING SOON!

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

Slated for release in the second half of 2022, ATP's DDR5 solutions are expected to deliver performance and reliability improvements over the previous generation, especially for critical computing applications.

As the next-generation DRAM specification, DDR5 is poised to exceed DDR4 in every way. DDR5 promises faster performance, higher memory bandwidth, higher densities, and a new power management structure that delivers better power efficiency.

All of these advantages, and more, are expected to meet the ever-growing memory needs of present and future applications. Both DDR4 and DDR5 dual-inline memory modules (DIMMs) still have 288 pins, but with DDR5's higher bandwidth, this means it can transmit data faster. While the pin count is the same, DDR5 DIMMs will not fit in DDR4 sockets as the alignment key is located differently and the pinouts have been changed to accommodate the new features.
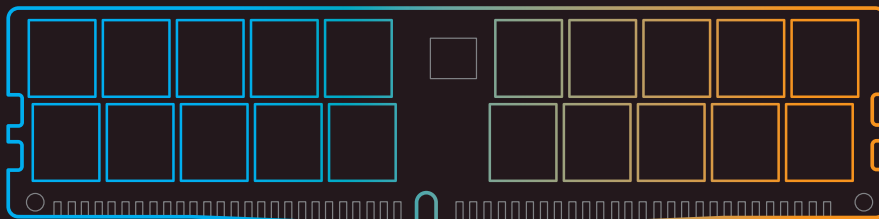
Up to
6.4 Gbps
Memory Bandwidth

4800 to **6400** MHz
Frequency / Transfer Rate

Per die
Up to **64** Gb
Memory Density

1.1 v
Operating Voltage

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 upcoming 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
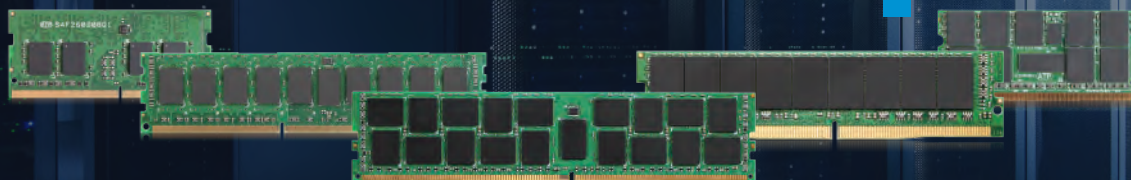
ATP DRAM modules meet the growing need for accelerated performance in memory-intensive and high-performance computing applications to keep up with intensifying data processing requirements as the Internet of Things (IoT) and industrial IoT (IIoT) inevitably become more pervasive. Multi-generational solutions range from legacy DDR3/DDR2/DDR1 to the latest DDR4-3200 modules and upcoming DDR5 solutions, which deliver robust performance, durable build and the right density for the toughest workloads.

Key Differentiators*

- **Value-Added Customization Services**

  - **Conformal Coating.** ATP's conformal coating solution uses parylene coating technology via chemical vapor deposition (CVD), which is compliant with US Military Material MIL-I-46058C and Fire Safety UL94V-0 Certification standards. The coating completely penetrates spaces as narrow as 0.01 mm, making it totally pinhole-free and truly conformal to shield the DRAM module from dust, chemicals, moisture, and other harmful substances.
  - **Chamfering PCB Design.** Chamfering refers to the process of "beveling or tapering" the connector edges for easier insertion into the memory slots. The bevel is done at specific angles, typically at around 40° to 50°.

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

- **Product Longevity Program.** Micron Technology, Inc. endorses ATP as a partner to support selected SDR/DDR/DDR2 modules. 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.** Test During Burn-In (TDBI) combines temperature, load, speed and time to stress test memory modules and expose weak modules. 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.

* May vary by product and project support.

Upcoming DDR5 Solutions: The New Memory Standard of Speed, Density and Power Management

The growing complexity and volume of workloads is necessitating the adoption of a new memory standard to meet a multitude of memory requirements across varied industries. ATP's DDR5 solutions, expected to roll out in the second half of 2022, are geared for rigorous applications requiring enhancements from the previous generation. They deliver better performance not only in terms of speed, but also superior reliability, higher densities, lower power consumption, and longer service life.
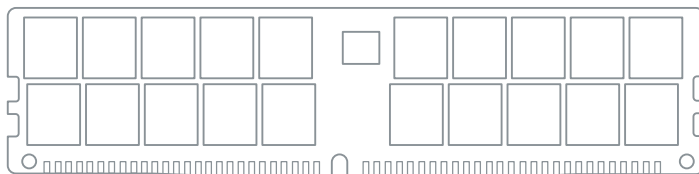
DDR5 Advantages Over DDR4

- **Memory Bandwidth.** DDR5 memory bandwidth is initially at 4.8 Gbps per pin, compared with DDR4's 3.2 Gbps. Future versions are expected to double DDR4's, going up to a maximum of 6.4 Gbps.

- **Frequency / Transfer Rate.** DDR4 frequency ranges from 1866 to 3200 MHz, while DDR5 ranges from 4800 to 6400 MHz initially, but may go as high as 8400 MHz.

- **Burst Length.** This is the amount of data, which is input/output based on a single read/write command in DRAM. DDR5 doubles DDR4 burst length from 8 to 16, thus increasing the read/write efficiency.

- **Power Management and Consumption.** The first power management IC (PMIC) on DIMM is introduced in DDR5. PMIC performs local voltage regulation on the module. Historically, voltage regulation has been done on the motherboard. PMIC on the module allows additional features such as threshold protection, error injection capabilities, programmable power-on sequence, and power management features. DDR5 further reduces power consumption from DDR4's 1.2V to 1.1V.

The following table summarizes important enhancements of DDR5 from DDR4.

	DDR5	DDR4
VDD*	1.1V	1.2V
Data Rates	4800 to 6400 MT/s	1866 to 3200 MT/s
Component Density	16 Gb to 64 Gb	4 Gb to 16 Gb
DQ Bus Width (NON-ECC/ECC)	64/80 bits	64/72 bits
On-Die ECC	Yes	No
Power Management	On DIMM PMIC*	On Motherboard

* VDD: Stands for Voltage Drain Drain, which is the drain power voltage
  PMIC: Power Management Integrated Circuit

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 Micron, 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 and ATP Partnership and License Agreements Ensure Legacy DDR2/DDR/SDR DRAM Module Supply

Recognizing that legacy memory modules are still in prevalent use, ATP Electronics, Inc. and Micron Technology, Inc. have signed partnership and license agreements to ensure consistent supply for customers that are yet unable to upgrade to newer-generation platforms after Micron announced end-of-life (EOL) notices for these modules.

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.
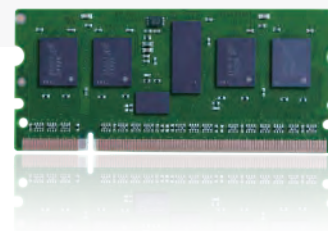
Legacy (SDR/DDR) DRAM Modules

Under a license agreement with Micron Technology, Inc. signed in August 2015, ATP will continue to manufacture legacy SDR/DDR DRAM modules for Micron's customers who are unable to migrate. The agreement was expanded in 2016 with the addition of selected legacy DRAM modules specifically for customers using AMD Embedded/Geode platforms. ATP works closely and exclusively with Micron to transfer module designs and extend long-term support to offer the legacy modules in selected form factors (SO-DIMM, UDIMM and RDIMM) and densities, along with ATP's unique services and features.

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 / 512 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"

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.

Memory Modules

Temperature
Load
Speed
Time

ATP DRAM Modules

Weak Module
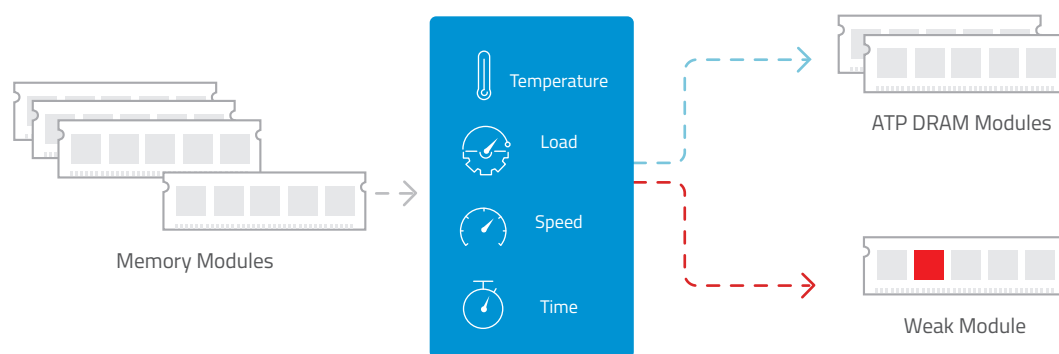
ATP TDBI: What Makes It Unique?

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.
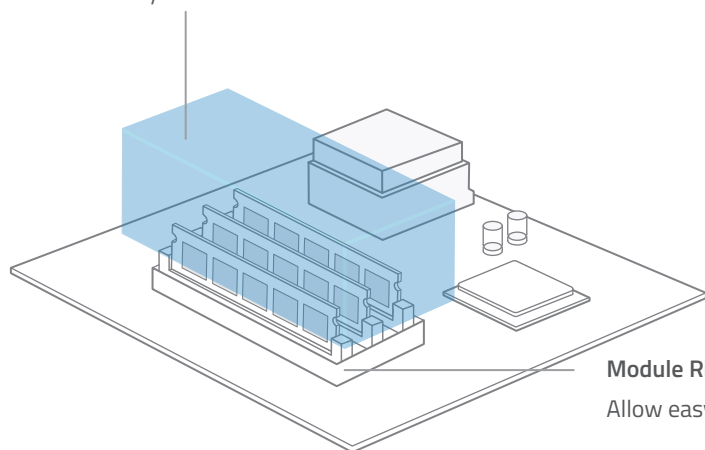
Module Riser Adapters from the Motherboard

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* Summary

Period	DPPM
2015 H1	3202
2015 H2	1955
2016 H1	1297
2016 H2	948
2017 H1	757
2017 H2	651
2018 H1	520
2018 H2	445
2019 H1	407
2019 H2	377
2020 H1	346
2020 H2	331
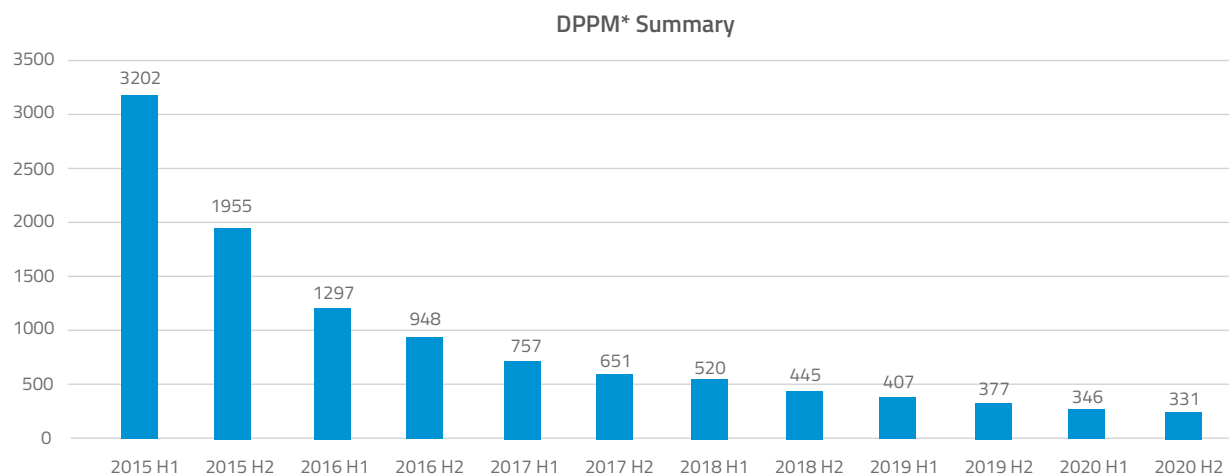
*DPPM = Defective Parts per Million

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
DDR4	RDIMM	4 GB to 128 GB	3200	●	●	●	▲	▲	-	▲
	ECC UDIMM	4 GB to 32 GB	3200	●	●	●	▲	▲	▲	▲
	Non-ECC UDIMM	4 GB to 32 GB	3200	●	●	●	▲	▲	▲	▲
	ECC SO-DIMM	4 GB to 32 GB	3200	-	●	●	▲	▲	▲	▲
	Non-ECC SO-DIMM	4 GB to 32 GB	3200	-	●	●	▲	▲	▲	▲
	Mini-RDIMM	4 GB to 16 GB	2400	●	●	●	▲	▲	-	-
	Mini-UDIMM	4 GB to 16 GB	2400	●	●	●	▲	▲	-	-
DDR3	RDIMM	1 GB to 32 GB	1866	●	●	●	▲	▲	-	▲
	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-RDIMM	1 GB to 8 GB	1600	●	●	●	▲	▲	-	-
	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	PC 133	-	●	●	-	-	-	-

▲: Optional
* VLP: height = 0.74"
  ULP: height below 0.74"

Flash Solutions

Customizable 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, CFast, CompactFlash, SD/microSD memory cards, and USB 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.

Memory Cards
Small Cards, Big Performance for the Intelligent Edge

ATP durable and trustworthy memory cards suit the needs of industrial applications, especially Automation and Energy.

From smart factory to smart delivery, these small, low-power removable storage devices are excellent for surveillance, robotics, point-of-sale (POS) transactions, and handheld computing to swap operating systems (OS) and/or application programs or to extend storage capacity. The small yet ruggedized form factor is IP57/IP67-certified and supports the industrial temperature range (-40°C to 85°C) to assure reliable function in harsh environments.

ATP CFast cards combine the convenient and trusted format of CompactFlash with the speed, capacity and performance of SATA III, while maintaining backward compatibility with other SATA versions. CompactFlash cards in the original IDE/PATA interface continue to enjoy wide usage in industrial and embedded environments due to their durability and rugged build.

Key Differentiators*

- **One Size Does Not Fit All.** Applications for removable storage are so numerous and so varied that off-the-shelf solutions may not be suitable for specific content volumes, security, reliability and endurance requirements. ATP can custom configure firmware and hardware so customers get what they really need.

- **ATP Joint Validation Service.**** Compatibility and function tests are conducted using client's host devices and systems to ensure compatibility.

- **Complete Coverage Rapid Diagnostic Test** includes testing in extreme temperatures to ensure reliable operation from -40°C to 85°C. RDT covers all areas of the storage device including user, firmware and spare areas.

- **Heavy Duty Construction.** Whether manufactured using System in Package (SiP) or Surface Mount Technology (SMT), ATP memory cards are exceptionally robust, resistant to damaging elements such as dust (IP5X/IP6X), humidity/water (IPX7), electrostatic discharge (ESD), extreme temperature, shock/vibration, and more.

* May vary by product and project support.
** Value-added service

SD/SDHC/SDXC Cards

Key Features
- SD Life Monitor
- Dynamic Data Refresh
- Power failure protection
- Industrial temperature
- 100% MP Level Test

SD/SDHC/SDXC					
	Premium		Superior		
Product Line	S800Pi	S700Pi	S700Sc	S650Si	S650Sc
Interface	512 MB to 2 GB, HS mode 4 GB to 8 GB, UHS-I	UHS-I	UHS-I		
Flash Type	SLC	3D Pseudo SLC	3D Pseudo SLC	3D TLC	
Form Factor	SD Card				
Operating Temperature	-40°C to 85°C		-25°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	8 GB to 64 GB	8 GB to 64 GB	32 GB to 128 GB	
Performance					
Sequential Read (MB/s) up to	70	95	95	96	
Sequential Write (MB/s) up to	39	62	62	62	
Endurance and Reliability					
Endurance (TBW)[1] up to	192 TB	512 TB	512 TB	256 TB	
Reliability MTBF @ 25°C	>5,000,000 hours	>3,000,000 hours	>3,000,000 hours	>2,000,000 hours	
Reliability Number of Insertions	20,000 (SDA spec minimum 10,000)				
Others					
Dimensions: L x W x H (mm)	32.0 x 24.0 x 2.1				
Certifications	CE, FCC, UKCA, RoHS				
Warranty	5 years		2 years		

SD/SDHC/SDXC				
	Superior			
Product Line	S600Si	S600Sc	S600Sia	S600Sc
Interface	UHS-I			
Flash Type	3D TLC	MLC	3D TLC	
Form Factor	SD Card			
Operating Temperature	-40°C to 85°C	-25°C to 85°C	-40°C to 85°C	-25°C to 85°C
Power Loss Protection Options	Firmware Based			
Optional SED Features	-			
Capacity	32 GB to 256 GB	4 GB to 64 GB	32 GB to 256 GB	
Performance				
Sequential Read (MB/s) up to	96	87	96	
Sequential Write (MB/s) up to	65	58	65	
Endurance and Reliability				
Endurance (TBW)[1] up to	307 TB	77 TB	307 TB	
Reliability MTBF @ 25°C	>2,000,000 hours			
Reliability Number of Insertions	20,000 (SDA spec minimum 10,000)			
Others				
Dimensions: L x W x H (mm)	32.0 x 24.0 x 2.1			
Certifications	CE, FCC, UKCA, RoHS			
Warranty	2 years			

Technologies & Add-On Services[2]											
Premium	▲	○	○	○	▲	—	○	○	○	○	▲
Superior	▲	○	○	○	○	▲	○	▲	○	○	▲

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 45-47.   ▲: Customization option available on a project basis.

microSD/microSDHC/ microSDXC Cards
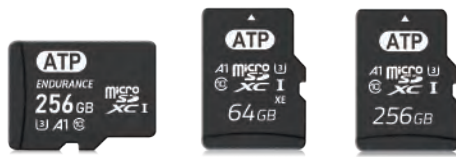
Key Features

- SD Life Monitor
- Dynamic Data Refresh
- Power failure protection
- Industrial temperature
- 100% MP Level Test

microSD/microSDHC/microSDXC					
Product Line	Premium		Superior		
	S800Pi	S700Pi	S700Sc	S650Si	S650Sc
Interface	512 MB to 2 GB, HS mode 4 GB to 8 GB, UHS-I	UHS-I	UHS-I		
Flash Type	SLC	3D Pseudo SLC	3D Pseudo SLC	3D TLC	
Form Factor	microSD Card				
Operating Temperature	-40°C to 85°C		-25°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	8 GB to 64 GB	8 GB to 64 GB	32 GB to 256 GB	
Performance					
Sequential Read (MB/s) up to	80	95	95	96	
Sequential Write (MB/s) up to	39	74	74	65	
Endurance and Reliability					
Endurance (TBW)[1] up to	192 TB	512 TB	512 TB	512 TB	
Reliability MTBF @ 25°C	>5,000,000 hours	>3,000,000 hours	>3,000,000 hours	>2,000,000 hours	
Reliability Number of Insertions	20,000 (SDA spec minimum 10,000)				
Others					
Dimensions: L x W x H (mm)	15.0 x 11.0 x 1.0				
Certifications	CE, FCC, UKCA, RoHS				
Warranty	5 years		2 years		

microSD/microSDHC/microSDXC				
Product Line	Superior			
	S600Si	S600Sc	S600Sia	S600Sc
Interface	UHS-I			
Flash Type	3D TLC	MLC	3D TLC	
Form Factor	microSD Card			
Operating Temperature	-40°C to 85°C	-25°C to 85°C	-40°C to 85°C	-25°C to 85°C
Power Loss Protection Options	Firmware Based			
Optional SED Features	-			
Capacity	32 GB to 256 GB	4 GB to 8 GB	32 GB to 256 GB	
Performance				
Sequential Read (MB/s) up to	96	68	96	
Sequential Write (MB/s) up to	70	24	70	
Endurance and Reliability				
Endurance (TBW)[1] up to	307 TB	10 TB	307 TB	
Reliability MTBF @ 25°C	>2,000,000 hours			
Reliability Number of Insertions	20,000 (SDA spec minimum 10,000)			
Others				
Dimensions: L x W x H (mm)	15.0 x 11.0 x 1.0			
Certifications	CE, FCC, UKCA, RoHS			
Warranty	2 years			

Technologies & Add-On Services[2]											
Premium	▲	○	○	○	▲	—	○	○	○	○	▲
Superior	▲	○	○	○	○	▲	○	▲	○	○	▲

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 45-47.　▲: Customization option available on a project basis.

CFast Cards

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	300
Random Reads IOPS (4K, QD32) up to	35,800
Random Writes IOPS (4K, QD32) 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: L x W x H (mm)	36.4 x 42.8 x 3.6
Certifications	CE, FCC
Warranty	5 years

Key Features

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

Technologies & Add-On Services[2]									
Premium	○	○	○	○	○	○	○	▲	▲

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

2 Please refer to pages 45-47.   ▲: Customization option available on a project basis.

CompactFlash Cards

CompactFlash Card			
Product Line	Premium	Superior	
	I800Pi	I700Sc	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	128 TB	38 TB
Reliability MTBF @ 25°C	>5,000,000 hours	>2,000,000 hours	
Reliability Number of Insertions	10,000 minimum		
Others			
Dimensions: L x W x H (mm)	36.4 x 42.8 x 3.3		
Certifications	CE, FCC, RoHS		
Warranty	5 years	2 years	

Key Features

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

Technologies & Add-On Services[2]								
Premium	○	○	○	○	○	○	▲	▲
Superior	○	—	○	○	○	—	▲	▲

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

2 Please refer to pages 45-47.   ▲: Customization option available on a project basis.

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, Android, Linux

* BSI Certification Target: 2022
** May vary on payload size (s)

Product Name	TSE Storage Solutions
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: L x W x H (mm)	15.0 x 11.0 x 1.0

SecurStor microSD

Security Features*

- **Multi-Layer Authentication:** Privilege control for up to 10 users offer high levels of protection.
- **SecurBoot:** Ensures the integrity and validity of the system's stored BIOS configuration.
- **Hardware AES-256 XTS Encryption (SecurEncrypt):** Protects the User Data area with the highest level of hardware encryption without performance trade-off.
- **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.

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

Product Name	SecurStor microSD
Product Line	SecurStor
Flash Type	MLC
Density	4 GB to 16 GB
Performance Sequential Read (MB/s) up to	10.35
Performance Sequential Write (MB/s) up to	5.3
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: L x W x H (mm)	15.0 x 11.0 x 1.0

Solid State Drives and Modules
Reliable Storage Solutions for the Data Era

ATP flash storage products are built for different workloads, usage scenarios, operating environments and platforms. Hard-wired for sustained operation in wide temperatures (-40°C to 85°C) and other environmental challenges, they may also be customized according to customers' requirements.* They are guaranteed to deliver outstanding performance, rugged durability, and many years of reliable performance. They support the latest high-speed NVMe™ protocol on a PCIe® 3.1 x4 interface as well as proven interfaces such as SATA 6 Gb/s and USB. Various form factors include U.2, 2.5" SSDs, M.2, mSATA and eUSB modules.

Key Differentiators*

- **Configurable Solutions.** ATP SSDs meet diverse embedded/industrial workloads and applications. Customers can use the Online SSD Configuration Tool (https://www.atpinc.com/ssd-configuration) to choose their specifications for available parameters or submit a request to build a custom SSD that will best fit their requirements.

- **Customizable FW/HW Thermal Management.** Currently available for high-density NVMe and SSDs, customizable solutions combine firmware and hardware technologies to overcome overheating challenges in high-speed and high-performance storage. By understanding the performance criteria, user application and system specifications, ATP can offer tailor-fitted solutions to deliver improve sustained performance.

- **High-Performance, High-Density Storage in Compact Form Factors.** ATP M.2 and mSATA modules deliver power-packed performance and massive storage capacity in lean footprints, making them ideal for space-restricted systems such as embedded/IPCs, point-of-sale (POS), and networking systems.

- **MCU-Based Power Loss Protection (PLP).*** NVMe modules and selected SATA SSDs feature a completely new design of the PLP array, which utilizes a new power management IC (PMIC) and new firmware-programmable MCU (microcontroller unit). Integrated into its latest PLP technology, the new MCU design allows the PLP array to perform intelligently in various temperatures, power glitches and charge states.

- **End-to-End Data Path Protection.** ATP industrial SSDs incorporate End-to-End Data Path Protection technology to ensure the integrity of data during transfers from the host system to the storage device and back by detecting and correcting errors on multiple transfer points.

* May vary by product and project support.

M.2 NVMe

Key Features

- MCU-based Power Loss Protection Design *
- Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG OPAL 2.0*
- Thermal Management Solutions**
- End-to-End Data protection
- TRIM function support

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

M.2 NVMe				
Product Line	Premium		Superior	
	N750Pi	N700Pi	N650Si	N650Sc
Interface	PCIe G3 x4			
Flash Type	3D TLC (pSLC mode)		3D TLC	
Form Factor	M.2 2280-D2-M			
Operating Temperature (Tcase)[1]	-40°C to 85°C		-40°C to 85°C	0°C to 70°C
Power Loss Protection Options	Hardware + Firmware Based		Hardware + Firmware Based or Firmware Based	
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0			
Capacity	40 GB to 320 GB	40 GB to 640 GB	120 GB to 960 GB	
Performance				
Sequential Read (MB/s) up to	3,150		3,420	
Sequential Write (MB/s) up to	2,670	2,820	3,050	
Random Reads IOPS up to	147,789 (4K, QD32)		222,700 (4K, QD32)	
Random Writes IOPS up to	114,227 (4K, QD32)		176,600 (4K, QD32)	
Endurance and Reliability				
Endurance (TBW)[2] up to	16,000 TB	21,300 TB	4,640 TB	
Reliability MTBF @ 25°C	>2,000,000 hours			
Others				
Dimensions: L x W x H (mm)	80.0 x 22.0 x 3.5 (M.2 2280 Bare PCBA) 80.0 x 24.4 x 12.5 (M.2 2280 with 8 mm heatsink)			
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH			
Warranty	5 years		2 years	

M.2 NVMe		
Product Line	Superior	
	N600Si	N600Sc
Interface	PCIe G3 x4	
Flash Type	3D TLC	
Form Factor	M.2 2280-D2-M	
Operating Temperature (Tcase)[1]	-40°C to 85°C	0°C to 70°C
Power Loss Protection Options	Hardware + Firmware Based or Firmware Based	
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0	
Capacity	120 GB to 1,920 GB	
Performance		
Sequential Read (MB/s) up to	3,420	
Sequential Write (MB/s) up to	3,050	
Random Reads IOPS up to	225,200 (4K, QD32)	
Random Writes IOPS up to	179,200 (4K, QD32)	
Endurance and Reliability		
Endurance (TBW)[2] up to	5,585 TB	
Reliability MTBF @ 25°C	>2,000,000 hours	
Others		
Dimensions: L x W x H (mm)	80.0 x 22.0 x 3.5 (M.2 2280 Bare PCBA) 80.0 x 24.4 x 12.5 (M.2 2280 with 8 mm heatsink)	
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH	
Warranty	2 years	

Technologies & Add-On Services[3]												
Premium	○	○	○	○	○	○	▲	○	○	▲	▲
Superior	○	○	○	○	○	○	▲	○	▲	▲	▲

1 Case Temperature, the composite temperature as indicated by SMART temperature attributes.
2 Under highest Sequential write value. May vary by density, configuration and applications.
3 Please refer to pages 45-47.   ▲: Customization option available on a project basis.

High-Capacity M.2 NVMe
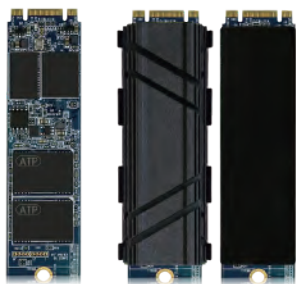
Key Features

- Superior Read/Write performance
- LDPC & RAID Data Recovery for error correction
- Thermal Management Solutions*
- Global wear leveling
- TRIM function support
- End-to End Data Protection

* Customization available on a project basis

High-Capacity M.2 NVMe		
Product Line	Superior	
	N600Si[3]	N600Sc
Interface	PCIe G3 x4	
Flash Type	TLC	
Form Factor	M.2 2280-D2-M	
Operating Temperature (Tcase)[1]	-40°C to 85°C	0°C to 70°C
Power Loss Protection Options	Firmware Based	
Optional SED Features	-	
Capacity	3.84 TB	
Performance		
Sequential Read (MB/s) up to	2,200	2,700
Sequential Write (MB/s) up to	1,250	1,500
Random Reads IOPS (4K, QD128) up to	195,000	195,000
Random Writes IOPS (4K, QD128) up to	170,000	170,000
Endurance and Reliability		
Endurance (TBW)[2] up to	10,600 TB	
Reliability MTBF @ 25°C	>2,000,000 hours	
Others		
Dimensions: L x W x H (mm)	80.0 x 22.0 x 3.5 (M.2 2280 Bare PCBA) 80.0 x 24.4 x 12.5 (M.2 2280 with 8 mm heatsink)	80.0 x 22.0 x 3.5 (M.2 2280 Bare PCBA) 80.0 x 24.4 x 12.5 (M.2 2280 with 8 mm heatsink)
Certifications	RoHS, VCCI, CE, FCC	
Warranty	2 years	

Technologies & Add-On Services[4]												
Superior	○	○	○	○	○	○	▲	▲	○	○	▲	▲

1 Case Temperature, the composite temperature as indicated by SMART temperature attributes.
2 Under highest Sequential write value. May vary by density, configuration and applications.
3 Data subject to change
4 Please refer to pages 45-47.   ▲: Customization option available on a project basis.

High-Density Thermal U.2 NVMe
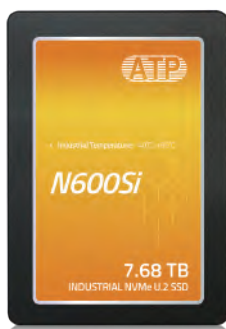
Key Features

- Thermal Management Solutions*
- High-Capacity NVMe Drive
- LDPC & RAID Data Recovery
- End-to-End Data Protection
- S.M.A.R.T / TRIM / Global Wear Leveling

* Customization available on a project basis

U.2 SSD	
Product Line	Superior
	N600Si
Interface	PCIe G3 x4
Flash Type	TLC
Form Factor	2.5"
Operating Temperature (Tcase)[1]	-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	3,100
Sequential Write (MB/s) up to	1,400
Random Reads IOPS (4K, QD128) up to	190,000
Random Writes IOPS (4K, QD128) up to	168,000
Endurance and Reliability	
Endurance (TBW)[2] up to	21,000 TB
Reliability MTBF @ 25°C	>2,000,000 hours
Others	
Dimensions: L x W x H (mm)	100.0 x 69.85 x 7.0
Certifications	RoHS, VCCI, CE, FCC
Warranty	2 years

Technologies & Add-On Services[3]												
Superior	○	○	○	○	○	○	○	○	○	○	▲	▲

1 Case Temperature, the composite temperature as indicated by SMART temperature attributes.
2 Under highest Sequential write value. May vary by density, configuration and applications.
3 Please refer to pages 45-47.   ▲: Customization option available on a project basis.
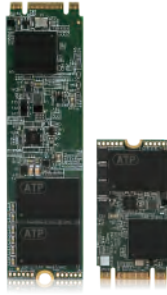
M.2 SATA

Key Features

- MCU-based Power Loss Protection Design*
- LDPC & RAID Data Recovery
- End-to-End Data Protection
- TRIM / Global Wear Leveling support

* Customization available on a project basis

M.2 SATA								
Product Line	Premium			Superior				Value
	A800Pi	A750Pi	A700Pi	A650Si	A650Sc	A600Si	A600Sc	A600Vc
Interface	SATA III 6 Gb/s							
Flash Type	SLC	3D TLC (pSLC mode)		3D TLC				
Form Factor	2242 D2-B-M							
Operating Temperature (Tcase)[1]	-40°C to 85°C	-40°C to 85°C		-40°C to 85°C	0°C to 70°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	40 GB to 160 GB		120 GB to 480 GB				32 GB to 128 GB
Performance								
Sequential Read (MB/s) up to	530	560		560		560		560
Sequential Write (MB/s) up to	400	520		480		510		420
Random Reads IOPS (4K, QD32) up to	76,000	68,000		100,000		100,000		68,000
Random Writes IOPS (4K, QD32) up to	76,000	88,000		90,000		88,000		81,000
Endurance and Reliability								
Endurance (TBW)[2] up to	5,333 TB	9,600 TB	6,400 TB	2,327 TB		1,396 TB		147.7 TB
Reliability MTBF @ 25°C	>2,000,000 hours							
Others								
Dimensions: L x W x H (mm)	42 x 22 x 3.5							42 x 22 x 3.2
Certifications	CE, FCC	CE, FCC, BSMI, UKCA, RoHS, REACH						CE, FCC
Warranty	5 years			2 years				

M.2 SATA							
Product Line	Premium		Superior				Value
	A750Pi	A700Pi	A650Si	A650Sc	A600Si	A600Sc	A600Vc
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 (Tcase)[1]	-40°C to 85°C			0°C to 70°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	80 GB to 320 GB		120 GB to 960 GB				32 GB to 512 GB
Performance							
Sequential Read (MB/s) up to	560		560		560		560
Sequential Write (MB/s) up to	520		480		510		440
Random Reads IOPS (4K, QD32) up to	90,000		100,000		100,000		72,000
Random Writes IOPS (4K, QD32) up to	88,000		90,000		88,000		85,000
Endurance and Reliability							
Endurance (TBW)[2] up to	19,200 TB	12,800 TB	4,655 TB		2,792 TB		590.8 TB
Reliability MTBF @ 25°C	>2,000,000 hours						
Others							
Dimensions: L x W x H (mm)	80 x 22 x 3.35						80 x 22 x 2.2
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH						CE, FCC
Warranty	5 years		2 years				

| Technologies & Add-On Services[3]											
Premium	○	○	○	○	○	○	▲	○	○	▲	▲
Superior	○	○	○	○	○	○	▲	○	▲	▲	▲
Value	○	—	○	○	○	—	—	—	—	—	—

1 Case Temperature, the composite temperature as indicated by SMART temperature attributes.
2 Under highest Sequential write value. May vary by density, configuration and applications.
3 Please refer to pages 45-47.　　▲: Customization option available on a project basis.

2.5" SSDs

Key Features

- MCU-based Power Loss Protection Design*
- Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG OPAL 2.0*
- NSA-compliant Secure Erase*
- MIL-STD-810G standards*

* May vary by product and project support

2.5" SSD					
Product Line	Premium			Superior	
	A800Pi	A750Pi	A700Pi	A650Si	A650Sc
Interface	SATA III 6 Gb/s				
Flash Type	SLC	3D TLC (pSLC mode)		3D TLC	
Form Factor	2.5"				
Operating Temperature (Tcase)[1]	-40°C to 85°C			0°C to 70°C	
Power Loss Protection Options	Hardware + Firmware Based				
Optional SED Features	-			AES 256-bit Encryption, TCG Opal 2.0	
Capacity	8 GB to 256 GB	80 GB to 640 GB		120 GB to 1,920 GB	
Performance					
Sequential Read (MB/s) up to	520	560		560	
Sequential Write (MB/s) up to	420	520		520	
Random Reads IOPS (4K, QD32) up to	76,000	90,000		100,000	
Random Writes IOPS (4K, QD32) up to	74,000	88,000		91,000	
Endurance and Reliability					
Endurance (TBW)[2] up to	21,333 TB	38,400 TB	25,600 TB	9,310 TB	
Reliability MTBF @ 25°C	>2,000,000 hours				
Reliability Number of Insertions	10,000 minimum				
Others					
Dimensions: L x W x H (mm)	100 x 69.9 x 9.2	100 x 69.9 x 7/9.2			
Certifications	CE, FCC	CE, FCC, BSMI, UKCA, RoHS, REACH			
Warranty	5 years			2 years	

2.5" SSD			
Product Line	Superior		Value
	A600Si	A600Sc	A600Vc
Interface	SATA III 6 Gb/s		
Flash Type	3D TLC		
Form Factor	2.5"		
Operating Temperature (Tcase)[1]	-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	120 GB to 1,920 GB		32 GB to 512 GB
Performance			
Sequential Read (MB/s) up to	560		560
Sequential Write (MB/s) up to	520		440
Random Reads IOPS (4K, QD32) up to	100,000		72,000
Performance Random Writes IOPS (4K, QD32) up to	91,000		85,000
Endurance and Reliability			
Endurance (TBW)[2] up to	5,585 TB		590.8 TB
Reliability MTBF @ 25°C	>2,000,000 hours		
Reliability Number of Insertions	10,000 minimum		
Others			
Dimensions: L x W x H (mm)	100 x 69.9 x 7/9.2		100 x 69.9 x 7
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH		CE, FCC
Warranty	2 years		

Technologies & Add-On Services[3]										
Premium	○	○	○	○	○	▲	○	○	▲	▲
Superior	○	○	○	○	○	▲	○	▲	▲	▲
Value	○	—	○	○	○	—	—	—	—	—

1 Case Temperature, the composite temperature as indicated by SMART temperature attributes.
2 Under highest Sequential write value. May vary by density, configuration and applications.
3 Please refer to pages 45-47.   ▲: Customization option available on a project basis.

mSATA

Key Features

- MCU-based Power Loss Protection Design*
- Self Encrytion Drive SED with AES 256-bit Encryption, TCG OPAL 2.0*
- LDPC & RAID Data Recovery
- End-to-End Data Protection
- TRIM / Global Wear Leveling support

* May vary by product and project support

mSATA					
Product Line	Premium			Superior	
	A800Pi	A750Pi	A700Pi	A650Si	A650Sc
Interface	SATA III 6 Gb/s				
Flash Type	SLC	3D TLC (pSLC mode)		3D TLC	
Form Factor	MO-300A				
Operating Temperature (Tcase)[1]	-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				
Optional SED Features	AES 128/256-bit Encryption	-		AES 256-bit Encryption, TCG Opal 2.0	
Capacity	8 GB to 128 GB	40 GB to 160 GB		120 GB to 480 GB	
Performance					
Sequential Read (MB/s) up to	530	560		560	
Sequential Write (MB/s) up to	430	520		480	
Random Reads IOPS (4K, QD32) up to	76,000	90,000	94,000	100,000	
Random Writes IOPS (4K, QD32) up to	-	88,000	85,000	90,000	
Endurance and Reliability					
Endurance (TBW)[2] up to	10,667 TB	9,600 TB	6,400 TB	2,327 TB	
Reliability MTBF @ 25°C	>2,000,000 hours				
Others					
Dimensions: L x W x H (mm)	50.8 x 29.85 x 3.5				
Certifications	CE, FCC	CE, FCC, BSMI, UKCA, RoHS, REACH			
Warranty	5 years			2 years	

mSATA			
Product Line	Superior		Value
	A600Si	A600Sc	A600Vc
Interface	SATA III 6 Gb/s		
Flash Type	3D TLC		
Form Factor	MO-300A		
Operating Temperature (Tcase)[1]	-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	120 GB to 480 GB		32 GB to 512 GB
Performance			
Sequential Read (MB/s) up to	560		560
Sequential Write (MB/s) up to	510		440
Random Reads IOPS (4K, QD32) up to	100,000		72,000
Random Writes IOPS (4K, QD32) up to	88,000		85,000
Endurance and Reliability			
Endurance (TBW)[2] up to	1,396 TB		590.8 TB
Reliability MTBF @ 25°C	>2,000,000 hours		
Others			
Dimensions: L x W x H (mm)	50.8 x 29.85 x 3.5		
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH		CE, FCC
Warranty	2 years		

Technologies & Add-On Services[3]										
Premium	○	○	○	○	○	▲	○	○	▲	▲
Superior	○	○	○	○	○	▲	○	▲	▲	▲
Value	○	—	○	○	○	—	—	—	—	—

1 Case Temperature, the composite temperature as indicated by SMART temperature attributes.
2 Under highest Sequential write value. May vary by density, configuration and applications.
3 Please refer to pages 45-47.   ▲: Customization option available on a project basis.

eUSB

Key Features
- Global wear leveling
- Power Loss Protection

	eUSB	
Product Line	Premium	Superior
	B800Pi	B600Sc
Interface	Compatible with 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	Hardware + Firmware Based	
Optional SED Features	-	
Capacity	1 GB to 32 GB	8 GB to 32 GB
Performance		
Sequential Read (MB/s) up to	30	25
Sequential Write (MB/s) up to	25	19
Endurance and Reliability		
Endurance (TBW)[1] up to	1,280 TB	38.4 TB
Reliability MTBF @ 25°C	>5,000,000 hours	>2,000,000 hours
Reliability Number of Insertions	10,000 minimum	
Others		
Dimensions: L x W x H (mm)	36.9 x 26.6 x 9.5	
Certifications	CE, FCC	
Warranty	5 years	2 years

Technologies & Add-On Services[2]						
Premium	○	○	○	○	▲	▲
Superior	○	○	○	—	▲	▲

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 45-47.   ▲: Customization option available on a project basis.

NANODURA

Key Features
- Global wear leveling
- Bad block management algorithm
- High reliability
- "Plug and play" connection support hot swap

	NANODURA	
Product Line	Premium	Superior
	B800Pi	B600Sc
Interface	Compatible with USB 2.0 (480 Mbps)	
Flash Type	SLC	MLC
Form Factor	USB Flash Drive (USB 2.0)	
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	31	26
Sequential Write (MB/s) up to	21	10
Endurance and Reliability		
Endurance (TBW)[1] up to	192 TB	9.6 TB
Reliability MTBF @ 25°C	>5,000,000 hours	>2,000,000 hours
Reliability Number of Insertions	10,000 minimum	
Others		
Dimensions: L x W x H (mm)	34 x 12.2 x 4.5	
Certifications	CE, FCC, RoHS	CE, FCC
Warranty	5 years	2 years

Technologies & Add-On Services[2]				
Premium	○	○	○	○
Superior	○	○	—	○

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 45-47.   ▲: Customization option available on a project basis.

Managed NAND
Extreme Endurance, Advanced Performance in a Tiny Package
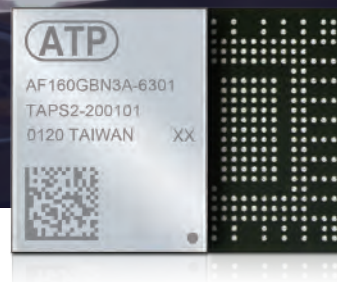
ATP's managed NAND solutions integrate raw NAND flash memory and hardware controller. As soldered-down solutions, they are secure against constant vibrations, making them ideal for embedded and automotive applications requiring rugged endurance and durability.

e.MMC offerings use a 153-ball fine pitch ball grid array (FBGA package). Smaller than a typical postage stamp, its tiny footprint makes the e.MMC perfectly suitable for embedded systems with space constraints but require rugged endurance, reliability and durability in harsh environments.

NVMe Heat Sink Ball Grid Array (HSBGA) SSDs are ATP's tiniest NVMe flash storage solutions. They use high-speed PCIe 3.0 interface x4 lanes and NVMe protocol to deliver up to 32 Gb/s bandwidth at 8 Gb/s per lane.

Key Differentiators*

- **Extreme Endurance:** ** 2-3X Higher than standard e.MMC for higher terabytes written (TBW), healthy memory storage, and long product service life.
- **SRAM Soft Error Detection and Recovery.** *** Maximizes data integrity by providing timely error detection, logging, and configurable action to address the error.
- **Product Traceability.** Laser imprints important information on the ATP e.MMC to identify each piece for accurate tracking and efficient inventory management.

* May vary by product and project support.
** Under best write amplification index (WAI) with highest sequential write value. May vary by density, test configuration, workload and applications.
*** Configuration is predetermined by the customer with ATP and cannot be changed on the field.

Key Differentiators*

- **pSLC Mode.** Storing only one bit per cell increases endurance and reliability, offering 2X-3X better sustainable performance.
- **Optimized Power Consumption.** Consuming low power at only 5 mW duringPower State 4 (Sleep Mode) to deliver huge power savings.
- **DRAM-Less Configuration.** Host Memory Buffer (HMB) support improves performance by obtaining DRAM resources as cache, thus overcoming the limited memory capacity within the storage and optimizing I/O performance.
- **Better 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

e.MMC

Key Features

- AEC-Q100 Grade 2 (-40°C~105°C) Compliant
- AEC-Q100 Grade 3 (-40°C~85°C) Compliant
- Extra-high endurance: 2-3X higher than standard e.MMC
- Complies with JEDEC e.MMC v5.1 Standard (JESD84-B51)
- 153-ball FBGA (RoHS compliant, "green package")
- LDPC ECC engine*
- Designed with 3D NAND

* Low-density parity-check error correcting code. By product support.

	e.MMC							
	Extended Industrial Grade		**Automotive Grade 2**		**Automotive Grade 3**		**Industrial Grade**	
Product Line	Premium	Superior	Premium	Superior	Premium	Superior	Premium	
	E700Pa	E600Sa	E700Paa	E600Saa	E700Pia	E600Sia	E750Pi	E700Pi
Flash Type	3D Pseudo SLC	3D MLC	3D Pseudo SLC	3D MLC	3D Pseudo SLC	3D MLC	3D Pseudo SLC	
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 105°C		-40°C to 85°C		-40°C to 85°C	
Capacity*	8 GB to 64 GB	16 GB to 128 GB	8 GB to 64 GB	16 GB to 128 GB	8 GB to 64 GB	16 GB to 128 GB	10 GB to 21 GB	8 GB to 64 GB
Performance								
Sequential Read/Write up to (MB/s)**	300 / 240	300 / 170	300 / 240	300 / 170	300 / 240	300 / 170	295/ 215	300 / 240
Bus Speed Modes	x1 / x4 / x8							
ICC (Typical RMS in Read/Write) mA	135 / 155	135 / 180	135 / 155	135 / 180	135 / 155	135 / 180	95.5 / 92	135 / 155
ICCQ (Typical RMS in Read/Write) mA	110 / 95	110 / 100	110 / 95	110 / 100	110 / 95	110 / 100	104 / 87.5	110 / 95
Endurance and Reliability								
Endurance TBW[2] (Max.)	1,213 TB	309 TB	1,213 TB	309 TB	1,320 TB	824 TB	1,034 TB	1,320 TB
Reliability MTBF @ 25°C	>2,000,000 hours							
Others								
Dimensions: L x W x H (mm)	11.5 x 13.0 x 1.3							
Certifications	AEC-Q100, RoHS, REACH					RoHS, REACH		
Warranty	One Year							

	e.MMC							
	Industrial Grade				**Commercial Grade**			
Product Line	Premium	Superior			Premium		Superior	Value
	E700Pi	E650Si	E600Si	E600Si	E750Pc	E700Pc	E650Sc	E600Vc
Flash Type	3D Pseudo SLC	3D TLC	3D MLC	3D TLC	3D Pseudo SLC		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		-40°C to 85°C		-25°C to 85°C			
Capacity*	10 GB to 21 GB	32 GB to 64 GB	16 GB to 128 GB	32 GB to 64 GB	10 GB to 21 GB		32 GB to 64 GB	
Performance								
Sequential Read/Write up to (MB/s)**	290 / 220	290 / 205	300 / 170	290 / 220	295 / 215	290 / 220	290 / 205	290 / 220
Bus Speed Modes	x1 / x4 / x8							
ICC (Typical RMS in Read/Write) mA	80 / 99	69.5 / 68.5	135 / 180	100 / 73	95.5 / 92	80 / 99	69.5 / 68.5	100 / 73
ICCQ (Typical RMS in Read/Write) mA	109 / 94	88 / 85.5	110 / 100	108 / 90	104 / 87.5	109 / 94	88 / 85.5	108 / 90
Endurance and Reliability								
Endurance TBW** (Max.)	682 TB	70 TB	824 TB	20 TB	1,034 TB	682 TB	70 TB	20 TB
Reliability MTBF @ 25°C	>2,000,000 hours							
Others								
Dimensions: L x W x H (mm)	11.5 x 13.0 x 1.0							
Certifications	RoHS, REACH							
Warranty	One Year							

Technologies & Add-On Services***													
Premium	○	○	○	○	○	○	○	○	○	○	○	○	▲
Superior	○	○	○	○	○	○	○	○	○	○	○	○	▲
Value	○	○	○	○	○	○	○	○	▲	○	○	○	▲

* Low-density parity-check error correcting code. By product support.
** All performance is collected or measured using ATP proprietary test environment, without file system overhead.
*** Please refer to pages 45-47. ▲: Customization option available on a project basis.

NVMe HSBGA

Key Features

- PCIe Gen3 x4, NVMe 1.3, M.2 Type 1620
- 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 HMB (Host Memory Buffer)*
- Optional Security features available **

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

**Optional, by project support.

HSBGA M.2, Type 1620		
Product Line	Premium	
	N700Pi	N700Pc
Interface	PCIe G3 x4, NVMe 1.3	
Flash Type	Pseudo SLC	
Form Factor	291-Ball, HSBGA	
Operating Temperature (Tcase)[1]	-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 / 80 GB / 160 GB	
Performance		
Sequential Read (MB/s) up to	2,000	
Sequential Write (MB/s) up to	1,600	
Random Reads IOPS (4K, QD32) up to	95,000	
Random Writes IOPS (4K, QD32) up to	75,000	
Endurance and Reliability		
Endurance (TBW)[2] up to	4,280 TB	
Reliability MTBF @ 25°C	>2,000,000 hours	
Others		
Dimensions: L x W x H (mm)	16.0 x 20.0 x 1.6	
Certifications	RoHS, REACH	
Warranty	One Year	

Technologies & Add-On Services[3]										
Premium	○	○	○	○	○	○	▲	▲	○	○

1 Case Temperature, the composite temperature as indicated by SMART temperature attributes.
2 Under highest Sequential write value. May vary by density, configuration and applications.
3 Please refer to pages 45-47.   ▲ Customization option available on a project basis.

Flash Products Naming Rule

N 650 S i a

Interface (uppercase)	Endurance (number)	Segment (uppercase)	Temperature (lowercase)	Edition (lowercase)
N: PCIe (NVMe)	800: Excellent	P: Premium Line	c: Commercial Temp	a: Automotive
A: SATA	750: Exceptional	S: Superior Line	i: Industrial Temp	
B: USB	700: Extended	V: Value Line	a: Automotive Temp	
I : PATA/IDE (CF)	650: Enhanced			
S: SD/microSD	600: Standard			
E: e.MMC/eMCP				
U: UFS				
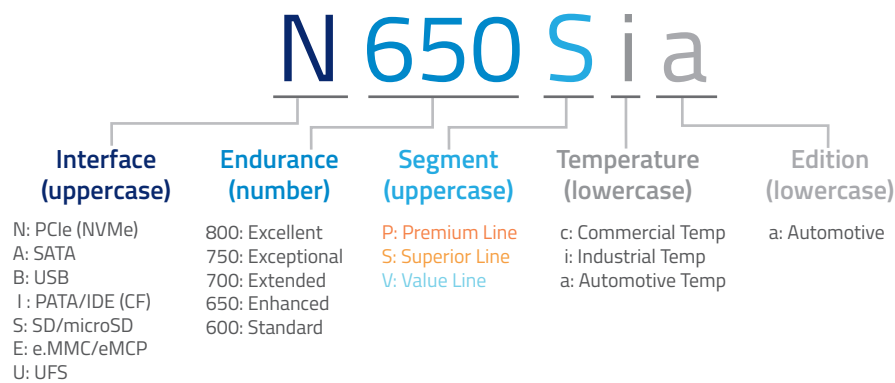
Premium Line

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. With industrial temperature ratings of -40°C to 85°C, these rugged solutions can withstand harsh operating environments and extreme temperatures. 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. ATP Superior Line products are available in both industrial temperature (-40°C to 85°C) and commercial temperature ratings (embedded SSD: 0°C to 70°C; SD/microSD card: -25°C to 85°C), so users can choose the temperature range most appropriate for their needs.

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.

Automotive Edition

The ATP Automotive Edition 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 to customer request.

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.

• Life Monitor/S.M.A.R.T.*

Provides a user-friendly interface for monitoring the health status and 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.

• Advanced Wear Leveling

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

• End-to-End Data 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.

• Hardware-based 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.

• Sudden Power-Off Recovery (SPOR)

The Sudden Power-Off Recovery (SPOR) 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.

• 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.

* Compatibility and support may vary by platform or operating system.
- Flash solutions
- DRAM solutions
- Flash/DRAM solution
- Value-added solutions

Secure Erase

A sanitization solution made especially for SSDs and memory cards making sure that sensitive data is not recovered or retrieved if the SSD or memory card needs to be disposed or repurposed. By making sure that no remnant of sensitive data remains, Secure Erase is the ideal solution for government and business applications with intense security requirements.

TCG Opal 2.0

TCG Opal Security 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.

Dynamic Thermal Throttling

This mechanism provides a delicate balance between performance and temperature instead of dramatic performance reduction. Temperature sensors continuously detect the device temperature. After sophisticated FW transactions, the performance gradually declines, and the temperature is adjusted.

Industrial Temperature

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

Wide Temp DRAM Modules

These modules use unique ATP testing and technologies to enable support for industrial temperature operating ranges from -40°C to 85°C but at lower price points than modules with native industrial grade ICs.

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.

Anti-Sulfur Resistors

ATP DRAM modules and 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.

■ **Chamfering PCB Design**

Chamfering refers to the process of "beveling or tapering" the connector edges for easier insertion into the memory slots. The bevel is done at specific angles, typically at around 40° to 50°.

■ **Thicker Gold Finger**

30μ"-thick gold plating of the DRAM contact optimizes signal transmission quality between the connector and DRAM modules.

● **Complete Drive Test** [+]

For NAND flash storage products, the entire drive, including firmware, user and spare areas, is thoroughly tested to ensure that there are no bad blocks. DRAM products also undergo complete testing, covering PHY and controller, including meta/mapping and data caching areas.

● **Joint Validation** [+]

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.

■ **Test During Burn-In (TDBI)** [+]

TDBI involves subjecting ATP DRAM modules to various temperatures, power cycling, voltages and other stress conditions within a certain period. It aims to cause weak ICs to fail so they can be screened out, thus making sure that the modules contain only the most robust ICs.

* Compatibility and support may vary by platform or operating system.
● Flash solutions
■ DRAM solutions
◆ Flash/DRAM solution
✦ Value-added solutions

Form Factor	Product Line	Life Monitor/ S.M.A.R.T.	Power Loss Protection	AutoRefresh	Advanced Wear Leveling	Dynamic Data Refresh	End-to-End Data Protection	Auto-Read Calibration	Secure Erase	TCG Opal 2.0	Dynamic Thermal Throttling	Industrial Temperature	SiP	Vibration-Proof BGA Package	Anti-Sulfur Resistors	Conformal Coating	Complete Drive Test	Joint Validation
SD/microSD	Premium	▲	○	○	○	▲	—	—	○	—	—	○	○	—	—	—	○	▲
SD/microSD	Superior	▲	○	○	○	○	—	▲	○	—	—	▲	○	—	—	—	○	▲
Cfast	Premium	○	○	○	○	○	—	—	○	—	—	○	—	—	▲	▲	—	—
Compact Flash	Premium	○	○	○	○	○	—	—	—	—	—	○	—	—	▲	▲	—	—
Compact Flash	Superior	○	—	○	○	○	—	—	—	—	—	—	—	—	▲	▲	—	—
M.2 NVMe	Premium	○	○	○	○	○	○	—	▲	○	—	○	—	—	▲	▲	—	—
M.2 NVMe	Superior	○	○	○	○	○	○	—	▲	○	—	▲	—	—	▲	▲	—	—
High Capacity M.2 NVMe	Superior	○	○	○	○	○	○	—	▲	▲	○	○	—	—	—	▲	—	▲
High Capacity U.2 NVMe	Superior	○	○	○	○	○	○	—	○	○	○	○	—	—	—	▲	—	▲
NVMe HSBGA	Premium	○	○	○	—	○	○	○	—	▲	—	▲	○	○	—	—	—	—
M.2 SATA	Premium	○	○	○	○	○	○	—	▲	○	—	○	—	—	▲	▲	—	—
M.2 SATA	Superior	○	○	○	○	○	○	—	▲	○	—	▲	—	—	▲	▲	—	—
M.2 SATA	Value	○	—	○	○	○	—	—	—	—	—	—	—	—	—	—	—	—
2.5"	Premium	○	○	○	○	○	—	—	▲	○	—	○	—	—	▲	▲	—	—
2.5"	Superior	○	○	○	○	○	—	—	▲	○	—	▲	—	—	▲	▲	—	—
2.5"	Value	○	—	○	○	○	—	—	—	—	—	—	—	—	—	—	—	—
mSATA	Premium	○	○	○	○	○	—	—	▲	○	—	○	—	—	▲	▲	—	—
mSATA	Superior	○	○	○	○	○	—	—	▲	○	—	▲	—	—	▲	▲	—	—
mSATA	Value	○	—	○	○	○	—	—	—	—	—	—	—	—	—	—	—	—
eUSB	Premium	○	○	—	○	—	—	—	—	—	—	○	—	—	▲	▲	—	—
eUSB	Superior	○	○	—	○	—	—	—	—	—	—	—	—	—	▲	▲	—	—
Nanodura	Premium	○	—	—	○	—	—	—	—	—	—	○	○	—	—	—	—	—
Nanodura	Superior	○	—	—	○	—	—	—	—	—	—	—	○	—	—	—	—	—
e.MMC	Premium	○	○	○	○	○	○	○	○	—	—	○	○	○	—	—	○	▲
e.MMC	Superior	○	○	○	○	○	○	○	○	—	—	○	○	○	—	—	○	▲
e.MMC	Value	○	○	○	○	○	○	○	○	—	—	▲	○	○	—	—	○	▲

Please refer to pages 45-47.   ▲: Customization option available on a project basis.

Complete Flash Portfolio

Form Factor	Product Line Naming	Interface	Capacity	NAND	Endurance TBW (max) *	Sequential Performance MB/s (up to)		Operating Temperature (°C)
						Read	Write	
SD/ SDHC/ SDXC	S800Pi	512 MB to 2 GB, HS mode 4 GB to 8 GB, UHS-I	512 MB to 8 GB	SLC	192 TB	70	39	-40 to 85
	S700Pi / S700Sc	UHS-I	8 GB to 64 GB	3D Pseudo SLC	512 TB	95	62	-40 to 85 / -25 to 85
	S650Si	UHS-I	32 GB to 128 GB	3D TLC	256 TB	96	62	-40 to 85
	S650Sc	UHS-I	32 GB to 128 GB	3D TLC	256 TB	96	62	-25 to 85
	S600Si	UHS-I	32 GB to 256 GB	3D TLC	307 TB	96	65	-40 to 85
	S600Sc	UHS-I	4 GB to 64 GB	MLC	77 TB	87	58	-25 to 85
	S600Sia	UHS-I	32 GB to 256 GB	3D TLC	307 TB	96	65	-40 to 85
	S600Sc	UHS-I	32 GB to 256 GB	3D TLC	307 TB	96	65	-25 to 85
microSD/ microSDHC/ microSDXC	S800Pi	512 MB to 2 GB, HS mode 4 GB to 8 GB, UHS-I	512 MB to 8 GB	SLC	192 TB	80	39	-40 to 85
	S700Pi / S700Sc	UHS-I	8 GB to 64 GB	3D Pseudo SLC	512 TB	95	74	-40 to 85 / -25 to 85
	S650Si	UHS-I	32 GB to 256 GB	3D TLC	512 TB	96	65	-40 to 85
	S650Sc	UHS-I	32 GB to 256 GB	3D TLC	512 TB	96	65	-25 to 85
	S600Si	UHS-I	32 GB to 256 GB	3D TLC	307 TB	96	70	-40 to 85
	S600Sc	UHS-I	4 GB to 8 GB	MLC	10 TB	68	24	-25 to 85
	S600Sia	UHS-I	32 GB to 256 GB	3D TLC	307 TB	96	70	-40 to 85
	S600Sc	UHS-I	32 GB to 256 GB	3D TLC	307 TB	96	70	-25 to 85

Form Factor	Product Line Naming	Interface	Capacity	NAND	Endurance TBW (max) *	Sequential Performance MB/s (up to)		Operating Temperature (°C)
						Read	Write	
CFast	A800Pi	SATA 6Gb/s	8 GB to 32 GB	SLC	2,667 TB	500	300	-40 to 85
CompactFlash	I800Pi	UDMA 0~4	512 MB to 32 GB	SLC	1,280 TB	61	55	-40 to 85
	I700Sc	UDMA 0~6	8 GB to 16 GB	Pseudo SLC	128 TB	110	80	0 to 70
	I600Sc	UDMA 0~6	16 GB to 32 GB	MLC	38 TB	108	46	0 to 70

* Under highest Sequential write value. May vary by density, configuration and applications.
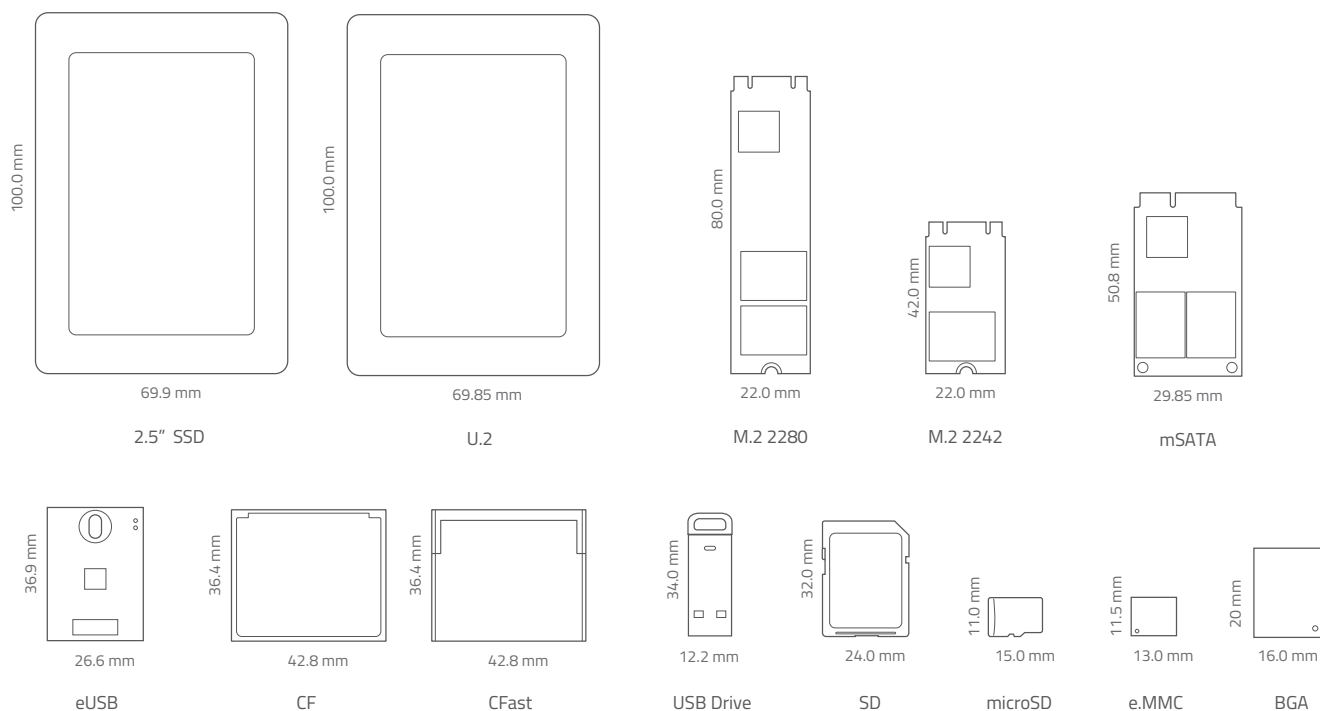
Form Factor	Product Line Naming	Interface	Capacity	NAND	Endurance TBW (max) *	Sequential Performance MB/s (up to)		Operating Temperature (°C)
						Read	Write	
M.2 2280	N750Pi	PCIe G3 x4	40 GB to 320 GB	3D TLC (pSLC mode)	16,000 TB	3,150	2,670	–40 to 85
	N700Pi	PCIe G3 x4	40 GB to 640 GB	3D TLC (pSLC mode)	21,300 TB	3,150	2,820	–40 to 85
	N650Si / N650Sc	PCIe G3 x4	120 GB to 960 GB	3D TLC	4,640 TB	3,420	3,050	–40 to 85 / 0 to 70
	N600Si / N600Sc	PCIe G3 x4	120 GB to 1,920 GB	3D TLC	5,585 TB	3,420	3,050	–40 to 85 / 0 to 70
	N600Si	PCIe G3 x4	3.84 TB	TLC	10,600 TB	2,200	1,250	–40 to 85
	N600Sc	PCIe G3 x4	3.84 TB	TLC	10,600 TB	2,700	1,500	0 to 70
	A750Pi	SATA 6Gb/s	80 GB to 320 GB	3D TLC (pSLC mode)	19,200 TB	560	520	–40 to 85
	A700Pi	SATA 6Gb/s	80 GB to 320 GB	3D TLC (pSLC mode)	12,800 TB	560	520	–40 to 85
	A650Si / A650Sc	SATA 6Gb/s	120 GB to 960 GB	3D TLC	4,655 TB	560	480	–40 to 85 / 0 to 70
	A600Si / A600Sc	SATA 6Gb/s	120 GB to 960 GB	3D TLC	2,792 TB	560	510	–40 to 85 / 0 to 70
	A600Vc	SATA 6Gb/s	32 GB to 512 GB	3D TLC	590.8 TB	560	440	0 to 70
M.2 2242	A800Pi	SATA 6Gb/s	8 GB to 64 GB	SLC	5,333 TB	530	400	–40 to 85
	A750Pi	SATA 6Gb/s	40 GB to 160 GB	3D TLC (pSLC mode)	9,600 TB	560	520	–40 to 85
	A700Pi	SATA 6Gb/s	40 GB to 160 GB	3D TLC (pSLC mode)	6,400 TB	560	520	–40 to 85
	A650Si / A650Sc	SATA 6Gb/s	120 GB to 480 GB	3D TLC	2,327 TB	560	480	–40 to 85 / 0 to 70
	A600Si / A600Sc	SATA 6Gb/s	120 GB to 480 GB	3D TLC	1,396 TB	560	510	–40 to 85 / 0 to 70
	A600Vc	SATA 6Gb/s	32 GB to 128 GB	3D TLC	147.7 TB	560	420	0 to 70
U.2	N600Si	PCIe G3 x4	960 GB to 7.68 TB	TLC	21,000 TB	3,100	1,400	–40 to 85
2.5"	A800Pi	SATA 6Gb/s	8 GB to 256 GB	SLC	21,333 TB	520	420	–40 to 85
	A750Pi	SATA 6Gb/s	80 GB to 640 GB	3D TLC (pSLC mode)	38,400 TB	560	520	–40 to 85
	A700Pi	SATA 6Gb/s	80 GB to 640 GB	3D TLC (pSLC mode)	25,600 TB	560	520	–40 to 85
	A650Si / A650Sc	SATA 6Gb/s	120 GB to 1,920 GB	3D TLC	9,310 TB	560	520	–40 to 85 / 0 to 70
	A600Si / A600Sc	SATA 6Gb/s	120 GB to 1,920 GB	3D TLC	5,585 TB	560	520	–40 to 85 / 0 to 70
	A600Vc	SATA 6Gb/s	32 GB to 512 GB	3D TLC	590.8 TB	560	440	0 to 70
mSATA	A800Pi	SATA 6Gb/s	8 GB to 128 GB	SLC	10,667 TB	530	430	–40 to 85
	A750Pi	SATA 6Gb/s	40 GB to 160 GB	3D TLC (pSLC mode)	9,600 TB	560	520	–40 to 85
	A700Pi	SATA 6Gb/s	40 GB to 160 GB	3D TLC (pSLC mode)	6,400 TB	560	520	–40 to 85
	A650Si / A650Sc	SATA 6Gb/s	120 GB to 480 GB	3D TLC	2,327 TB	560	480	–40 to 85 / 0 to 70
	A600Si / A600Sc	SATA 6Gb/s	120 GB to 480 GB	3D TLC	1,396 TB	560	510	–40 to 85 / 0 to 70
	A600Vc	SATA 6Gb/s	32 GB to 512 GB	3D TLC	590.8 TB	560	440	0 to 70
eUSB	B800Pi	USB 2.0	1 GB to 32 GB	SLC	1,280 TB	30	25	–40 to 85
	B600Sc	USB 2.0	8 GB to 32 GB	MLC	38.4 TB	25	19	0 to 70
USB (NANODURA)	B800Pi	USB 2.0	512 MB to 8 GB	SLC	192 TB	31	21	–40 to 85
	B600Sc	USB 2.0	4 GB to 8 GB	MLC	9.6 TB	26	10	0 to 70

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

Form Factor	Product Line Naming	Interface	Capacity	NAND	Endurance TBW (max) *	Sequential Performance MB/s (up to)		Operating Temperature (°C)
						Read	Write	
e.MMC	E700Pa	v5.1, HS400	8 GB to 64 GB	3D Pseudo SLC	1,213 TB	300	240	-40 to 105
	E600Sa	v5.1, HS400	16 GB to 128 GB	3D MLC	309 TB	300	170	-40 to 105
	E700Paa	v5.1, HS400	8 GB to 64 GB	3D Pseudo SLC	1,213 TB	300	240	-40 to 105 (AEC-Q100 Grade 2)
	E600Saa	v5.1, HS400	16 GB to 128 GB	3D MLC	309 TB	300	170	-40 to 105 (AEC-Q100 Grade 2)
	E700Pia	v5.1, HS400	8 GB to 64 GB	3D Pseudo SLC	1,320 TB	300	240	-40 to 85 (AEC-Q100 Grade 3)
	E600Sia	v5.1, HS400	16 GB to 128 GB	3D MLC	824 TB	300	170	-40 to 85 (AEC-Q100 Grade 3)
	E750Pi	v5.1, HS400	10 GB to 21 GB	3D Pseudo SLC	1,034 TB	295	215	-40 to 85
	E700Pi	v5.1, HS400	8 GB to 64 GB	3D Pseudo SLC	1,320 TB	300	240	-40 to 85
	E700Pi	v5.1, HS400	10 GB to 21 GB	3D Pseudo SLC	682 TB	290	220	-40 to 85
	E650Si	v5.1, HS400	32 GB to 64 GB	3D TLC	70 TB	290	205	-40 to 85
	E600Si	v5.1, HS400	16 GB to 128 GB	3D MLC	824 TB	300	170	-40 to 85
	E600Si	v5.1, HS400	32 GB to 64 GB	3D TLC	20 TB	290	220	-40 to 85
	E750Pc	v5.1, HS400	10 GB to 21 GB	3D Pseudo SLC	1,034 TB	295	215	-25 to 85
	E700Pc	v5.1, HS400	10 GB to 21 GB	3D Pseudo SLC	682 TB	290	220	-25 to 85
	E650Sc	v5.1, HS400	32 GB to 64 GB	3D TLC	70 TB	290	205	-25 to 85
	E600Vc	v5.1, HS400	32 GB to 64 GB	3D TLC	20 TB	290	220	-25 to 85
HSBGA M.2, Type 1620	N700Pi / N700Pc	PCIe G3 x4	40 GB / 80 GB / 160 GB	Pseudo SLC	4,280 TB	2,000	1,600	-40 to 85 / 0 to 70

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

Product Dimensions (Size) Comparison

100.0 mm / 69.9 mm	2.5" SSD
100.0 mm / 69.85 mm	U.2
80.0 mm / 22.0 mm	M.2 2280
42.0 mm / 22.0 mm	M.2 2242
50.8 mm / 29.85 mm	mSATA
36.9 mm / 26.6 mm	eUSB
36.4 mm / 42.8 mm	CF
36.4 mm / 42.8 mm	CFast
34.0 mm / 12.2 mm	USB Drive
32.0 mm / 24.0 mm	SD
11.0 mm / 15.0 mm	microSD
11.5 mm / 13.0 mm	e.MMC
20 mm / 16.0 mm	BGA

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Data Center and Cloud Computing, and WAN-Edge Infrastructure consider ATP as a strategic supplier.

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