The Global Leader in Specialized Storage and Memory Solutions

WE BUILD WITH YOU

2024 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

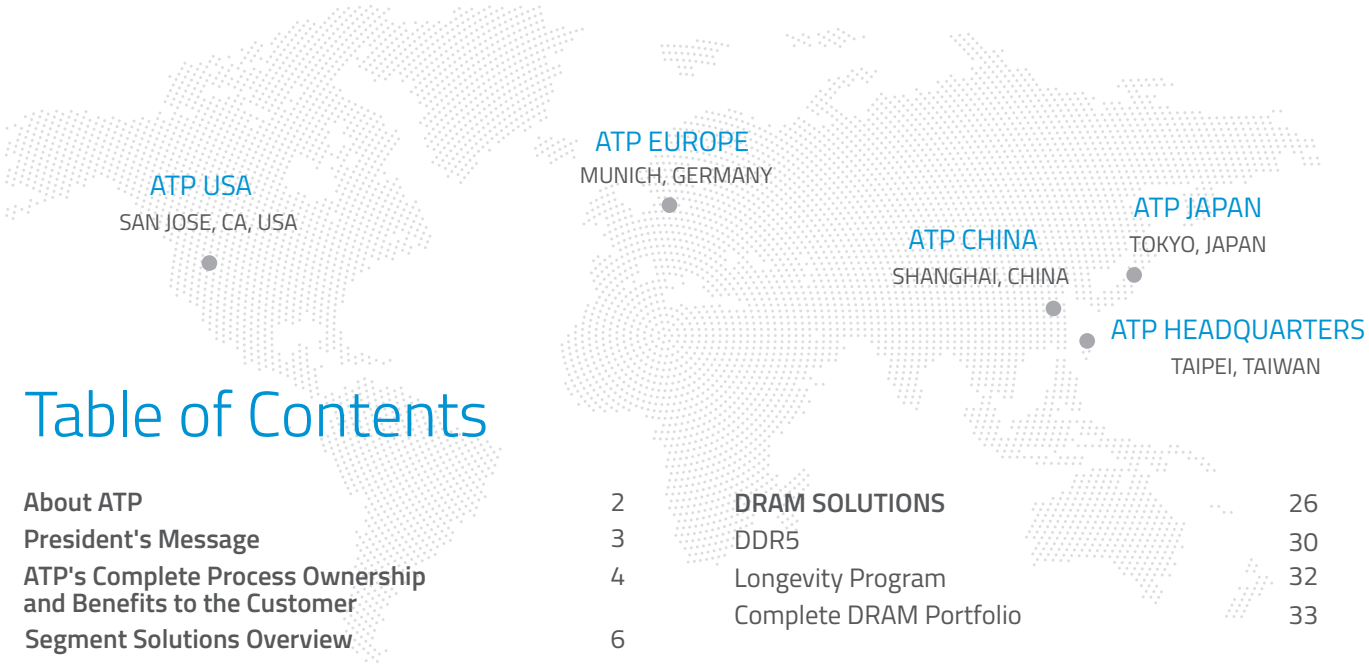
ATP-developed firmware and mass production infrastructure are fully capable of addressing any variety of embedded/ industrial usage cases. We can provide specialized configurations to support unique memory and storage requirements, all with the aim of delivering best total cost of ownership (TCO) for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



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President's Message

2023 was a challenging year, not only for ATP Electronics, but for the global memory and storage business. With over 30 years of experience, we have once again risen above the challenges, strongly convinced that the long-term value we provide our customers and suppliers surpasses the cyclical turns in the market. Closely working with you has led to stronger partnerships that have enabled us to navigate challenging times.

Despite this latest downturn, we have doubled down by undertaking two of the largest and most significant investments in our company's history.

First, we have completely overhauled our enterprise resource planning (ERP) system and business processes to be more efficient, ultimately becoming more agile in our service and flexibility.

Second, we are one year into developing our new validation, production, and test facility with our schedule on time to enter production by early 2025. The deployed digital transformation, automation, and sustainability technologies will allow for green and lean production in both our legacy "high mix" and "high volume" manufacturing areas. This will ultimately result in ongoing cost and logistics improvements for our customers.

By aggressively investing in the downturn, ATP is positioning our "We Build With You" readiness to a new level. This year, you can expect many exciting announcements and invitations to learn more about these initiatives.

The past year may have been challenging, but we are moving forward with unwavering confidence. We appreciate your constant support and partnership and invite you to keep building with us through 2024 and beyond.

Jeff Hsieh
President

ATP's Complete Process Ownership

Why are We Unique?

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

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

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

Our Commitment: We Build With You.

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

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

Industry-Standard Product Development

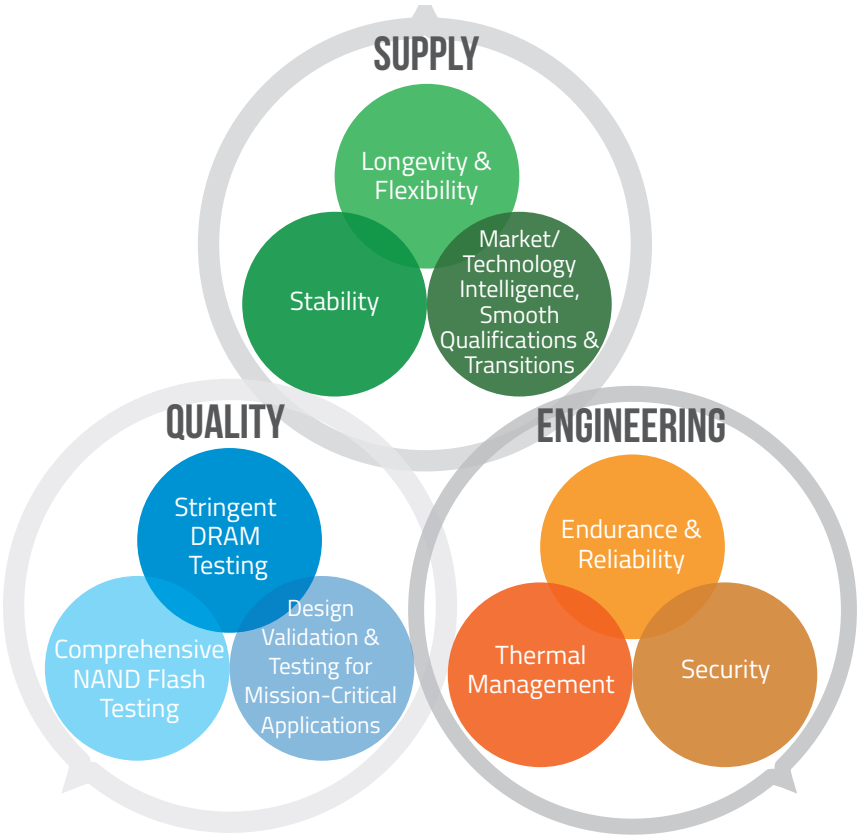
Our quality journey begins here,
at the very basic component level, the ICs.

How Does ATP's Process Ownership Help You?

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

Stability
Dual-sourcing strategy

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



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

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

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

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

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

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

Segment Solutions Overview

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

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

Our Corporate Responsibility Commitment


Responsible Business Alliance

Recognition that

ATP ELECTRONICS TAIWAN INC. KAOHSIUNG BRANCH

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

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

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

Robert F. Lederer
CEO, RBA

Certifications

According to leading industry standards


ISO 9001:2015


ISO 14001:2015


ISO 45001:2018


ISO14064-1:2018


ISO/IEC 17025:2017


VDA 6.3


IATF16949:2016


Sony
Green Partner

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

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

Industry Associations and Compliances

Two Worlds are Merging!

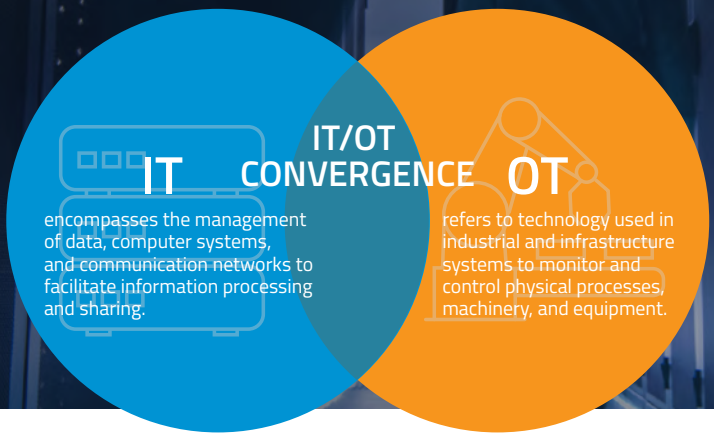
IT and OT Convergence Requires a New Breed of Data Storage Solutions for the Industrial Enterprise

The world of information technology (IT) deals with data handling, communication, and processing using traditional server/storage, software, inventory management, enterprise systems software, and more. The world of operational technology (OT) is typically associated with supervisory monitoring and control in enterprise and industrial environments.

These two worlds are converging. The convergence is being brought about by the rapid acceleration in the deployment of the Internet of Things (IoT), Industrial IoT (IIoT), artificial intelligence, and other emerging technologies that are requiring the broad integration of compute/storage/networking at the edge with big data analytics.

Historically, IT usage called for enterprise/client solid state drives (SSDs) while OT applications typically required industrial SSDs.

The convergence of IT and OT is leading to the generation of data at unprecedented volumes, requiring suitable storage solutions that enable the processing and transformation of data into actionable insight. This has given rise to Edge computing, where storage and compute resources are closer to the source, in contrast to centralized repositories like data centers.



The Rise of Data at the Edge and the Emergence of SSDs as Vital Components

As data generation continues to accelerate, compute resources are moving to the edge, closer to the source of data instead of in controlled environments such as data centers. Amidst this evolution, SSDs are becoming the de facto storage media of choice as organizations maximize computing power on edge servers due to SSDs' advantages, such as:

- A range of suitable capacity points
- High performance
- Low latency
- High endurance
- Environmental ruggedness
- Intelligent thermal management
- Ideal form factors commonly designed for "boot drive," "storage drive," and hybrid usage under mainstream x86 systems
- They are capable of handling enterprise operational workloads as well as endurance and reliability requirements while working in harsher environmental conditions for extended periods without supervision.

Neither Traditional Industrial nor Enterprise SSDs Perfectly Fit the Needs of Edge Computing

Edge computing offers reduced latency, better cost-effectiveness, real-time analytics, and the convenience of offline accessibility where network availability may be limited. However, IT and OT convergence requires a multitude of different systems, applications, and use cases; hence, a comprehensive storage solution is needed to hurdle these challenges.

ATP Enterprise-Readiness Standards:
Ensuring SSD Reliability in Edge Computing Systems

ATP Electronics makes sure that its flash storage solutions function reliably and have a long product lifetime with high-quality service. The following summarizes the scope of ATP's Enterprise Readiness Standards (ERS), including stringent testing and enhanced firmware features.

Product images and labels are for reference only and may differ from the actual products.

Media/NAND Level Testing

Aims to characterize NAND behavior and reliability with NAND error-handling mechanisms.

Enhanced Performance Testing

Tests the SSD's performance with various workloads, a mix of read and write operations, and sequential/ random addressing.

Enhanced Power Consumption Testing

Includes characterizing the power consumption of SSDs under different workloads, which is not limited to only the maximum and average measurements under a single worst-case scenario.

Thermal Characterization & Testing

Includes testing the SSD's thermal throttling behavior at various ambient operating temperatures and with various airflow settings.

Power Cycle Testing

Validates the design of the power loss protection (PLP) mechanism under sudden power-off conditions.

Operating Temperature Cycling Test

Operating temperature and input voltage can impact SSD functionality. Four-corner testing validates the power cycling reliability and operational functionality of the SSD using a combination of different variants in four quadrants: High/low operating temperature and high/low input voltage.

Enhanced FW Features

Describes firmware features validated by ATP's stringent testing for storage solutions for Embedded Computing Systems.

The following enhanced firmware features ensure the stability, reliability, and functionality of storage products built for the industrial enterprise.

- Download Microcode Capability
- Enhanced Read Disturb Resilience
- Flush Cache Command Bypass
- Multiple Thermal Throttling Stages
- Optimized Flush Cache Timing for Sudden Power Loss Data Protection
- PLP Capacitor Health Check
- SMART ID Customization
- Steady Write Latency Tuning

Industrial Enterprise Product Line (Coming Soon)

A New Era of SSDs is Born from ATP's Enterprise Readiness Standards

As a testament to ATP storage products meeting these requirements, over 70% of companies listed on Gartner's Magic Quadrant report for Primary Storage, Data Center and Cloud Computing, and WAN-Edge Infrastructure consider ATP as a strategic supplier and have integrated ATP SSDs into their infrastructure.

Product Line	N651Sie / N651Sce		
Interface	Gen4 x4		
Form Factor	M.2	U.2	E1.S
Dimensions (mm)	80 x 22 x 3.85	100 x 69.85 x 15	118.75 x 33.75 x 9.5
Flash Type	TLC		
Capacity	120 GB to 960 GB	480 GB to 3.84 TB	
Sequential Read (up to) [1,6,7]	6,450 MB/s	6,000 MB/s	6,100 MB/s
Sequential Write (up to) [1,6,7]	6,050 MB/s	5,500 MB/s	6,000 MB/s
Random Read (up to) [2,6,7]	1,100 KIOPS	820 KIOPS	870 KIOPS
Random Write (up to) [2,6,7]	1,250 KIOPS	1,200 KIOPS	
Sustained Sequential Write (up to) [3,6,7]	3,000 MB/s	3,200 MB/s	
Sustained Random Write (up to) [4,6,7]	250 KIOPS (1,000 MB/s)	320 KIOPS (1,280 MB/s)	
Endurance [DWPD] [8]	>2.5		
QoS 99.9999% [5,6,7]	Read <90µs | Write <10µs	Read <80µs | Write <10µs	Read <80µs | Write <10µs
Data Retention	5 years (10% P/E cycle) @ 30°C		
Power Loss Protection	Yes		
End to End Data Path Protection	Yes		
Sustained Read Power (Max) [7]	<9W	<14.5W	<13W
Sustained Write Power (Max) [7]	<11.5W	<17.5W	<15.5W
Supply Voltage	3.3V	12V	
Operating Temperature Tc	-40°C to 85°C (I-Temp) | 0°C to 70°C (C-Temp)		
Storage Temperature Tc	-40°C to 85°C		
Vibration	Sine 16.4G,10~2,000Hz		
Shock	Half sine 1,500G/0.5ms		
MTBF @ 25°C	2,000,000 hours		
UBER	1 sector per 10^17 bits read		
Warranty	5 years		

Notes:
1. Sequential Burst Performance tested with IOmeter 4MB, QD64
2. Random Burst Performance tested with IOmeter 4KB, QD64
3. Average Sustained Sequential Write Performance tested with IOmeter, 4MB, QD64 for 30 minutes
4. Average Sustained Random Write Performance tested with IOmeter, 4KB, QD64 for 30 minutes
5. 4KB Random QD=1
6. Actual performance may vary depending on user conditions and system environment
7. Parameters tested with highest capacity drive
8. DWPD for 5 years tested with JESD219A Enterprise workload

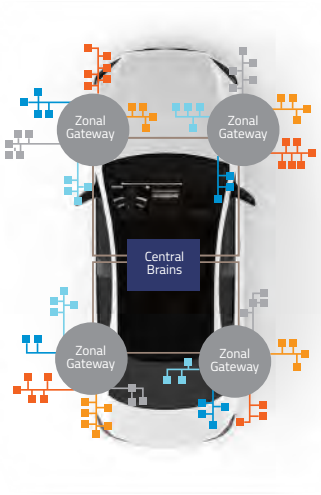
Automotive Megatrends and the Migration of E/E architecture

The automotive industry's innovation, known as C.A.S.E., is fueled by the growing demand for Connected, Autonomous, Secured/Shared, and Electric vehicles.

Domain/Centralized & Zonal E/E architecture:

By 2030, electric cars are projected to make up at least one-third of total vehicle sales (Deloitte). The architecture moves from distributed ECU to Domain and centralized/Zonal design to reduce cable lengths for cost-saving.

This shift is driving the replacement of small control units with a few powerful vehicle computing systems. This surge in technology is revolutionizing NAND storage devices.



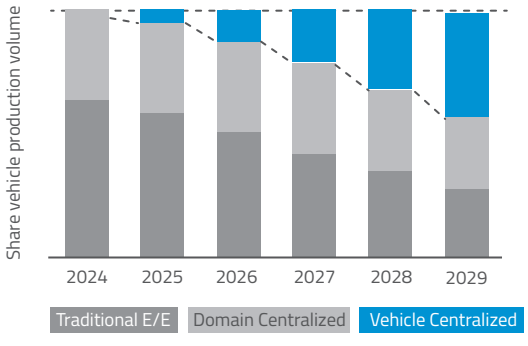
Smart Cockpit / Enriched Cabin = More Data

Integrating ADAS with the infotainment system enhances user experience, offering entertainment or productive meetings on up to 12 4K displays with Apple Carplay and Android Auto support. The domain gateway manages OTA (over-the-air) software updates, traffic monitoring, and maintenance data uploads.

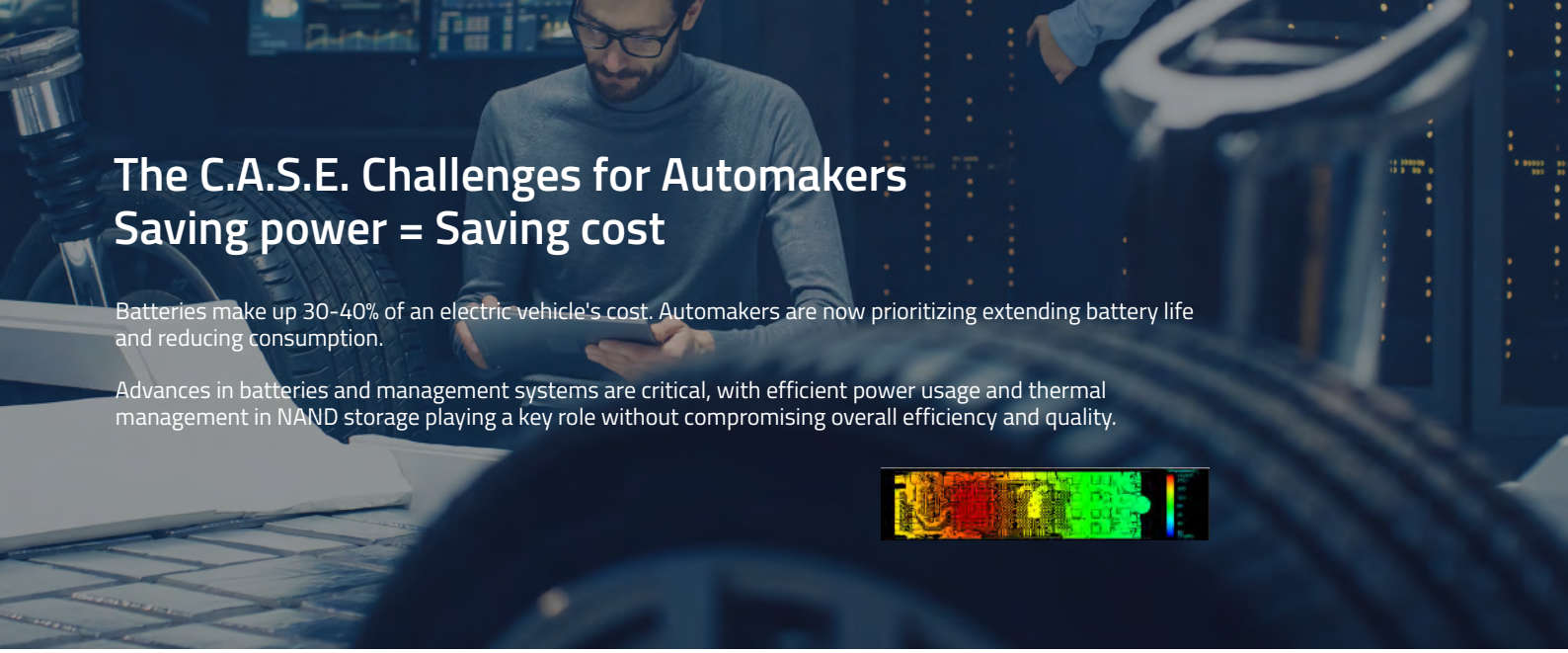
By 2025, Micron anticipates a fourfold increase in NAND (1TB) per car compared to 2021, enabling a high-density SSD supporting the domain gateway alongside eMMC, UFS, and UFD with diverse functions.

The C.A.S.E. Challenges for Automakers Stable supply and Longevity

- Legacy architectures are decreasing but not expected to be eliminated in the next five years.
- Traditional Internal Combustion Engine (ICE) cars usually last around 15 years.
- Semiconductor suppliers may stop producing legacy parts during the NAND process migration.
- **Sourcing suitable longevity successors meeting automotive qualifications may become challenging.**
- Diverse storage suppliers' sourcing strategies are crucial to address this uncertainty.



Source: Bosch-Mobility



The C.A.S.E. Challenges for Automakers
Saving power = Saving cost

Batteries make up 30-40% of an electric vehicle's cost. Automakers are now prioritizing extending battery life and reducing consumption.

Advances in batteries and management systems are critical, with efficient power usage and thermal management in NAND storage playing a key role without compromising overall efficiency and quality.

Why work with ATP ?

ATP Qualification and Services:

- 15+ years of automotive experience
- IATF 16949
- VDA 6.3
- AEC-Q100 and AEC-Q104 test[1]
- Thermal management solution[2]
- Content preload and Encryption by project support
- Joint development and validation

ATP Product lineup and Features for Automotive

- Extended Longevity with high-quality NAND Flash
- Industrial temp. grade 3 (-40°C/85°C) and grade 2 (-40°C/105°C)
- pSLC configuration offering
- Power Loss Protector (Hardware, Firmware)
- Read Disturb, Data Retention Protector
- Content preload and Encryption by project support
- Error handling and recovery mechanism

Legacy support:
SD/microSD

Across E/E architecture:
eMMC

SSD series:
E1.S, BGA SSD, U.2, M.2

1 Selected*
2 Customized FW & and features support by selected BOMs. To learn more about ATP's Thermal Management Solution , please refer to pages 15 to 17 for more details.

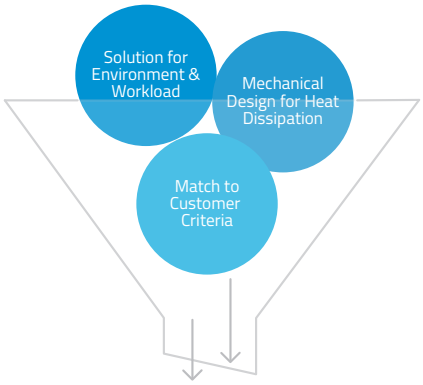
ATP Customizable Thermal Management Solutions: Steady Wins the Race

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

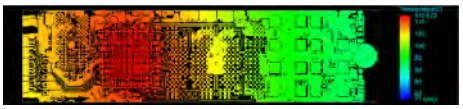
NVMe solid state drives (SSDs) deliver blazing-fast performance, running at four to six times the speed of Serial ATA (SATA), but their blistering speeds, exacerbated by extreme temperature variations and constricted embedded environments with little to no ventilation, can lead to heating issues that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

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

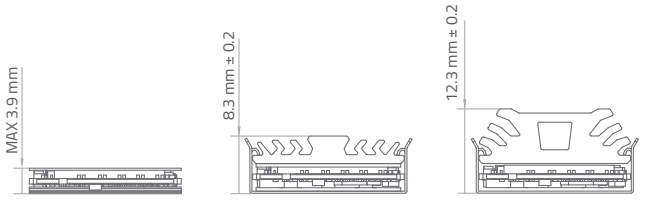
STEP 1: ASSESSMENT



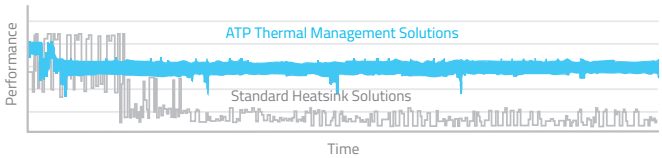
STEP 2: SIMULATION



STEP 3: CUSTOMIZATION



STEP 4: OPTIMIZATION

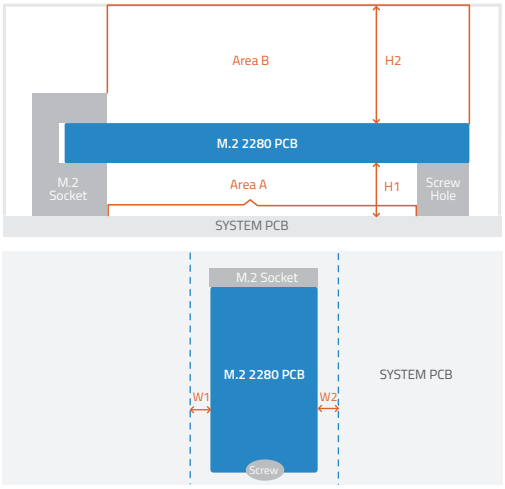


STEP 1: ASSESSMENT

How can NVMe SSDs beat the heat?

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

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



STEP 2: SIMULATION

Comprehensive Thermal Simulation coverage

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

Full Coverage of Thermal Simulation Test

Component Design Phase

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

Mechanical Design Phase

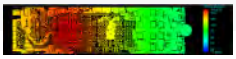
- **Mechanical Thermal Simulation**
- **Predict airflow, temperature, and heat transfer in IC** packages, PCBs, electronic assemblies/heatsinks/ enclosures, and power electronics.

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

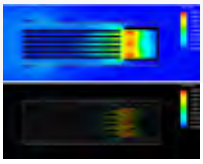
- Firmware to **optimize performance** based on the temperature reported from **Thermal sensors** and **microcontroller unit (MCU)**
- **Thermal-related FW Error handling and Recovery**
- Temp. information is available via **S.M.A.R.T.** tool

Drive (SSD) Environment Test

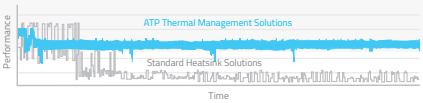
- **ATP-built mini chamber**
- Simulate real test environment
- Adjustable **ambient temperature, airflow, and SSD setting**
- Log files of **Performance, power consumption, and S.M.A.R.T.** info.



cadence



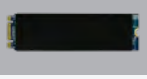
Ansys Icepak



STEP 3: CUSTOMIZATION

One Scenario Does Not Fit All

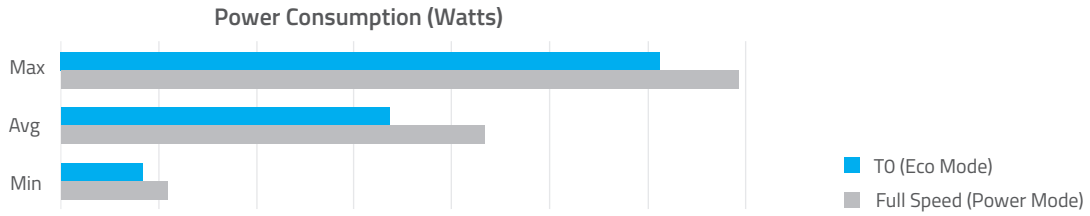
We adopt a collaborative approach with our customers, focusing on a 'we build with you' philosophy through joint development efforts. Our commitment to optimizing heat dissipation involves a continuous evaluation of our mechanical designs. This includes examining materials, appearance, airflow, and assembly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

Heat Dissipation Solutions					
					
Form Factor supported	M.2 2280			U.2	E1.S
Type	Copper Foil	4 mm Fin-Type Heatsink	8 mm Fin-Type Heatsink	15 mm Fin-Type Housing	9.5 mm Symmetric Enclosure
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	100.5 x 69.85 x 15	118.75 x 33.75 x 9.5
Material	Copper	Upper: Aluminum alloy Bottom: Stainless steel	Upper: Aluminum alloy Bottom: Stainless steel	Aluminum alloy	Aluminum alloy
Suitability	Limited space	Enough space for effective heat dissipation			
Fixedness	Stick	Clips design		Screwed	Screwed

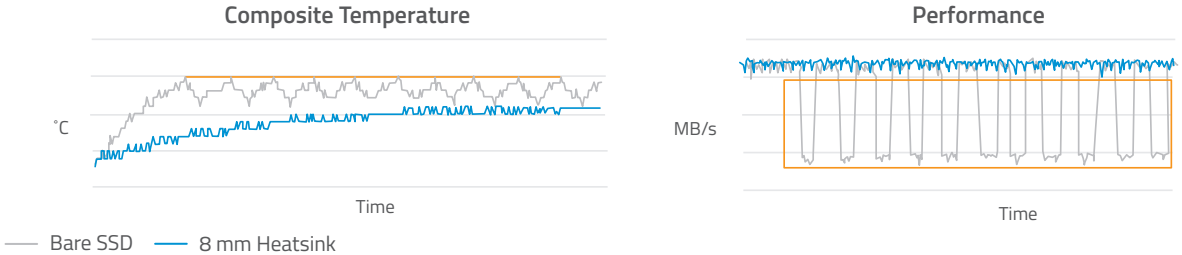
STEP 4: OPTIMIZATION

Steady Wins the Race

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



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



N651/N601 Series Industrial 176-Layer PCIe® Gen4 x4 M.2 2280, U.2 SSDs Offer High-Endurance 5K+ P/E Cycles, Robust Cross Temp Integrity, 7.68 TB Max. Capacity

The latest high-speed N651/N601 Series M.2 2280 and U.2 SSDs sport the PCIe® Gen4 x4 interface to deliver faster data transfer rates.

The N651/N601 Series SSDs offer a remarkable 5,000+ program/erase (P/E) cycles endurance and cross temperature integrity with low bit errors even when operating in varying read/write temperatures. This integrity is maintained even beyond their rated endurance, thanks to ATP's error handling technology.

Built on 176-layer 3D triple-level cell (TLC) NAND flash and using prime 512 Gbit die package, the N651/N601 Series SSDs offer performance as well as price improvements over the 64-layer technology.

The M.2 2280 SSDs are available in capacities from 240 GB up to 3.84 TB, while the U.2 SSDs are available from 960 GB to 7.68 TB (native TLC) and 320 GB to 2.56 TB (pSLC mode).

They are suitable for both read/write-intensive, mission-critical industrial applications such as networking/server, 5G, data logging, surveillance, and imaging, with performance on par, if not better, than mainstream PCIe Gen4 consumer SSDs in the market.

PCIe® Gen4 NVMe M.2 2280 SSD — FEATURE HIGHLIGHTS

- Capacities
  - 240 GB to 3.84 TB
- Operating Temp
  - I-Temp (-40°C to 85°C): N651Si
  - C-Temp (0°C to 70°C): N651Sc/N601Sc
- Thermal Management for Optimal Heat Dissipation
  - Nickel-coated copper heat spreader on controller
  - 4 mm or 8 mm fin-type heatsink design
- Security
  - AES 256-bit encryption
  - TCG Opal 2.0
- Data Integrity
  - End-to-End data path protection
- Performance
  - Sequential Read/Write up to 6,450/6,050 MB/s

Please refer to page 37 for product specifications.

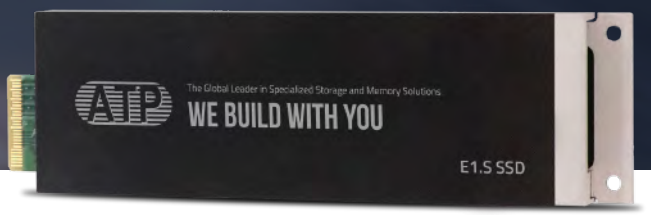
PCIe® Gen4 NVMe U.2 SSD — FEATURE HIGHLIGHTS

- Capacities
  - 960 GB to 7.68 TB (TLC mode)
  - 320 GB to 2.56 TB (pSLC mode)
- Operating Temp
  - I-Temp (-40°C to 85°C): N651Si
  - C-Temp (0°C to 70°C): N601Sc
- Thermal Management for Optimal Heat Dissipation
  - 15 mm fin-type heatsink design
- Security
  - AES 256-bit encryption
  - TCG Opal 2.0
- Data Integrity
  - End-to-End data path protection
- Performance
  - Sequential Read/Write up to 6,100/6,000 MB/s
- Hot-swappable

Please refer to page 39 for product specifications.

E1.S PCIe Gen4 x4 SSD (Coming Soon)

New Form Factor Offers Hot-Swap/Hot-Plug Support, Better Power and Thermal Efficiency, Higher Densities



Built with 176-layer NAND and boasting an impressive 5,000+ program/erase (P/E) cycle endurance, ATP's E1.S SSDs are designed for optimal performance leveraging cutting-edge PCIe® interface and NVMe protocol technologies.

Engineered for 1U Edge servers, ATP's E1.S SSDs are designed for vertical placement in small-footprint systems, allowing up to 6 to 12 drives in a 1U chassis. They support hot swapping/hot plugging for easy serviceability and replacement of drives while the system is on.

High cross-temperature reliability translates to low bit errors and better transmission accuracy for higher data integrity.

Housed in a 9.5 mm symmetric enclosure, ATP's E1.S SSDs are a result of thermal management solutions*. The enclosure features customized hardware and sustained performance firmware tuning, making it an ideal solution to meet the demanding requirements of hyperscale architecture.

PCIe® Gen4 NVMe E1.S SSD

FEATURE HIGHLIGHTS

- E1.S 9.5 mm symmetric enclosure
- PCIe Gen4 x4 interface
- From 960 GB to 8 TB storage capacity
- Industrial temperature operable
- Thermal Management Solution*
- Hardware PLP
- Hot-pluggable/Hot-swappable

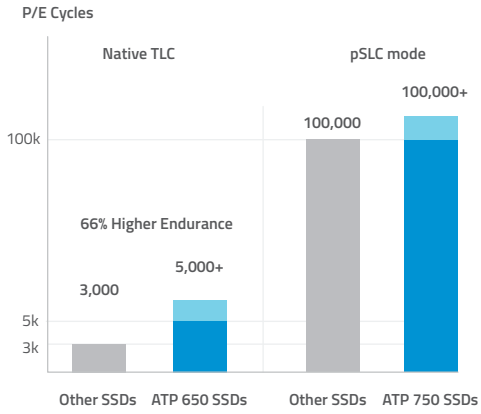
*To learn more about ATP's Thermal Management Solution , please refer to pages 15 to 17 for more details.

A750/A650, N750/N650 Series: New-Generation 3D TLC SSDs Deliver Near-SLC/MLC Endurance

Endurance suited for write-intensive workloads:
66% higher native TLC endurance; surpasses with 100K+ P/E cycles in pSLC

Manufactured using a new die package, the new-generation 3D TLC SATA and NVMe embedded SSDs are breaking endurance records. The SATA A750 and A650 Series are available in M.2 2280/2242, 2.5" and mSATA form factors, while the N750 and N650 Series support the NVMe 1.3 protocol with PCIe Gen3 x4 interface and are available as M.2 2280 modules.

The following graph shows that compared with other industrial native 3D TLC SSDs, the A/N650 Series has significantly increased endurance by 66%, while the A/N750 Series with 100,000+ P/E cycles outperforms its pSLC-configured counterparts.



A750/A650 Series

FEATURE HIGHLIGHTS

- SATA III 6 Gb/s interface
- Available in M.2 2280/2242, 2.5" and mSATA form factors
- A750 model with 100,000+ P/E cycles;
  A650 model with 5,000+ P/E cycles
- Operating Temp
  - I-Temp (-40°C to 85°C): A750Pi /A650Si
  - C-Temp (0°C to 70°C): A650Sc

Please refer to page 41, 42, 43 for product specifications

N750/N650 Series

FEATURE HIGHLIGHTS

- PCIe Gen3 x4 interface
- Available in M.2 2280 form factor
- N750 model with 100,000+ P/E cycles;
  N650 model with 5,000+ P/E cycles
- Operating Temp
  - I-Temp (-40°C to 85°C): N750Pi /N650Si
  - C-Temp (0°C to 70°C): N650Sc

Please refer to page 38 for product specifications

S650Si/S750Pi Series High-Endurance 512 GB Max. Capacity SD/microSD Cards for Reliable Video Recording in AI Surveillance Infrastructures

The S650Si/S750Pi Series SD and microSD memory cards built with 176-layer 3D NAND technology and low-density parity check (LDPC) controller are targeted for growing segments spurred by 5G, artificial intelligence (AI), and edge technologies, such as AI-enabled surveillance, smart homes, mobile monitoring, automotive recorders, remote healthcare, and security surveillance systems requiring heavy write and re-write usage.

Compared with previous-generation ATP SD/microSD offerings, the new memory cards offer 3X faster sequential write and better sustained writing performance.

These memory cards offer high endurance and stable latency for consistent performance even after long-term writing, ensuring good-quality continuous video recording. Their outstanding cross-temperature reliability enables them to withstand fluctuating temperatures to ensure total device dependability in a wide range of operating conditions.

They are available in two configurations:

- **Native Triple Level Cell (TLC):** S650Si with capacities from 64 GB to 512 GB, endurance of 5K+ P/E cycles, and Terabytes Written (TBW) of up to 1,400 TB.
- **Pseudo Single Level Cell (pSLC)**: S750Pi with capacities from 16 GB to 128 GB, endurance of 100K+ P/E cycles, and TBW of up to 10,160 TB.

S650/S750 Series

FEATURE HIGHLIGHTS

- Capacities
  - S650Si Series: 64 GB to 512 GB (native TLC)
  - S750Pi Series: 16 GB to 128 GB (pSLC mode)
- Operating Temp
  - I-Temp (-40 to 85°C)
- Endurance
  - S650Si Series: 1,400 TB
  - S750Pi Series: 10,160 TB
- Supply Longevity Support: 5 years
- Joint Validation Service
- ATP own-developed firmware
  - ATP SD Life Monitor: Intelligent Workload Inspection
  - Error Recovery Algorithm: Read Retry, Auto Read Calibration
  - Back-up Mechanism and Sudden Power Off Recovery
- ATP own-developed advanced card analysis for System-in-Package SiP design
  - ATP-Developed Hardware Design - Substrate with reserved testing pin is available for future component analysis.
  - Solder Mask Removal by Laser – Precise and efficient method to remove the solder mask to reach the reserved testing pins on the substrate.
  - ATP's Own Customized Debug Tool - This is connected to the Hardware reserved testing pin and then linked to the Software analysis system.

Please refer to page 47, 48 for product specifications

N651Si/N601Sc Series Type B CFexpress Cards, B600Sc Series NANODURA Dual UFDs Deliver High-Speed Data Transfers and Secure Storage with Write Protection Feature

ATP N651Si/N601Sc Series CFexpress Type B memory cards are the latest generation of CompactFlash (CF). Using the PCIe 4.0 x2 interface, they deliver more superior, high-speed performance compared with other cards using the PCIe 3.0 x2 interface.

ATP N651Si/N601Sc Series CFexpress Type B memory cards come with an optional hardware write protect feature. TCG Opal 2.0-compliant encryption/decryption secures data from theft and tampering without performance degradation.

ATP B600Sc Series NANODURA Dual universal flash drives (UFDs) are compliant with the Superspeed USB 3.2 Gen 1 specifications and can transfer data at speeds up to 5 Gb/s – a huge leap from USB 2.0 transfer speed of 480 Mb/s.

ATP B600Sc Series NANODURA Dual UFDs come with a hardware and firmware solution that integrates Write Protect Commands into software tools for easy access and improved user interface.

- The system supports .dll and Command Prompt Commands (CMD) guidelines for customer software development.
- ATP provides its proprietary Windows tool for the convenient locking/unlocking of the device.

N651Si/N601 Series CFexpress Type B FEATURE HIGHLIGHTS

- Capacities
  - 128 GB to 1 TB
- Operating Temp:
  - I-Temp (-40 to 85°C): N651Si
  - C-Temp (0 to 70°C): N601Sc
- Endurance
  - Up to 1,000 TB
- Host Memory Buffer (HMB) support
- Security
  - TCG Opal 2.0
  - HW Write Protection (optional)
- RAID 0, 1 compatibility

Please refer to page 49 for product specifications

B600Sc Series NANODURA Dual FEATURE HIGHLIGHTS

- Form Factor: USB flash drive (USB 3.2) Gen1, backward compatible with USB 2.0
- Connector Types:
  - USB Type A
  - USB Type A/Type C Dual Connectors (optional)
- Capacities: 32 GB to 128 GB
- Operating Temp: C-Temp (0 to 70°C)
- Endurance: Up to 84 TB
- True Plug and Play connection, supports hot swap function
- HW/FW Write Protection

Please refer to page 44 for product specifications

DRAM-less Value Line SSDs

Available in I-Temp/C-Temp Operable Models

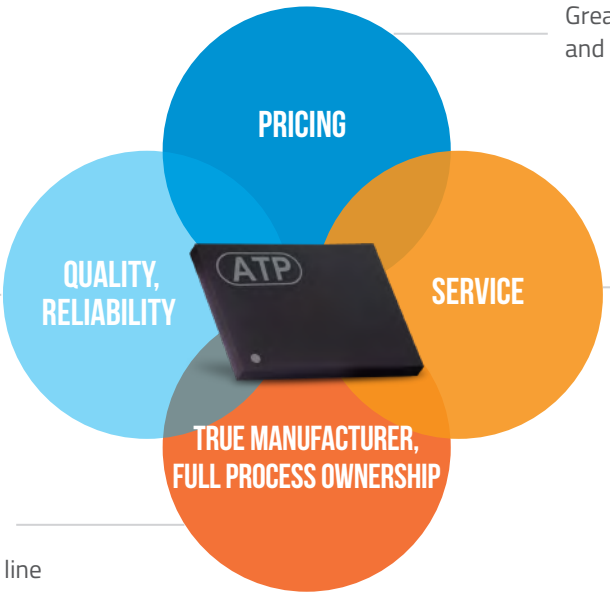
Please refer to page 38, 41, 42, 43 for product specifications.

N600Vi/Vc Series M.2 2242/2280 PCIe Gen3 NVMe and A600Vi/Vc Series SATA 2.5", M.2 2242/2280, and mSATA Value Line solid state drives (SSDs) are built with prime die triple-level cell (TLC) NAND on leading 176-layer 3D architecture.

Value line SSDs are geared toward industrial/embedded applications requiring reliable performance, a wide range of capacity options, and long-term supply commitment at friendly price points. The DRAM-less configuration provides lower power consumption and less heat signature.

The Value Line is tailored for read-intensive or general R/W mixed applications, such as web servers, box PCs, kiosk/point-of-sale systems (POS), and other industrial/embedded boot drives requiring reliability and lower cost of investment.

Why Value Line SSDs ?



Great cost-per-GB value for read-intensive and write-moderate applications

- Industry-leading NAND screening capability
- ISO 9001, ISO 14001

- Comprehensive pre-qualification to post-production failure analysis service support
- 5-year supply longevity support

- Wafer-to-finished product process ownership
- Traceability to the production line

N600Vi/Vc Series

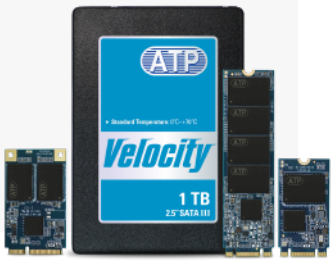
FEATURE HIGHLIGHTS

- PCIe Gen3 x4, NVMe 1.3
- Available in M.2 2280/2242
- 120 GB to 960 GB capacity
- I-Temp/C-Temp operable
- Firmware-based Power Loss Protection with Level 3 data-at-rest protection
- Host Memory Buffer (HMB) support
- End-to-end data path protection

A600Vi/Vc Series

FEATURE HIGHLIGHTS

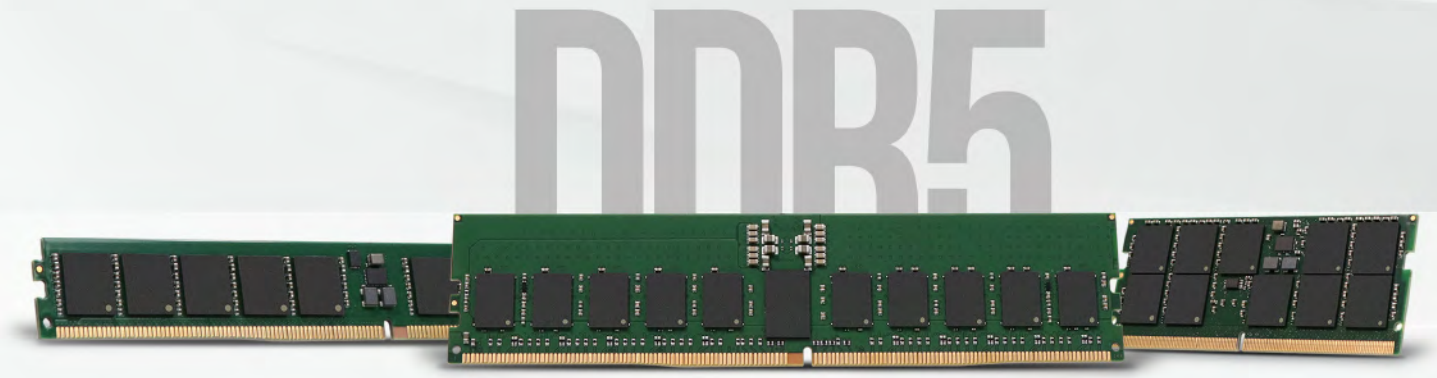
- SATA III 6 Gb/s
- Available in M.2 2280/2242, 2.5" & mSATA
- 128 GB to 1 TB capacity
- I-Temp/C-Temp operable
- Firmware-based Power Loss Protection with Level 3 data-at-rest protection
- Power-efficient DRAM-less design



Product Line	Value					
	N600Vi / N600Vc		A600Vi / A600Vc			
Interface	PCIe G3 x4		SATA III 6 Gb/s			
Flash Type	3D TLC					
Form Factor	M.2 2280 S2-M	M.2 2242 D5-M	2.5"	M.2 2280 S2-B-M	M.2 2242 D2-B-M	MO-300A
Operating Temperature	-40°C to 85°C / 0°C to 70°C		-40°C to 85°C / 0°C to 70°C			
Power Loss Protection Options	Firmware Based					
Optional SED Features	-					
Capacity	120 GB to 960 GB		32 GB to 1TB			
Performance						
Sequential Read (MB/s) up to	2,600		560			
Sequential Write (MB/s) up to	1,870		525			
Random Reads IOPS up to	184,300		72,000		70,500	72,000
Random Writes IOPS up to	145,900		85,000		81,000	85,000
Endurance and Reliability						
Endurance (TBW)[1] up to	2,880 TB		2,792 TB			
Reliability MTBF @ 25°C (hours)	>2,000,000 hours					
Others						
Dimensions (mm)	80.0 x 22.0 x 2.2	42.0 x 22.0 x 3.6	100 x 69.85 x 7	80 x 22 x 2.2	42 x 22 x 3.5	50.8 x 29.85 x 3.5
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH					
Warranty	2 years					

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

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



Please refer to page 30 for product specifications.

ATP introduces DDR5, the next-generation DRAM specification memory that brings several significant improvements and advantages over its previous memory generation, DDR4.

2X the Speed

ATP DDR5 DIMMs debut with 4800/5600 MT/s memory bandwidth, which supersede DDR4's maximum speed of 3200 MT/s. DDR5 is expected to scale up to 6400 MT/s channel speed, thus doubling DDR4's and translating to overall higher performance.

Up to 128 Gb Density with 4-Layer TSV

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

Lower Power Consumption

From DDR4's 1.2V, DDR5 operating voltage is a mere 1.1V, resulting in lower power consumption and more energy savings.

Better Power Architecture with PMIC

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

Precise Temperature Control

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

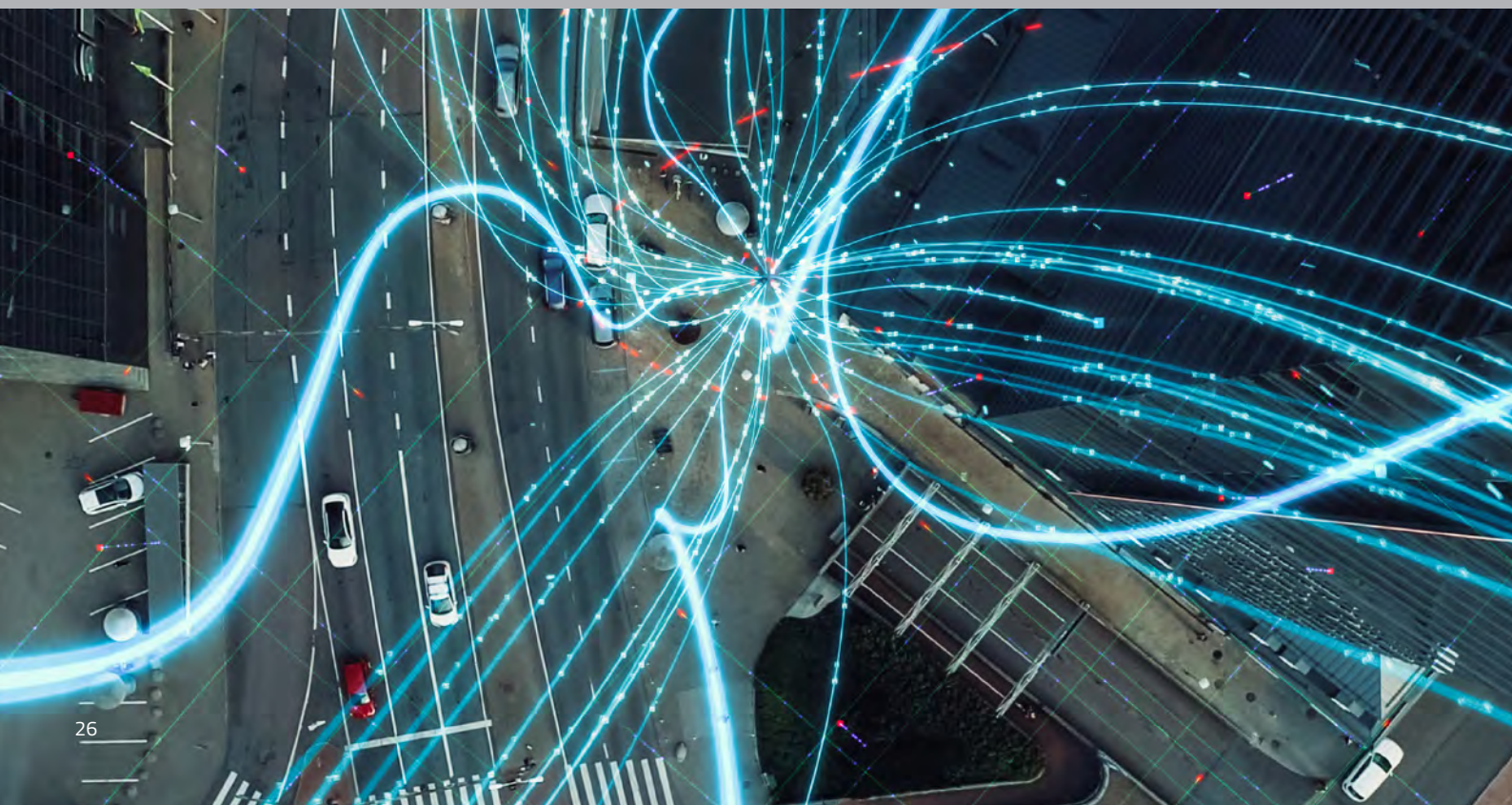
Other Key Enhancements Over DDR4

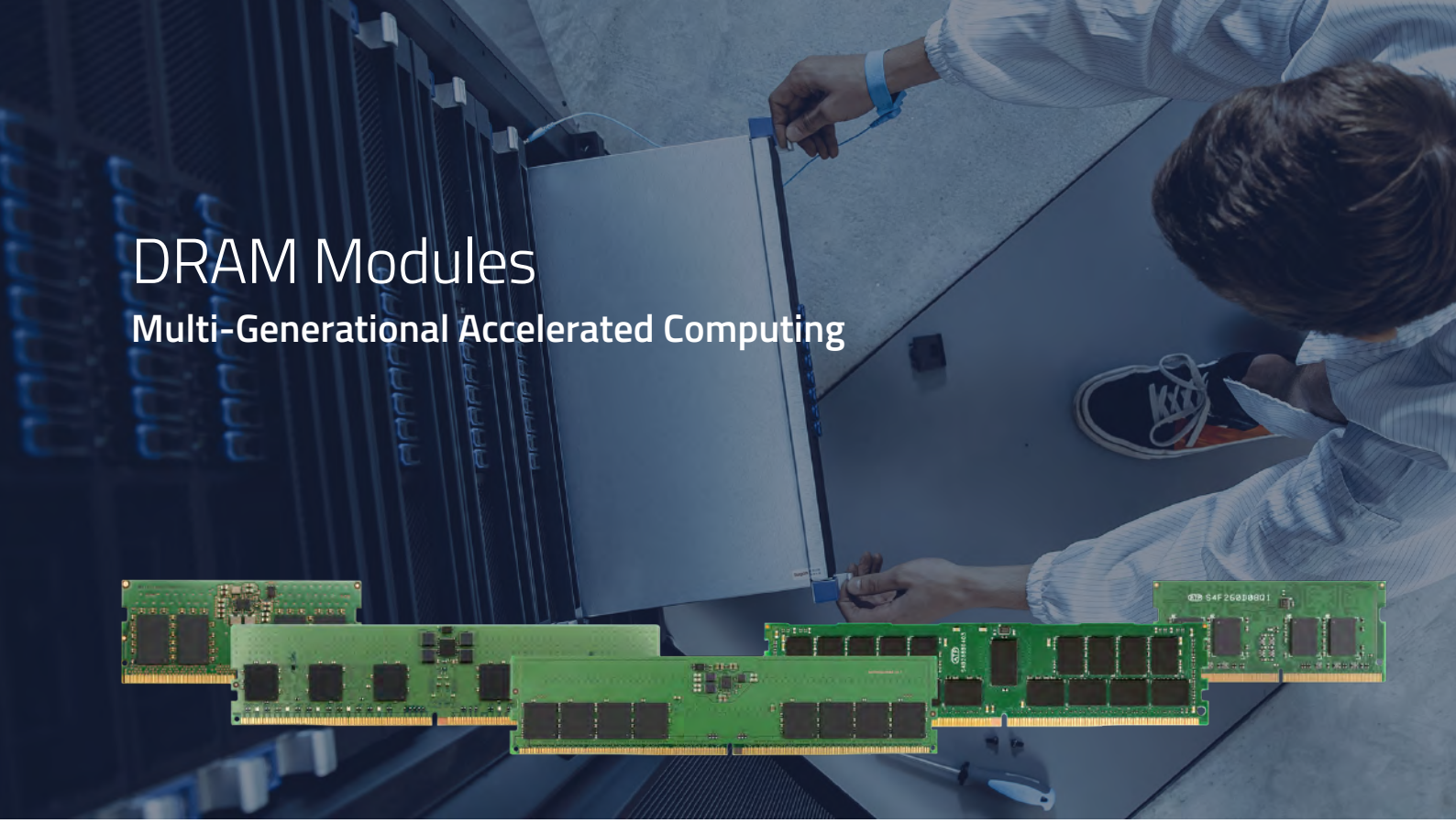
- **On-Die ECC** detects and corrects errors before data is sent to the CPU.
- **Dual Subchannels on a DIMM.** Two 40-bit-wide channels (32 data bits and 8 ECC bits) improve memory access.
- **Burst length of 16.** Having twice the burst length of DDR4, DDR5 can access 64 Bytes of data with a single burst and using just one of two independent channels (half a DIMM), translating to better efficiency.
- **Dual Data Rate (DDR)** on command and address interface, as opposed to Single Data Rate (SDR) on command and address interface with DDR4, have freed up additional pins for isolation enhancements.

DRAM Solutions

Intense Performance for Intense Workloads

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





DRAM Modules

Multi-Generational Accelerated Computing

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

The ATP Advantage: WE BUILD WITH YOU*

Value-Added Customization Services*

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

Best TCO with Wide-Temp ICs

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

Longevity Support for Legacy Modules

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

System-Level TDBI Screens Out 0.01% Error

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

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

ATP DRAM Modules: Tested Rigorously for Maximum Reliability

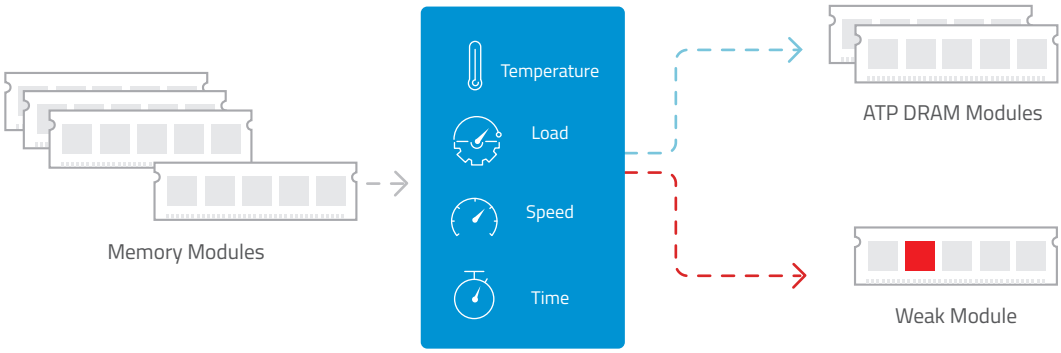
Dynamic Random Access Memory (DRAM) modules perform critical tasks for rigid workloads. Many of them are installed in systems that work non-stop in high-stress environments. They are constantly exposed to thermal, environmental as well as electro-mechanical challenges. Knowing that any vulnerability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

Automatic Test Equipment (ATE)

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

Test During Burn-in (TDBI)

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

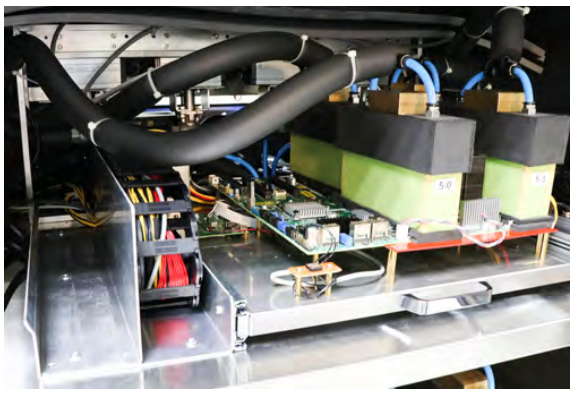


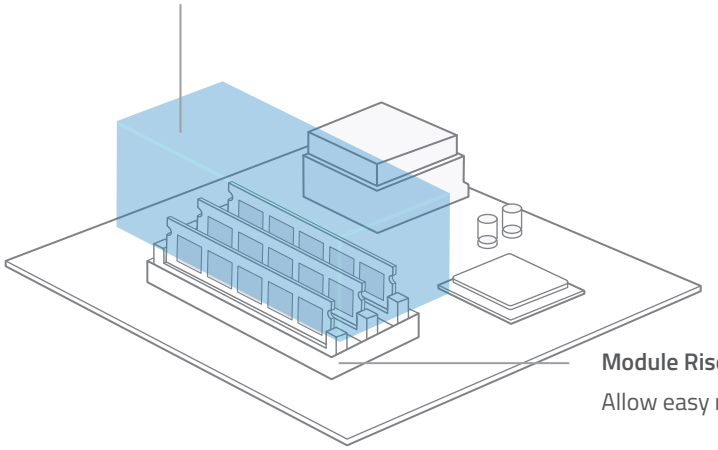
ATP TDBI: What Makes It Unique?

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

The Mini Chamber

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



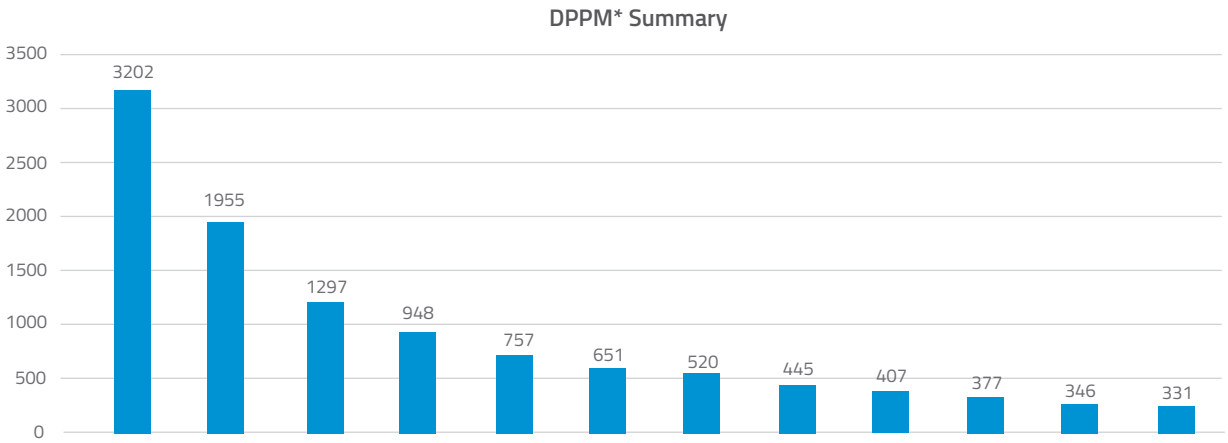


Module Riser Adapters from the Motherboard

Allow easy module insertions in production-level volumes.

Improvements After TDBI Adoption

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



*DPPM = Defective Parts per Million

DDR5: BUILT TO MEET EVER-GROWING MEMORY NEEDS WITH 2X THE SPEED, 4X THE CAPACITY AND GREATER POWER EFFICIENCY

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

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.

For more information on DDR5 and its advantages over DDR4, please go to page 25.

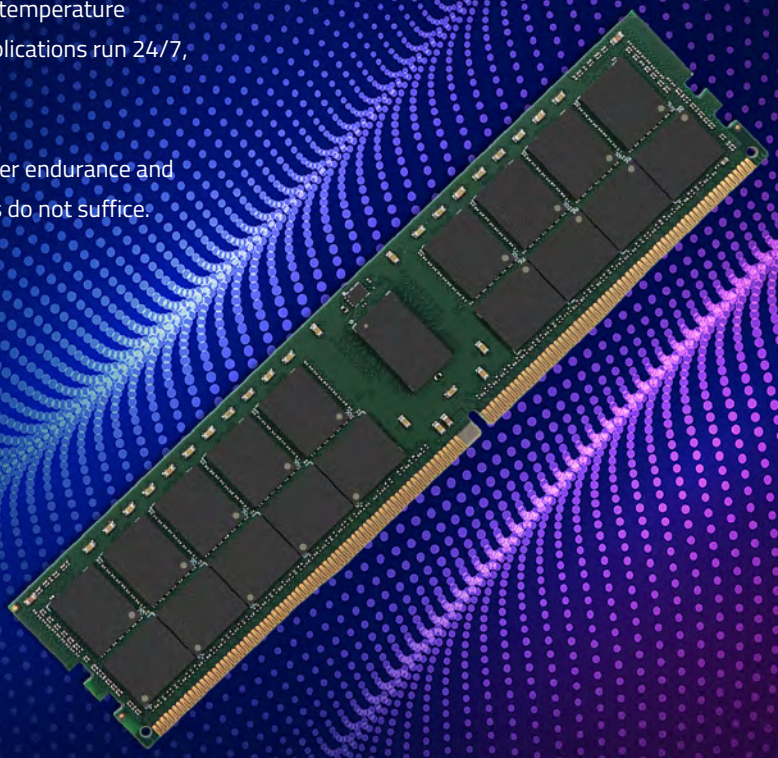
DDR5					
DIMM Type	RDIMM	ECC UDIMM	Non-ECC UDIMM	ECC SO-DIMM	Non-ECC SO-DIMM
Density	16 GB to 256 GB	16 GB to 64 GB	8 GB to 64 GB	16 GB to 64 GB	8 GB to 64 GB
Speed up to (MT/s)	4800/5600	4800/5600	4800/5600	4800/5600	4800/5600
PCB Height*	Low profile / VLP*	Low profile / VLP*	Low profile	Low profile	Low profile
Operating Temperature	0°C to 85°C / -40°C to 85°C				

* VLP: 0.74"

Why Wide-Temp Modules?

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

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



Benefits of ATP's Wide-Temp Modules

100%
Major ICs sourced from Tier 1 Manufacturers

Lifetime
Warranty*

-40˚C to 85˚C
Operating Temperature range

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

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

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

ATP Meets Continued Demand for DDR3 Modules

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

Product Information

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

Micron-ATP Partnership and License Agreements: DDR2 Continuity Program

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

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

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

Legacy (SDR/DDR) DRAM Modules

The license agreement stipulates the following conditions for ATP:

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

Product Information

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

Build To Order (BTO)					
Module Type	Capacity	Function	Frequency	Number of Pins	PCB Height
DDR UDIMM	256 MB / 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"

Complete DRAM Portfolio

Product	DIMM Type	Capacity	Speed (MT/s, up to)	VLP/ULP*	30μ" Golden Finger	ATP TDBI	Wide Temperature	Anti-Sulfur Resistors	Conformal Coating	PCB Chamfer
DDR5	RDIMM	16 GB to 256 GB	4800/5600	●	●	●	▲	▲	-	▲
	ECC UDIMM	16 GB to 64 GB	4800/5600	●	●	●	▲	▲	▲	▲
	Non-ECC UDIMM	8 GB to 64 GB	4800/5600	-	●	●	▲	▲	▲	▲
	ECC SO-DIMM	16 GB to 64 GB	4800/5600	-	●	●	▲	▲	▲	▲
	Non-ECC SO-DIMM	8 GB to 64 GB	4800/5600	-	●	●	▲	▲	▲	▲
DDR4	RDIMM	4 GB to128 GB	3200	●	●	●	▲	▲	-	▲
	ECC UDIMM	4 GB to 32 GB	3200	●	●	●	▲	▲	▲	▲
	Non-ECC UDIMM	2 GB to 32 GB	3200	●	●	●	▲	▲	▲	▲
	ECC SO-DIMM	4 GB to 32 GB	3200	-	●	●	▲	▲	▲	▲
	Non-ECC SO-DIMM	2 GB to 32 GB	3200	-	●	●	▲	▲	▲	▲
	Mini-RDIMM	4 GB to 16 GB	2400	●	●	●	▲	▲	-	-
	Mini-UDIMM	4 GB to 16 GB	2400	●	●	●	▲	▲	-	-
DDR3	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	133	-	●	●	-	-	-	-

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

Flash Solutions

Specialized Storage Solutions for Mission-Critical Applications

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

Solid State Drives and Modules

A New Breed of Storage Solutions for the Industrial Enterprise

As information technology (IT) and operational technology (OT) converge, relentless data generation is requiring a new breed of data storage solutions. ATP SSDs and modules meet the diverse and growing data storage needs of the industrial enterprise. They are custom-configurable, offer enhanced firmware, and undergo stringent reliability testing to ensure reliable performance even at extreme temperatures (-40°C to 85°C) and sudden power loss events.

Four-Corner, Temperature Cycling, and Power Cycling are just some of the reliability tests performed to guarantee that ATP SSDs and modules deliver outstanding performance, rugged durability, and many years of reliable performance. They support the latest high-speed NVMe™ protocol on a PCIe®Gen4 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, eUSB modules, and E1.S drives (upcoming)

The ATP Advantage: WE BUILD WITH YOU*

Value-Added Customization Services*

Thermal, Endurance, Security, and Longevity features are custom-configurable to meet unique application- and segment-specific requirements. ATP-developed firmware and hardware options are available to address special embedded and industrial use cases.

Thermal Management Solutions

Available for NVMe SSDs, customizable solutions combine firmware and hardware technologies (with heatsink options), 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.

Extended Endurance

SSDs built on 3D TLC NAND flash deliver exceptional endurance. In native TLC, they match MLC endurance, while those configured in pSLC mode are nearly on par with SLC drives.

MCU-Based HW+FW Power Loss Protection

Advanced power loss protection preserves data in sudden power loss events. Select SSDs feature microcontroller unit-based design with level 4 (data-in-flight) protection.

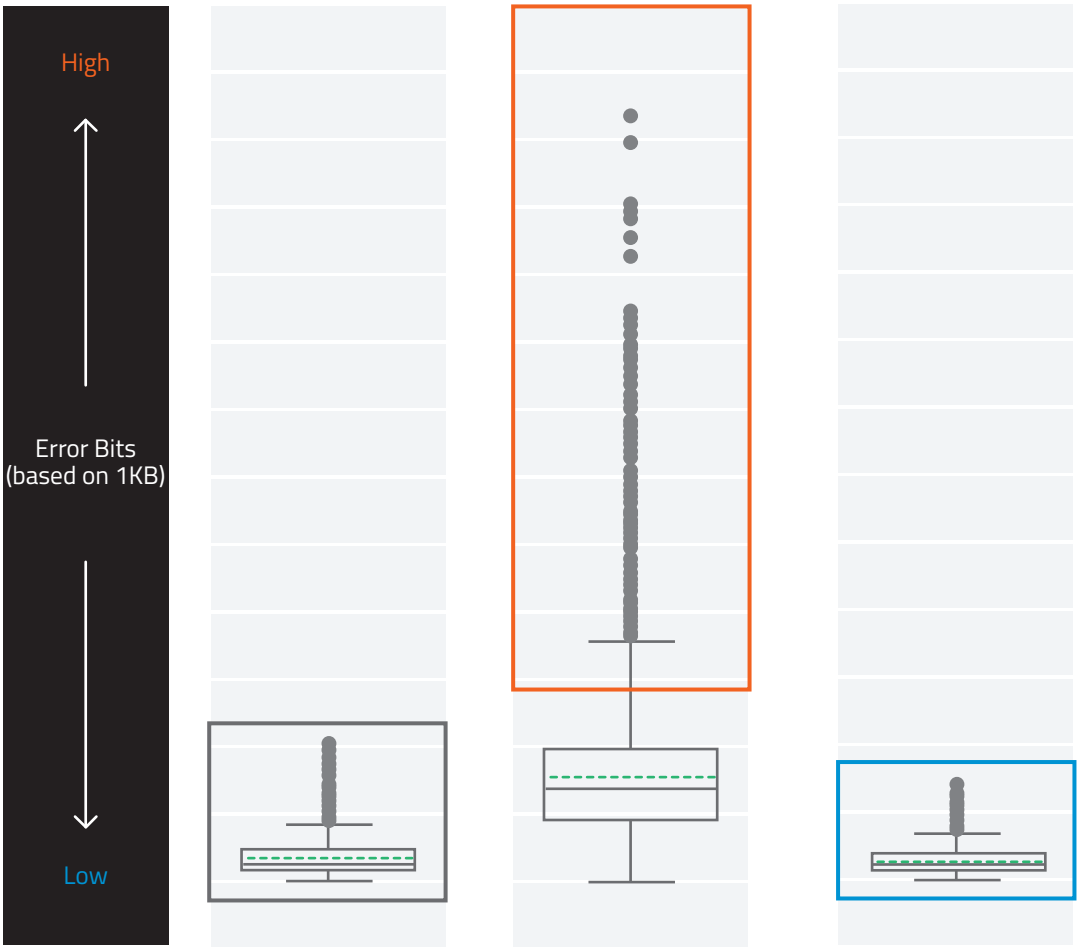
* Features and services may vary depending on project and customer request.

Cross-Temperature Operation Robustness for 176-Layer NAND Storage Solutions

Robust error handling in cross temperature with a 125˚C operating range

Performing operations across varying temperatures, such as writing in low-temperature conditions and reading at high temperatures, can increase the occurrence of error bits, potentially compromising data integrity over time. ATP's cross-temperature error handling feature mitigates these issues, reducing errors and maintaining data integrity even as the NAND approaches the end of its operational life.

Fresh NAND (1 P/E cycle)	End-of-Life NAND (100% P/E cycle)	
ATP's use of known good die (KGD) industrial-grade NAND flash ensures minimal impact from cross-temperature variations in the initial state.	**Without Error Handling** Errors in NAND flash begin to rise as it approaches the end of its operational life.	**With Cross-Temp Error Handling** As NAND flash nears the end of its life, implementing a robust error-handling mechanism is vital for minimizing errors and preserving data integrity.



PCIe® Gen4 NVMe M.2 2280 SSD

KEY FEATURES

- Superior Read/Write performance
- MCU-based Power Loss Protection Design with Level 4 (data-in-flight) protection*
- Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0 *
- Thermal Heatsink Solutions**
- End-to-End Data Path Protection
- Anti-sulfuric resistor support*

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

PCIe® Gen4 NVMe M.2 2280 SSD			
Product Line	Superior		
	N651Si / N651Sc		N601Sc
Interface	PCIe G4 x4		
Flash Type	3D TLC		
Form Factor	M.2 2280-D6-M[1]	M.2 2280-D2-M	M.2 2280-D2-M
Operating Temperature	-40°C to 85°C / 0°C to 70°C		0°C to 70°C
Power Loss Protection Options	Hardware + Firmware Based	Firmware Based	Firmware Based
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0		
Capacity	240 GB to 1.92 TB	240 GB to 3.84 TB	240 GB to 1.92 TB
Performance			
Sequential Read (MB/s) up to	6,450		
Sequential Write (MB/s) up to	6,050		
Random Reads IOPS up to	1,091,000		1,095,000
Random Writes IOPS up to	1,245,000		1,244,000
Endurance and Reliability			
Endurance (TBW)[2] up to	9,230 TB	17,930 TB	5,700 TB
Reliability MTBF @ 25°C	>2,000,000 hours		
Others			
Dimensions (mm)	80.0 x 22.0 x 3.85 80.0 x 24.4 x 12.5 (with 8 mm heatsink)	80.0 x 22.0 x 3.6 80.0 x 24.4 x 12.5 (with 8 mm heatsink)	80.0 x 22.0 x 3.6 80.0 x 24.4 x 12.5 (with 8 mm heatsink)
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH		
Warranty	2 years		

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

1. M.2 2280-D6-M form factor (max height: 3.85mm), offers Hardware Based Power Loss Protection. M.2 2280-D2-M form factor (max height: 3.6mm), provides Firmware Based Power Loss Protection.
2. Under highest Sequential write value. May vary by density, configuration and applications.
3. Please refer to pages 56-58. ▲: Customization option available on a project basis.

PCIe® Gen3 NVMe M.2 2280 / 2242 / 2230 SSD

KEY FEATURES

- MCU-based Power Loss Protection Design with Level 4 (data-in-flight) protection*
- Self-Encrypting Drive (SED) with AES 256-bit encryption, TCG Opal 2.0 *
- Thermal Heatsink Solutions**
- End-to-End Data Path Protection
- TRIM function support

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

PCIe® Gen3 NVMe M.2 2280 / 2242 / 2230 SSD								
Product Line	Premium				Superior			
	N750Pi	N700Pi	N700Pi	N700Pc	N650Si	N650Sc	N600Si	N600Sc
Interface	PCIe G3 x4							
Flash Type	3D TLC (pSLC mode)				3D TLC			
Form Factor	M.2 2280-D2-M		M.2 2230-S4-M		M.2 2280-D2-M			
Operating Temperature	-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	-40°C to 85°C	0°C to 70°C
Power Loss Protection Options	Hardware + Firmware Based		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	40 GB to 160 GB		120 GB to 960 GB		120 GB to 3.84 TB	
Performance								
Sequential Read (MB/s) up to	3,150		2,000		3,420			
Sequential Write (MB/s) up to	2,670	2,820	1,600		3,050			
Random Reads IOPS up to	147,789		135,600		222,700		225,200	
Random Writes IOPS up to	114,227		112,000		176,600		179,200	
Endurance and Reliability								
Endurance (TBW)[1] up to	16,000 TB	21,300 TB	4,280 TB		4,640 TB		10,600 TB	
Reliability MTBF @ 25°C	>2,000,000 hours							
Others								
Dimensions (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)		30.0 x 22.0 x 2.5		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						CE, FCC, BSMI, UKCA, RoHS, and REACH are available for SSD models with capacities between 120 GB to 1,920 GB; RoHS/VCCI/CE/FCC are available for the 3.84 TB SSD model.	
Warranty	5 years		2 years					

PCIe® Gen3 NVMe M.2 2280 / 2242 / 2230 SSD						
Product Line	Value					
	N600Vi	N600Vc	N600Vi	N600Vc	N600Vi	N600Vc
Interface	PCIe G3 x4					
Flash Type	3D TLC					
Form Factor	M.2 2280 S2-M		M.2 2242 D5-M		M.2 2230-S4-M	
Operating Temperature	-40°C to 85°C	0°C to 70°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	Firmware Based					
Optional SED Features	-					
Capacity	120 GB to 960 GB				120GB to 480GB	
Performance						
Sequential Read (MB/s) up to	2,600				2,050	
Sequential Write (MB/s) up to	1,870				1,550	
Random Reads IOPS up to	184,300				138,000	
Random Writes IOPS up to	145,900				112,600	
Endurance and Reliability						
Endurance (TBW)[1] up to	2,880 TB				768 TB	
Reliability MTBF @ 25°C	>2,000,000 hours					
Others						
Dimensions (mm)	80.0 x 22.0 x 2.2		42.0 x 22.0 x 3.6		30.0 x 22.0 x 2.5	
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH					
Warranty	2 years					

Technologies & Add-On Services[2]														
PCIe® Gen3 NVMe M.2 2280 / 2242 / 2230	Premium	○	○	○	○	○	○	○	○	▲	○	○	▲	▲	▲
	Superior	○	○	○	○	○	○	○	○	▲	○	▲	▲	▲	▲
	Value	○	○	–	○	○	○	○	○	–	▲	–	▲	▲	–

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 56-58. ▲: Customization option available on a project basis.

PCIe® Gen4 NVMe U.2 SSD

KEY FEATURES

- 15 mm Fin-Type Heatsink Design
- MCU-based Power Loss Protection Design with Level 4 (data-in-flight) protection*
- Self-Encrypting Drive (SED) with AES 256-bit Encryption, TCG Opal 2.0*
- End-to-End Data Path Protection
- Hot-swappable
- pSLC mode support *
- Anti-sulfuric resistor support*

* May vary by product and project support

PCIe® Gen4 NVMe U.2 SSD			
Product Line	Premium	Superior	
	N751Pi	N651Si	N601Sc
Interface	PCIe G4 x4		
Flash Type	3D TLC (pSLC mode)	3D TLC	
Form Factor	2.5"		
Operating Temperature	-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	320 GB to 2.56 TB	960 GB to 7.68 TB	
Performance			
Sequential Read (MB/s) up to	6,100	6,000	
Sequential Write (MB/s) up to	6,000	5,500	
Random Reads IOPS up to	870,000	819,000	
Random Writes IOPS up to	1,250,000	1,177,000	
Endurance and Reliability			
Endurance (TBW)[1] up to	157,000 TB	10,280 TB	10,370 TB
Reliability MTBF @ 25°C	>2,000,000 hours		
Others			
Dimensions (mm)	100 x 69.85 x 15		
Certifications	RoHS/VCCI/CE/FCC/UKCA		
Warranty	5 years	2 years	

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

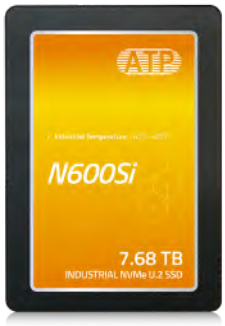
1 The actual lifetime of the product will depend on the JESD219A enterprise workload.
2 Please refer to pages 56-58. ▲: Customization option available on a project basis.

PCIe® Gen3 NVMe U.2 SSD

KEY FEATURES

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

* Customization available on a project basis



PCIe® Gen3 NVMe U.2 SSD	
Product Line	Superior
	N600Si
Interface	PCIe G3 x4
Flash Type	3D TLC
Form Factor	2.5"
Operating Temperature	-40°C to 85°C
Power Loss Protection Options	Hardware + Firmware Based
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0
Capacity	960 GB to 7.68 TB
Performance	
Sequential Read (MB/s) up to	3,100
Sequential Write (MB/s) up to	1,400
Random Reads IOPS up to	190,000
Random Writes IOPS up to	168,000
Endurance and Reliability	
Endurance (TBW)[1] up to	21,000 TB
Reliability MTBF @ 25°C	>2,000,000 hours
Others	
Dimensions (mm)	100.0 x 69.85 x 7.0
Certifications	RoHS, VCCI, CE, FCC
Warranty	2 years

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

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 56-58. ▲: Customization option available on a project basis.

SATA III M.2 2280 / 2242 SSD

KEY FEATURES

- MCU-based Power Loss Protection Design with Level 4 (data-in-flight) protection*
- LDPC & RAID Data Recovery
- End-to-End Data Path Protection
- TRIM / Global Wear Leveling support

* May vary by product and project support

SATA III M.2 2280 SSD							
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				3D TLC
Form Factor	2280 D2-B-M		2280 D1-B-M		2280 D2-B-M		2280 S2-B-M
Operating Temperature	-40°C to 85°C		-40°C to 85°C	0°C to 70°C	-40°C to 85°C	0°C to 70°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		240 GB to 960 GB		120 GB to 960 GB		32 GB to 1 TB
Performance							
Sequential Read (MB/s) up to	560		560		560		560
Sequential Write (MB/s) up to	520		520		510		525
Random Reads IOPS up to	90,000		103,000		100,000		72,000
Random Writes IOPS up to	88,000		86,000		88,000		85,000
Endurance and Reliability							
Endurance (TBW)[1] up to	19,200 TB	12,800 TB	4,655 TB		2,792 TB		2,792 TB
Reliability MTBF @ 25°C	>2,000,000 hours						
Others							
Dimensions (mm)	80 x 22 x 3.35						80 x 22 x 2.2
Certifications	CE, FCC, BSMI, UKCA, RoHS, REACH						
Warranty	5 years		2 years				

SATA III M.2 2242 SSD								
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				3D TLC
Form Factor	2242 D2-B-M			2242 D6-B-M		2242 D2-B-M		
Operating Temperature	-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	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		240 GB to 960 GB		120 GB to 480 GB		32 GB to 1 TB
Performance								
Sequential Read (MB/s) up to	530	560		560		560		560
Sequential Write (MB/s) up to	400	520		525		510		525
Random Reads IOPS up to	76,000	68,000		104,000		100,000		70,500
Random Writes IOPS up to	76,000	88,000		92,000		88,000		81,000
Endurance and Reliability								
Endurance (TBW)[1] up to	5,333 TB	9,600 TB	6,400 TB	4,655 TB		1,396 TB		2,792 TB
Reliability MTBF @ 25°C	>2,000,000 hours							
Others								
Dimensions (mm)	42 x 22 x 3.5							
Certifications	CE, FCC, UKCA, RoHS, REACH	CE, FCC, BSMI, UKCA, RoHS, REACH						
Warranty	5 years			2 years				

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

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 56-58. ▲: Customization option available on a project basis.

SATA III 2.5" SSD

KEY FEATURES

- MCU-based Power Loss Protection Design with Level 4 (data-in-flight) protection*
- 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

SATA III 2.5" SSD								
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	2.5"							
Operating Temperature	-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	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 256 GB	80 GB to 640 GB		240 GB to 1,920 GB		120 GB to 1,920 GB		32 GB to 1 TB
Performance								
Sequential Read (MB/s) up to	520	560		560				560
Sequential Write (MB/s) up to	420	520		525		520		525
Random Reads IOPS up to	76,000	90,000		103,000		100,000		72,000
Random Writes IOPS up to	74,000	88,000		90,000		91,000		85,000
Endurance and Reliability								
Endurance (TBW)[1] up to	21,333 TB	38,400 TB	25,600 TB	9,310 TB		5,585 TB		2,792 TB
Reliability MTBF @ 25°C	>2,000,000 hours							
Reliability Number of Insertions	10,000 minimum							
Others								
Dimensions (mm)	100 x 69.85 x 9.2	100 x 69.85 x 7/9.2						100 x 69.85 x 7
Certifications	CE, FCC, UKCA, RoHS, REACH	CE, FCC, BSMI, UKCA, RoHS, REACH						
Warranty	5 years			2 years				

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

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 56-58. ▲: Customization option available on a project basis.

SATA III mSATA SSD

KEY FEATURES

- MCU-based Power Loss Protection Design with Level 4 (data-in-flight) protection*
- Self-Encrypting Drive (SED) with AES 256-bit encryption, TCG Opal 2.0*
- LDPC & RAID Data Recovery
- End-to-End Data Path Protection
- TRIM / Global Wear Leveling support

* Customization available on a project basis

SATA III mSATA SSD								
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	MO-300A							
Operating Temperature	-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	0°C to 70°C
Power Loss Protection Options	Hardware + Firmware Based							Firmware Based
Optional SED Features	AES 128/256-bit Encryption	AES 256-bit Encryption, TCG Opal 2.0						-
Capacity	8 GB to 128 GB	40 GB to 160 GB		240 GB to 960 GB		120 GB to 480 GB		32 GB to 1 TB
Performance								
Sequential Read (MB/s) up to	530	560		560		560		560
Sequential Write (MB/s) up to	430	520		525		510		525
Random Reads IOPS up to	76,000	90,000	94,000	104,000		100,000		72,000
Random Writes IOPS up to	-	88,000	85,000	90,000		88,000		85,000
Endurance and Reliability								
Endurance (TBW)[1] up to	10,667 TB	9,600 TB	6,400 TB	4,655 TB		1,396 TB		2,792 TB
Reliability MTBF @ 25°C	>2,000,000 hours							
Others								
Dimensions (mm)	50.8 x 29.85 x 3.5							
Certifications	CE, FCC, UKCA, RoHS, REACH	CE, FCC, BSMI, UKCA, RoHS, REACH						
Warranty	5 years			2 years				

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

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 56-58. ▲: Customization option available on a project basis.

USB 3.2 NANODURA Dual

KEY FEATURES

- Global wear leveling
- Bad block management algorithm
- High reliability
- "Plug and play"connection support hot swap
- With higher random write performance
- Support OTG Type-C connector

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

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

1 Dual connector device supports USB On-The-Go (OTG)
2 Under highest Sequential write value. May vary by density, configuration and applications.
3 Please refer to pages 56-58. ▲: Customization option available on a project basis.

USB 2.0 NANODURA

USB 2.0 NANODURA		
Product Line	Premium B800Pi	Superior B600Sc
Interface	USB 2.0 (480 Mbps)	
Flash Type	SLC	MLC
Form Factor	USB Type-A	
Operating Temperature	-40°C to 85°C	0°C to 70°C
Power Loss Protection Options	Firmware Based	
Optional SED Features	-	
Capacity	512 MB to 8 GB	4 GB to 8 GB
Performance		
Sequential Read (MB/s) up to	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 (mm)	34 x 12.2 x 4.5	
Certifications	CE, FCC, UKCA, RoHS	
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 56-58. ▲: Customization option available on a project basis.

KEY FEATURES

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

USB 2.0 eUSB

USB 2.0 eUSB			
Product Line	Premium		Superior
	B800Pi	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	Firmware Based	Hardware + Firmware Based	
Optional SED Features	-		
Capacity	1 GB to 16 GB	1 GB to 32 GB	8 GB to 32 GB
Performance			
Sequential Read (MB/s) up to	36	30	25
Sequential Write (MB/s) up to	23	25	19
Endurance and Reliability			
Endurance (TBW)[1] up to	1,548 TB	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 (mm)	36.9 x 26.6 x 9.5		
Certifications	CE, FCC, UKCA, RoHS		
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 56-58. ▲: Customization option available on a project basis.

KEY FEATURES

- Global wear leveling
- Power Loss Protection
- Higher random write performance
- Hardware Write Protect*

* Optional, by project support.

Memory Cards

Small Cards, Big Performance for the Intelligent Edge

ATP memory cards are excellent for non-stop video recording, edge computing, artificial intelligence (AI)-enabled surveillance, robotics, point-of-sale (POS) transactions, handheld computing, and other applications requiring the portability of removable storage media. Ideal for storing 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) for reliable function even in harsh environments.

Available form factors include SD/microSD cards, which are also available as Technical Security Solutions (TSE) for the German fiscal market, ensuring tamper-proof point-of-sale (POS) transactions. Memory card that comply with CompactFlash Association standards include legacy CF and CFast cards (SATA interface) as well as the CFexpress Type B (PCIe/NVMe) cards using the PCIe 4.0 x 2 interface.

The ATP Advantage: WE BUILD WITH YOU*

Value-Added Customization Services*

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-Developed Firmware, Hardware, and Value-Added Services

ATP Joint Validation Service**. Compatibility and function tests are conducted using the client's host devices and systems.
ATP SD Life Monitor: Intelligent Workload Inspection. This gives customers a quick look at the write operation and file size by the host systems pre-qualification.
Advanced Card Analysis. ATP's uniquely designed substrate and debug tool make system-in-package (SiP) component post-analysis possible.
Firmware Power Loss Protection. Prevents data loss or corruption in the event of sudden power outages.

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.

Rugged Design for Harsh Environments

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.

* Features and services may vary depending on project and customer request.
** Value-added service

SD/SDHC/SDXC Card

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

SD/SDHC/SDXC Card							
Product Line	Premium					Superior	
	S800Pi	S750Pi	S750Pc	S700Pi	S700Pc	S650Si	S650Sc
Interface	512 MB to 2 GB, HS mode 4 GB to 8 GB, UHS-I	UHS-I					
Flash Type	SLC	3D TLC (pSLC mode)				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	-40°C to 85°C	-25°C to 85°C
Power Loss Protection Options	Firmware Based						
Optional SED Features	-						
Capacity	512 MB to 8 GB	16 GB to 128 GB		8 GB to 32 GB		64 GB to 512 GB	
	Performance						
Sequential Read (MB/s) up to	68	97		98		97	
Sequential Write (MB/s) up to	39	82		80		76	
	Endurance and Reliability						
Endurance (TBW)[1] up to	192 TB	10,160 TB		582 TB		1,400 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 (mm)	32.0 x 24.0 x 2.1						
Certifications	CE, FCC, UKCA, RoHS						
Warranty	5 years					2 years	

SD/SDHC/SDXC Card				
Product Line	Superior			
	S600Si	S600Sc	S600Sc	S600Si / Sc
Interface	UHS-I			
Flash Type	3D TLC		MLC	MLC / 3D TLC
Form Factor	SD Card			
Operating Temperature	-40°C to 85°C	-25°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 128 GB		8 GB to 16 GB	8 GB to 256 GB
	Performance			
Sequential Read (MB/s) up to	94		68	96
Sequential Write (MB/s) up to	55		23	65
	Endurance and Reliability			
Endurance (TBW)[1] up to	77 TB		19 TB	307 TB
Reliability MTBF @ 25°C	>2,000,000 hours			
Reliability Number of Insertions	20,000 (SDA spec minimum 10,000)			
	Others			
Dimensions (mm)	32.0 x 24.0 x 2.1			
Certifications	CE, FCC, UKCA, RoHS			
Warranty	2 years			

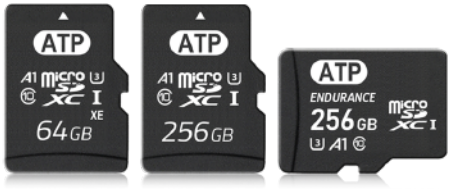
Technologies & Add-On Services[2]											
Premium	▲	○	○	○	▲	_	○	○	○	○	▲
Superior	▲	○	○	○	○	▲	○	▲	○	○	▲

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 56-58. ▲: Customization option available on a project basis.

microSD/microSDHC/microSDXC Card

KEY FEATURES

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



microSD/microSDHC/microSDXC Card							
Product Line	Premium					Superior	
	S800Pi	S750Pi	S750Pc	S700Pi	S700Pc	S650Si	S650Sc
Interface	512 MB to 2 GB, HS mode 4 GB to 8 GB, UHS-I	UHS-I					
Flash Type	SLC	3D TLC (pSLC mode)		3D TLC (pSLC mode)		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	-40°C to 85°C	-25°C to 85°C
Power Loss Protection Options	Firmware Based						
Optional SED Features	-						
Capacity	512 MB to 8 GB	16 GB to 128 GB		8 GB to 64 GB		64 GB to 512 GB	
Performance							
Sequential Read (MB/s) up to	68	97		96		97	
Sequential Write (MB/s) up to	39	82		76		76	
Endurance and Reliability							
Endurance (TBW)[1] up to	192 TB	10,160 TB		1,164 TB		1,400 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 (mm)	15.0 x 11.0 x 1.0						
Certifications	CE, FCC, UKCA, RoHS						
Warranty	5 years					2 years	

microSD/microSDHC/microSDXC Card			
Product Line	Superior		
	S600Si	S600Sc	S600Sc
Interface	UHS-I		
Flash Type	3D TLC		MLC
Form Factor	microSD Card		
Operating Temperature	-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		8 GB to 32 GB
Performance			
Sequential Read (MB/s) up to	97		68
Sequential Write (MB/s) up to	62		24
Endurance and Reliability			
Endurance (TBW)[1] up to	153 TB		38 TB
Reliability MTBF @ 25°C	>2,000,000 hours		
Reliability Number of Insertions	20,000 (SDA spec minimum 10,000)		
Others			
Dimensions (mm)	15.0 x 11.0 x 1.0		
Certifications	CE, FCC, UKCA, RoHS		
Warranty	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 56-58. ▲: Customization option available on a project basis.

PCIe® Gen4 NVMe CFexpress Card

KEY FEATURES

- Superior Read/Write performance
- Self Encrytion Drive SED with AES 256-bit Encryption, TCG OPAL 2.0*
- Host Memory Buffer (HMB) support
- Hardware Write Protect*

* Optional, by project support.

PCIe® Gen4 NVMe CFexpress Card			
Product Line	Premium	Superior	
	N751Pi	N651Si	N601Sc
Interface	PCIe G4 x2		
Flash Type	3D TLC (pSLC mode)	3D TLC	
Form Factor	CFexpress Type B		
Operating Temperature	-40°C to 85°C		0°C to 70°C
Power Loss Protection Options	Firmware Based		
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0		
Capacity	40 GB to 320GB	128 GB to 1 TB	
Performance			
Sequential Read (MB/s) up to	3,500		
Sequential Write (MB/s) up to	3,100	3,200	
Random Reads IOPS up to	770,000		
Random Writes IOPS up to	735,000	750,000	
Endurance and Reliability			
Endurance (TBW)[1] up to	4,410 TB	1,000 TB	
Reliability MTBF @ 25°C	>2,000,000 hours		
Reliability Number of Insertions	10,000 minimum		
Others			
Dimensions (mm)	29.6 x 38.5 x 3.8		
Certifications	CE, FCC, RoHS, UKCA		
Warranty	5 years	2 years	

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 56-58. ▲: Customization option available on a project basis.

CFast Card

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 up to	35,800
Random Writes IOPS up to	-
Endurance and Reliability	
Endurance (TBW)[1] up to	2,667 TB
Reliability MTBF @ 25°C	>2,000,000 hours
Reliability Number of Insertions	10,000 minimum
Others	
Dimensions (mm)	36.4 x 42.8 x 3.6
Certifications	CE, FCC, UKCA, RoHS
Warranty	5 years

KEY FEATURES

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

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

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 56-58. ▲: Customization option available on a project basis.

CompactFlash Card

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 (mm)	36.4 x 42.8 x 3.3		
Certifications	CE, FCC, RoHS, UKCA		
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 56-58. ▲: Customization option available on a project basis.

SecurStor microSD Card

KEY FEATURES

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

SECURITY FEATURES*

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

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

Product Name	SecurStor microSD
Product Line	SecurStor
Flash Type	MLC
Density	4 GB to 16 GB
Performance Sequential Read (MB/s) up to	10
Performance Sequential Write (MB/s) up to	5
Interface	UHS-I
Operating Temperature	-25°C to 85°C
Reliability MTBF @ 25°C	>2,000,000 hours
Reliability Number of Insertions	10,000
Dimensions (mm)	15.0 x 11.0 x 1.0

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

* 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 (mm)	15.0 x 11.0 x 1.0

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. Their tiny footprint makes them perfectly suitable for embedded systems with space constraints but require rugged endurance, reliability and durability in harsh environments.

They are available in two form factors: e.MMC, which uses a 153-ball fine pitch ball grid array (FBGA package) and NVMe Heat Sink Ball Grid Array (HSBGA), using high-speed PCIe 3.0 interface x4 lanes to deliver up to 32 Gb/s bandwidth at 8 Gb/s per lane.

The ATP Advantage: WE BUILD WITH YOU*

Value-Added Customization Services*

Integrated circuits (IC) package customization service is enabled by ATP's process ownership. Legacy land grid array (LGA) package support is available from 3 to 5 years. ATP also offers packaging flexibility:

- Package sizes (9x10, 11.5x13, 12x18 mm)
- Package forms (100-/132-ball BGA, LGA)
- Die packages (octa-die or higher)

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

Extreme Endurance**

2-3X higher endurance 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.

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

NVMe HSBGA

pSLC Mode

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

5 mW Power Consumption in Sleep Mode

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

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.

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*

* May vary by product and project 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	E700Pi
Flash Type	3D MLC (pSLC mode)	3D MLC	3D MLC (pSLC mode)	3D MLC	3D MLC (pSLC mode)	3D MLC	3D TLC (pSLC mode)	3D MLC (pSLC mode)	3D TLC (pSLC mode)
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	10 GB to 40 GB
Performance									
Sequential Read/ Write up to (MB/s) (Max.)**	300 / 240	300 / 170	300 / 240	300 / 170	300 / 240	300 / 170	295/ 215	300 / 240	290 / 225
Bus Speed Modes	x1 / x4 / x8								
ICC (Typical RMS in Read/Write) mA (Max.)	145 / 175	125 / 175	145 / 175	125 / 175	145 / 175	125 / 175	95.5 / 92	145 / 175	100 / 110
ICCQ (Typical RMS in Read/Write) mA (Max.)	120 / 100	115 / 95	120 / 100	115 / 95	110 / 95	115 / 95	104 / 87.5	120 / 100	105 / 100
Endurance and Reliability									
Endurance TBW** (Max.)	1,213 TB	824 TB	1,213 TB	824 TB	1,320 TB	824 TB	1,034 TB	1,320 TB	1,364 TB
Reliability MTBF @ 25°C	>2,000,000 hours								
Others									
Dimensions (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	Superior			Premium		Superior	Value	
	E650Si	E600Si	E600Si	E750Pc	E700Pc	E650Sc	E600Vc	E600Vc
Flash Type	3D TLC	3D MLC	3D TLC	3D TLC (pSLC mode)		3D TLC	3D TLC	
IC Package	153-ball FBGA							
JEDEC Specification	v5.1, HS400							
Power Loss Protection Options	Firmware Based							
Operating Temperature	-40°C to 85°C			-25°C to 85°C				
Capacity*	32 GB to 64 GB	16 GB to 128 GB	32 GB to 128 GB	10 GB to 21 GB	10 GB to 40 GB	32 GB to 64 GB	32 GB to 128 GB	32 GB
Performance								
Sequential Read/ Write up to (MB/s)**	270 / 215	300 / 170	290 / 225	295 / 215	290 / 225	270 / 215	290 / 225	250 / 135
Bus Speed Modes	x1 / x4 / x8							
ICC (Typical RMS in Read/Write) mA (Max.)	69.5 / 68.5	125 / 175	100 / 110	95.5 / 92	100 / 110	69.5 / 68.5	100 / 110	81.5 / 49.5
ICCQ (Typical RMS in Read/Write) mA (Max.)	88 / 85.5	110 / 100	105 / 100	104 / 87.5	105 / 100	88 / 85.5	105 / 100	80.5 / 61.5
Endurance and Reliability								
Endurance TBW** (Max.)	70 TB	824 TB	52 TB	1,034 TB	1,364 TB	70 TB	52 TB	8.3 TB
Reliability MTBF @ 25°C	>2,000,000 hours							
Others								
Dimensions (mm)	11.5 x 13.0 x 1.0							9.0 x 10.0 x 0.8
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 56-58. ▲: Customization option available on a project basis.

PCIe® Gen3 NVMe M.2 Type 1620 HSBGA SSD

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 Host Memory Buffer (HMB)*
- Optional Security features available**

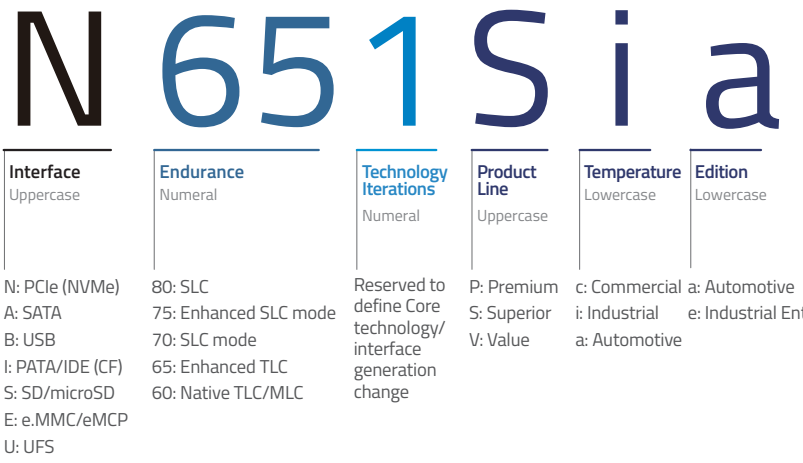
* Under highest Sequential write value. May vary by density, configuration, and applications.
** Customization available on a project basis

PCIe® Gen3 NVMe M.2 Type 1620 HSBGA SSD				
Product Line	Premium		Value	
	N700Pi	N700Pc	N600Vi	N600Vc
Interface	PCIe G3 x4			
Flash Type	3D TLC (pSLC mode)		3D TLC	
Form Factor	291-Ball, HSBGA			
Operating Temperature	-40°C to 85°C	0°C to 70°C	-40°C to 85°C	0°C to 70°C
Power Loss Protection Options	Firmware Based			
Optional SED Features	AES 256-bit Encryption, TCG Opal 2.0		-	
Capacity	40 GB to 160 GB		120 GB to 480 GB	
Performance				
Sequential Read (MB/s) up to	2,000		2,050	
Sequential Write (MB/s) up to	1,600		1,550	
Random Reads IOPS up to	135,600		138,000	
Random Writes IOPS up to	112,000		112,600	
Endurance and Reliability				
Endurance (TBW)[1] up to	4,280 TB		768 TB	
Reliability MTBF @ 25°C	>2,000,000 hours			
Others				
Dimensions (mm)	16.0 x 20.0 x 1.6			
Certifications	RoHS, REACH			
Warranty	1 year			

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

1 Under highest Sequential write value. May vary by density, configuration and applications.
2 Please refer to pages 56-58. ▲: Customization option available on a project basis.

Flash Products Naming Rule



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.

Industrial Enterprise Edition

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

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.

- **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.

- **Firmware-based Power Loss Protection**

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

- **Advanced Wear Leveling**

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

- **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.

- **End-to-End Data Path Protection**

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

- **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 solutions
✦ 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 solutions
✦ Value-added solutions

Form Factor	Product Line	Life Monitor/ S.M.A.R.T.	Firmware-based Power Loss Protection	Hardware-based Power Loss Protection	AutoRefresh	Advanced Wear Leveling	Dynamic Data Refresh	End-to-End Data Path 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
PCIe® Gen4 NVMe M.2 2280 SSD	Superior	○	○	○	○	○	○	○	○	▲	▲	–	○	–	–	▲	▲	–	▲
PCIe® Gen3 NVMe M.2 2280 / 2242 / 2230 SSD	Premium	○	○	○	○	○	○	○	○	▲	○	–	○	–	–	▲	▲	–	▲
	Superior	○	○	○	○	○	○	○	○	▲	○	–	▲	–	–	▲	▲	–	▲
	Value	○	○	–	○	○	○	○	○	–	▲	–	–	–	–	▲	▲	–	–
PCIe® Gen4 NVMe U.2 SSD	Premium	○	○	○	○	○	○	○	○	▲	▲	–	○	–	–	▲	▲	–	▲
	Superior	○	○	○	○	○	○	○	○	▲	▲	–	○	–	–	–	▲	–	▲
PCIe® Gen3 NVMe U.2 SSD	Superior	○	○	○	○	○	○	○	○	○	○	○	○	–	–	–	▲	–	▲
SATA III M.2 2280 / 2242 SSD	Premium	○	○	○	○	○	○	○	○	▲	○	–	○	–	–	▲	▲	–	▲
	Superior	○	○	○	○	○	○	○	○	▲	○	–	▲	–	–	▲	▲	–	▲
	Value	○	○	–	○	○	○	–	○	–	–	–	–	–	–	–	–	–	–
SATA III 2.5" SSD	Premium	○	○	○	○	○	○	–	○	▲	○	–	○	–	–	▲	▲	–	▲
	Superior	○	○	○	○	○	○	–	○	▲	○	–	▲	–	–	▲	▲	–	▲
	Value	○	○	–	○	○	○	–	○	–	–	–	–	–	–	–	–	–	–
SATA III mSATA SSD	Premium	○	○	○	○	○	○	–	○	▲	○	–	○	–	–	▲	▲	–	▲
	Superior	○	○	○	○	○	○	–	○	▲	○	–	▲	–	–	▲	▲	–	▲
	Value	○	○	–	○	○	○	–	–	–	–	–	–	–	–	–	–	–	–
USB 3.2 NANODURA Dual	Superior	○	○	–	–	○	–	–	–	–	–	–	–	○	–	–	–	–	–
USB 2.0 NANODURA	Premium	○	○	–	–	○	–	–	–	–	–	–	○	○	–	–	–	–	–
	Superior	○	○	–	–	○	–	–	–	–	–	–	–	○	–	–	–	–	–
USB 2.0 eUSB	Premium	○	○	▲	–	○	–	–	–	–	–	–	○	–	–	▲	▲	–	–
	Superior	○	○	▲	–	○	–	–	–	–	–	–	–	–	–	▲	▲	–	–
(micro)SD/(micro)SDHC/ (micro)SDXC Card	Premium	▲	○	–	○	○	▲	–	–	○	–	–	○	○	–	–	–	○	▲
	Superior	▲	○	–	○	○	○	–	▲	○	–	–	▲	○	–	–	–	○	▲
PCIe® Gen4 NVMe CFexpress Card	Premium	○	○	–	○	○	○	○	○	▲	▲	–	○	–	–	▲	▲	○	▲
	Superior	○	○	–	○	○	○	○	○	▲	▲	–	○	–	–	–	▲	○	▲
Cfast Card	Premium	○	○	▲	○	○	○	–	–	○	–	–	○	–	–	▲	▲	–	▲
Compact Flash Card	Premium	○	○	○	○	○	○	–	–	–	–	–	○	–	–	▲	▲	–	–
	Superior	○	○	–	○	○	○	–	–	–	–	–	–	–	–	▲	▲	–	–
e.MMC	Premium	○	○	–	○	○	○	○	○	○	–	–	○	○	○	–	–	○	▲
	Superior	○	○	–	○	○	○	○	○	○	–	–	○	○	○	–	–	○	▲
	Value	○	○	–	○	○	○	○	○	○	–	–	▲	○	○	–	–	○	▲
PCIe® Gen3 NVMe M.2 Type 1620 HSBGA SSD	Premium	○	○	–	○	○	○	○	○	▲	▲	–	▲	○	○	–	–	–	▲
	Value	○	○	–	○	○	○	○	–	–	–	–	○	○	○	–	–	–	–

Please refer to pages 56-58.

▲: Customization option available on a project basis.

Complete Flash Portfolio

Form Factor	Product Line Naming	Interface	Capacity	NAND	Reliability TBW (max) *	Sequential Performance MB/s (up to)		Operating Temperature (°C)
						Read	Write	
PCIe® Gen4 NVMe M.2 2280 SSD	N651Si / N651Sc	PCIe G4 x4	240 GB to 3.84 TB	3D TLC	17,930	6,450	6,050	-40 to 85 / 0 to 70
	N601Sc	PCIe G4 x4	240 GB to 1.92 TB	3D TLC	5,700	6,450	6,050	0 to 70
PCIe® Gen3 NVMe M.2 2280 SSD	N750Pi	PCIe G3 x4	40 GB to 320 GB	3D TLC (pSLC mode)	16,000	3,150	2,670	-40 to 85
	N700Pi	PCIe G3 x4	40 GB to 640 GB	3D TLC (pSLC mode)	21,300	3,150	2,820	-40 to 85
	N650Si / N650Sc	PCIe G3 x4	120 GB to 960 GB	3D TLC	4,640	3,420	3,050	-40 to 85 / 0 to 70
	N600Si / N600Sc	PCIe G3 x4	120 GB to 3.84 TB	3D TLC	10,600	3,420	3,050	-40 to 85 / 0 to 70
	N600Vi / N600Vc	PCIe G3 x4	120 GB to 960 GB	3D TLC	2,880	2,600	1,870	-40 to 85 / 0 to 70
PCIe® Gen3 NVMe M.2 2242 SSD	N600Vi / N600Vc	PCIe G3x4	120 GB to 960 GB	3D TLC	2,880	2,600	1,870	-40 to 85 / 0 to 70
PCIe® Gen3 NVMe M.2 2230 SSD	N700Pi / N700Pc	PCIe G3 x4	40 GB to 160 GB	3D TLC (pSLC mode)	4,280	2,000	1,600	-40 to 85 / 0 to 70
	N600Vi / N600Vc	PCIe G3 x4	120 GB to 480 GB	3D TLC	768	2,050	1,550	-40 to 85 / 0 to 70
PCIe® Gen4 NVMe U.2 SSD	N751Pi	PCIe G4 x4	320 GB to 2.56 TB	3D TLC (pSLC mode)	157,000	6,100	6,000	-40 to 85
	N651Si / N601Sc	PCIe G4 x4	960 GB to 7.68 TB	3D TLC	10,370	6,000	5,500	-40 to 85 / 0 to 70
PCIe® Gen3 NVMe U.2 SSD	N600Si	PCIe G3 x4	960 GB to 7.68 TB	3D TLC	21,000	3,100	1,400	-40 to 85
SATA III M.2 2280 SSD	A750Pi	SATA 6Gb/s	80 GB to 320 GB	3D TLC (pSLC mode)	19,200	560	520	-40 to 85
	A700Pi	SATA 6Gb/s	80 GB to 320 GB	3D TLC (pSLC mode)	12,800	560	520	-40 to 85
	A650Si / A650Sc	SATA 6Gb/s	240 GB to 960 GB	3D TLC	4,655	560	520	-40 to 85 / 0 to 70
	A600Si / A600Sc	SATA 6Gb/s	120 GB to 960 GB	3D TLC	2,792	560	510	-40 to 85 / 0 to 70
	A600Vc	SATA 6Gb/s	32 GB to 1 TB	3D TLC	2,792	560	525	0 to 70
SATA III M.2 2242 SSD	A800Pi	SATA 6Gb/s	8 GB to 64 GB	SLC	5,333	530	400	-40 to 85
	A750Pi	SATA 6Gb/s	40 GB to 160 GB	3D TLC (pSLC mode)	9,600	560	520	-40 to 85
	A700Pi	SATA 6Gb/s	40 GB to 160 GB	3D TLC (pSLC mode)	6,400	560	520	-40 to 85
	A650Si / A650Sc	SATA 6Gb/s	240 GB to 960 GB	3D TLC	4,655	560	525	-40 to 85 / 0 to 70
	A600Si / A600Sc	SATA 6Gb/s	120 GB to 480 GB	3D TLC	1,396	560	510	-40 to 85 / 0 to 70
	A600Vc	SATA 6Gb/s	32 GB to 1 TB	3D TLC	2,792	560	525	0 to 70
SATA III 2.5" SSD	A800Pi	SATA 6Gb/s	8 GB to 256 GB	SLC	21,333	520	420	-40 to 85
	A750Pi	SATA 6Gb/s	80 GB to 640 GB	3D TLC (pSLC mode)	38,400	560	520	-40 to 85
	A700Pi	SATA 6Gb/s	80 GB to 640 GB	3D TLC (pSLC mode)	25,600	560	520	-40 to 85
	A650Si / A650Sc	SATA 6Gb/s	240 GB to 1,920 GB	3D TLC	9,310	560	525	-40 to 85 / 0 to 70
	A600Si / A600Sc	SATA 6Gb/s	120 GB to 1,920 GB	3D TLC	5,585	560	520	-40 to 85 / 0 to 70
	A600Vc	SATA 6Gb/s	32 GB to 1 TB	3D TLC	2,792	560	525	0 to 70
SATA III mSATA SSD	A800Pi	SATA 6Gb/s	8 GB to 128 GB	SLC	10,667	530	430	-40 to 85
	A750Pi	SATA 6Gb/s	40 GB to 160 GB	3D TLC (pSLC mode)	9,600	560	520	-40 to 85
	A700Pi	SATA 6Gb/s	40 GB to 160 GB	3D TLC (pSLC mode)	6,400	560	520	-40 to 85
	A650Si / A650Sc	SATA 6Gb/s	240 GB to 960 GB	3D TLC	4,655	560	525	-40 to 85 / 0 to 70
	A600Si / A600Sc	SATA 6Gb/s	120 GB to 480 GB	3D TLC	1,396	560	510	-40 to 85 / 0 to 70
	A600Vc	SATA 6Gb/s	32 GB to 1 TB	3D TLC	2,792	560	525	0 to 70
USB 3.2 NANODURA Dual	B600Sc	USB 3.2	32 GB to 128 GB	3D TLC	84	270	85	0 to 70
USB 2.0 NANODURA	B800Pi	USB 2.0	512 MB to 8 GB	SLC	192	31	21	-40 to 85
	B600Sc	USB 2.0	4 GB to 8 GB	MLC	9.6	26	10	0 to 70
USB 2.0 eUSB	B800Pi	USB 2.0	1 GB to 32 GB	SLC	1,548	36	25	-40 to 85
	B600Sc	USB 2.0	8 GB to 32 GB	MLC	38.4	25	19	0 to 70

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

Form Factor	Product Line Naming	Interface	Capacity	NAND	Reliability TBW (max) *	Sequential Performance MB/s (up to)		Operating Temperature (°C)
						Read	Write	
SD/ SDHC/ SDXC Card	S800Pi	HS mode / UHS-I	512 MB to 8 GB	SLC	192	68	39	-40 to 85
	S750Pi / S750Pc	UHS-I	16 GB to 128 GB	3D TLC (pSLC mode)	10,160	97	82	-40 to 85 / -25 to 85
	S700Pi / S700Pc	UHS-I	8 GB to 64 GB	3D TLC (pSLC mode)	582	98	80	-40 to 85 / -25 to 85
	S650Si / S650Sc	UHS-I	64 GB to 512 GB	3D TLC	1,400	97	76	-40 to 85 / -25 to 85
	S600Si / S600Sc	UHS-I	32 GB to 128 GB	3D TLC	77	94	55	-40 to 85 / -25 to 85
	S600Sc	UHS-I	8 GB to 16 GB	MLC	19	68	23	-25 to 85
	S600Si / Sc	UHS-I	8 GB to 256 GB	MLC / 3D TLC	307	96	65	-40 to 85 / -25 to 85
microSD/ microSDHC/ microSDXC Card	S800Pi	HS mode / UHS-I	512 MB to 8 GB	SLC	192	68	39	-40 to 85
	S750Pi / S750Sc	UHS-I	16 GB to 128 GB	3D TLC (pSLC mode)	10,160	97	82	-40 to 85 / -25 to 85
	S700Pi / S700Sc	UHS-I	8 GB to 64 GB	3D TLC (pSLC mode)	1,164	96	76	-40 to 85 / -25 to 85
	S650Si / S650Sc	UHS-I	64 GB to 512 GB	3D TLC	1,400	97	76	-40 to 85 / -25 to 85
	S600Si / S600Sc	UHS-I	32 GB to 256 GB	3D TLC	153	97	62	-40 to 85 / -25 to 85
	S600Sc	UHS-I	8 GB to 32 GB	MLC	38	68	24	-25 to 85

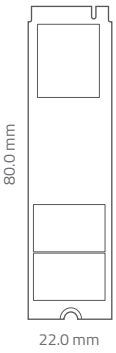
Form Factor	Product Line Naming	Interface	Capacity	NAND	Reliability TBW (max) *	Sequential Performance MB/s (up to)		Operating Temperature (°C)
						Read	Write	
PCIe® Gen4 NVMe CFexpress Card	N751Pi	PCIe G4 x2	40 GB to 320 GB	3D TLC (pSLC mode)	4,410	3,500	3,100	-40 to 85
	N651Si / N601Sc	PCIe G4 x2	128 GB to 1 TB	3D TLC	1,000	3,500	3,200	-40 to 85 / 0 to 70
CFast Card	A800Pi	SATA 6Gb/s	8 GB to 32 GB	SLC	2,667	500	300	-40 to 85
CompactFlash Card	I800Pi	UDMA 0~4	512 MB to 32 GB	SLC	1,280	61	55	-40 to 85
	I700Sc	UDMA 0~6	8 GB to 16 GB	Pseudo SLC	128	110	80	0 to 70
	I600Sc	UDMA 0~6	16 GB to 32 GB	MLC	38	108	46	0 to 70

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

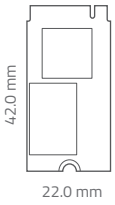
Form Factor	Product Line Naming	Interface	Capacity	NAND	Reliability TBW (max) *	Sequential Performance MB/s (up to)		Operating Temperature (°C)
						Read	Write	
e.MMC	E700Pa	v5.1, HS400	8 GB to 64 GB	3D MLC (pSLC mode)	1,213	300	240	-40 to 105 (Extended Industrial Grade)
	E600Sa	v5.1, HS400	16 GB to 128 GB	3D MLC	824	300	170	-40 to 105 (Extended Industrial Grade)
	E700Paa	v5.1, HS400	8 GB to 64 GB	3D MLC (pSLC mode)	1,213	300	240	-40 to 105 (AEC-Q100 Grade 2)
	E600Saa	v5.1, HS400	16 GB to 128 GB	3D MLC	824	300	170	-40 to 105 (AEC-Q100 Grade 2)
	E700Pia	v5.1, HS400	8 GB to 64 GB	3D MLC (pSLC mode)	1,320	300	240	-40 to 85 (AEC-Q100 Grade 3)
	E600Sia	v5.1, HS400	16 GB to 128 GB	3D MLC	824	300	170	-40 to 85 (AEC-Q100 Grade 3)
	E750Pi	v5.1, HS400	10 GB to 21 GB	3D TLC (pSLC mode)	1,034	295	215	-40 to 85 (Industrial Grade)
	E700Pi	v5.1, HS400	8 GB to 64 GB	3D MLC (pSLC mode)	1,320	300	240	-40 to 85 (Industrial Grade)
	E700Pi	v5.1, HS400	10 GB to 40 GB	3D TLC (pSLC mode)	1,364	290	225	-40 to 85 (Industrial Grade)
	E650Si	v5.1, HS400	32 GB to 64 GB	3D TLC	70	270	215	-40 to 85 (Industrial Grade)
	E600Si	v5.1, HS400	16 GB to 128 GB	3D MLC	824	300	170	-40 to 85 (Industrial Grade)
	E600Si	v5.1, HS400	32 GB to 128 GB	3D TLC	52	290	225	-40 to 85 (Industrial Grade)
	E750Pc	v5.1, HS400	10 GB to 21 GB	3D TLC (pSLC mode)	1,034	295	215	-25 to 85 (Commercial Grade)
	E700Pc	v5.1, HS400	10 GB to 40 GB	3D TLC (pSLC mode)	1,364	290	225	-25 to 85 (Commercial Grade)
	E650Sc	v5.1, HS400	32 GB to 64 GB	3D TLC	70	270	215	-25 to 85 (Commercial Grade)
	E600Vc	v5.1, HS400	32 GB to 128 GB	3D TLC	52	290	225	-25 to 85 (Commercial Grade)
	E600Vc	v5.1, HS400	32 GB	3D TLC	8.3	250	135	-25 to 85 (Commercial Grade)
PCIe® Gen3 NVMe M.2 Type 1620 HSBGA SSD	N700Pi / N700Pc	PCIe G3 x4	40 GB to 160 GB	3D TLC (pSLC mode)	4,280	2,000	1,600	-40 to 85 / 0 to 70
	N600Vi / N600Vc	PCIe G3 x4	120 GB to 480 GB	3D TLC	768	2,050	1,550	-40 to 85 / 0 to 70

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

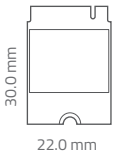
Product Dimensions (Size) Comparison



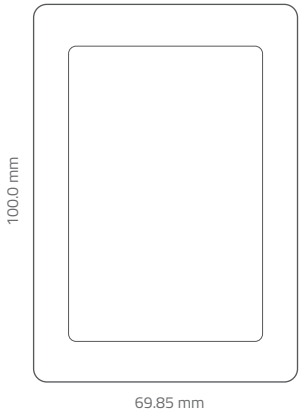
M.2 2280 SSD



M.2 2242 SSD

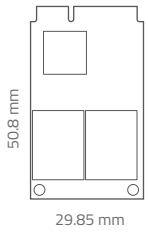


M.2 2230 SSD

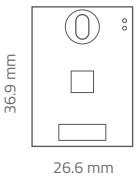


U.2 SSD / 2.5" SSD

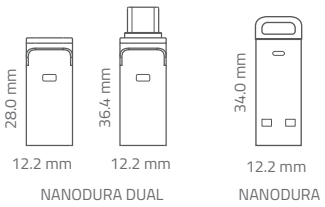
E1.S SSD (Coming Soon)



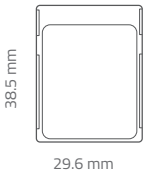
mSATA SSD



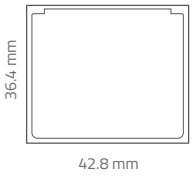
eUSB



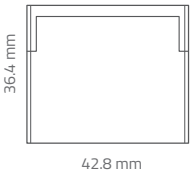
USB Drive



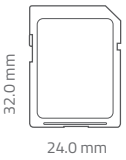
CFexpress Card



Compact Flash Card

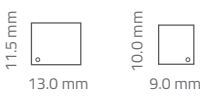


CFast Card

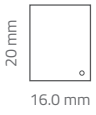


SD Card

microSD Card



e.MMC



M.2 Type 1620 HSBGA SSD

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