



 Western Digital®

# Advanced Flash Storage Solutions for Automotive Applications





## Key Advantages

- Decades of innovation in the flash memory industry
- Full portfolio of NAND flash products for automotive applications
- IATF 16949 certified on embedded automotive-grade products
- Automotive SPICE certified products
- Expertise in system-level architecture
- World-class fabs and manufacturing factories
- Close ties with global automotive OEMs and Tier-1 suppliers
- Partnerships with leading chipset vendors



**AUTONOMOUS DRIVE**



**ADAS**



**NAV/INFOTAINMENT**



**ECOCKPIT**



**HD MAPPING**



**EVENT/DRIVE RECORDERS**



**TELEMATICS & OTA**



**V2X COMMUNICATIONS**

## Driving Automotive Innovation

The automotive industry is going through a revolutionary stage — from the driver to the driverless vehicle — generating a whole new world of applications around safety, connectivity and entertainment. Among these applications, high-definition 3D maps, advanced driver-assist systems (ADAS), autonomous computers, AI databases, data recorders, enhanced infotainment, over-the-air updates, and V2X all require on-board data storage. While the cloud is an important component for analyzing data to improve algorithms and databases, it is not sufficient to meet the needs of real-time edge computing.

Western Digital enables Automobile OEMs and Tier-1 suppliers to create highly reliable systems for their customers.

## Providing a Complete Data Storage Solution

From the automobile to the cloud, Western Digital has a complete portfolio of storage products to support current and future vehicle system requirements. Western Digital offers embedded edge storage and removable storage for various automotive use cases and data center solutions for capturing and analyzing massive amounts of data collected from vehicles.

## Meeting Automotive's Stringent Quality Requirements

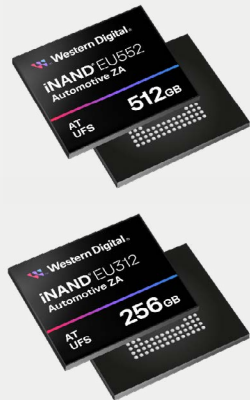
Western Digital automotive-grade flash products are IATF 16949 certified and AEC-Q100/Q104 compliant. In addition, these products are fully vertically integrated, designed in-house and manufactured on dedicated production lines at Western Digital's state-of-the-art manufacturing facilities. Lastly, automotive-grade products go through rigorous testing to ensure high reliability that is necessary for safety applications. This vertical integration enables Western Digital to have tight controls on every step of product development and manufacturing to achieve high-quality storage solutions. Western Digital also provides supply longevity to reduce costs of additional qualifications.

## A Trusted Partner

Western Digital has been a storage solution supplier to the automotive industry since 2002 when it launched its first HDD for automotive. Since then, Western Digital has continued to invest in the industry, launching new products at a regular cadence with automotive-grade NAND flash products launching in 2015.

## iNAND® Automotive Embedded Flash Drives

iNAND Automotive Embedded Flash Drives (EFDs) are designed to support the harsh environments, high reliability and quality required by the automotive industry. The automotive iNAND product portfolio supports both UFS and e.MMC interfaces in a small 11.5x13mm package with a wide range of capacities to provide automotive OEMs and Tier-1 suppliers with choices that best meet their needs.



### UFS Embedded Flash Drive

The **iNAND AT EU552** and **iNAND AT EU312** embedded storage solution is designed to meet the demanding requirements for data-intensive automotive applications such as ADAS (Advanced Driver Assistance Systems), high-performance central computing and data rich 3D maps.

#### Features and Benefits

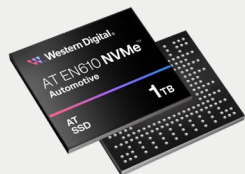
- Fast boot, auto refresh, manual refresh, enhanced health status
- UFS 3.1 and UFS 2.1 standard interface embedded flash drive for automotive applications
- Capacities up to 512GB<sup>1</sup> in small form-factor BGA
- AEC-Q100/Q104 temperature grade-2 and grade-3
- Automotive SPICE CL3 certified (AT EU552)

### Automotive PCIe® NVMe™ SSD

Western Digital **AT EN610** NVMe SSD offers an automotive-grade, high-performance, wide-temperature range storage solution designed for the demanding requirements of next-generation automotive architectures. With flexibility through high-capacity TLC and high-endurance SLC options, the **AT EN610** offers M.2 Type 1620 BGA form factors and up to 1TB of storage space.

#### Features and Benefits

- PCIe Gen4x4 NVMe 1.4
- SR-IOV with 8 x Virtual Functions
- 32 namespaces TLC and SLC configurable
- Auto refresh, manual refresh, S.M.A.R.T.
- TCG Opal 2.02, support Secure boot, Secure FFU and locking external connections
- Capacities up to 1TB in M.2 Type 1620-S5 BGA per PCI-SIG
- Supports extended temperatures of -40°C to +105°C



1. One gigabyte (GB) is equal to one billion bytes, one terabyte (TB) is equal to one trillion bytes, and one petabyte (PB) is equal to one quadrillion bytes. Actual user capacity may be less due to operating environment.



## Automotive SD Card

Automotive SD cards are ideal for automotive applications that require a removable storage medium such as navigation map data and data/video recorders. Western Digital (SanDisk), as a pioneer in SD cards, has shipped billions of cards and is well known to both retail and commercial customers. Automotive-grade SD cards provide a highly reliable data storage solution to capture and store the vehicle's data.

### Features and Benefits

- Auto refresh, manual refresh, health status, host lock
- SD 5.1 specification
- Up to 64GB
- AEC-Q100 temperature grade-3

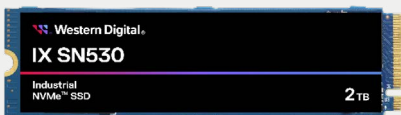
## Industrial microSD™ Card



Western Digital also offers extended temperature industrial microSD cards to support customers who not only want a removable solution but also a small form factor. Western Digital offers both SLC and MLC solutions to meet a variety of use cases.

### Features and Benefits

- Health status, host lock
- Available in SLC
- Up to 64GB
- Supports extended temperatures of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$



## Industrial PCIe NVMe SSD

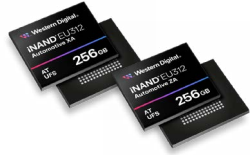
The need for high-capacity solutions continues to increase as the automotive industry develops autonomous vehicles. Capturing and analyzing all of the massive amounts of data from sensors and cameras requires terabytes of storage every day. This data is analyzed to develop better algorithms to make vehicles safer. In addition, the data may be used as evidence in the event of an accident or a legal or an insurance claim.

### Features and Benefits

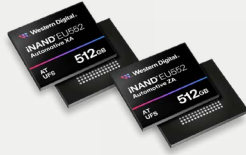
- PCIe Gen3x4 NVMe 1.4
- M.2 2280 and M.2 2230 form factors
- TLC and SLC storage options for high endurance of up to 24 PBW<sup>2</sup>
- High capacities up to 2TB
- Supports extended temperatures of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

2. PBW = Petabytes Written. Projected endurance is calculated based on sustained sequential write operation without frequent idle.

## iNAND Automotive Embedded Flash Drives



iNAND AT EU312



iNAND AT EU552



iNAND AT EM122



iNAND AT EM132

### Product Specification

|                       |   |   |   |   |
|-----------------------|---|---|---|---|
| Interface             | UFS 2.1                                   | UFS 3.1                                   | eMMC 5.1                                  | eMMC 5.1                                  |
| Capacity <sup>1</sup> | 16GB to 256GB                             | 64GB to 512GB                             | 8GB to 64GB                               | 32GB to 256GB                             |
| Operating temperature | XA: -40°C to +85°C<br>ZA: -40°C to +105°C | XA: -40°C to +85°C<br>ZA: -40°C to +105°C | XA: -40°C to +85°C<br>ZA: -40°C to +105°C | XA: -40°C to +85°C<br>ZA: -40°C to +105°C |
| NAND flash technology | 3D TLC                                    | 3D TLC                                    | 2D MLC                                    | 3D TLC                                    |






### Package (mm)

|       |               |               |               |               |
|-------|---------------|---------------|---------------|---------------|
| 8GB   | —             | —             | 11.5x13x0.8mm | —             |
| 16GB  | 11.5x13x1.2mm | —             | 11.5x13x0.8mm | —             |
| 32GB  | 11.5x13x1.2mm | —             | 11.5x13x1.0mm | 11.5x13x1.0mm |
| 64GB  | 11.5x13x1.2mm | 11.5x13x1.2mm | 11.5x13x1.2mm | 11.5x13x1.0mm |
| 128GB | 11.5x13x1.2mm | 11.5x13x1.2mm | —             | 11.5x13x1.0mm |
| 256GB | 11.5x13x1.2mm | 11.5x13x1.2mm | —             | 11.5x13x1.2mm |
| 512GB | —             | 11.5x13x1.2mm | —             | —             |

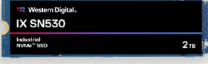


### Ordering Information

|       |                                      |  |                                      |  |
|-------|--------------------------------------|--|--------------------------------------|--|
| 8GB   | —                                    | —                                      | SDINBDG4-8G-XA3<br>SDINBDG4-8G-ZA3   | —                                      |
| 16GB  | SDINDDH-16G-XA2<br>SDINDDH-16G-ZA2   | —                                      | SDINBDG4-16G-XA3<br>SDINBDG4-16G-ZA3 | —                                      |
| 32GB  | SDINDDH-32G-XA2<br>SDINDDH-32G-ZA2   | —                                      | SDINBDG4-32G-XA3<br>SDINBDG4-32G-ZA3 | SDINBDA6-32G-XA1<br>SDINBDA6-32G-ZA1   |
| 64GB  | SDINDDH-64G-XA2<br>SDINDDH-64G-ZA2   | SDINFDQ6-64G-XA1<br>SDINFDQ6-64G-ZA1   | SDINBDG4-64G-XA3<br>SDINBDG4-64G-ZA3 | SDINBDA6-64G-XA1<br>SDINBDA6-64G-ZA1   |
| 128GB | SDINDDH-128G-XA2<br>SDINDDH-128G-ZA2 | SDINFDQ6-128G-XA1<br>SDINFDQ6-128G-ZA1 | —                                    | SDINBDA6-128G-XA1<br>SDINBDA6-128G-ZA1 |
| 256GB | SDINDDH-256G-XA2<br>SDINDDH-256G-ZA2 | SDINFDQ6-256G-XA1<br>SDINFDQ6-256G-ZA1 | —                                    | SDINBDA6-256G-XA1<br>SDINBDA6-256G-ZA1 |
| 512GB | —                                    | SDINFDQ6-512G-XA1<br>SDINFDQ6-512G-ZA1 | —                                    | —                                      |

## Automotive SD and Industrial microSD Cards

|                                    | <br><b>Automotive AT LD332</b> | <br><b>Industrial Wide Temp IX QD332</b> | <br><b>Industrial Ext Temp IX QD332</b> | <br><b>Industrial Ext Temp High Endurance IX QD334</b> | <br><b>Industrial Wide Temp IX QD342</b> |
|------------------------------------|---|---|---|---|---|
| Interface                          | UHS-1104  | UHS-1104  | UHS-1104  | UHS-1104  | UHS1-104  |
| Form factor                        | SD  | microSD   | microSD   | microSD   | microSD   |
| Capacity <sup>1</sup>              | 8GB to 64GB   | 8GB to 128GB  | 8GB to 128GB  | 8GB to 64GB   | 16GB to 256GB   |
| Operating temperature <sup>3</sup> | -40°C to +85°C  | -25°C to +85°C  | -40°C to +85°C  | -40°C to +85°C  | -25°C to +85°C  |
| NAND flash technology              | 2D MLC  | 2D MLC  | 2D MLC  | 2D SLC  | 3D TLC  |
| Speed class                        | C10   | C10, U1   | C10, U1   | C10, U3   | C10, U1, U3, V10, V30   |
| Performance R/W <sup>4</sup>       | Up to 80/50 MB/s  | Up to 80/50 MB/s  | Up to 80/50 MB/s  | Up to 90/50 MB/s  | Up to 100/50 MB/s   |
| 8GB                                | SDSDAG3-008G-XA   | SDSDQAF3-008G-I   | SDSDQAF3-008G-XI  | SDSDQED-008G-XI   | —   |
| 16GB                               | SDSDAG3-016G-XA   | SDSDQAF3-016G-I   | SDSDQAF3-016G-XI  | SDSDQED-016G-XI   | SDSDQAF4-016G-I   |
| 32GB                               | SDSDAG3-032G-XA   | SDSDQAF3-032G-I   | SDSDQAF3-032G-XI  | SDSDQED-032G-XI   | SDSDQAF4-032G-I   |
| 64GB                               | SDSDAG3-064G-XA   | SDSDQAF3-064G-I   | SDSDQAF3-064G-XI  | SDSDQED-064G-XI   | SDSDQAF4-064G-I   |
| 128GB                              | —   | SDSDQAF3-128G-I   | SDSDQAF3-128G-XI  | —   | SDSDQAF4-128G-I   |
| 256GB                              | —   | —   | —   | —   | SDSDQAF4-256G-I   |

## Automotive and Industrial grade SSDs

|                                    | <br><b>Automotive AT EN610</b> | <br><b>Industrial-grade IX SN530</b> | <br><b>Industrial-grade IX SN530</b> | <br><b>Industrial-grade IX SN530</b> | <br><b>Industrial-grade IX SN530</b> |
|------------------------------------|---|---|--|---|---|
| Interface                          | PCIe Gen4x4 NVMe 1.4  | PCIe Gen3x4 NVMe 1.4  | PCIe Gen3x4 NVMe 1.4   | PCIe Gen3x4 NVMe 1.4  | PCIe Gen3x4 NVMe 1.4  |
| Form factor (per PCI-SIG)          | M.2 Type 1620-S5 BGA  | M.2 2280-S3-M   | M.2 2280-S3-M  | M.2 2230-S3-M   | M.2 2230-S3-M   |
| Capacity <sup>1</sup>              | 256GB to 1TB  | 256GB to 2TB  | 85GB to 340GB  | 256GB to 1TB  | 85GB to 340GB   |
| Operating temperature <sup>3</sup> | -40°C to +105°C   | -40°C to +85°C  | -40°C to +85°C   | -40°C to +85°C  | -40°C to +85°C  |
| NAND flash technology              | 3D TLC  | 3D TLC  | 3D SLC   | 3D TLC  | 3D SLC  |
| Performance R/W <sup>5</sup>       | Up to 3,700/3,000 MB/s  | Up to 2,500/1,800 MB/s  | Up to 2,400/1,950 MB/s   | Up to 2,400/1,950 MB/s  | Up to 2,400/1,950 MB/s  |
| Performance sustain W <sup>6</sup> | Up to 800 MB/s  | Up to 540   | Up to 1,950 MB/s   | Up to 540 MB/s  | Up to 1,950 MB/s  |
| Endurance <sup>7</sup> (Projected) | Up to 2,800 TBW(TLC) / 30,000 TBW (SLC)   | Up to 5,200 TBW   | Up to 24,000 TBW   | Up to 2,600 TBW   | Up to 24 PBW  |
| 256GB (TLC) / 85GB (SLC)           | SDDQUGD-256G-ZA   | SDBPNPZ-256G-XI   | SDBPNPZ-085G-XI  | SDBPTPZ-256G-XI   | SDBPTPZ-085G-XI   |
| 512GB (TLC) / 170GB (SLC)          | SDDQUGD-512G-ZA   | SDBPNPZ-512G-XI   | SDBPNPZ-170G-XI  | SDBPTPZ-512G-XI   | SDBPTPZ-170G-XI   |
| 1TB (TLC) / 340GB (SLC)            | SDDQUGD-1T00-ZA   | SDBPNPZ-1T00-XI   | SDBPNPZ-340G-XI  | SDBPTPZ-1T00-XI   | SDBPTPZ-340G-XI   |
| 2TB (TLC)                          | —   | SDBPNPZ-2T00-XI   | —  | —   | —   |

3. Operational temperature is defined such as -40°C refers to ambient temperature. 85°C or 105°C refers to SMART composite temperature reported by the drive (when thermal throttling is triggered).

4. Based on Western Digital internal testing. Performance based on e.MMC high speed interface, using an 8-bit bus. Read and write speeds may vary depending on read/write conditions. 1 megabyte (MB) = 1 million bytes.

5. Measured with CrystalDiskMark, 1000MB LBA range, secondary 1TB drive. Sequential: 1T QD32, Random: 8T QD32. Performance may vary based on host device.

6. Sustained performance is measured by FIO 1.97, using 100% LBA range as a secondary drive. Performance may vary based on host device.

7. Endurance is calculated based on sustained sequential write operation without frequent idle.

## Contact Information

For all inquiries, please email:  
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April 2024

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