INDUSTRIAL ONLY

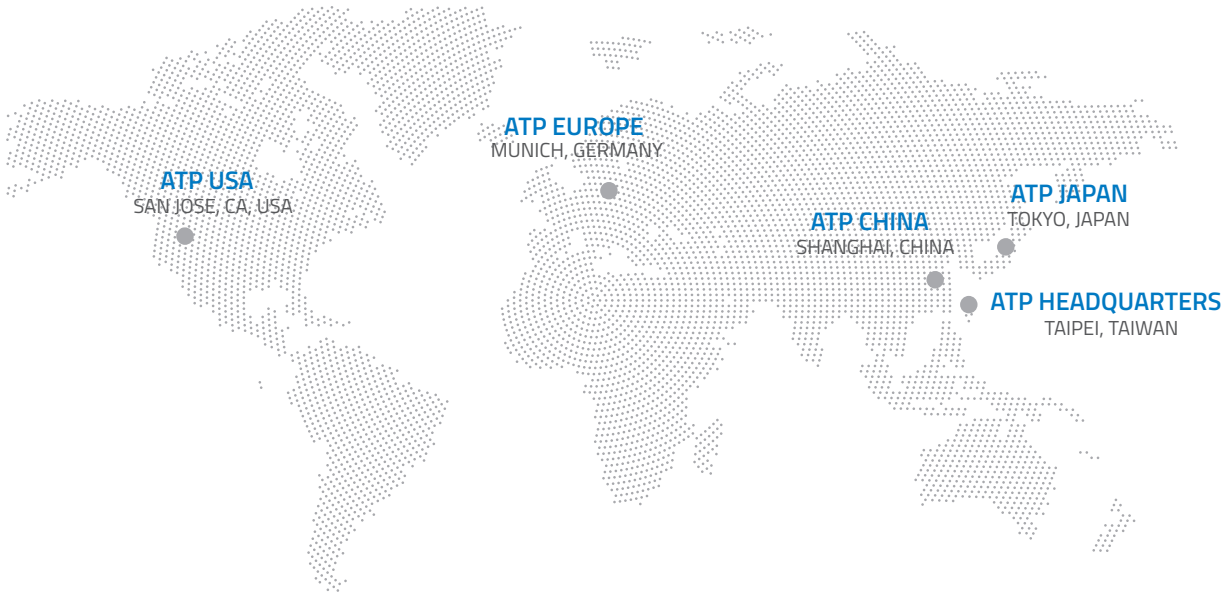
2019 Product Catalog

Memory & Storage Solutions

Targeted Product Portfolio
Engineered Specifically
for Your Mission-Critical Applications

ATP Global Footprint

ATP Electronics started its operations in Silicon Valley, California, USA in 1991. In 2001, it moved its headquarters in Taipei, Taiwan with manufacturing facilities in Kaohsiung. Today, ATP Electronics has extended its global presence in five countries with support sales and service offices as well as several global and regional franchised distributors including representatives proudly carrying the ATP brand. Additionally, ATP's personnel distribution shows ATP's strong commitment to and focus on delivering quality products and excellent service, with engineering and technical staff making up majority of the total global workforce.



ATP TAIWAN
Headquarters

TEL: +886-2-2659-6368
FAX: +886-2-2659-4982
sales-apac@atpinc.com
10F, No. 185, Tiding Blvd. Sec. 2,
Neihu, Taipei,
Taiwan 11493

ATP USA

TEL: +1-408-732-5000
FAX: +1-408-732-5055
sales@atpinc.com
2590 North First Street,
Suite #150 , San Jose, CA 95131,
USA

ATP EUROPE

TEL: +49-89-374-9999-0
FAX: +49-89-374-9999-29
sales-europe@atpinc.com
Max-Planck-Str. 5,
D-85716 Unterschleißheim,
Germany

ATP JAPAN

TEL: +81-3-6260-0797
FAX: +81-3-6260-0798
sales-japan@atpinc.com
Advance Kamichi Building 6F,
1-2-7 Kita-Shinagawa,
Shinagawa-ku, Tokyo
140-0001 Japan

ATP CHINA

TEL: +86-21-5080-2220
FAX: +86-21-9687-0000-026
sales@cn.atpinc.com
2F, Building 15, No. 115, Lane 572,
Bibo Road, Zhangjiang High-Tech Park
Pudong, Shanghai, China 201203

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About ATP

ATP Electronics is a leading original equipment manufacturer (OEM) of high-performance, high-quality and high-endurance NAND flash products and DRAM modules. Since its inception in 1991, ATP has established itself as a manufacturing leader providing industrial memory and storage solutions designed and built to accomplish mission-critical tasks in diverse industries where high levels of technical proficiency, manufacturing quality, and wide operating temperature ranges are required.

For nearly three decades, ATP has been an established name trusted in key industries, such as:

- Networking/Telecommunications
- The Internet of Things
- Automotive Computing
- Automation
- Industrial/Embedded PC
- Health Care
- Enterprise Mobility
- Aerospace and Defense
- ...and many more

As a true manufacturer, ATP manages 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 the ATP 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. When even the shortest down time and milliseconds of latency can impact business operations, ATP memory and storage products can be trusted to accomplish mission-critical as well as time-critical tasks.

Product Portfolio

e.MMC

Memory Cards

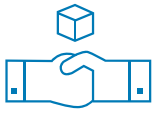
Embedded Modules

SSDs

DRAM Modules

The ATP Brand Promise

Every product stamped with our company name comes with ATP's solid commitment.



Advanced Capabilities

- **Strategic partnerships** with industry leaders ensure high-quality components and stable supply. Proactive supply chain disaster recovery planning involves dual-sourcing strategy to ensure supply stability. Controlled BOM guarantees long product cycles with buffer inventory.
- **Long-term support for legacy systems.** ATP's strategic partnership with Micron Technology, Inc. under the Product Longevity Program (PLP) and DDR2 Continuity Program ensures long-term bill of materials (BOM) stability.
- **Complete process ownership** allows ATP to maintain complete control of its supply chains and take charge of all stages of the manufacturing process.

Innovative Technology

- **State-of-the-art manufacturing technologies** along with unique features and value-added solutions maximize your investment.
- **Top-of-the-line engineering support capabilities** enable ATP to meet your customization requirements.
- **OEM Joint Validation Program.** ATP conducts compatibility and function tests with client-supplied host devices and systems to proactively detect and minimize failures that may not have been caught in production tests.

Reliable Products

- **Rigorous testing and validation** from IC to module/drive level ensure reliable performance and longevity in demanding environments.
  - IC-level testing ensures die reliability.
  - Module/Drive-level testing covers design and layout, controller hardware and firmware validation.
  - Mass Production-level Rapid Diagnostic Test (RDT) establishes 100% proven reliability at MP scale.
- **World-class engineers and technology experts** at ATP-owned manufacturing facilities and service centers are on hand to meet customer and industry requirements.

Industry Associations and Compliances

The ATP Advantages

Strategic Partnerships

ATP partners with top-tier suppliers to ensure the highest product quality, longevity and availability. Through years of collaboration with its partners, ATP remains resilient even in the face of industry crises, such as when the global memory industry faced a NAND and DRAM shortage in 2017, threatening the survival of many companies because of allocation. ATP delivered 100% of its commitments, thanks to its strategic partners.

Supply Stability and Flexibility

Proactive supply chain planning entails roadmap and capacity alignment several years ahead. Dual-sourcing strategy ensures supply stability, controlled BOM guarantees long product cycles, and buffer inventories are aligned with sales forecasts in close coordination with customers to meet long-term supply requirements. With NAND flash stability and control, ATP provides better Last Time Buy (LTB) and Last Time Ship (LTS) control over the product life cycles, better return on investment (ROI) and lower total cost of ownership (TCO).

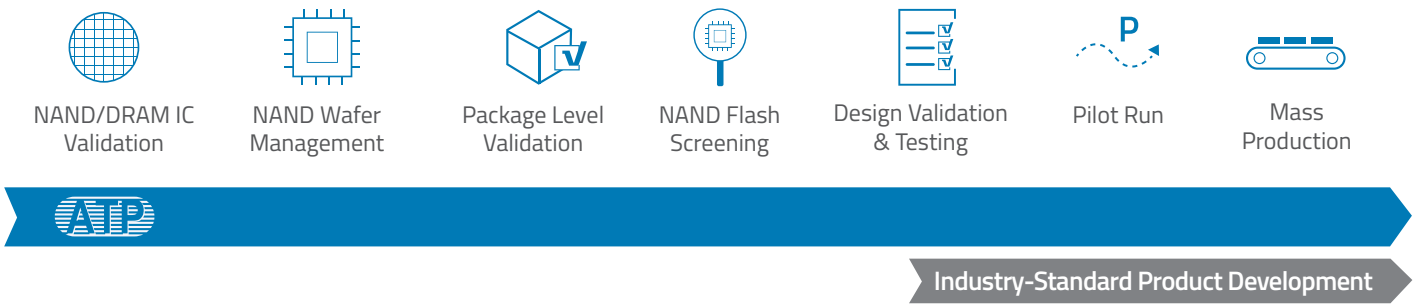
Stringent Testing and Validation

ATP performs comprehensive testing and validation on all its memory and storage products to ensure total product reliability from the IC to module and drive level. With ATP-designed test systems and ATP-developed programs together with the most advanced industrial testing equipment, all products go through functional, electro-mechanical, environmental tests and more to screen out weak components, reduce failures and deliver the highest-quality products to its customers.

Exclusive Inside Peek:
Our Passion for Precision and Reliability

ATP as a True Manufacturer

As a true manufacturer, ATP maintains complete control of its supply and value chains and takes charge of all the stages of the manufacturing process. The quality journey begins with the wafer management and package level validation which provides the very basic component level, the ICs, which serve as the building blocks of all ATP products.



Three Stages of ATP's Complete Process Ownership

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

NAND Flash IC Level

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

Mass Production Level

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

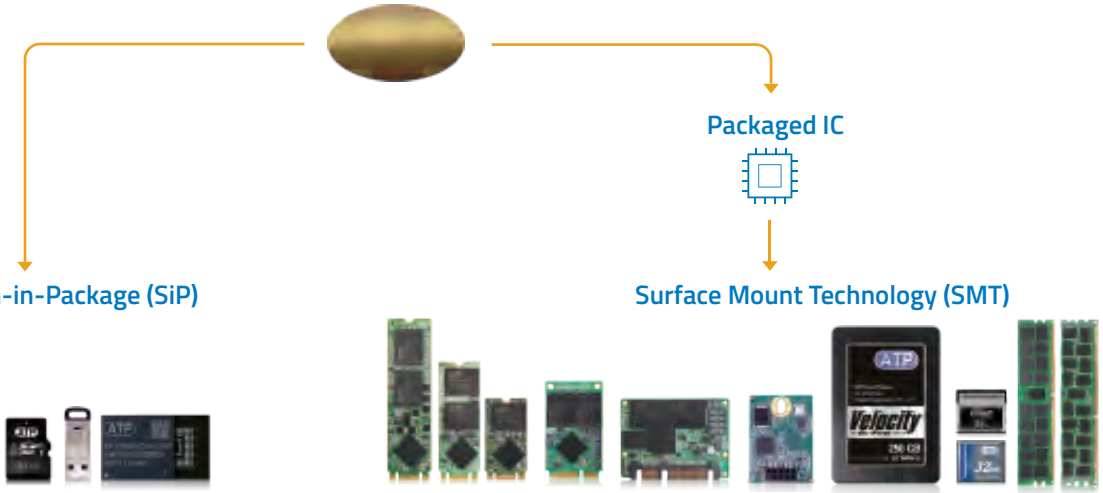
Module Level

To ensure complete module functionality and reliability, ATP performs:

- Module design/layout validation
- Controller hardware validation
- Controller firmware/FTL (flash translation layer) validation
- OEM customer joint validation: Compatibility testing for new device; module-level validation with host platform

Key Manufacturing Processes

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



SiP Process

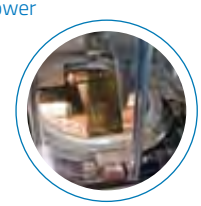
Integrates components within a single package. ATP's SiP process encapsulates all exposed components to provide protection and shielding.

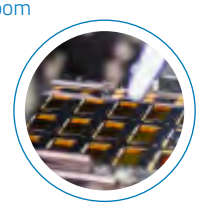

Air Shower

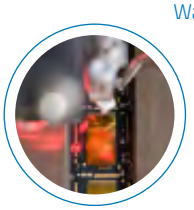

Clean Room

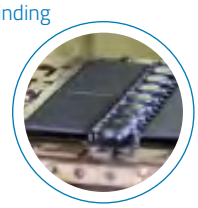

Wafer


Wafer Grinding


Wafer Saw


Die Attach


Wire Bonding


Molding

Surface Mount Technology

ATP's SMT process includes mandatory 100% Solder Paste Inspection (SPI) In-Line System, which is optional for other manufacturers. In ATP's N_2 Reflow, oxygen concentration is 5X lower—just under 1000 ppm—to avoid oxidation, while other manufacturers typically have 5000 ppm.


Solder Paste Printing


Solder Paste Inspection


Component Placement


N_2 Reflow


Automatic Optical Inspection


PCB Depanelization

Our Passion for Technological Leadership

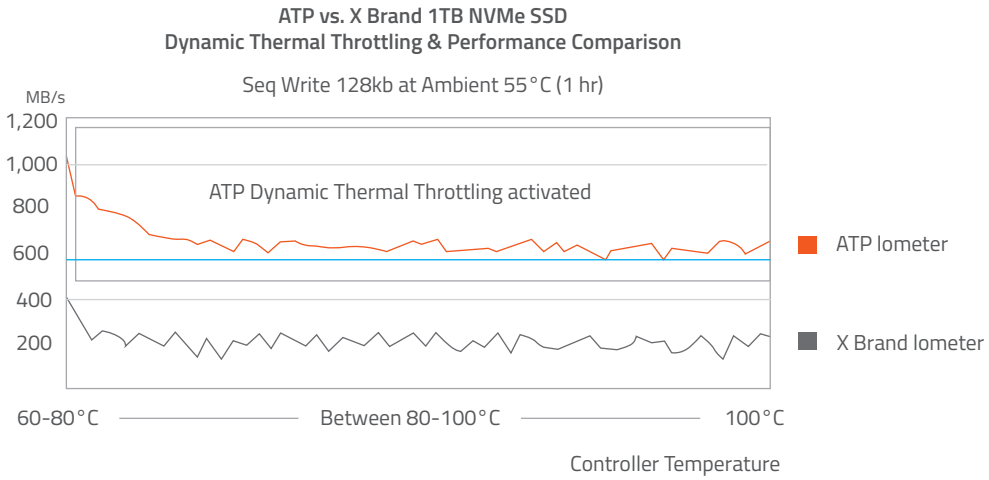
In this section, we highlight unique technologies for specific product lines. Please refer to the respective product pages for detailed specifications.

M.2 NVMe™ SSD: Dynamic Thermal Throttling

Under heavy workloads, the flash storage device operates at high speeds that could cause temperatures to rise rapidly. When the thermal sensor detects that the temperature is about to reach the threshold value that could potentially damage the data and the device, ATP Dynamic Thermal Throttling automatically activates to prevent overheating.

ATP Dynamic Thermal Throttling intelligently regulates speed and power to reduce heat without aggressive declines in performance. It keeps the SSD from overheating while maintaining optimal performance and prevents abrupt drops leading to unstable operation.

ATP flash storage solutions have been found to perform better than other brands even with ATP Dynamic Throttling activated while operating at full strength. By ensuring that the flash storage device is performing within temperature threshold values, ATP Dynamic Throttling ensures data reliability and minimizes drive replacements.



Please refer to page 31 for more information on ATP M.2 NVMe SSDs.

e.MMC: SRAM Soft Error Detection and Recovery*

SRAM soft errors randomly corrupt memory bits and alter stored data but do not cause physical damage to the memory or storage device. Such errors can significantly jeopardize data accuracy because they cannot be detected nor solved by ECC engines.

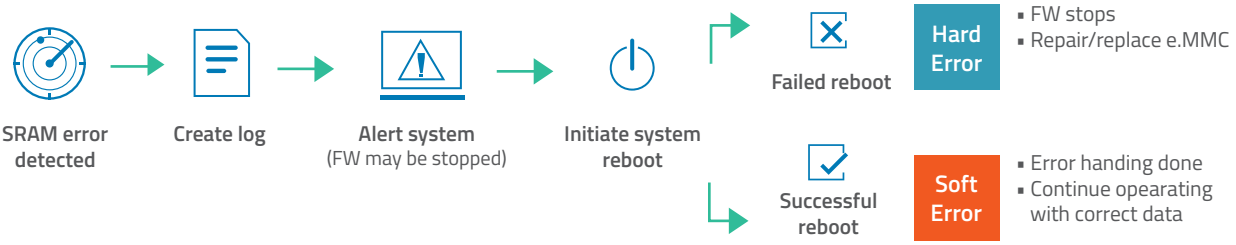
The SRAM Soft Error Detection and Recovery mechanism maximizes data integrity by monitoring and detecting soft error risks. As soon as an SRAM error is detected, a log is created in the flash. Depending on the configuration predetermined by the customer, the mechanism may alert the system, stop the firmware, and then attempt to correct the error by initiating a system reboot (Host cooperation may be required).

If the reboot fails, then it means that it was a hard (physical) error and the device should be removed and replaced. If the reboot succeeds, it is confirmed that the soft error is successfully handled, and the user can continue operating with the correct data.

SRAM Soft Error Detection and Recovery can guarantee better system stability, high levels of data integrity, and optimal device endurance.

Please refer to page 37-38 for more information on ATP e.MMC.

*Error alerts and handling may vary depending on configuration pre-determined by the user. The user will be unable to modify the configuration on the field.



DRAM: Mini-Chamber Testers for TDBI

Burn-in is one of the most effective ways to demonstrate module reliability. It involves subjecting memory modules to extreme temperatures to accelerate failure in order to screen out weak ICs and further characterize products according to customer requirements.

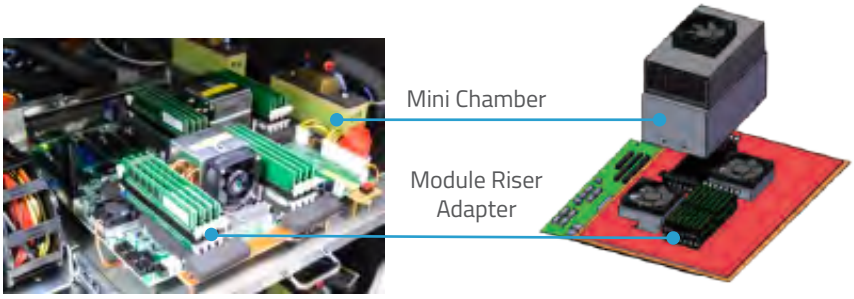
In conventional test during burn-In (TDBI), entire motherboards installed with DRAM modules are placed inside a chamber. Since all components are thermally stressed, this method causes false failures whereby non-DRAM components also fail, necessitating retesting and increasing test time.

ATP TDBI aims to effectively screen out defective DRAM chips that will potentially fail during the early life failure (ELF) period. By ensuring that only robust DRAM chips are on the module, TDBI can significantly lower failure rates and extend the product service life. The ATP TDBI system simulates the ELF period by applying extreme high/low temperature, high/low voltage, and pattern testing on the DRAM modules.

The ATP-designed uses mini-chamber TDBI testers that isolate temperature profile testing only to the DRAM modules. This allows faster debug for defects per million (DPM) fallout and reduces false failures.

To prevent wearing out motherboard connectors with the constant swapping for DRAM modules being tested, module riser adapters elevate and extend the modules from the motherboard, allowing them to be fully immersed within the mini-chamber.

Multiple temperature sensors regulate temperature profiles, operating on a wide testing temperature range of -40° to 85°C.



Please refer to page 19-20 for more information on ATP DRAM Modules.

ATP Secure SD/microSD: Customized AES-256 Security

In mission- and safety-critical operations, it is extremely important to use only authorized memory cards with licensed content.

Typically, cards have a unique Card Identification (CID) as a key so the hosts can identify approved cards with matching contents. However, the CID is defined by SD Association specifications and is readable with SD standard Command. Thus, the CID may be replicated in unauthorized SD cards.

ATP Security SD Overview and Benefits

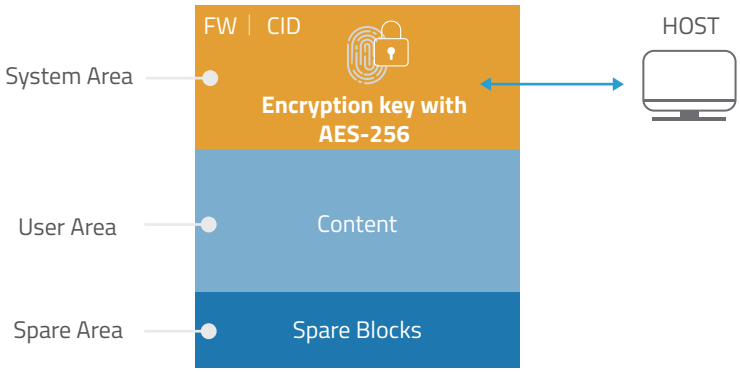
To make sure that the host will not accept unauthorized cards with unlicensed content, ATP encrypts the designated key with AES-256, the proven encryption standard certified by the National Security Agency (NSA). The authentication code is safely hidden within the card's System Area and can only be accessed by a special vendor command.

ATP offers a secure and cost efficient solution and can develop the encryption formula together with the customer's software team.

As soon as the authentication code is authorized, the host can access and read the memory card's contents. Only the key is encrypted/decrypted, so normal operation is not affected after the authentication process.

Use Cases

ATP's secure memory cards are best used in applications where authorization of storage device is required for content access, such as point-of-sale (POS) systems, navigations, digital signages, and devices to store application programs.



Please refer to page 26-28 for more information on SD/microSD Cards.

Trustworthy Solutions & Technologies

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

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

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

AutoRefresh

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

Advanced Wear Leveling

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

Vibration-Proof BGA Package

The ATP e.MMC comes in a 153-ball fine pitch ball grid array (FBGA) package and is soldered directly to the printed circuit board, making it resistant against vibrations for reliable performance even during grueling operations.

PowerProtector

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.

Sudden Power-Off Recovery (SPOR)

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

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, defense, and business applications with intense security requirements.

TCG Opal 2.0

Supported on ATP's M.2 NVMe SSDs, the 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.

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

Industrial Temperature

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

SiP (System in Package)

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

Conformal Coating

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

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.

3D NAND Flash Technology

Stacking up vertically instead of scaling down planarly expands the capacity within the limited die size. It also delivers better performance, endurance and data retention by reducing cell-to-cell interference and utilizing proven architecture and technology suitable for withstanding a wide operating temperature range from -40°C to 85°C.

ATP Dynamic Thermal Throttling

ATP Dynamic Thermal Throttling intelligently regulates speed and power to reduce heat without aggressive declines in performance. It keeps the SSD from overheating while maintaining optimal performance and prevents abrupt drops leading to unstable operation.

Thicker Gold Finger

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

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.

Read Retry

Read Retry allows the adjustment of reference voltage in multi-level cell (MLC) flash memory so that the four memory states are distributed and significantly separated from each other in order to prevent retention errors and ensure that data is read accurately.

Add-On Services

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)

Components are subjected to low and elevated temperatures within an enclosed chamber to detect failure as a result of high-failure rates in the early life failure (ELF) period.

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.

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, and DDR4 modules including the latest DDR4-2933. They are available as RDIMM, RDIMM VLP, UDIMM/UDIMM ECC, SO-DIMM/SO-DIMM ECC, SO-CDIMM, Mini-RDIMM, and Mini-UDIMM/Mini-UDIMM ECC.

What's New

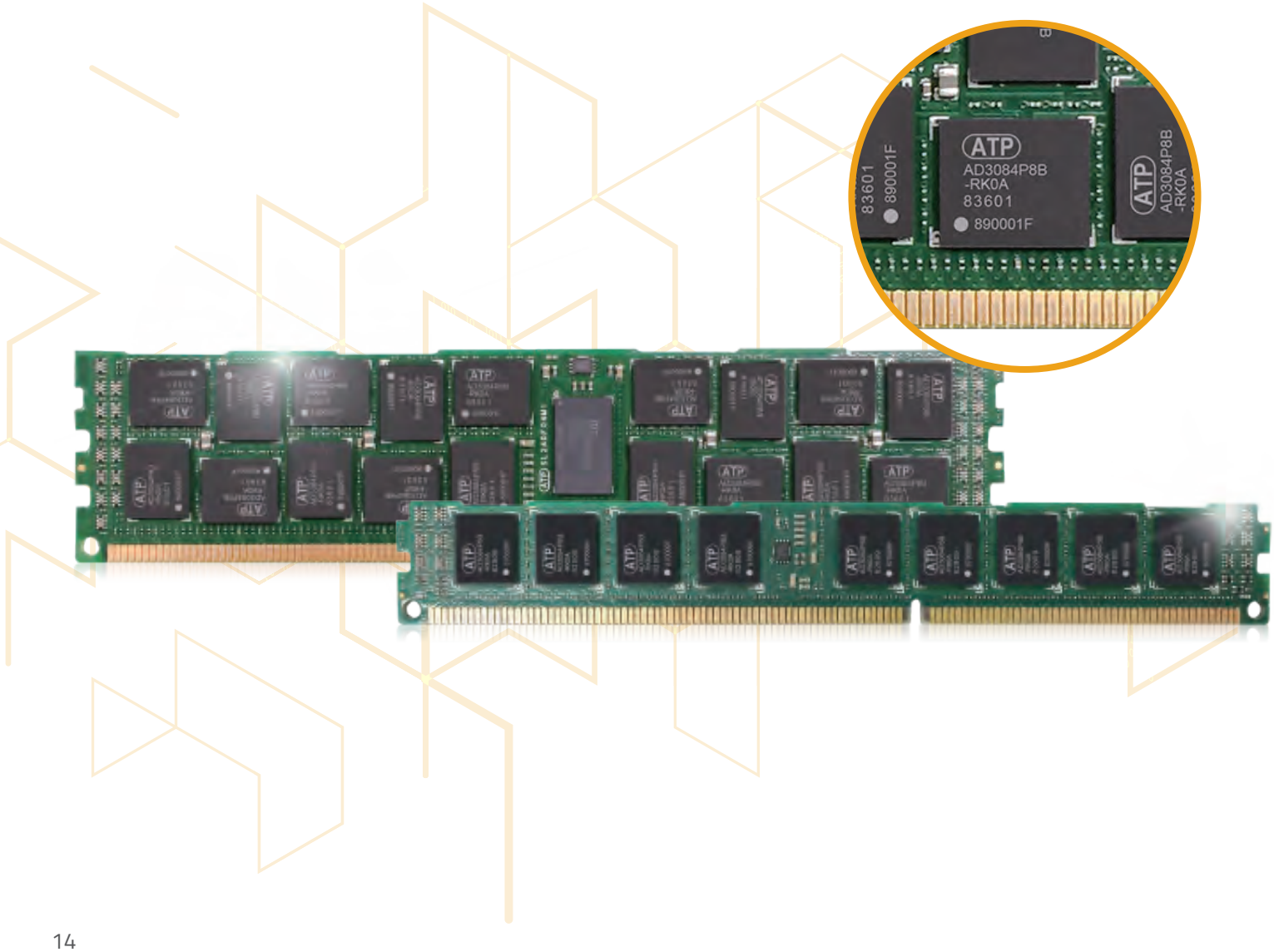
ATP Reaffirms Commitment to Long-Term DDR3 Legacy Memory Module Supply with ATP DDR3 8 Gbit components

As the DRAM market makes a steady migration to DDR4 memory, several key manufacturers have already announced end-of-life (EOL) production of DDR3 modules based on high density DDR3 8 Gbit components including EOL notice of the components. However, a sizable number of customers in the networking and embedded industries are still unable to shift to the latest generation and continue to use legacy systems requiring specific DDR3 memory such as VLP RDIMMs or high-density SO-DIMMs. To avert a supply shortage that could adversely affect these customers' business operations, ATP has decided to provide its own DDR3 8 Gbit components for these modules.

ATP-Built from IC to Module

ATP's own-built DDR3 modules consist of meticulously characterized and tested high-quality integrated circuits (ICs). The components are manufactured according to ATP's exacting standards using 2x nm manufacturing process technology and are tested via an extensive component test program to improve the overall memory module performance.

ATP DDR3 8 Gbit components are free from row hammer effects, thus preventing any disastrous random bit flips caused by the electrical charge of cells leaking to adjacent cells and successively writing data to them. At module level, ATP implements 100% test during burn-in (TDBI) into the production flow to guarantee the high quality module.



ATP DDR3 Configurations

A typical monolithic DDR3 DRAM chip has a density of 4 Gigabits (Gb). To pack 8 Gb in a monolithic DRAM die, manufacturers employ a die-stacking method called dual-die package (DDP), which combines two bare memory dies within a single chip package. Each die has a separate set of control lines where each memory die is separately selectable, and the processor treats the chip as two components despite being in the same package.

ATP DDR3 components are available in monolithic 8 Gb one-chip select (1CS) or as DDP two-chip select (2CS) for a variety of memory modules based on this technology.

With ATP's own-built DDR3 modules, the company reaffirms its commitment to continue supporting legacy memory requirements to maximize customers' infrastructure investments.

DDR3 DIMM								
Capacity (GB)	Form Factor	ECC	Org	Ranks	Component Org	Component Qty.	Technology	Speed up to (MT/s)
32	LRDIMM	Yes	4Gx72	4	1Gx4x2R	36/72 Die	DDP	1600
32	RDIMM	Yes	4Gx72	4	1Gx4x2R	36/72 Die	DDP	1333
16	VLP RDIMM	Yes	2Gx72	2	1Gx4x2R	18/36 Die	DDP	1600
16	UDIMM	Yes	2Gx72	2	1Gx8	18	Mono	1600
16	UDIMM	No	2Gx64	2	1Gx8	16	Mono	1600

DDR3 SO-DIMM								
Capacity (GB)	Form Factor	ECC	Org	Ranks	Component Org	Component Qty.	Technology	Speed up to (MT/s)
16	SO-DIMM ECC	Yes	2Gx72	2	1Gx8	18	Mono	1600
16	SO-DIMM	No	2Gx64	2	1Gx8	16	Mono	1600

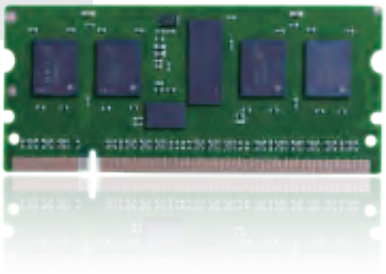
DDR3 Mini-DIMM								
Capacity (GB)	Form Factor	ECC	Org	Ranks	Component Org	Component Qty.	Technology	Speed up to (MT/s)
16	Mini-RDIMM	Yes	2Gx72	2	1Gx8	18	Mono	1600
16	Mini-UDIMM	Yes	2Gx72	2	1Gx8	18	Mono	1600
8	VLP Mini-UDIMM	Yes	1Gx72	2	512Mx8x2R	9/18 Die	DDP	1600
8	VLP Mini-RDIMM	Yes	1Gx72	2	512Mx8x2R	9/18 Die	DDP	1600

Micron and ATP Collaborate on DDR2 Continuity Program Partnership Agreement Ensures Legacy DRAM Module Supply

ATP Electronics, Inc. and Micron Technology, Inc. have signed a partnership agreement to make sure that Micron DDR2 SO-DIMMs, UDIMMs and RDIMMs will continue to be available after Micron announced end-of-life (EOL) notices for these modules. According to the agreement, ATP will manufacture DDR2 DRAM modules for customers that cannot upgrade to newer-generation platforms and continue to use platforms supporting these memory types.

With DDR2 still widely deployed in the US, Japan and Europe, ATP and Micron expect these markets to benefit significantly from the consistent supply of DDR2 memory for industrial/embedded systems installed in high-reliability and mission-critical environments. All modules will be 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, Vice President, Micron Technology, Inc.



Product Information

Module Type	DDR2 RDIMM	DDR2 UDIMM	DDR2 SO-DIMM	DDR2 SO-DIMM
Capacity	1 GB / 2 GB	1 GB / 2 GB	512 MB / 1 GB / 2 GB	256 MB / 1 GB / 2 GB / 4 GB
Function	Registered ECC	Unbuffered ECC/ Unbuffered Non-ECC	Registered ECC	Unbuffered Non-ECC
Frequency	800 MHz	800 MHz	800 MHz	800 MHz
Number of Pins	240	240	200	200
PCB Height	0.70"	1.18"	1.18"	1.18"

Legacy (SDR/DDR) DRAM Modules

Micron endorses ATP as a partner to support selected SDR/DDR DRAM Modules

Under a license agreement with Micron Technology, Inc. signed in August 2015, ATP will continue to manufacture legacy (SDR/DDR) DRAM modules for Micron's customers who are unable to migrate. The agreement was expanded in 2016 with the addition of selected legacy DRAM modules specifically for customers using AMD Embedded/Geode platforms.

The expanded coverage demonstrates the strong partnership between ATP and Micron. As a strategic partner, ATP works closely and exclusively with Micron to transfer module designs and extend long-term support to offer the legacy modules in selected form factors (SO-DIMM, UDIMM and RDIMM) and densities, along with ATP's unique services and features.

The license agreement stipulates the following conditions for ATP:

- **100% follow Micron's design.** Offer extended support for these legacy products to minimize the customer's (re)qualification efforts.
- **100% follow Micron's BOM selection.** Implement the same 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.

Endorsements

"Micron Technology, Inc. is committed to supporting legacy application requirements. By partnering with ATP, we're able to provide stability for our customers who are unable to transition their existing platforms." - Bruce Franklin, Product Marketing Director, Micron's Embedded Business Unit

"Embedded applications require a long life cycle, which is why AMD is pleased to collaborate with ATP and Micron to support the extended life of AMD's Geode platform. ATP's legacy SDR/DDR SO-DIMM module solutions utilizing Micron memory are a critical component to industrial control and automation, industrial PCs, HMI panels, point of sales and communication applications." - Colin Cureton, Product Marketing Manager, AMD Embedded Solutions

Product Information

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

Build To Order (BTO)				
Module Type	DDR RDIMM	DDR UDIMM	DDR SO-DIMM	SDRAM SO-DIMM
Capacity	1 GB / 2 GB	256 MB / 512 MB	256 MB / 512 MB / 1 GB	64 MB / 128 MB / 256 MB / 512 MB
Function	Registered ECC	Unbuffered ECC/ Unbuffered Non ECC	Unbuffered ECC	Unbuffered Non ECC
Frequency	400 MHz	400 MHz	400 MHz	133 MHz
Number of Pins	184	184	200	144
PCB Height	1.125"/1.2"	1.25"	1.25"	1.0"/1.25"

ATP DRAM Unique Features

Unique memory technologies and solutions enable ATP DRAM modules to deliver peak performance and exceptional reliability in any demanding industrial computing environment.

Industrial Temperature

ATP DRAM modules can endure extreme temperatures ranging from -40°C to 85°C, ensuring long-term stability for systems installed in telecom, industrial and military/aerospace operations where consistent availability and steadfast performance are of critical importance.

ATP's modules undergo two levels of testing to ensure maximum reliability:

1. **Advanced IC Level Testing** screens for ICs with the best reliability and quality characteristics that are suitable for applications requiring wide temperature.
2. **Enhanced Module Level Test During Burn-In (TDBI) and Automatic Test Equipment (ATE)** guarantee that modules meet and even exceed qualifying parameters.

Conformal Coating

A protective layer of Parylene is applied to electronic circuits and modules, accessing spaces as narrow as 0.01 mm to shield against dust, chemical, extreme temperatures, moisture and corrosion. The coating film is formed by the chemical vapor deposition (CVD) process, and unlike dipping and spraying techniques, is completely pinhole free as the film conforms to any irregular shape, forming a vacuum-like environment to coat all components and points of failure.

Increased Thickness, Strength

In order to ensure the quality of the signal transmission between the connector and ATP DRAM module, ATP utilizes gold finger plating with 30μ” thickness, compared to competitors' DRAM modules thickness typically at less than 10μ”.

Anti-Sulfur Resistors

Ordinary silver resistors corrode and become non-conductive when exposed to sulfur. ATP DRAM modules use anti-sulfur resistors that repel the damaging 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.

DRAM Modules

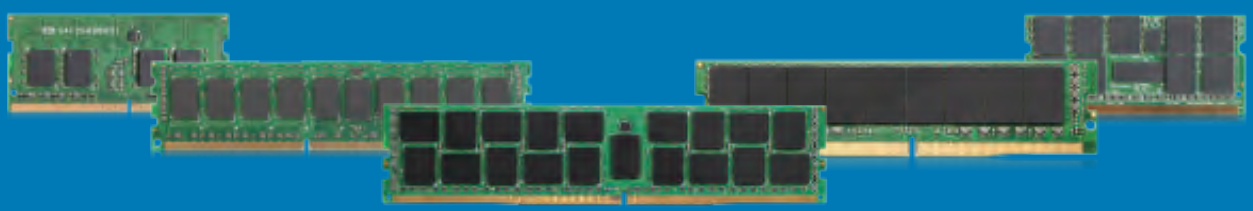
Multi-Generational Accelerated Computing

ATP DRAM modules meet the growing need for accelerated performance in memory-intensive and high-performance computing applications to keep up with intensifying data processing requirements as the Internet of Things (IoT) and industrial IoT (IIoT) inevitably become more pervasive. Multi-generational solutions range from legacy DDR3/DDR2/DDR1 to the latest DDR4-2933 modules, which deliver robust performance, durable build and the right density for the toughest workloads.

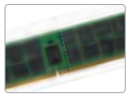
Key Differentiators*

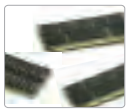
- **Wide Temperature.** Industrial-grade performance with wide-temperature ICs supporting -40°C to 85°C operating range.
- **Product Longevity Program.** Micron Technology, Inc. endorses ATP as a partner to support selected SDR/DDR/DDR2 modules. ATP will continue to manufacture legacy SDR/DDR/DDR2 DRAM modules for Micron's customers that are unable to migrate, including selected legacy DRAM modules specifically for customers using AMD Embedded/Geode platforms.
- **Module-Level TDBI.** Test During Burn-In (TDBI) combines temperature, load, speed and time to stress test memory modules and expose weak modules. Even just 0.01% error on a 99.99% effective device can increase the failure rates at the module level and lead to failure in actual usage. ATP's module-level TDBI can detect and screen out the 0.01% error to ensure utmost reliability.

* May vary by product and project support.



Complete DRAM Portfolio

Product	Category	Speed (MT/s)	Form Factor	Features
DDR4 	LRDIMM/RDIMM UDIMM/UDIMM ECC SO-DIMM/SO-DIMM ECC/ SO-RDIMM Mini-RDIMM Mini-UDIMM ECC	2933 2666 2400 2133	▪ Low profile ▪ Very Low Profile (VLP) options (VLP: 0.74" height) ▪ Ultra Low Profile (ULP) options (ULP: 0.7"~0.72" height)	▪ Density: 2 GB to 64 GB ▪ Increased performance and bandwidth (up to 3200 MT/s) ▪ Decreased voltage for better power consumption ▪ Provides better reliability, availability and serviceability (RAS) and improves data integrity.
DDR3 	RDIMM UDIMM/UDIMM ECC SO-RDIMM SO-DIMM/SO-DIMM ECC Mini-RDIMM Mini-UDIMM ECC	1866 1600 1333 1066	▪ Low profile ▪ Very Low Profile (VLP) options (VLP: 0.74" height) ▪ Ultra Low Profile (ULP) options (ULP: 0.7"~0.72" height)	▪ Density: 1 GB to 32 GB ▪ Chipkill support ▪ Fly-by command/address/control bus with on-DIMM termination. ▪ Higher bandwidth performance, effectively up to 1866 MT/s ▪ Better performance at low power; 1.5 V (Normal) and 1.35 V (Low Voltage)
DDR2 	RDIMM UDIMM/UDIMM ECC SO-RDIMM SO-CDIMM SO-DIMM Mini-RDIMM	800 667 533 400	▪ Low Profile ▪ Very Low Profile (VLP) options (VLP: 0.72"~0.74" height)	▪ Density: 1 GB to 8 GB ▪ Chipkill support
DDR* 	UDIMM/UDIMM ECC SO-CDIMM SO-DIMM	400 333 266	▪ Low Profile	▪ Chipkill support ▪ Legacy system support
SDRAM* 	SO-DIMM	133 100	▪ Low Profile	▪ Legacy system support

Product Portfolio	Category	Product	Features
Industrial Grade Family 	SO-DIMM UDIMM RDIMM Mini-DIMM	DDR4 DDR3 DDR2 DDR* SDRAM*	▪ Extended temperature: -40°C ~ 95°C ▪ Controlled BOM and SPD ▪ For mission-critical industrial applications ▪ Conformal Coating

* Available on a project basis.

Flash Solutions

Ruggedized Industrial Flash Products for Mission-Critical Applications

ATP's industrial flash products deliver dependable performance, efficient responsiveness, and long usage life to accomplish mission-critical tasks. Sturdy and built to withstand rigorous operating environments, ATP flash storage comes in different form factors such as 2.5" SSDs, M.2 embedded modules, mSATA, SlimSATA, CFast, CompactFlash, SD/microSD memory cards, and USB drives for enterprise and industrial applications. They support high-speed interfaces such as SATA 6 Gb/s and the latest NVMe™ protocol on a PCIe® 3.0 x4 interface for reliable, blazing-fast, and future-ready performance. ATP's latest flash offering is the automotive/industrial grade e.MMC, a managed NAND solution that complies with JEDEC Standard 5.1.

Automotive Edition

All-terrain solutions for the road ahead

Today's vehicles are no longer just means of transportation. They also provide information and entertainment, can communicate with anything or anyone over a network and can perform functions with little to no human intervention. Driving them to unprecedented levels of connectivity and automation is a new kind of fuel: DATA. Applications such as maps/navigation systems, in-vehicle infotainment (IVI), Advanced Driver Assistance Systems (ADAS), and other data- intensive applications require higher levels of data accuracy, consistency and integrity to ensure safer and more comfortable driving.

With nearly 30 years of manufacturing leadership and a decade of automotive experience, ATP delivers automotive solutions trusted by major automotive OEM/Tier 1 suppliers, system developers and service providers. These solutions can withstand harsh environmental challenges such as unpredictable weather shifts, extreme temperatures, vibration, humidity, dust and shock/vibration. They maintain data integrity under power cycling or sudden power-off events and perform reliably over extended periods of time. ATP's automotive solutions comply with and are certified according to automotive -specific standards. Additionally, ATP-designed testing, validation and qualification processes ensure total reliability and longer service life.

Engineering Capabilities*

- ATP IVI Test Plan
- Selected AEC-Q100 test items and conditions approved by customers
- Power Cycling test: ATP unique F/W and testing script
- ATP NAND flash IC-level test (Data Retention, Endurance, Read Disturbance)
- Joint Validation: compatibility and function tests with IVI systems

*** May vary by product and project support.**

Please refer to Flash product pages for more information

Quality Capabilities*

- VDA 6.3/APQP/ASPICE
- Certifications: ISO9001, ISO14001, IATF16949
- Product Validation: PPAP
- IMDS (International-Material-Data-System)
- Continuous improvement — 8D reports and failure analysis

*** May vary by product and project support.**

What's New

I-Temp ATP NVMe™ SSDs Break Speed Limits in Extreme Temperatures

Hard-wired for speedy, secure and stable performance whether it's freezing cold or blazing hot

ATP's industrial temperature-rated M.2 NVMe SSDs can perform dependably in tough environments within a wide temperature range of -40°C to 85°C. With up to 1 TB capacity, these SSDs in the M.2 2280 form factor offer high-speed, high-density, and high-performance storage, making them perfect for compact and fanless embedded systems. They leverage the blazing-fast PCI Express® (PCIe®) interface to deliver dramatic improvements in speed and performance with up to 32 Gb/s bandwidth on a PCIe 3.0 x4 slot (8 Gb/s per lane), outperforming Serial ATA 6 Gb/s SSDs with 4-6X faster access, over 3X lower latency, and higher Input/Output per Second (IOPS).

ATP Dynamic Thermal Throttling intelligently keeps the SSD device from overheating without drastically impacting performance, enabling ATP NVMe SSDs to perform better than other brands even with Dynamic Throttling activated while operating at full strength. ATP NVMe SSDs are self-encrypting storage devices complying with TCG Opal 2.0 specifications and employing Advanced Encryption Standard (AES) 256-bit technology to ensure that data is secure and protected.

ATP Automotive and Industrial-Grade e.MMC: Built Small for Big Storage Demands

Soldered-down tiny storage delivers solid performance and reliability in challenging operating environments

Following its introduction of the industrial e.MMC, ATP launches the automotive-grade e.MMC, further expanding its array of flash storage products for the unrelenting storage demands of space-restricted embedded and industrial systems. Rated "Grade 3," ATP automotive e.MMC products undergo stricter testing and qualification processes to comply with reliability and safety standards specific to the automotive industry, such as AEC-Q100 reliability specifications, Production Part Approval Process (PPAP) and Advanced Product Quality Planning (APQP). The ATP e.MMC, which adheres to JEDEC e.MMC v5.1 Standard (JESD84-B51), is constructed with 3D NAND flash and packs up to 128 GB in a 153-ball fine pitch ball grid array (FBGA) package that is smaller than a typical postage stamp. Designed as a soldered-down solution, the e.MMC is resistant against vibrations, ensuring reliable performance even during grueling operations. The compact package, ample capacity and low power consumption make the ATP e.MMC perfect for handling big data while taking up small space.

The industrial operating temperature rating (-40°C to 85°C) delivers exceptional thermal tolerance, allowing the e.MMC to operate reliably in harsh environments. A special SRAM Soft Error Detection and Recovery Mechanism effectively ensures that soft errors do not put data or the device at risk. The ATP e.MMC achieves unprecedented reliability and 2-3X the endurance of standard e.MMC solutions by employing superior IC NAND flash characterization and exhaustive testing and validation from IC to device level.

A1 3D MLC Memory Cards Deliver Exceptional Agility

Applications benefit from higher IOPS, lower write latency and lower power consumption

Trends such as the Internet of Things (IoT), connected cars and automation are gaining momentum and requiring not only massive data storage, but also portable and scalable solutions that can meet the growing demand for higher random and sequential performance. ATP's A1 performance class industrial and automotive grade memory cards are ready to meet these requirements head on.

ATP A1 memory cards deliver 93% lower write latency, 3X higher random read/write performance* with 1500/500 IOPS, 53% lower power consumption and robust durability to withstand environmental and power challenges. Easily expandable and conveniently portable they also feature state-of-the-art security technologies to protect applications and data. Using 3D MLC NAND flash, they deliver enhanced reliability and endurance and are best used in applications requiring exceptional levels of data integrity and responsiveness such as surveillance/video recording, networking gateways/switches, IoT, automation, artificial intelligence (AI), mobile computing and health care. They also meet the growing demands of automotive and Internet of Vehicles (IoV) applications such as in-vehicle infotainment (IVI), event data recording and Advanced Driver Assistance Systems (ADAS).

*Compared with standard UHS-1 cards.

Memory Cards

Small Cards, Big Performance for the Intelligent Edge

ATP memory cards meet the growing data storage needs of the Internet of Things (IoT) and industrial IoT by enabling the intelligent edge. These small and low-power yet powerful data collection solutions are excellent for gateways. They store huge amounts of data closer to the source, providing local intelligence and ensuring reliable operation even with limited or no Internet connection. Memory cards are also used as handy boot devices, conveniently storing the gateway operating system.

ATP industrial SD and microSD cards are the ideal storage format for industrial and automotive applications as they can be conveniently inserted into and easily removed from small host devices for convenient data transfer and storage expansion. ATP CFast cards combine the convenient and trusted format of CompactFlash with the speed, capacity and performance of SATA III, while maintaining backward compatibility with other SATA versions. CompactFlash cards in the original IDE/PATA interface continue to enjoy wide usage in industrial and embedded environments due to their durability and rugged build.

Key Differentiators*

- **ATP Joint Validation Service.**** Compatibility and function tests are conducted using client's host devices and systems to ensure compatibility.
- **Complete Coverage Rapid Diagnostic Test (RDT)** includes testing in extreme temperatures to ensure reliable operation from -40°C to 85°C. RDT covers all areas of the storage device including user, firmware and spare areas.
- **Heavy Duty Construction.** Whether manufactured using System in Package (SiP) or Surface Mount Technology (SMT), ATP memory cards are exceptionally robust, resistant to damaging elements such as dust (IP5X/IP6X), humidity/water (IPX7), electrostatic discharge (ESD), extreme temperature, shock/vibration, and more.

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

SD/SDHC/SDXC Cards

Key Features

- SD Life Monitor
- Advanced Wear Leveling
- SiP (System in Package)
- AutoRefresh technology
- Dynamic Data Refresh
- Power failure protection
- Industrial Temperature
- Joint Validation
- 100% MP Level Test

Product Name		SD/SDHC/SDXC				
Product Line		Premium			Superior	
Naming		S800Pi	S700Pi	S700Pi	S700Sc	S700Sc
Flash Type		SLC	iTemp SLC mode	iTemp 3D NAND SLC mode	SLC mode	3D NAND SLC mode
Density		512 MB to 8 GB	4 GB to 32 GB	8 GB to 32 GB	4 GB to 64 GB	8 GB to 32 GB
Performance	Sequential Read up to (MB/s)	69	96	99	96	99
	Sequential Write up to (MB/s)	39	80	64	80	64
Interface		512 MB ~ 2 GB, HS mode 4 GB ~ 8 GB, UHS-I	UHS-I	UHS-I	UHS-I	UHS-I
Operating Temperature		-40°C to 85°C			-25°C to 85°C	
Reliability	TBW* (max.)	192 TB	512 TB	320 TB	1024 TB	320 TB
	MTBF @ 25°C	>5,000,000 hours	>3,000,000 hours			
	Number of Insertions:	20,000 (SDA spec minimum 10,000)				
Dimensions: L x W x H (mm)		32.0 x 24.0 x 2.1				

Product Name		SD/SDHC/SDXC				
Product Line		Superior				Value
Naming		S600Si	S600Sc	S600Si	S600Sc	S600Vc
Flash Type		iTemp MLC	MLC	iTemp 3D NAND MLC	3D NAND MLC	3D NAND TLC
Density		8 GB to 64 GB	8 GB to 256 GB**	16 GB to 64 GB	16 GB to 128 GB	32 GB to 128 GB
Performance	Sequential Read up to (MB/s)	96	96	99	99	80
	Sequential Write up to (MB/s)	78	78	64	64	76
Interface		UHS-I				
Operating Temperature		-40°C to 85°C	-25°C to 85°C	-40°C to 85°C	-25°C to 85°C	-25°C to 85°C
Reliability	TBW* (max.)	77 TB	307 TB	77 TB	77 TB	77 TB
	MTBF @ 25°C	>2,000,000 hours				>1,000,000 hours
	Number of Insertions:	20,000 (SDA spec minimum 10,000)				
Dimensions: L x W x H (mm)		32.0 x 24.0 x 2.1				

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

Technologies & Add-On Services*									SiP		
Product Line	Premium	Δ	●	●	●	Δ	●	●	●	●	Δ
	Superior	Δ	●	●	●	●	●	Δ	●	●	Δ
	Value			●					●		

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

microSD/microSDHC/microSDXC Cards

Key Features

- SD Life Monitor
- Advanced Wear Leveling
- SiP (System in Package)
- AutoRefresh technology
- Dynamic Data Refresh
- Power failure protection
- Industrial temperature
- Joint Validation
- 100% MP Level Test

Product Name		microSD/microSDHC/microSDXC				
Product Line		Premium			Superior	
Naming		S800Pi	S700Pi	S700Pi	S700Sc	S700Sc
Flash Type		SLC	iTemp SLC mode	iTemp 3D NAND SLC mode	SLC mode	3D NAND SLC mode
Density		512 MB to 8 GB	4 GB to 16 GB	8 GB to 64 GB	4 GB to 32 GB	8 GB to 64 GB
Performance	Sequential Read up to (MB/s)	82	88	99	96	99
	Sequential Write up to (MB/s)	39	78	64	85	64
Interface		512 MB~2 GB, HS mode 4 GB~8 GB, UHS-I	UHS-I		UHS-I	
Operating Temperature		-40°C to 85°C			-25°C to 85°C	
Reliability	TBW* (max.)	192 TB	256 TB	640 TB	512 TB	640 TB
	MTBF @ 25°C	>5,000,000 hours	>3,000,000 hours			
	Number of Insertions:	20,000 (SDA spec minimum 10,000)				
Dimensions: L x W x H (mm)		15.0 x 11.0 x 1.0				

Product Name		microSD/microSDHC/microSDXC				
Product Line		Superior				Value
Naming		S600Si	S600Sc	S600Si	S700Sc	S600Vc
Flash Type		iTemp MLC	MLC	iTemp 3D NAND MLC	3D NAND MLC	3D NAND TLC
Density		8 GB to 32 GB	8 GB to 64 GB	16 GB to 128 GB	16 GB to 128 GB	32 GB to 128 GB
Performance	Sequential Read up to (MB/s)	79	96	99	99	80
	Sequential Write up to (MB/s)	75	81	64	64	76
Interface		UHS-I				
Operating Temperature		-40°C to 85°C	-25°C to 85°C	-40°C to 85°C	-25°C to 85°C	-25°C to 85°C
Reliability	TBW* (max.)	39 TB	77 TB	154 TB	154 TB	77 TB
	MTBF @ 25°C	>2,000,000 hours				>1,000,000 hours
	Number of Insertions:	20,000 (SDA spec minimum 10,000)				
Dimensions: L x W x H (mm)		15.0 x 11.0 x 1.0				

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

Technologies & Add-On Services*									SiP		
Product Line	Premium	Δ	●	●	●	Δ	●	●	●	●	Δ
	Superior	Δ	●	●	●	●	●	Δ	●	●	Δ
	Value			●					●		

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

CompactFlash Cards

Key Features

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

Product Name		CompactFlash Card		
Product Line		Premium	Superior	
Naming		I800Pi	I700Sc	I600Sc
Flash Type		SLC	SLC mode	MLC
Density		512 MB to 32 GB	4 GB to 16 GB	8 GB to 32 GB
Performance	Sequential Read up to (MB/s)	61	110	108
	Sequential Write up to (MB/s)	55	80	46
Interface		UDMA 0~4	UDMA 0~6	
Operating Temperature		-40°C to 85°C	0°C to 70°C	
Endurance	TBW* (max.)	1,280 TB	128 TB	38 TB
	DWPD* (max.)	22.4	11.2	1.7
Reliability	MTBF @ 25°C	>5,000,000 hours	>2,000,000 hours	
	Number of Insertions	10,000 minimum		
Dimensions: L x W x H (mm)		36.4 x 42.8 x 3.3		

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

Technologies & Add-On Services*									
Product Line	Premium	●	●	●	●	●	●	Δ	Δ
	Superior	●		●	●	●		Δ	Δ

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

CFast Cards

Key Features

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

Product Name		CFast Card		
Product Line		Premium	Superior	
Naming		A800Pi	A600Si	A600Sc
Flash Type		SLC	iTemp MLC	MLC
Density		8 GB to 32 GB	16 GB to 128 GB	16 GB to 128 GB
Performance	Sequential Read up to (MB/s)	500	510	510
	Sequential Write up to (MB/s)	300	175	175
	Random Read IOPS up to	35,800	29,400	29,400
Interface		SATA III 6 Gb/s		
Operating Temperature		-40°C to 85°C	-40°C to 85°C	0°C to 70°C
Endurance	TBW* (max.)	2,667 TB	267 TB	320 TB
	MTBF @ 25°C	>2,000,000 hours		
Reliability of Insertions		10,000 minimum		
Dimensions: L x W x H (mm)		36.4 x 42.8 x 3.6		

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

Technologies & Add-On Services*										
Product Line	Premium	●	●	●	●	●	●	●	Δ	Δ
	Superior	●	●	●	●	●	●	Δ	Δ	Δ

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

Solid State Drive and Modules

Reliable Storage Solutions for the Data Era

ATP's embedded storage solutions deliver reliable performance and efficient responsiveness for mission-critical as well as time-critical applications in an era where billions of devices are creating astounding amounts of data. Whether data goes to the cloud or stays at the edge, ATP solid state drives (SSDs) and modules feature the latest technologies in different form factors and capacities with specifications to meet the diverse and rigorous requirements of industrial applications. ATP flash storage products are built for different workloads, usage scenarios, operating environments and platforms. Hard-wired for sustained operation in wide temperatures (-40°C to 85°C) and other environmental challenges, they are guaranteed to deliver outstanding performance, rugged durability, and many years of reliable performance. They support the latest high-speed NVMe™ protocol on a PCIe® 3.0 x4 interface as well as proven interfaces such as SATA 6 Gb/s and USB. Various form factors include the 2.5" SSDs, M.2, mSATA, SlimSATA and eUSB modules.

Key Differentiators*

- **I-Temp Support.** ATP industrial SSDs can withstand extreme temperatures from -40°C to 85°C, enabling them to operate reliably even in extremely cold or hot operating environments.
- **High-Performance, High-Density Storage in Compact Form Factors.** ATP M.2, SlimSATA and mSATA modules deliver power-packed performance and massive storage capacity in lean footprints, making them ideal for space-restricted systems such as embedded/IPCs, point-of-sale (POS), and networking systems.
- **Power Loss Protection.** To prevent data loss during a power loss event, ATP PowerProtector ensures that the last read/write/erase command is completed, and data is stored safely in non-volatile flash memory. ATP SSDs with PowerProtector use tantalum capacitors, which have minimal sensitivity to temperature and humidity, assuring high reliability and endurance even in harsh environments.

* May vary by product and project support.

M.2 NVMe

Key Features

- Superior Read/Write performance
- LDPC & RAID Data Recovery for error correction
- Dynamic Thermal Throttling
- PCIe Gen3 Interface, x4 Lanes
- Global wear leveling
- TRIM function support

Product Name		M.2 NVMe 2280-D2-M	
Product Line		Superior	
Naming		N600Si	N600Sc
Flash Type		iTemp MLC	MLC
Density		128 GB to 1 TB	
Performance	Sequential Read up to (MB/s)	2,540	
	Sequential Write up to (MB/s)	1,100	
	Random Read IOPS (4K, QD32)	Up to 100,000	
Interface		PCIe Gen3 Interface, x4 Lanes	
Operating Temperature		-40°C to 85°C	0°C to 70°C
Endurance	TBW* (max.)	1,280 TB	1,536 TB
	DWPD* (max.)	1.75	2.1
Reliability MTBF @ 25°C		>2,000,000 hours	
Dimensions: L x W x H (mm)		80.0 x 22.0 x 3.5	

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

Technologies & Add-On Services*										
Product Line	Superior	●	Δ	●	●	●	Δ	●	Δ	Δ

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

M.2 SATA

Key Features

- Global wear leveling
- TRIM function support
- Static Data Refresh and Idle Clean F/W algorithm
- Firmware live update
- PowerProtector

Product Name	M.2							
	2242 D2-B-M				2260 D2-B-M			
Product Line	Premium	Superior		Value	Premium		Superior	
Naming	A800Pi	A600Si	A600Sc	A600Vc	A800Pi	A700Pi	A600Si	A600Sc
Flash Type	SLC	iTemp MLC	MLC	TLC	SLC	iTemp SLC mode	iTemp MLC	MLC
Density	8 GB to 64 GB	16 GB to 256 GB		32 GB to 128 GB	32 GB to 128 GB	64 GB to 256 GB	64 GB to 512 GB	
Performance Sequential Read up to (MB/s)	530	550		450	530	550	550	
Performance Sequential Write up to (MB/s)	400	350		220	430	440	450	
Performance Random Read IOPS up to	76,000	70,000		61,000	76,000	73,000	70,000	
Interface	SATA III 6 Gb/s							
Operating Temperature	-40°C to 85°C	-40°C to 85°C	0°C to 70°C	0°C to 70°C	-40°C to 85°C		-40°C to 85°C	0°C to 70°C
Endurance TBW* (max.)	5,333 TB	533 TB	640 TB	147.7TB	10,677 TB	8,533 TB	1,067 TB	1,280 TB
Endurance DWPD* (max.)	77.9	2.9	3.5	1.6	77.9	46.8	2.9	3.5
Reliability MTBF @ 25°C	>2,000,000 hours							
L x W x H (mm)	42.0 x 22.0 x 3.5			42.0 x 22.0 x 3.2	60.0 x 22.0 x 3.5			

Product Name	M.2			
	2280 D2-B-M			2280 S2-B-M
Product Line	Premium	Superior		Value
Naming	A700Pi	A600Si	A600Sc	A600Vc
Flash Type	iTemp SLC mode	iTemp MLC	MLC	TLC
Density	64 GB to 512 GB	128 GB to 1 TB		32 GB to 128 GB
Performance Sequential Read up to (MB/s)	550	550		450
Performance Sequential Write up to (MB/s)	440	450		220
Performance Random Read IOPS up to	73,000	70,000		61,000
Interface	SATA III 6 Gb/s			
Operating Temperature	-40°C to 85°C	-40°C to 85°C	0°C to 70°C	0°C to 70°C
Endurance TBW* (max.)	17,066 TB	2,133 TB	2,560 TB	147.7 TB
Endurance DWPD* (max.)	46.8	2.9	3.5	1.6
Reliability MTBF @ 25°C	>2,000,000 hours			
L x W x H (mm)	80.0 x 22.0 x 3.5			80.0 x 22.0 x 2.2

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

Technologies & Add-On Services*										
Product Line	Premium	●	●	●	●	●	●	●	Δ	Δ
	Superior	●	●	●	●	●	●	Δ	Δ	Δ
	Value	●		●	●	●				

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

2.5” SSDs

Key Features

- Global wear leveling
- TRIM function support
- Static Data Refresh and Idle Clean F/W algorithm
- Firmware live update
- PowerProtector
- Write protect disabled/enabled
- NSA-compliant Secure Erase

Product Name		Velocity 2.5" SSD				
		SII Pro	XE	MV		Value Line
Product Line		Premium		Superior		Value
Naming		A800Pi	A700Pi	A600Si	A600Sc	A600Vc
Flash Type		SLC	iTemp SLC mode	iTemp MLC	MLC	TLC
Density		8 GB to 256 GB	64 GB to 512 GB	64 GB to 1 TB		32 GB to 256 GB
Performance	Sequential Read up to (MB/s)	520	540	530		450
	Sequential Write up to (MB/s)	420	450	420		320
	Random Read IOPS up to	76,000	73,000	70,000		70,000
Interface		SATA III 6 Gb/s				
Operating Temperature		-40°C to 85°C		-40°C to 85°C	0°C to 70°C	0°C to 70°C
Endurance	TBW* (max.)	21,333 TB	17,066 TB	2,133 TB	2,560 TB	295.38 TB
	DWPD* (max.)	77.9	46.8	5.8	7.0	1.6
Reliability	MTBF @ 25°C	>2,000,000 hours				
	Number of Insertions	10,000 minimum				
Dimensions: L x W x H (mm)		100.0 x 69.9 x 9.2				100.0 x 69.9 x 7.0

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

Technologies & Add-On Services*										
Product Line	Premium	●	●	●	●	●	●	●	Δ	Δ
	Superior	●	●	●	●	●	●	Δ	Δ	Δ
	Value	●		●	●	●				

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

mSATA

Key Features

- Global wear leveling
- TRIM function support
- AutoRefresh and Idle Clean F/W algorithm
- Firmware live update
- PowerProtector

Product Name		mSATA				
Product Line		Premium		Superior		Value
Naming		A800Pi	A700Pi	A600Si	A600Sc	A600Vc
Flash Type		SLC	iTemp SLC mode	iTemp MLC	MLC	TLC
Density		8 GB to 128 GB	64 GB to 256 GB	16 GB to 512 GB		32 GB to 512 GB
Performance	Sequential Read up to (MB/s)	530	550	550		450
	Sequential Write up to (MB/s)	430	440	450		440
	Random Read IOPS up to	76,000	73,700	70,000		70,000
Interface		SATA III 6 Gb/s				
Operating Temperature		-40°C to 85°C		-40°C to 85°C	0°C to 70°C	0°C to 70°C
Endurance	TBW* (max.)	10,667 TB	8,533 TB	1,067 TB	1,280 TB	590 TB
	DWPD* (max.)	77.9	46.8	2.9	3.5	1.6
Reliability MTBF @ 25°C		>5,000,000 hours		>2,000,000 hours		>2,000,000 hours
Dimensions: L x W x H (mm)		50.8 x 29.85 x 3.4				

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

Technologies & Add-On Services*										
Product Line	Premium	●	●	●	●	●	●	●	Δ	Δ
	Superior	●	●	●	●	●	●	Δ	Δ	Δ
	Value	●		●	●	●				

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

SlimSATA

Key Features

- Global wear leveling
- TRIM function support
- AutoRefresh and Idle Clean F/W algorithm
- Firmware live update
- PowerProtector

Product Name		SlimSATA			
Product Line		Premium		Superior	
Naming		A800Pi	A700Pi	A600Si	A600Sc
Flash Type		SLC	iTemp SLC mode	iTemp MLC	MLC
Density		8 GB to 128 GB	64 GB to 256 GB	16 GB to 512 GB	
Performance	Sequential Read up to (MB/s)	530	550	550	
	Sequential Write up to (MB/s)	430	440	450	
	Random Read IOPS up to	76,000	73,700	70,000	
Interface		SATA III 6 Gb/s			
Operating Temperature		-40°C to 85°C		-40°C to 85°C	0°C to 70°C
Endurance	TBW* (max.)	10,667 TB	8,533 TB	1,067 TB	1,280 TB
	DWPD* (max.)	77.9	46.8	2.9	3.5
Reliability MTBF @ 25°C		>5,000,000 hours	>2,000,000 hours	>2,000,000 hours	
Dimensions: L x W x H (mm)		54.0 x 39.0 x 4.0			

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

Technologies & Add-On Services*										
Product Line	Premium	●	●	●	●	●	●	●	Δ	Δ
	Superior	●	●	●	●	●	●	Δ	Δ	Δ

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

eUSB

Key Features

- Global wear leveling
- PowerProtector

Product Name		eUSB		
Product Line		Premium	Superior	Superior
Naming		B800Pi	B600Sc	B600Sc
Flash Type		SLC	MLC	MLC
Density		1 GB to 32 GB	8 GB to 32 GB	16 GB to 64 GB
Performance	Sequential Read up to (MB/s)	30	25	44
	Sequential Write up to (MB/s)	25	19	17
Interface		Compatible with USB 2.0 (480 Mbps)		
Operating Temperature		-40°C to 85°C	0°C to 70°C	
Endurance	TBW* (max.)	1,280 TB	38.4 TB	>76.8 TB**
	DWPD* (max.)	37.4	1.7	>1.7**
Reliability	MTBF @ 25°C	>5,000,000 hours	>2,000,000 hours	
	Number of Insertions	10,000 minimum		
Dimensions: L x W x H (mm)		36.9 x 26.6 x 9.5		
Connector Pin Pitch***		2.54 mm***		2.54 mm / 2.00 mm

* Under highest Sequential write value. May vary by density, configuration and applications.
** Estimated endurance only.
*** By project support.

Technologies & Add-On Services*								
Product Line	Premium	●	●	●	●	●	Δ	Δ
	Superior	●	●	●	Δ		Δ	Δ

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

NANODURA

Key Features

- Global wear leveling
- Bad block management algorithm
- High reliability
- Hot swap supported

Product Name		NANODURA	
Product Line		Premium	Superior
Naming		B800Pi	B600Sc
Flash Type		SLC	MLC
Density		512 MB to 8 GB	8 GB to 16 GB
Performance	Sequential Read up to (MB/s)	21	25
	Sequential Write up to (MB/s)	16	18
Interface		Compatible with USB 2.0 (480 Mbps)	
Operating Temperature		-40°C to 85°C	0°C to 70°C
Endurance	TBW* (max.)	192 TB	19.2 TB
	DWPD* (max.)	13.5	1.7
Reliability	MTBF @ 25°C	>5,000,000 hours	>2,000,000 hours
	Number of Insertions	10,000 minimum	
Dimensions: L x W x H (mm)		34.0 x 12.2 x 4.5	

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

Technologies & Add-On Services*					
Product Line	Premium	●	●	●	●
	Superior	●	●	Δ	●

* Please refer to pages 8-12. Δ: Customization option available on a project basis.

e.MMC

Extreme Endurance, Advanced Performance in a Tiny Package

The ATP e.MMC integrates raw NAND flash memory and hardware controller integrated within a 153-ball fine pitch ball grid array (FBGA package). Smaller than a typical postage stamp, its tiny footprint makes the e.MMC perfectly suitable for embedded systems with space constraints but require rugged endurance, reliability and durability in harsh environments. As a soldered-down solution, the ATP e.MMC is secure against constant vibrations, while the industrial temperature rating means that severe scenarios from freezing cold -40°C to blistering hot 85°C will not cause adverse impact on the device or the data in it. ATP e.MMC products with Automotive Grade 3 rating comply with stringent qualifications and testing specific to the automotive industry, such as AEC-Q100 reliability specifications, Production Part Approval Process (PPAP) and Advanced Product Quality Planning (APQP). The ATP e.MMC is compliant with the latest JEDEC e.MMC 5.1 Standard (JESD84-B51).

Key Differentiators*

- **Extreme Endurance: 2-3X Higher than Standard e.MMC.** Through stringent NAND flash sorting, screening, testing and meticulous validation, the ATP e.MMC achieves up to 1,320 TBW**, thus ensuring high P/E cycles, healthy memory storage, and long product service life.
- **SRAM Soft Error Detection and Recovery.** The ATP e.MMC advanced SRAM Soft Error Detection and Recovery mechanism maximizes data integrity by providing timely error detection, logging, and configurable action to address the error***. The mechanism helps avoid unpredictable events that could damage the system, or worse, cause personal safety risks in critical autonomous applications.
- **Product Traceability.** Laser imprints important information on the ATP e.MMC to identify each piece for accurate tracking and efficient inventory management.

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

e.MMC

Key Features

- Complies with JEDEC e.MMC v5.1 Standard (JESD84-B51)
- 153-ball FBGA (RoHS compliant, "green package")
- Industrial operating temperature range -40°C to 85°C
- LDPC ECC engine*
- Designed with 3D NAND
- Capacities: 8 GB to 128 GB
- SRAM soft error detection
- AutoRefresh, Dynamic Data Refresh read disturb management
- Extra-high endurance: 2-3X higher than standard e.MMC

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

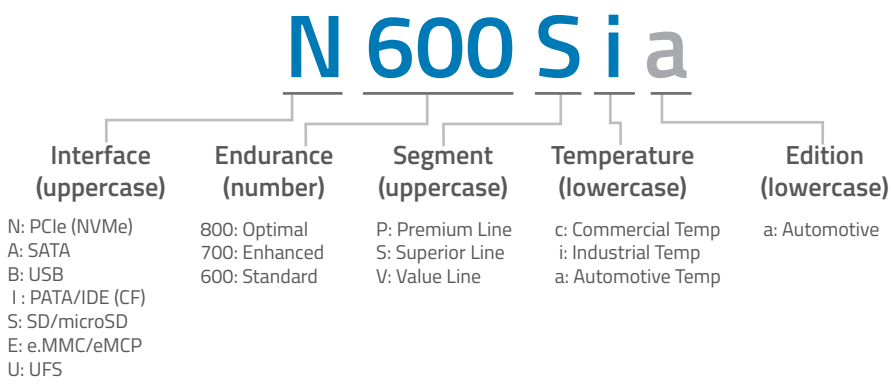
Product Name		e.MMC	
Product Line		Premium	Superior
Naming		E700Pi	E600Si
IC Package		153-ball FBGA	
JEDEC Specification		v5.1, HS400	
Flash Type		3D NAND, SLC Mode	3D NAND
Density*		8 GB to 64 GB	16 GB to 128 GB
Bus Speed Modes		x1 / x4 / x8	
Performance**	Sequential Read/Write up to (MB/s)	300 / 240	300 / 170
	Random Read/Write up to (IOPS)	15K / 30K	
Operating Temperature		-40°C to 85°C	
Endurance Max. TBW***		1,320 TB	824 TB
Reliability MTBF @ 25°C		> 2,000,000 Device hours	
VCC (Typical RMS in Read/Write)		130 / 215	130 / 215
VCCQ (Typical RMS in Read/Write)		115 / 105	115 / 105
L x W x H (mm)		11.5 x 13.0 x 1.3 (max.)	

*1 GB=1,000,000,000 bytes. Actual user storage may be less.
**Based on internal testing; performance may vary depending upon drive capacity, file attributes, host device, OS and application. Cache On.
***Under best write amplification index (WAI) with highest sequential write value. May vary by density, test configuration, workload and applications.

Technologies & Add-On Services*										
Product Line	Premium	Δ	●	●	●	●	●	●	●	●
	Superior	Δ	●	●	●	●	●	●	●	●

* Please refer to pages 8-12. Δ: 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 PowerProtector 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.

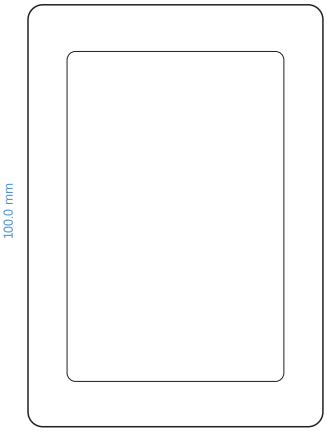
Complete Flash Portfolio

Product			Dimensions (L x W x H mm)	Flash Type	Densities	Operating Temp.	Data Transfer Rate (max.)	TBW* (max.)	Power Failure Protection / PowerProtector	Secure Erase (S/W)**	Life Monitor (S/W)**
SATA											
2.5" SSD	Velocity SII Pro		100.0 x 69.9 x 9.2	SLC	8 GB~256 GB	-40°C~ 85°C	Read: 520 MB/s Write: 420 MB/s	21,333 TB	✓	✓	✓
	Velocity XE			iTemp SLC mode	64 GB~512 GB		Read: 540 MB/s Write: 450 MB/s	17,066 TB	✓	✓	✓
	Velocity MV			iTemp MLC	64 GB~1 TB		Read: 530 MB/s Write: 420 MB/s	2,133 TB	✓	✓	✓
				MLC		0°C~ 70°C		2,560 TB			
M.2	2280 D2-B-M		80.0 x 22.0 x 3.5	iTemp SLC mode	64 GB~512 GB	-40°C~ 85°C	Read: 550 MB/s Write: 440 MB/s	17,066 TB	✓	✓	✓
				iTemp MLC	128 GB~1 TB		Read: 550 MB/s Write: 450 MB/s	2,133 TB			
				MLC		0°C~ 70°C		2,560 TB			
	2260 D2-B-M		60.0 x 22.0 x 3.5	SLC	32 GB~128 GB	-40°C~ 85°C	Read: 530 MB/s Write: 430 MB/s	10,667 TB	✓	✓	✓
				iTemp SLC mode	64 GB~256 GB		Read: 550 MB/s Write: 440 MB/s	8,533 TB			
				iTemp MLC	64 GB~512 GB		Read: 550 MB/s Write: 450 MB/s	1,067 TB			
				MLC		0°C~ 70°C		1,280 TB			
	2242 D2-B-M		42.0 x 22.0 x 3.5	SLC	8 GB~64 GB	-40°C~ 85°C	Read: 530 MB/s Write: 400 MB/s	5,333 TB	✓	✓	✓
				iTemp MLC	16 GB~256 GB		Read: 550 MB/s Write: 350 MB/s	533 TB			
				MLC		0°C~ 70°C		640 TB			
mSATA			50.8 x 29.85 x 3.4	SLC	8 GB~128 GB	-40°C~ 85°C	Read: 530 MB/s Write: 430 MB/s	10,667 TB	✓	✓	✓
				iTemp SLC mode	64 GB~256 GB		Read: 550 MB/s Write: 440 MB/s	8,533 TB			
				iTemp MLC	16 GB~512 GB		Read: 550 MB/s Write: 450 MB/s	1,067 TB			
				MLC		0°C~ 70°C		1,280 TB			
SlimSATA			54.0 x 39.0 x 4.0	SLC	8 GB~128 GB	-40°C~ 85°C	Read: 530MB/s Write: 430 MB/s	10,667 TB	✓	✓	✓
				iTemp SLC mode	64 GB~256 GB		Read: 550 MB/s Write: 440 MB/s	8,533 TB			
				iTemp MLC	16 GB~512 GB		Read: 550 MB/s Write: 450 MB/s	1,067 TB			
				MLC		0°C~ 70°C		1,280 TB			
CFast			36.4 x 42.8 x 3.6	SLC	8 GB~32 GB	-40°C~ 85°C	Read: 500 MB/s Write: 300 MB/s	2,667 TB	✓	✓	✓
				iTemp MLC	16 GB~128 GB		Read: 510 MB/s Write: 175 MB/s	267 TB			
				MLC		0°C~ 70°C		320 TB			

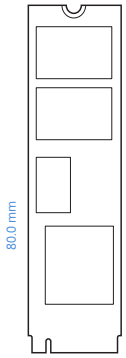
Product		Dimensions (L x W x H mm)	Flash Type	Densities	Operating Temp.	Data Transfer Rate (max.)	TBW* (max.)	Power Failure Protection / PowerProtector	Secure Erase (S/W)**	Life Monitor (S/W)**
NVMe										
M.2		80.0 x 22.0 x 3.5	iTemp MLC	128 GB~1 TB	-40°C~ 85°C	Read: 2,540 MB/s Write: 1,100 MB/s	1,280 TB	-	✓***	✓
			MLC		0°C~ 70°C		1,536 TB			
PATA/IDE										
CompactFlash		36.4 x 42.8 x 3.3	SLC	512 MB~32 GB	-40°C~ 85°C	Read: 61 MB/s Write: 55 MB/s	1,280 TB	✓	-	✓
			SLC mode	4 GB~16 GB	0°C~ 70°C	Read: 110 MB/s Write: 80 MB/s	128 TB	-	-	✓
			MLC	8 GB~32 GB		Read: 108 MB/s Write: 46 MB/s	38 TB	-	-	✓
USB Drive										
eUSB		36. 9 x 26.6 x 9.5	SLC	1 GB~32 GB	-40°C~ 85°C	Read: 30 MB/s Write: 25 MB/s	1,280 TB	✓	-	✓
			MLC	8 GB~32 GB	0°C~ 70°C	Read: 25 MB/s Write: 19 MB/s	38.4 TB	✓	-	✓
NANODURA		34 x 12.2 x 4.5	SLC	512 MB~8 GB	-40°C~ 85°C	Read: 21 MB/s Write: 16 MB/s	192 TB	-	-	✓
			MLC	8 GB~16 GB	0°C~ 70°C	Read: 25 MB/s Write: 18 MB/s	19.2 TB	-	-	✓
SD										
SD/SDHC/SDXC		32.0 x 24.0 x 2.1	SLC	512 MB~8 GB	-40°C~ 85°C	Read: 69 MB/s Write: 39 MB/s	192 TB	✓	✓	✓***
			SLC mode	4 GB~64 GB	-25°C~ 85°C	Read: 96 MB/s Write: 80 MB/s	1024 TB			
			iTemp SLC mode	4 GB~32 GB	-40°C~ 85°C		512 TB			
			MLC	8 GB~256 GB***	-25°C~ 85°C	Read: 96 MB/s Write: 78 MB/s	307 TB			
			iTemp MLC	8 GB~64 GB	-40°C~ 85°C		77 TB			
microSD/ microSDHC/ microSDXC		15.0 x 11.0 x 1.0	SLC	512 MB~8 GB	-40°C~ 85°C	Read: 82 MB/s Write: 39 MB/s	192 TB	✓	✓	✓***
			SLC mode	4 GB~32 GB	-25°C~ 85°C	Read: 96 MB/s Write: 85 MB/s	512 TB			
			iTemp SLC mode	4 GB~16 GB	-40°C~ 85°C	Read: 88 MB/s Write: 78 MB/s	256 TB			
			MLC	8 GB~64 GB	-25°C~ 85°C	Read: 96 MB/s Write: 81 MB/s	77 TB			
			iTemp MLC	8 GB~32 GB	-40°C~ 85°C	Read: 79 MB/s Write: 75 MB/s	39 TB			
Managed NAND										
e.MMC		11.5 x 13.0 x 1.3 (max.)	3D SLC mode	8 GB~64 GB	-40°C~ 85°C	Read: 300 MB/s Write: 240 MB/s	1,320 TB	✓	✓	✓***
			3D MLC	16 GB~128 GB		Read: 300 MB/s Write: 170 MB/s	824 TB			

* Under highest Sequential write value. May vary by density, configuration and applications.
** ATP software support for demo use only.
*** By project support

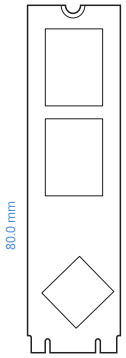
Product Dimensions (Size) Comparison



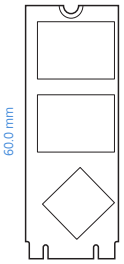
2.5" SATA SSD



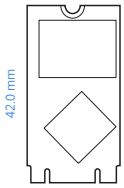
M.2 NVMe



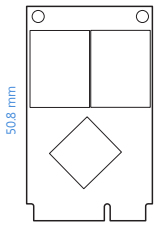
M.2 2280



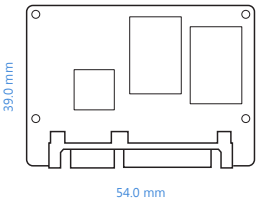
M.2 2260



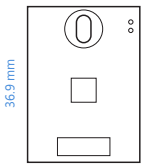
M.2 2242



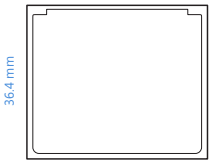
mSATA



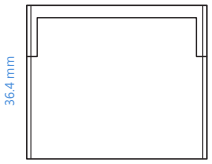
SlimSATA



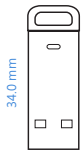
eUSB



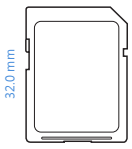
CF



CFast



USB Drive



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ATP TAIWAN
Headquarters

TEL: +886-2-2659-6368
FAX: +886-2-2659-4982
sales-apac@atpinc.com
10F, No. 185, Tiding Blvd. Sec. 2,
Neihu, Taipei,
Taiwan 11493

ATP USA

TEL: +1-408-732-5000
FAX: +1-408-732-5055
sales@atpinc.com
2590 North First Street,
Suite #150 , San Jose, CA 95131,
USA

ATP JAPAN

TEL: +81-3-6260-0797
FAX: +81-3-6260-0798
sales-japan@atpinc.com
Advance Kamichi Building 6F,
1-2-7 Kita-Shinagawa,
Shinagawa-ku, Tokyo
140-0001 Japan

ATP EUROPE

TEL: +49-89-374-9999-0
FAX: +49-89-374-9999-29
sales-europe@atpinc.com
Max-Planck-Str. 5,
D-85716 Unterschleißheim,
Germany

ATP CHINA

TEL: +86-21-5080-2220
FAX: +86-21-9687-0000-026
sales@cn.atpinc.com
2F, Building 15, No. 115, Lane 572,
Bibo Road, Zhangjiang High-Tech Park
Pudong, Shanghai, China 201203

www.atpinc.com