



www.exascend.com

Product Guide

Industrial, enterprise and automotive storage solutions

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About Exascend

Exascend is a leader in industrial and enterprise data storage specialized in fully customizable advanced storage solutions developed entirely in-house. Our passion is to develop flash storage solutions that deliver enterprise-grade performance and industrial-grade stability to the world's most demanding storage applications.

Recognizing the benefit that in-house development brings to our customers, we engineer our products from the ground up – from hardware to software – and manufacture them in-house to ensure only the highest quality. Since our founding in 2006, we have accumulated over 60 U.S. and global patents on flash storage technology, firmly establishing Exascend as a leading innovator in the storage industry.

For over a decade, our storage solutions have been qualified and deployed by Fortune 500 companies, top defense contractors and government agencies around the world. Our unique commitment to 100% in-house development of hardware and firmware, our leading validation suite, ISO 9001- and IATF 16949-certified manufacturing and quality management processes makes us the ideal partner for leaders no matter their location or industry.

Our unwavering commitment to deliver the best-engineered, most reliable and truly innovative solutions allows us to push the boundaries of what is possible for our products and our customers' applications.

Inspiration to Innovation.

A partner that delivers

At Exascend, we are all about making our customers and their applications excel at what they do. By leveraging our best-in-class products combined with our unique customization services, we provide a superior experience that guarantees the best results. We measure our success in how successful we make our customers. That is our commitment.

Raise your profit margin

Deliver perfectly engineered and truly differentiated products and services by leveraging Exascend's fully optimized storage products – enabling you to put yourself ahead of the competition and avoid competing on price.

Accelerate your time to market

Exascend is the industry's only one-stop solution provider – with design, validation and manufacturing all done in-house – reducing the time and complexity of bringing even the most thoroughly customized products to life.

Focus on what you do best

Let us take care of your storage challenges for you, helping you save resources and mitigate the risk of uncertainty and delays.

Stop worrying about reliability

Rest assured that your storage devices are at no risk of unexpected failure with Exascend's unwavering commitment to product quality and industry-best reliability. Our products are designed, validated and manufactured according to the highest standards, including 10,000 sudden power-loss testing cycles and fully dynamic -45–90 °C wide temperature chamber testing.

Commodity SSD

International module houses

- “Me too” products based on third-party turnkey solutions offering inadequate customization, in-depth engineering know-how and support.
- Late to market with little or no differentiation dependent on competing on price to gain market share in existing markets.
- Little or no control over product quality, reliability, technical support or after-sales service.

v.s.



Value-added SSD

Exascend

- Differentiated product with unique features, optimized for customer's operation profile, carving out uncontested market space where the customer does not need to compete on price.
- Quick turnaround time allowing the customer to seize windows of opportunity in the market, thus being able to seize market share and charge a premium on its products.
- High-quality products with unparalleled reliability, support directly from the engineering team and outstanding after-sales service.

Customization

Engineering Imagination to Innovation



Core competency

Enterprise performance, industrial ruggedness – engineered by Exascend.

In a world of ever-accelerating data generation, Exascend empowers organizations and individuals in capturing, preserving, accessing and transforming data.



Focused and exclusive

Exascend is the only industrial and enterprise SSD manufacturer among its peers with engineering expertise to fully utilize Marvell's premium SATA & NVMe controllers. We distinguish ourselves from the competition with our full range of Marvell-based SSDs featuring our in-house hardware and firmware designs, extreme customizability and perfect combination of enterprise-grade performance and industrial-grade ruggedness.

Exascend customization

We offer our Marvell-based SSD products in standard form factors and entirely custom designs. In standard form factors, we offer capacities ranging from 128 GB all the way up to 8 TB. With custom designs, we go as high as 32 TB on a single SSD. We provide tailored hardware, firmware, performance, latency and QoS tuning, power and thermal throttling and much more – making our customization services second to none in the flash storage industry.



In-house design, validation and testing

We take pride in holding our design and total solution validation and testing to the highest standards. With our ISO 9001:2015-certified manufacturing and quality management system and our over 10 years of experience delivering products to Fortune 500 companies and leading global OEMs, we are fully dedicated to ushering in a new – and much higher – quality standard for our industry. In addition to using well-known commercially available testing programs, Exascend also develops its own testing platform to continuously improve product stability, reliability and quality.

Product quality assurance and consistency

Exascend guarantees fixed BOM for key components such as NAND flash, controller and firmware. All our SSDs are fully tested at the mass production stage for being delivered to customers. Moreover, our exclusive quality management system guarantees 100 percent transparency and traceability for all our products.



Failure analysis and one-stop resolution service

With our full control over hardware and firmware in our solutions, we are uniquely positioned to provide customers with swift resolutions to any issues. In the event of an issue, we provide failure analysis, root cause report as well as fully resolving the issue encountered by our customer. Upon request, we can also provide an 8D report.

Factory data recovery

An SSD's most valuable asset is not the device itself but rather the data stored within. Exascend is fully committed to safeguarding customers' data with unequaled product quality, stringent testing and advanced data security technologies such as RAID ECC. In the unlikely event that a customer's Exascend device experiences issues, whether due to a defect or an accident, we offer exclusive on-site resolution and factory data recovery service to ensure that the customer's data has the highest chances of full recovery. Our unique control over both hardware and firmware puts us in the perfect position to carry out deep-level data recovery unlike any of our peers in the industry. Our customers' data is our number-one priority. Always.



Corporate profile

Corporate profile

Company overview

Founded | 2006

Established as Exascend | 2016

R&D center | Shanghai, China

Service centers | Shanghai, Shenzhen, Taipei, Sunnyvale (CA, USA) and Eindhoven (Netherlands)

Manufacturing | Available in Taiwan and China

Products | SSD (PCIe NVMe & SATA-III), CFexpress, CFast, eMMC, SD & microSD cards, card readers, portable SSD, DRAM

Our vision and mission

Vision

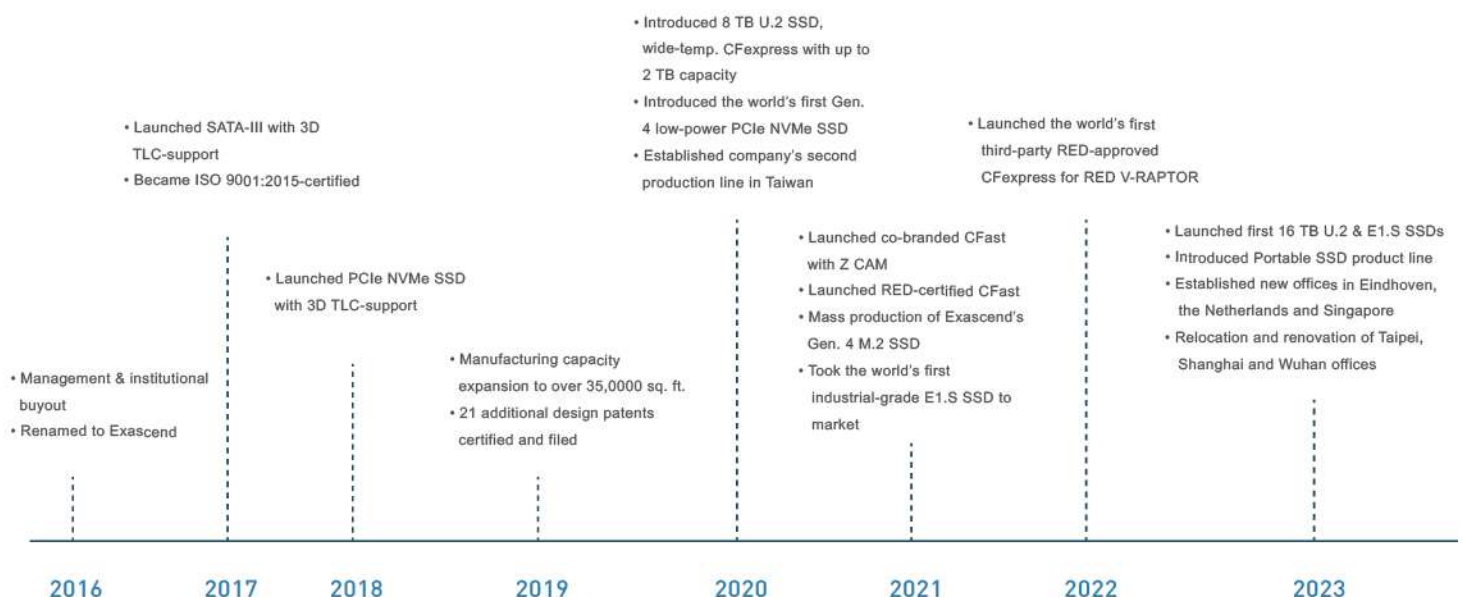
To be the most respected provider of reliable customized storage solutions across the industrial and enterprise markets.

Mission

To provide innovative tailored storage technology solutions that empower users to push the boundaries of what is possible.

Engineering imagination to innovation

Recent company highlights





Technology highlights



We are deeply passionate about flash storage and the technologies that power the future of computing. Each day, we bring that passion into action by being an early adopter of the latest form factors, interfaces and standards that push our industry forward. Whether you require performance, ruggedness, stability or security – we offer uniquely capable technologies for giving your applications a real storage upgrade.

Data integrity & security

Data integrity



Data recovery

Your data is in safe hands with Exascend's flash storage devices. However, in the unlikely event of a user accident or a device malfunction, Exascend goes above and beyond to give your data the highest chances of full recovery. Our on-site resolution and factory data recovery services are second to none in the industry – ensuring that your data is in safe hands even if disaster strikes.

With our unique position as fully in control of hardware engineering, firmware design and manufacturing, we are uniquely qualified to carry out advanced data recovery unlike any of our peers.



Dual Power Loss Protection

Sudden loss of power can cause severe issues in flash storage devices, putting data integrity at risk. Exascend's standard firmware power loss protection provides a first line of defense against these issues. For applications particularly sensitive to loss of power or subject to unstable power supply, Exascend's hardware-based power loss protection provides an invaluable extra line of defense against data integrity issues by leveraging tantalum capacitors that guarantee that all in-flight data is safely stored before controlled storage device shutdown.

Exascend SSD	Hardware PLP	Firmware PLP
PCIe M.2	Upon request	V
U.2, E1.S and 2.5"	V	V
SATA-III M.2	Upon request	V



RAID ECC

RAID ECC is an exclusive Exascend technology that, alongside our industry-best LDPC algorithm, guarantee unparalleled error checking and correction capabilities in our flash storage devices. By leveraging RAID5 technology on a flash memory block-level, RAID ECC can retrieve and reconstruct severely corrupted data.



Firmware Integrity Plus™

Firmware corruption and firmware loss are rare events that risk rendering storage devices entirely inoperable under critical operation. Firmware Integrity Plus™ is an advanced Exascend-engineered technology that keeps multiple firmware images backed up and ready to replace a faulty firmware image at a moment's notice. Firmware integrity plus provides an extra layer of protection against device malfunction perfect for equipment used in mission-critical applications.



Data Path Protection

From the moment data enters the flash storage device from the host until it reaches its resting place in the NAND flash, data passes through many intermediate points where corruption can occur. Exascend's Data Path Protection ensures the highest level of data integrity by leveraging error-checking throughout the data's entire path from host computer to the NAND flash and back.

Data security



Tamper-Proof Firmware

Malicious firmware tampering is a security threat that risks compromising the very heart of the flash storage device, posing a potentially critical threat to device and system security. Tamper-Proof Firmware technology mitigates these risks with firmware encryption featuring a tamper-proof cryptographic signature, guaranteeing that any unauthorized firmware modification is rejected.



AES-256

Exascend's secure storage solutions offer the highest level of data protection with virtually unbreakable AES-256 encryption, guaranteeing unbeatable encryption compliant with federal agencies' stringent data security requirements.



TCG Opal 2.0

Exascend's secure storage solutions are fully compliant with TCG Opal 2.0 – a set of specifications for SEDs established by the Trusted Computing Group (TCG). Compliance with the TCG Opal 2.0 specifications protects user data from unauthorized access with features such as hardware encryption and LBA-based read/write permissions while guaranteeing industry-wide device interoperability.



Custom Data Sanitization

Rapid purging of sensitive data is a critical feature in mission-critical applications. Exascend's storage devices offer customizable secure data sanitization, including normal erasure as well as software and hardware-triggered data erasure fully compliant with federal agencies' data sanitization protocols – ensuring rapid-fast and fully secure data erasure.

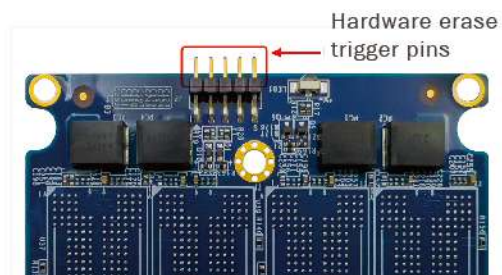
Firmware-supported modes

- NSA 9-12
- NSA 130-2
- AFSSI 5020
- DoD52220.22-M
- USA Army 380-19
- USA Navy NAVSO P-5239-26
- IRIG 106-7

Customized modes available upon request.

Hardware triggers

Standard trigger with customized hardware triggers available upon request.



Write Protection

Triggered by the user using either firmware or hardware, write protection technology safeguards data stored on the flash storage device by setting it to read-only mode, thereby blocking the host device from deleting or making any changes to the data.

Ruggedness

Ruggedness



IP67-compliance

Thoroughly tested and thoroughly robust, our IP67-rated products protect your data from storage failure caused by dangers such as dust and water. In tough applications, IP67 provides ample protection against the elements.



Underfill

Underfill is a rugged SSD technology that dramatically reduces the likelihood of BGA-related malfunction by bonding the integrated circuits to the PCB with epoxy.



Conformal Coating

Conformal coating is a rugged technology that protects the entire Exascend SSD against environmental threats by applying a water and particle-resistant coating to the printed circuit board and all embedded components.



Sidefill

Exascend's sidefill technology boosts SSD ruggedness by applying a resin on the sides of all BGA-mounted components, ensuring a strong connection that can handle mechanical and thermal stress.



MIL-STD-810-compliance

With Exascend's MIL-STD-810-compliant products, you get flash storage that has been tested to withstand extreme environmental stress – making them suitable for even the most demanding applications.



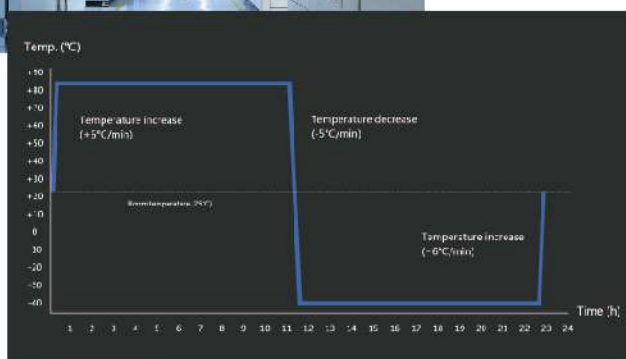
Neutron Shield™

Exascend's Neutron Shield™ technology shields your data from neutron-induced single-event upsets (SEUs). Caused by cosmic rays and other types of ionizing radiation, SEUs jeopardize data integrity in any type of application.



Wide Temperature

Extreme-temperature environments poses a major challenge to flash storage devices, requiring high-end components and a thermally-optimized design to guarantee stable operation in the -40–85 °C (-40–185 °F) wide-temperature range. Exascend's wide temperature-optimized storage solutions use only the best components, are perfectly engineered and manufactured for demanding operation and undergo stringent validation to guarantee flawless operation in thermally challenging applications.



Extreme-temperature chamber testing at one of Exascend's manufacturing facilities.

Wide Temperature

-40 °C

85 °C

Extended Temperature

-25 °C

85 °C

Standard Temperature

0 °C

70 °C

System performance & stability

System performance & stability



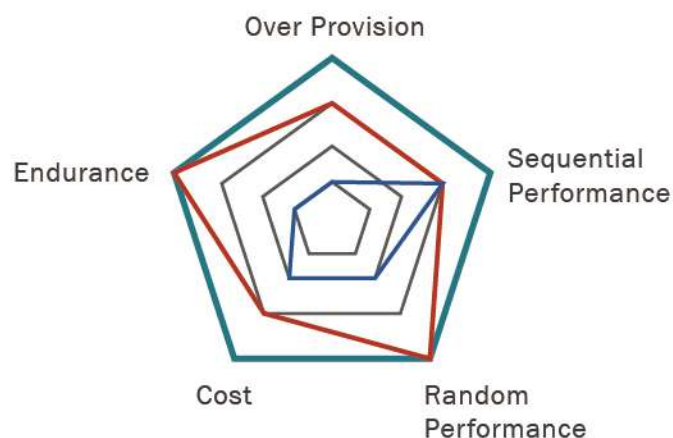
True Next-Gen Performance

Next-generation PCIe NVMe flash storage brings incredible performance to demanding applications and ushers in a new era where we must look beyond sequential transfer rates and random IOPS as the most important performance indicators. Exascend optimizes its flash storage devices for ultra-low latency and high Quality of Service (QoS) – going beyond a focus on raw speed to also guarantee that devices meet the ever-growing demands for low-latency and high-reliability operation in enterprise and industrial applications.



Unlimited Over-Provisioning

Over-provisioning (OP) is an important technology that allows storage devices to be configured to achieve specific performance profiles suitable for specific workloads and operational requirements. With Exascend's flash storage devices, over-provisioning is completely unlocked, allowing us to meet your exact needs without being limited to the industry-standard 7% and 28% rates of over-provisioning – ensuring that your application can reach its full potential.





SuperCruise™

Developed by Exascend and exclusively available for Exascend's flash storage devices, SuperCruise™ is an extremely sophisticated firmware technology that optimizes write performance for stability over time. The SuperCruise™ algorithm monitors the flash storage device's ratio of free block production and consumption and adjusts read/write behavior in order to achieve consistent performance that does not fluctuate over time.

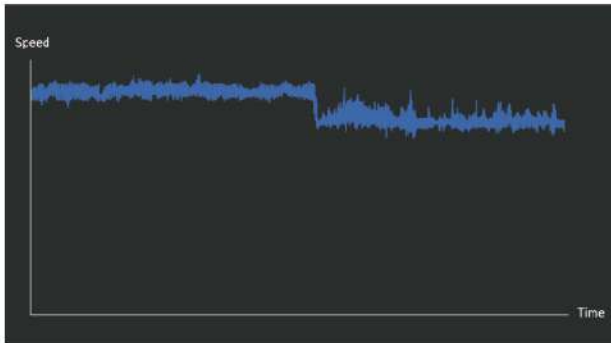


Figure 1: Typical SSD performance over time (sequential/random mixture)

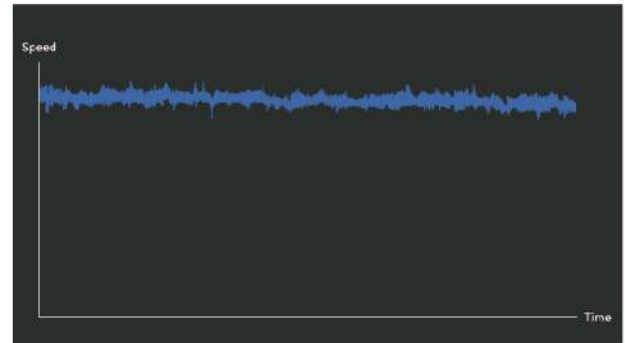
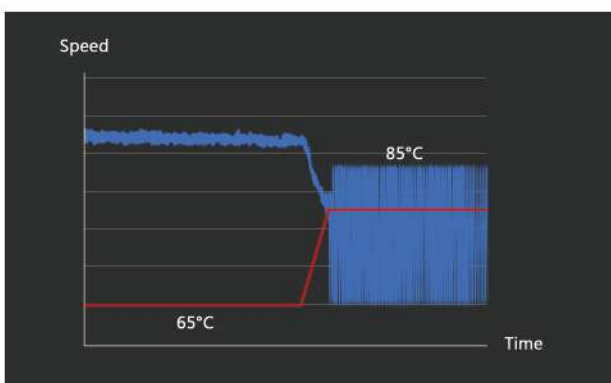


Figure 2: Exascend SSD with SuperCruise™ performance over time

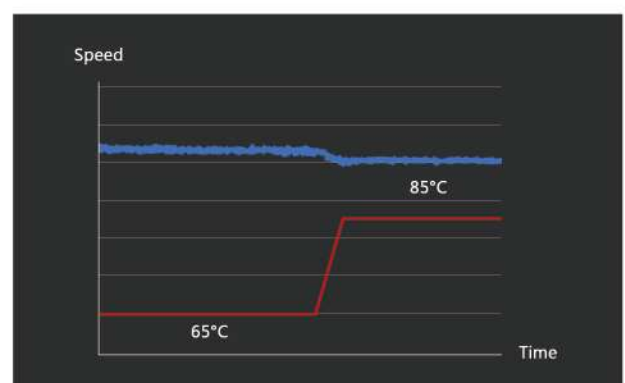


Adaptive Thermal Control™

Exascend's proprietary Adaptive Thermal Control™ technology tackles the issue of overheating and thermal throttling that is unavoidable in high-performance PCIe NVMe flash storage devices. Typically, flash storage devices maintain thermals under a set threshold by throttling performance – causing massive drops and spikes in performance as the devices try to keep up with changes in temperature. Exascend's Adaptive Thermal Control™ technology mitigates this issue by intelligently finding the perfect equilibrium point between performance and device thermals where a consistently high level of performance holds steady over time – avoiding the constant performance bursts and drops endemic with high-speed NVMe devices.



SSD write burn-in performance going from 75 °C to 85 °C with typical thermal throttling



SSD write burn-in performance going from 75 °C to 85 °C with Exascend's Adaptive Thermal Control™



Power Tuning

Our unique level of control over hardware, firmware and manufacturing enables us to provide unmatched tuning services. By tuning the performance of our product specifically for your applications, we can achieve the highest possible performance to thermals and performance to power ratios.



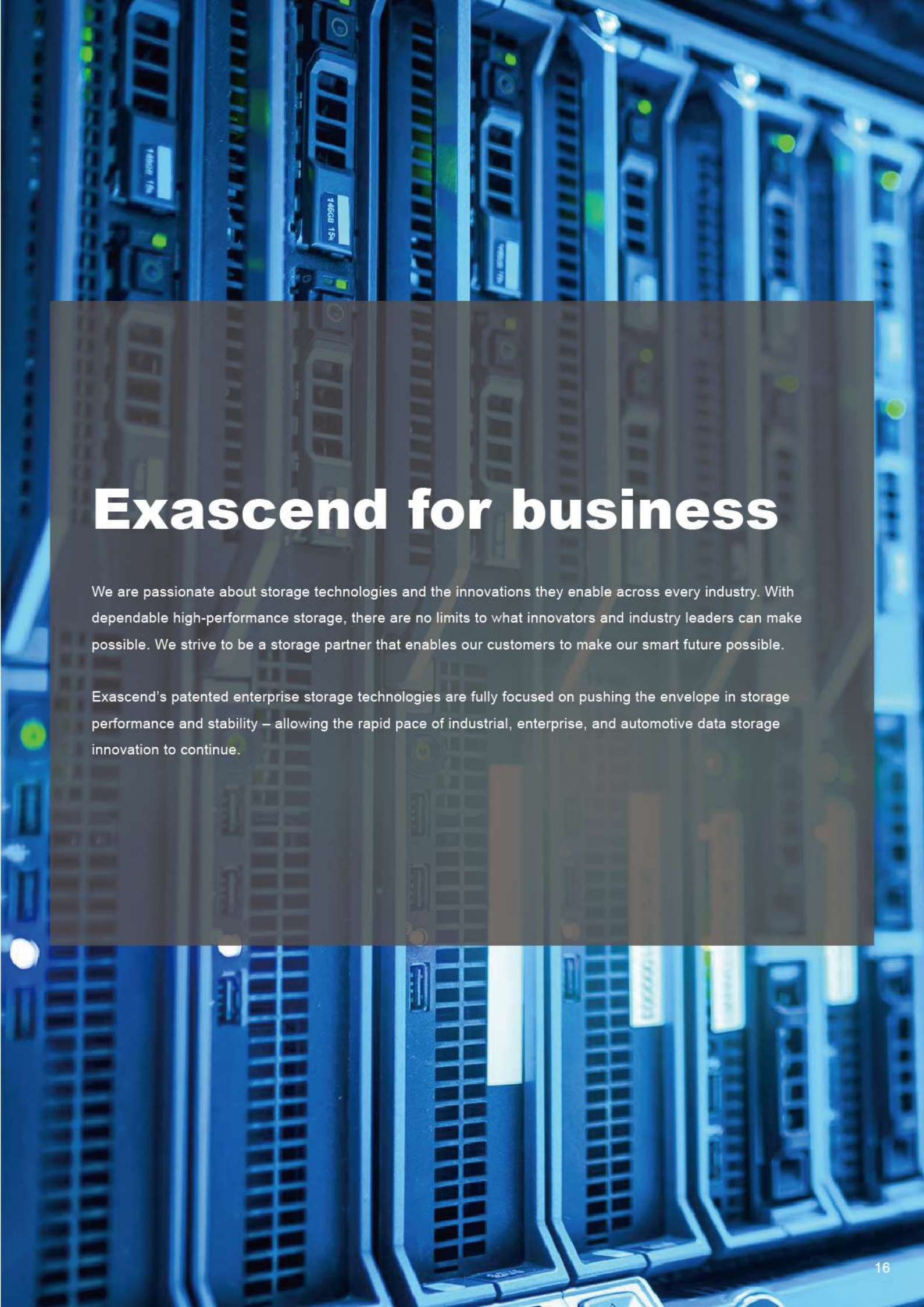
Extreme Capacity

Our extreme-capacity flash storage solutions leverage the best high-capacity NAND flash in the industry and blazing-fast controllers. The firmware we write ourselves, guaranteeing support for capacity configurations like no other – even in small form factors.



Afterburner™

Afterburner™ is a performance-enhancing Exascend technology that leverages SLC cache to boost sequential read and write speeds in storage devices with 3D TLC NAND.



Exascend for business

We are passionate about storage technologies and the innovations they enable across every industry. With dependable high-performance storage, there are no limits to what innovators and industry leaders can make possible. We strive to be a storage partner that enables our customers to make our smart future possible.

Exascend's patented enterprise storage technologies are fully focused on pushing the envelope in storage performance and stability – allowing the rapid pace of industrial, enterprise, and automotive data storage innovation to continue.

Industrial

Engineered for providing the industry's best performance and endurance in rugged applications.

Life in industrial environments is tough. Machines vibrate, spins things around and slam things in their place. Temperatures go low and rise high. Flawless industrial precision, high speed and constant production are the expectation.

Is your equipment up for the task?

Requirements

Precision and performance above all

New manufacturing processes rely on unbeatable precision and performance to produce high-quality products at a staggering pace. Our flash storage devices are designed to deliver the cutting-edge sustained performance required by industrial applications.

Stability for minimized downtime

Downtime can be extremely costly in industrial applications, making stability and reliability paramount. Our solutions put stability and reliability first, making sure that modules remain operational no matter the challenges.

Truly customized solutions

Industrial applications vary greatly in terms of environmental challenges and requirements. Each solution must be tuned to meet the specific needs of its application. Exascend's customization services offer second-to-none in-house hardware and firmware tailoring – ensuring that each solution is perfectly optimized for its intended use.

Recommended product series



PI4 Series

Industrial-grade PCIe Gen4 SSDs

- The world's first industrial-grade PCIe Gen4 SSD lineup
- The world's only industrial-grade E1.S, also available in M.2 and U.2 form factors
- Wide temperature support (-40–85°C)
- Up to 8 TB capacity
- Extreme sustained and write performance



SI4 Series

SATA-III made for industrial applications

- Industrial-grade hardware and wide temperature support (-40–85°C)
- 2.5", M.2 and mSATA form factors
- Up to 8 TB capacity
- Guaranteed long-term supply



Industrial CFexpress

Compact card storage for rugged applications

- Industrial-grade hardware and wide temperature support (-40–85°C)
- CFexpress Type B form factor
- Up to 1 TB capacity
- For applications that demand ruggedness and portability, including industrial automation, ADAS, data loggers and rugged edge equipment

Enterprise

Designed for delivering maximum sustained performance under tough enterprise workloads.

How would you describe the ideal enterprise-grade SSD? Enterprise applications never settle for anything less than the best. They demand the highest capacity, the best performance, the highest reliability and unwavering stability. Otherwise, end users will be disappointed and unnecessary costs will be incurred.

Requirements

Non-stop performance

Due to massive workloads, enterprise applications require sustained top performance that does not waver. Our enterprise-class solutions are designed to deliver the highest possible level of sustained performance that enterprise applications require.

A long-term solution

For storage devices working in demanding applications to be economically feasible, long-term reliability is a must. We design our storage products to last, and our generous warranty services reflects this commitment.

Dependable security

Enterprise applications often handle sensitive data, making data security a major concern. At Exascend, we treat security not as an afterthought but as a top priority, providing customers with a wealth of built-in and optional security-enhancing features and technologies.

Recommended product series



PE4 Series

Ultra-low latency and blistering PCIe Gen4 performance

- Enterprise-class PCIe Gen4 SSDs with extreme quality of service (QoS)
- 3,500 MB/s sustained read
- 3,000 MB/s sustained read
- Up to 8 TB capacity
- Optimized for demanding enterprise workloads



PE3 Series

Ultra-low latency and PCIe Gen3 performance

- Enterprise-class PCIe Gen3 SSDs with extreme quality of service (QoS)
- U.2 and M.2 2280 form factors
- Up to 16 TB capacity
- Up to 3,500 MB/s sustained write
- Guaranteed long-term supply



SE4 Series

SATA-III enterprise applications

- 2.5" and M.2 2280 form factors
- Up to 8 TB capacity
- Up to 535 MB/s sustained write
- Guaranteed long-term supply

Automotive

Built with top performance and capacity in mind to meet the data storage needs of the automotive industry.

The Automotive sector encompasses applications such as in-vehicle infotainment (IVI), data loggers, advanced driver-assistance systems (ADAS), navigation systems and vehicle-to-everything (V2X) communication. Whether it is driverless cars, high-speed trains, 18-wheelers, aircraft or container ships, all vehicles require rugged, high-quality storage to address common challenges such as intense data-writing, small form factors and extreme ambient temperatures.

Requirements

Massive data collection capabilities

Automotive systems are essentially like data centers on wheels. Each minute, they generate excessive amounts of data, which requires not only high-capacity storage, but also storage with unrelenting performance to handle.

Fail-safe ruggedness and reliability

Vibrations, high temperatures, and tough environmental conditions are typical threats for Automotive systems. As a result, automobile storage must support wide-temperature operation and sustain all kinds of environmental hazards, including humidity, vibrations and sudden power failures. This is where our industrial hardware and power loss protection services come in.

Data security for networked connection

A growing number of networked systems and autonomous vehicles emphasizes the need for data security and integrity. Our flash storage solutions feature hardware- and firmware-based security technologies, mitigating any risks of data corruption and leakage.

Customizable form factor

Our Automotive flash storage offering includes NVMe PCIe and legacy SATA-III SSD in U.2, E1.S, M.2, and mSATA form factors. Also available are our Industrial e.MMC, CFexpress and CFast memory. These form factors can be fully customized to tailor to the unique requirements of your automotive application.

Recommended product series



PA4 Series

Automotive-grade thermally-optimized SSD

- Blistering PCIe Gen4 performance
- 3,500 MB/s sustained read
- 3,000 MB/s sustained read
- Wide temperature support (-40–85°C)
- Optimized for ADAS trucking and in-vehicle data logging



SA4 Series

Automotive-grade SATA-III storage

- M.2, mSATA and 2.5" form factors
- Up to 4 TB capacity
- 535 MB/s sustained write
- Wide temperature support (-40–85°C)
- Optimized for ADAS trucking and in-vehicle data logging



Engineered for the auto industry of the future

Advanced driver-assistance systems (ADAS) are central to the future of driving, improving car and road safety while making driving more enjoyable than ever before.

The basic structure of ADAS has three main parts:

- Data generation: sensors, cameras and other data sources generate data about the car and its surroundings.
- Data processing: a computing platform processes data using powerful hardware and intelligent software.
- Data logging: the system stores raw and processed data onto a storage platform for analysis and further processing.

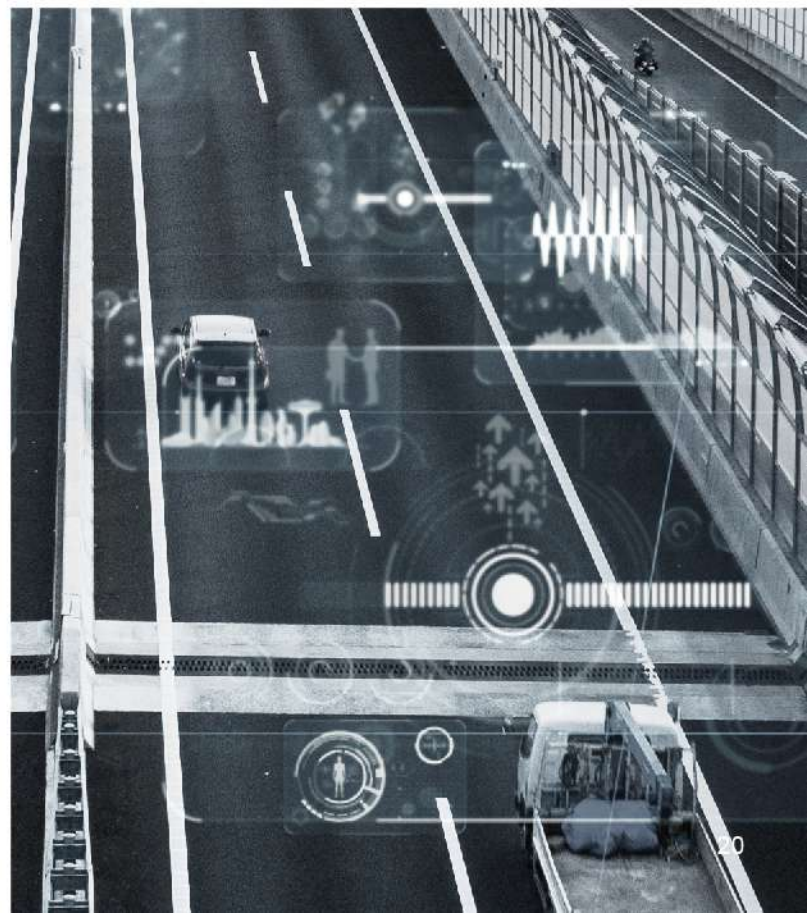
In terms of data logging, ADAS demands not only incredible storage capacities to store all the data generated by the system but also unrelenting storage performance that can keep up with a constant flood of data.

That's not easy, and that's where Exascend comes in.



Certified for ADAS

We're a proven ADAS storage partner whose products have undergone testing and certification with major advanced driver-assistance system (ADAS) manufacturers.





The ADAS data challenge

Advanced driver-assistance systems (ADAS) generate extreme amounts of data through their numerous **sensors, LiDAR, cameras** and more.

More accurate systems = more data = **higher data rates and larger storage capacities** required:

- In **2017**, Intel and Micron found that ADAS requires around **1 GB** of data to be processed per second.
- In Intel's latest Mobileye system, EyeQ5 from **2020**, up to **7.25 GB/s** of data must be processed each second.
- In next-generation systems, **even higher bitrates** are required.

2017

1 GB/s

2020

7.25 GB/s

202X

1X.X GB/s

The ADAS power and thermal challenge

Powerful ADAS hardware means high power-draw

- **GPU**: up to **350 W** per installation.
- **Server CPU**: up to **285 W** per installation.
- **Enterprise SSD**: **15–20 W** active power consumption.
- Throttles performance at 149 °F (65 °C), causing **unpredictable performance** and sudden drops in transfer speeds.

Compact ADAS systems and high power-draw means high temperatures

- **Thermal management** is becoming a critical part of high-power systems.
- **Low power and intelligent thermal management** are cornerstones in achieving sustainable high performance.



The ADAS environmental challenge

Advanced driver-assistance systems face some of the toughest **environmental challenges** imaginable, both from their operating environment and the outside ambient environment.

For example, they're up against...:

- **Extreme temperatures** and sudden swings in temperature.
- **Vibrations, shocks and pressure** – both continuous and sudden.
- **Particles, contaminants, pollution and humidity**.





At the intersection of enterprise and industrial storage

We are deeply passionate about creating innovative and pioneering products at the intersection of our core areas of expertise: enterprise-class and industrial-grade flash storage. By combining the unbeatable performance and stability in our enterprise-class products with our rugged expertise from our industrial-grade products, we craft truly unique products that combine the best of both worlds. That's the perfect recipe for ADAS and data logging applications: enterprise performance everywhere.



Next-generation form factors – or something special

Why limit yourself to form factors optimized for consumer products and controlled environments? We love the standard M.2 and 2.5" form factors, but that doesn't mean that they're the perfect form factors for every application. That's why we offer next-generation form factors like E1.S and U.2 that have performance and thermal profiles ideal for applications like ADAS and data logging. But why stop there – we also provide fully customized form factors tailored for your application and its unique requirements.



PA4 series

The PA4 series is Exascend's automotive-grade PCIe 4.0 storage lineup featuring extreme sustained read and write speeds and incredible storage capacity. With Exascend's technologies, the PA4 series bridges the gap between the PCIe 4.0 interface and the future of the automotive industry.

PCIe 4.0
Interface

3D TLC
Flash

Automotive-grade
Design

Up to
3,500 MB/s
Sustained read

Up to
3,000 MB/s
Sustained write

SA4 series

The SA3 series is Exascend's automotive-grade SATA-III storage devices available in the M.2, mSATA and 2.5" form factors. With Exascend's technologies, the SA3 series bridges the gap between the SATA interface and the future of the automotive industry.



SATA-III
Interface

3D TLC
Flash

Automotive-grade
Design

Up to
550 MB/s
Sustained read

Up to
535 MB/s
Sustained write

Success story

High-end testing equipment for autonomous vehicles

As we enter the era of autonomous driving, complex computing devices are replacing human inputs. While we lay back and enjoy the convenience that autonomous vehicles bring to our lives, computer systems deal with heavy workloads as they process enormous amounts of sensory information, carries out simulations and does complex calculations to keep us safe.

Exascend worked with a client that engineers advanced data logging and testing equipment for autonomous vehicle manufacturers. Their sophisticated system collects, analyses and responds to sensor data with precision and in time, even in harsh environments with threats such as shocks, vibrations and extreme temperatures. The tough requirements demanded storage designed to provide extreme performance and rugged features, which is why the client decided to work together with Exascend and leverage its industry-leading rugged storage products.

Challenges

- The storage must have a high minimum performance level for necessary output, but most storage solutions only focus on maximum performance rather than consistent, stable performance.
- The storage must still reach a certain performance level even in extreme temperatures.
- The application requires maximum storage capacity for collecting sensor data, but most of the off-the-shelf solutions either does not have big enough capacity or are not built for consistent performance nor can they guarantee the required minimum performance.

Solutions

Exascend storage with server-grade performance, guaranteeing low latency and a high minimum performance level in extreme operating temperatures. Ultra-high capacity of over 4 TB and MIL-STD-810G compliant.

Added- value services

- Customized over-provisioning and capacity.
- Customized hardware features, e.g., form factor and interface.
- Customized firmware features, e.g., security features such as crypto erase.
- Thorough analysis for performance tuning according to each system's unique requirements.
- Factory data recovery service.

Edge server storage

With edge computing, processing power comes closer to where it is needed the most. But the edge is challenging. Exposed to the elements and often located in places hard to reach, edge devices require efficiency, ruggedness and power.

Are your devices ready for life on the edge?

Key challenges

Limited space, unlimited power

Edge devices are often compact but require high-performing components to carry out their increasingly complex tasks.

Long-term economic feasibility

Edge infrastructure is built for the long haul, requiring devices to remain fully functional with minimal downtime to be a worthwhile investment.

Tough working environments

Often exposed to challenging outdoor conditions, tough industrial environments and remote settings, edge devices must be engineered with ruggedness as a priority.

Our solutions

Compact and competent

We offer exceptional performance across form factors of all sizes, including customized form factors for particularly compact or unique edge systems.

Reliable hardware and stable performance

Our hardware is engineered to last and our firmware is designed to provide applications with a consistently high level of performance.

Rugged to the core

Our rugged storage devices are designed from the ground up to withstand severe environmental challenges and mechanical stress – ideal for the rugged edge.

Recommended products



PI3 M.2 2280 3.84 TB

High-capacity industrial M.2 PCIe Gen3 SSD

- Industrial-grade hardware designed for the rugged edge
- Wide temperature-support (-40 to 85 °C)
- 3,200 MB/s sustained read
- 1,600 MB/s sustained write
- Massive 3.84 TB capacity
- 3D TLC NAND flash



SI3 mSATA 1.92 TB

Legacy mSATA for demanding edge applications

- Industrial-grade hardware designed for the rugged edge
- Wide temperature-support (-40 to 85 °C)
- Legacy SATA-III interface
- 3D TLC NAND flash

Success story

Edge server with ultra low latency

Edge servers used in edge computing is a new type of application that has gained traction in recent years. Edge servers combine traditional industrial computers with server-grade performance, providing extreme performance away from traditional datacenters. According to the Market Study Report, edge computing is expected to have a CAGR of 41.9% between 2020 and 2025, making it one of the fastest-growing industries. Most edge computing solutions are purpose-built with unique functions and system requirements.

In order to maximize the value of data collected locally and to provide efficient, effective feedback in time, server-grade performance is needed to achieve the minimal latency required. These computing devices are typically operating in outside environments, meaning that the devices must withstand a wide temperature range.

A recent Exascend user case is from a railway system that has adopted AI that needed enterprise-level performance SSDs with a specific latency target operating in -40–85 °C temperatures.

Challenges

- Typical industrial storage vendors do not offer enterprise-grade solutions and are unable to guarantee specific latencies.
- Most of the enterprise SSDs available in the market do not support wide temperature ranges.
- New-generation platforms utilize the PCIe interface which often faces heat dissipation issues in fan-less box PCs, as well as performance issues after a period of usage.
- When encountering data corruption issues, critical data cannot be fully recovered using any available tools.

Solutions

- Exascend has several patented designs on SSD technology, focusing on enterprise-grade performance for operation in wide-temperature environments.
- Exascend's exclusive Adaptive Thermal Control algorithm finds the perfect balance between temperature and speed – allowing the SSD to sustain the highest level of performance while maintaining a manageable temperature.
- All the product's flash transaction layers are designed by Exascend's R&D department, enabling Exascend to provide a tool for deep data recovery.

Added- value services

- Customized hardware features, e.g., form factor and interface.
- Customized performance for operating consistently in a given temperature range, e.g., a minimum 400 MB/s write performance in a 70 °C environment.
- Extended warranty service.
- Factory data recovery tool.

Mission critical

Mission critical applications require only the best. As the name explicitly states, the mission is critical – and failure is not an option – no matter what challenges stand in its way. Even in the face of harsh conditions and unexpected variables, every component must continue operating at its best.

Are your devices ready for action?

Key challenges

Extreme environments and unique threats

Mission critical applications present extreme environmental challenges and unique threats to device integrity and functionality.

Fail-safe for life

Mission success is critical, leaving no room for error or fatal device malfunctions. Top-level stability and device reliability are absolute must – as is providing maximum security.

Customized everything

Unique form factors, unique technologies and unique features are necessary to guarantee a perfect fit and performance you can count on no matter what.

Our solutions

Devices engineered for maximum ruggedness

Our industrial-class storage devices are designed for extreme ruggedness at both the hardware and firmware levels, guaranteeing enterprise-level performance everywhere.

Unparalleled stability and security

We optimize our products to deliver top-level sustained performance, delivering best-in-class stability and performance in any environment. This, combined with our security features, means that our products are always ready for action.

Customization like no other

We provide the industry's most extensive customization services with thorough customization of both hardware and firmware always available as an option.



20 TB fully customized SATA-III SSD

Example of an Exascend-designed fully customized form factor that enables an ultra-rigid storage connection in a client's mission-critical application.

Success story

Fully customized rugged storage

Edge servers used in edge computing is a new type of application that has gained traction in recent years. Edge servers combine traditional industrial computers with server-grade performance, providing extreme performance away from traditional datacenters. According to the Market Study Report, edge computing is expected to have a CAGR of 41.9% between 2020 and 2025, making it one of the fastest-growing industries. Most edge computing solutions are purpose-built with unique functions and system requirements.

In order to maximize the value of data collected locally and to provide efficient, effective feedback in time, server-grade performance is needed to achieve the minimal latency required. These computing devices are typically operating in outside environments, meaning that the devices must withstand a wide temperature range.

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Challenges

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- Most of the enterprise SSDs available in the market do not support wide temperature ranges.
- New-generation platforms utilize the PCIe interface which often faces heat dissipation issues in fan-less box PCs, as well as performance issues after a period of usage.
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Solutions

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- All the product's flash transaction layers are designed by Exascend's R&D department, enabling Exascend to provide a tool for deep data recovery.

Added- value services

- Customized hardware features, e.g., form factor and interface.
- Customized performance for operating consistently in a given temperature range, e.g., a minimum 400 MB/s write performance in a 70 °C environment.
- Extended warranty service.
- Factory data recovery tool.

NVMe over Fabrics (NVMe-oF)

NVMe performance over networking fabrics

NVMe-oF is an implementation of the NVMe standard that enables the use of the NVMe protocol across storage networking fabrics. With performance just shy of direct-attached storage (DAS), NVMe-oF is an increasingly popular implementation of NVMe that overcomes the challenges of relying on DAS for NVMe-level storage performance.



Key benefits

High scalability

By separating storage from compute, each can be scaled independently according to the network operator's needs.

Fabric agnostic

NVMe-oF can be used across any networking fabric, e.g., Fibre Channel, RDMA (Infini-Band, RoCE, iWARP and more), TCP and more.

Little impact on performance

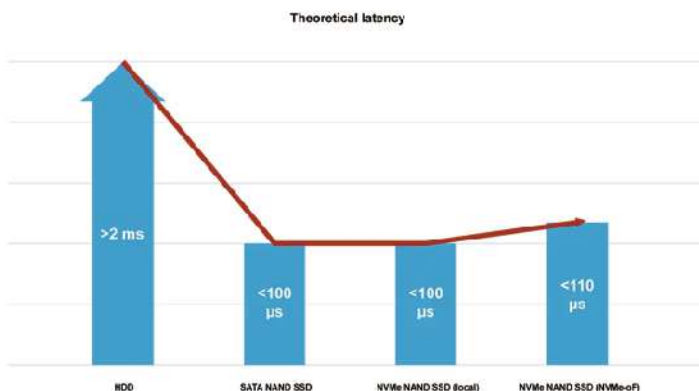
NVMe-oF offers speeds near local NVMe with a close to negligible impact on storage latency.



Exascend offers its enterprise series NVMe SSDs with firmware enabled for NVMe-oF, making integration into next-generation storage infrastructure a breeze.

NVMe-oF

Minimal latency overhead



Remote storage, local latency

The NVMe-oF standard is designed to provide local NVMe-like performance across a distance. The specification allows a latency overhead compared to local NVMe of a minuscule 10 μ s.

What NVMe-oF's minimal latency overhead means in practice is that the storage network provides instantaneous response times just like with local NVMe storage. With NVMe-oF storage access, gone are the days of slow networked storage that is a clear downgrade from DAS.

Recommended NVMe-oF SSDs



PE4 series

The PE4 series is Exascend's enterprise-grade lineup of high-performing PCIe 4.0 devices. With extreme sustained read and write speeds along with Exascend's technologies, the PE4 series brings the PCIe 4.0 interface to the next level.

PCIe 4.0
Interface

3D TLC
Flash

Enterprise-grade
Design

Up to
3,500 MB/s
Sustained read

Up to
3,000 MB/s
Sustained write

PE3 series

The PE3 series brings high-level performance to enterprise applications without compromising on stability. Available in a wide variety of configurations and storage capacities, the PE3 series fits any demanding enterprise application.



PCIe 3.0
Interface

Enterprise-grade
Design

Up to
7,680 GB
Capacity

Up to
3,200 MB/s
Sustained read

Up to
2,000 MB/s
Sustained write

Or are you looking for a customized NVMe-oF storage solution?
Send us an inquiry: sales@exascend.us

NVMe-oF SSDs customized and optimized to perfection

Our commitment to the NVMe-oF standard means that Exascend's exclusive technologies and unique customization services are available in NVMe-oF-capable SSDs. For network infrastructure operators, this brings an incredible level of flexibility to deploy NVMe-oF in essentially any environment.



Self-encrypting drive (SED)



Get serious about security

The current era of rugged edge computing and the Internet of Things (IoT) brings incredible opportunity for innovation. However, the inherent security challenges in edge computing environments risks stifling innovation. That is why Exascend's self-encrypting drive (SED) solutions present a unique opportunity to double-down on edge innovation without jeopardizing data security.

Better yet, SEDs' negligible impact on system performance means that encryption and data security no longer come with notable tradeoffs. With impenetrable AES-256 encryption, powerful protocols like TCG Opal 2.0 and intelligent features such as user-specific locking ranges, SEDs make it easy to get serious about security.

Exascend SED benefits

Perfect for the edge

Edge and IoT devices are uniquely exposed to external security threats. Exascend's secure SSDs ensure that data is safe even in the event of device theft.

Made for any environment

TCG Opal 2.0 enables compatibility across devices and operating systems, guaranteeing fortified security everywhere.

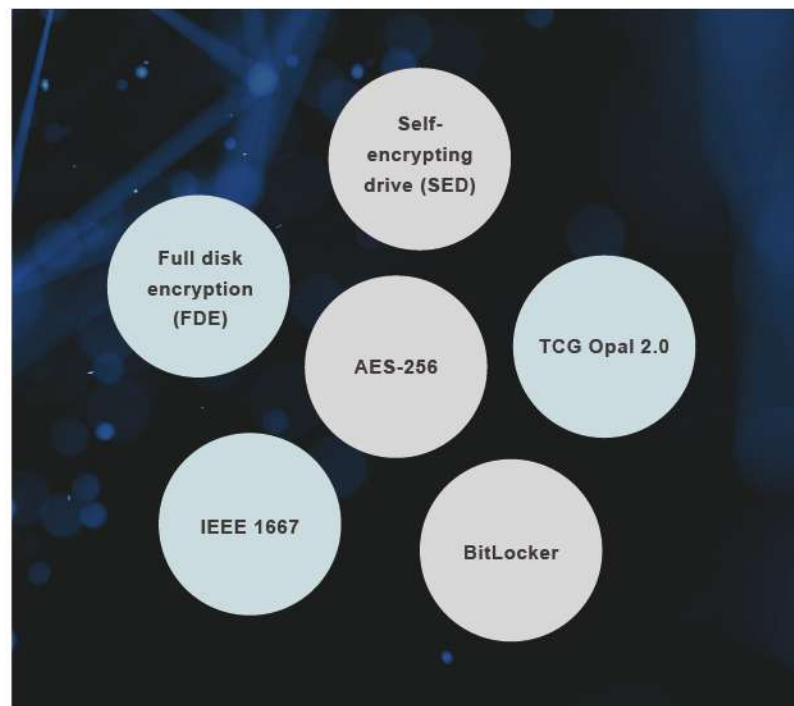
Unbeatable security

The combination of the AES cipher and hardware encryption provides data security invulnerable to software and operating system-level breaches.

Blazing-fast performance

Hardware encryption ensures that the task of encrypting and decrypting data does not waste valuable system resources.

Data security for any system



Data sanitization options

Crypto erase

The near-instant *crypto erase* protocol is only available on SEDs and works by simply replacing the key that encrypts/decrypts all data stored inside the device. Without the original key, the data is scrambled beyond even a theoretical chance of recovery.

Normal erase

The *normal erase* protocol thoroughly sanitizes data by overwriting the storage device's mapping table and data, removing all original data. Unlike the two other options, data is not only rendered irrecoverable – it is no longer on the device.

Fast erase

Fast erase quickly sanitizes data by only overwriting the storage device's mapping table. While the encrypted data still technically resides on the device, without the mapping table, the system has no way of recovering it.

Understand SEDs

Full disk encryption (FDE)

With full disk encryption, also known as whole disk encryption, all data stored inside the storage device is encrypted. That means that if the storage device gets in the wrong hands, none of the data can be accessed by the perpetrator.

FDE benefits:

- Negligible impact on system performance with hardware-based implementations.
- Encryption is not limited to specific partitions, folders or files.

Self-encrypting drive (SED)

A common implementation of FDE is self-encrypting drives. SEDs achieve full disk encryption by leveraging purpose-designed storage devices that implement encryption on the hardware level. With SEDs, the storage device automatically encrypts data before storing it on the device, leaving no data unencrypted.

SED benefits:

- Negligible impact on system performance as the storage device leverages an integrated encryption engine – not the host device.
- Many different implementations available, allowing a high degree of flexibility.

256-bit AES encryption

Exascend's implementation of AES-256 leverages a dedicated crypto processor inside the flash storage device, allowing encryption and decryption of data stored on the device to take place independently of the host. The result is a software-independent military-grade encryption that you can trust with both data and not slowing down your system.

AES-256 benefits:

- Utilizes an uncrackable 256-bit cipher, also known as the Rijndael cipher.
- Approved by the United States for the highest level of classified information, i.e., Top Secret.
- Well-supported industry standard used across a wide range of product categories and industries.

TCG Opal 2.0

Exascend's compliance with the TCG Opal 2.0 specifications means that our SEDs protect user data from unauthorized access with features such as hardware encryption and LBA-based read/write permissions. TCG Opal 2.0 also guarantees industry-wide device interoperability, making it a platform-agnostic way to implement the secure features that a self-encrypting drive brings to users and applications.

TCG Opal benefits:

- Innovative features such as user-specific locking ranges make it easy to subdivide device data on a per-user basis.
- Near-instant cryptographic erase that works by destroying the Media Encryption Key (MEK).
- Well-supported industry standard used across a wide range of product categories and industries.

Recommended SED products

PI4 series

The PI4 series brings together Exascend's industrial expertise with the high-speed PCIe 4.0 interface and high-density 3D TLC.

The result is a highly competent lineup of industrial-grade storage with enterprise-class performance available in the M.2, U.2 and E1.S form factors.



PCIe 4.0
Interface

3D TLC
Flash

Industrial-grade
Design

Up to
3,500 MB/s
Sustained read

Up to
3,000 MB/s
Sustained write



PI3 series

The PI3 series brings together Exascend's industrial expertise with the high-speed PCIe 3.0 interface and high-density 3D TLC – resulting in a highly competent lineup of industrial-grade storage.

PCIe 3.0
Interface

3D TLC
Flash

Industrial-grade
Design

Up to
3,100 MB/s
Sustained read

Up to
1,600 MB/s
Sustained write

PE3 series

The PE3 series brings high-level performance to enterprise applications without compromising on stability. Available in a wide variety of configurations and storage capacities, the PE3 series fits any demanding enterprise application.



PCIe 3.0
Interface

Enterprise-grade
Design

Up to
7,680 GB
Storage capacity

Up to
3,200 MB/s
Sustained read

Up to
2,000 MB/s
Sustained write



SI4 series

The SI4 series is a high-end product line featuring industrial-grade SATA-III storage devices available in the M.2 and 2.5" form factors.

SATA-III
Interface

3D TLC
Flash

Industrial-grade
Design

Up to
550 MB/s
Sustained read

Up to
535 MB/s
Sustained write

Or are you looking for a customized SED storage solution?
Send us an inquiry: sales@exascend.us

Telecommunications

Global telecommunications is experiencing a period of rapid change with massive upgrades to wireless and wired connectivity across mobile networking, Wi-Fi and broadband underway. Faster networks and added bandwidth means new business opportunities and new innovations.

Are you positioned to capitalize on the future of telecom?

Key challenges

Extreme performance

The point of new telecommunications infrastructure is higher bandwidth, higher connection density, and lower latencies. And all hardware must be able to keep up.

Tough environments

Telecommunications devices are deployed far and wide, including in environmentally-exposed infrastructure as well as in challenging industrial environments. For such applications, ample ruggedness is an absolute must.

Cost-efficient maintenance

The scale of telecommunications infrastructure is vast, which means that maintenance needs to be kept at a minimum to make infrastructure investments economically feasible.

Our solutions

Telecom performance in excess

Our storage devices provide incredible performance that meet and exceed the requirements of next-generation telecommunications infrastructure.

Tuned to tackle any challenge

With Exascend's unique customization and tuning services, we make sure that our devices provide the best possible performance in tough environments and facing any workload.

Uniquely reliable flash storage devices

We engineer our devices to provide the highest levels of reliability, ensuring that maintenance and repairs can be kept to a minimum.

Recommended product series

PE4 Series

Ultra-low latency and blistering PCIe Gen4 performance

- Enterprise-class PCIe Gen4 SSDs with extreme quality of service (QoS)
- 3,500 MB/s sustained read
- 3,000 MB/s sustained write
- Features Exascend's unique performance and stability-enhancing technologies
- Ultra-low latency optimal for telecommunications infrastructure



SE4 series

Legacy SATA-III for demanding telecom applications

- SATA-III interface with 3D TLC NAND flash
- 2.5", M.2 and mSATA form factors
- Up to 4 TB capacity
- Guaranteed long-term supply



Success story

A high-performance and enduring replacement for telecom application

A combination of key factors make up the ideal SSD solution for the telecommunications sector. Technical aspects such as stable random IOPS performance, low power consumption, long endurance, extended temperature range and compact size are all critical factors. However, services provided by the manufacturer are also hugely important, including a fixed bill of materials and – most importantly – long-term support and supply.

For example, critical telecommunications infrastructure such as routers utilized in a railway system must function flawlessly for at least five years. Therefore, the manufacturer's long-term services and support are just as important as providing the right solution in the first place.

A customer of Exascend utilized 64 GB M.2 SSDs based on MLC technology from a different vendor and was facing some challenges as MLC technology got increasingly difficult to obtain each year, making the customer unable to fulfill urgent upstream demand.

Challenges

- Endurance tends to decrease from one generation of flash storage technology to the next.
- Newer flash storage technology used to change every three years but now almost every year there is a "new" generation, making a fixed bill of materials difficult to manage.
- Once SSDs receive an end-of-life (EOL) notice, issues will no longer be resolved by the manufacturer.

Solutions

Exascend's commitment to flexible solutions and unique configurations allows Exascend to provide extra-endurance products with extended warranty service. After discussing with the customer, it turned out that the application only needed up to 32 GB capacity, so Exascend's SATA enterprise (SE3) Max series that provides over five times the number of endurance cycles than the customer's MLC solution proved a perfect replacement.

Moreover, since Exascend's firmware is designed in-house, the customer is guaranteed full resolutions to potential issues after each failure analysis – even after the EOL product notice – making Exascend's replacement solution a clear upgrade.

Added- value services

- Customized hardware features, e.g., unique compact form factors.
- Customized product endurance to prolong SSD lifespan, e.g., pseudo SLC solution.
- Extended warranty service with both standard and customized products.
- Factory data recovery service.

Product specifications



PCIe Gen4

Basic features

- PCIe NVMe 1.2/1.3/1.4
- Supports TRIM and SMART
- Advanced ECC and global wear-leveling algorithm
- Firmware power loss protection (PLP) for additional data protection
- Hardware power loss protection

Exclusive features

- RAID ECC for full data integrity
- Tamper-proof firmware with cryptographic signature
- Firmware Integrity Plus™: ROM-based backup of multiple firmware images
- In-field firmware updates
- Data Retention Plus™: dynamically refreshes data to strengthen data retention
- High quality of Service (QoS): consistently low latency

Optional features

- TCG Opal 2.0
- Hardware secure erase
- Performance, power and thermal throttling
- 30 μ" gold finger for all product series
- AES-256 encryption

Solution	Industrial / Automotive				
Interface	PCIe 4.0 (NVMe 1.4)				
Form factor	M.2 2280	M.2 2242	M.2 2230	U.2	E1.S
Capacity	960–7,680 GB	960–1,920 GB	240–960 GB	960–7,680 GB	960–7,680 GB
Flash type	3D TLC				
Input voltage	3.3V±5%; 12V±5%				
Power consumption	Active <12.0W; Idle <1.0W				
Max. seq. read	2,200 MB/s	3,200 MB/s	3,200 MB/s	3,500 MB/s	3,500 MB/s
Max. seq. write	2,200 MB/s	3,000 MB/s	1,800 MB/s	3,000 MB/s	3,000 MB/s
Max. TBW*	4,800 TB	1,200 TB	600 TB	4,800 TB	4,800 TB
Operational temp.	-40–85°C				
Warranty	3 years				
PI4	EXPI4M960GB EXPI4M1920GB EXPI4M3840GB EXPI4M7680GB	EXPI4Q960GB EXPI4Q1920GB	EXPI4R240GB EXPI4R480GB EXPI4R960GB	EXPI4U960GB EXPI4U1920GB EXPI4U3840GB EXPI4U7680GB	EXPI4E960GB EXPI4E1920GB EXPI4E3840GB EXPI4E7680GB
PA4	EXPA4M960GB EXPA4M1920GB EXPA4M3840GB EXPA4M7680GB	EXPA4Q960GB EXPA4Q1920GB	EXPA4R240GB EXPA4R480GB EXPA4R960GB	EXPA4U960GB EXPA4U1920GB EXPA4U3840GB EXPA4U7680GB	EXPA4E960GB EXPA4E1920GB EXPA4E3840GB EXPA4E7680GB

Solution	Enterprise					Commercial
Interface	PCIe 4.0 (NVMe 1.4)					
Form factor	M.2 2280	M.2 2242	M.2 2230	U.2	E1.S	M.2 2280
Capacity	960–7,680 GB	960–1,920 GB	240–960 GB	960–7,680 GB	960–7,680 GB	1,024–2,048 GB
Flash type	3D TLC					
Input voltage	3.3V±5%; 12V±5%					
Power consumption	Active <12.0W; Idle <1.0W					Active <8.0W; Idle <0.5W
Max. seq. read	2,200 MB/s	3,200 MB/s	3,200 MB/s	3,500 MB/s	3,500 MB/s	3,500 MB/s
Max. seq. write	2,200 MB/s	3,000 MB/s	1,800 MB/s	3,000 MB/s	3,000 MB/s	3,500 MB/s
Max. TBW*	8,000 TB	2,000 TB	1,000 TB	8,000 TB	8,000 TB	1,200 TB
Max. DDPD*	0.6					
Operational temp.	0–70°C					
Warranty	5 years					
PE4 Standard (Streaming)	EXPE4M960GB EXPE4M1920GB EXPE4M3840GB EXPE4M7680GB	EXPE4Q960GB EXPE4Q1920GB	EXPE4R240GB EXPE4R480GB EXPE4R960GB	EXPE4U960GB EXPE4U1920GB EXPE4U3840GB EXPE4U7680GB	EXPE4E960GB EXPE4E1920GB EXPE4E3840GB EXPE4E7680GB	
PC4						EXPC4M001TB EXPC4M002TB

* TBW and DDPD are JEDEC JESD 47-compliant

* Warranty valid for the stated number of years or until the device has reached the guaranteed TBW

* DDPD stands for Drive Writes Per Day. TBW = DDPD * capacity * warranty * 365/1000

* pSLC version available upon request for M.2 2280 and U.2 SSDs

* Pro version of SSDs with DDPD rated at 1.5 available upon request

PCIe Gen3

Basic features

- PCIe NVMe 1.2/1.3
- Supports TRIM and SMART
- Advanced ECC and global wear-leveling algorithm
- Firmware power loss protection (PLP) for additional data protection
- Hardware power loss protection

Exclusive features

- RAID ECC for full data integrity
- Tamper-proof firmware with cryptographic signature
- Firmware Integrity Plus™: ROM-based backup of multiple firmware images
- In-field firmware updates
- Data Retention Plus™: dynamically refreshes data to strengthen data retention
- High quality of Service (QoS): consistently low latency

Optional features

- TCG Opal 2.0
- Hardware secure erase
- Performance, power and thermal throttling
- 30 µ" gold finger for all product series
- AES-256 encryption
- Hardware PLP available upon request for M.2 2280 SSDs

Solution	Industrial		
Interface	PCIe 3.0 (NVMe 1.2)		
Form factor	M.2 2280	U.2	CFexpress Type B
Capacity	960–3,840 GB	960–15,360 GB	128–1,024GB
Flash type	3D TLC		
Input voltage	3.3V±5%; 12V±5%		
Power consumption	Active <12.0W; Idle <1.0W		Active <4.5W; Idle <0.3W
Max. seq. read	2,200 MB/s	3,500 MB/s	1,800 MB/s
Max. seq. write	2,200 MB/s	3,500 MB/s	1,500 MB/s
Max. TBW*	4,800 TB	9,600 TB	600 TB
Operational temp.	–40–85°C		
Warranty	3 years		
PI3	EXPI3M240GB EXPI3M480GB EXPI3M960GB EXPI3M1920GB EXPI3M3840GB	EXPI3U480GB EXPI3U960GB EXPI3U1920GB EXPI3U3840GB EXPI3U7680GB EXPI3U15360GB	
Industrial CFexpress			EXPC3S128GB-I EXPC3S256GB-I EXPC3S512GB-I EXPC3S001TB-I

- * TBW and DWPD are JEDEC JESD 47-compliant
- Warranty valid for the stated number of years or until the device has reached the guaranteed TBW
- DWPD stands for Drive Writes Per Day. TBW = DWPD * capacity * warranty * 365/1000

- pSLC version available upon request for M.2 2280 and U.2 SSDs
- Pro version of SSDs with DWPD rated at 1.5 available upon request

PCIe Gen3

Basic features

- PCIe NVMe 1.2/1.3
- Supports TRIM and SMART
- Advanced ECC and global wear-leveling algorithm
- Firmware power loss protection (PLP) for additional data protection
- Hardware power loss protection

Exclusive features

- RAID ECC for full data integrity
- Tamper-proof firmware with cryptographic signature
- Firmware Integrity Plus™: ROM-based backup of multiple firmware images
- In-field firmware updates
- Data Retention Plus™: dynamically refreshes data to strengthen data retention
- High quality of Service (QoS): consistently low latency

Optional features

- TCG Opal 2.0
- Hardware secure erase
- Performance, power and thermal throttling
- 30 µ" gold finger for all product series
- AES-256 encryption
- Hardware PLP available upon request for M.2 2280 SSDs

Solution	Enterprise		Commercial	
Interface	PCIe 3.0 (NVMe 1.2)			
Form factor	M.2 2280	U.2	M.2 2280	U.2
Capacity	240–3,840 GB	480–15,360 GB	512–4,096 GB	1,024–4,096 GB
Flash type	3D TLC			
Input voltage	3.3V±5%; 12V±5%			
Power consumption	Active <12.0W; Idle <1.0W		Active <9.0W; Idle <1.5W	
Max. seq. read	3,100 MB/s	3,500 MB/s	3,100 MB/s	
Max. seq. write	1,600 MB/s	3,500 MB/s	2,100 MB/s	
Max. TBW*	4,000 TB	16,000 TB	2,400 TB	
Max. DDPD*	0.6			
Operational temp.	0–70°C			
Warranty	5 years			
PE3 Standard (Streaming)	EXPE3M240GB EXPE3M480GB EXPE3M960GB EXPE3M1920GB EXPE3M3840GB	EXPE3U480GB EXPE3U960GB EXPE3U1920GB EXPE3U3840GB EXPE3U7680GB EXPE3U15360GB		
PC3			EXPC3M512GB EXPC3M001TB EXPC3M002TB EXPC3M004TB	EXPC3U001TB EXPC3U002TB EXPC3U004TB

- * TBW and DDPD are JEDEC JESD 47-compliant
- Warranty valid for the stated number of years or until the device has reached the guaranteed TBW
- DDPD stands for Drive Writes Per Day. TBW = DDPD * capacity * warranty * 365/1000

- pSLC version available upon request for M.2 2280 and U.2 SSDs
- Pro version of SSDs with DDPD rated at 1.5 available upon request

SATA-III

Basic features

- Backwards compatible with SATA-II (3 Gb/s) and SATA-I (1.5 Gb/s)
- Supports TRIM, NCQ, DEVSLP, SMART and ATA security
- Advanced ECC and global wear-leveling algorithm
- Firmware power loss protection (PLP) for additional data protection

Exclusive features

- RAID ECC for full data integrity
- Tamper-proof firmware with cryptographic signature
- Firmware Integrity Plus™: ROM-based backup of multiple firmware images
- In-field firmware updates
- Data Retention Plus™: dynamically refreshes data to strengthen data retention

Optional features

- TCG Opal 2.0
- Hardware secure erase
- Performance, power and thermal throttling
- 30 µ" gold finger for all product series
- AES-256 encryption
- Hardware PLP available upon request

Solution	Industrial / Automotive					
Interface	SATA-III, 6.0Gbps					
Form factor	M.2 2280	M.2 2260	M.2 2242	2.5"	mSATA	CFast 2.0
Capacity	240–3,840 GB	240–960 GB	120–960 GB	240–7,480 GB	120–960 GB	128–1,024 GB
Flash type	3D TLC					
Input voltage	5V±5%; 3.3V±5%					
Power consumption	Active <5W; Idle <0.9W					
Max. seq. read	550 MB/s	550 MB/s	550 MB/s	550 MB/s	550 MB/s	520 MB/s
Max. seq. write	535 MB/s	535 MB/s	535 MB/s	535 MB/s	535 MB/s	520 MB/s
Max. TBW*	2,400 TB	600 TB	600 TB	4,800 TB	600 TB	600 TB
Operational temp.	-40–85°C					
Warranty	3 years					
SI3	EXSI3M240GB EXSI3M480GB EXSI3M960GB EXSI3M1920GB EXSI3M3840GB			EXSI3A240GB EXSI3A480GB EXSI3A960GB EXSI3A1920GB EXSI3A3840GB EXSI3A7680GB	EXSI3B120GB EXSI3B240GB EXSI3B480GB EXSI3B960GB	
SI4	EXSI4M240GB EXSI4M480GB EXSI4M960GB EXSI4M1920GB EXSI4M3840GB			EXSI4A240GB EXSI4A480GB EXSI4A960GB EXSI4A1920GB EXSI4A3840GB EXSI4A7680GB	EXSI4B120GB EXSI4B240GB EXSI4B480GB EXSI4B960GB	
Industrial CFast						EXSD3X128GB-I EXSD3X256GB-I EXSD3X512GB-I EXSD3X001TB-I
SA4	EXSA4M240GB EXSA4M480GB EXSA4M960GB EXSA4M1920GB EXSA4M3840GB	EXSA4N240GB EXSA4N480GB EXSA4N960GB	EXSA4Q120GB EXSA4Q240GB EXSA4Q480GB EXSA4Q960GB	EXSA4A240GB EXSA4A480GB EXSA4A960GB EXSA4A1920GB EXSA4A3840GB		

- * TBW and DWPD are JEDEC JESD 47-compliant
- Warranty valid for the stated number of years or until the device has reached the guaranteed TBW

- pSLC version available upon request for M.2 2280 and U.2 SSDs
- Higher-endurance SSDs available upon request

SATA-III

Basic features

- Backwards compatible with SATA-II (3 Gb/s) and SATA-I (1.5 Gb/s)
- Supports TRIM, NCQ, DEVSLP, SMART and ATA security
- Advanced ECC and global wear-leveling algorithm
- Firmware power loss protection (PLP) for additional data protection

Exclusive features

- RAID ECC for full data integrity
- Tamper-proof firmware with cryptographic signature
- Firmware Integrity Plus™: ROM-based backup of multiple firmware images
- In-field firmware updates
- Data Retention Plus™: dynamically refreshes data to strengthen data retention

Optional features

- TCG Opal 2.0
- Hardware secure erase
- Performance, power and thermal throttling
- 30 µ" gold finger for all product series
- AES-256 encryption
- pSLC version available upon request for M.2 2280 and 2.5" SSDs
- Hardware PLP available upon request
- Higher-endurance SSDs available upon request

Solution	Industrial					Commercial	
Interface	SATA-III, 6.0Gbps						
Form factor	M.2 2280	M.2 2260	M.2 2242	2.5"	mSATA	M.2 2280	2.5"
Capacity	120–1,920 GB	240–480 GB	240 GB	120–1,920 GB	120–960 GB	256–2,048 GB	128–4,096 GB
Flash type	MLC					3D TLC	
Input voltage	5V±5%; 3.3V±5%						
Power consumption	Active <5W; Idle <0.9W						
Max. seq. read	530 MB/s	530 MB/s	530 MB/s	530 MB/s	530 MB/s	550 MB/s	550 MB/s
Max. seq. write	500 MB/s	530 MB/s	350 MB/s	530 MB/s	530 MB/s	535 MB/s	535 MB/s
Max. TBW*	1,200 TB	300 TB	150 TB	1,200 TB	600 TB	1,200 TB	2,400 TB
Operational temp.	-40–85°C					-0–70°C	
Warranty	3 years					5 years	
SI2	EXSI2M120GB EXSI2M240GB EXSI2M480GB EXSI2M960GB EXSI2M1920GB	EXSI2N480GB EXSI2N240GB	EXSI2Q240GB	EXSI2A120GB EXSI2A240GB EXSI2A480GB EXSI2A960GB EXSI2A1920GB	EXSI2B120GB EXSI2B240GB EXSI2B480GB EXSI2B960GB		
SC3						EXSC3M256GB EXSC3M512GB EXSC3M001TB EXSC3M002TB	EXSC3A128GB EXSC3A256GB EXSC3A512GB EXSC3A001TB EXSC3A002TB EXSC3A004TB

- * TBW and DWPD are JEDEC JESD 47-compliant
- Warranty valid for the stated number of years or until the device has reached the guaranteed TBW

- pSLC version available upon request for M.2 2280 and U.2 SSDs
- Higher-endurance SSDs available upon request

SATA-III

Basic features

- Backwards compatible with SATA-II (3 Gb/s) and SATA-I (1.5 Gb/s)
- Supports TRIM, NCQ, DEVSLP, SMART and ATA security
- Advanced ECC and global wear-leveling algorithm
- Firmware power loss protection (PLP) for additional data protection

Exclusive features

- RAID ECC for full data integrity
- Tamper-proof firmware with cryptographic signature
- Firmware Integrity Plus™: ROM-based backup of multiple firmware images
- In-field firmware updates
- Data Retention Plus™: dynamically refreshes data to strengthen data retention

Optional features

- TCG Opal 2.0
- Hardware secure erase
- Performance, power and thermal throttling
- 30 µ" gold finger for all product series
- AES-256 encryption
- Hardware PLP available upon request

Solution	Enterprise		
Interface	SATA-III, 6.0Gbps		
Form factor	M.2 2280	2.5"	2.5"
Capacity	240–7,680 GB	120–7,680 GB	240–1,920 GB
Flash type	3D TLC		MLC
Input voltage	5V±5%; 3.3V±5%		
Power consumption	Active <5W; Idle <0.5W		Active <5W; Idle <0.9W
Max. seq. read	550 MB/s	550 MB/s	530 MB/s
Max. seq. write	535 MB/s	535 MB/s	530 MB/s
Max. TBW*	8,000 TB	8,000 TB	2000 TB
Max. DWPD*	0.6		
Operational temp.	5 years		
SE4	EXSE4M240GB EXSE4M480GB EXSE4M960GB EXSE4M1920GB EXSE4M3840GB EXSE4M7680GB	EXSE4A120GB EXSE4A240GB EXSE4A480GB EXSE4A960GB EXSE4A1920GB EXSE4A3840GB EXSE4A7680GB	
SE1			EXSE1A240GB EXSE1A480GB EXSE1A960GB EXSE1A1920GB

- * TBW and DWPD are JEDEC JESD 47-compliant
- Warranty valid for the stated number of years or until the device has reached the guaranteed TBW

- pSLC version available upon request for M.2 2280 and U.2 SSDs
- Pro version of SSDs with DWPD rated at 1.5 available upon request

Basic features

- JEDEC e.MMC 5.1 compliant
- Advanced ECC and global wear-leveling algorithm
- Extended temperature-support: -13–185 °F (-25–85 °C)
- For industrial, automotive and consumer applications

Exclusive features

- RAID ECC for full data integrity
- Supports LDPC ECC, Secure Erase and Write Protection
- Firmware Integrity Plus™: ROM-based backup of multiple firmware images
- In-field firmware updates
- Data Retention Plus™: dynamically refreshes data to strengthen data retention
- Certified for full compatibility with leading-brand system platforms

Solution	Industrial	
Interface	153-ball FBGA	
Form factor	e.MMC 5.1	
Capacity	16–128 GB	4–8 GB
Flash type	3D TLC	MLC
Input voltage	3.3V±5%	
Power consumption	Active <3.3W; Idle <1.8W	
Max. seq. read	295 MB/s	
Max. seq. write	197 MB/s	
Max. TBW*	340 TB	
Operational temp.	-25–85°C	
Warranty	5 years	
e.MMC	ESEMSA016GYBG ESEMSA032GYBG ESEMSA064GYBG ESEMSA128GYBG	ESEMSA004GQBG ESEMSA008GQBG

* TBW and DWPD are JEDEC JESD 47-compliant

• Warranty valid for the stated number or years or until the device has reached the guaranteed TBW

Industrial SD & microSD

Basic features

- Built-in write protection
- Extended temperature support (-40–85°C)
- Built-in LDPC ECC functionality
- S.M.A.R.T function supported

Exclusive features

- pSLC version for SD and microSD cards
- U3 and V30 performance classes
- Guaranteed endurance: 3,000 P/E cycles

Solution	Industrial			
Interface	UHS-I			
Form factor	SDHC / SDXC		microSDHC / microSDXC	
Capacity	32-256 GB	8-16 GB	32-256 GB	8-16 GB
Flash type	3D TLC	pSLC	3D TLC	pSLC
Speed class	C10 / U3 / V30			
Input voltage	3.3V±5%			
Max. seq. read	550 MB/s		530 MB/s	
Max. seq. write	535 MB/s		530 MB/s	
File system	FAT32 / exFAT			
Operational temp.	-40–85°C			
Warranty	5 years			
Industrial SD	EX32GSDU1-IDE EX64GSDU1-IDE EX128GSDU1-IDE EX256GSDU1-IDE	EX8GSDU1-PIDE EX16GSDU1-PIDE		
Industrial microSD			EX32GUSDU1-IDE EX64GUSDU1-IDE EX128GUSDU1-IDE EX256GUSDU1-IDE	EX8GUSDU1-PIDE EX16GUSDU1-PIDE



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